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UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

FORM 10-K

(Mark One)

☒ **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the fiscal year ended December 31, 2019

OR

☐ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934 FOR THE TRANSITION PERIOD FROM TO**

Commission File Number 001-37383

Arcadia Biosciences, Inc.

(Exact name of Registrant as specified in its Charter)

Delaware **(State or other jurisdiction of incorporation or organization)**	**81-0571538** **(I.R.S. Employer Identification No.)**
202 Cousteau Place, Suite 105 **Davis, CA** **(Address of principal executive offices)**	**95618** **(Zip Code)**

(530) 756-7077
(Registrant's Telephone Number, Including Area Code)

Securities registered pursuant to Section 12(b) of the Act:

Title of each class	Trading Symbol(s)	Name of each exchange on which registered
Common	RKDA	NASDAQ CAPITAL MARKET

Securities registered pursuant to Section 12(g) of the Act: None

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. YES ☐ NO ☒

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or 15(d) of the Act. YES ☐ NO ☒

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the Registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. YES ☒ NO ☐

Indicate by check mark whether the Registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§232.405 of this chapter) during the preceding 12 months (or for such shorter period that the Registrant was required to submit such files). YES ☒ NO ☐

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company, or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company," and "emerging growth company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer	☐	Accelerated filer	☐
Non-accelerated filer	☒	Smaller reporting company	☒
Emerging growth company	☒		

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. ☒

Indicate by check mark whether the Registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act). YES ☐ NO ☒

The aggregate market value of the voting and non-voting common equity held by non-affiliates of the Registrant as of June 28, 2019, the last business day of the Registrant's most recently completed second fiscal quarter, was approximately $15,800,000 (based on the closing price of $3.07 on June 28, 2019 on the NASDAQ Capital Market).

The number of shares outstanding of the Registrant's common stock on March 18, 2020, was 8,654,095 shares.

DOCUMENTS INCORPORATED BY REFERENCE

Information required by Part III of this Annual Report on Form 10-K is incorporated by reference to the Registrant's Definitive Proxy Statement for its 2020 Annual Meeting of Stockholders, which proxy statement will be filed with the Securities and Exchange Commission within 120 days after the end of the fiscal year covered by this Form 10-K.

INTRODUCTION

“Arcadia,” the “Company,” “we,” “our” and “us” are used interchangeably to refer to Arcadia Biosciences, Inc. and its subsidiary.

SPECIAL NOTE REGARDING FORWARD-LOOKING STATEMENTS

This Annual Report on Form 10-K contains forward-looking statements within the meaning of the federal securities laws, which statements involve substantial risks and uncertainties. Forward-looking statements generally relate to future events, our future financial or operating performance, growth strategies, anticipated trends in our industry, the anticipated impact of the novel coronavirus on our business, and our potential opportunities, plans, and objectives. In some cases, you can identify forward-looking statements because they contain words such as "may," "will," "should," "expects," "plans," "anticipates," "could," "intends," "target," "projects," "contemplates," "believes," "estimates," "predicts," "potential," or "continue" or the negative of these words or other similar terms or expressions that concern our expectations, strategy, plans, or intentions. Forward-looking statements contained in this Annual Report on Form 10-K include, but are not limited to, statements about:

- our or our collaborators' ability to develop commercial products that incorporate our traits and complete the regulatory process for such products;
- our ability to earn revenues from the sale of products that incorporate our traits;
- our ability to maintain our strategic collaborations and joint ventures and enter into new arrangements;
- estimated commercial value for traits;
- market conditions for products, including competitive factors and the supply and pricing of competing products;
- compliance with laws and regulations that impact our business, and changes to such laws and regulations;
- our ability to license patent rights from third parties for development as potential traits;
- our ability to maintain, protect, and enhance our intellectual property;
- our future capital requirements and our ability to satisfy our capital needs;
- industry conditions and market conditions;
- the preceding and other factors discussed in Part I, Item 1A, “Risk Factors,” and other reports we may file with the Securities and Exchange Commission from time to time; and
- the factors set forth in Part II, Item 7, “Management’s Discussion and Analysis of Financial Condition and Results of Operations.”

We caution you that the foregoing list may not contain all of the forward-looking statements made in this Annual Report on Form 10-K.

You should not rely upon forward-looking statements as predictions of future events. We have based the forward-looking statements contained in this Annual Report on Form 10-K primarily on our current expectations and projections about future events and trends that we believe may affect our business, financial condition, results of operations and prospects. The outcome of the events described in these forward-looking statements is subject to risks, uncertainties and other factors described in the section titled "Risk Factors" and elsewhere in this Annual Report on Form 10-K. Moreover, we operate in a very competitive and rapidly changing environment. New risks and uncertainties emerge from time to time and it is not possible for us to predict all risks and uncertainties that could have an impact on the forward-looking statements contained in this Annual Report on Form 10-K. We cannot assure you that the results, events and circumstances reflected in the forward-looking statements will be achieved or occur, and actual results, events or circumstances could differ materially from those described in the forward-looking statements.

The forward-looking statements made in this Annual Report on Form 10-K relate only to events as of the date on which the statements are made. We undertake no obligation to update any forward-looking statements to reflect events or circumstances or to reflect new information or the occurrence of unanticipated events, except as required by law.

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PART I

Item 1. Business.

Overview

We are a leader in science-based approaches to developing high value crop productivity traits primarily in hemp, wheat, and soybean, designed to enhance farm economics by improving the performance of crops in the field, as well as their value as food ingredients, health and wellness products, and their viability for industrial applications. We use state of the art gene-editing technology and advanced breeding techniques to develop these proprietary innovations which we are beginning to monetize through a number of methods including seed and grain sales, product extract sales, trait licensing and royalty agreements.

Our commercial strategy is to link consumer's nutrition, health and wellness demands with the superior functional benefits our crops deliver directly from the farm, enabling us to share premium economics throughout the ag-food supply chain and to build a world-class estate of high value traits and varieties. In particular, we believe the recent legalization of hemp in the U.S. and many other areas of the world has created a significant agricultural and financial opportunity. The demonstrated broad demand for industrial, nutritional, health and wellness products from hemp, coupled with its poor genetics represent a vast, new opportunity for Arcadia to add substantial value to its existing high value trait and seed estate. We are applying our proprietary, rapid prototyping technology platform, ArcaTech, to target innovations addressing the many challenges farmers face in growing what is essentially an undomesticated crop. As such, our forward discovery research is focused on non-GM hemp innovations.

The passage of the U.S. Agriculture Improvement Act of 2018 – also known as the Farm Bill – confirmed the federal legalization of hemp, the term given to non-psychoactive cannabis containing less than 0.3% tetrahydrocannabinol (THC). It also included provisions for legalizing on a federal level hemp's cultivation, transport and sale for the first time in more than 75 years. Hemp, not previously distinguished by the federal government from cannabis, a Schedule 1 drug and banned as an agricultural crop, lacks substantive plant biology research and suffers from suboptimal genetics, highly fragmented germplasm and rampant inconsistencies. We are targeting hemp-based solutions that allow farmers to reliably and consistently achieve compliance with U.S. Department of Agriculture ("USDA") regulations, through varieties with improved functionality and application of specific attributes such as select cannabinoid contents for health and wellness, enhanced proteins profiles for plant-based dietary applications and industrial applications such as clothing and hempcrete. Arcadia conducts its business in only federal and state markets in which its activities are legal.

On October 31, 2019, the USDA published the interim final rule as authorized by the Agriculture Improvement Act of 2018 for hemp cultivation, which mandates that states test hemp crops and dispose of "hot" crops that exceed 0.3% THC. While hemp farmers will have access to crop protection options, the destruction of hot

crops that fail these stringent inspections will not be a covered loss under crop insurance programs. In 2019 alone, more than 20% of U.S. hemp crops were non-compliant, representing over $2 billion in losses for growers.

Arcadia GoodHemp™

In December 2019, we announced the launch of a new product line, GoodHemp, as the company's new commercial brand for delivering genetically superior hemp seeds, transplants, flower and extracts. The first variety in GoodHemp's catalog, Complia™ Bot+, is a widely adapted cannabis strain that delivers high cannabinoid (CBD) content (more than 10%) with ultra-low THC, the psychoactive compound in cannabis. It is part of the Complia hemp seed line Arcadia is bringing to market through GoodHemp, with six additional proprietary varieties in early adopter farmer trials with sales expected in the 2020 season.

The Hemp Business Journal estimates the hemp CBD market – the primary non-psychoactive compound in hemp – totaled $190 million in U.S. sales in 2018. By 2022, the Brightfield Group, a hemp and CBD market research firm, projects U.S. sales of hemp-based CBD to reach $22 billion. Additionally, Grandview research estimates the market for non-cannabinoid, industrial hemp market will exceed $15 billion by 2027.

In future years, we expect to bring to market proprietary and patent-protected varieties of hemp designed for their utility as fiber and hemp-based protein. While the addressable market for hemp in these markets still remains to be determined, it can be estimated that hemp would compete favorably for share in the $40.6 billion global protein extract and isolated protein market forecast in 2025 (source: MarketsandMarkets).

Arcadia GoodWheat™

In 2018, we launched our GoodWheat brand, a non-genetically modified (non-GM) portfolio of wheat products that enables food manufacturers to differentiate their consumer-facing brands. Consumer food companies are looking to simplify their food ingredient formulations and consumers are demanding “clean labeling” in their foods, paying more for foods having fewer artificial ingredients and more natural, recognizable and healthy ingredients. A 2017 survey by PR agency Ingredient Communications found that 73% of consumers are happy to pay a higher retail price for a food or drink product made with ingredients they recognize. Because GoodWheat increases the nutrient density directly in the primary grains and oils, it provides the mechanism for food formulation simplification naturally and cost effectively to meet evolving consumer demands.

The brand launch is a key element of the company’s go-to-market strategy to achieve greater value for its innovations by participating in downstream consumer revenue opportunities. We designed the brand to make an immediate connection with consumers that products made with GoodWheat meet their demands for healthier wheat options that also taste great. The GoodWheat brand encompasses our current and future non-GM wheat portfolio of high fiber Resistant Starch (RS) and Reduced Gluten wheat varieties, as well as future wheat innovations. In October 2019, the U.S. Patent and Trademark Office granted us the latest patents for extended shelf life wheat, the newest trait in our non-genetically modified wheat portfolio. This new trait was designed to promote whole wheat consumption by improving the shelf life and taste of whole grain wheat products.

With additional patents granted in 2019, we now hold more than 15 global patents on our high fiber Resistant Starch wheat, protecting both bread wheat and durum (pasta) wheat. Claims granted in 2019 strengthen our intellectual property for our Resistant Starch portfolio of products.

We announced in August 2019 an agreement with Bay State Milling Company and Arista Cereal Technologies to bring to market our resistant starch GoodWheat in North America and other key markets, beginning in late 2019. In the daily American diet approximately 500 calories come from wheat products, 25% of the FDA’s recommended daily caloric intake for a woman and 20% for a man. The GoodWheat portfolio of specialty wheat varieties delivers new functional value through an ingredient already an important component of the human diet.

Verdeca HB4® Soybean

In 2012, we partnered with Bioceres, Inc. (“Bioceres”) an Argentina-based technology company, to form Verdeca LLC, (“Verdeca”) a U.S.-based joint venture company to deploy next-generation soybean traits developed to benefit soybean producers through quality improvement, stress mitigation and management practices. The HB4® soybean varieties deliver two layers of value for growers: drought and herbicide tolerance, offering resistance to a broad-spectrum herbicide utilized to prevent growth of a wide range of annual and perennial broadleaf weeds and grasses.

HB4® was discovered by researchers of the CONICET, the National Scientific and Research Council in Argentina, through the identification of one gene that gives sunflower the capacity to tolerate hydric and saline stress. This gene was transferred from sunflower to soybean.

Verdeca’s HB4® soybeans have undergone extensive testing, including multi-location field trials in Argentina and the United States and multiple regulatory field trials. The results of these trials demonstrate that the HB4® trait can provide yield advantages under stress conditions – including drought and low-water conditions – found in several soybean production areas. Verdeca introduced a trait stack combining HB4® with an herbicide tolerance trait to deliver two layers of value for growers.

HB4® is the first trait offering tolerance to drought and salinity in soybeans, with 30 international patents. HB4® is currently approved in the four main countries producing this strategic crop – the U.S., Brazil, Argentina and Paraguay - representing 80% of the global soybean market. Regulatory submissions are under consideration by China, Canada, Bolivia and Uruguay. Import approval by China is required for commercial launch and the expectation to obtain such approval in late 2020 is under review in light of the recent coronavirus.

Soybeans are the world’s fourth largest crop, grown on more than 120 million hectares annually. Global population growth, combined with a growing middle class in countries like China and India, have resulted in increased demand for this important protein source. More than 50 million of the world’s soybean hectares are grown in Argentina and Brazil, a region that has experienced significant drought conditions in recent years.

Our Strengths

We believe we are well positioned among our peers to capitalize on the need to increase the efficiency, quality and speed of innovation in agricultural product differentiation to meet the demand for healthier food choices and new crop applications. Our combination of technological innovation, assets and experience is why we believe we are uniquely positioned to meet this challenge through improving crop yields, nutrition, and functionality:

- ***World-class research capabilities.*** The scientific leadership team at Arcadia brings more than 100 years of combined experience in science and agriculture, delivering innovation through multiple advanced breeding tools and capabilities. Our five key enabling platforms are:
  - GENOMICS: Our team of molecular biologists and biostatisticians map and analyze plant genomes to understand the function of plants. With insight into the plant’s DNA, we optimize our plant breeding programs toward efficient outcomes.
  - TARGETING INDUCED LOCAL LESIONS IN GENOMES (“TILLING”): Arcadia researchers create plant populations optimized for high allelic diversity, creating seed and DNA libraries. These libraries are used to create new crop characteristics by lowering gene function – like GoodWheat high amylose wheat.
  - CRISPR-Cas9 (“CRISPR”): In select crops, Arcadia scientists can also use CRISPR gene-editing to accelerate the pace of research. These and other genome editing tools enable us to create diverse plant populations by modulating gene function, enabling rapid trait discovery.
  - PHENOTYPING: Plant scientists in Arcadia’s California labs and greenhouses measure and test the result of gene changes we’ve produced through our breeding programs, ensuring consistent expression of our target attributes.
  - PLANT BREEDING & FIELD EVALUATION: Our development of new varieties through conventional plant breeding and our ability to conduct high quality field testing across key production geographies and climate zones provide us insight into crop performance in variable conditions. We leverage this platform to identify and effectively place new products in

appropriate market segments. Additionally, our field data helps guide our grower customers to successful production practices.

- ***Industry leading early phase trait development.*** Since the inception of the Company we have successfully advanced, and continue to advance, several potentially high value traits beyond the proof of concept stage to advanced field testing. More recently, in the case of our HB4® stress tolerant soybeans we have, through our Verdeca joint venture, advanced the trait into commercial germplasm and the regulatory submission and approval phase. We have received regulatory approval in the U.S., Argentina, Brazil and Paraguay, and have submitted for import approval in China, Canada, Bolivia, and Uruguay. Regulatory studies are in progress for submission in Europe.
- ***A broad intellectual property portfolio.*** As of March 1, 2020, Arcadia's patent portfolio includes 153 issued patents and 63 pending patent applications worldwide in 30 patent families, relating to our trait technologies and business methods that are either owned or exclusively controlled by us. Arcadia had 48 patents issued and has filed 53 new patent applications since January 2015. Our ability to secure exclusive patent rights to our technologies is a key strength for the Company and one that preserves our competitive position.

Our Growth Strategy

We believe there are significant opportunities to grow our business by executing the following elements of our strategy:

- ***Scale up our GoodHemp seed sales, develop and introduce novel genetics in hemp.*** Arcadia has acquired superior germplasm, and through its own breeding program developed a suite of quality hemp seed varieties and is adding to its catalogue by developing more novel, compliant hemp seed varieties possessing productivity, pest resistance and crop quality attributes for license to cultivators, and for derivative products serving the nutraceutical and food industries. We intend to develop these innovations through our ArcaTech platform under the guidelines of the 2014 and 2018 farm bills in the U.S. Because of our proven ability to develop innovative traits in some of the most complex plant genomes such as wheat, we believe turning our attention to the critical needs facing the rapidly evolving hemp industry greatly enhances our growth markets. In parallel, we are evaluating key partnerships to extend our capabilities vertically to maximize the value creation potential of our innovations.
- ***Accelerate the commercialization of our health and nutrition trait portfolio.*** In 2019, we introduced resistant starch and reduced gluten varieties of GoodWheat to the market and are scaling sales in 2020, working with multiple public breeding platforms and continuing to build partnerships across the wheat value chain, having met the FDA requirement for "high in fiber" and "good source of fiber" designations.
- ***Advance commercialization of HB4® soybean.*** Our Verdeca joint venture continues to advance our HB4® Drought Tolerance trait in soybeans towards commercialization, with Argentina to be the first launch country. Currently, the HB4® trait has regulatory approval in more than 80 percent of the global soybean market, including the U.S., Brazil, Argentina and, most recently, Paraguay. Regulatory submissions are currently under consideration by China, Canada, Bolivia and Uruguay. Import approval from China is needed for commercial launch in Argentina. While we are encouraged by recent GM approvals in China as an indication of progress towards the advancement of the global GM landscape and had expected to obtain such import approval in late 2020, that expectation is under review in light of the recent coronavirus. The regulatory package for approval in the European Union is expected to be submitted later in 2020.
- ***Continue to invest in our human resources and commercialization capabilities.*** As we become more consumer facing and commercially aligned with consumer food companies, greater in-house consumer product knowledge and industry experience will be required. We will continue to invest in acquisition, development and retention of the requisite management and industry experience and production and logistics capacity to more fully participate in, and control, the route to market for our high value food ingredients. We will continue to build our commercialization expertise, refine go-to-market strategies and execute branding strategy.

Our Products and Product Development Pipeline

We are improving the quality and nutritional value of plant-based ingredients while improving production efficiency using advanced plant breeding and gene-editing technologies and accelerating innovation through industry leading partners. Our innovations address the challenges facing our food systems as depicted below:

We believe our core competencies in plant genomics position Arcadia for unique innovations in new crops. We leverage a research and development team that has over 100 years of combined experience across best in class technology platforms. Our competitive advantages allow for accelerated discovery and market entry.

In 2019, we announced hemp as a new strategic crop. Within the first year of our entry into hemp we have developed a pipeline for commercialization and a catalog of multiple compelling varieties. Through our ArcaTech platform, we have also developed six novel varieties that we intend to deploy and evaluate in on-farm trials in 2020 as part of our hemp innovation partners network of growers. This gives us the opportunity to demonstrate to our customers the quality and value of our new varieties and to generate the data to effectively place new varieties in the market in 2021.

Innovative hemp varieties

GoodHemp is our commercial pipeline of superior non-GMO hemp seed varieties developed with modern crop innovation tools focused on genetic improvement of hemp. The varieties improve plant quality and productivity, working within federal legal guidelines. GoodHemp products deliver superior emergence and growth characteristics and are available as both seeds and clones. Our seed and clone specifications meet compliance requirements because of their low THC profiles, in addition to a multitude of other beneficial characteristics.

We are leading the charge in developing top hemp varieties for industrial production as we bring the improvements of modern agriculture to this newly legal crop. Due to our vast experience in optimizing other crops, we are working to bring innovative hemp varieties to market and meeting grower needs. We have experience working within federal regulations for novel ingredients and for proprietary varieties and are committed to partnering with growers through a supportive, transparent approach to the market with innovative products that are designed to meet all regulatory standards.

Our focus on modern hemp seed innovation extends beyond variety production to excellence in seed harvesting and conditioning. GoodHemp seeds will be delivered with our proprietary seed conditioning package to ensure seed singulation and optimize early vigor for optimum plant emergence and yield.

To support the continued success of the GoodHemp line, Arcadia has established the GoodHemp Innovation Partners platform, a select group of growers who will work closely with Arcadia's team of regional agronomists to further the shared understanding of GoodHemp seed performance at industrial scale throughout the production season. This unique go-to-market approach will be a hub model with centers initially in Hawaii, the Pacific Northwest, Southern California, Northern California, the Desert Southwest and the Mountain West. Innovation partners will receive exclusive access to the team of breeders, geneticists and computational biologists at Arcadia's R&D headquarters in Davis, and serve as a hemp production advisory board highlighting grower challenges to inform Arcadia's future breeding efforts. They will also have early access to developmental seed varieties and will help validate innovations under real farm conditions.

New Reliables

New Reliables are grower-proven varieties improved through our proprietary seed production processes and seed conditioning program. With valued attributes and consistently performing genetics, New Reliables meet our strict quality requirements and are tested and improved each season.

Our 2020 GoodHemp seed offering focuses on cannabinoid production and was designed anticipating USDA guidance for hemp production, emphasizing compliance with THC constraints and managing for grower profitability.

Developmental Varieties

Our developmental varieties are the latest advancements from our team of breeders. Reliably bred using conventional techniques, these varieties represent the game changing innovations farmers need.

Regional Success Teams

We're deploying field experts in key production areas, supporting GoodHemp Innovation Partner growers throughout the season. Tasked with providing technical support of the varieties, field sampling, data collection and analysis, plus grower education, these teams are our on-farm champions every day. With backgrounds in agronomy, plant science, breeding, production agriculture and production cannabis, these teams works closely with growers all season to bring a quality crop to harvest.

GoodWheat

Enhanced Quality Grains

Our GoodWheat brand redesigns wheat as a functional food adding value to the wheat supply chain by enabling a wider range of choices to meet consumer demands. We believe our GoodWheat products will allow consumers to enjoy unique health benefits in their favorite foods featuring wheat. Our GoodWheat product allows consumer food companies to deliver specialty products to discerning consumers. We have multiple programs aimed at developing wheat and other small grains with improved nutritional qualities. One such program generated multiple bread wheat and pasta wheat lines with very high levels of amylose, leading to increased levels of resistant starch. Resistant starch increases the total dietary fiber content of wheat and reduces its glycemic index, which are both desirable nutritional qualities that are important in the management of diabetes and healthy blood glucose levels. High fiber Resistant Starch wheat can deliver fiber and other benefits to refined white flour products and also whole grain food products. In 2016, the FDA approved the use of qualified health claims for corn-based resistant starch in the risk reduction of type-2 diabetes, thus establishing a key precedent for the health benefits associated with this fiber. According to the USDA's What We Eat in America Survey of 2015-2016, only 5% of the U.S. population meets the recommended level of dietary fiber. On average, Americans consume only 57% of the daily recommended levels. We believe improving the fiber content of wheat can deliver improved health benefits to a wide population.

A second program, in collaboration with Ardent Mills, aims at improving the flavor profile and shelf-life of whole wheat. A third program is aimed at reducing gluten in wheat and other grains. This program additionally targets improved protein quality and amino acid profile in wheat. All of these programs utilize our TILLING platform, and the resulting products are non-GM.

High Fiber Resistant Starch Wheat

Our high fiber resistant starch (RS) wheat provides a source of wheat with inherently high levels of resistant starch, increasing the total dietary fiber content of food products without the need for fiber additives from other sources. Currently, corn resistant starch is a product in two market segments: dietary fiber additives and modified starch additives. According to MarketsandMarkets, the global dietary fibers market is projected to reach $6.5 billion by 2022 and the modified starch market is projected to reach $12.4 billion in 2022. Major growth in these markets is being driven by the convenience health food sector and functional food sector. Flour from our RS wheat lines has resistant starch levels that are 12 to 20 times higher than the control wheat, and total dietary fiber, or TDF, which is more than eight times higher than the control. RS wheat flour has been tested in applications in bread, where loaf quality was comparable to bread made with conventional wheat flour, and pasta, where it had the highest consumer preference rankings in tests carried out by a major consumer products company.

RS wheat flour is currently being introduced to North American bakery and CPG companies by our partners, Bay State Milling. In markets outside North America, RS wheat is currently being tested in a range of additional bakery, ready-to-eat cereals and pasta products with industrial partners. We have many RS wheat lines that are being evaluated for optimal quality and agronomic characteristics.

Improved Shelf Life of Whole Grain Flour

The USDA recommends that “at least one serving of grains per day must be whole grain-rich” due to evidence that a diet containing whole grains provides a multitude of benefits, including lower risk of obesity, cardiovascular disease, and type-2 diabetes. Despite these health benefits, consumption of whole grain products is negatively affected by the bitter and rancid flavors and odors that accumulate in whole wheat flour after milling. Our improved stability and flavor wheat lines greatly reduced the production of rancid and bitter compounds in milled whole grain flour as it progresses through the supply chain. Whole wheat flour from these lines is being tested further for sensory characteristics and improved shelf life stability. This new trait could help improve the shelf life and flavor profile of whole grain products, thus reducing formulation costs and increasing consumer preference and palatability for whole grains.

Reduced Gluten (RG) Wheat

Many consumers are interested in reducing levels of gluten in their diet. Critically, for some, this is due to having Celiac disease (CD), an autoimmune disease that impacts many people worldwide with estimates from 1% of the population in Europe to 3.5% in Mexico. Furthermore, non-celiac gluten sensitivity (NCGS) impacts an estimated additional 6% of the population. Both CD and NCGS are characterized by sensitivity to dietary gluten. The only effective treatment of CD and NCGS requires removal of gluten sources from the diet. Since required adherence to a gluten-free diet is extremely difficult to accomplish for average consumers, efforts to develop alternative approaches are needed.

Research conducted by the Connell Group in 2018 indicates there is a significant portion of consumers (26% of general population) that choose to reduce gluten levels in their diet despite not having Celiac disease. Further internal qualitative research conducted in 2019 identified a valuable consumer segment recognized as “Gluten Reducers” who aspire to reduce gluten but are not strict gluten-free.

Arcadia is developing and launching a new wheat variety with reduced gluten levels. Our proprietary, non-GM wheat variety developed using advanced screening and plant breeding techniques have reduced allergenic glutens and increased essential amino acids such as lysine, along with all the other health benefits of high protein wheat. This new variety is beneficial for both food and feed applications. We are breeding the trait into commercial wheat varieties and working with food processors to give people a choice to enjoy higher quality wheat in the products they love while reducing gluten in their diet. Our successful, limited quantity commercial market test in December 2019 proved consumers value (and are willing to pay more for) this reduced gluten attribute.

Wheat Yield

Our non-transgenic wheat yield program, initially supported by the USDA, aims to increase yield in wheat using TILLING, a non-GM reverse genetics tool, to identify novel alleles of candidate wheat yield genes in tetraploid and hexaploid wheat. These alleles are being evaluated for the ability to alter wheat architecture and improve yield in the field. As a non-GM technology, products from TILLING can rapidly advance to commercialization and do not face market or regulatory restrictions. According to the USDA's estimate in 2017/2018, with a conservative 5% increase in yield, the yearly value creation to the U.S. farmer is estimated at over $30 per hectare. In addition, the value of higher yielding wheat varieties to a seed company arising from this research in the U.S. alone is more than $40 million annually. By incorporating favorable alleles of plant architecture genes into a commercial wheat breeding program, we believe we can make a significant contribution to improving yield in this vital food crop.

Nutritional Oils

Gamma Linolenic Acid (GLA) Oil

Under a license agreement with Abbott Laboratories, we developed a new source of vegetable oil with very high levels of gamma linolenic acid, or GLA, an omega-6 fatty acid. To our knowledge, our GLA safflower oil product has the highest concentration of GLA available in any plant oil at 65%; conventional plant oils range from 10 to 22% GLA. We sell the oil in the United States to manufacturers of dietary supplements, nutritional supplements, medical foods, dog food, and other products. GLA safflower oil is also approved in Canada as a natural health product. Our key customers include significant participants in those markets.

GLA has multiple clinically-demonstrated nutritional and medical benefits, including anti-inflammatory effects, improving skin conditions such as atopic dermatitis and healthy weight management. Multiple parties have expressed commercial interest in incorporating an enhanced GLA oil into their foods, dietary supplements, or medical products where conventional sources of GLA are not sufficiently concentrated to deliver amounts that are cost- and performance-effective.

Against a commercial target of 40% GLA concentration, we developed, deregulated and commercialized GLA safflower oil containing up to 75% GLA concentration in fewer than six years. This is significantly shorter timeline than the 13 years it takes, on average, to commercialize an agricultural biotechnology product, according to Phillips McDougall in 2018. We produced GLA safflower oil by contracting with farmers in Idaho and processing the seed under contract with a manufacturer in California to make refined oil. We sell GLA safflower oil under the brand name, SONOVA, with multiple concentrations and formulations.

In January 2017 we received notification from the FDA that our GRAS petition (generally recognized as safe) for the use of SONOVA GLA in medical foods and nutritional beverages had been accepted, which means that we can now market and sell this product in a new market segment. In August 2017, the FDA published in the Federal Register a food additive regulation for the use of SONOVA GLA in dog food. The FDA published a similar regulation for cat food in February 2019. These approvals and authorizations are generating additional revenue opportunities for our GLA business.

Joint Ventures

Verdeca

In 2012, we partnered with Bioceres, an Argentina-based technology company, to form Verdeca LLC, a U.S.-based joint venture company to deploy next-generation soybean traits, of which we own 50%. We selected Bioceres as our partner in soybeans, the world's fourth largest crop by area grown, due to their desirable trait portfolio, their presence in key South American markets, and the significant presence of large soybean growers in their ownership structure. Our joint venture agreement provides for each of the joint venture partners to license its trait technologies to Verdeca for use in soybeans, with product development and regulatory efforts equitably divided and managed by us and Bioceres under stand-alone service agreements that are executed annually.

The newest product in the Verdeca pipeline is HB4®, a drought and herbicide tolerant soybean trait for which extensive validation trials have been completed. This trait has been demonstrated to confer a yield advantage over conventional soybeans grown under the same suboptimal conditions. Currently, the HB4® trait has regulatory approval in more than 80 percent of the global soybean market, including the U.S., Brazil, Argentina and Paraguay. Regulatory submissions are currently under consideration by China, Canada, Bolivia and Uruguay.

Archipelago Ventures Hawaii, LLC

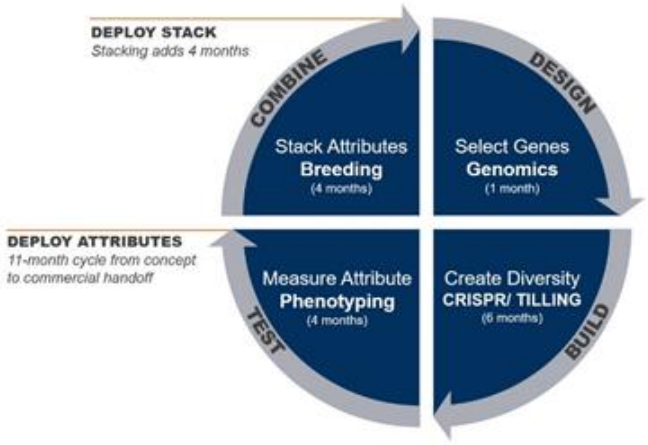
In August 2019, we formed a new joint venture to serve the Hawaiian, North American and Asian hemp markets, Archipelago Ventures Hawaii, LLC ("Archipelago"). This new venture between Arcadia and Legacy Ventures Hawaii ("Legacy") combines Arcadia's extensive genetic expertise and seed innovation history with Legacy's growth capital and strategic advisory expertise in the Hawaiian markets. Additionally, Legacy brings to the partnership years of proven success in extraction, product formulation and sales of cannabinol oil and distillate products through its equity partner, Vapen CBD. Legacy was originally formed to be a vehicle for its partners to pursue hemp opportunities within the Hawaiian Islands. Legacy's primary role within Archipelago is to build world class cGMP extraction facilities to allow Hawaiian farmers an outlet for maximizing their profits growing and converting hemp to high grade CBD, as well as other high-value compounds. Legacy's equity partner, Vapen CBD, is a wholly owned subsidiary of VEXT which is a publicly traded cannabis operator based in Phoenix, Arizona listed on both the Canadian and Frankfurt exchanges.

Archipelago creates a vertically integrated supply chain, from seed to sale, we believe the first of its kind in Hawaii, and has three important strategic imperatives: (1) ensure a reliable supply chain during critical scale up of the global hemp market, a major risk mitigation for success, (2) ensure high quality throughout the supply chain, from genetics to the field and field to the customer, and (3) ensure being well-positioned to address the unique needs and opportunities of the Hawaiian market.

Research and Development

Product Development Platforms

As mentioned above, our R&D program is centered around ArcaTech, our proprietary, rapid prototyping and product development pipeline, which consists of our five key enabling platforms that are tightly integrated to synergistically support rapid product development advancement.



Genomics (gene target discovery and editing)- Our team of molecular biologists and data scientists use cutting edge next-generation sequencing technology to rapidly map and analyze plant genomes. This enables us to understand the function of genes and genetic networks in plants and, importantly, to be able to determine the genetic basis for valuable traits and attributes in any crop. Identification of gene targets to deliver product concepts is a key function of this platform. We also leverage the genomics platform to accelerate our breeding program through the deployment of marker assisted and genomic selection techniques. This enables us to accurately select superior individuals from a large population thereby significantly reducing the number of generations required to develop improved plant varieties.

Our genome editing platform is closely integrated with our genomics team and includes a cross disciplinary group of experienced molecular biologists, plant scientists, and CRISPR gene-editing experts who work together to identify, test and select gene targets, and ultimately to build research prototypes of novel product concepts. Those prototypes are rapidly evaluated with high throughput assays and indoor phenotyping and have the potential to become the basis for advancement through our commercial TILLING platform. The genome editing platform also houses the expertise and deep experience to genetically transform key crop species. Our team has demonstrated transformation capabilities in all primary and some secondary agricultural crops, including but not limited to rice (japonica, indica and NERICA types), wheat, corn, canola, safflower, barley, sorghum, alfalfa, tomato, potato, tobacco and grapes. This capability gives Arcadia the optionality to address both GM and non-GM markets depending on the value and sensitivity of the target attribute and crop.

TILLING—Non-GM Traits. Our advanced breeding TILLING platform enables us to develop value-added crops without the use of GM methods. TILLING was invented by Arcadia scientists and we have continued to refine and improve our process, which puts us at a competitive advantage in applying this technology for commercial purposes. The TILLING platform is managed by a dedicated team of scientists able to apply TILLING to multiple crops with complex genomes. TILLING technology utilizes specialized laboratory equipment to carry out high-throughput allele screening of DNA samples from genetic diversity populations created in major crops. Our populations include wheat, rice, soybean, canola, and hemp. These populations include numerous native and induced gene function alterations, which can be discovered and evaluated rapidly at low cost and with minimal regulatory requirements. We believe the combination of our background in the technology as the first to apply TILLING to crop plants such as wheat and tomato, and our highly refined skills in developing and screening genetic diversity in plant populations makes us a leader in commercial applications of TILLING.

Rapid phenotyping and controlled plant growth. The rapid phenotyping and controlled plant growth group manages our growth chamber facilities, where plants are grown under precisely controlled conditions, and our greenhouse facility, consisting of approximately 26,000 square feet of high-quality greenhouse space. They also carry out a number of essential functions to support breeding and prototype evaluation including the phenotypic evaluation of plants, controlled crosses, accelerated breeding protocols, rapid phenotyping as well as conducting seed increases for pre-commercial developmental varieties. Additionally, for hemp projects, this team manages our cannabinoid chemistry pipeline, which enables high throughput characterization of cannabinoids and terpenes across all research hemp populations. Our growth chamber facilities are located at our headquarters in Davis, California, and our greenhouses are located nearby in Yolo county California.

Breeding & research field evaluation. Our breeding and research field evaluation team is closely integrated with the rest of the ArcaTech platform. Consisting of plant breeding, field trial design and statistical expertise, this team executes Arcadia's breeding strategy and conducts high-quality replicated trials to ensure advancement of superior new genetics. The team leverages the infrastructure and expertise of the genomics platform to conduct marker assisted and genomic selection schemes to rapidly develop powerful new varieties. The team also works closely with the phenotyping and controlled growth team to ensure the purity of lines early in the breeding process. To enable field selection of optimal genetics under uncontrolled field conditions the team manages selection and evaluation fields in Oregon, California and Idaho, as well as manages a network of cooperators to conduct multi-state regional trials.

The Arcadia research and development activities are rapidly progressing in both our Hawaii Industrial Hemp Pilot Program with multiple hemp harvests in Molokai, as well as breeding advances with our research activities in California. The Arcadia research & development facility located in Molokai has demonstrated the capability to successfully grow and harvest multiple hemp varieties for eventual flower and CBD production in multiple production seasons. This milestone represents what we believe to be the first successful hemp harvest on Molokai and one of the first in all of Hawaii, which we believe positions Arcadia and Archipelago as a leader in this industry in Hawaii. The next phase of Arcadia and Archipelago growth in the Hawaiian market is establishing varieties that can deliver commercial grade performance without exceeding the 0.3% THC threshold that defines legal industrial hemp. Arcadia has now entered the next commercial phase of growth in Hawaii which includes rapid ramp-up of hemp flower production acreage and the establishment of processing and extraction facilities through Archipelago in accordance with current and forthcoming regulations.

Our Arcadia hemp breeding program has achieved multiple milestones which lay the foundation for our expansion of hemp breeding research activities in the U.S. Our indoor growth facilities are operational in Davis, establishing breeding procedures that can be replicated in each of our research locations. The internal platform to analyze cannabinoid and terpene profiles are operational, enabling our breeding program to select lines with altered potency and/or composition. Our analytical laboratory houses critical CO2 extraction capabilities enabling rapid evaluation of lines and allowing for new innovations. In July 2019, the breeding team achieved a major milestone with the creation of the first Arcadia proprietary variety developed in-house. This is an important milestone demonstrating Arcadia's proven technological competencies in plant transformation in hemp and sets the stage for expansion of our breeding operations, acceleration of varietal development and genetic optimization. As was the intention from the onset, Arcadia has adopted an aggressive germplasm acquisition strategy that has resulted in the development of a germplasm library containing improved genetic variation sufficient to fuel a robust breeding pipeline. Archipelago has tripled the acreage in Hawaii with two new licensed growers. Arcadia also established a hemp research facility in California and is partnering with an Oregon research company to conduct field research in that key hemp territory. As a result, the company now has operational locations in three states to produce hemp and hemp seed – Hawaii, California and Oregon – and plans to begin sales of hemp seed, hemp extract and CBD products in 2020.

Research, Field Trials, Breeder & Foundation Seed Production. Our trait evaluation and development group is based in Davis, California and conducts remote field operations in American Falls, Idaho; Yuma, Arizona; Brawley, California and multiple locations in Montana, North Dakota, Oregon and Washington. The trait evaluation and development group have extensive field and specialized statistical analytical capabilities that we deploy to support field trial execution and data analysis internally and with our collaborators. Late-stage regional and agronomic trials are intended to develop extensive data on a limited number of potential commercial plant varieties and develop the best crop management practices suited for these commercial products. Similarly, regulatory trials develop data for use in submissions for regulatory review and may involve plant varieties developed by our collaborators or our own oil quality and grain quality programs.

Commercial Seed, and Grain Production. The commercial development group is based in Davis, California. The group conducts grower field trials and manages the commercial seed and grain production throughout the United States working through seed production specialists and growers and elsewhere globally with our collaborators and joint venture partners. Grower field evaluations are designed to test new commercial seed varieties for yield and agronomic performance and as well as characterizing performance of seed and grain quality attributes.

Regulatory Data Generation. Our Analytical Services and Regulatory Science group is located in Davis, California and provides automated DNA preparations, genomic blot analyses, lipid profiling, metabolomics and protein purification services and develops data for use in product selection and validation, certification of SONOVA, GoodWheat and other product specifications, and regulatory submissions. These data support regulatory submissions and provide core trait regulatory packages to our collaborators for use in their crop-specific regulatory applications.

Biological Materials Inventory and Tracking. Our proprietary Pedigree and Inventory Management System, or PIMS, tracks the genetic, phenotypic and location information for all our plant materials. PIMS encompasses genetic elements such as genes and promoters, GM seeds and plant material received by us, as well as seeds and plants developed by us and used in trait development. The performance of our plant materials is recorded through a variety of laboratory and field observations, and the data are stored within PIMS. The location of all plant materials is tracked throughout the plant life cycle. This includes specific seeds planted within a specific plot of a specific field trial, harvest, seed storage location and use by, or distribution of plant material to, our collaborators or elsewhere. PIMS interfaces with our Biotechnology Quality Management System, or BQMS, to manage all movement and release of regulated GM plant materials. This ensures all our plant materials are accounted for, tracked and inventoried, which enables us to maintain control over and documentation of all plant materials.

Regulatory, Compliance, Quality, and Stewardship

Our regulatory, compliance, quality and stewardship team ensures that Arcadia, its subsidiaries, key partners and collaborators not only remain compliant with all applicable laws, but operate with rigorous procedures and standards that ensure traceability and high quality product development throughout the pipeline. This critical function implements and oversees quality management procedures spanning research, development, commercialization and supply chain. Critical activities include, but are not limited to, establishing standard operating procedures and best practices, completing regulatory permits and monitoring regulatory and stewardship compliance for all products at all stages. Our regulatory team includes key individuals who are directly responsible for leading all global regulatory agency interactions, providing tactical and strategic regulatory direction, and working closely with consultants and outside support as needed to ensure we have access to appropriate expertise and resources.

In order to enable our hemp business, we must ensure compliance with the national regulatory framework for hemp managed through the USDA U.S. Domestic Hemp Production Program. Compliance with this program includes obtaining and maintaining permits from the states and localities in which we produce hemp as well as complying with the guidelines set forth in the USDA interim final rule. We also must ensure compliance with regulations related to producing, selling and appropriately labeling seed in all commercial geographies. Our Regulatory, Compliance, Quality and Stewardship team has successfully obtained hemp permits in each of the geographies in which we are currently conducting hemp related activities.

Specific to our GM products, our regulatory management and compliance activities encompass three broad categories: deregulation, stewardship, and authorization, each of which is described in further detail below. In the United States, these activities are regulated by various government agencies, including the USDA, the FDA and the U.S. Environmental Protection Agency (EPA). Our regulatory team has completed significant regulatory activities (new dietary ingredient review, food additive regulation, GRAS (generally recognized a safe) notice and GM food consultation) with the FDA Division of Dietary Supplement Programs, with the FDA Center for Food Safety and Applied Nutrition, with the FDA Center for Veterinary Medicine with the Health Canada Natural Health Products Directorate and the Canadian Food Inspection Agency.

Deregulation of GM products

Our business is subject to regulations related to agriculture, food and the environment. Plant products produced using GM technology are subject to laws and regulations in countries where the plants are grown and in countries where the GM plant-derived food and feed are consumed by humans or animals. Commodity products utilizing our GM traits may require approvals in multiple countries prior to commercialization.

U.S. Regulatory Agencies:

U.S. Department of Agriculture. We must obtain USDA authorizations and permits in order to conduct the field releases of GM regulated materials that are necessary to advance the development of GM crops. Obtaining such authorizations and permits is generally routine and delays impacting the planned movement or release of GM material are uncommon. The USDA provides detailed regulations and guidance for obtaining a *"Determination of Deregulated Status,"* which authorizes the commercial and uncontained growing of GM plants. For regulated GM plants, the USDA requires that a company petition the agency to demonstrate that the product is unlikely to pose a risk. Based on the information provided, the USDA prepares an Environmental Assessment (EA) and/or an Environmental Impact Statement (EIS) in order to make its determination. These procedures afford the public an opportunity to submit written comments on the draft EA or EIS for consideration by the USDA before the final version of the EA or EIS is published. For any GM plant product, there may be delays or requests for additional information based on the USDA's review or the public comments. As of March 2019, USDA has issued 126 Determinations of Nonregulated Status. Submissions received by the USDA from all applicants prior to 2011 averaged more than 2 years for approval. Since then, the USDA has significantly shortened the time to approval, averaging 1 year in 2017.

U.S. Food and Drug Administration. The FDA is responsible for food safety under the Federal Food, Drug and Cosmetic Act. The FDA recommended in its 1992 *Statement of Policy: Foods Derived from New Plant Varieties* that developers of GM plant products consult with the agency about the safety of GM products under development. In 1996, the FDA provided additional guidance to the industry on procedures for these consultations. These procedures require a developer intending to commercialize a food or feed product derived from a GM plant to first meet with the agency to identify and discuss relevant safety, nutritional and other regulatory issues regarding the product. Subsequently, the developer submits to the FDA a scientific and regulatory assessment supporting proposed product safety. The FDA evaluates the submission and engages with the developer to resolve any questions, requests for additional data or other informational requirements. Once the FDA has determined that all requirements have been satisfied, the FDA concludes the consultation process by issuing a letter to the developer acknowledging completion of the consultation process with the addition of the product to the list of completed consultations on the FDA website. The completed consultation acknowledges product safety for use as food and feed. To date, over 150 GM products have completed this process with the FDA. This process may have delays if the FDA requires additional data and information for its consultation and to resolve any questions the FDA may have. The FDA completed 21 consultations from 2015 to 2017, with consultation time periods in 2017 ranging from 2 to 15 months and averaging just over one year from first submission to conclusion.

Environmental Protection Agency. Certain products may also be regulated by the EPA, including plants that contain a plant-incorporated protectant, such as a pesticides or herbicide, or plants engineered to be treated with industrial chemicals.

International Deregulation of GM products:

When products from GM crops are expected to be exported from the United States, commercialization of such crops in the United States will require approvals in those countries into which the crops or derivative products, such as grain, oil or meal, will be exported. The laws and regulations for GM plant products are well defined in most commercially significant countries, including Australia, South American countries, India, China, several African countries and the European Union. Typically, our collaborators are responsible for obtaining all regulatory permits and approvals relevant to product development and commercialization in their licensed countries and for generating crop and transformation event-specific data required by their countries of interest. We provide basic safety data on trait expression products in accordance with generally accepted standards. In addition, we may serve as a regulatory consultant and participate in the design of regulatory protocols, data generation and development of detailed regulatory submissions. In certain countries, we may develop strategic business relationships or employ independent consultants with country-specific knowledge and expertise to support and obtain required approvals.

Stewardship of GM products

Stewardship, or the careful and responsible management of assets, forms the foundation of our regulatory compliance programs associated with GM plants. Our stewardship framework for GM plants is defined by government regulations and related internal policies and practices. In previous years, Arcadia's Biotechnology Quality Management System (now identified as ABQMS) was developed by us and then audited/certified by the USDA Animal and Plant Health Inspection Service, Biotechnology Regulatory Service (APHIS BRS). Recently, USDA updated its BQMS program renaming it the Biotechnology Quality Management Support Program, discontinuing the mandatory auditing/certification standard.

Our ABQMS program was developed to address all conditions required under USDA authority to ensure containment of regulated plant material. The ABQMS includes standard operating procedures, or SOPs, recording and reporting forms, instructions for managing all compliance related activities, and training requirements for all individuals handling GM plant materials. SOPs are highly detailed and consider all elements of each relevant activity or process. Each field trial site is accompanied by a Field Compliance Guide and Record (GUIDE) containing multiple SOPs and associated forms for each activity. For example, a GM wheat trial requires 19 SOPs and associated verification forms. A GUIDE is completed for each regulated field trial and serves as a completed record to support compliance with government regulations. Example copies of the GUIDE have been provided to our collaborators for use in other countries where they conduct GM field trials.

Since our ABQMS program was first recognized by the USDA in 2011, each annual independent audit conducted by USDA until discontinuation of their audit program confirmed that our program was functioning as intended. Our ABQMS manager has attended USDA BQMS training programs at the request of the USDA to assist in training personnel at other companies and organizations and to share our experience and the SOPs that form the basis of our program.

Compliance with the specific parameters of regulatory requirements is only one element of stewardship. Additional activities within each functional group throughout the company are integral to the overall stewardship program. Each of our employees is trained on, and must comply with, relevant stewardship guidelines as defined and described in our ABQMS.

Authorization of GM products

The USDA APHIS Biotechnology Regulatory Service (BRS) has legal and regulatory authority over the movement and release of GM plants and seeds. "Movement" includes movement of regulated GM plant material between states and the importation of regulated GM plant material into the United States. "Release" includes field trials of any size and any other use of regulated GM plant material outside of contained greenhouses.

We have obtained more than 200 authorizations from the BRS for the movement, importation or release of GM plants under development. General and specific conditions to maintain containment during all activities associated with the movement or release are a requirement of each authorization. These conditions are defined, applied and recorded in the GUIDE following our ABQMS program.

Intellectual Property

We rely on patents and other proprietary right protections, including trade secrets and contractual protection of our proprietary know-how and confidential information, to preserve our competitive position.

As of December 31, 2019, and in summary, we owned or exclusively controlled 143 issued patents and 59 pending patent applications worldwide. These totals reflect the following: (i) with respect to the U.S. territory, we owned 16 and exclusively in-licensed 10 U.S. issued patents, and we owned nine U.S. patent applications relating to our trait technologies and business methods; and (ii) in connection with foreign territories, we owned 26 and exclusively in-licensed 91 foreign issued patents, and owned 46 and exclusively in-licensed four pending foreign patent applications. With respect to all of the foregoing patent assets, our exclusive licenses afford us control over the prosecution and maintenance of the licensed patents and patent applications. These numbers do not include in-licensed patents for which we either do not have exclusive rights (such as certain enabling technology licenses), or for which we have exclusive rights only in a limited field of use or do not control prosecution and maintenance of the licensed patents.

As of December 31, 2019, we had eight registered trademarks in the United States and also six registered trademarks in various other countries.

Key Collaborations

We have established numerous trait collaborations and have developed close relationships with industry-leading seed and consumer product companies. Our partnerships with global strategic seed and consumer product players enable us to further participate in the development and commercialization of innovative products that promise to play significant roles in improving global crop efficiency and enhancing human health. We believe that the expertise and opportunities created by these collaborations represent important assets to our business. Below is a summary of selected collaborative partnerships that we view as key to the achievement of our near-term and mid-term business objectives.

Ardent Mills

In November 2018, we announced our collaboration with Ardent Mills, LLC to develop and commercialize wheat innovations. Ardent Mills, LLC is North America's leading flour-milling and ingredient company. Our first project focuses on extending the shelf life and improving the flavor of whole wheat products.

By using patented Arcadia trait technology, the storage life of whole wheat flour can be extended by slowing the enzymatic processes that reduce shelf life. Because milled flour from wheat carrying Arcadia's trait technology oxidizes more slowly, it also minimizes the bitterness associated with most whole wheat products. This trait is expected to help improve the taste of whole wheat products and help reduce waste.

The extended shelf life wheat trait was developed using our proprietary non-GM wheat genetic diversity TILLING library, an extensive and exclusive resource of trait lines with high-density variations in genetic composition and gene function. Because it is non-GM, the trait has wide application potential across both conventional and organic farming practices. We recently received a U.S. patent for the technology which extends the storage life of whole wheat flour by minimizing oxidation, the latest in our portfolio of wheat trait improvements. We will continue further collaboration with Ardent Mills, LLC and university partners to bring this trait to commercialization in products.

Corteva Agriscience

In August 2017, we entered into a new strategic collaboration with Corteva AgriScience to jointly develop and commercialize a breakthrough improved wheat quality trait in North America. The collaboration leverages our TILLING platform with Corteva Agriscience's enabling technology platforms, high-quality elite germplasm and global commercial channels.

Under the collaboration, the companies will further develop and commercialize an improved wheat quality trait, which has completed initial field trials and is advancing to next-stage field trials. Corteva AgriScience will introgress Arcadia's trait into its proprietary elite germplasm lines and manage all aspects related to the trait commercialization. Certain development costs will be co-funded, and we will share in the commercial value resulting from products produced.

Arista Cereal Seeds Pty Ltd and Bay State Milling Company

In August 2019, we entered into a binding term sheet with Arista and BSM to resolve the parties' disputes, including the Delaware Action and the 716 Interference proceeding. Under the binding term sheet, Bay State Milling Company will become the exclusive commercial partner for our high fiber wheat in North America under Bay State Milling's HealthSense™ brand portfolio, while Arista receives exclusive rights under our high fiber wheat intellectual property in certain geographies, including Australia and Europe. We will continue to market our high fiber wheat under our GoodWheat portfolio of specialty wheat ingredients in other international markets. In December 2019, the three parties entered into a settlement agreement reflecting the terms of the binding term sheet.

Scientific Advisory Board

We maintain a scientific advisory board ("SAB") consisting of the members identified below. Our scientific advisory board meets on a quarterly basis and is comprised of industry and academic experts that have extensive experience in the analysis, research and development, and commercialization of biotech plants, including experience relating to discovery, transformation, and field trials. We consult with our scientific advisory board on a variety of matters pertaining to our current and future pipeline of products in development, including, for example, trait selection and development, transformation and TILLING methodologies, field trials, regulatory matters, and intellectual property evaluation.

We currently have a scientific advisory board that consists of the two members listed below. At times, we rotate the members on our SAB to support our business as it grows and evolves.

Luca Comai, Ph.D. is a professor of plant biology at the University of California, Davis Genome Center. Dr. Comai's lab is involved in two areas pertinent to breeding. In the first, they study genome regulation, hybridization, and heterosis responses in chromosome copy number variants and interspecific hybridization. In the second, they develop methods and resources for functional genomic discovery, including TILLING, which allows targeted inactivation of genes in crop plants. The research combines plant genetics and genomics with the use of next-generation sequencing, bioinformatics and genome editing to identify genes responsible for traits of interest as well as to discover and use natural and induced variation. Dr. Comai is known for his pioneering work creating glyphosate tolerant crops, and as a founding scientist in Calgene Pacific, Targeted Growth, Inc. and Tilligen. He is a Fellow of the American Association for the Advancement of Science.

Scott Haley, Ph.D. is a professor and wheat breeder in the Soil and Crop Sciences Department at Colorado State University (CSU). Since 1999 he has led the Wheat Breeding and Genetics Program focused on developing improved hard red and hard white winter wheat varieties for eastern Colorado and the High Plains region. Among Dr. Haley's accomplishments are the development of 40 improved wheat varieties and 2 wheat germplasm lines. In addition to research, Dr. Haley is also active in teaching, student advising, and outreach. Following completion of a B.S. degree in botany at Washington State University, Dr. Haley served with the Peace Corps in West Africa prior to joining CSU as a graduate student in wheat breeding. He then completed a post-doctoral appointment in bean breeding at Michigan State University and served 5.5 years as a wheat breeder at South Dakota State University.

Competition

The markets for seed traits and agricultural biotechnology products are highly competitive, and we face significant direct and indirect competition in several aspects of our business. Competition for improving plant genetics comes from conventional and advanced plant breeding techniques, as well as from the development of advanced biotechnology traits. Other potentially competitive sources of improvement in crop yields include improvements in crop protection chemicals, fertilizer formulations, farm mechanization, other biotechnology, and information management. Programs to improve genetics and chemistry are generally concentrated within a relatively small number of large companies, while non-genetic approaches are underway with broader set of companies.

In general, we believe that our competitors generally fall into the following categories:

- *Specialty health and nutrition ingredient companies*: In response to the growing consumer demand for healthier food alternatives, a number of agricultural and food-based companies are augmenting their product and market strategies to bring new quality food ingredients to market. Calyxt, Inc. (formerly known as Cellectis Plant Sciences, Inc) is an agriculture biotechnology company that has a similar strategy as ours and is using gene-editing technology to create healthier specialty food ingredients and agriculturally advantageous food crops.

- *Large Agricultural Biotechnology, Seed, and Chemical Companies:* According to Phillips McDougall, the leading 10 seed and trait companies as a group invested $3.9 billion in seed and trait research and development in 2017. This includes conventional and advanced plant breeding, as well as biotechnology and gene-editing trait development. According to Phillips McDougall, only a limited number of companies have been actively involved in new trait discovery, development, and commercialization: Corteva (formerly DuPont Pioneer and Dow), Syngenta, BASF, Bayer (including former Monsanto), KWS, and Genective (a joint venture between KWS and Limagrain). Many of these companies have substantially larger budgets for gene discovery, research, development, and product commercialization than we do. Some of these companies also have substantial resources and experience managing the regulatory process for new GM seed traits. Each of Corteva, Syngenta, and Bayer, which accounted for 87% of the 2017 seed trait research and development spend noted above, also have significant chemical crop protection background and businesses. The trait pipelines of these companies are heavily weighted toward biotic stress traits, although they also have significant programs aimed at development of abiotic stress traits and increasingly on output traits such as nutritional content. While these companies have internal programs that may compete with our own, they also seek new traits externally and, as such, some of them either currently are, or may in the future be, our collaborators.
- *Trait Research and Development Companies:* There are a number of companies that specialize in research and development of agricultural yield and product quality traits, and we believe that a dozen or more companies, including Ebbu (acquired by Cannopy Growth), Front Range Biosciences, Segra, Yield 10, Arista, Benson Hill Biosystems, Evogene, Keygene, Oregon CBD, High Grade Hemp, and Trilogene, among others, are competitors in our field. We believe that these companies typically focus on a limited number of traits, and do not generally have the product development and regulatory infrastructure necessary to bring traits to market. Therefore, we believe they typically license trait technologies to large industry players with in-house development and regulatory capabilities at a relatively early stage of development. In the development of nutritional traits using non-GM methods, companies like Calyxt and Arista Cereal Technologies are competitors who are also developing quality traits in wheat and other crops.
- *Companies Focused on the Development and Commercialization of Microbial Crop Enhancements:* The use of microbial products to enhance crop performance via application to soil, seed, or to crops directly is an area where increased research and development activity has been underway for the past decade or more. We believe that there are more than 20 companies of varying size working in this space. There have been a number of acquisitions, including Becker Underwood by BASF, and joint collaborations in this space but multiple independent companies remain, including Verdesian, Marrone Bioinnovations, Biagro Agrinos, Indigo Agriculture, and Bioconsortia. While these companies could be considered to compete with us as their products seek to improve crop yields, we believe that such products and our traits may be additive, or synergistic, to our future products in terms of increasing crop yields.
- *Companies Focused on Farming Data Management, or Precision Agriculture:* Within the past several years there has been a rapid increase in technologies and companies focused on acquiring, analyzing, and acting upon data in ways that may improve farm economics via increased crop yield and more efficient management of crop production inputs. Technical approaches include weather prediction and monitoring, high-density field and crop imaging systems, precision field soil and yield mapping, and others. Companies focusing on this space include Climate Corporation (acquired by Monsanto), Granular (acquired by DuPont), Farmers Business Network, Farmers Edge, Trimble, Planet Labs, Ceres Imaging, Blue River Technologies, and others. While these products are potentially competitive with us for increasing crop yields, we believe that certain of these products could also be additive or synergistic with our traits.
- *Agricultural Research Universities and Institutions:* Given the global importance of agriculture, numerous agricultural research universities and institutions around the world focus on basic and applied research aimed at increasing crop yield. Most of this publicly funded research is focused on basic research. Many public research programs aim to understand basic biological processes and do not necessarily engage in further development and commercialization of discovered traits. While these programs are potentially competitive with us, we view them primarily as sources of innovation that are fully compatible with our business model. We have an established track record of working closely and effectively with public research programs, including a number from the U.S., Canada, Bangladesh, Japan, Australia, Ireland, and elsewhere.

We believe that we are uniquely positioned at the nexus of basic research and commercial product development. Unlike many companies in our space, we generally do not compete in the area of basic research. Our focus is on development and validation and, therefore, we provide a value-added link by which basic research can be brought to market. Additionally, uncertainty regarding the classification – as GM or not - of gene-editing technologies like CRISPR by regulatory authorities in certain geographies, may increase interest in our proprietary TILLING platform and libraries as a mechanism for new trait development. While internal programs at the largest seed and technology companies are competitive with ours in some cases, we are technology providers to some of these companies, and we have collaborations with many of them. To remain competitive, we are pursuing multiple strategies, including further building our non-GM pipeline of new technologies, increasing the scope and range of our field-testing activities, and continuing to protect our intellectual property rights in key jurisdictions globally.

Employees

As of December 31, 2019, we had 41 full-time employees dedicated to research and development, 18 of whom are development and field personnel focused on demonstration and research field trials. Our research and development team possesses technical expertise in molecular biology, biochemistry, genetics, genetic engineering, analytical chemistry, and plant physiology. Our research and development activities are conducted principally at our Davis, California facility, with ongoing field trials conducted in American Falls, Idaho; Brawley, California, Yuma, Arizona; Molokai, Hawaii; and numerous other locations throughout the United States, as well as locations managed by our collaborators worldwide. We have made, and will continue to make, substantial investments in research and development. Our research and development expenses were $7.1 million and $6.1 million in the years ended December 31, 2019 and 2018, respectively.

As of December 31, 2019, we had 61 full-time employees, of whom four hold doctorate degrees. Approximately 41 employees are engaged in research and development and regulatory activities and 20 in management, operations, commercial operations, accounting/finance, legal and administration. We believe our employee relations to be good. None of our employees are represented by a labor union or collective bargaining agreement.

Facilities

Our corporate headquarters are located in Davis, California, in a facility consisting of approximately 16,280 square feet of office, laboratory and growth chamber space under a lease which expires on July 31, 2023. This facility accommodates research and development, operations, commercial operations, analytical services, regulatory and administrative activities. Our administrative offices in Phoenix, Arizona, consist of 2,976 square feet under a lease expires on December 31, 2021. The facility accommodates our finance, legal and other administrative activities. We lease greenhouse space and farmland for agricultural use in Northern California, as well as farmland in Southern California, Idaho and Hawaii. We also lease office and warehouse space in Idaho under a lease that expires on December 31, 2020.

In January 2020, we entered into a lease for additional office space in Davis, CA. The lease is expected to commence in the second quarter of 2020. We believe that our leased facilities are adequate to meet our current needs and that, if needed, suitable additional or alternative space will be available to accommodate our operations.

Item 1A. Risk Factors.

You should carefully consider the following risk factors, in addition to the other information contained in this report on Form 10K, including the section of this report titled "Management's Discussion and Analysis of Financial Condition and Results of Operations" and our financial statements and related notes. If any of the events described in the following risk factors and the risks described elsewhere in this report occurs, our business, operating results and financial condition could be seriously harmed. This report on Form 10K also contains forward-looking statements that involve risks and uncertainties. Our actual results could differ materially from those anticipated in the forwardlooking statements as a result of factors that are described below and elsewhere in this report.

Risks Related to our Activities in the Legal Hemp Industry

We will be subject to a myriad of different laws and regulations governing hemp and our inability to comply with such laws in a cost-effective manner may have an adverse effect on our business and result of operations.

Laws and regulations governing the use of hemp in the United States are broad in scope; subject to evolving interpretations; and subject to enforcement by a myriad of regulatory agencies and law enforcement entities. Under the Agriculture Improvement Act of 2018, also known as the 2018 Farm Bill, a state or Indian tribe that desires to have primary regulatory authority over the production of hemp in the state or territory of the Indian tribe must submit a plan to monitor and regulate hemp production to the Secretary of the USDA. The Secretary must then approve the state or tribal plan after determining if the plan complies with the requirements set forth in the Agriculture Improvement Act of 2018. The Secretary may also audit the state or Indian tribe's compliance with the federally-approved plan. If the Secretary does not approve the state or Indian tribe's plan, then the production of hemp in that state or territory of that Indian tribe will be subject to a plan established by USDA. USDA has not yet established such a plan. We anticipate that many states will seek to have primary regulatory authority over the production of hemp. States that seek such authority may create new laws and regulations that limit or restrict the use of hemp.

Federal and state laws and regulations on hemp may address production, monitoring, manufacturing, distribution, and laboratory testing to ensure that that the hemp has a delta-9 tetrahydrocannabinol concentration of not more than 0.3% on a dry weight basis. Federal laws and regulations may also address the transportation or shipment of hemp or hemp products, as the Agriculture Improvement Act of 2018 prohibits states and Indian tribes from prohibiting the transportation or shipment of hemp or hemp products produced in accordance with that law through the state or territory of the Indian tribe, as applicable. We may be subject to many different state-based regulatory regimens for hemp, all of which could require us to incur substantial costs associated with compliance requirements. Our research and development operations will be restricted to only where such operations are legal on the local, state and federal levels.

In addition, it is possible that additional regulations may be enacted in the future in the United States and globally that will be directly applicable to our research and development operations. We cannot predict the nature of any future laws, regulations, interpretations, or applications, nor can we determine what effect additional governmental regulations or administrative policies and procedures, when and if promulgated, could have on our business.

We may be forced to dispose of hemp we produce should a harvested crop test in excess of 0.3% THC levels.

The USDA's Interim Final Ruling for hemp cultivation mandates that states test hemp crops and dispose of "hot" crops that exceed 0.3% THC. If a producer has produced cannabis exceeding the acceptable hemp THC level, the material must be disposed of in accordance with the CSA and DEA regulations because such material constitutes marijuana, a schedule I controlled substance under the CSA. Consequently, the material must be collected for destruction by a person authorized under the CSA to handle marijuana, such as a DEA-registered reverse distributor, or a duly authorized Federal, State, or local law enforcement officer. Arcadia is responsible for the costs of disposal of non-compliant crops for which it is the producer, which could potentially be significant should a large number of acres test positive.

We have no operating history in the legal hemp or cannabis industry, which makes it difficult to accurately assess our future growth prospects.

The legal hemp and cannabis industry is an evolving industry that may not develop as expected. Furthermore, our operations continue to evolve as we continually assess new strategic opportunities for our business within this industry. Assessing the future prospects of this industry is challenging in light of both known and unknown risks and difficulties we may encounter. Growth prospects in the legal hemp and cannabis industry can be affected by a wide variety of factors including:

- Competition from other similar companies;
- Fluctuations in the market price of CBD oil;
- Regulatory limitations on the types of research and development with respect to cannabis;
- Other changes in the regulation of cannabis and legal hemp use; and
- Changes in underlying consumer behavior, which may affect the demand of our legal hemp and cannabis traits.

We may not be able to successfully address the above factors, which could negatively impact our intended business plans.

Because we have only recently begun our legal hemp operations, we anticipate our operating expenses will increase prior to earning revenue from these operations.

As we conduct research and development with respect to legal hemp, we anticipate significant increases in our operating expenses, and we may not realize significant revenues from such operations. As a result, the Company may incur significant financial losses with respect to such operations in the foreseeable future. There is no history upon which to base any assumption as to the likelihood that these operations will prove successful.

We will be required to return certain customer deposits if we are unable to fulfill seed orders.

We recently launched our GoodHemp seed catalog, and we intend to collect a deposit from certain growers that order hemp seeds from us. We would collect a deposit of 50% of the order commitment when the order is made and the remaining 50% when we deliver the hemp seeds to these growers. We may not be able to successfully fulfill the orders prior to the delivery of seeds if we are unable to source or if our contracted growers are unable to produce sufficient quantity of seed at our accepted quality level. We would be required to return the deposit if are unable to fulfil the order, which could adversely affect our results of operations and financial condition.

Negative press from being in the hemp/cannabis space could have a material adverse effect on our business, financial condition, and results of operations.

The hemp plant and the cannabis/marijuana plant are both part of the same *cannabis sativa* genus/species of plant, except that hemp, by definition, has less than 0.3% THC content, but the same plant with a higher THC content is cannabis/marijuana, which is legal under certain state laws, but which is not legal under federal law. The similarities between these plants can cause confusion, and our activities with legal hemp may be incorrectly perceived as us being involved in federally illegal cannabis. Also, despite growing support for the cannabis industry and legalization of cannabis in certain U.S. states, many individuals and businesses remain opposed to the cannabis industry. Any negative press resulting from any incorrect perception that we have entered into the cannabis space could result in a loss of current or future business. It could also adversely affect the public's perception of us and lead to reluctance by new parties to do business with us or to own our common stock. We cannot assure you that additional business partners, including but not limited to financial institutions and customers, will not attempt to end or curtail their relationships with us. Any such negative press or cessation of business could have a material adverse effect on our business, financial condition, and results of operations.

Risks Related to Our Business and Our Other Industries

Unfavorable global economic or political conditions could adversely affect our business, financial condition or results of operations.

Our results of operations could be adversely affected by general conditions in the global economy and in the global financial markets. A global financial crisis or a global or regional political disruption could cause extreme volatility in the capital and credit markets. For example, outbreaks of epidemic, pandemic, or contagious diseases, such as the recent COVID-19 outbreak, could disrupt our business. Business disruptions could include disruptions to the productivity of our employees working remotely and restrictions on their travel may hinder their ability to meet with potential customers and close transactions, as well as temporary closures of the facilities of suppliers or contract growers in our supply chain. Import approval by China is required for the successful commercial launch of our HB4® soybean, and it is uncertain whether the pandemic will cause delays in the approval process. If there are significant delays in China's approval, our results of operations and financial condition could be materially adversely affected. In addition, the COVID-19 outbreak may result in a severe economic downturn and has already significantly affected the financial markets of many countries. A severe or prolonged economic downturn or political disruption could result in a variety of risks to our business, including our ability to raise capital when needed on acceptable terms, if at all. A weak or declining economy or political disruption could also strain our manufacturers or suppliers, possibly resulting in supply disruption, or cause our customers to delay making payments for our services. Any of the foregoing could harm our business and we cannot anticipate all of the ways in which the political or economic climate and financial market conditions could adversely impact our business.

We or our partners may not be successful in developing commercial products that incorporate our traits.

Our future growth depends on our ability to identify genes that will improve selected crop traits and license these genes to our collaborators to develop and commercialize seeds that contain the genes. Pursuant to our collaboration agreements, we are entitled to share in the revenues from the sale of products that integrate our trait. We expect it will take between nine and eighteen months before the first seeds integrating our agricultural traits complete the development process and become commercially available for sale, resulting in revenues for us. However, the development process could take longer than we anticipate or could ultimately fail to succeed in commercialization for any of the following reasons:

- our traits may not be successfully validated in one or more target crops;
- our traits may not have the desired effect sought by our collaborators in the relevant crop or geography, or under certain environmental conditions;
- relevant milestones under our agreements with collaborators may not be achieved; and
- we or our collaborators may be unable to complete the regulatory process for the products containing our traits.

If products containing our traits are never commercialized or are commercialized on a slower timeline than we anticipate, our ability to generate revenues and become profitable, as well as our long-term growth strategy, would be materially and adversely affected. For example, the development processes for one of our key agricultural traits have experienced delays related to regulatory matters, particularly in China, and we expect that these development processes may continue to face delays, which have negatively impacted the commercialization timelines for products containing such traits.

Even if we or our collaborators are successful in developing commercial products that incorporate our traits, such products may not achieve commercial success.

Our long-term growth strategy is dependent upon our ability, or our collaborators' ability, to incorporate our traits into a variety of crops with global scope. Even if we or our collaborators are able to develop commercial products that incorporate our traits, any such products may not achieve commercial success as quickly as we project, or at all, for one or more of the following reasons, among others:

- products may fail to be effective in particular crops, geographies or circumstances, limiting their commercialization potential;

- our competitors may launch competing or more effective traits or products;
- the market for abiotic seed traits is evolving and not well established, and the market opportunities for any product we or our collaborators develop may be smaller than we or our collaborators believe;
- as we do not have a sales or marketing infrastructure for our agricultural yield traits, we depend entirely on our collaborators to commercialize our products, and they may fail to devote the necessary resources and attention to sell, market and distribute our current or any future products effectively;
- significant fluctuations in market prices for agricultural inputs and crops could have an adverse effect on the value of our traits;
- farmers are generally cautious in their adoption of new products and technologies, with conservative initial purchases and proof of product required prior to widespread deployment, and accordingly, it may take several growing seasons for farmers to adopt our or our collaborators' products on a large scale;
- farmers may reuse certain non-hybrid seeds from prior growing seasons in violation of applicable seed license agreements;
- we or our collaborators may not be able to produce high-quality seeds in sufficient amounts to meet demand; and
- we or our collaborators may decide, for whatever reason, not to commercialize products containing our traits.

Our financial condition and results of operations could be materially and adversely affected if any of the above were to occur.

Our product development cycle is uncertain, and we may never earn revenues from the sale of products containing our traits.

Research and development in the seed, agricultural biotechnology, and larger agriculture industries is expensive, prolonged, and entails considerable uncertainty. We and our collaborators may spend many years and dedicate significant financial and other resources, developing traits that will never be commercialized. The process of discovering, developing, and commercializing a seed trait through either genetic modification or advanced breeding involves multiple phases, and it may require from two to thirteen years or more from discovery to commercialization. The length of the process may vary depending on one or more of the complexities of the trait, the particular crop, and the intended geographical market involved. This long product development cycle is in large part attributable to the nature-driven breeding period for a commercial product, as well as a lengthy regulatory process.

We have a history of significant losses, which we expect to continue, and we may never achieve or maintain profitability.

We have incurred significant net losses since our formation in 2002 and expect to continue to incur net losses for the foreseeable future. We incurred net losses of $28.9 million, and $13.5 million for the years ended December 31, 2019 and 2018, respectively. As of December 31, 2019, we had an accumulated deficit of $207.2 million. Net cash used in operations was $17.2 million and $13.6 million for the years ended December 31, 2019 and 2018, respectively. We expect to continue to incur losses. Because we have incurred and will continue to incur significant costs and expenses for these efforts before we obtain any incremental revenues from the sale of seeds incorporating our traits, our losses in future periods could be even more significant. In addition, we may find our development efforts are more expensive than we anticipate or that they do not generate revenues in the time period we anticipate, which would further increase our losses. If we are unable to adequately control the costs associated with operating our business, including costs of development and commercialization of our traits, our business, financial condition, operating results, and prospects will suffer.

In addition, our ability to generate meaningful revenues and achieve and maintain profitability depends on our ability, alone or with strategic collaborators, to successfully commercialize our products and complete the development of and complete the regulatory process to commercialize our traits. Most of our revenues since inception have consisted of upfront and milestone payments associated with our contract research and license agreements. Additional revenues from these agreements are not expected to be significant. To date, we have not generated any significant revenues from product sales other than from our SONOVA products. If we are unsuccessful in selling our commercial wheat or hemp products, or products containing our traits fail to achieve market acceptance or generate significant revenues, we may never become profitable.

We may require additional financing and may not be able to obtain such financing on favorable terms, if at all, which could force us to delay, reduce, or eliminate our research and development activities.

We will continue to need capital to fund our research and development projects, the commercialization of our products, and to provide working capital to fund other aspects of our business. If our capital resources are insufficient to meet our capital requirements, we will have to raise additional funds. If future financings involve the issuance of equity securities, our existing stockholders would suffer dilution. If we are able to raise debt financing, we may be subject to restrictive covenants that limit our operating flexibility. We may not be able to raise sufficient additional funds on terms that are favorable to us, if at all. If we fail to raise sufficient funds and continue to incur losses, our ability to fund our operations, take advantage of strategic opportunities, develop and commercialize products or technologies, or otherwise respond to competitive pressures could be significantly limited. If this happens, we may be forced to delay or terminate research and development programs or the commercialization of products or curtail operations. If adequate funds are not available, we will not be able to successfully execute on our business strategy or continue our business.

If ongoing or future field trials by us or our collaborators are unsuccessful, we may be unable to complete the regulatory process for or commercialize our products in development on a timely basis.

The successful completion of field trials in the United States and foreign locations is critical to the success of product development and marketing efforts for products containing our traits. If our ongoing or future field trials, or those of our collaborators, are unsuccessful or produce inconsistent results or unanticipated adverse effects on crops or on non-target organisms, or if we or our collaborators are unable to collect reliable data, regulatory review of products in development containing our traits could be delayed or commercialization of products in development containing our traits may not be possible. In addition, more than one growing season may be required to collect sufficient data to develop or market a product containing our traits, and it may be necessary to collect data from different geographies to prove performance for customer adoption. Even in cases where field trials are successful, we cannot be certain that additional field trials conducted on a greater number of acres, or in different crops or geographies, will be successful. Generally, our collaborators conduct these field trials, or we pay third parties, such as farmers, consultants, contractors, and universities, to conduct field trials on our behalf. Poor trial execution or data collection, failure to follow required agronomic practices, regulatory requirements, or mishandling of products in development by our collaborators or these third parties could impair the success of these field trials.

Many factors that may adversely affect the success of our field trials are beyond our control, including weather and climatic variations, such as drought or floods, severe heat or frost, hail, tornadoes and hurricanes, uncommon pests and diseases, or acts of protest or vandalism. For example, if there was prolonged or permanent disruption to the electricity, climate control, or water supply operating systems in our greenhouses or laboratories, the crops in which we or our collaborators are testing our traits and the samples we or our collaborators store in freezers, both of which are essential to our research and development activities, could be severely damaged or destroyed, adversely affecting these activities and thereby our business and results of operations. Unfavorable weather conditions can also reduce both acreage planted and incidence, or timing of, certain crop diseases or pest infestations, each of which may halt or delay our field trials. For example, in 2018, one of our trials was subjected to frost, as a result of which seed production and test results were compromised. We had to incur additional costs to repeat the trials in the following season. We have also experienced crop failures in the past for then-unknown reasons, causing delays in our achievement of milestones and delivery of results and necessitating that we repeat the impacted field trials. Any field test failure we may experience may not be covered by insurance and, therefore, could result in increased cost for the field trials and development of our traits, which may negatively impact our business and results of operations. Additionally, we are subject to USDA regulations, which may require us to abandon a field trial or to purchase and destroy neighboring crops that are planted after our field trials have commenced. For

example, while conducting early field trials for GLA safflower oil, we were forced to purchase and destroy an adjacent safflower crop when the placement of bee hives by a third party altered the required isolation distance between our crop and the neighboring crop, requiring us to either purchase and destroy the adjacent crop or abandon our field trial. In order to prevent the significant delays that would result from terminating our field trial, we decided to purchase and destroy the neighboring crop at a cost of approximately $30,000. Similar factors outside of our control can create substantial volatility relating to our business and results of operations.

Competition in traits and seeds is intense and requires continuous technological development, and, if we are unable to compete effectively, our financial results will suffer.

We face significant competition in the markets in which we operate. The markets for traits and agricultural biotechnology products are intensely competitive and rapidly changing. In most segments of the seed and agricultural biotechnology market, the number of products available to consumers is steadily increasing as new products are introduced. At the same time, the expiration of patents covering existing products reduces the barriers to entry for competitors. We may be unable to compete successfully against our current and future competitors, which may result in price reductions, reduced margins and the inability to achieve market acceptance for products containing our traits. In addition, several of our competitors have substantially greater financial, marketing, sales, distribution, research and development, and technical resources than us, and some of our collaborators have more experience in research and development, regulatory matters, manufacturing, and marketing. We anticipate increased competition in the future as new companies enter the market and new technologies become available. Our technologies may be rendered obsolete or uneconomical by technological advances or entirely different approaches developed by one or more of our competitors, which will prevent or limit our ability to generate revenues from the commercialization of our traits being developed.

We derive a small portion of our current revenues from government agencies, which are not expected to continue in the future and which may expose us to government audits and potential penalties.

We historically have derived a significant portion of our revenues from grants from U.S. government agencies, although such grants were a small portion of our revenues in 2019. Our activities that have been funded by our government grants are subject to audits by U.S. government agencies. As part of an audit, these agencies may review our performance, cost structures and compliance with applicable laws, regulations and standards, and the terms and conditions of the grant. An audit could result in a material adjustment to our results of operations and financial condition. Moreover, if an audit uncovers improper or illegal activities, we may also be subject to civil and criminal penalties and administrative sanctions, including termination of contracts, forfeiture of profits, suspension of payments, or fines, and we may be suspended or prohibited from doing business with the government. In addition, serious reputational harm or significant adverse financial effects could occur if allegations of impropriety are made against us, even if we are ultimately found to have done no wrong.

A significant portion of our revenues to date are from a limited number of strategic collaborations, and the termination of these collaborations could have a material adverse effect on our results of operations if we are unable to generate revenue from our other products.

We have historically derived a substantial amount of our revenues from a limited number of strategic collaborations, under which we have generated revenues through licensing arrangements such as research and development payments, up-front payments, milestone payments, and, once a product is commercialized, a portion of the commercial value of the trait. The termination or non-renewal of our arrangements with our commercial partners could have a material adverse effect on our business, financial condition, results of operations, and prospects.

Our prospects for successful development and commercialization of our products are dependent upon the research, development, commercialization, and marketing efforts of ourselves and our collaborators.

We primarily rely on third parties for research, development, commercialization, and marketing of our products and products in development. Other than as provided for in our collaboration agreements, we have no control over the resources, time and effort that our collaborators may devote to the development of products incorporating our traits and have limited access to information regarding or resulting from such programs. We rely on our third-party collaborators to fund and conduct the research and development of product candidates, to complete the regulatory process, and for the successful marketing and commercialization of one or more of such products or products in development. Such success will be subject to significant uncertainty.

Our ability to recognize revenues from successful collaborations may be impaired by multiple factors including:

- a collaborator may shift its priorities and resources away from our programs due to a change in business strategies, or a merger, acquisition, sale, or downsizing of its company or business unit;
- a collaborator may cease development in a specific crop area that is the subject of a collaboration agreement;
- a collaborator may change the success criteria for a particular program or product in development, thereby delaying or ceasing development of such program or product in development;
- a significant delay in initiation of certain development activities by a collaborator will also delay payment of milestones tied to such activities, thereby impacting our ability to fund our own activities;
- a collaborator could develop or acquire a product that competes, either directly or indirectly, with our current products or any future products;
- a collaborator with commercialization obligations may not commit sufficient financial or human resources to the marketing, distribution, or sale of a product;
- a collaborator with manufacturing responsibilities may encounter regulatory, resource, or quality issues and be unable to meet demand requirements;
- a collaborator may exercise its rights under the agreement to terminate our collaboration;
- a dispute may arise between us and a collaborator concerning the development and commercialization of a product in development, resulting in a delay in milestones, royalty payments, or termination of a program and possibly resulting in costly litigation or arbitration that may divert management attention and resources;
- a collaborator may not adequately protect the intellectual property rights associated with a product or product in development; and
- a collaborator may use our proprietary information or intellectual property in such a way as to expose us to litigation from a third party.

If our collaborators do not perform in the manner we expect or fulfill their responsibilities in a timely manner, or at all, the development, regulatory, and commercialization process could be delayed, terminated, or otherwise unsuccessful. Conflicts between us and our collaborators may arise. In the event of termination of one or more of our collaboration agreements, it may become necessary for us to assume the responsibility for any terminated products or products in development at our own expense or seek new collaborators. In that event, we likely would be required to limit the size and scope of one or more of our independent programs or increase our expenditures and seek additional funding, which may not be available on acceptable terms or at all, and our business may be materially and adversely affected.

We rely on third parties to conduct, monitor, support, and oversee field trials and commercial production and, in some cases, to maintain regulatory files for those products in development, and any performance issues by third parties, or our inability to engage third parties on acceptable terms, may impact our or our collaborators' ability to complete the regulatory process for or commercialize such products.

We rely on third parties, including farmers, to conduct, monitor, support, and oversee field trials and commercial production. As a result, we have less control over the timing and cost of these activities than if we conducted them with our own personnel. If we are unable to maintain or enter into agreements with these third parties on acceptable terms, or if any such engagement is terminated prematurely, we may be unable to conduct and complete our trials and commercial production in the manner we anticipate. In addition, there is no guarantee that these third parties will devote adequate time and resources to our activities or perform as required by our contract or in accordance with regulatory requirements, including maintenance of field trial or production information. If these third parties fail to meet expected deadlines, fail to transfer to us any regulatory or other information in a timely manner, fail to adhere to protocols, or fail to act in accordance with regulatory requirements or our agreements with them, or if they otherwise perform in a substandard manner or in a way that compromises the quality or accuracy of their activities or the data they obtain, then field trials and commercial production of our products in development may be extended or delayed with additional costs incurred, or our data may be rejected by the USDA or FDA, the U.S. Environmental Protection Agency, or EPA, or other regulatory agencies. Ultimately, we are responsible for ensuring that each of our field trials and commercial production is conducted in accordance with the applicable protocol, legal, regulatory and scientific standards, and our reliance on third parties does not relieve us of our responsibilities.

If our relationship with any of these third parties is terminated, we may be unable to enter into arrangements with alternative parties on commercially reasonable terms, or at all. Switching or adding growers or other suppliers can involve substantial cost and require extensive management time and focus. In addition, there is a natural transition period when a new farmer or other third party commences work. As a result, delays may occur, which can materially impact our ability to meet our desired development or commercial timelines. If we are required to seek alternative supply arrangements, the resulting delays and potential inability to find a suitable replacement could materially and adversely impact our business.

Most of our collaborators have significant resources and development capabilities and may develop their own products that compete with or negatively impact the advancement or sale of products containing our traits.

Most of our collaborators are significantly larger than us and may have substantially greater resources and development capabilities. As a result, we are subject to competition from many of our collaborators, who could develop or pursue competing products and traits that may ultimately prove more commercially viable than our traits. In addition, former collaborators, by virtue of having had access to our proprietary technology, may utilize this insight for their own development efforts, despite the fact that our collaboration agreements prohibit such use. The development or launch of a competing product by a collaborator may adversely affect the advancement and commercialization of any traits we develop and any associated research and development and milestone payments and value-sharing payments we receive from the sale of products containing our traits.

Our joint venture agreements could present a number of challenges that may have a material adverse effect on our business, financial condition, and results of operations.

We currently participate in two joint ventures, Verdeca LLC, and Archipelago. Verdeca LLC focuses on the development and deregulation of soybean traits, while Archipelago creates a vertically integrated hemp supply chain, from seed to sale, to serve the Hawaiian, North American and Asian markets. We may enter into additional joint ventures in the future. Our joint venture arrangements may present financial, managerial, and operational challenges, including potential disputes, liabilities, or contingencies and may involve risks not otherwise present when operating independently, including:

- our joint venture partners may have business interests, goals or cultures that are or become inconsistent with our business interests, goals or culture;
- our joint venture partners may share certain approval rights,

- we may incur liabilities or losses as a result of an action taken by the joint venture or our joint venture partners;
- our joint venture partners may take action contrary to our instructions, requests, policies or objectives, which could reduce our return on investment, harm our reputation or restrict our ability to run our business; and
- disputes between us and our joint venture partners may result in delays, litigation or operational impasses.

The risks described above or the failure to continue any joint venture or joint development arrangement or to resolve disagreements with our current or future joint venture partners could materially and adversely affect our ability to transact the business that is the subject of such joint venture, which would in turn negatively affect our financial condition and results of operations.

We and our collaborators may disagree over our right to receive payments under our collaboration agreements, potentially resulting in costly litigation and loss of reputation.

Our ability to receive payments under our collaboration agreements depends on our ability to clearly delineate our rights under those agreements. We typically license our intellectual property to our collaborators, who then develop and commercialize seeds with improved traits. However, a collaborator may use our intellectual property without our permission, dispute our ownership of certain intellectual property rights, or argue that our intellectual property does not cover, or add value to, their marketed product. If a dispute arises, it may result in costly patent office procedures and litigation, and our collaborator may refuse to pay us while the dispute is ongoing. Furthermore, regardless of any resort to legal action, a dispute with a collaborator over intellectual property rights may damage our relationship with that collaborator and may also harm our reputation in the industry.

Even if we are entitled to payments from our collaborators, we may not actually receive these payments, or we may experience difficulties in collecting the payments to which we believe we are entitled. After our collaborators launch commercial products containing our licensed traits, we will need to rely on the good faith of our collaborators to report to us the sales they earn from these products and to accurately calculate the payments we are entitled to, a process that will involve complicated and difficult calculations. Although we seek to address these concerns in our collaboration agreements by reserving our right to audit financial records, such provisions may not be effective.

Our business is subject to various government regulations and if we or our collaborators are unable to timely complete the regulatory process for our products in development, our or our collaborators' ability to market our traits could be delayed, prevented or limited.

Our business is generally subject to two types of regulations: regulations that apply to how we and our collaborators operate and regulations that apply to products containing our traits. We apply for and maintain the regulatory permits necessary for our operations, particularly those covering our hemp seed breeding, seed production, and crop production operations or field trials, while we or our collaborators apply for and maintain regulatory approvals necessary for the commercialization of products containing our seed traits. The large-scale field trials that our collaborators conduct during advanced stages of product development are subject to regulations similar to those to which we are subject. Even if we and our collaborators make timely and appropriate applications for regulatory permits for our field trials, government delays in issuing such permits can significantly affect the development timelines for our products, particularly if the planting period for a crop growing season expires before the necessary permits are obtained. Pursuant to our collaboration agreements, our collaborators also apply for the requisite regulatory approvals prior to commercialization of products containing our traits. In most of our key target markets, regulatory approvals must be received prior to the importation of genetically modified products. These regulatory processes may be complex; for example, the U.S. federal government's regulation of biotechnology is divided among the EPA, which regulates activity related to the use of plant pesticides and herbicides, the USDA, which regulates the import, field testing, interstate movement, and environmental release of specific technologies that may be used in the creation of genetically modified plants, and the FDA, which regulates foods derived from new plant varieties.

In addition to regulation by the U.S. government, products containing our biotech traits may be subject to regulation in each country in which such products are tested or sold. International regulations may vary from country to country and from those of the United States. The difference in regulations under U.S. law and the laws of foreign countries may be significant and, in order to comply with the laws of foreign countries, we may have to implement global changes to our products or business practices. Such changes may result in additional expense to us and either reduce or delay product development or sales. Additionally, we or our collaborators may be required to obtain certifications or approvals by foreign governments to test and sell the products in foreign countries.

The regulatory process is expensive and time-consuming, and the time required to complete the process is difficult to predict and depends upon numerous factors, including the substantial discretion of the regulatory authorities. Other than for our SONOVA products, neither we nor our collaborators have completed all phases of the regulatory process for any of our products in development. Our traits could require a significantly longer time to complete the regulatory process than expected, or may never gain approval, even if we and our collaborators expend substantial time and resources seeking such approval. A delay or denial of regulatory approval could delay or prevent our ability to generate revenues and to achieve profitability. Changes in regulatory review policies during the development period of any of our traits, changes in, or the enactment of, additional regulations or statutes, or changes in regulatory review practices for a submitted product application may cause a delay in obtaining approval or result in the rejection of an application for regulatory approval. Regulatory approval, if obtained, may be made subject to limitations on the indicated uses for which we or our collaborators may market a product. These limitations could adversely affect our potential revenues. Failure to comply with applicable regulatory requirements may, among other things, result in fines, suspensions of regulatory approvals, product recalls, product seizures, operating restrictions, and criminal prosecution. We have on certain occasions notified the USDA of instances of noncompliance with regulations. Although these occasions did not result in any enforcement actions, we may have occasions of noncompliance in the future that result in USDA or other governmental agency enforcement action.

Consumer resistance to genetically modified organisms may negatively affect our public image and reduce sales of seeds containing our traits.

While much of our research and development effort has focused on non-transgenic approaches to crop innovation, we historically have been and continue to be active in the field of agricultural biotechnology research and development in seeds and crop protection, including GM seeds. Foods made from such seeds are not accepted by many consumers due to concerns over such products' effects on food safety and the environment. The high public profile of biotechnology in food production and lack of consumer acceptance of products to which we have devoted substantial resources could negatively affect our public image and results of operations. The current resistance from consumer groups, particularly in Europe, to GM crops not only limits our access to such markets, but also has the potential to spread to and influence the acceptance of products developed through biotechnology in other regions of the world. Certain labeling-related initiatives have heightened consumer awareness of GM crops generally and may make consumers less likely to purchase food products containing GM ingredients, which could have a negative impact on the commercial success of products that incorporate our traits and materially and adversely affect our financial condition and results of operations.

Governmental restrictions on the testing, production, and importation of GM crops may negatively affect our business and results of operations.

The production of certain GM crops is effectively prohibited in certain countries, including throughout the European Union, which limits our commercial opportunities and may influence regulators in other countries to limit or ban the testing, production, or importation of GM crops and products of GM crops. Our GM crops are grown principally in North America and South America, where there are fewer restrictions on the production of GM crops. If these or other countries where our GM crops are grown enact laws or regulations that ban the production of such crops or make regulations more stringent, we could experience a longer product development cycle for our products, encounter difficulty obtaining intellectual property protection, and may even have to abandon projects related to certain crops or geographies, any of which would negatively affect our business and results of operations. Furthermore, any changes in such laws and regulations or consumer acceptance of our GM crops and products made from these crops could negatively impact our collaborators, who in turn might terminate or reduce the scope of their collaborations with us or seek to alter the financial terms of our agreements with them.

The unintended presence of our traits in other products or plants may negatively affect us.

Trace amounts of our traits may unintentionally be found outside our containment area in the products of third parties, which may result in negative publicity and claims of liability brought by such third parties against us. Furthermore, in the event of an unintended dissemination of our genetically engineered materials to the environment or the presence of unintended but unavoidable trace amounts, sometimes called "adventitious presence," of our traits in conventional seed, or in the grain or products produced from conventional or organic crops, we could be subject to claims by multiple parties, including environmental advocacy groups, as well as governmental actions such as mandated crop destruction, product recalls, or additional stewardship practices and environmental cleanup or monitoring.

Loss of or damage to our germplasm collection would significantly slow our product development efforts.

We have developed and maintain a comprehensive collection of germplasm through strategic collaborations with leading institutions, which we utilize in our non-GM programs. Germplasm comprises collections of genetic resources covering the diversity of a crop, the attributes of which are inherited from generation to generation. Germplasm is a key strategic asset since it forms the basis of seed development programs. To the extent that we lose access to such germplasm because of the termination or breach of our collaboration agreements, our product development capabilities would be severely limited. In addition, loss of or damage to these germplasm collections would significantly impair our research and development activities. Although we restrict access to our germplasm at our research facilities to protect this valuable resource, we cannot guarantee that our efforts to protect our germplasm collection will be successful. The destruction or theft of a significant portion of our germplasm collection would adversely affect our business and results of operations.

The regulatory environment outside the United States varies greatly from jurisdiction to jurisdiction and there is less certainty how some of our products will be regulated.

We may use gene-editing and TILLING technology to develop some of our product portfolio. The regulatory environment around gene-editing and TILLING in plants for food ingredients is greatly uncertain outside of the United States and varies greatly from jurisdiction to jurisdiction. Each jurisdiction may have its own regulatory framework regarding genetically modified foods, which may include restrictions and regulations on planting and growing genetically modified plants and in the consumption and labeling of genetically modified foods, and which may encapsulate our products. To the extent regulatory frameworks outside of the United States are not receptive to our gene-editing and TILLING technologies, this may limit our ability to expand into other global markets.

Complying with the regulatory requirements outside the United States will be costly and time-consuming, and there is no guarantee we will be able to commercialize our products outside the United States.

We cannot predict whether or when any jurisdiction will change its regulations with respect to our products. Advocacy groups have engaged in publicity campaigns and filed lawsuits in various countries against companies and regulatory authorities, seeking to halt regulatory approval or clearance activities or influence public opinion against genetically engineered and/or gene-edited products. In addition, governmental reaction to negative publicity concerning our products could result in greater regulation of genetic research and derivative products or regulatory costs that render our products cost prohibitive.

The scale of the commodity food industry may make it difficult to monitor and control the distribution of our products. As a result, our products may be sold inadvertently within jurisdictions where they are not approved for distribution. Such sales may lead to regulatory challenges or lawsuits against us, which could result in significant expenses and management attention.

We depend on our key personnel and, if we are not able to attract and retain qualified scientific and business personnel, we may not be able to grow our business or develop and commercialize our products.

Our future performance depends on the continued services and contributions of our management team and other key employees, the loss of whose services might significantly delay or prevent the achievement of our scientific or business objectives. The replacement of any member of our management team involves significant time and costs and such loss could significantly delay or prevent the achievement of our business objectives. A member of our leadership team who has been our employee for many years and therefore, has significant experience and understanding of our business, would be difficult to replace.

Additionally, the majority of our workforce is involved in research, development, and commercial activities. Our business is therefore dependent on our ability to recruit and maintain a highly skilled and educated workforce with expertise in a range of disciplines, including molecular biology, biochemistry, plant genetics, agronomics, mathematics, agribusiness, and other subjects relevant to our operations. All of our current employees are at-will employees, and the failure to retain or hire skilled and highly educated personnel could limit our growth and hinder our research and development efforts.

Our business is subject to the risks of earthquakes, fire, flood, crop losses, epidemics, and other catastrophic natural events, and security breaches, including cybersecurity incidents.

Our headquarters, certain research and development operations and our seed storage warehouse are located in Davis, California. Production of hemp and wheat is conducted in California, Hawaii, Idaho and other locations. Our seed, grain and hemp crops are vulnerable to adverse weather conditions, including windstorms, floods, drought and temperature extremes, which are common but difficult to predict. In addition, the crops are vulnerable to crop disease and to pests, which may vary in severity and effect, depending on the stage of production at the time of infection or infestation, the type of treatment applied and climatic conditions. Unfavorable growing conditions can reduce both crop size and quality. Weather conditions, disease or pest infestation could damage the crop in spite of precautions we would normally take to avoid such losses. Our SONOVA product inventory is stored in a single cold storage facility in Northern California. We take precautions to safeguard our facilities, including insurance, health and safety protocols, and off-site storage of critical research results and computer data. However, a natural disaster, such as a fire, flood, or earthquake, could cause substantial delays in our operations, damage or destroy our equipment, inventory, or development projects, and cause us to incur additional expenses. The insurance we maintain against natural disasters may not be adequate to cover our losses in any particular case.

We utilize and critically rely upon information technology systems in all aspects of our business, including increasingly large amounts of data to support our products and advance our research and development. Failure to effectively prevent, detect, and recover from the increasing number and sophistication of information security threats could result in theft, misuse, modification, and destruction of information, including trade secrets and confidential business information, and cause business disruptions, delays in research and development, and reputational damage, which could significantly affect our results of operations and financial condition.

A lack of availability of water in any of our production areas could impact our business.

Adequate quantities and correct timing of the application of water are vital for most agriculture to thrive. Whether particular farms are experiencing water shortages depends, in large part, on their location. However, continuing drought conditions can threaten all farmland other than those properties with their own water sources. Domestic regulations regarding water usage and rights may also limit the availability of water. Moreover, if the farmers and others who purchase our seed to grow crops cannot get an adequate supply of water, or if the cost of water makes it uneconomical for the farmers to grow the crops, we may not be able to sell our seed, which could have an adverse impact on our results of operations.

Disruption to our IT system could adversely affect our reputation and have a material adverse effect on our business and results of operations.

Our technologies rely on our IT system to collect and analyze our genomic data, including TILLING and other experimental data, and manage our plant inventory system, which tracks every plant that we have ever produced. We can provide no assurance that our current IT system is fully protected against third-party intrusions, viruses, hacker attacks, information, or data theft, or other similar threats. Furthermore, we store significant amounts of data and, though we have back-up storage for our stored data, we cannot assure you that our back-up storage arrangements will be effective if it becomes necessary to rely on them.

If our IT system does not function properly or proves incompatible with new technologies, we could experience interruptions in data transmissions and slow response times, preventing us from completing routine research and business activities. Furthermore, disruption or failure of our IT system due to technical reasons, natural disaster, or other unanticipated catastrophic events, including power interruptions, storms, fires, floods, earthquakes, terrorist attacks, and wars could significantly impair our ability to deliver data related to our projects to our collaborators on schedule and materially and adversely affect the outcome of our collaborations, our relationships with our collaborators, our business, and our results of operations.

Our use of hazardous materials exposes us to potential liabilities.

Certain of our operations involve the storage and controlled use of hazardous materials, including laboratory chemicals, herbicides, and pesticides. This requires us to conduct our operations in compliance with applicable environmental and safety standards, and we cannot completely eliminate the risk of accidental contamination from hazardous materials. In the event of such contamination, we may be held liable for significant damages or fines, which could have a material adverse effect on our business and operating results.

Most of the licenses we grant to our collaborators to use our proprietary genes in certain crops are exclusive within certain jurisdictions, which limits our licensing opportunities.

Most of the licenses we grant our collaborators to use our proprietary genes in certain crops are exclusive within specified jurisdictions, so long as our collaborators comply with certain diligence requirements. That means that once genes are licensed to a collaborator in a specified crop or crops, we are generally prohibited from licensing those genes to any third party. The limitations imposed by these exclusive licenses could prevent us from expanding our business and increasing our product development initiatives with new collaborators, both of which could adversely affect our business and results of operations.

Our business model for discovery of genes is dependent on licensing patent rights from third parties, and any disruption of this licensing process could adversely affect our competitive position and business prospects.

Our business model involves acquiring technologies that have achieved proof of concept through rigorous development and testing by third-party basic researchers in order to avoid the significant risks and high costs associated with basic research. Only a small number of the genes we evaluate for acquisition are likely to provide viable commercial candidates and an even more limited number, if any, are likely to be commercialized by us or our collaborators. A failure by us to continue identifying genes that improve specific crop traits could make it difficult to grow our business. If we are unable to identify additional genes, we may be unable to develop new traits, which may negatively impact our ability to generate revenues.

If we are unable to enter into licensing arrangements to acquire rights to these potentially viable genes on favorable terms in the future, it may adversely affect our business. In addition, if the owners of the patents we license do not properly maintain or enforce the patents underlying such licenses, our competitive position and business prospects could be harmed. Without protection for the intellectual property we license, other companies might be able to offer substantially similar or identical products for sale, which could adversely affect our competitive business position and harm our business prospects.

If we fail to comply with our obligations under license agreements, our counterparties may have the right to terminate these agreements, in which event we may not be able to develop, manufacture, register, or market, or may be forced to cease developing, manufacturing, registering, or marketing, any product that is covered by these agreements or may face other penalties under such agreements. Such an occurrence could materially adversely affect the value of the applicable products to us and have an adverse effect on our business and result of operations.

Our commercial success depends on our ability to protect our intellectual property and our proprietary technologies and on the ability to operate without infringing the patents and other proprietary rights of third parties.

Our success will depend in part on our ability to obtain and maintain patent protection both in the United States and in other countries for any products we successfully develop. The patents and patent applications in our patent portfolio are either owned by us, exclusively licensed to us, or co-owned by us and others and exclusively licensed to us. Our ability to protect any products we successfully develop from unauthorized or infringing use by third parties depends substantially on our ability to obtain and maintain valid and enforceable patents. Due to evolving legal standards relating to the patentability, validity and enforceability of patents covering biotechnology inventions and the scope of claims made under these patents, our ability to obtain and enforce patents is uncertain and involves complex legal and factual questions. Accordingly, rights under any issued patents may not provide us with sufficient protection for any products we successfully develop or provide sufficient protection to afford us a commercial advantage against our competitors or their competitive products or processes. In addition, we cannot guarantee that any patents will be issued from any pending or future patent applications owned by or licensed to us. Even if patents have been issued or will be issued, we cannot guarantee that the claims of these patents are, or will be, valid or enforceable, or provide us with any significant protection against competitive products or otherwise be commercially valuable to us.

The U.S. Congress passed the Leahy-Smith America Invents Act, or the America Invents Act, which was signed into law in September 2011. The America Invents Act reforms U.S. patent law in part by changing the standard for patent approval from a “first to invent” standard to a “first inventor to file” standard and developing a post-grant review system. This new legislation affects U.S. patent law in a manner that may impact our ability to obtain or maintain patent protection for current or future inventions in the U.S. or otherwise cause uncertainty as to our patent protection.

We may not have identified all patents, published applications or published literature that may affect our business, either by blocking our ability to commercialize our traits, by preventing the patentability of our traits by us, our licensors or co-owners, or by covering the same or similar technologies that may invalidate our patents, limiting the scope of our future patent claims or adversely affecting our ability to market our products. For example, patent applications are maintained in confidence for at least 18 months after their filing. In some cases, patent applications remain confidential in the United States Patent and Trademark Office (“USPTO”) for the entire time prior to issuance of a U.S. patent. Patent applications filed in countries outside the United States are not typically published until at least 18 months from their first filing date. Similarly, publication of discoveries in the scientific or patent literature often lags behind actual discoveries. Therefore, we cannot be certain that we or our licensors or co-owners were the first to invent, or the first inventors to file, patent applications on our processes, products or their uses. In the event that another party has filed a U.S. patent application covering the same invention as one of our patent applications or patents, we may have to participate in an adversarial proceeding, known as an interference, declared by the USPTO to determine priority of invention in the United States.

If we are unable to protect the confidentiality of our trade secrets, the value of our technology could be materially and adversely affected and our business could be harmed.

We treat our proprietary technologies, including unpatented know-how and other proprietary information, as trade secrets. We seek to protect these trade secrets, in part, by entering into non-disclosure and confidentiality agreements with any third parties who have access to them, such as our consultants, independent contractors, advisors, corporate collaborators, and outside scientific collaborators. We also enter into confidentiality and invention or patent assignment agreements with employees and certain consultants. Any party with whom we have executed such an agreement could breach that agreement and disclose our proprietary information, including our trade secrets, and we may not be able to obtain adequate remedies for such breaches. Enforcing a claim that a party illegally disclosed or misappropriated a trade secret is difficult, expensive, and time consuming, and the outcome is unpredictable. In addition, if any of our trade secrets were to be lawfully obtained or independently developed by a competitor, we would have no right to prevent such third party, or those to whom they communicate such technology or information, from using that technology or information to compete with us. If any of our trade secrets were to be disclosed to or independently developed by a competitor, or if we otherwise lose protection for our trade secrets or proprietary know-how, the value of this information may be greatly reduced and our business and competitive position could be harmed.

Changes in U.S. patent law could diminish the value of patents in general, thereby impairing our ability to protect our products in development.

As an agricultural biotechnology company, our success is heavily dependent on intellectual property, particularly patents. Obtaining and enforcing patents involves technological and legal complexity, and is costly, time consuming, and inherently uncertain. In addition, the U.S. Supreme Court has ruled on several patent cases in recent years, either narrowing the scope of patent protection available in certain circumstances or weakening the rights of patent owners in certain situations. In addition to increasing uncertainty with regard to our ability to obtain patents in the future, this combination of events has created uncertainty with respect to the value of patents once obtained. Depending on decisions by the U.S. Congress, the federal courts, and the U.S. Patent and Trademark Office, the laws and regulations governing patents could change in unpredictable ways that may weaken or undermine our ability to obtain new patents or to enforce our existing patents and patents we might obtain in the future.

We may not be able to protect our intellectual property rights throughout the world.

Filing, prosecuting, maintaining, and defending patents on products in development in all countries throughout the world would be prohibitively expensive, and our intellectual property rights in some countries outside the United States are less extensive than those in the United States. In addition, the laws of some foreign countries do not protect intellectual property rights to the same extent as federal and state laws in the United States. For example, several countries outside the United States prohibit patents on plants and seeds entirely. In addition, we may at times license third-party technologies for which limited international patent protection exists and for which the time period for filing international patent applications has passed. Consequently, we are unable to prevent third parties from using intellectual property we develop or license in all countries outside the United States, or from selling or importing products made using our intellectual property in and into the jurisdictions in which we do not have patent protection. Competitors may use our technologies in jurisdictions where we have not obtained patent protection to develop their own products, and we may be unable to prevent such competitors from importing those infringing products into territories where we have patent protection, but where enforcement is not as strong as in the United States. These products may compete with our products in development and our patents and other intellectual property rights may not be effective or sufficient to prevent them from competing in those jurisdictions. Moreover, farmers or others in the chain of commerce may raise legal challenges to our intellectual property rights or may infringe upon our intellectual property rights, including through means that may be difficult to prevent or detect, and local regulators may choose to not enforce our intellectual property rights.

Many companies have encountered significant problems in protecting and defending intellectual property rights in foreign jurisdictions where we have filed patent applications. The legal systems of certain countries have not historically favored the enforcement of patents or other intellectual property rights, which could hinder us from preventing the infringement of our patents or other intellectual property rights and result in substantial risks to us. Proceedings to enforce our patent rights in the United States or foreign jurisdictions could result in substantial costs and divert our efforts and attention from other aspects of our business, could put our patents at risk of being invalidated or interpreted narrowly and our patent applications at risk of not issuing and could provoke third parties to assert patent infringement or other claims against us. We may not prevail in any lawsuits that we initiate and the damages or other remedies awarded, if any, may not be commercially meaningful or even cover our associated legal costs. Accordingly, our efforts to enforce our intellectual property rights around the world may be inadequate to obtain a significant commercial advantage from the intellectual property that we develop or license from third parties.

If we or one of our collaborators are sued for infringing the intellectual property rights of a third party, such litigation could be costly and time consuming and could prevent us or our collaborators from developing or commercializing our products.

Our ability to generate significant revenues from our products depends on our and our collaborators' ability to develop, market and sell our products and utilize our proprietary technology without infringing the intellectual property and other rights of any third parties. In the United States and abroad there are numerous third-party patents and patent applications that may be applied toward our proprietary technology, business processes, or developed traits, some of which may be construed as containing claims that cover the subject matter of our products or intellectual property. Because of the rapid pace of technological change, the confidentiality of patent applications in some jurisdictions (including U.S. provisional patent applications), and the fact that patent applications can take

many years to issue, there may be currently pending applications that are unknown to us that may later result in issued patents upon which our products in development or proprietary technologies infringe. Similarly, there may be issued patents relevant to our products in development of which we are not aware. These patents could reduce the value of the traits we develop or the plants containing our traits or, to the extent they cover key technologies on which we have unknowingly relied, require that we seek to obtain licenses or cease using the technology, no matter how valuable to our business. We may not be able to obtain such a license on commercially reasonable terms. If any third-party patent or patent application covers our intellectual property or proprietary rights and we are not able to obtain a license to it, we and our collaborators may be prevented from commercializing products containing our traits.

As the agricultural biotechnology industry continues to develop, we may become party to, or threatened with, litigation or other adverse proceedings regarding intellectual property or proprietary rights in our technology, processes, or developed traits. Third parties may assert claims based on existing or future intellectual property rights and the outcome of any proceedings is subject to uncertainties that cannot be adequately quantified in advance. Any litigation proceedings could be costly and time consuming, and negative outcomes could result in liability for monetary damages, including treble damages and attorneys' fees, if we are found to have willfully infringed a patent. There is also no guarantee that we would be able to obtain a license under such infringed intellectual property on commercially reasonable terms or at all. A finding of infringement could prevent us or our collaborators from developing, marketing or selling a product or force us to cease some or all of our business operations. Even if we are successful in these proceedings, we may incur substantial costs and the time and attention of our management and scientific personnel may be diverted as a result of these proceedings, which could have a material adverse effect on us. Claims that we have misappropriated the confidential information or trade secrets of third parties could similarly have a negative impact on our business.

Our success will depend in part on our ability to uphold and enforce patents or patent applications owned or co-owned by us or licensed to us, which cover products we successfully develop. Proceedings involving our patents or patent applications could result in adverse decisions regarding:

- ownership of patents and patent applications;
- rights concerning licenses;
- the patentability of our inventions relating to our products; and/or
- the enforceability, validity or scope of protection offered by our patents relating to our products.

Even if we are successful in these proceedings, we may incur substantial costs and divert management's time and attention in pursuing these proceedings, which could have a material adverse effect on us.

Our results of operations will be affected by the level of royalty payments that we are required to pay to third parties.

We are a party to license agreements that require us to remit royalty payments and other payments related to in-licensed intellectual property. Under our in-license agreements, we may pay up-front fees and milestone payments and be subject to future royalties. We cannot precisely predict the amount, if any, of royalties we will owe in the future, and if our calculations of royalty payments are incorrect, we may owe additional royalties, which could negatively affect our results of operations. As our product sales increase, we may, from time to time, disagree with our third-party collaborators as to the appropriate royalties owed and the resolution of such disputes may be costly and may consume management's time. Furthermore, we may enter into additional license agreements in the future, which may also include royalty, milestone and other payments.

We are subject to governmental export and import controls that could impair our ability to compete in international markets due to licensing requirements and subject us to liability if we are not in compliance with applicable laws.

Our products and products in development are subject to export control and import laws and regulations, including the U.S. Export Administration Regulations, U.S. Customs regulations, and various economic and trade sanctions regulations administered by the U.S. Treasury Department's Office of Foreign Assets Controls. Exports of our products and technology must be made in compliance with these laws and regulations. If we fail to comply with these laws and regulations, we and certain of our employees could be subject to substantial civil or criminal penalties, including the possible loss of export or import privileges; fines, which may be imposed on us and responsible employees or managers; and, in extreme cases, the incarceration of responsible employees or managers.

In addition, changes in our products or solutions or changes in applicable export or import laws and regulations may create delays in the introduction and sale of our products and solutions in international markets, prevent our customers from deploying our products and solutions or, in some cases, prevent the export or import of our products and solutions to certain countries, governments or persons altogether. Any change in export or import laws and regulations, shift in the enforcement or scope of existing laws and regulations, or change in the countries, governments, persons or technologies targeted by such laws and regulations, could also result in decreased use of our products and solutions, or in our decreased ability to export or sell our products and solutions to existing or potential customers. Any decreased use of our products and solutions or limitation on our ability to export or sell our products and solutions would likely adversely affect our business, financial condition and results of operations.

We are subject to anti-corruption and anti-money laundering laws with respect to both our domestic and international operations, and non-compliance with such laws can subject us to criminal and civil liability and harm our business.

We are subject to the U.S. Foreign Corrupt Practices Act of 1977, as amended, the U.S. domestic bribery statute contained in 18 U.S.C. § 201, the U.S. Travel Act, the USA PATRIOT Act, and possibly other anti-bribery and anti-money laundering laws in countries in which we conduct activities. Anti-corruption laws are interpreted broadly and prohibit us and our collaborators from authorizing, offering, or directly or indirectly providing improper payments or benefits to recipients in the public or private sector. We or our collaborators may have direct and indirect interactions with government agencies and state-affiliated entities and universities in the course of our business. We may also have certain matters come before public international organizations such as the United Nations. We use third-party collaborators, joint venture and strategic partners, law firms, and other representatives for regulatory compliance, patent registration, lobbying, deregulation advocacy, field testing, and other purposes in a variety of countries, including those that are known to present a high corruption risk such as India, China, and Latin American countries. We can be held liable for the corrupt or other illegal activities of these third-party collaborators, our employees, representatives, contractors, partners, and agents, even if we do not explicitly authorize such activities. In addition, although we have implemented policies and procedures to ensure compliance with anti-corruption and related laws, there can be no assurance that all of our employees, representatives, contractors, partners, or agents will comply with these laws at all times. Noncompliance with these laws could subject us to whistleblower complaints, investigations, sanctions, settlements, prosecution, other enforcement actions, disgorgement of profits, significant fines, damages, other civil and criminal penalties or injunctions, suspension and debarment from contracting with certain governments or other persons, the loss of export privileges, reputational harm, adverse media coverage, and other collateral consequences. If any subpoenas or investigations are launched, or governmental or other sanctions are imposed, or if we do not prevail in any possible civil or criminal litigation, our business, results of operations, and financial condition could be materially harmed. In addition, responding to any action will likely result in a materially significant diversion of management's attention and resources and significant defense costs and other professional fees. Enforcement actions and sanctions could further harm our business, results of operations, and financial condition.

Adverse outcomes in future legal proceedings could subject us to substantial damages and adversely affect our results of operations and profitability.

We may become party to legal proceedings, including matters involving personnel and employment issues, personal injury, environmental matters, and other proceedings. Some of these potential proceedings could result in substantial damages or payment awards that exceed our insurance coverage. We will estimate our exposure to any future legal proceedings and establish provisions for the estimated liabilities where it is reasonably possible to estimate and where an adverse outcome is probable. Assessing and predicting the outcome of these matters will involve substantial uncertainties. Furthermore, even if the outcome is ultimately in our favor, our costs associated with such litigation may be material. Adverse outcomes in future legal proceedings or the costs and expenses associated therewith could have an adverse effect on our results of operations.

We may be required to pay substantial damages as a result of product liability claims for which insurance coverage is not available.

We are subject to product liability claims with respect to our SONOVA and GoodWheat products, and as additional products integrating our traits reach commercialization, product liability claims will increasingly be a commercial risk for our business, particularly as we are involved in the supply of biotechnological products, some of which may be harmful to humans and the environment. Product liability claims against us or our collaborators selling products that contain our traits, or allegations of product liability relating to seeds containing traits developed by us, could damage our reputation, harm our relationships with our collaborators, and materially and adversely affect our business, results of operations, financial condition, and prospects. Furthermore, while our collaboration agreements typically require that our collaborators indemnify us for the cost of product liability claims brought against us as a result of our collaborator's misconduct, such indemnification provisions may not always be enforced, and we may receive no indemnification if our own misconduct contributed to the claims.

We may seek to expand through acquisitions of and investments in other brands, businesses, and assets. These acquisition activities may be unsuccessful or divert management's attention.

We may consider strategic and complementary acquisitions of and investments in other agricultural biotechnology brands, businesses or other assets, and such acquisitions or investments are subject to risks that could affect our business, including risks related to:

- the necessity of coordinating geographically disparate organizations;
- implementing common systems and controls;
- integrating personnel with diverse business and cultural backgrounds;
- integrating acquired manufacturing and production facilities, technology and products;
- combining different corporate cultures and legal systems;
- unanticipated expenses related to integration, including technical and operational integration;
- increased costs and unanticipated liabilities, including with respect to registration, environmental, health and safety matters, that may affect sales and operating results;
- retaining key employees;
- obtaining required government and third-party approvals;
- legal limitations in new jurisdictions;
- installing effective internal controls and audit procedures;
- issuing common stock that could dilute the interests of our existing stockholders;
- spending cash and incurring debt;
- assuming contingent liabilities; and
- creating additional expenses.

We may not be able to identify opportunities or complete transactions on commercially reasonable terms, or at all, or actually realize any anticipated benefits from such acquisitions or investments. Similarly, we may not be able to obtain financing for acquisitions or investments on attractive terms. In addition, the success of any acquisitions or investments also will depend, in part, on our ability to integrate the acquisition or investment with our existing operations.

We incur significant costs and devote substantial management time as a result of operating as a public company.

As a public company, we incur significant legal, accounting, and other expenses. For example, we are subject to the reporting requirements of the Securities Exchange Act of 1934, as amended, or the Exchange Act, and are required to comply with the applicable requirements of the Sarbanes-Oxley Act and the Dodd-Frank Wall Street Reform and Consumer Protection Act, as well as rules and regulations subsequently implemented by the SEC and The Nasdaq Stock Market, including the establishment and maintenance of effective disclosure and financial controls and corporate governance practices. Compliance with these requirements has increased and will continue to increase our legal and financial compliance costs and has made and will continue to make some activities more time consuming and costly. Our management and other personnel has had to, and will continue to, divert attention from operational and other business matters to devote substantial time to these public company requirements, which could adversely affect our business, financial condition, and operating results.

As a result of being a public company, we are obligated to develop and maintain proper and effective internal control over financial reporting. We may not complete our analysis of our internal control over financial reporting in a timely manner, or these internal controls may not be determined to be effective, which may adversely affect investor confidence in our company and, as a result, the value of our common stock.

Pursuant to Section 404(a) of the Sarbanes-Oxley Act of 2002 ("the Act") and the related rules adopted by the SEC and the Public Company Accounting Oversight Board, starting with the second annual report that we filed with the SEC after the consummation of our public offering, our management is required to report on the effectiveness of our internal control over financial reporting. Section 404(b) of the Act requires that our independent registered public accounting firm will also need to attest to the effectiveness of our internal control over financial reporting if we qualify as an accelerated filer or a large accelerated filer. As an emerging growth company under the JOBS Act, we are currently exempt from the auditor attestation requirement of Section 404(b). If we lose this eligibility, we will incur increased personnel and audit fees in connection with the additional audit requirements.

In connection with the preparation of our financial statements for the years ended December 31, 2019 and 2018, we identified certain internal control deficiencies that did not rise to the level of a significant deficiency or material weakness, on an individual basis or in the aggregate. We are continuously improving our internal control environment. As a result, we may experience higher than anticipated operating expenses, as well as higher auditor fees during and after the implementation of these changes. If we are unable to implement any of the required changes to our internal control over financial reporting effectively or efficiently or are required to do so earlier than anticipated, it could adversely affect our operations, financial reporting, and results of operations and could result in an adverse opinion on internal controls from our independent registered public accounting firm.

Our ability to use our net operating loss carryforwards to offset future taxable income may be subject to certain limitations.

Under Section 382 of the Internal Revenue Code of 1986, as amended, or the Code, a corporation that undergoes an "ownership change" is subject to limitations on its ability to utilize its NOLs to offset future taxable income. A significant portion of our existing NOLs are limited due to an ownership change under IRC Section 382 that we experienced as a result of the common shares issued in connection with the June 2018 Offering. Future changes in our stock ownership, some of which are outside of our control, could result in an ownership change under Section 382 of the Code. If we undergo an ownership change in the future, our ability to utilize NOLs could be further limited by Section 382 of the Code. Furthermore, our ability to utilize NOLs of companies that we may acquire in the future may be subject to limitations. There is also a risk that, due to regulatory changes, such as suspensions on the use of NOLs, or other unforeseen reasons, our existing NOLs could expire or otherwise be unavailable to offset future income tax liabilities. For these reasons, we may not be able to realize a tax benefit from the use of our NOLs, whether or not we obtain profitability.

Risks Related to Ownership of Our Common Stock

Sales of a substantial number of shares of our common stock in the public market, or the perception that these sales might occur, could cause our stock price to decline.

Sales of a substantial number of our common stock in the public market, or the perception that these sales might occur, could cause the market price of our common stock to decline and could impair our ability to raise capital through the sale of additional equity securities. As of December 31, 2019, there were 8,646,149 shares of our common stock outstanding, of which approximately 7,020,477 shares were held by non-affiliates. All of our common stock is freely transferable, except shares held by our "affiliates," as defined in Rule 144 under the Securities Act.

We may also issue common stock or options to purchase shares of our common stock that under our 2015 Omnibus Equity Incentive Plan and our 2015 Employee Stock Purchase Plan. Securities issued under these plans will be registered under a Form S-8 and are freely tradable upon issuance. There were 410,270 options exercisable as of December 31, 2019 at a weighted average exercise price of $29.24.

Our stock price has been and may continue to be volatile, and you could lose all or part of your investment.

The market price of our common stock since our initial public offering has been and may continue to be volatile. Since shares of our common stock were sold in our initial public offering in May 2015 at a price of $160.00 per share, our stock price has ranged from $2.65 to $176.00, through December 31, 2019. The market price of our common stock is subject to wide fluctuations in response to various risk factors, some of which are beyond our control and may not be related to our operating performance, including:

- addition or loss of significant customers, collaborators or distributors;
- changes in laws or regulations applicable to our industry or traits;
- additions or departures of key personnel;
- the failure of securities analysts to cover our common stock after an offering;
- actual or anticipated changes in expectations regarding our performance by investors or securities analysts;
- price and volume fluctuations in the overall stock market;
- volatility in the market price and trading volume of companies in our industry or companies that investors consider comparable;
- share price and volume fluctuations attributable to inconsistent trading volume levels of our shares;
- our ability to protect our intellectual property and other proprietary rights;
- sales of our common stock by us or our stockholders;
- the expiration of contractual lock-up agreements;
- litigation involving us, our industry, or both;
- major catastrophic events; and
- general economic and market conditions and trends.

Further, the stock markets have experienced extreme price and volume fluctuations that have affected and continue to affect the market prices of equity securities of many companies. These fluctuations often have been unrelated or disproportionate to the operating performance of those companies. In addition, the stock prices of many seed and agricultural biotechnology companies have experienced wide fluctuations that have often been unrelated to the operating performance of those companies. These broad market and industry fluctuations, as well as general economic, political, and market conditions such as recessions, interest rate changes, or international currency fluctuations, may cause the market price of our common stock to decline. If the market price of our common stock fluctuates or declines, you may not realize any return on your investment and may lose some or all of your investment.

We expect our operating results to vary significantly from quarter to quarter, which may cause our stock price to fluctuate widely.

We expect our quarterly operating results to fluctuate widely and unpredictably for the following reasons, among others:

- our significant customer concentration;
- the variable timing, stage, and results of our and our collaborators' research, development, and regulatory activities;
- the impact of seasonality in agricultural operations on our field trials and sales of products, including those that incorporate our seed traits;
- supplier, manufacturing, or quality problems; and
- variance in the timing of customer and distributor orders for our products.

Further, a large proportion of our costs are fixed, due in part to our significant research and development costs and general and administrative expenses. Thus, even a small decline in revenues could disproportionately affect our quarterly operating results and could cause such results to differ materially from expectations. Any unanticipated change in revenues or operating results is likely to cause our stock price to fluctuate since such changes reflect new information available to investors and analysts.

Provisions in our amended and restated certificate of incorporation and amended and restated bylaws might discourage, delay or prevent a change of control of our company or changes in our management and, therefore, depress the trading price of our common stock.

Our amended and restated certificate of incorporation and amended and restated bylaws contain provisions that could depress the trading price of our common stock by discouraging, delaying or preventing a change of control of our company or changes in our management that the stockholders of our company may believe advantageous. These provisions include:

- establishing a classified board of directors so that not all members of our board of directors are elected at one time;
- authorizing "blank check" preferred stock that our board of directors could issue to increase the number of outstanding shares to discourage a takeover attempt;
- eliminating the ability of stockholders to call a special stockholder meeting;
- eliminating the ability of stockholders to act by written consent;
- the requirement that, to the fullest extent permitted by law and unless we consent to an alternate form, certain proceedings against or involving us or our directors, officers, or employees be brought exclusively in the Court of Chancery in the State of Delaware;
- providing that the board of directors is expressly authorized to make, alter, or repeal our bylaws; and
- establishing advance notice requirements for nominations for elections to our board of directors or for proposing matters that can be acted upon by stockholders at stockholder meetings.

If securities or industry analysts do not publish or cease publishing research or reports about us, our business, or our market, or if they change their recommendations regarding our stock adversely, our stock price and trading volume could decline.

The trading market for our common stock is influenced by the research and reports that industry or securities analysts may publish about us, our business, our market or our competitors. If any of the analysts who may cover us make adverse changes to their recommendation regarding our stock, or provide more favorable relative recommendations about our competitors, our stock price would likely decline. If any analyst who may cover us were to cease coverage of our company or fail to regularly publish reports on us, we could lose visibility in the financial markets, which in turn could cause our stock price or trading volume to decline.

As an emerging growth company within the meaning of the Securities Act, we utilize certain modified disclosure requirements, and we cannot be certain if these reduced requirements will make our common stock less attractive to investors.

We are an emerging growth company within the meaning of the rules under the Securities Act and we utilize the modified disclosure requirements available to emerging growth companies, including reduced disclosure about our executive compensation and omission of compensation discussion and analysis, and an exemption from the requirement of holding a nonbinding advisory vote on executive compensation. In addition, we are not subject to certain requirements of Section 404 of the Sarbanes-Oxley Act, including the additional testing of our internal control over financial reporting as may occur when outside auditors attest as to our internal control over financial reporting. As a result, our stockholders may not have access to certain information they may deem important. We cannot predict if investors will find our common stock less attractive because we rely on these exemptions. If some investors find our common stock less attractive as a result, there may be a less active trading market for our common stock and our stock price may be more volatile.

We will no longer qualify as an emerging growth company as of January 1, 2021.

Because we do not expect to pay any dividends for the foreseeable future, investors may be forced to sell their stock to realize a return on their investment.

We do not anticipate that we will pay any dividends to holders of our common stock for the foreseeable future. Any payment of cash dividends will be at the discretion of our board of directors and will depend on, among other things, our results of operations, cash requirements, financial condition, contractual restrictions including compliance with covenants under our debt agreements, and other factors that our board of directors may deem relevant. Our ability to pay dividends might be restricted by the terms of any indebtedness that we incur in the future. In addition, certain of our current outstanding debt agreements prohibit us from paying cash dividends on our common stock. Consequently, you should not rely on dividends to receive a return on your investment.

Our common stock may be delisted from The Nasdaq Capital Market if we are unable to maintain compliance with Nasdaq's continued listing standards.

As a company traded on The Nasdaq Capital Market, we are subject to compliance with The Nasdaq Stock Market's rules and requirements, which require, among other things, that our minimum bid price be $1.00 or higher and that either our shareholders' equity be at least $2.5 million or the market value of our common stock be at least $35 million.

In the event we are delisted from the Nasdaq Capital Market, we would be forced to list our shares on the OTC Electronic Bulletin Board or some other quotation medium, such as the pink sheets, depending on our ability to meet the specific listing requirements of those quotation systems. As a result, an investor might find it more difficult to trade or to obtain accurate price quotations for such shares.

Any delisting of our common stock could adversely affect the market liquidity of our common stock and the market price of our common stock could decrease and/or become more volatile. Furthermore, if our common stock were delisted, it could adversely affect our ability to obtain additional financing and/or result in the loss of confidence by investors, collaborators and other third parties, customers, and employees.

Item 1B. Unresolved Staff Comments.

Not applicable.

Item 2. Properties.

Our corporate headquarters are located in Davis, California, in a facility consisting of approximately 16,280 square feet of office, laboratory and growth chamber space under a lease that expires on July 31, 2023. This facility accommodates research and development, operations, commercial operations, analytical services, regulatory and administrative activities. Our administrative offices in Phoenix, Arizona, consist of 2,976 square feet under a lease that expires on December 31, 2021. The Phoenix office accommodates our finance, legal and other administrative activities. We lease greenhouse space and farmland for agricultural use in Northern California, as well as farmland in Southern California, Idaho and Hawaii. We also lease office and warehouse space in Idaho under a lease that expires on December 31, 2020.

In January 2020, we entered into a lease for additional office space in Davis, CA. The lease is expected to commence in the second quarter of 2020. We believe that our leased facilities are adequate to meet our current needs and that, if needed, suitable additional or alternative space will be available to accommodate our operations.

Item 3. Legal Proceedings.

Except as set forth below, we currently are not a party to any material litigation or other material legal proceedings. From time to time, we may be subject to legal proceedings and claims in the ordinary course of business.

In February 2018, we initiated an interference proceeding with the United States Patent and Trademark Office ("USPTO") concerning a patent application owned by us and a patent owned by Arista Cereals Technologies Pty Limited ("Arista") relating to our Resistant Starch Wheat products to determine priority of invention. On August 14, 2018, the USPTO issued a decision that resulted in termination of the interference which we appealed. On August 9, 2019, the United States Court of Appeals for the Federal Circuit upheld the decision. Based on this decision, our patent interference proceeding is now terminated, and Arista maintains its patent.

On April 1, 2019, Arista and Bay State Milling Company ("BSM") filed a complaint against us in the United States District Court for the District of Delaware, asserting claims for alleged patent infringement ("the Delaware Action"). On June 26, 2019 the Court issued a Joint Stipulation and Order to Extend Time to Serve Summons and Complaint until October 15, 2019 indicating that "the parties have agreed on this stipulation seeking additional time… in light of the ongoing settlement discussions between the parties and the desire to preserve the litigation status quo for a short period of time in order to enable continuing settlement discussions."

On April 24, 2019, Arista initiated an interference proceeding with the USPTO concerning the same patent relating to our Resistant Starch Wheat products (U.S. 10,246,716) to determine the priority of invention ("the 716 Interference"). If the USPTO determined Arista was the first to invent, the subject matter of the interference would be granted in a patent to Arista. On the other hand, if the USPTO determined we were the first to invent, we would maintain our patent.

On August 21, 2019, we entered into a binding term sheet with Arista and BSM to resolve the parties' disputes, including the Delaware Action and the 716 Interference proceeding. Under the binding term sheet, Bay State Milling Company will become the exclusive commercial partner for our high fiber wheat in North America under Bay State Milling's HealthSense™ brand portfolio, while Arista receives exclusive rights under our high fiber wheat intellectual property in certain geographies, including Australia and Europe. We will continue to market our high fiber wheat under our GoodWheat portfolio of specialty wheat ingredients in other international markets. In December 2019, the three parties entered into a settlement agreement reflecting the terms of the binding term sheet.

Item 4. Mine Safety Disclosures.

Not applicable.

PART II

Item 5. Market for Registrant's Common Equity, Related Stockholder Matters and Issuer Purchases of Equity Securities.

Our common stock has been listed on the NASDAQ Stock Market under the symbol "RKDA" since May 15, 2015. Prior to May 15, 2015, there was no public trading for our common stock.

Holders of Record

As of March 18, 2020, we had 36 holders of record of our common stock. Because many of our shares of common stock are held by brokers and other institutions on behalf of stockholders, we are unable to estimate the total number of beneficial stockholders represented by these record holders.

Dividend Policy

We have never declared or paid cash dividends on our capital stock. We currently intend to retain all available funds and any future earnings for use in the operation of our business and do not anticipate paying any cash dividends in the foreseeable future. Any decision to declare and pay cash dividends in the future will be made at the discretion of our board of directors and will depend on, among other things, our results of operations, cash requirements, financial condition, contractual restrictions, and other factors that our board of directors may deem relevant.

Securities Authorized for Issuance under Equity Compensation Plans

See Part III, Item 12, for a description of securities authorized for issuance under equity compensation plans.

Recent Sales of Unregistered Securities

During 2019, we issued the securities described below without registration under the Securities Act. Unless otherwise indicated below, the securities were issued pursuant to the private placement exemption provided by Section 4(a)(2) of the Securities Act.

On April 15, 2019, we issued two warrants to a consulting entity to purchase up to 100,000 and 45,154 shares of our common stock, respectively. Each warrant has an exercise price per share of $6.18 and has a term of 5 years.

On June 14, 2019, we issued and sold to five investors warrants to purchase a total of 1,489,575 shares of common stock at a total price of $186,197. The warrants have an exercise price per share of $5.00 and terms of five and one-half years. We also issued to the placement agent in this transaction warrants to purchase a total of 74,479 shares of common stock, which warrants have an exercise price per share of $6.2938 and terms of 5 years.

On July 31, 2019, we issued a warrant to a consulting entity to purchase up to 10,000 shares of our common stock. The warrant has an exercise price per share of $2.19 and a term of 2 years.

On August 5, 2019, we issued two warrants to consulting entities, each to purchase up to 10,000 shares of our common stock. Each warrant has an exercise price per share of $1.92 and a term of 2 years.

On September 10, 2019, we issued and sold to two investors warrants to purchase a total of 659,414 shares of common stock at a total price of $82,426. The warrants have an exercise price per share of $7.52 and terms of five and one-half years. We also issued to the placement agent in this transaction warrants to purchase a total of 65,942 shares of common stock, which warrants have an exercise price per share of $9.4781 and terms of 5 years.

Purchases of Equity Securities by the Issuer and Affiliated Purchasers

We did not repurchase any of our equity securities during the year ended December 31, 2019.

Item 6. Selected Financial Data.

Not applicable.

Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operations.

Special Note Regarding Forward-Looking Statements

The following discussion and analysis of our financial condition and results of operations should be read in conjunction with our audited consolidated financial statements and the related notes to those statements included herein. In addition to historical financial information, this report contains forward-looking statements that involve risks and uncertainties. Our actual results could differ materially from those discussed in the forward-looking statements. The statements contained in this report that are not purely historical are forward-looking statements within the meaning of Section 27A of the Securities Act and Section 21E of the Securities Exchange Act of 1934, as amended, or the Exchange Act. Forward-looking statements are often identified by the use of words such as, but not limited to, "anticipate," "believe," "can," "continue," "could," "estimate," "expect," "intend," "may," "plan," "project," "seek," "should," "strategy," "target," "will," "would" and similar expressions or variations intended to identify forward-looking statements. These statements are based on the beliefs and assumptions of our management based on information currently available to management. Such forward-looking statements are subject to risks, uncertainties and other important factors that could cause actual results and the timing of certain events to differ materially from future results expressed or implied by such forward-looking statements. Factors that could cause or contribute to such differences include, but are not limited to, those identified below. Furthermore, such forward-looking statements speak only as of the date of this report. Except as required by law, we undertake no obligation to update any forward-looking statements to reflect events or circumstances after the date of such statements.

"Arcadia Biosciences," "Sonova," "Sonova GLA Safflower Oil and design," "GoodHemp" and "GoodWheat" are our registered trademarks in the United States and, in some cases, in certain other countries. This report may also contain trademarks, service marks, and trade names of other companies. Solely for convenience, the trademarks, service marks and trade names referred to in this report may appear without the ®, TM, or SM symbols, but such references do not constitute a waiver of any rights that might be associated with the respective trademarks, service marks, or trade names.

Overview

We are a leader in science-based approaches to developing high value crop productivity traits primarily in hemp, wheat, and soybean, designed to enhance farm economics by improving the performance of crops in the field, as well as their value as food ingredients, health and wellness products, and their viability for industrial applications. We use state of the art gene-editing technology and advanced breeding techniques to develop these proprietary innovations which we are beginning to monetize through a number of methods including seed and grain sales, product extract sales, trait licensing and royalty agreements.

Our commercial strategy is to link consumer's nutrition, health and wellness demands with the superior functional benefits our crops deliver directly from the farm, enabling us to share premium economics throughout the ag-food supply chain and to build a world-class estate of high value traits and varieties. In particular, we believe the recent legalization of hemp in the U.S. and many other areas of the world has created a significant agricultural and financial opportunity. The demonstrated broad demand for industrial, nutritional, health and wellness products from hemp, coupled with its poor genetics represent a vast, new opportunity for Arcadia to add substantial value to its existing high value trait and seed estate. We are applying our proprietary, rapid prototyping technology platform, ArcaTech, to deliver innovations addressing the many challenges farmers face in growing what is essentially an undomesticated crop. As such, our forward discovery research is focused on non-GM hemp innovations.

The passage of the U.S. Agriculture Improvement Act of 2018 – also known as the Farm Bill – confirmed the federal legalization of hemp, the term given to non-psychoactive cannabis containing less than 0.3% tetrahydrocannabinol (THC). It also included provisions for legalizing on a federal level hemp's cultivation, transport and sale for the first time in more than 75 years. Hemp, not previously distinguished by the federal government from cannabis, a Schedule 1 drug and banned as an agricultural crop, lacks substantive plant biology research and suffers from suboptimal genetics, highly fragmented germplasm and rampant inconsistencies. We are targeting hemp-based solutions that allow farmers to reliably and consistently achieve compliance with USDA regulations, through varieties with improved functionality and application of specific attributes such as select cannabinoid contents for health and wellness, enhanced proteins profiles for plant-based dietary applications and industrial applications such as clothing and hempcrete. Arcadia conducts its business in only federal and state markets in which its activities are legal.

On October 31, 2019, the USDA published the interim final rule as authorized by the Agriculture Improvement Act of 2018 for hemp cultivation, which mandates that states test hemp crops and dispose of "hot" crops that exceed 0.3% THC. While hemp farmers will have access to crop protection options, the destruction of hot crops that fail these stringent inspections will not be a covered loss under crop insurance programs. In 2019 alone, more than 20% of U.S. hemp crops were non-compliant, representing over $2 billion in losses for growers.

Arcadia GoodHemp

In December 2019, we announced the launch of a new product line, GoodHemp, as the company's new commercial brand for delivering genetically superior hemp seeds, transplants, flower and extracts. The first variety in GoodHemp's catalog, Complia Bot+, is a widely adapted cannabis strain that delivers high cannabinoid (CBD) content (more than 10%) with ultra-low THC, the psychoactive compound in cannabis. It is part of the Complia hemp seed line Arcadia is bringing to market through GoodHemp, with six additional proprietary varieties in early adopter farmer trials with sales expected in the 2020 season.

The Hemp Business Journal estimates the hemp CBD market – the primary non-psychoactive compound in hemp – totaled $190 million in U.S. sales in 2018. By 2022, the Brightfield Group, a hemp and CBD market research firm, projects U.S. sales to reach $22 billion. Additionally, Grandview research estimates the market for non-cannabinoid, industrial hemp market will exceed $15 billion by 2027.

Archipelago Ventures Hawaii, LLC

In August 2019, we formed a new joint venture to serve the Hawaiian, North American and Asian hemp markets, Archipelago Ventures Hawaii, LLC (“Archipelago”). This new venture between Arcadia and Legacy Ventures Hawaii (“Legacy”) combines Arcadia’s extensive genetic expertise and seed innovation history with Legacy’s growth capital and strategic advisory expertise in the Hawaiian markets. Additionally, Legacy brings to the partnership years of proven success in extraction, product formulation and sales of cannabinol oil and distillate products through its equity partner, Vapen CBD. Legacy was originally formed to be a vehicle for its partners to pursue hemp opportunities within the Hawaiian Islands. Legacy’s primary role within Archipelago is to build world class cGMP extraction facilities to allow Hawaiian farmers an outlet for maximizing their profits growing and converting hemp to high grade CBD, as well as other high-value compounds. Legacy’s equity partner, Vapen CBD, is a wholly owned subsidiary of VEXT which is a publicly traded cannabis operator based in Phoenix, Arizona listed on both the Canadian and Frankfurt exchanges.

Archipelago creates a vertically integrated supply chain, from seed to sale, we believe the first of its kind in Hawaii, and has three important strategic imperatives: (1) ensure a reliable supply chain during critical scale up of the global hemp market, a major risk mitigation for success, (2) ensure high quality throughout the supply chain, from genetics to the field and field to the customer and (3) ensure being well-positioned to address the unique needs and opportunities of the Hawaiian market.

Arcadia GoodWheat

In 2018, we launched our GoodWheat brand, a non-genetically modified (non-GM) portfolio of wheat products that enables food manufacturers to differentiate their consumer-facing brands. Consumer food companies are looking to simplify their food ingredient formulations and consumers are demanding “clean labeling” in their foods, paying more for foods having fewer artificial ingredients and more natural, recognizable and healthy ingredients. A 2017 survey by PR agency Ingredient Communications found that 73% of consumers are happy to pay a higher retail price for a food or drink product made with ingredients they recognize. Because GoodWheat increases the nutrient density directly in the primary grains and oils, it provides the mechanism for food formulation simplification naturally, cost effectively and in a time-frame to meet evolving consumer demands.

The brand launch is a key element of the company’s go-to-market strategy to achieve greater value for its innovations by participating in downstream consumer revenue opportunities. We designed the brand to make an immediate connection with consumers that products made with GoodWheat meet their demands for healthier wheat options that also taste great. The GoodWheat brand encompasses our current and future non-GM wheat portfolio of high fiber Resistant Starch (RS) and Reduced Gluten wheat varieties, as well as future wheat innovations. In October 2019, the U.S. Patent and Trademark Office granted us the latest patents for extended shelf life wheat, the newest trait in our non-genetically modified wheat portfolio. This new trait was designed to promote whole wheat consumption by improving the shelf life and taste of whole grain wheat products.

With additional patents granted in 2019, we now hold more than 15 global patents on our high fiber Resistant Starch wheat, protecting both bread wheat and durum (pasta) wheat. Claims granted in 2019 strengthen our intellectual property for our Resistant Starch portfolio of products.

We announced in August 2019 an agreement with Bay State Milling Company and Arista Cereal Technologies to bring to market our resistant starch GoodWheat in North America and other key markets, beginning in late 2019. In the daily American diet approximately 500 calories come from wheat products, 25% of the FDA's recommended daily caloric intake for a woman and 20% for a man. The GoodWheat portfolio of specialty wheat varieties delivers new functional value through an ingredient already an important component of the human diet.

In years to come, we expect to achieve enhanced nutritional characteristics within a number of other broad acre crops using advanced breeding and gene-editing techniques. Targets include but are not limited to higher fiber, longer shelf life and enhanced protein in crops other than wheat.

Verdeca HB4® Soybean

In 2012, we partnered with Bioceres, Inc. ("Bioceres") an Argentina-based technology company, to form Verdeca LLC, ("Verdeca") a U.S.-based joint venture company to deploy next-generation soybean traits developed to benefit soybean producers through quality improvement, stress mitigation and management practices. The HB4® soybean varieties deliver two layers of value for growers: drought and herbicide tolerance, offering resistance to a broad-spectrum herbicide utilized to prevent growth of a wide range of annual and perennial broadleaf weeds and grasses.

HB4® was discovered by researchers of the CONICET, the National Scientific and Research Council in Argentina, through the identification of one gene that gives sunflower the capacity to tolerate hydric and saline stress. This gene was transferred from sunflower to soybean.

Verdeca's HB4® soybeans have undergone extensive testing, including multi-location field trials in Argentina and the United States and multiple regulatory field trials. The results of these trials demonstrate that the HB4® trait can provide yield advantages under stress conditions – including drought and low-water conditions – found in several soybean production areas. Verdeca introduced a trait stack combining HB4® with an herbicide tolerance trait to deliver two layers of value for growers.

HB4® is the first trait offering tolerance to drought and salinity in soybeans, with 30 international patents. HB4® is currently approved in the four main countries producing this strategic crop – the U.S., Brazil, Argentina and Paraguay - representing 80% of the global soybean market. Regulatory submissions are under consideration by China, Canada, Bolivia and Uruguay. Import approval by China is required for commercial launch and the expectation to obtain such approval in late 2020 is under review in light of the recent coronavirus.

Soybeans are the world's fourth largest crop, grown on more than 120 million hectares annually. Global population growth, combined with a growing middle class in countries like China and India, have resulted in increased demand for this important protein source. More than 50 million of the world's soybean hectares are grown in Argentina and Brazil, a region that has experienced significant drought conditions in recent years.

Since our inception, we have devoted substantially all our efforts to research and development activities, including the discovery, development, and testing of our traits and products in development incorporating our traits. To date, we have not generated revenues from sales of commercial products, other than limited revenues from our GoodWheat and SONOVA products. We do receive revenues from fees associated with the licensing of our traits to commercial partners. Our long-term business plan and growth strategy is based in part on our expectation that revenues from products that incorporate our traits will comprise a significant portion of our future revenues.

We have never been profitable and had an accumulated deficit of $207.2 million as of December 31, 2019. We incurred net losses of $28.9 million and $13.5 million for the years ended December 31, 2019 and 2018, respectively. We expect to incur substantial costs and expenses before we obtain any revenues from the sale of seeds incorporating our traits. As a result, our losses in future periods could become even more significant, and we will need additional funding to support our operating activities.

Impact of Novel Coronavirus

We are closely monitoring how the spread of the novel coronavirus is affecting our employees and business operations. We have developed preparedness plans to help protect the safety of our employees while safely continuing business operations. Due to the spread of the outbreak in California and elsewhere where we have corporate offices, we have temporarily restricted access to our offices until at least April 1, 2020 and implemented a mandatory remote work policy during this period.

At this time, there is significant uncertainty relating to the trajectory of the novel coronavirus outbreak and impact of related responses. The continued spread of the outbreak may further impact our business, results of operations, and financial condition. See "Risk Factors— Risks Related to Our Business and Our Other Industries—The novel coronavirus outbreak could adversely impact our business, financial condition and results of operations."

Components of Our Statements of Operations Data

Revenues

We derive our revenues from product revenues, licensing agreements, royalties, contract research agreements, and government grants. Given our acute focus on selling our GoodWheat and GoodHemp products, we do not intend to continue pursuing contract research agreements and government grant projects.

Product Revenues

Our product revenues to date have consisted primarily of sales of our SONOVA products, with initial GoodWheat seed sale revenues recognized in the fourth quarter of 2019. We recognize revenue from product sales when control of the product is transferred to third-party distributors and manufacturers, collectively “our customers,” which generally occurs upon shipment. Our revenues fluctuate depending on the timing of shipments of product to our customers.

License Revenues

Our license revenues to date consist of up-front, nonrefundable license fees, annual license fees, and subsequent milestone payments that we receive under our research and license agreements.

Milestone fees are variable consideration that is initially constrained and recognized only when it is probable that such amounts would not be reversed. Given the seasonality of agriculture and time required to progress from one milestone to the next, achievement of milestones is inherently uneven, and our license revenues are likely to fluctuate significantly from period to period.

Contract Research and Government Grant Revenues

Contract research and government grant revenues consist of amounts earned from performing contracted research primarily related to breeding programs or the genetic engineering of plants for third parties. Contract research revenue is accounted for as a single performance obligation for which revenues are recognized over time using the input method (e.g. costs incurred to date relative to the total estimated costs at completion).

We have received payments from government entities in the form of government grants. Government grant revenue is accounted for as a single performance obligation for which revenues are recognized over time using the input method (e.g. costs incurred to date relative to the total estimated costs at completion). Our obligation with respect to these agreements is to perform the research on a best-efforts basis.

Operating Expenses

Cost of Product Revenues

Cost of product revenues relates to the sale of our SONOVA and GoodWheat products and consists of in-licensing and royalty fees, any adjustments or write-downs to inventory, as well as the cost of raw materials, including inventory and third-party services costs related to procuring, processing, formulating, packaging and shipping our products.

Research and Development Expenses

Research and development expenses consist of costs incurred in the discovery, development and testing of our products and products in development incorporating our traits. These expenses consist primarily of employee salaries and benefits, fees paid to subcontracted research providers, fees associated with in-licensing technology, land leased for field trials, chemicals and supplies, and other external expenses. These costs are expensed as incurred. Additionally, we are required from time to time to make certain milestone payments in connection with the development of technologies in-licensed from third parties. Our research and development expenses may fluctuate from period to period.

Change in Fair Value of Contingent Consideration

Change in the fair value of contingent consideration is comprised of the gain associated with the reduction of our contingent liability as the result of a decision to abandon a program that was previously accrued. See Note 13.

Selling, General and Administrative Expenses

Selling, general and administrative expenses consist primarily of employee costs, professional service fees, and overhead costs. Our selling, general, and administrative expenses may fluctuate from period to period. In connection with our commercialization activities for our consumer ingredient products, we expect to increase our investments in sales and marketing and business development.

Interest Expense

Interest expense consists primarily of contractual interest on notes payable that were entered into in the third quarter of 2019 to finance the purchase of company vehicles.

Other Income, Net

Other income, net, consists of interest income and the amortization of investment premium and discount on our cash and cash equivalents and investments.

Initial Loss on Common Stock Warrant and Common Stock Adjustment Feature Liabilities

Initial loss on common stock warrant and common stock adjustment feature liabilities is comprised of the loss associated with the initial recognition of the common stock warrant and common stock adjustment feature liabilities associated with the March 2018 Private Placement at their respective fair values.

Change in the Estimated Fair Value of Common Stock Warrant Liabilities and Common Stock Adjustment Feature Liability

Change in the estimated fair value of common stock warrant liabilities and common stock adjustment feature liability is comprised of the fair value remeasurement of the liabilities associated with the March 2018 Private Placement and the June 2018, June 2019, and September 2019 Offerings.

Offering Costs

Offering costs consists of the costs incurred with the issuance of Common Stock and the March 2018 Warrants in connection with the March 2018 Private Placement. Also included are costs incurred with the June 2018, June 2019, and September 2019 Offerings and Private Placements that have been allocated to the common stock warrant liability. Costs include placement agent, legal, advisory, accounting and filing fees.

Income Tax Provision

Our income tax provision has not been historically significant, as we have incurred losses since our inception. The provision for income taxes consists of state and foreign income taxes. Due to cumulative losses, we maintain a valuation allowance against our U.S. deferred tax assets as of December 31, 2019 and 2018. We consider all available evidence, both positive and negative, including but not limited to, cumulative losses, projected future outcomes, industry and market trends and the nature of each of the deferred tax assets in assessing the extent to which a valuation allowance should be applied against our U.S. deferred tax assets.

Results of Operations

Comparison of the Years ended December 31, 2019 and 2018

	Year Ended December 31,	
	2019	2018
	(in thousands)	
Revenues:		
Product	$ 814	$ 657
License	67	150
Contract research and government grants	288	657
Total revenues	1,169	1,464
Operating expenses (income):		
Cost of product revenues	885	661
Research and development	7,098	6,069
Change in fair value of contingent consideration	(1,000)	—
Selling, general and administrative	13,567	11,604
Total operating expenses	20,550	18,334
Loss from operations	(19,381)	(16,870)
Interest expense	(5)	—
Other income, net	466	394
Initial loss on common stock warrant and common stock adjustment feature liabilities	—	(4,000)
Change in fair value of common stock warrant and common stock adjustment feature liabilities	(9,243)	9,561
Offering costs	(708)	(2,555)
Loss before income taxes	(28,871)	(13,470)
Income tax provision	(2)	(10)
Net loss	(28,873)	(13,480)
Net loss attributable to non-controlling interests	(68)	—
Net loss attributable to common stockholders	$ (28,805)	$ (13,480)

Revenues

Product revenues accounted for 70% and 45% of our total revenues for the years ended December 31, 2019 and 2018, respectively. The $157,000, or 24%, increase in product revenues from sales of our SONOVA products was primarily driven by additional volume of encapsulated orders.

License revenues accounted for 6% and 10% of our total revenues for the years ended December 31, 2019 and 2018, respectively. There were no license agreements executed in 2018 and 2019.

Contract research and government grant revenues accounted for 25% and 45% of our total revenues for the years ended December 31, 2019 and 2018, respectively. The $369,000, or 56%, decrease in contract research and government grant revenues was primarily driven by the completion of agreements and grants. Given our acute focus on selling our GoodWheat and GoodHemp products, we do not intend to continue pursuing contract research agreements and government grant projects.

Cost of Product Revenues

Cost of product revenues increased by $224,000, or 34%, for the year ended December 31, 2019 compared to the year ended December 31, 2018. The increase is primarily due to increased product revenues and the write-down of wheat inventory.

Research and Development

Research and development expenses increased by $1.0 million, or 17%, for the year ended December 31, 2019 compared to the year ended December 31, 2018. The increase was primarily driven by additional soybean pre-commercial activities and higher employee-related expenses as we expand our research teams, as well as external hemp-related costs. The increase was partially offset by the reduction in GoodWheat field research costs as our commercial efforts progress, as well as reduced subcontracting expenses related to government grants.

Change in Fair Value of Contingent Consideration

Change in the fair value of contingent consideration is comprised of the gain of $1.0 million associated with the reduction of our contingent liability as the result of a decision to abandon a program that was previously accrued. See Note 13.

Selling, General, and Administrative

Selling, general, and administrative expenses increased by $2.0 million, or 17%, for the year ended December 31, 2019 compared to the year ended December 31, 2018. The increase was primarily driven by higher consulting fees and consultants' stock compensation expense, stock compensation expense associated with modification of CEO stock options, higher employee-related expenses, and increased marketing and public relations activities. These increases were partially offset by lower intellectual property legal fees.

Interest Expense

Interest expense was $5,000 for the year ended December 31, 2019, due to new notes payable agreements entered into during 2019. See Note 10. There was no such expense for the year ended December 31, 2018.

Other Income, Net

Other income, net, increased $72,000, or 18%, for the year ended December 31, 2019 compared to the year ended December 31, 2018. This was primarily related to the higher investment balance in 2019.

Initial Loss on Common Stock Warrant and Common Stock Adjustment Feature Liabilities

Initial loss on common stock warrant and common stock adjustment feature liabilities of $4.0 million for the year ended December 31, 2018 is comprised of the non-cash loss associated with the initial recognition of the common stock warrant and common stock adjustment feature liabilities associated with the Private Placement in March 2018 at estimated fair values of $10.2 million and $3.8 million, respectively. The combined fair value of $14.0 million less $10.0 million of proceeds yields the $4.0 million initial loss. There was no such loss during the year ended December 31, 2019.

Change in the Estimated Fair Value of Common Stock Warrant Liabilities and Common Stock Adjustment Feature Liability

Change in the estimated fair value of common stock warrant liabilities and common stock adjustment feature liability of $9.2 million of expense for the year ended December 31, 2019 resulted from the fair value remeasurement of the March 2018 Warrants pursuant to the March 2018 Purchase Agreement, the June 2018 Offering, June 2019 Offering, and the September 2019 Offering. The estimated fair value of the March 2018 Warrants increased by $2.2 million and the estimated fair value of the June 2018 Offering Warrants increased by $2.7 million, driven largely by the increase in the Company's stock price from December 31, 2018 to December 31, 2019. The estimated fair value of the June 2019 Offering Warrants increased by $4.8 million, the result of the increase in the Company's stock price from their issuance date of June 14, 2019 to the August 31, 2019 and December 31, 2019 remeasurement dates, partially offset by the reduction in the number of warrants outstanding with the exercise of 1,053,745 warrants. The estimated fair value of the September 2019 Warrants decreased by $0.5 million due to the decrease in the Company's stock price from their issuance on September 10, 2019 to December 31, 2019.

Change in the estimated fair value of common stock warrant liabilities and common stock adjustment feature liability of $9.6 million of income for the year ended December 31, 2018 resulted from the fair value remeasurements of the March 2018 Purchase Agreement liabilities at March 31, 2018 and the final remeasurement of the common stock adjustment feature on May 7, 2018. Also included is the remeasurement of the June Offering liabilities and the Purchase Agreement common stock warrant liabilities through December 31, 2018. The estimated fair value of the Purchase Agreement common stock adjustment feature was $4.6 million, the estimated fair value of the Purchase Agreement common stock warrants decreased by $7.9 million, and the estimated fair value of the June Offering common stock warrants decreased by $6.3 million due to the decrease in the Company's stock price. The Purchase Agreement common stock adjustment feature liability was released to equity following the final fair value remeasurement in May 2018. See Note 11.

Offering Costs

Offering costs for the year ended December 31, 2019 of $0.7 million is comprised of the placement agent fees, placement agent warrants, advisory fees, and legal and accounting fees related to the June 2019 and September 2019 Offerings. Offering costs for the year ended December 31, 2018 of $2.6 million is comprised of $1.8 million associated with the March 2018 Private Placement and $721,000 related to the June 2018 Offering and the June 2018 Private Placement.

Income Tax Provision

The income tax provision decreased $8,000 or 80% for the year ended December 31, 2019 compared to the year ended December 31, 2018. See Note 15.

Seasonality

We and our commercial partners operate in different geographies around the world and conduct field trials used for data generation, which must be conducted during the appropriate growing seasons for particular crops and markets. Often, there is only one crop-growing season per year for certain crops and markets. Similarly, climate conditions and other factors that may influence the sales of our products may vary from season to season and year to year. In particular, weather conditions, including natural disasters such as heavy rains, hurricanes, hail, floods, tornadoes, freezing conditions, drought or fire, may affect the timing and outcome of field trials, which may delay milestone payments and the commercialization of products incorporating our seed traits. In the future, sales of commercial products that incorporate our seed traits will vary based on crop growing seasons and weather patterns within particular regions.

The level of seasonality in our business overall is difficult to evaluate at this time due to our relatively early stage of development, our relatively limited number of commercialized products, our expansion into new geographical markets and our introduction of new products and traits.

Liquidity, Capital Resources and Going Concern

We have funded our operations primarily with the net proceeds from our initial public offering, private placements of equity securities and debt, as well as proceeds from the sale of our SONOVA products and payments under license agreements, contract research agreements and government grants. Our principal use of cash is to fund our operations, which are primarily focused on completing development and commercializing our quality seed traits. This includes replicating field trials, coordinating with our partners on their development programs and scaling harvest production of wheat, hemp and soy. As of December 31, 2019, we had cash and cash equivalents of $8.4 million and short-term investments of $16.9 million. For the years ended December 31, 2019 and 2018, the Company had net losses of $28.9 million and $13.5 million, respectively, and net cash used in operations of $17.2 million and $13.6 million, respectively.

As is disclosed in Note 11, the Company obtained funding through two separate arrangements during the first half of 2018 and two offerings during June 2019 and September 2019. On March 19, 2018, the Company entered into securities purchase agreements with institutional investors in connection with a private placement of common stock and warrants in the amount of $10 million, exclusive of any related transaction fees. On June 11, 2018, the Company entered into agreements with institutional investors through a registered direct offering in the amount of $14 million, exclusive of any related transaction fees. On June 12, 2019, the Company entered into agreements with institutional investors through a registered direct offering in the amount of $7.5 million exclusive of any related transaction fees. In August and September 2019, investors exercised warrants, generating cash proceeds totaling $5.3 million. On September 5, 2019, the Company entered into agreements with institutional investors through a registered direct offering in the amount of $10 million exclusive of any related transaction fees.

We believe that our existing cash, cash equivalents and short-term investments will not be sufficient to meet our anticipated cash requirements for at least the next 12 months which raises substantial doubt about the Company’s ability to continue as a going concern. See Note 1 of the notes to the consolidated financial statements for more information.

We may seek to raise additional funds through debt or equity financings, if necessary. We may also consider entering into additional partner arrangements. Our sale of additional equity would result in dilution to our stockholders. Our incurrence of debt would result in debt service obligations, and the instruments governing our debt could provide for additional operating and financing covenants that would restrict our operations. If we do require additional funds and are not able to secure adequate additional funding, we may be forced to reduce our spending, extend payment terms with our suppliers, liquidate assets, or suspend or curtail planned development programs. Any of these actions could materially harm our business, results of operations and financial condition.

At this time, there is significant uncertainty relating to the trajectory of the novel coronavirus outbreak and impact of related responses. The continued spread of the outbreak could materially harm our business, results of operations, and financial condition. Due to this uncertainty and plans outside of management’s control, we may not be able to achieve and implement such plans within one year after the date that the financial statements are issued to address the substantial doubt that exists.

Cash Flows

The following table summarizes our cash flows for the periods indicated (in thousands):

	Year Ended December 31,	
	2019	2018
Net cash (used in) provided by:		
Operating activities	$ (17,198)	$ (13,631)
Investing activities	(8,369)	(5,975)
Financing activities	21,986	22,479
Net (decrease) increase in cash and cash equivalents	$ (3,581)	$ 2,873

Cash Flows from Operating Activities

Cash used in operating activities for the year ended December 31, 2019 was $17.2 million. Our net loss of $28.9 million, change in fair value of contingent consideration of $1.0 million, operating lease payments of $715,000, and net amortization of investment premium and discount of $180,000 were partially offset by the change in fair value of common stock warrant liabilities and common stock adjustment feature liability of $9.2 million, non-cash charges of $2.3 million for stock-based compensation, depreciation and amortization of $902,000, as well as $708,000 of offering costs incurred in connection with financing activities and adjustments in our working capital accounts of $0.1 million.

Cash used in operating activities for the year ended December 31, 2018 was $13.6 million. Our net loss of $13.5 million, the change in fair value of common stock warrant liabilities and common stock adjustment feature liability of $9.6 million and net amortization of investment premium and discount of $193,000 were partially offset by the initial loss on common stock warrant and adjustment feature liabilities of $4.0 million, non-cash charges of $1.6 million for stock-based compensation, and depreciation and amortization of $154,000, as well as $2.6 million of offering costs incurred in connection with financing activities and adjustments in our working capital accounts of $1.1 million.

Cash Flows from Investing Activities

Cash used in investing activities for the year ended December 31, 2019 of $8.4 million primarily consisted of $28.4 million in purchases of short-term investments and $1.5 million in purchases of property and equipment, partially offset by $21.5 million in proceeds from sales and maturities of investments.

Cash used in investing activities for the year ended December 31, 2018 of $6.0 million primarily consisted of $29.9 million in purchases of short-term investments and $250,000 in purchases of property and equipment, partially offset by $24.2 million in proceeds from sales and maturities of investments.

Cash Flows from Financing Activities

Cash provided by financing activities for the year ended December 31, 2019 of $21.9 million consisted of proceeds from the issuance of stock and warrants relating to the June 2019 Offering of $7.5 million and from the September 2019 Offering of $10.0 million, proceeds from the exercise of some of the June 2019 warrants of $5.3 million, capital contributions from the non-controlling interest in our joint venture of $689,000 and proceeds from the purchase of ESPP shares of $21,000. Partially offsetting these proceeds were payments of offering costs totaling $798,000 and $663,000 for the September 2019 and June 2019 Offerings, respectively, as well as $24,000 in payments of offering costs for the June 2018 Offering.

Cash provided by financing activities for the year ended December 31, 2018 of $22.5 million consisted of proceeds from the issuance of stock and warrants in March 2018 of $10.0 million and in June 2018 of $14.0 million, partially offset by $2.5 million of offering costs for both transactions paid during the period. Proceeds from the exercise of stock options and the purchase shares under the employee stock purchase plan totaled $969,000.

Off-Balance Sheet Arrangements

Since our inception, we have not engaged in any off-balance sheet arrangements, including the use of structured finance, special purpose entities or variable interest entities other than Verdeca, which is discussed in the notes to the consolidated financial statements.

Critical Accounting Polices and Estimates

Our management's discussion and analysis of our financial condition and results of operations is based on our financial statements, which have been prepared in accordance with GAAP. The preparation of these financial statements requires us to make estimates and assumptions that affect the reported amounts of assets and liabilities and the disclosure of contingent assets and liabilities at the date of the financial statements, as well as the reported revenue generated, and expenses incurred during the reporting periods. Our estimates are based on our historical experience and on various other factors that we believe are reasonable under the circumstances, the results of which form the basis for making judgments about the carrying value of assets and liabilities that are not readily apparent from other sources. Actual results may differ from these estimates under different assumptions or conditions.

We consider our critical accounting policies and estimates to be revenue recognition, determination of the provision for income taxes, stock-based compensation, fair value of certain equity instruments, and net realizable value of inventory. See Notes 5 and 11 for the estimates made in connection with the securities purchase agreements executed during the years ended December 31, 2019 and 2018.

Revenue Recognition

We recognize revenue when control of the promised goods or services is transferred to customers at an amount that reflects the consideration to which the entity expects to be entitled to in exchange for those goods or services. See Note 2 for further detail.

We generally recognize product revenues once passage of title has occurred, which is generally upon shipment. Shipping and handling costs charged to customers are recorded as revenues and included in cost of product revenues at the time the sale is recognized.

We have determined that, at the inception of each license agreement, there is only one deliverable for the license for, access to and assistance with the development of the specified intellectual property. We recognize revenue up-front and annual license fees in full when it is deemed probable to be earned. See Note 2 for further detail.

We recognize revenue related to milestone payments when it is probable that such amounts would not be reversed. See Note 2 for further detail.

Up-front license fees for newly executed agreements are recognized upon execution. Annual license fees and milestone fees are variable consideration that is initially constrained and recognized only when it is probable that such amounts would not be reversed. The evaluation and analysis of such fees is performed and once the annual license or milestone fee is deemed probable to have been earned, it is recognized in full in that period. See Note 2 for further detail.

Contract research revenue consists of amounts earned from performing contracted research activities for third parties. Activities performed are related to breeding programs or the genetic engineering of plants and are subject to an executed agreement. We generally recognize fees for research activities ratably over the contractually specified performance period.

Grant revenues are recognized as eligible research and development expenses are incurred using a proportional performance recognition methodology.

Inventories

Inventory costs are tracked on a lot-identified basis, valued at the lower of cost or net realizable value and are included as cost of product revenues when sold. We compare the cost of inventories with market value and write down inventories to net realizable value, if lower. We write down inventory when conditions indicate that the net realizable value may be less than cost due to physical deterioration, obsolescence, changes in price levels or other factors. Additionally, we provide reserves for excess and slow-moving inventory to its estimated net realizable value. The inventory write-downs are based upon estimates about future demand from our customers and distributors and market conditions. Future events that could significantly influence our judgment and related estimates include conditions in target markets, introduction of new products or changes to current or future competitor products.

Stock-Based Compensation

We recognize compensation expense related to the employee stock purchase plan and stock options based on the estimated fair value of the awards on the date of grant, net of estimated forfeitures. We estimate the grant date fair value, and the resulting stock-based compensation expense, using the Black-Scholes option-pricing model. The grant date fair value of the stock-based awards is generally recognized on a straight-line basis over the requisite service period, which is generally the vesting period of the respective awards.

We recorded stock-based compensation expense related to equity awards of $2.3 million and $1.6 million for the years ended December 31, 2019 and 2018, respectively.

In determining the fair value of stock-based awards, we use the Black-Scholes option-pricing model and assumptions discussed below. Each of these inputs is subjective and generally requires significant judgment to determine.

Expected Term—The expected term represents the period that stock-based awards are expected to be outstanding and was estimated based on a simplified method allowed by the SEC due to insufficient historical data, and defines the term as the average of the contractual term of the options and the weighted-average vesting period for all open employee awards.

Expected Volatility—Since we were privately held and do not have sufficient trading history for our common stock, the expected volatility was estimated based on the average historical volatilities of common stock of comparable publicly traded entities over a period equal to the expected term of the stock option grants. The comparable companies were chosen based on their similar size, stage in the life cycle, or area of specialty. We will continue to apply this process until a sufficient amount of historical information regarding the volatility of our own stock price becomes available.

Risk-Free Interest Rate—The risk-free interest rate is based on the U.S. Treasury zero coupon issues in effect at the time of grant for periods corresponding with the expected term of option.

Expected Dividend—We have never paid dividends on our common stock and have no plans to pay dividends on our common stock. Therefore, we used an expected dividend yield of zero.

For stock options and other equity awards, our board of directors determine the fair value of each share of underlying common stock based on the closing price of our common stock as reported on the NASDAQ Stock Market on the date of grant.

In addition to the Black-Scholes assumptions, we estimate our forfeiture rate based on an analysis of our actual forfeitures and will continue to evaluate the adequacy of the forfeiture rate based on actual forfeiture experience, analysis of employee turnover behavior, and other factors. The impact from any forfeiture rate adjustment would be recognized in full in the period of adjustment and if the actual number of future forfeitures differs from our estimates, we might be required to record adjustments to stock-based compensation in future periods.

Income Taxes

We use the asset and liability method of accounting for income taxes. Under this method, deferred tax assets and liabilities are determined based on the differences between the financial reporting and the tax bases of assets and liabilities and are measured using the enacted tax rates and laws that will be in effect when the differences are expected to reverse. A valuation allowance is provided when it is more likely than not that some portion or all of a deferred tax asset will not be realized.

Recent Accounting Pronouncements

For discussions of the adoption and potential impacts of recently issued accounting standards, refer to Note 3 – Recent Accounting Pronouncements and Note 14 – Leases to the accompanying consolidated financial statements.

Item 7A. Quantitative and Qualitative Disclosures About Market Risk.

Not applicable.

Item 8. Financial Statements and Supplementary Data.

INDEX TO CONSOLIDATED FINANCIAL STATEMENTS

REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the stockholders and the Board of Directors of Arcadia Biosciences, Inc.

Opinion on the Financial Statements

We have audited the accompanying consolidated balance sheets of Arcadia Biosciences, Inc. and subsidiaries (the "Company") as of December 31, 2019 and 2018, the related consolidated statements of operations and comprehensive loss, stockholders' equity, and cash flows, for each of the two years in the period ended December 31, 2019, and the related notes (collectively referred to as the "financial statements"). In our opinion, the consolidated financial statements present fairly, in all material respects, the financial position of the Company as of December 31, 2019 and 2018, and the results of its operations and its cash flows for each of the two years in the period ended December 31, 2019, in conformity with accounting principles generally accepted in the United States of America.

Going Concern

The accompanying consolidated financial statements have been prepared assuming that the Company will continue as a going concern. As discussed in Note 1 to the consolidated financial statements, the Company has suffered recurring losses from operations and is experiencing difficulty in generating sufficient cash flow to meet its obligations and sustain operations, which raises substantial doubt about its ability to continue as a going concern. Management's plans in regard to these matters are also described in Note 1. The consolidated financial statements do not include any adjustments that might result from the outcome of this uncertainty.

Basis for Opinion

These consolidated financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on the Company's consolidated financial statements based on our audits. We are a public accounting firm registered with the Public Company Accounting Oversight Board (United States) (PCAOB) and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the consolidated financial statements are free of material misstatement, whether due to error or fraud. The Company is not required to have, nor were we engaged to perform, an audit of its internal control over financial reporting. As part of our audits, we are required to obtain an understanding of internal control over financial reporting but not for the purpose of expressing an opinion on the effectiveness of the Company’s internal control over financial reporting. Accordingly, we express no such opinion.

Our audits included performing procedures to assess the risks of material misstatement of the consolidated financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the consolidated financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the consolidated financial statements. We believe that our audits provide a reasonable basis for our opinion.

/s/ Deloitte & Touche LLP

Phoenix, Arizona

March 25, 2020

We have served as the Company's auditor since 2007.

Arcadia Biosciences, Inc.
Consolidated Balance Sheets
(In thousands, except share data)

	As of December 31,	
	2019	**2018**
Assets		
Current assets:		
Cash and cash equivalents	$ 8,417	$ 11,998
Short-term investments	16,915	9,825
Accounts receivable	602	165
Unbilled revenue	—	3
Inventories, net — current	1,794	181
Prepaid expenses and other current assets	712	704
Total current assets	28,440	22,876
Property and equipment, net	1,799	395
Right of use asset	1,963	—
Inventories, net — noncurrent	364	746
Other noncurrent assets	8	7
Total assets	$ 32,574	$ 24,024
Liabilities and stockholders' equity		
Current liabilities:		
Accounts payable and accrued expenses	$ 4,685	$ 2,645
Amounts due to related parties	40	29
Notes payable - current	24	—
Unearned revenue — current	42	96
Operating lease liability - current	611	—
Other current liabilities	306	284
Total current liabilities	5,708	3,054
Notes payable - noncurrent	107	—
Operating lease liability - noncurrent	1,497	—
Common stock warrant liabilities	14,936	5,083
Other noncurrent liabilities	2,000	3,072
Total liabilities	24,248	11,209
Commitments and contingencies (Note 13)		
Stockholders' equity:		
Common stock, $0.001 par value—150,000,000 shares authorized as of December 31, 2019 and December 31, 2018; 8,646,149 and 4,774,919 shares issued and outstanding as of December 31, 2019 and December 31, 2018, respectively.	49	45
Additional paid-in capital	214,826	191,136
Accumulated other comprehensive income	1	—
Accumulated deficit	(207,171)	(178,366)
Total Arcadia Biosciences stockholders' equity	7,705	12,815
Non-controlling interest	621	—
Total stockholders' equity	8,326	12,815
Total liabilities and stockholders' equity	$ 32,574	$ 24,024

The accompanying notes are an integral part of these consolidated financial statements.

Arcadia Biosciences, Inc.
Consolidated Statements of Operations and Comprehensive Loss
(In thousands, except share and share data)

	Year Ended December 31,	
	2019	2018
Revenues:		
Product	$ 814	$ 657
License	67	150
Contract research and government grants	288	657
Total revenues	1,169	1,464
Operating expenses (income):		
Cost of product revenues	885	661
Research and development	7,098	6,069
Change in fair value of contingent consideration	(1,000)	—
Selling, general and administrative	13,567	11,604
Total operating expenses	20,550	18,334
Loss from operations	(19,381)	(16,870)
Interest expense	(5)	—
Other income, net	466	394
Initial loss on common stock warrant and common stock adjustment feature liabilities	—	(4,000)
Change in fair value of common stock warrant and common stock adjustment feature liabilities	(9,243)	9,561
Offering costs	(708)	(2,555)
Net loss before income taxes	(28,871)	(13,470)
Income tax provision	(2)	(10)
Net loss	(28,873)	(13,480)
Net loss attributable to non-controlling interest	(68)	—
Net loss attributable to common stockholders	$ (28,805)	$ (13,480)
Net loss per share attributable to common stockholders:		
Basic and diluted	$ (4.53)	$ (3.58)
Weighted-average number of shares used in per share calculations:		
Basic and diluted	6,363,112	3,766,419
Other comprehensive income, net of tax		
Unrealized gains on available-for-sale securities	1	—
Other comprehensive income	1	—
Comprehensive loss attributable to common stockholders	$ (28,804)	$ (13,480)

The accompanying notes are an integral part of these consolidated financial statements.

Arcadia Biosciences, Inc.
Consolidated Statements of Stockholders' Equity

(In thousands, except share data)

	Common Stock		Additional Paid-In Capital	Accumulated Deficit	Accumulated Other Comprehensive (Loss) Income	Non-controlling Interest	Total Stockholders' Equity
	Shares	Amount					
Balance at January 1, 2018	2,134,153	$ 42	$ 175,223	$ (167,257)	$ (1)	$ —	$ 8,007
Impact of adoption of Topic 606	—	—	—	2,371	—	—	2,371
Issuance of shares related to employee stock option exercises	44,354	—	963	—	—	—	963
Issuance of shares related to employee stock purchase plan	1,122	—	6	—	—	—	6
Issuance of shares related to March 2018 Purchase Agreement	1,201,634	1	(1)	—	—	—	—
Issuance of placement agent warrants related to March 2018 Purchase Agreement	—	—	526	—	—	—	526
Common stock adjustment feature	—	—	8,378	—	—	—	8,378
Issuance of shares related to June 2018 Offering	1,392,345	2	4,976	—	—	—	4,978
Offering costs related to June 2018 Offering	—	—	(912)	—	—	—	(912)
Issuance of placement agent warrants related to June 2018 Offering	—	—	427	—	—	—	427
Stock-based compensation	—	—	1,550	—	—	—	1,550
Issuance of shares related to reverse stock split	1,311	—	—	—	—	—	—
Other comprehensive income	—	—	—	—	1	—	1
Net loss	—	—	—	(13,480)	—	—	(13,480)
Balance at December 31, 2018	4,774,919	$ 45	$ 191,136	$ (178,366)	$ —	$ —	$ 12,815
Issuance of shares related to employee stock purchase plan	8,536	—	18	—	—	—	18
Issuance of shares related to employee stock option exercises	546	—	3	—	—	—	3
Issuance of shares related to June 2019 Offering	1,489,575	2	3,301	—	—	—	3,303
Offering costs related to June 2019 Offering	—	—	(489)	—	—	—	(489)
Issuance of placement agent warrants related to June 2019 Offering	—	—	198	—	—	—	198
Issuance of shares related to the exercise of warrants issued with the June 2019 offering	1,053,745	1	5,268	—	—	—	5,269
Reclassification of common stock warrant liability balance with exercise	—	—	7,016	—	—	—	7,016
Issuance of shares related to September 2019 Offering	1,318,828	1	6,570	—	—	—	6,571
Offering costs related to September 2019 Offering	—	—	(808)	—	—	—	(808)
Issuance of placement agent warrants related to September 2019 Offering	—	—	326	—	—	—	326
Stock-based compensation	—	—	2,287	—	—	—	2,287
Non-controlling interest contributions	—	—	—	—	—	689	689
Unrealized gains on available-for-sale securities	—	—	—	—	1	—	1
Net loss	—	—	—	(28,805)	—	(68)	(28,873)
Balance at December 31, 2019	8,646,149	$ 49	$ 214,826	$ (207,171)	$ 1	$ 621	$ 8,326

The accompanying notes are an integral part of these consolidated financial statements.

Arcadia Biosciences, Inc.
Consolidated Statements of Cash Flows
(In thousands)

	Year Ended December 31,	
	2019	**2018**
CASH FLOWS FROM OPERATING ACTIVITIES:		
Net loss	$ (28,873)	$ (13,480)
Adjustments to reconcile net loss to cash used in operating activities:		
Initial loss on common stock warrant and common stock adjustment feature liabilities	—	4,000
Change in fair value of common stock warrant and common stock adjustment feature liabilities	9,243	(9,561)
Change in fair value of contingent consideration	(1,000)	—
Offering costs	708	2,555
Depreciation	194	154
Lease amortization	708	—
Loss (gain) on disposal of equipment	3	(3)
Net amortization of investment premium	(180)	(193)
Stock-based compensation	2,287	1,550
Write down of inventory	304	310
Changes in operating assets and liabilities:		
Accounts receivable	(437)	1,066
Unbilled revenue	3	2
Inventories	(1,535)	160
Prepaid expenses and other current assets	(8)	(151)
Other noncurrent assets	(1)	—
Accounts payable and accrued expenses	2,102	176
Amounts due to related parties	11	(1)
Unearned revenue	(54)	(312)
Other current liabilities	42	25
Other noncurrent liabilities	—	72
Operating lease payments	(715)	—
Net cash used in operating activities	(17,198)	(13,631)
CASH FLOWS FROM INVESTING ACTIVITIES:		
Proceeds from sale of property and equipment	16	10
Purchases of property and equipment	(1,477)	(250)
Purchases of investments	(28,358)	(29,885)
Proceeds from sales and maturities of investments	21,450	24,150
Net cash used in investing activities	(8,369)	(5,975)
CASH FLOWS FROM FINANCING ACTIVITIES:		
Proceeds from issuance of common stock and warrants from June 2019 Offering	7,500	—
Payments of offering costs relating to June 2019 Offering	(663)	—
Proceeds from issuance of common stock and warrants from September 2019 Offering	10,000	—
Payments of offering costs relating to September 2019 Offering	(798)	—
Proceeds from issuance of common stock and warrants under March 2018 Purchase Agreement	—	10,000
Payments of offering costs relating to March 2018 Purchase Agreement	—	(1,308)
Proceeds from issuance of common stock and warrants from June 2018 Offering	—	14,000
Payments of offering costs relating to June 2018 Offering	(24)	(1,182)
Principal payments on notes payable	(8)	—
Proceeds from exercise of warrants	5,269	—
Proceeds from exercise of stock options and purchases through ESPP	21	969
Capital contributions received from non-controlling interest	689	—
Net cash provided by financing activities	21,986	22,479
Net (decrease) increase in cash and cash equivalents	(3,581)	2,873
Cash and cash equivalents — beginning of period	11,998	9,125
Cash and cash equivalents — end of period	$ 8,417	$ 11,998
SUPPLEMENTAL DISCLOSURES OF CASH FLOW INFORMATION:		
Cash paid for interest	$ 4	$ —
Cash paid for taxes	$ 2	$ 34
NONCASH TRANSACTIONS:		
Offering costs in accounts payable and accrued expenses at end of period	$ 20	$ 23
Common stock warrants issued to placement agent and included in offering costs related to March 2018 Purchase Agreement	$ —	$ 526
Common stock warrants issued to placement agent and included in offering costs related to June 2018 Offering	$ —	$ 239
Common stock warrants issued to placement agent and included in offering costs related to June 2019 Offering	$ 86	$ —
Common stock warrants issued to placement agent and included in offering costs related to September 2019 Offering	$ 95	$ —
Reclassification of common stock warrant liability balance with warrant exercises	$ 7,016	$ —
Reclassification of unearned revenue to other short term liabilities	$ —	$ 259
Reclassification of common stock adjustment feature liability balance to equity	$ —	$ 8,378
Right of use assets obtained in exchange for new operating lease liabilities	$ 2,328	$ —
Right of use assets obtained through modification of existing lease agreement	$ 194	$ —
Fixed assets acquired with notes payable	$ 139	$ —
Purchases of fixed assets included in accounts payable and accrued expenses	$ 1	$ —

The accompanying notes are an integral part of these consolidated financial statements.

Arcadia Biosciences, Inc.
Notes to Consolidated Financial Statements

Note 1. Description of Business

Organization

Arcadia Biosciences, Inc. (the "Company"), was incorporated in the state of Arizona in 2002 and maintains its headquarters in Davis, California, with additional facilities in Phoenix, Arizona, American Falls, Idaho, and Molokai, Hawaii. The Company was reincorporated in Delaware in March 2015.

We are a leader in science-based approaches to developing high value crop productivity traits primarily in hemp, wheat, and soybean, designed to enhance farm economics by improving the performance of crops in the field, as well as their value as food ingredients, health and wellness products, and their viability for industrial applications. We use state of the art gene-editing technology and advanced breeding techniques to develop these proprietary innovations which we are beginning to monetize through a number of methods including seed and grain sales, product extract sales, trait licensing and royalty agreements.

In February 2012, the Company formed Verdeca LLC (“Verdeca,” see Note 7), which is jointly owned by us with Bioceres, Inc. (“Bioceres”), a U.S. wholly owned subsidiary of Bioceres, S.A., an Argentine corporation. Bioceres, S.A. is an agricultural investment and development cooperative. Verdeca**,** which is consolidated by the Company, was formed to develop and deregulate soybean varieties using both partners’ agricultural technologies.

On August 9, 2019, the Company entered into a joint venture agreement with Legacy Ventures Hawaii, LLC (“Legacy,” see Note 6) to grow, extract, and sell hemp products. The new partnership, Archipelago Ventures Hawaii, LLC (“Archipelago”), combines the Company’s extensive genetic expertise and resources with Legacy’s experience in hemp extraction and sales.

Reverse Stock Split

In January 2018, the Company’s board of directors approved a reverse split of 1:20 on the Company’s issued and outstanding common stock which became effective on January 23, 2018. All issued and outstanding common stock, options to purchase common stock and per share amounts contained in the consolidated financial statements have been retroactively adjusted to reflect the reverse stock split for all periods presented. The reverse stock split did not change the total number of authorized shares of common stock which remained at one hundred and fifty million shares.

Liquidity, Capital Resources, and Going Concern

The accompanying consolidated financial statements have been prepared on a going concern basis, which contemplates the realization of assets and the satisfaction of liabilities during the normal course of business. Since inception, the Company has financed its operations primarily through equity and debt financings. As of December 31, 2019, the Company had an accumulated deficit of $207.2 million, cash and cash equivalents of $8.4 million, and short-term investments of $16.9 million. For the years ended December 31, 2019 and 2018, the Company had net losses of $28.9 million and $13.5 million, respectively, and net cash used in operations of $17.2 million and $13.6 million, respectively. The Company believes that its existing cash, cash equivalents and investments will be insufficient to meet its anticipated cash requirements for at least through March 2021, and thus raises substantial doubt about the Company’s ability to continue as a going concern. The financial statements do not include any adjustments that might result from the outcome of this uncertainty.

The Company may seek to raise additional funds through debt or equity financings. The Company may also consider entering into additional partner arrangements. The sale of additional equity would result in dilution to the Company’s stockholders. The incurrence of debt would result in debt service obligations, and the instruments governing such debt could provide for additional operating and financing covenants that would restrict operations. If the Company does require additional funds and is unable to secure adequate additional funding at terms agreeable to the Company, the Company may be forced to reduce spending, extend payment terms with suppliers, liquidate assets, or suspend or curtail planned development programs. Any of these actions could materially harm the business, results of operations and financial condition.

Arcadia Biosciences, Inc.
Notes to Consolidated Financial Statements. (Continued)

At this time, there is significant uncertainty relating to the trajectory of the novel coronavirus outbreak and impact of related responses. The continued spread of the outbreak could materially harm our business, results of operations, and financial condition. Due to this uncertainty and plans outside of management's control, we may not be able to achieve and implement such plans within one year after the date that the financial statements are issued to address the substantial doubt that exists.

Note 2. Summary of Significant Accounting Policies

Basis of Presentation and Principles of Consolidation

The consolidated financial statements include the accounts of the Company, Verdeca LLC and Archipelago. All intercompany balances and transactions have been eliminated in consolidation. The Company prepares its consolidated financial statements in conformity with accounting principles generally accepted in the United States of America, or U.S. GAAP ("GAAP"), and with the rules of the Securities and Exchange Commission.

The Company uses a qualitative approach in assessing the consolidation requirement for variable interest entities ("VIEs"). This approach focuses on determining whether the Company has the power to direct the activities of the VIE that most significantly affect the VIE's economic performance and whether the Company has the obligation to absorb losses, or the right to receive benefits, that could potentially be significant to the VIE.

For all periods presented, the Company has determined that it is the primary beneficiary of Verdeca, which is a VIE. Accordingly, the Company consolidates the entity in the condensed consolidated financial statements after eliminating intercompany transactions. The Company evaluates its relationships with its VIEs upon the occurrence of certain significant events that affect the design, structure or other factors pertinent to the primary beneficiary determination. Verdeca LLC has no operations, assets or liabilities as of and for the years ended December 31, 2019 and 2018.

For all periods presented, the Company has determined that it is the primary beneficiary of Archipelago, a joint venture, as it has a controlling interest in Archipelago. Accordingly, the Company consolidates the entity in the condensed consolidated financial statements after eliminating intercompany transactions. For consolidated joint ventures, the non-controlling partner's share of the assets, liabilities and operations of the joint venture is included in non-controlling interests as equity of the Company. The non-controlling partner's interest is generally computed as the joint venture partner's ownership percentage of Archipelago. Net loss attributable to non-controlling interest of $68,000 is recorded as an adjustment to net loss to arrive at net loss attributable to common stockholders for the year ended December 31, 2019. The non-controlling partner's equity interests are presented as non-controlling interests on the Consolidated Balance Sheets as of December 31, 2019.

Use of Estimates

The preparation of consolidated financial statements in conformity with GAAP requires management to make estimates and assumptions in the Company's consolidated financial statements and notes thereto. Significant estimates and assumptions made by management included the determination of the provision for income taxes, stock-based compensation, fair value of certain equity instruments, and net realizable value of inventory. Management bases its estimates on historical experience and on various other market-specific and relevant assumptions that management believes to be reasonable under the circumstances. Actual results could differ from those estimates.

Cash and Cash Equivalents

The Company considers any liquid investments with a stated maturity of three months or less at the date of purchase to be cash equivalents. Cash and cash equivalents consist of cash on deposit with banks. The Company limits cash investments to financial institutions with high credit standings; therefore, management believes that there is no significant exposure to any credit risk in the Company's cash and cash equivalents. However, as of December 31, 2019 and 2018, a substantial portion of the Company's cash in depository accounts is in excess of the federal deposit insurance limits.

Investments in Debt Securities

Investments in debt securities are carried at fair value and classified as available-for-sale. Realized gains and losses on available-for-sale securities are included in other income — net in the Consolidated Statements of Operations and Comprehensive Loss. Unrealized gains and losses, net of deferred taxes, on available-for-sale securities are included in the Consolidated Balance Sheets as a component of accumulated other comprehensive income. Securities classified as available-for-sale are reported as cash and cash equivalent, short-term investments or long-term investments in the Consolidated Balance Sheets based on the nature of the investments and maturity period. Short-term investments have maturities of less than a year and long-term investments have maturities of a year and greater from the balance sheet date. The Company's debt securities are primarily comprised of U.S. government securities, treasury bills, commercial paper, corporate securities, and money markets. These available-for-sale investments are held in the custody of a major financial institution.

Other-than-Temporary Impairments on Investment

The Company regularly reviews each of its investments for impairment by determining if the investment has sustained an other-than-temporary decline in its value, in which case the investment is written down to its fair value by a charge to earnings. Factors that are considered by the Company in determining whether an other-than-temporary decline in value has occurred include (i) the market value of the investment in relation to its cost basis, (ii) the financial condition of the investment, and (iii) the Company's intent and ability to retain the investment for a sufficient period of time to allow for recovery of the market value of the investment. As of December 31, 2019 and 2018, there was no impairment of the Company's investments.

Accounts Receivable

Accounts receivable represents amounts owed to the Company from product sales, licenses and contract research and government grants. The carrying value of the Company's receivables represents estimated net realizable values. The Company generally does not require collateral and estimates any required allowance for doubtful accounts based on historical collection trends, the age of outstanding receivables, and existing economic conditions. If events or changes in circumstances indicate that specific receivable balances may be impaired, further consideration is given to the collectability of those balances and the allowance is recorded accordingly. Past-due receivable balances are written off when the Company's internal collection efforts have been unsuccessful in collecting the amounts due. The Company had no amounts reserved for doubtful accounts at December 31, 2019 and 2018 as the Company expected full collections of all accounts receivable balances as of each of these dates.

Inventory

GoodWheat: Propriety wheat plants are grown, producing seed with a variety of improved nutritional qualities, including high levels of amylose, improved shelf-life, and reduced gluten. This seed is used for subsequent plantings or processed, and sold as GoodWheat seeds, grain, and flour, which we refer to collectively as our GoodWheat products. Amounts inventoried consist primarily of fees paid to contracted cooperators to grow the crops, costs to process and store harvested seed and grain, and costs to mill the grain into flour.

SONOVA® Gamma Linolenic Acid ("GLA") Safflower Oil: Proprietary safflower plants are grown, producing seed with a high-GLA content. This seed is used for subsequent plantings or processed, and sold as GLA oil, including SONOVA 400 GLA safflower oils and SONOVA Ultra GLA safflower oil, which we refer to collectively as our SONOVA products. Amounts inventoried consist primarily of fees paid to contracted cooperators to grow the crops and costs to process and store harvested seed.

Hemp seeds are procured for the purpose of planting, harvesting, and extracting CBD oil to eventually be sold. Amounts inventories consist primarily of fees paid to suppliers to obtain the seeds.

Inventory costs are tracked on a lot-identified basis and are included as cost of product revenues when sold. Inventories are stated at the lower of cost or net realizable value. The Company makes adjustments to inventory when conditions indicate that the net realizable value may be less than cost due to physical deterioration, obsolescence, changes in price levels, or other factors. Additional adjustments to inventory are made for excess and slow-moving inventory on hand that is not expected to be sold within a reasonable timeframe to reduce the carrying amount to its estimated net realizable value. The write downs to inventory are based upon estimates about future demand from the Company's customers and distributors and market conditions. The Company recorded $304,000 and $310,000 of inventory write-downs for the years ended December 31, 2019 and 2018, respectively.

The inventories—current line item on the balance sheet consists of the cost of GoodWheat seed, grain, and flour, GLA oil, and hemp seed inventory forecasted to be sold or used in production in the next 12 months, as of the balance sheet date. The inventories—noncurrent line item consists of GLA oil and seed inventory expected to be used in production or sold beyond the next 12 months, as of the balance sheet date.

Raw materials inventories consist primarily of the cost of hemp seeds and GLA seed production costs incurred by our contracted cooperators. Goods in process inventories consist of costs to process hemp seed and GoodWheat seed and grain. Finished goods inventories consist of GoodWheat products and GLA oil that are available for sale.

Inventories, net consist of the following (in thousands):

	As of December 31,	
	2019	2018
Raw Materials	$ 67	$ 41
Goods in process	188	—
Finished Goods	1,903	886
Inventories, net	$ 2,158	$ 927

Property and Equipment

Property and equipment acquisitions are recorded at cost. Provisions for depreciation are calculated using the straight-line method over the following average estimated useful lives of the assets:

	Years
Laboratory equipment	5
Software and computer equipment	3
Machinery and equipment	2-20
Furniture and fixtures	7
Vehicles	5
Leasehold improvements	2-10*

* *Leasehold improvements are depreciated over the shorter of the estimated life of the asset or the remaining life of the lease.*

Impairment of Long-Lived Assets

The Company evaluates if events and circumstances have occurred that indicate the remaining estimated useful life of long-lived assets and identifiable intangible assets may warrant revision or that the remaining balance of these assets may not be recoverable. In evaluating for recoverability, the Company estimates the future undiscounted cash flows expected to result from the use of the assets and their eventual disposition. In the event that the balance of any asset exceeds the future undiscounted cash flow estimate, impairment is recognized based on the excess of the carrying amounts of the asset above its estimated fair value. As of December 31, 2019 and 2018, there was no impairment of the Company's long-lived assets.

Fair Value of Financial Instruments

Fair value accounting is applied for all financial assets and liabilities and non-financial assets and liabilities that are recognized or disclosed at fair value in the consolidated financial statements on a recurring basis. Assets and liabilities recorded at fair value in the consolidated financial statements are categorized based upon the level of judgment associated with the inputs used to measure their fair value. Hierarchical levels, which are directly related to the amount of subjectivity associated with the inputs to the valuation of these assets or liabilities, are as follows:

- Level 1 inputs are quoted prices (unadjusted) in active markets for identical assets or liabilities that the Company can access at the measurement date.
- Level 2 inputs are observable inputs other than quoted prices in active markets for identical assets and liabilities, quoted prices for identical or similar assets or liabilities in inactive markets, or other inputs that are observable or can be corroborated by observable market data for substantially the full term of the assets or liabilities.
- Level 3 inputs are unobservable inputs for the asset or liability.

The carrying values of the Company's financial instruments, including cash equivalents, accounts receivable, accounts payable, and notes payable approximated their fair values due to the short period of time to maturity or repayment.

Concentration of Risk

Cash and cash equivalents are maintained with several financial institutions. Deposits held with banks may exceed the amount of insurance provided on such deposits. Generally, these deposits may be redeemed upon demand and are maintained with financial institutions with reputable credit and therefore bear minimal credit risk. The Company seeks to mitigate its credit risks by spreading such risks across multiple counterparties and monitoring the risk profiles of these counterparties.

Customer Concentration

Significant customers are those that represent greater than 10% of the Company's total revenues or gross accounts receivable balance at each respective balance sheet date.

The Company had three customers that represented 47%, 17%, and 15% of accounts receivable, and three customers that represented 44%, 34%, and 13% of accounts receivable, as of December 31, 2019 and 2018, respectively. The Company had two customers that represented 40% and 15% of total revenues, and four customers that represented 19%, 16%, 13%, and 11% of total revenues, for the years ended December 31, 2019 and 2018, respectively.

Stock-Based Compensation

The Company recognizes compensation expense related to its employee stock purchase plan and the cost of stock-based compensation awards on a straight-line basis over the requisite service period, net of estimated forfeitures. Judgment is required in estimating the amount of stock-based awards that will be forfeited prior to vesting. Compensation expense could be revised in subsequent periods if actual forfeitures differ from those estimates. The Company has selected the Black-Scholes option-pricing model and various inputs to estimate the fair value of its stock-based awards. See Note 12 for additional information. Amounts recognized in the Consolidated Statements of Operations and Comprehensive Loss were as follows (in thousands):

	Year Ended December 31,	
	2019	2018
	(in thousands)	
Research and development	$ 321	$ 379
Selling, general and administrative	1,966	1,171
Total stock-based compensation	$ 2,287	$ 1,550

Income Taxes

The Company uses the asset and liability method of accounting for income taxes. Under this method, deferred tax assets and liabilities are determined based on the differences between the financial reporting and the tax bases of assets and liabilities and are measured using the enacted tax rates and laws that will be in effect when the differences are expected to reverse. A valuation allowance is provided when it is more likely than not that some portion or all of a deferred tax asset will not be realized.

Net Loss per Share

Basic net loss per share, which excludes dilution, is computed by dividing the net loss attributable to common stockholders by the weighted-average number of shares of common stock outstanding during the period. Diluted net loss per share reflects the potential dilution that could occur if securities or other contracts to issue common stock, such as stock options, convertible promissory notes, convertible preferred stock, redeemable convertible preferred stock and warrants, result in the issuance of common stock which share in the losses of the Company. Certain potential shares of common stock have been excluded from the computation of diluted net loss per share as their effect would be anti-dilutive. Such potentially dilutive shares are excluded when the effect would be to reduce the loss per share. Due to net losses, there is no impact on earnings per share calculation in applying the two-class method since the participating securities have no legal requirement to share in any losses.

Revenue Recognition

We derive our revenues from product revenues, licensing agreements, royalties, contract research agreements, and government grants.

Product Revenues

Our product revenues to date have consisted primarily of sales of our SONOVA products, with initial GoodWheat seed sale revenues recognized in the fourth quarter of 2019. We recognize revenue from product sales when control of the product is transferred to third-party distributors and manufacturers, collectively “our customers,” which generally occurs upon shipment. Our revenues fluctuate depending on the timing of shipments of product to our customers.

License Revenues

Our license revenues to date consist of up-front, nonrefundable license fees, annual license fees, and subsequent milestone payments that we receive under our research and license agreements. We recognize revenue generated from up-front, nonrefundable license fees upon execution of the agreement. We recognize annual license fees when it is probable that a material reversal will not occur.

Milestone fees are variable consideration that is initially constrained and recognized only when it is probable that such amounts would not be reversed. The Company assesses when achievement of milestones is probable to determine the timing of revenue recognition for milestone fees. Milestones typically consist of significant stages of development for our traits in a potential commercial product, such as achievement of specific technological targets, completion of field trials, filing with regulatory agencies, completion of the regulatory process, and commercial launch of a product containing our traits. Given the seasonality of agriculture and time required to progress from one milestone to the next, achievement of milestones is inherently uneven, and our license revenues are likely to fluctuate significantly from period to period.

Contract Research Revenues

Contract research and government grant revenues consist of amounts earned from performing contracted research primarily related to breeding programs or the genetic engineering of plants for third parties. Contract research revenue is accounted for as a single performance obligation for which revenues are recognized over time using the input method (e.g. costs incurred to date relative to the total estimated costs at completion).

Government Grant Revenues

The Company receives payments from government entities in the form of government grants. Government grant revenue is accounted for as a single performance obligation for which revenues are recognized over time using the input method (e.g. costs incurred to date relative to the total estimated costs at completion). The Company's obligation with respect to these agreements is to perform the research on a best-efforts basis.

Unearned Revenue

The Company defers revenue to the extent that cash received in conjunction with a license agreement, contract or grant exceeds the revenue recognized in accordance with Company policies. During the year ended December 31, 2019, we recognized revenue of $96,000 that was included in unearned revenue on the consolidated balance sheet as of December 31, 2018.

Cost of Product Revenues

Cost of product revenues relates to the sale of our SONOVA and GoodWheat products and consists of in-licensing and royalty fees, any adjustments or write-downs to inventory, as well as the cost of raw materials, including inventory and third-party services costs related to procuring, processing, formulating, packaging, and shipping our products.

Research and Development Expenses

Research and development expenses consist of costs incurred in the discovery, development, and testing of our products and products in development incorporating our traits. These expenses consist primarily of employee salaries and benefits, fees paid to subcontracted research providers, fees associated with in-licensing technology, land leased for field trials, chemicals and supplies, and other external expenses. These costs are expensed as incurred. Additionally, as disclosed in Note 13, the Company is required from time to time to make certain milestone payments in connection with the development of technologies in-licensed from third parties. These milestone payments are expensed at the time the milestone is achieved and deemed payable.

Change in Fair Value of Contingent Consideration

Change in the fair value of contingent consideration is comprised of the gain associated with the reduction of our contingent liability. See Note 13.

Change in the Estimated Fair Value of Common Stock Warrant Liabilities and Common Stock Adjustment Feature Liability

Change in the estimated fair value of common stock warrant liabilities and common stock adjustment feature liability is comprised of the fair value remeasurement of the liabilities associated with the March 2018 Private Placement and the June 2018, June 2019, and September 2019 Offerings. See Note 11.

Note 3. Recent Accounting Pronouncements

In February 2016, the Financial Accounting Standards Board ("FASB") issued ASU No. 2016-02, *Leases (Topic 842)*. Based on the new standard, lessees recognize lease assets and lease liabilities for leases classified as operating leases under previous GAAP and disclose qualitative and quantitative information about leasing arrangements with terms longer than 12 months. The adoption required recording right-of-use assets and corresponding lease obligation liabilities for the current operating leases. The Company adopted ASU No. 2016-02 on January 1, 2019. See Note 14.

In June 2016, the FASB issued ASU No. 2016-13, *Financial Instruments - Credit Losses (Topic 326): Measurement of Credit Losses on Financial Instruments*. Additionally, the FASB issued ASU No. 2019-04, *Codification Improvements to Topic 326*, in April 2019 and ASU 2019-05, *Financial Instruments — Credit Losses (Topic 326) — Targeted Transition Relief*, in May 2019. The amendments affect loans, debt securities, trade receivables, net investments in leases, off-balance-sheet credit exposures, reinsurance receivables, and any other financial assets not excluded from the scope that have the contractual right to receive cash. In November 2019, the FASB issued ASU No. 2019-10, which defers the effective date of ASU No. 2016-13 for smaller reporting companies to fiscal years beginning after December 15, 2022, including interim periods within those fiscal years. The Company is currently evaluating the impact of the adoption of ASU No. 2016-13 on the consolidated financial statements.

In August 2016, the FASB issued ASU No. 2016-15, *Statement of Cash Flows (Topic 230): Classification of Certain Cash Receipts and Cash Payments*. The amendments address cash flow issues such as debt prepayment or debt extinguishment costs and zero-coupon debt instruments. The amendments in this update are effective for fiscal years beginning after December 15, 2018, and interim periods within fiscal years beginning after December 15, 2019. Early adoption is permitted, including adoption in an interim period. The amendments are to be applied using a retrospective transition method to each period presented. If it is impractical to retrospectively apply, it can be applied prospectively as of the earliest date practicable. The Company adopted ASU No. 2016-15 on January 1, 2019 with no material impact to the consolidated financial statements.

In August 2018, the FASB issued ASU No. 2018-13, *Fair Value Measurement (Topic 820): Disclosure Framework – Changes to the Disclosure Requirements for Fair Value Measurement*. The amendments affect any entity required to make disclosures about recurring or nonrecurring fair value measurements. The amendments are effective for all entities for fiscal years beginning after December 15, 2019. The Company is currently evaluating the adoption of ASU No. 2018-13, and expects that the disclosures regarding measurement of Level 3 fair value instruments will be expanded.

In June 2018, the FASB issued ASU No. 2018-07, *Compensation—Stock Compensation (Topic 718): Improvements to Nonemployee Share-Based Payment Accounting*. The standard expands the scope of ASC Topic 718 to include share-based payment transactions for acquiring goods and services from nonemployees, and supersedes ASC Topic 505-50, *Equity – Equity Based Payments to Non-Employees*. The Company adopted ASU 2018-07 on January 1, 2019 with no material impact to the consolidated financial statements.

In December 2019, the FASB issued ASU No. 2019-12, *Income Taxes (Topic 740): Simplifying the Accounting for Income Taxes.* The amendments simplify the accounting for income taxes by removing certain exceptions to the general principles in Topic 740 and clarifying other areas of existing guidance. The amendments are effective for all entities for fiscal years beginning after December 15, 2020. The Company is currently evaluating the impact of the adoption of ASU No. 2019-12 on the consolidated financial statements.

Note 4. Property and Equipment, Net

Property and equipment, net consisted of the following (in thousands):

	As of December 31,	
	2019	2018
Laboratory equipment	$ 2,443	$ 2,348
Software and computer equipment	502	477
Machinery and equipment	989	—
Furniture and fixtures	90	85
Vehicles	395	204
Leasehold improvements	2,023	2,082
Property and equipment, gross	6,442	5,196
Less accumulated depreciation and amortization	(4,643)	(4,801)
Property and equipment, net	$ 1,799	$ 395

Arcadia Biosciences, Inc.
Notes to Consolidated Financial Statements. (Continued)

Depreciation expense was $194,000 and $154,000 for the years ended December 31, 2019 and 2018, respectively.

As of December 31, 2019 and 2018, respectively, there was $1,014,000 and $10,000 of construction in progress included in property and equipment that had not been placed into service and was not subject to depreciation.

Note 5. Investments and Fair Value Measurements

Available-for-Sale Investments

The Company classified short-term investments as "available-for-sale." These short-term investments are free of trading restrictions. The investments are carried at fair value, based on quoted market prices or other readily available market information. Unrealized gains and losses, net of taxes, are included in accumulated other comprehensive loss, which is reflected as a separate component of stockholder's equity in the Consolidated Balance Sheets. Gains and losses are recognized when realized in the Consolidated Statements of Operations and Comprehensive Loss.

The following tables summarize the amortized cost and fair value of the available-for-sale investment securities portfolio at December 31, 2019 and December 31, 2018, and the corresponding amounts of unrealized gains and losses recognized in accumulated other comprehensive income:

(Dollars in thousands)	Amortized Cost	Unrealized Gains	Unrealized Losses	Estimated Fair Value
December 31, 2019				
Cash equivalents:				
Money market funds	$ 6,864	$ —	$ —	$ 6,864
Commercial paper	900	—	—	900
Short-term investments:				
Corporate securities	3,300	—	—	3,300
Treasury bills	1,495	1	—	1,496
Commercial paper	12,119	—	—	12,119
Total Assets at Fair Value	$ 24,678	$ 1	$ —	$ 24,679

(Dollars in thousands)	Amortized Cost	Unrealized Gains	Unrealized Losses	Estimated Fair Value
December 31, 2018				
Cash equivalents:				
Money market funds	$ 9,902	$ —	$ —	$ 9,902
Commercial paper	1,345	—	—	1,345
Short-term investments:				
Corporate securities	656	—	—	656
Treasury bills	1,195	—	—	1,195
Commercial paper	6,776	—	—	6,776
U.S. government securities	1,198	—	—	1,198
Total Assets at Fair Value	$ 21,072	$ —	$ —	$ 21,072

The Company did not have any investment categories that were in a continuous unrealized loss position for more than twelve months as of December 31, 2019.

Fair Value Measurement

The fair value of the available-for-sale investments at December 31, 2019 were as follows:

	Fair Value Measurements at December 31, 2019			
(Dollars in thousands)	Level 1	Level 2	Level 3	Total
Assets at Fair Value				
Cash equivalents:				
Money market funds	$ 6,864	$ —	$ —	$ 6,864
Commercial paper	—	900	—	900
Short-term investments:				
Corporate securities	—	3,300	—	3,300
Treasury bills	1,496	—	—	1,496
Commercial paper	—	12,119	—	12,119
Total Assets at Fair Value	$ 8,360	$ 16,319	$ —	$ 24,679

The fair value of the available-for-sale investments at December 31, 2018 were as follows:

	Fair Value Measurements at December 31, 2018			
(Dollars in thousands)	Level 1	Level 2	Level 3	Total
Assets at Fair Value				
Cash equivalents:				
Money market funds	$ 9,902	$ —	$ —	$ 9,902
Commercial paper	—	1,345	—	1,345
Short-term investments:				
Corporate securities	—	656	—	656
Treasury bills	1,195	—	—	1,195
Commercial paper	—	6,776	—	6,776
U.S. government securities	1,198	—	—	1,198
Total Assets at Fair Value	$ 12,295	$ 8,777	$ —	$ 21,072

The Company uses the market approach technique to value its financial instruments and there were no changes in valuation techniques during 2019 or 2018. The Company's financial instruments consist primarily of cash and cash equivalents, accounts receivable, accounts payable, accrued liabilities, and notes payable. For accounts receivable, accounts payable, accrued liabilities, and notes payable the carrying amounts of these financial instruments as of December 31, 2019 and 2018 were considered representative of their fair values due to their short term to maturity or repayment. Cash equivalents are carried at cost, which approximates their fair value.

The Company's Level 3 liabilities consist of a contingent liability resulting from the Anawah acquisition, as described in Note 13, and liabilities related to the March 2018 Purchase Agreement, the June 2018 Offering, the June 2019 Offering and the September 2019 Offering described in Note 11 (the "warrant liabilities").

The contingent liability was measured and recorded on a recurring basis as of December 31, 2019 and 2018 using unobservable inputs, namely the Company's ability and intent to pursue certain specific products developed using technology acquired in the purchase. A significant deviation in the Company's ability and/or intent to pursue the technology acquired in the purchase could result in a significantly lower (higher) fair value measurement.

Arcadia Biosciences, Inc.
Notes to Consolidated Financial Statements. (Continued)

The warrant liabilities were measured and recorded on a recurring basis using the Black-Scholes Model with the following assumptions as of December 31, 2019:

Assumptions:	Common Stock Warrant Liability - March 2018 Purchase Agreement	Common Stock Warrant Liability - June 2018 Offering	Common Stock Warrant Liability - June 2019 Offering	Common Stock Warrant Liability - September 2019 Offering
Stock price	$ 5.48	$ 5.48	$ 5.48	$ 5.48
Expected term (years)	3.22	3.96	4.96	5.20
Expected volatility	125%	123%	120%	120%
Risk-free interest rate	1.63%	1.65%	1.69%	1.70%
Expected dividend yield	—	—	—	—

The warrant liabilities were measured and recorded on a recurring basis using the Black-Scholes Model with the following assumptions as of December 31, 2018:

Assumptions:	Common Stock Warrant Liability - March 2018 Purchase Agreement	Common Stock Warrant Liability - June 2018 Offering
Stock price	$ 3.17	$ 3.17
Expected term (years)	4.22	4.96
Expected volatility	110%	105%
Risk-free interest rate	2.49%	2.50%
Expected dividend yield	—	—

The significant unobservable input used in the fair value measurement of the Company's Level 3 warrant liabilities is volatility. A significant increase (decrease) in volatility could result in a significantly lower (higher) fair value measurement.

Arcadia Biosciences, Inc.
Notes to Consolidated Financial Statements. (Continued)

The following table sets forth the establishment of the Company's Level 3 liabilities, as well as a summary of the changes in the fair value and other adjustments (in thousands):

	(Level 3)						
(Dollars in thousands)	Common Stock Warrant Liability - March 2018 Purchase Agreement	Common Stock Adjustment Feature Liability - March 2018 Purchase Agreement	Common Stock Warrant Liability - June 2018 Offering	Common Stock Warrant Liability - June 2019 Offering	Common Stock Warrant Liability - September 2019 Offering	Contingent Liability	Total
Balance as of December 31, 2017	$ —	$ —	$ —	$ —	$ —	$ 3,000	$ 3,000
Common stock and warrants issued in conjunction with March 2018 Offering	10,200	3,800	—	—	—	—	$ 14,000
Common stock and warrants issued in conjunction with June 2018 Offering	—	—	9,022	—	—	—	$ 9,022
Change in fair value and other adjustments	(7,846)	4,578	(6,293)	—	—	—	$ (9,561)
Reclassification of common stock adjustment feature liability balance to equity	—	(8,378)	—	—	—	—	$ (8,378)
Balance as of December 31, 2018	2,354	—	2,729	—	—	3,000	$ 8,083
Common stock and warrants issued in conjunction with June 2019 Offering	—	—	—	4,198	—	—	$ 4,198
Common stock and warrants issued in conjunction with September 2019 Offering	—	—	—	—	3,428	—	$ 3,428
Change in fair value and other adjustments	2,225	—	2,715	4,811	(508)	(1,000)	$ 8,243
Exercise of warrants	—	—	—	(7,016)	—	—	$ (7,016)
Balance as of December 31, 2019	$ 4,579	$ —	$ 5,444	$ 1,993	$ 2,920	$ 2,000	$ 16,936

Note 6. Consolidated Joint Venture

On August 9, 2019, the Company and Legacy Ventures Hawaii, LLC, a Nevada limited liability company ("Legacy"), formed Archipelago Ventures Hawaii, LLC, a Delaware limited liability company and entered into a Limited Liability Company Operating Agreement (the "Operating Agreement"). The Company and Legacy formed Archipelago to develop, extract and commercialize hemp-derived products from industrial hemp grown in Hawaii.

Pursuant to the Operating Agreement, a joint operating committee consisting of two individuals appointed by the Company and two individuals appointed by Legacy will manage Archipelago. As of December 31, 2019, the Company and Legacy hold 50.75% and 49.25% interests in Archipelago, respectively, and have made capital contributions to Archipelago of $709,000 and $689,000, respectively, as determined by the joint operating committee. The Operating Agreement includes indemnification rights, non-competition obligations, and certain rights and obligations in connection with the transfer of membership interests, including rights of first refusal.

We consolidate Archipelago in the consolidated financial statements after eliminating intercompany transactions. Net loss attributable to non-controlling interest of $68,000 is recorded as an adjustment to net loss to arrive at net loss attributable to common stockholders for the year ended December 31, 2019. Legacy's equity interests are presented as non-controlling interests on the Consolidated Balance Sheets. Refer to Note 2 for basis of presentation.

Note 7. Variable Interest Entity

In February 2012, the Company formed Verdeca LLC ("Verdeca"), which is equally owned with Bioceres, Inc. ("Bioceres"), a U.S. wholly owned subsidiary of Bioceres, S.A., an Argentine corporation. Bioceres, S.A. is an agricultural investment and development cooperative owned by approximately 300 shareholders, including some of South America's largest soybean growers. Verdeca was formed to develop and deregulate soybean varieties using both partners' agricultural technologies.

Both the Company and Bioceres incur expenses in support of specific activities agreed, as defined by joint work plans, which apply fair market value to each partner's activities. Unequal contributions of services are equalized by the partners through cash payments. Verdeca is not the primary obligor for these activities performed by the Company or Bioceres. An agreement executed in conjunction with the formation of Verdeca specified that if Bioceres determines it requires cash to fund its contributed services (subject to certain annual limits), Bioceres, S.A. may elect to sell shares of its common stock to the Company for an amount not exceeding $5.0 million in the aggregate over a four-year period. The Company determined that its commitment to purchase common stock in Bioceres, S.A. as a means to provide capital to Verdeca resulted in a de facto agency relationship between the Company and Bioceres. The Company considers qualitative factors in assessing the primary beneficiary which include understanding the purpose and design of the VIE, associated risks that the VIE creates, activities that could be directed by the Company, and the expected relative impact of those activities on the economic performance of the VIE. Based on an evaluation of these factors, the Company concluded that it is the primary beneficiary of Verdeca.

Under the terms of the joint development agreement, the Company has incurred direct expenses and allocated overhead in the amount of $559,000 and $947,000 for the years ended December 31, 2019 and 2018, respectively.

Note 8. Accounts Payable and Accrued Expenses

Accounts payable and accrued expenses consisted of the following (in thousands):

	As of December 31,	
	2019	2018
Accounts payable - trade	$ 492	$ 285
Payroll and benefits	1,290	1,096
Inventory	1,143	—
Research and development	629	433
Royalty fees due to unrelated parties	226	187
Consulting	397	92
Rent and utilities	23	91
Audit and tax fees	113	23
Legal	138	285
Other	234	153
Total accounts payable and accrued expenses	$ 4,685	$ 2,645

Note 9. Collaborative Arrangements

In August 2017, the Company entered into a collaborative arrangement for the research, development and commercialization of an improved wheat quality trait in North America. This collaborative arrangement is a contractual agreement with Corteva Agriscience ("Corteva") involves a joint operating activity where both Arcadia and Corteva are active participants in the activities of the collaboration. Arcadia and Corteva participate in the research and development, and Arcadia has the primary responsibility for the intellectual property strategy while Corteva will generally lead the marketing and commercialization efforts. Both parties are exposed to significant risks and rewards of the collaboration and the agreement includes both cost sharing and profit sharing. The activities are performed with no guarantee of either technological or commercial success.

The Company accounts for research and development ("R&D") costs in accordance ASC 730, *Research and Development*, which states R&D costs must be charged to expense as incurred. Accordingly, internal R&D costs are expensed as incurred. Third-party R&D costs are expensed when the contracted work has been performed or as milestone results are achieved.

Note 10. Notes Payable

During the year ended December 31, 2019, the Company entered into notes payable agreements to finance the purchase of company vehicles. These notes have an interest rate of 8%, term of five years, and mature in 2024. There were no notes payable as of December 31, 2018.

Maturities of notes payable as of December 31, 2019 are as follows (in thousands):

Years Ending December 31,	Amounts
2020	$ 24
2021	27
2022	29
2023	31
2024	20
Total notes payable	$ 131
Less: current portion	24
Notes payable - noncurrent	$ 107

Note 11. Private Placement and Registered Direct Offerings

Private Placement (2018)

On March 22, 2018, the Company issued 300,752 shares of its common stock ("Common Stock") and warrants to purchase up to 300,752 shares of Common Stock with an initial exercise price equal to $45.75 (the "March 2018 Warrants"), in a private placement (the "March 2018 Private Placement") in accordance with a securities purchase agreement (the "March 2018 Purchase Agreement") entered into with certain institutional and accredited investors (collectively, the "Purchasers") on March 19, 2018. The March 2018 Warrants are immediately exercisable, subject to certain ownership limitations, and expire five years after the date of issuance.

The per share purchase price of the Common Stock and per share exercise price for the March 2018 Warrants were subject to adjustment based on the volume weighted average price for the three trading days (the "VWAP Calculation") after each of the following: (i) the date that a registration statement covering the resale of the securities being issued in the March 2018 Private Placement ("March 2018 Resale Registration Statement") has been declared effective by the SEC, (ii) if a registration statement covering all securities issued in the March 2018 Private Placement is not declared effective, then the date that the securities can be sold under Rule 144 under the Securities Act of 1933, as amended, and (iii) if later than the dates set forth in item (i) and (ii), then the date that the Company's shareholders approve the March 2018 Private Placement. After each adjustment, the per share purchase price for Common Stock was automatically reduced to 80% of the VWAP Calculation, and the per share exercise price for the March 2018 Warrant was automatically reduced, to 110% of the VWAP Calculation; provided, that in no event, will the per share purchase price for the Common Stock or the exercise price for the March 2018 Warrants be less than $8.322. Upon any adjustment of the per share exercise price for the March 2018 Warrants, then the number of shares exercisable under the March 2018 Warrants would be increased so that the aggregate exercise price payable after adjustment was equal to the aggregate exercise price payable prior to such adjustment.

The Company filed the March 2018 Resale Registration Statement with the SEC on March 30, 2018, and it was declared effective on April 23, 2018. As described above and based upon the applicable VWAP Calculations relating to these events, each of these events caused an adjustment to the number of shares issued in the March 2018 Private Placement and underlying the March 2018 Warrants. Following the effectiveness of the March 2018 Resale Registration Statement, on April 23, 2018 the number of shares issued pursuant to the March 2018 Purchase Agreement increased from 300,752 to 798,754, the total number of shares issuable upon exercise of the March 2018 Warrants increased from 300,752 to 799,300 and the per share exercise price of the March 2018 Warrants reduced from $45.75 to $17.2143. The Company held a special meeting of its shareholders on May 2, 2018 and obtained shareholder approval for the issuance of Common Stock in the March 2018 Private Placement. Following shareholder approval of the issuance of shares in the March 2018 Private Placement, on May 8, 2018 the number of shares issued pursuant to the March 2018 Purchase Agreement increased from 798,754 to 1,201,634, the total number of shares issuable upon exercise of the Warrants increased from 799,300 to 1,282,832 and the per share exercise price of the March 2018 Warrants reduced from $17.2143 to $10.7258.

The aggregate net proceeds received by the Company from the March 2018 Private Placement was $8.7 million, consisting of gross proceeds of $10.0 million less offering costs of $1.3 million.

The adjustment feature for the Common Stock and the March 2018 Warrants were determined to be liabilities based on each instrument's adjustment features and the contingent cash payment feature of the common stock warrants. The liabilities were accounted for at their respective fair values at inception using a Monte Carlo simulation model with the following assumptions: volatility of 100%, stock price of $32.52 and risk-free rate of 2.63%. At inception, the fair values of the Common Stock adjustment feature and the March 2018 Warrant liabilities were $3.8 million and $10.2 million, respectively. As the combined value of the liabilities exceeded the $10.0 million of proceeds, no value was assigned to the Common Stock issued and an initial loss of $4.0 million was recognized.

In May 2018, following the March 2018 Private Placement's final adjustment, the terms of the March 2018 Warrants and the number of Common Stock shares issuable in the March 2018 Private Placement became known and fixed. As a result, the Common Stock adjustment feature liability was marked-to-market and valued at $8.4 million at May 7, 2018, resulting in an additional loss of $2.4 million recognized in the second quarter of 2018. The Company subsequently reclassified the Common Stock adjustment feature liability's balance of $8.4 million to stockholders' equity. The March 2018 Warrant liability was marked-to-market and valued at $2.4 million at December 31, 2018, resulting in income of $7.9 million recognized throughout the year ended December 31, 2018. The March 2018 Warrant liability was marked-to-market and valued at $4.6 million at December 31, 2019, resulting in expense of $2.2 million recognized throughout the year ended December 31, 2019.

Registration Rights Agreement

In connection with the March 2018 Private Placement, the Company entered into a registration rights agreement (the "March 2018 Registration Rights Agreement"). Pursuant to the March 2018 Registration Rights Agreement, the Company filed the March 2018 Resale Registration Statement with the SEC on March 30, 2018 for purposes of registering the resale of the shares of Common Stock issued pursuant to the March 2018 Purchase Agreement and the shares of Common Stock issuable upon exercise of the March 2018 Warrants. The SEC declared the registration statement effective on April 23, 2018.

Offering Costs

In connection with the March 2018 Private Placement, the Company paid to a placement agent an aggregate fee equal to $850,000. The Company also granted warrants to purchase a total of 15,038 shares of Common Stock (the "March 2018 Placement Agent Warrants") that have an exercise price per share equal to $41.5625 and a term of five years. The March 2018 Placement Agent Warrants were issued for services performed by the placement agent as part of the March 2018 Private Placement and were treated as offering costs. The value of the March 2018 Placement Agent Warrants was determined to be $526,000 using the Black-Scholes Model with input assumptions including the Company's stock price, expected life of the warrants, stock price volatility determined from the Company's historical stock prices and the volatility of a peer group, and the risk-free interest rate for the term of the warrants. The Company incurred additional offering costs totaling $458,000 that consist of direct incremental legal, advisory, accounting and filing fees relating to the March 2018 Private Placement. The offering costs, inclusive of the March 2018 Placement Agent Warrants, totaled $1.8 million was expensed in the year ended December 31, 2018.

Registered Direct Offering (2018)

On May 11, 2018, the Company filed a shelf Registration Statement on Form S-3 with the SEC which was declared effective on June 8, 2018. This shelf registration process allows the Company to sell any combination of common stock, preferred stock, warrants and units consisting of such securities in one or more offerings from time to time having an aggregate initial offering price of $50 million.

On June 11, 2018, the Company entered into agreements with several institutional and accredited investors (the "June 2018 Purchase Agreement") for the purchase of 1,392,345 shares of its Common Stock at a purchase price of $9.93 per share for gross proceeds of $13.8 million (the "June 2018 Offering"). The 1,392,345 shares of Common Stock sold in the June 2018 Offering were issued pursuant to a prospectus, dated June 8, 2018, and a prospectus supplement dated June 11, 2018, in connection with a takedown from the Company's shelf Registration Statement on Form S-3. The June Offering closed on June 14, 2018.

Additionally, in a concurrent private placement (the "June 2018 Private Placement"), the Company issued to the investors unregistered warrants (the "June 2018 Warrants") to purchase up to 1,392,345 shares of Common Stock at a purchase price per warrant of $0.125, for gross proceeds of $174,000. The June 2018 Warrants, and the shares of Common Stock underlying the warrants, have an exercise price of $9.94 per share. Subject to certain ownership limitations, the June 2018 Warrants are exercisable upon issuance and expire five and one-half years after the date of issuance.

The aggregate net proceeds received by the Company for the June 2018 Offering were $12.8 million, consisting of gross proceeds of $14.0 million less offering costs of $1.2 million.

The June 2018 Warrants were determined to be a liability as they have a contingent cash payment feature. The June 2018 Warrants were accounted for at their fair value at inception using the Black-Scholes model with the following assumptions: volatility of 108%, stock price of $8.20 and risk-free rate of 2.83%. At inception, the fair value of the June 2018 Warrants was $9.0 million and the remaining $5.0 million of the $14.0 million of proceeds was allocated to the Common Stock using the residual method and accounted for as stockholders' equity. The June 2018 Warrants were marked-to-market and valued at $2.7 million at December 31, 2018, resulting in income of $6.3 million recognized throughout the year ended December 31, 2018. The June 2018 Warrants were marked-to-market and valued at $5.4 million at December 31, 2019, resulting in expense of $2.7 million recognized throughout the year ended December 31, 2019.

Offering Costs

In connection with the June 2018 Offering, the Company paid to a placement agent an aggregate fee equal to $980,000. The Company also granted warrants to purchase a total of 69,617 shares of common stock ("June 2018 Placement Agent Warrants") that have an exercise price per share equal to $12.568 and a term of five years. The June 2018 Placement Agent Warrants were issued for services performed by the placement agent as part of the June 2018 Offering and were treated as offering costs. The value of the June 2018 Placement Agent Warrants was determined to be $427,000 using the Black-Scholes Model with input assumptions including the Company's stock

price, expected life of the warrants, stock price volatility determined from the Company's historical stock prices and the volatility of a peer group, and the risk-free interest rate for the term of the warrants. The Company incurred additional offering costs totaling $226,000 that consist of direct incremental legal, advisory, accounting and filing fees relating to the June 2018 Offering. The offering costs, inclusive of the June 2018 Placement Agent Warrants, totaled $1.6 million and allocated to the June 2018 Warrants and the Common Stock using their relative fair values. A total of $721,000 was allocated to the June 2018 Warrants which was expensed during the year ended December 31, 2018. The remaining $912,000 was allocated to the common stock and offset to additional paid in capital.

Registration of Warrant Shares (2018)

On December 27, 2018, the Company filed a registration statement with the SEC to register for resale 15,038 shares of Common Stock underlying the March 2018 Placement Agent Warrants, 1,392,345 shares of Common Stock underlying the June 2018 Warrants, and 69,617 shares of Common Stock underlying the June 2018 Placement Agent Warrants. This registration statement was declared effective by the SEC on February 15, 2019.

Registered Direct Offering (June 2019)

On June 12, 2019, the Company entered into a securities purchase agreement with certain institutional and accredited investors (the "June 2019 Purchase Agreement") relating to the offering and sale of 1,489,575 shares of its Common Stock at a purchase price of $4.91 per share for gross proceeds of $7.3 million (the "June 2019 Offering"). The 1,489,575 shares of Common Stock sold in the June 2019 Offering were issued pursuant to a prospectus, dated June 8, 2018, and a prospectus supplement dated June 12, 2019, in connection with a takedown from the Company's shelf Registration Statement on Form S-3. The June 2019 Offering closed on June 14, 2019.

Additionally, in a concurrent private placement (the "June 2019 Private Placement"), the Company issued to the investors unregistered warrants to purchase up to 1,489,575 shares of Common Stock at a purchase price per warrant of $0.125, for gross proceeds of $186,000 (the "June 2019 Warrants"). The June 2019 Warrants, and the shares of Common Stock underlying the June 2019 Warrants have an exercise price of $5.00 per share. Subject to certain ownership limitations, the June 2019 Warrants are exercisable upon issuance and expire five and one-half years after the date of issuance.

The aggregate net proceeds received by the Company for the June 2019 Offering were $6.8 million, consisting of gross proceeds of $7.5 million less offering costs of $663,000.

The June 2019 Warrants were determined to be a liability as they have a contingent cash payment feature. The June 2019 Warrants were accounted for at their fair value at inception using the Black-Scholes Model with the following assumptions: volatility of 108%, stock price of $3.66 and risk-free rate of 1.88%. At inception, the fair value of the June 2019 Warrants was $4.2 million and the remaining $3.3 million of the $7.5 million of proceeds was allocated to the Common Stock using the residual method and accounted for as stockholders' equity. In August and September 2019, investors exercised 1,053,745 warrants, generating cash proceeds totaling $5.3 million. The June 2019 Warrants were marked-to-market at the time of exercise and valued at $9.9 million, resulting in expense recognized of $6.5 million. Of the $9.9 million warrant liability balance, $7.0 million was allocated to the exercised warrants and reclassified to stockholders' equity with the remaining $2.9 million attributed to the unexercised warrants. The 435,830 June 2019 Warrants outstanding were marked-to-market and valued at $2.0 million at December 31, 2019, resulting in income of $1.7 million recognized throughout the year ended December 31, 2019, exclusive of the expense recognized in conjunction with the warrant exercise.

Offering Costs

In connection with the June 2019 Offering, the Company paid to a placement agent an aggregate fee equal to $525,000. The Company also granted warrants to purchase a total of 74,479 shares of Common Stock ("June 2019 Placement Agent Warrants") that have an exercise price per share equal to $6.2938 and a term of five years. The June 2019 Placement Agent Warrants were issued for services performed by the placement agent as part of the June 2019 Offering and were treated as offering costs. The value of the June 2019 Placement Agent Warrants was determined to be $198,000 using the Black-Scholes Model with input assumptions including the Company's stock price, expected life of the warrants, stock price volatility determined from the Company's historical stock prices and

the volatility of a peer group, and the risk-free interest rate for the term of the warrants. The Company incurred additional offering costs totaling $115,000 that consist of direct incremental legal, advisory and filing fees relating to the June 2019 Offering. The offering costs, inclusive of the June 2019 Placement Agent Warrants, totaled $0.9 million and were allocated to the June 2019 Warrants and the Common Stock using their relative fair values. A total of $377,000 was allocated to the June 2019 Warrants which was expensed during the year ended December 31, 2018. The remaining $489,000 was allocated to the common stock and offset to additional paid in capital.

Registered Direct Offering (September 2019)

On September 5, 2019, the Company entered into a securities purchase agreement with certain institutional and accredited investors (the "September 2019 Purchase Agreement") relating to the offering and sale of 1,318,828 shares of its common stock at a purchase price of $7.52 per share for gross proceeds of $9.92 million (the "September 2019 Offering"). The 1,318,828 shares of Common Stock sold in the September 2019 Offering were issued pursuant to a prospectus, dated June 8, 2018, and a prospectus supplement dated September 5, 2019, in connection with a takedown from the Company's shelf Registration Statement on Form S-3. The September 2019 Offering closed on September 10, 2019.

Additionally, in a concurrent private placement (the "September 2019 Private Placement"), the Company issued to the investors unregistered warrants to purchase up to 659,414 shares of Common Stock at a purchase price per warrant of $0.125, for gross proceeds of $82,000 (the "September 2019 Warrants"). The September 2019 Warrants, and the shares of Common Stock underlying the September 2019 warrants have an exercise price of $7.52 per share. Subject to certain ownership limitations, the September 2019 Warrants are exercisable upon issuance and expire five and one-half years after the date of issuance.

The aggregate net proceeds received by the Company for the September 2019 Offering were $9.2 million, consisting of gross proceeds of $10.0 million less offering costs of $799,000.

The September 2019 Warrants were determined to be a liability as they have a contingent cash payment feature. The September 2019 Warrants were accounted for at their fair value at inception using the Black-Scholes Model with the following assumptions: volatility of 116%, stock price of $6.34 and risk-free rate of 1.60%. At inception, the fair value of the September 2019 Warrants was $3.4 million and the remaining $6.6 million of the $10.0 million of proceeds was allocated to the Common Stock using the residual method and accounted for as stockholders' equity. The September 2019 Warrants were marked-to-market and valued at $2.9 million at December 31, 2019, resulting in income of $0.5 million recognized throughout the year ended December 31, 2019.

Offering Costs

In connection with the September 2019 Offering, the Company paid to a placement agent an aggregate fee equal to $700,000. The Company also granted warrants to purchase a total of 65,942 shares of common stock ("September 2019 Placement Agent Warrants") that have an exercise price per share equal to $9.4781 and a term of five years. The September 2019 Placement Agent Warrants were issued for services performed by the placement agent as part of the September 2019 Offering and were treated as offering costs. The value of the September 2019 Placement Agent Warrants was determined to be $326,000 using the Black-Scholes Model with input assumptions including the Company's stock price, expected life of the warrants, stock price volatility determined from the Company's historical stock prices and the volatility of a peer group, and the risk-free interest rate for the term of the warrants. The Company incurred additional offering costs totaling $113,000 that consist of direct incremental legal, advisory and filing fees relating to the September 2019 Offering. The offering costs, inclusive of the September 2019 Placement Agent Warrants, totaled $1.1 million and were allocated to the September 2019 Warrants and the Common Stock using their relative fair values. A total of $331,000 was allocated to the September 2019 Warrants which was expensed during the year ended December 31, 2019. The remaining $808,000 was allocated to the common stock and offset to additional paid in capital.

Registration of Warrant Shares (2019)

On August 21, 2019, the Company filed a registration statement with the SEC to register for resale 1,489,575 shares of Common Stock underlying the June 2019 Warrants and 74,479 shares of Common Stock underlying the June 2019 Placement Agent Warrants. The registration statement was declared effective by the SEC on August 27, 2019.

On December 11, 2019, the Company filed a registration statement with the SEC to register for resale 659,414 shares of Common Stock underlying the September 2019 Warrants and 65,942 shares of Common Stock underlying the September 2019 Placement Agent Warrants. The registration statement was declared effective by the SEC on December 20, 2019.

Note 12. Stock-Based Compensation and Warrants

Stock Incentive Plans

The Company has two equity incentive plans: the 2006 Stock Plan (“2006 Plan”) and the 2015 Omnibus Equity Incentive Plan (“2015 Plan”).

In 2006, the Company adopted the 2006 Plan, which provided for the granting of stock options to executives, employees, and other service providers under terms and provisions established by the Board of Directors. The Company granted non-statutory stock options (“NSOs”) under the 2006 Plan until May 2015, when it was terminated as to future awards, although it continues to govern the terms of options that remain outstanding and were issued under the 2006 Plan. The 2015 Plan became effective upon the Company’s IPO in May 2015 and all shares that were reserved, but not issued, under the 2006 Plan were assumed by the 2015 Plan. Upon effectiveness, the 2015 Plan had 154,387 shares of common stock reserved for future issuance, which included 10,637 that were transferred to and assumed by the 2015 Plan. The 2015 Plan provides for automatic annual increases in shares available for grant. In addition, shares subject to awards under the 2006 Plan that are forfeited or canceled will be added to the 2015 Plan. The 2015 Plan provides for the grant of incentive stock options (“ISOs”), NSOs, restricted stock awards, stock units, stock appreciation rights, and other forms of equity compensation, all of which may be granted to employees, officers, non-employee directors, and consultants. The ISOs and NSOs will be granted at a price per share not less than the fair value at the date of grant. Options granted generally vest over a four-year period; however, the options granted in the third quarter of 2018 vest over two-year period, vesting monthly on a pro-rated basis. Options granted, once vested, are generally exercisable for up to 10 years, after grant.

In June 2019, the shareholders approved an amendment to the Company’s 2015 Plan for a one-time increase to the number of shares of common stock that may be issued under the 2015 Plan by 120,000 shares. As of December 31, 2019, a total of 675,340 shares of common stock were reserved for issuance under the 2015 Plan, of which 58,868 shares of common stock are available for future grant. As of December 31, 2019, a total of 45,229 and 616,472 options are outstanding under the 2006 and 2015 Plans, respectively.

Arcadia Biosciences, Inc.
Notes to Consolidated Financial Statements. (Continued)

The following is a summary of stock option information and weighted average exercise prices under the Company's stock incentive plans (in thousands, except share data and price per share):

	Shares Subject to Outstanding Options	Weighted-Average Exercise Price Per Share	Aggregate Intrinsic Value
Outstanding — Balance at December 31, 2017	288,129	$ 63.62	$ —
Options granted	302,077	6.65	
Options exercised	(44,354)	21.73	
Options forfeited	(4,006)	14.21	
Options expired	(11,802)	43.73	
Outstanding — Balance at December 31, 2018	530,044	35.53	$ —
Options granted	208,571	5.13	
Options exercised	(546)	4.63	
Options forfeited	(30,132)	33.95	
Options expired	(46,236)	98.69	
Outstanding — Balance at December 31, 2019	661,701	21.60	$ 305
Vested and expected to vest — December 31, 2019	654,170	21.74	$ 301
Exercisable —December 31, 2019	410,270	$ 29.24	$ 192

Aggregate intrinsic value represents the difference between the exercise price of the options and the estimated fair value of the Company's common stock determined by our Board of Directors for each of the respective periods. The intrinsic value of options exercised was $0 for both years ended December 31, 2019 and 2018.

At December 31, 2019 and 2018, the total grant-date fair value of shares vested during the years was $2.2 million and $1.3 million, respectively.

As of December 31, 2019, there was $0.9 million of unrecognized compensation cost related to unvested stock-based compensation grants that will be recognized over the weighted-average remaining recognition period of 1.7 years.

On August 22, 2019, Rajendra Ketkar provided notice to the Company of his retirement as Arcadia's president, chief executive officer and director, effective as of September 1, 2019. On August 23, 2019, Arcadia and Mr. Ketkar entered into a Separation and Release Agreement (the "Separation Agreement") which provides that the vesting of certain options previously issued to Mr. Ketkar will be accelerated pursuant to the terms of the Separation Agreement. In addition, the Separation Agreement extends the post-termination exercise period of the accelerated options from 90 days to up to two years. The stock compensation expense related to the modification of Mr. Ketkar's stock options was $438,000 and recognized in selling, general and administrative expenses during the year ended December 31, 2019.

In determining the fair value of the stock-based awards, the Company uses the Black-Scholes option-pricing model and assumptions discussed below. Each of these inputs is subjective and generally requires significant judgment to determine.

Expected Term—The expected term is the estimated period of time outstanding for stock options granted and was estimated based on a simplified method allowed by the SEC due to insufficient historical data, and defines the term as the average of the contractual term of the options and the weighted-average vesting period for all open employee awards.

Expected Volatility—Since the Company was privately held and does not have a long trading history for its common stock, the expected volatility was estimated based on the average volatility for comparable publicly traded biotechnology companies over a period equal to the expected term of the stock option grants. When selecting comparable publicly traded biotechnology companies on which it has based its expected stock price volatility, the Company selected companies with comparable characteristics to it, including enterprise value, risk profiles, position within the industry, and with historical share price information sufficient to meet the expected life of the stock-based awards. The historical volatility data was computed using the daily closing prices for the selected companies' shares during the equivalent period of the calculated expected term of the stock-based awards. The Company will continue to apply this process until a sufficient amount of historical information regarding the volatility of its own stock price becomes available.

Risk-Free Interest Rate—The risk-free interest rate is based on the interest rate of U.S. Treasuries of comparable maturities on the date the options were granted.

Expected Dividend—The expected dividend yield is based on the Company's expectation of future dividend payouts to common stockholders.

The fair value of stock option awards was estimated at the date of grant using a Black-Scholes option-pricing model with the following weighted-average assumption:

	Year Ended December 31,	
Assumptions	**2019**	**2018**
Expected term (years)	7.04	5.99
Expected volatility	99%	99%
Risk-free interest rate	2.01%	2.95%
Expected dividend yield	—	—

The weighted- average, estimated grant date fair value of employee stock options granted during the years ended December 31, 2019 and 2018 was $5.13 and $6.65, respectively. The Company recognized $2.3 million and $1.6 million of compensation expense for stock options awards for the years ended December 31, 2019 and 2018, respectively.

Employee Stock Purchase Plan

The Company's 2015 Employee Stock Purchase Plan ("ESPP") became effective on May 14, 2015. The ESPP allows eligible employees to purchase shares of the Company's common stock at a discount of up to 15% of their eligible compensation through payroll deductions, subject to any plan limitations. After the first offering period, which began on May 14, 2015 and ended on February 1, 2016, the ESPP provides for six-month offering periods, and at the end of each offering period, employees are able to purchase shares at 85% of the lower of the fair market value of the Company's common stock on the first trading day of the offering period or on the last day of the offering period. As of December 31, 2019, the number of shares of common stock reserved for future issuance under the ESPP is 102,828. The ESPP provides for automatic annual increases in the shares available for purchase beginning on January 1, 2016. As of December 31, 2019, 15,389 shares had been issued under the ESPP. The Company recorded $16,000 and $11,000 of ESPP related compensation expense for the years ended December 31, 2019 and 2018, respectively.

Warrants

As of December 31, 2019, the Company had 4,170,651 common stock warrants outstanding with a weighted average exercise price of $9.18. The expiration of the warrants ranges from July 2020 to March 2025.

On December 2013, the Company issued warrants to Mahyco International to purchase 3,784 shares of common stock, exercisable as of the issuance date, at an exercise price of $330.40 per share. These warrants expired on December 11, 2018.

Arcadia Biosciences, Inc.
Notes to Consolidated Financial Statements. (Continued)

In connection with the Series D preferred stock financing in the first half of 2014, the Company issued warrants, exercisable as of the issuance date, to the Series D preferred stock investors to purchase an aggregate of 61,397 shares of common stock at an exercise price of $363.20 per share and to the placement agents to purchase 1,674 shares of common stock at $268.80. These warrants expired during the year ended December 31, 2019.

As of December 31, 2019, 1,297,870 common stock warrants that were issued in the March 2018 Private Placement are outstanding. Of the total, 1,282,832 shares have a purchase price of $10.7258 and the remaining 15,038 common stock warrants have an exercise price of $41.5625. See Note 11.

As of December 31, 2019, 1,461,962 common stock warrants that were issued in the June 2018 Offering are outstanding. Of the total, 1,392,345 shares have a purchase price of $9.94 and the remaining 69,617 common stock warrants have an exercise price of $12.568. See Note 11.

In connection with a professional services agreement with a non-affiliated third party, executed in April 2019, the Company issued 45,154 warrants (“Service Warrants”) at an exercise price of $6.18. The Service Warrants vest ratably over 12 months and expire in five years from the date of issuance. The Service Warrants are cancelable immediately prior to a change of control subsequent to the termination/expiration of the advisory agreement. The Company also issued 100,000 performance-based warrants (“Performance Warrants”) at an exercise price of $6.18 and vest in 1/6 increments upon the achievement of a qualifying milestone as defined within the agreement. The Performance Warrants expire in five years from the date of issuance and are cancelable immediately prior to a change of control subsequent to the sixth month anniversary of the termination/expiration of the advisory agreement.

The Service and Performance Warrants were determined to be equity instruments. The Service and Performance Warrants were measured on the grant date using the Black-Scholes Model with the following assumptions: volatility of 112.5%, stock price of $6.18 and risk-free rate of 2.37%. At the grant date, the fair value of the Service and Performance Warrants were $224,000 and $497,000, respectively. Compensation expense associated with the Service Warrants is recognized ratably over the service period (i.e. one-year term). A performance acceleration event was deemed to have been achieved in August 2019, triggering the full vesting of the Performance Warrants. The Company recognized a portion of the Performance Warrants’ compensation expense during the year ended December 31, 2019 totaling $228,000 as a cumulative adjustment for the period during which services have already been provided. The remaining Performance Warrants expense will be recognized ratably over the remaining service period. For the Performance Warrants, $352,000 of stock compensation was recognized during the year ended December 31, 2019, including the $228,000 cumulative adjustment. For the Service Warrants, $156,000 of stock compensation was recognized during the year ended December 31, 2019.

As of December 31, 2019, 510,309 common stock warrants that were issued in the June 2019 Offering are outstanding. Of the total, 435,830 shares have a purchase price of $5.00 and the remaining 74,479 common stock warrants have an exercise price of $6.2938. See Note 11.

As of December 31, 2019, 725,356 common stock warrants that were issued in the September 2019 Offering are outstanding. Of the total, 659,414 shares have a purchase price of $7.52 and the remaining 65,942 common stock warrants have an exercise price of $9.4781. See Note 11.

Note 13. Commitments and Contingencies

Notes Payable

During the year ended December 31, 2019, the Company entered into notes payable agreements to finance the purchase of company vehicles. See Note 10.

Leases

The Company leases office and laboratory space, greenhouse space, grain storage bins, warehouse space, farmland, and equipment under operating lease agreements having initial lease terms ranging from one to five years, including certain renewal options available to the Company at market rates. The Company also leases land for field trials on a short-term basis. See Note 14.

Legal Matters

From time to time, in the ordinary course of business, the Company may become involved in certain legal proceedings. Except as set forth below, we currently are not a party to any material litigation or other material legal proceedings.

In February 2018, we initiated an interference proceeding with the United States Patent and Trademark Office ("USPTO") concerning a patent application owned by us and a patent owned by Arista Cereals Technologies Pty Limited ("Arista") relating to our Resistant Starch Wheat products to determine priority of invention. On August 14, 2018, the USPTO issued a decision that resulted in termination of the interference which we appealed. On August 9, 2019, the United States Court of Appeals for the Federal Circuit upheld the decision. Based on this decision, our patent interference proceeding is now terminated, and Arista maintains its patent.

On April 1, 2019, Arista and Bay State Milling Company ("BSM") filed a Complaint against us in the United States District Court for the District of Delaware, asserting claims for alleged patent infringement ("the Delaware Action"). On June 26, 2019 the Court issued a Joint Stipulation and Order to Extend Time to Serve Summons and Complaint until October 15, 2019 indicating that "the parties have agreed on this stipulation seeking additional time… in light of the ongoing settlement discussions between the parties and the desire to preserve the litigation status quo for a short period of time in order to enable continuing settlement discussions."

On April 24, 2019, Arista initiated an interference proceeding with the USPTO concerning the same patent relating to our Resistant Starch Wheat products (U.S. 10,246,716) to determine the priority of invention ("the 716 Interference"). If the USPTO determined Arista was the first to invent, the subject matter of the interference would be granted in a patent to Arista. On the other hand, if the USPTO determined we were the first to invent, we would maintain our patent.

On August 21, 2019, we entered into a binding term sheet with Arista and BSM to resolve the parties' disputes, including the Delaware Action and the 716 Interference. Under the binding term sheet, BSM will become the exclusive commercial partner for our high fiber wheat in North America under Bay State Milling's HealthSense™ brand portfolio, while Arista receives exclusive rights under our high fiber wheat intellectual property in certain geographies, including Australia and Europe. We will continue to market our high fiber wheat under our GoodWheat portfolio of specialty wheat ingredients in other international markets. In December 2019, the three parties entered into a settlement agreement reflecting the terms of the binding term sheet.

Contingent Liability Related to the Anawah Acquisition

On June 15, 2005, the Company completed its agreement and plan of merger and reorganization with Anawah, Inc. ("Anawah"), to purchase the Anawah's food and agricultural research company through a non-cash stock purchase. Pursuant to the merger with Anawah, and in accordance with the ASC 805 - Business Combinations, the Company incurred a contingent liability not to exceed $5.0 million. This liability represents amounts to be paid to Anawah's previous stockholders for cash collected on revenue recognized by the Company upon commercial sale of certain specific products developed using technology acquired in the purchase. As of December 31, 2010, the Company ceased activities relating to three of the six Anawah product programs thus, the contingent liability was reduced to $3.0 million. During the third quarter of 2016, one of the programs previously accrued for was abandoned and another program previously abandoned was reactivated. During the fourth quarter of 2019, the Company determined that one of the technologies was no longer active and decided to abandon the previously accrued program. As a result, the Company recognized a gain of $1.0 million in the Consolidated Statements of Operations and Comprehensive Loss. As of December 31, 2019, the Company continues to pursue a total of two development programs using this technology and believes that the contingent liability is probable. As a result, $2.0 million remains on the Consolidated Balance Sheet as an other noncurrent liability.

Contracts

The Company has entered into a non-cancelable service agreement with an unrelated party that requires the Company to pay certain funding commitments. The following table sets forth our minimum funding requirements under this agreement as of December 31, 2019 (in thousands):

Years Ending December 31,	Amounts
2020	$ 500
2021	750
2022	—
2023	—
2024	—
Thereafter	—
Total	$ 1,250

The Company has entered into contract research agreements with unrelated parties that require the Company to pay certain funding commitments. The initial terms of these agreements range from one to three years in duration and in certain cases are cancelable.

The Company licenses certain technologies via executed agreements ("In-Licensing Agreements") that are used to develop and advance the Company's own technologies. The Company has entered into various In-Licensing Agreements with related and unrelated parties that require the Company to pay certain license fees, royalties, and/or milestone fees. In addition, certain royalty payments ranging from 2% to 15% of net revenue amounts as defined in the In-Licensing Agreements will be due.

Royalties due to both related and unrelated parties on license revenue accrued as of December 31, 2019 and 2018 were $266,000 and $216,000, respectively. Royalties are included within research and development on the Consolidated Statements of Operations and Comprehensive Loss.

Milestone payments are contingent upon the successful development or implementation of various technologies. Payments for milestones yet to be achieved totaled $2.0 million for both the years ended December 31, 2019 and 2018, respectively. The timing of the payments is not determinable at this time pending research and development currently in progress; however, no payments were made during the years ended December 31, 2019 and 2018.

The Company could be adversely affected by certain actions by the government as it relates to government contract revenue received in prior years. Government agencies, such as the Defense Contract Audit Agency routinely audit and investigate government contractors. These agencies review a contractor's performance under its agreements; cost structure; and compliance with applicable laws, regulations and standards. The agencies also review the adequacy of, and a contractor's compliance with, its internal control systems and policies, including the contractor's purchasing, property, estimating, compensation and management information systems. While the Company's management anticipates no adverse result from an audit, should any costs be found to be improperly allocated to a government agreement, such costs will not be reimbursed, or if already reimbursed, may need to be refunded. If an audit uncovers improper or illegal activities, civil and criminal penalties and administrative sanctions, including termination of contracts, forfeiture of profits, suspension of payments or fines, and suspension or prohibition from doing business with the government could occur. In addition, serious reputational harm or significant adverse financial effects could occur if allegations of impropriety were made against the Company. There currently are routine audits in process relating to government grant revenues.

Note 14. Leases

Operating Leases

The Company adopted the new lease accounting standards (Topic 842) on January 1, 2019 and used the effective date as our initial application. Prior to January 1, 2019, we accounted for leases in accordance with Topic 840, *Leases*. The Company used the modified retrospective approach, applying the new standard to all leases existing as of the date of initial application. Consequently, financial information and disclosures for the periods before January 1, 2019 are presented in accordance with Topic 840. On January 1, 2019, the Company recognized an ROU asset of $2.3 million and an operating lease liability of $2.4 million.

As of December 31, 2019, the Company leases office space in Davis, CA, Phoenix, AZ, and Molokai, HI, as well as additional buildings, land and equipment. Leases with an initial term of 12 months or less are not recorded on the balance sheet; the Company recognizes lease expense for these leases on a straight-line basis. The Company subleases a portion of the Davis office lease and greenhouse to third parties. As of December 31, 2019, the Company does not currently have any finance leases or material leases that have not yet commenced.

Some leases (the Davis office, warehouse, greenhouse and a copy machine) include one or more options to renew, with renewal terms that can extend the lease term from one to six years. The exercise of lease renewal options is at the Company's sole discretion. The renewal options were not included in the initial measurement of the ROU assets or operating lease liabilities. During the fourth quarter of 2019, the Company concluded that it was reasonably certain to exercise one of its renewal options. In accordance with ASC 842, the Company accounted for the expected renewal as a lease modification and remeasured the operating lease liability, resulting in an additional $0.2 million right of use asset and operating lease liability.

The Company's lease agreements do not contain any material variable lease payments, material residual value guarantees or material restrictive covenants. Leases consisted of the following (in thousands):

Leases	Classification	December 31, 2019
Assets		
Operating lease assets	Right of use asset	$ 1,963
Total leased assets		$ 1,963
Liabilities		
Current - Operating	Operating lease liability - current	$ 611
Noncurrent - Operating	Operating lease liability - noncurrent	1,497
Total leased liabilities		$ 2,108

Arcadia Biosciences, Inc.
Notes to Consolidated Financial Statements. (Continued)

Lease Cost	Classification	For the Year Ended December 31, 2019
Operating lease cost	SG&A and R&D Expenses	$ 708
Short term lease cost (1)	R&D Expenses	205
Sublease income (2)	SG&A and R&D Expenses	(55)
Net lease cost		$ 858

(1) Short term lease cost consists of field trial lease agreements with a lease term of 12 months or less.
(2) Sublease income is recorded as a credit to lease expense.

Lease Term and Discount Rate	December 31, 2019
Weighted-average remaining lease term (years)	2.6
Weighted-average discount rate	7%

Rent expense recorded under Topic 840 for the year ended December 31, 2018 was $1.3 million.

The maturities of our operating lease liabilities as of December 31, 2019 are as follows (in thousands):

Years Ending December 31,	Amounts
2020	$ 735
2021	681
2022	575
2023	372
Total operating lease payments	$ 2,363
Less: imputed interest	$ 255
Total current and noncurrent operating lease liabilities	$ 2,108

Note 15. Income Taxes

The components of loss before income taxes are as follows (in thousands):

	Year Ended December 31, 2019	2018
Domestic	$ (28,871)	$ (13,470)
Foreign	—	—
Loss before income taxes	$ (28,871)	$ (13,470)

Arcadia Biosciences, Inc.
Notes to Consolidated Financial Statements. (Continued)

The total income tax expense for the years ended December 31, 2019 and 2018 was $2,000 and $10,000, respectively, and is comprised of current state taxes and foreign taxes withheld by governmental agencies outside of the United States, as follows (in thousands):

	Year Ended December 31,	
	2019	2018
Current:		
Federal	$ —	$ —
State	2	1
Foreign	—	9
Total current tax expense	2	10
Deferred:		
Federal	—	—
State	—	—
Foreign	—	—
Total deferred tax asset	—	—
Total tax expense	$ 2	$ 10

The Company operates in only one federal jurisdiction, the United States. The following is a reconciliation of the statutory federal income tax rate to the Company's effective tax rate is as follows:

	Year Ended December 31,	
	2019	2018
Expected income tax provision at the federal statutory rate	21.0%	21.0%
State taxes, net of federal benefit	5.3%	8.5%
Change in valuation allowance	(26.4)%	(27.3)%
Transaction costs	—	(2.9)%
Related offering costs	(0.5)%	(1.1)%
Excess windfall benefit	—	1.4%
Withholding taxes	—	(0.1)%
Other	0.6%	0.4%
Income tax provision	—	(0.1)%

Arcadia Biosciences, Inc.
Notes to Consolidated Financial Statements. (Continued)

Deferred income taxes reflect the net tax effects of temporary differences between the carrying amounts of assets and liabilities for financial reporting purposes and the amounts used for income tax purposes, net operating loss carryforwards ("NOLs") and other tax credits. Significant components of the Company's deferred tax assets and liabilities are as follows (in thousands):

	As of December 31,	
	2019	2018
Deferred tax assets:		
Net operating loss carryforwards	$ 13,267	$ 42,097
Unearned revenue	11	26
Stock-based compensation	3,384	2,855
Accrued payroll and benefits	224	255
Research and development credits	—	171
Fixed asset basis difference	90	114
Inventory reserve	568	508
Operating lease liability	565	—
Common stock warrant assets	988	—
Charitable contributions	2	3
Total deferred tax assets	19,099	46,029
Deferred tax liabilities:		
Right of use asset	(526)	—
Common stock warrant liabilities	—	(1,529)
Total deferred tax liabilities	(526)	(1,529)
Less valuation allowance	(18,573)	(44,500)
Net deferred tax assets	$ —	$ —

Realization of the deferred tax assets is dependent upon future taxable income, if any, the amount and timing of which are uncertain. Accordingly, the net deferred tax assets have been offset by a valuation allowance. The net valuation allowance decreased by $25.9 million during the year ended December 31, 2019 and increased by $3.2 million during the year ended December 31, 2018.

At December 31, 2019, the Company had federal and state NOLs aggregating approximately $186.6 million and $47.9 million, respectively. At December 31, 2019, the utilization of a portion of our federal NOLs is subject to an annual limitation under Section 382 of the Internal Revenue Code (IRC). Of the $186.6 million generated, $7.2 million was previously determined as unavailable to be utilized within the carryforward period, and $130.5 million is expected to be unavailable due to an ownership change under IRC Section 382 that the Company experienced as a result of the common shares issued in connection with the June 2018 Offering. The Company is currently conducting additional analysis regarding the valuation of the Company at the time of the ownership change to assess what, if any, portion of the limitation may be reversed. If not utilized, these federal NOLs will begin to expire in 2020 and state NOLs will begin to expire in 2024.

The Company evaluates deferred tax assets, including the benefit from NOLs, to determine if a valuation allowance is required. Such evaluation is based on consideration of all available evidence using a "more likely than not" standard with significant weight being given to evidence that can be objectively verified. This assessment considers, among other matters, the nature, frequency, and severity of current and cumulative losses; forecasts of future profitability; the length of statutory carryforward periods; the Company's experience with operating losses; and tax-planning alternatives. The significant piece of objective negative evidence evaluated was the cumulative loss incurred through the year ended December 31, 2019. Given this evidence and the expectation to incur operating losses in the foreseeable future, a full valuation allowance has been recorded against the net deferred tax asset. The Company will continue to maintain a full valuation allowance against the entire amount of its net deferred tax asset, until such time as the Company has determined that the weight of the objectively verifiable positive evidence exceeds that of the negative evidence and it is likely that the Company will be able to utilize all of its net deferred tax asset relating to its federal and state NOL carryforwards. Although the Company has established a full valuation

allowance on its net deferred tax asset, for Federal tax losses before 2018 and for all state tax losses, it has not forfeited the right to carryforward tax losses up to 20 years and apply such tax losses against taxable income in such years, thereby reducing its future tax obligations. Federal tax losses generated in 2018 and later do not expire. The Company is subject to taxation in the United States and various state jurisdictions. As of December 31, 2019, the Company's tax years for 2000 through 2019 are generally subject to examination by the tax authorities. The years are open back to 2000 to the extent the NOLs being carried forward were generated then.

The Company applies the provisions of ASC 740 related to accounting for uncertain tax positions and concluded there were no such positions associated with the Company requiring accrual of a liability. As of December 31, 2019, the Company has not accrued for any such positions. The Company is currently not under audit for federal or state tax purposes. The Company does not expect a significant change to occur within the next 12 months.

Note 16. Retirement Benefits

The Company has a 401(k) retirement plan (the "Plan") available for participation by all regular full-time employees who have completed three months of service with the Company. The Company established the Plan in 2008. The Plan provides for a discretionary matching contribution equal to 50% of the amount of the employee's salary deduction, not to exceed 3% of the salary per employee. Highly compensated employees are excluded from receiving any discretionary matching contribution. Employees' rights to employer contributions vest on the one-year anniversary of their date of employment. The Company has the option to make discretionary matching contributions. The Company did not make discretionary matching contributions during the years ended December 31, 2019 and 2018.

Note 17. Segment and Geographic Information

Management has determined that it has one business activity and operates in one segment as it only reports financial information on an aggregate and consolidated basis to its Chief Executive Officer, who is the Company's chief operating decision maker.

Revenues based on the location of the customers, are as follows (in thousands):

	Year Ended December 31,	
	2019	2018
United States	$ 722	$ 1,168
India	7	90
Africa	182	115
Canada	258	91
Total	$ 1,169	$ 1,464

Note 18. Net Loss per Share

Basic net loss per share is calculated by dividing net loss attributable to common stockholders by the weightedaverage number of common shares outstanding during the period and excludes any dilutive effects of stockbased awards and warrants. Diluted net loss per share attributable to common stockholders is computed giving effect to all potentially dilutive common shares, including common stock issuable upon exercise of stock options and warrants. As the Company had net losses for the years ended December 31, 2019 and 2018, all potentially dilutive common shares were determined to be antidilutive.

Securities that were not included in the diluted per share calculations because they would be antidilutive were as follows (in shares):

	Year Ended December 31,	
	2019	2018
Options to purchase common stock	661,701	530,044
Warrants to purchase common stock	4,170,651	2,822,903
Total	4,832,352	3,352,947

Note 19. Related Party Transactions

The Company's related parties include Moral Compass Corporation ("MCC") and the John Sperling Foundation ("JSF"). The rights to the intellectual property owned by Blue Horse Labs, Inc. ("BHL") were assigned to its sole shareholder, the John Sperling Revocable Trust ("JSRT") due to BHL's dissolution and then subsequently to the JSF. The JSF is deemed a related party of the Company because MCC, the Company's largest stockholder, and the JSF share common officers and directors.

Transactions with related parties are reflected in the consolidated financial statements under amounts due to related parties. Outlined below are details of agreements between the Company and its related parties:

JSF receives a single digit royalty from the Company when revenue has been collected on product sales or for license payments from third parties that involve certain intellectual property developed under research funding originally from BHL. Royalty fees due to JSF were $40,000 and $29,000 as of December 31, 2019 and December 31, 2018, respectively, and are included in the Consolidated Balance Sheets as amounts due to related parties.

Note 20. Subsequent Events

The Company has reviewed and evaluated subsequent events through March 25, 2020, the date the consolidated financial statements were available to be issued.

Leases

In January 2020, the Company entered into a lease amendment for additional office space in Davis, CA, and extended the term through April 2025, with one option to renew for an additional five-year term. The lease is expected to commence in the second quarter of 2020.

Item 9. Changes in and Disagreements With Accountants on Accounting and Financial Disclosure.

None.

Item 9A. Controls and Procedures.

Evaluation of Disclosure Controls and Procedures

As of December 31, 2019, Arcadia's disclosure controls and procedures (as defined in Rules 13a-15(e) and 15d-15(e) under the Securities Exchange Act of 1934, or the Exchange Act) were evaluated, with the participation of Arcadia's principal executive officer and principal financial officer, to assess whether they are effective in providing reasonable assurance that information required to be disclosed by Arcadia in the reports that it files or submits under the Exchange Act is accumulated and communicated to management, including its principal executive officer and principal financial officer, as appropriate, to allow timely decisions regarding required disclosure and to provide reasonable assurance that such information is recorded, processed, summarized and reported within the time periods specified in Securities and Exchange Commission rules and forms. Based on this evaluation, Matthew T. Plavan, Arcadia's principal executive officer, and Pamela Haley, Arcadia's principal financial officer, concluded that these disclosure controls and procedures were effective as of December 31, 2019.

Management's Report on Internal Control Over Financial Reporting

Management is responsible for establishing and maintaining adequate internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)). Arcadia's management, including Matthew T. Plavan, its principal executive officer, and Pamela Haley, its principal financial officer, evaluated the effectiveness of Arcadia's internal control over financial reporting using the framework in Internal Control—Integrated Framework (2013) issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO). Based on this evaluation, management concluded that Arcadia's internal control over financial reporting was effective as of December 31, 2019.

Changes in Internal Control over Financial Reporting

Under the supervision and with the participation of our management, including our Principal Executive Officer and Principal Financial Officer, we conducted an evaluation of any changes in our internal control over financial reporting (as such term is defined in Rules 13a-15(f) and 15d-15(f) under the Exchange Act) that occurred during our most recently completed fiscal quarter. Based on that evaluation, our Principal Executive Officer and Principal Financial Officer concluded that there has not been any change in our internal control over financial reporting during that quarter that has materially affected, or is reasonably likely to materially affect, our internal control over financial reporting.

Item 9B. Other Information.

None.

PART III

Item 10. Directors, Executive Officers and Corporate Governance.

The information required by this item will be contained in our definitive proxy statement to be filed with the Securities and Exchange Commission on Schedule 14A in connection with our 2020 Annual Meeting of Stockholders (the "Proxy Statement"), which is expected to be filed no later than 120 days after the end of our fiscal year ended December 31, 2019, under the headings "Executive Officers," "Election of Directors," "Corporate Governance," and "Section 16(a) Beneficial Ownership Reporting Compliance," and is incorporated herein by reference.

The Company has adopted a written code of business conduct and ethics that applies to our directors, officers, and employees, including our principal executive officer, principal financial officer, principal accounting officer or controller, or persons performing similar functions. A current copy of the code is posted on the Corporate Governance section of our website, which is located at www.arcadiabio.com. If Arcadia makes any substantive amendments to, or grant any waivers from, the code of business conduct and ethics for our principal executive officer, principal financial officer, principal accounting officer, controller or persons performing similar functions, or any officer or director, the Company will disclose the nature of such amendment or waiver on our website or in a current report on Form 8-K.

Item 11. Executive Compensation.

The information required by this item will be contained in Proxy Statement under the headings "Executive Compensation" and "Director Compensation," and is incorporated herein by reference.

Item 12. Security Ownership of Certain Beneficial Owners and Management and Related Stockholder Matters.

The information required by this item will be contained in Proxy Statement under the headings "Security Ownership of Certain Beneficial Owners and Management" and "Equity Compensation Plan Information," and is incorporated herein by reference.

Item 13. Certain Relationships and Related Transactions, and Director Independence.

The information required by this item will be contained in Proxy Statement under the headings "Certain Relationships and Related Party Transactions" and "Corporate Governance," and is incorporated herein by reference.

Item 14. Principal Accounting Fees and Services.

The information required by this item will be contained in Proxy Statement under the heading "Ratification of Independent Registered Public Accounting Firm-Principal Accounting Fees and Services," and is incorporated herein by reference.

PART IV

Item 15. Exhibits, Financial Statement Schedules.

The financial statements schedules and exhibits filed as part of this Annual Report on Form 10-K are as follows:

(a)(1) Financial Statements

Reference is made to the financial statements included in Item 8 of Part II hereof.

(a)(2) Financial Statement Schedules

All other schedules are omitted because they are not required or the required information is included in the statements or notes thereto.

(a)(3) Exhibits

Reference is made to the Exhibit Index accompanying this Annual Report on Form 10-K.

Item 16. Form 10-K Summary.

Not applicable.

Exhibit Index

Exhibit Number	Exhibit Description	Incorporated by Reference				Filed Herewith
		Form	File No.	Exhibit	Filing Date	
3.1	Amended and Restated Certificate of Incorporation of Registrant.	8-K	001-37383	3.1	5/26/2015	
3.2	Certificate of Amendment to the Amended and Restated Certificate of Incorporation of Registrant.	10-Q	001-37383	3.1	8/10/2017	
3.3	Amendment to the Amended and Restated Certificate of Incorporation of Registrant.	8-K	001-37383	3.1	1/23/2018	
3.4	Amended and Restated Bylaws of Registrant.	8-K	001-37383	3.2	5/26/2015	
4.1	Form of Registrant’s common stock certificate	S-3	333-224061	4.1	3/30/2018	
4.2	Form of Common Stock Purchase Warrant	8-K	001-37383	4.1	3/23/2018	
4.3	Form of Common Stock Purchase Warrant	8-K	001-37383	4.1	6/14/2019	
4.4	Form of Placement Agent Warrant	8-K	001-37383	4.2	6/14/2019	
4.5	Form of Common Stock Purchase Warrant	8-K	001-37383	4.1	9/9/2019	
4.6	Form of Placement Agent Warrant	8-K	001-37383	4.2	9/9/2019	
4.7	Description of Registrant's Securities Pursuant to Section 12 of the Securities Exchange Act of 1934, as amended.					X
10.1*	Form of Indemnification Agreement between the Registrant and each of its Officers and Directors.	S-1	333-202124	10.7	2/17/2015	
10.2*	2006 Stock Plan, as amended and restated, and form of agreement thereunder.	S-1	333-202124	10.8	2/17/2015	
10.3*	2015 Omnibus Equity Incentive Plan and forms of agreement thereunder.	S-1	333-232858	10.9	7/26/2019	
10.4*	2015 Employee Stock Purchase Plan and form of agreement thereunder.	S-1/A	333-202124	10.10	5/11/2015	
10.5*	Executive Incentive Bonus Plan.	S-1/A	333-202124	10.15	5/11/2015	
10.6*	Amended and Restated Director Compensation Policy.	10-Q	001-37383	10.14	5/10/2016	
10.7*	Form of Severance and Change in Control Agreement.	S-1/A	333-202124	10.18	4/6/2015	
10.8	Amendment No. 8 to the Office Lease dated March 17, 2003 between the Registrant and Pac West Office Equities, LP.					X
10.9*	Separation and Release Agreement between the Registrant and Rajendra Ketkar, dated August 23, 2019.	8-K	001-37383	10.1	8/28/2019	

10.10*	Employment Letter and appended form of Severance and Change In Control Agreement between the Registrant and Matthew Plavan, dated October 1, 2019.	8-K/A	001-37383	10.1	10/7/2019	
10.11*	Offer Letter and appended form of Severance and Change In Control Agreement between the Registrant and Sarah Reiter, dated February 16, 2018.	S-1	333-232858	10.17	7/26/2019	
10.12*	Employment Letter and appended form of Severance and Change In Control Agreement between the Registrant and Pam Haley, dated October 1, 2019.	8-K/A	001-37383	10.2	10/7/2019	
10.13+	Limited Liability Company Operating Agreement for Archipelago Ventures Hawaii, LLC, dated as of August 9, 2019.	8-K	001-37383	10.1	8/9/2019	
10.14	Securities Purchase Agreement dated as of March 19, 2018, between Arcadia Biosciences, Inc. and each purchaser named in the signature pages thereto	8-K	001-37383	10.1	3/23/2018	
10.15	Form of Registration Rights Agreement	8-K	001-37383	10.2	3/23/2018	
10.16	Form of Securities Purchase Agreement dated as of June 11, 2018, between Arcadia Biosciences, Inc. and each purchaser named in the signature pages thereto	8-K	001-37383	10.1	6/14/2018	
10.17	Form of Securities Purchase Agreement dated as of June 12, 2019, between Arcadia Biosciences, Inc. and each purchaser named in the signature pages thereto	8-K	001-37383	10.1	6/14/2019	
10.18	Form of Securities Purchase Agreement dated as of September 5, 2019, between Arcadia Biosciences, Inc. and each purchaser named in the signature pages thereto	8-K	001-37383	10.1	9/9/2019	
21.1	List of subsidiaries of the Registrant.	S-1	333-202124	21.1	2/17/2015	
23.1	Consent of Deloitte & Touche LLP, independent registered public accounting firm					X
31.1	Certification of Principal Executive Officer Pursuant to Rules 13a-14(a) and 15d-14(a) under the Securities Exchange Act of 1934, as Adopted Pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.					X
31.2	Certification of Principal Financial Officer Pursuant to Rules 13a-14(a) and 15d-14(a) under the Securities Exchange Act of 1934, as Adopted Pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.					X

32.1	Certification of Principal Executive Officer Pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.	X
32.2	Certification of Principal Financial Officer Pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.	X
101.INS	XBRL Instance Document.	X
101.SCH	XBRL Taxonomy Extension Schema Document.	X
101.CAL	XBRL Taxonomy Extension Calculation Linkbase Document.	X
101.DEF	XBRL Taxonomy Extension Definition Linkbase Document.	X
101.LAB	XBRL Taxonomy Extension Label Linkbase Document.	X
101.PRE	XBRL Taxonomy Extension Presentation Linkbase Document	X

* Indicates a management contract or compensatory plan or arrangement.

\+ Certain information has been excluded from this exhibit because it is not material and would likely cause competitive harm to the registrant if publicly disclosed.

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, as amended, the Registrant has duly caused this Report to be signed on its behalf by the undersigned, thereunto duly authorized.

ARCADIA BIOSCIENCES, INC.

Date: March 25, 2020

By: /s/ MATTHEW T. PLAVAN

Matthew T. Plavan
President and Chief Executive Officer
(Principal Executive Officer)

Date: March 25, 2020

By: /s/ PAMELA HALEY

Pamela Haley
Chief Financial Officer
(Principal Financial and Accounting Officer)

Each person whose individual signature appears below hereby authorizes and appoints Matthew T. Plavan with full power of substitution and resubstitution and full power to act without the other, as his or her true and lawful attorney-in-fact and agent to act in his or her name, place and stead and to execute in the name and on behalf of each person, individually and in each capacity stated below, and to file any and all amendments to this Annual Report on Form 10-K, and to file the same, with all exhibits thereto, and other documents in connection therewith, with the Securities and Exchange Commission, granting unto said attorneys-in-fact and agents, and each of them, full power and authority to do and perform each and every act and thing, ratifying and confirming all that said attorneys-in-fact and agents or any of them or their or his substitute or substitutes may lawfully do or cause to be done by virtue thereof.

Pursuant to the requirements of the Securities Exchange Act of 1934, as amended, this Report has been signed below by the following persons on behalf of the registrant in the capacities and on the dates indicated.

Name	Title	Date
/s/ MATTHEW T. PLAVAN **Matthew T. Plavan**	**Director**	March 25, 2020
/s/ ALBERT B. BOLLES **Albert D. Bolles**	**Director**	March 25, 2020
/s/ KEVIN COMCOWICH **Kevin Comcowich**	**Director**	March 25, 2020
/s/ LILLIAN SHACKELFORD MURRAY **Lilian Shackelford Murray**	**Director**	March 25, 2020
/s/ GREGORY D. WALLER **Gregory D. Waller**	**Director**	March 25, 2020
/s/ AMY YODER **Amy Yoder**	**Director**	March 25, 2020

EXHIBIT 4.7

DESCRIPTION OF THE REGISTRANT'S SECURITIES REGISTERED PURSUANT TO SECTION 12 OF THE SECURITIES EXCHANGE ACT OF 1934

As of the date of this Annual Report on Form 10-K, Arcadia Biosciences, Inc. ("Arcadia," "we," "us," "our") has one class of its securities registered under Section 12 of the Securities Exchange Act of 1934, as amended: common stock. The following summary of the terms of our capital stock is based upon our certificate of incorporation, as amended ("Certificate of Incorporation") and our Amended and Restated Bylaws ("Bylaws") and does not purport to be complete. This summary is subject to, and is qualified in its entirety by, or Certificate of Incorporation and Bylaws, each of which is incorporated by reference as exhibits to the Annual Report on Form 10-K of which this Exhibit is a part, and the applicable provisions of the Delaware General Corporation Law ("DGCL"). We encourage you to read our Certificate of Incorporation and Bylaws for additional information.

General

Our authorized capital stock consists of 150,000,000 shares of common stock, $0.001 par value, and 20,000,000 shares of preferred stock, $0.001 par value, all of which shares of preferred stock are undesignated.

Common Stock

Holders of our common stock are entitled to one vote per share for each share held of record on all matters submitted to a vote of stockholders and do not have cumulative voting rights. Our Certificate of Incorporation does not provide for cumulative voting. Subject to preferences that may be applicable to any outstanding preferred stock, the holders of our common stock are entitled to receive ratably such dividends, if any, as may be declared by our board of directors out of legally available funds. Upon liquidation, dissolution or winding-up, the holders of our common stock are entitled to share ratably in all of our assets which are legally available for distribution, after payment of or provision for all liabilities and the liquidation preference of any outstanding preferred stock. The holders of our common stock have no preemptive, subscription, redemption or conversion rights.

Preferred Stock

The board of directors has the authority, without further action by the stockholders, to issue up to 20,000,000 shares of preferred stock, $0.001 par value per share, in one or more series. The board of directors will also have the authority to designate the rights, preferences, privileges and restrictions of each such series, including dividend rights, dividend rates, conversion rights, voting rights, terms of redemption, redemption prices, liquidation preferences, and the number of shares constituting any series.

The issuance of preferred stock may have the effect of delaying, deferring or preventing a change in control of the company without further action by the stockholders. The issuance of preferred stock with voting and conversion rights may also adversely affect the voting power of the holders of common stock. In certain circumstances, an issuance of preferred stock could have the effect of decreasing the market price of the common stock.

Anti-Takeover Effects of Provisions of our Certificate of Incorporation and Bylaws

Our Certificate of Incorporation and Bylaws contain certain provisions that could have the effect of delaying, deterring or preventing another party from acquiring control of us. These provisions and certain provisions of the DGCL, which are summarized below, are expected to discourage coercive takeover practices and inadequate takeover bids. These provisions are also designed, in part, to encourage persons seeking to acquire control of us to negotiate first with our board of directors. We believe that the benefits of increased protection of our potential ability to negotiate more favorable terms with an unfriendly or unsolicited acquirer outweigh the disadvantages of discouraging a proposal to acquire us.

Undesignated Preferred Stock

As discussed above, our board of directors will have the ability to issue preferred stock with voting or other rights or preferences that could impede the success of any attempt to change control of us. These and other provisions may have the effect of deterring hostile takeovers or delaying changes in control or management of our company.

Limits on Ability of Stockholders to Act by Written Consent or Call a Special Meeting

Our Certificate of Incorporation provides that our stockholders may not act by written consent, which may lengthen the amount of time required to take stockholder actions. As a result, a holder controlling a majority of our capital stock would not be able to amend our Bylaws or remove directors without holding a meeting of our stockholders called in accordance with our Bylaws.

In addition, our Bylaws provide that special meetings of the stockholders may be called only by the majority of our board of directors. Stockholders may not call a special meeting, which may delay the ability of our stockholders to force consideration of a proposal or for holders controlling a majority of our capital stock to take any action, including the removal of directors.

Requirements for Advance Notification of Stockholder Nominations and Proposals

Our Bylaws require advance notice procedures with respect to stockholder proposals and the nomination of candidates for election as directors, other than nominations made by or at the direction of our board of directors or a committee of our board of directors. These provisions may have the effect of precluding the conduct of certain business at a meeting if the proper procedures are not followed. These provisions may also discourage or deter a potential acquirer from conducting a solicitation of proxies to elect the acquirer's own slate of directors or otherwise attempting to obtain control of our company.

Board Classification

Our board of directors is divided into three classes, one class of which is elected each year by our stockholders. The directors in each class will serve three-year terms. A third party may be discouraged from making a tender offer or otherwise attempting to obtain control of us as it is more difficult and time consuming for stockholders to replace a majority of the directors on a classified board.

No Cumulative Voting

Our Certificate of Incorporation and Bylaws do not permit cumulative voting in the election of directors. Cumulative voting allows a stockholder to vote a portion or all of its shares for one or more candidates for seats on the board of directors. Without cumulative voting, a minority stockholder may not be able to gain as many seats on our board of directors as the stockholder would be able to gain if cumulative voting were permitted. The absence of cumulative voting makes it more difficult for a minority stockholder to gain a seat on our board of directors to influence our board's decision regarding a takeover.

Amendment of Charter and Bylaws Provisions

The amendment of the above provisions of our Certificate of Incorporation requires approval by holders of at least two-thirds of our outstanding capital stock entitled to vote generally in the election of directors. The amendment of our Bylaws requires approval by the holders of at least two-thirds of our outstanding capital stock entitled to vote generally in the election of directors.

Delaware Anti-Takeover Statute

We are subject to the provisions of Section 203 of the DGCL, regulating corporate takeovers. In general, Section 203 prohibits a publicly-held Delaware corporation from engaging, under certain circumstances, in a business combination with an interested stockholder for a period of three years following the date the person became an interested stockholder unless:

- prior to the date of the transaction, our board of directors approved either the business combination or the transaction which resulted in the stockholder becoming an interested stockholder;
- upon completion of the transaction that resulted in the stockholder becoming an interested stockholder, the interested stockholder owned at least 85% of the voting stock of the corporation outstanding at the time the transaction commenced, calculated as provided under Section 203; or
- at or subsequent to the date of the transaction, the business combination is approved by our board of directors and authorized at an annual or special meeting of stockholders, and not by written consent, by the affirmative vote of at least two-thirds of the outstanding voting stock which is not owned by the interested stockholder.

Generally, a business combination includes a merger, asset or stock sale, or other transaction resulting in a financial benefit to the interested stockholder. An interested stockholder is a person who, together with affiliates and associates, owns or, within three years prior to the determination of interested stockholder status, did own 15% or more of a corporation's outstanding voting stock. We expect the existence of this provision to have an anti-takeover effect with respect to transactions our board of directors does not approve in advance. We anticipate that Section 203 may also discourage attempts that might result in a premium over the market price for the shares of common stock held by stockholders.

The provisions of the DGCL and the provisions of our Certificate of Incorporation and Bylaws, as amended upon the completion of this offering, could have the effect of discouraging others from attempting hostile takeovers and, as a consequence, they might also inhibit temporary fluctuations in the market price of our common stock that often result from actual or rumored hostile takeover attempts. These provisions might also have the effect of preventing changes in our management. It is possible that these provisions could make it more difficult to accomplish transactions that stockholders might otherwise deem to be in their best interests.

Forum Selection

Our Certificate of Incorporation provides that unless we consent in writing to the selection of an alternative forum, the Court of Chancery of the State of Delaware is the sole and exclusive forum for:

- any derivative action or proceeding brought on our behalf;
- any action asserting a breach of fiduciary duty owed by any of our directors, officers or other employees to us or our stockholders;
- any action asserting a claim against us arising pursuant to any provisions of the DGCL, our Certificate of Incorporation or our Bylaws; or
- any action asserting a claim against us that is governed by the internal affairs doctrine.

These exclusive-forum provisions may limit a stockholder's ability to bring a claim in a judicial forum that it finds favorable for disputes with us or our directors, officers or other employees, which may discourage lawsuits against us and our directors, officers and other employees. Furthermore, the enforceability of similar choice of forum provisions in other companies' charter documents has been challenged in legal proceedings, and it is possible that a court could find these types of provisions to be inapplicable or unenforceable. If a court were to find either exclusive-forum provision in our Certificate of Incorporation to be inapplicable or unenforceable in an action, we may incur additional costs associated with resolving the dispute in other jurisdictions, which could harm our business.

These exclusive-forum provisions are not intended to apply to any causes of action arising under the Securities Act of 1933 or the Exchange Act of 1934 or any other claim for which the federal courts have exclusive jurisdiction.

Listing

Our common stock is listed on the NASDAQ Capital Market under the symbol "RKDA".

Exhibit 10.8

LEASE AMENDMENT NO. 8

This Lease Amendment No. 8 (the **"Eighth Amendment"**), dated for reference purposes only **January 24, 2020**, is entered into by and between **Pac West Office Equities, LP**, a California limited partnership (**"Landlord"**), and **Arcadia Biosciences, Inc.**, a Delaware corporation (**"Tenant"**). (Landlord and Tenant are collectively referred to herein as the **"Parties"**).

RECITALS

1. Landlord and Tenant are parties to that that certain lease dated for reference purposes only March 17, 2003 (*incorrectly identified as May 17, 2003 in the following amendments*), as amended by those certain amendments dated for reference purposes only June 30, 2004, August 22, 2007, May 16, 2012, June 29, 2015, January 18, 2018, February 15, 2018 and May 22, 2018 (collectively, the **"Lease"**) with respect to the premises described therein as Suite 105 containing approximately 9,224 rentable square feet located on the 1st floor, and Suite 200, containing approximately 7,056 rentable square feet, together with the **"IT Closet"**, located on the 2nd floor, for an approximate combined rentable square feet of 16,280, which Suites are a portion of the "Building" containing approximately 105,307 rentable square feet, commonly known by the street address of 202 Cousteau Place, located in the City of Davis, County of Yolo, State of California, with zip code 95616 (the **"Existing Premises"**).

2. The Parties now desire to amend the Lease to extend the Term of the Lease and to increase the size of the Existing Premises upon the terms and conditions set forth in this Eighth Amendment.

AGREEMENT

THEREFORE, in consideration of the covenants and agreements contained herein, the parties hereby mutually agree as follows:

1. Modification of Lease Term. The Parties agree that the existing Term of the Lease shall be amended and extended to the date which is sixty (60) months following the Expansion Commencement Date (as that term is defined below). The Expiration Date of the Lease (formerly July 31, 2023) shall now be the date that is sixty (60) months after the Expansion Commencement Date.

2. Modification of the Premises. The Parties agree that, effective Expansion Commencement Date, the Existing Premises shall be increased by Suite 220 containing approximately 5,200 square feet (the **"Expansion Premises"**), as shown on **Exhibit A** attached hereto and incorporated herein by reference. Effective upon the Expansion Commencement Date, the Existing Premises and the Expansion Premises shall be collectively referred to as the "**Premises"**.

   The **"Expansion Commencement Date"** shall be the later of (i) April 1, 2020 and (ii) the date on which the Landlord Work (as defined below) is substantially complete and delivery of possession of the Expansion Premises to Tenant by Landlord. Promptly after the determination of the Expansion Commencement Date, Landlord and Tenant shall enter into a commencement letter agreement.

   Following mutual execution of this Eighth Amendment, Landlord shall, at its sole cost, in accordance with Landlord's building standards, cause to be performed certain improvement work in the Expansion Premises described as follows: (i) removal of existing tile and installation of new carpet and tile, as mutually agreed upon by Landlord and Tenant; (ii) repainting of walls; (iii) replacement of ceiling tiles, as necessary; (iv) replacement of light fixtures, as necessary; and (v) installation of additional electrical outlets, as mutually agreed upon by Landlord and Tenant (collectively, the **"Landlord Work"**).

   Subject to the occurrence of the following: (i) mutual execution of this Eighth Amendment, and (ii) receipt by Landlord of the amount set forth in Paragraph 5 below, together with proof of insurance required pursuant to Paragraph 23 of the Lease, Landlord agrees to give Tenant (and its employees, agents and contractors) reasonable access to the Expansion Premises (the **"Early Access"**) during the fifteen (15) day period immediately prior to the Expansion Commencement Date (the **"Early Access Period"**), during the course of Landlord's performance and completion of the Landlord Work, for the limited purpose of Tenant's initial setup and fixturization of the Expansion Premises. Such Early Access shall be subject to the following conditions:

   (a) During the Early Access Period the terms of the Lease, as amended by this Eighth Amendment, shall be in effect (including but not limited to the Tenant's indemnification and insurance obligations required by Paragraphs 22 and 23, respectively). Such Early Access Period shall not affect nor advance the Expansion Commencement Date, as defined herein above, or the Expiration Date, as amended by Paragraph 1 above.

(b) During any Early Access to the Expansion Premises, Tenant shall not unreasonably interfere with, hinder or delay Landlord's contractor in the performance and completion of the Landlord Work. Any such interference, hindrance or delay resulting from any Early Access shall be deemed a Tenant Delay.

(c) Any Early Access shall be subject to reasonable prior written notice and scheduled in Landlord's reasonable discretion. Tenant shall coordinate any Early Access requests with Jon Salzberg, of Buzz Oates Management Services, Landlord's representative.

(d) Any Early Access shall be at Tenant's sole risk and Tenant shall bear all risk of loss with regard to any personal property, equipment or other materials or improvements located by Tenant in the Expansion Premises. Tenant acknowledges that Landlord, its contractor, subcontractors, and agents have no obligation to secure the Expansion Premises or safeguard Tenant's personal property.

3. Adjustment of Base Rent. Effective upon mutual execution of this Eighth Amendment, commencing upon the Expansion Commencement Date, Base Rent shall be adjusted in accordance with the Rent Schedule set forth below:

			Existing Premises	Expansion Premises	Base Rent
Expansion Commencement Date	to	7/31/2020	$38,567.32	$13,000.00	$51,567.32
8/1/2020	to	Month 12	$39,724.24	$13,000.00	$52,724.24
Month 13	to	7/31/2021	$39,724.24	$13,390.00	$53,114.24
8/1/2021	to	Month 24	$40,916.07	$13,390.00	$54,306.07
Month 25	to	7/31/2022	$40,916.07	$13,791.70	$54,707.77
8/1/2022	to	Month 36	$42,143.55	$13,791.70	$55,935.25
Month 37	to	7/31/2023	$42,143.55	$14,205.45	$56,349.00
8/1/2023	to	Month 48	$43,407.86	$14,205.45	$57,613.31
Month 49	to	7/31/2024	$43,407.86	$14,631.61	$58,039.47
8/1/2024	to	Month 60	$44,710.09	$14,631.61	$59,341.70

Notwithstanding anything to the contrary herein or elsewhere within the Lease, all payments received by Landlord from Tenant shall be applied to the oldest payment obligation owed by Tenant to Landlord and no designation made by Tenant, either in a separate writing or on a check or money order, shall modify this provision or have any force or effect. For the purpose of clarity and the avoidance of doubt, Tenant hereby acknowledges that the identification of Base Rent for the Existing Premises and the Expansion Premises, as set forth above, has no bearing on the amount of Base Rent due by Tenant for the Premises nor the manner in which Landlord shall apply payments received by Landlord from Tenant.

4. Adjustment of Tenant's Share. Effective upon the Expansion Commencement Date, Tenant's Share as set forth in Paragraph 2(d), as amended by Lease Amendment No. 2 and Lease Amendment No. 5, shall increase by 4.92% from 15.46% to 20.38%.

5. Establishment & Adjustment of Base Year. Effective upon the Expansion Commencement Date, the Base Year for the Existing Premises shall continue to be 2018 and the Base Year for the Expansion Premises shall be 2020. Effective August 1, 2023, the Base Year for the Existing Premises shall be amended and restated to be 2023 and the Base Year for the Expansion Premise shall continue to be 2020.

6. Modification of Project Operating Costs. Effective upon the Expansion Commencement Date, the Parties hereby agree that the last sentence of Paragraph 6(b)(iii)(A) beginning with the words "If at any time during the Term," shall be deleted in its entirety and the following shall be inserted in lieu thereof:

"If at any time during the Term, the assessed valuation of, or taxes on, the Project are not based on a completed Project having at least ninety-five percent (95%) of the Rental Area occupied, then the "taxes" component of the Project Operating Costs shall be adjusted by Landlord to reasonably approximate the taxes which would have been payable if the Project were completed and at least ninety-five percent (95%) occupied."

Effective upon the Expansion Commencement Date, the Parties hereby agree that the last sentence of the first paragraph of Paragraph 6(b)(iii)(B) beginning with the words "If at any time during the Term," shall be deleted in its entirety and the following shall be inserted in lieu thereof:

"If at any time during the Term, less than ninety-five percent (95%) of the Rental Area of the Project is occupied, the "operating costs" component of the Project Operating Costs shall be adjusted by Landlord to reasonably approximate the operating costs which would have been payable if the Project had been at least ninety-five percent (95%) occupied."

7. Adjustment of Tenant's Parking. Effective upon the Expansion Commencement Date, the number of parking spaces Tenant shall be permitted to use pursuant to Paragraph 2(o), as amended by Lease Amendment No. 2 and Lease Amendment No. 5, shall be increased by twenty-one (21) parking spaces, from sixty-five (65) parking spaces to eighty-six (86) parking spaces (calculated based on four (4) parking spaces per 1,000 square feet within the Premises).

8. Security Deposit. Upon Tenant's execution and delivery of this Eighth Amendment to Landlord, Tenant shall deposit with Landlord the amount of $14,631.61 (**"Security Deposit"**), in cash, as security for the performance of Tenant's obligations under the Lease, as amended by this Eighth Amendment.

9. Relocation of Premises. The Parties agree that Paragraph 32 (Relocation of Premises) of the Lease is null and void and of no further force and effect as to any future right relocate the Premises to another part of the Building.

10. Tenant Improvements; Tenant Allowance. Tenant desires to make tenant improvements within the Existing Premises (**"Tenant Improvements"**). Subject to the terms and conditions of this Eighth Amendment and the Work Letter, attached hereto as **Exhibit B**, Landlord agrees to reimburse Tenant for the TI Costs incurred by Tenant in connection with the Tenant Improvements in an amount not to exceed $65,120.00 (**"Tenant Allowance"**). The "**TI Costs**" shall include all of the following costs: space planning and studies; architectural and engineering fees; permits, approvals and other governmental fees; construction costs, taxes, and all other costs expended or to be expended in connection with the Tenant Improvements, as applicable. Tenant may use up to $32,560.00 of the Tenant Allowance (**"FF&E Maximum Amount"**) for the installation of Tenant's telecom/data, furniture, fixtures and equipment for the Premises (as that term is defined in Paragraph 2 above) and moving expenses incurred with respect to the Premises. The FF&E Maximum Amount shall be disbursed to Tenant within ten (10) days after Landlord's receipt of Tenant's written request for the same, which request shall be accompanied by an itemization of the costs associated with any such installation of such telecom/data, furniture, fixtures and equipment for the Premises and moving expenses incurred with respect to the Premises, together with paid receipts showing that the requested sums were spent on same.

    If Tenant fails to satisfy all of the conditions set forth in Paragraph 6 of the Work Letter attached hereto as **Exhibit B** and/or request reimbursement of the Tenant Allowance (or unpaid portion thereof) within twelve (12) months following the Expansion Commencement Date, then Tenant's right to receive the same shall be deemed waived and null and void, and Landlord shall thereafter have no obligation to pay the Tenant Allowance (or unpaid portion thereof) to Tenant.

11. Option to Extend Term. Landlord grants to Tenant a total of one (1) option to extend the Lease Term (the **"Extension Option"**) on the terms and conditions set forth in this Paragraph. The Extension Option shall be for a period of five (5) years (the **"Option Term"**). If Tenant wishes to exercise the Extension Option, Tenant shall deliver written notice of such exercise to Landlord not less than nine (9) months, and not more than twelve (12) months, before the expiration of the then existing Lease Term. Tenant may only exercise the Extension Option if, as of the date of delivery of the notice, Tenant is not in default under this Lease. If Tenant properly exercises the Extension Option, and provided Tenant is not in default under the Lease at the end of the then existing Lease Term, then the Lease will be extended for the Option Term, and Base Rent during the Option Term, and escalations thereto, shall be based upon ninety-five percent (95%) of the then currently prevailing rent for comparable space of similar quality and location of the Premises determined as of the deadline for Tenant to exercise the Extension Option, with annual increases of three percent (3%); provided, however, that in no event shall Base Rent payable by Tenant during the Option Term be decreased below the amount of Base Rent due for the last month of the existing Lease Term.

12. CASp Inspection Disclosure. Landlord hereby advises Tenant that to Landlord's actual knowledge the Premises has not undergone an inspection by a certified access specialist (CASp). Except to the extent expressly set forth elsewhere in the Lease, Landlord shall have no liability or responsibility to make any repairs or modifications to the Premises or the Industrial Center in order to comply with accessibility standards. The following disclosure is hereby made pursuant to applicable California law:

"A Certified Access Specialist (CASp) can inspect the subject premises and determine whether the subject premises comply with all of the applicable construction-related accessibility standards under state law. Although state law does not require a CASp inspection of the subject premises, the commercial property owner or lessor may not prohibit the lessee or tenant from obtaining a CASp inspection of the subject premises for the occupancy or potential occupancy of the lessee or tenant, if requested by the lessee or tenant. The parties shall mutually agree on the arrangements for the time and manner of the CASp inspection, the payment of the fee for the CASp inspection, and the cost of making any repairs necessary to correct violations of construction-related accessibility standards within the premises." [Cal. Civ. Code Section 1938(e)].

Any CASp inspection shall be conducted in compliance with reasonable rules in effect at the Building with regard to such inspections and shall be subject to Landlord's prior written consent.

13. Energy Disclosure. Tenant agrees to cooperate with any energy consumption disclosure requirements imposed on Landlord and with the requirements under any existing or future energy conservation or sustainability programs applicable to the Building, including without limitation those of the U.S. Green Building Council's LEED rating system, or which may be imposed on Landlord by law. Tenant shall within five (5) days after receipt of Landlord's written request therefor, provide any and all written consents to utility companies providing services to the Building required to authorize such utility companies to release energy usage data for Tenant's Premises to or for the use of Landlord, or to such other sites or parties as required for Landlord's compliance with the applicable program.

14. Brokers. Landlord and Tenant each represent to the other that they have had no dealings with any real estate broker or agent in connection with the negotiation of this Eighth Amendment, except for Buzz Oates Real Estate (Landlord's Broker) and Corporate Advisory Group Inc., doing business as Cresa Sacramento (Tenant's Broker) and that no other real estate broker or agent is entitled to a commission or finder's fee in connection with this Eighth Amendment. Each party shall indemnify, protect, defend, and hold harmless the other party against all claims or liability for any commission, finder's fee, or equivalent compensation alleged to be owing on account of the indemnifying party's dealings with any real estate broker or agent other than Landlord's Broker and Tenant's Broker. In connection with this Eighth Amendment, Landlord agrees to pay a commission to Landlord's Broker and Tenant's Broker pursuant to the terms of a separate agreement. The terms of this Paragraph shall survive the expiration or earlier termination of the Lease.

15. Lease Status. Tenant warrants, represents and certifies to Landlord that, to the best of Tenant's actual knowledge, as of the date of this Eighth Amendment: (a) Landlord is not in default under the Lease; (b) Tenant has accepted possession and now occupies the Existing Premises and is currently open for business; (c) Tenant does not have any defenses or offsets to payment of rent and performance of its obligations under the Lease as and when same becomes due; (d) Tenant has not made any assignment, sublease, transfer, or conveyance of the Lease or any interest therein or in the Premises; (e) no actions, whether voluntary or otherwise, are pending against Tenant under the bankruptcy laws of the United States or any state thereof; and (f) except as set forth in Paragraph 7 of this Eighth Amendment, the Lease does not grant Tenant any right or option to extend the term of the Lease, to expand the Premises, or to terminate the Lease.

16. Counterparts. This Eighth Amendment may be executed in two or more counterparts, each of which shall be deemed an original, but all of which together constitute one and the same instrument.

17. All other terms and conditions of the Lease shall remain the same in full force and effect.

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Signatures of the Parties Follow on the Next Page

IN WITNESS WHEREOF, the Parties hereto have caused this Eighth Amendment to be executed as of the day and year written below.

LANDLORD:

Pac West Office Equities, LP, a California limited partnership

By: PW GP, LP, a California limited partnership, General Partner

By: PW Lead, LLC, a California limited liability company, General Partner

By: _____
Daniel Corfee, Investment Committee Chair

By: _____
Daniel Corfee, Investment Committee Chair

Dated: January ___, 2020

TENANT:

Arcadia Biosciences, Inc., a Delaware corporation

By: /s/ Matt Plavan
Name: Matt Plavan
Its: President & CEO

By: _____
Name: _____
Its:

Dated: January ___, 2020

EXHIBIT A

EXISTING PREMISES/EXPANSION PREMISES

(Page 1 of 2)

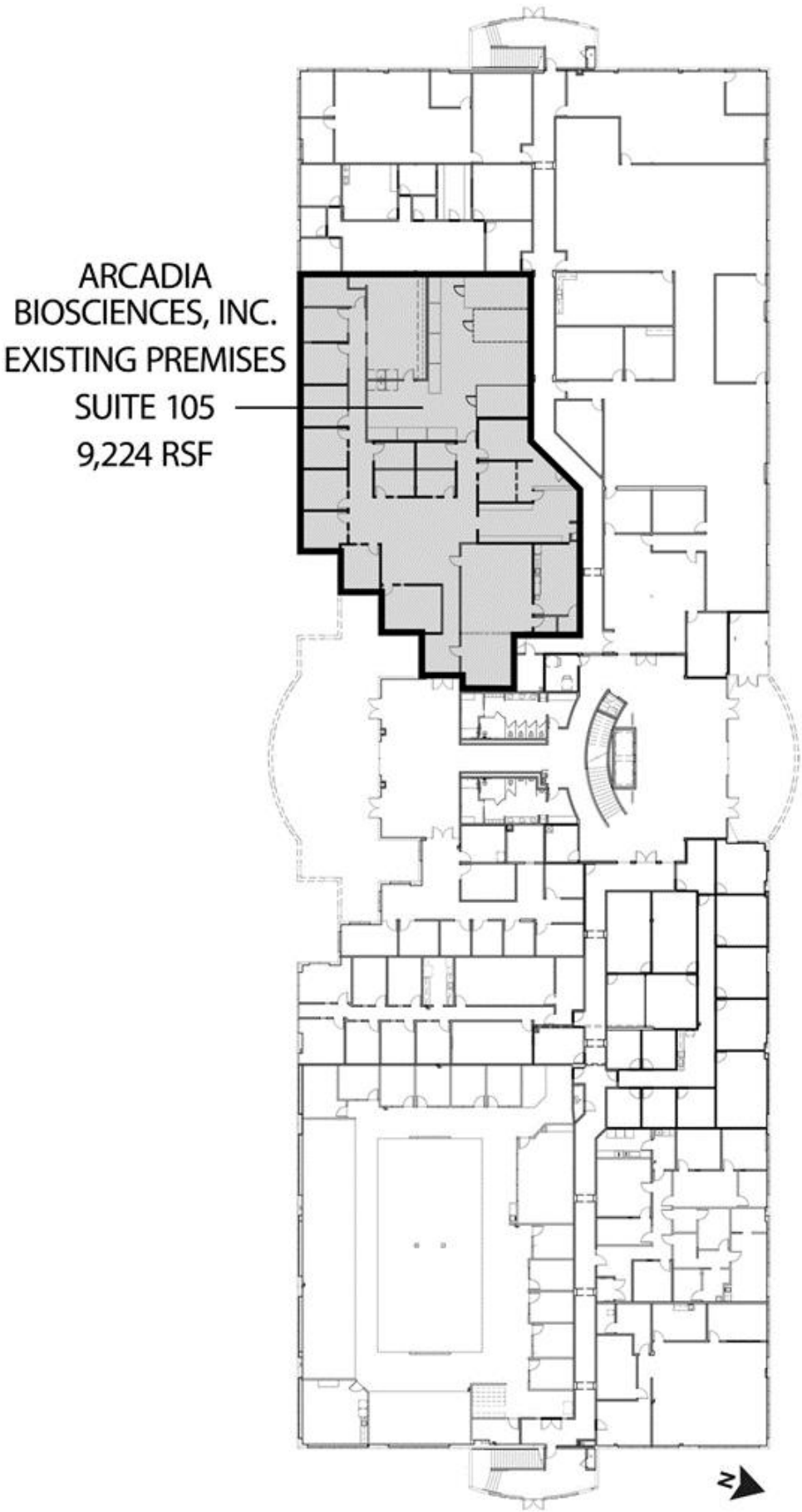

EXHIBIT A

EXISTING PREMISES/EXPANSION PREMISES

(Page 2 of 2)

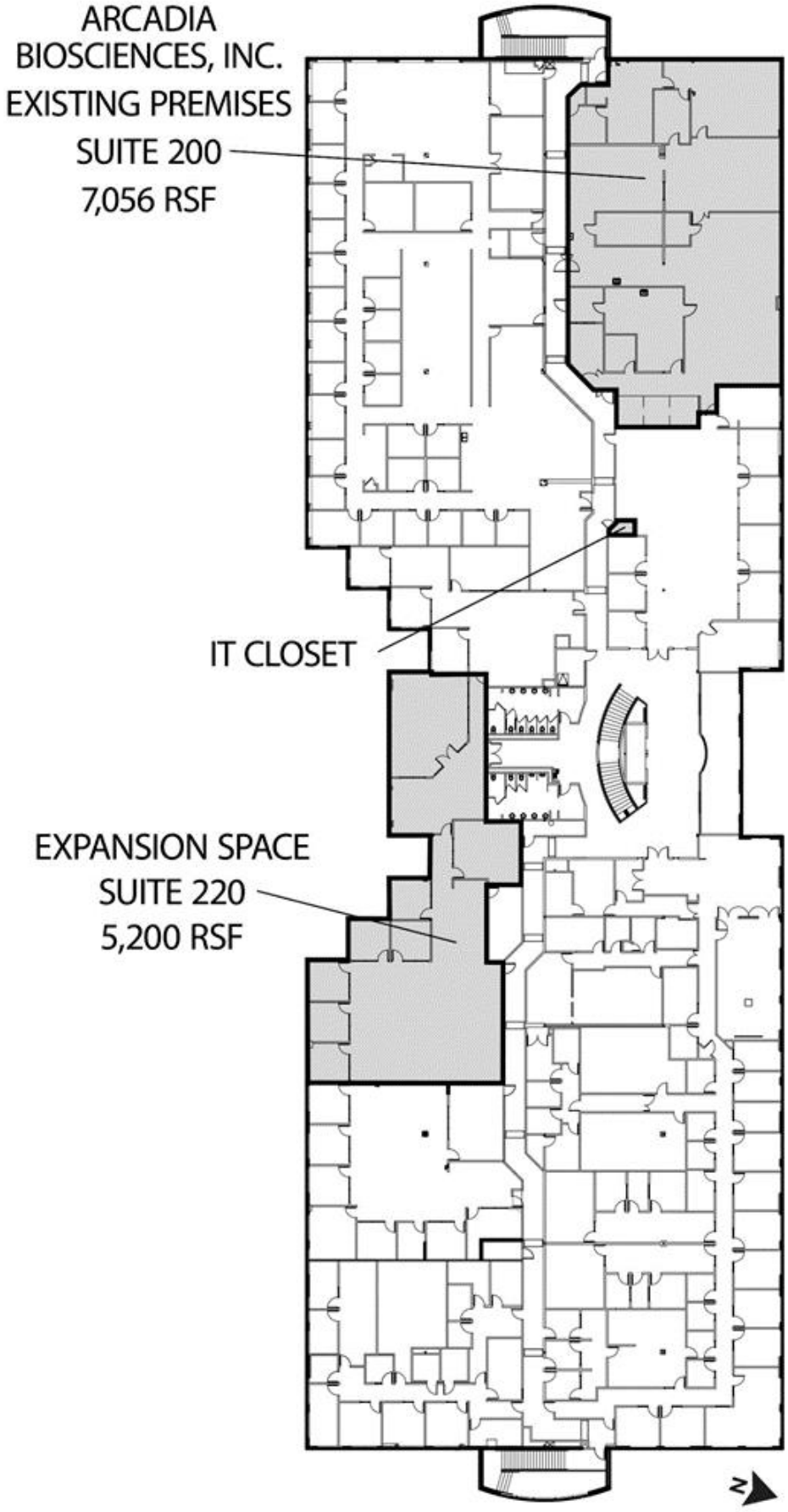

EXHIBIT B

WORK LETTER

Tenant may perform, or cause to be performed, the Tenant Improvements (as that term is defined in Paragraph 6 of the Eighth Amendment) as provided for in the Approved Plans (as defined in Paragraph 2 below), and in accordance with the terms and conditions set forth in this Exhibit. The Tenant Improvements shall be at Tenant's sole cost and expense, except for Landlord's obligation to pay the Tenant Allowance (as defined in Paragraph 6 of the Eighth Amendment).

1. **Pre-Construction Activities**. Prior to Tenant's commencement of the Tenant Improvements, Tenant shall submit the following information and items to Landlord for Landlord's review and approval:

(a) The names and addresses of Tenant's contractor(s). Landlord may, at its election, designate a list of approved contractors for performance of those portions of work involving electrical, mechanical, plumbing, heating, air conditioning, life safety systems or the roof, from which Tenant must select its contractors for such designated portions of the Tenant Improvements.

(b) Certificates of insurance as hereinafter described. Tenant shall not permit Tenant's contractors to commence work until the required insurance has been obtained and certified copies of policies or certificates have been delivered to Landlord.

(c) The Plans (as hereinafter defined) for the Tenant Improvements, which Plans shall be subject to Landlord's approval in accordance with Paragraph 2 below.

(d) Copies of all necessary building permits.

Tenant will update such information and items by notice to Landlord of any changes.

2. **Approval of Plans**. The term **"Approved Plans"** shall mean the Plans (as hereinafter defined), as and when approved in writing by Landlord. The term **"Plans"** shall mean the full and detailed architectural and engineering plans and specifications covering the Tenant Improvements (including, without limitation, architectural, mechanical and electrical working drawings for the Tenant Improvements). The Plans shall be subject to Landlord's approval and the approval of all local governmental authorities requiring approval of the Tenant Improvements and/or the Approved Plans. Landlord shall give its approval or disapproval (giving general reasons in case of disapproval) of the Plans within ten (10) business days after their delivery to Landlord. Landlord agrees not to unreasonably withhold its approval of said Plans; provided, however, that Landlord shall not be deemed to have acted unreasonably if it withholds its approval of the Plans because, in Landlord's reasonable opinion: the Tenant Improvements as shown in the Plans: (1) is likely to adversely affect Building systems, the structure of the Building or the safety of the Building and/or its occupants; (2) might impair Landlord's ability to furnish services to Tenant or other tenants; (3) would increase the cost of operating the Building; (4) would violate any governmental laws, rules or ordinances (or interpretations thereof); (5) involves hazardous or toxic materials or substances which are not customarily used in the building trade; (6) would adversely affect the appearance of the Building or might materially adversely affect another tenant's premises; or (7) is prohibited by any mortgage or trust deed encumbering the Building. The foregoing reasons, however, shall not be exclusive of the reasons for which Landlord may withhold consent.

3. **Change Orders**. All material changes to the Approved Plans requested by Tenant must be approved by Landlord in advance of the implementation of such changes as part of the Tenant Improvements, which approval shall not be unreasonably conditioned or withheld and shall be delivered as soon as reasonably possible.

4. **Standards of Design and Construction and Conditions of Tenant's Performance**. All work done in or upon the Premises by Tenant shall be done according to the standards set forth in this Paragraph 4, except as the same may be modified in the Approved Plans approved by or on behalf of Landlord and Tenant.

(a) Tenant's Approved Plans and all design and construction of the Tenant Improvements shall comply with all applicable statutes, ordinances, regulations, laws, codes and industry standards, including, but not limited to, requirements of Landlord's fire insurance underwriters.

(b) Tenant shall, at its own cost and expense, obtain all required building permits and occupancy permits.

(c) Tenant's contractors shall be reputable licensed contractors. The Tenant Improvements shall be coordinated with any other construction or other work in the Building in order not to adversely affect construction work being performed by or for Landlord or its tenants.

(d) Tenant shall use only new materials in the Tenant Improvements, except where explicitly shown in the Approved Plans. All Tenant Improvements shall be done in a good and workmanlike manner. Tenant shall obtain contractors' warranties of at least one (1) year duration from the completion of the Tenant Improvements against defects in workmanship and materials on all work performed and equipment installed in the Premises as part of the Tenant Improvements.

(e) Tenant and Tenant's contractors shall not unreasonably interfere with any other tenants of the Building where the Premises are located.

(f) Landlord shall have the right to order Tenant or any of Tenant's Contractors who violate the requirements imposed on Tenant or Tenant's contractors in performing work to cease work and remove its equipment and employees from the Building. No such action by Landlord shall delay the commencement of the Lease or the obligation to pay Rent or any other obligations therein set forth.

(g) Tenant shall permit access to the Premises, and the Tenant Improvements shall be subject to inspection, by Landlord and Landlord's architects, engineers, contractors and other representatives, at all times during the period in which the Tenant Improvements is being constructed and installed and following completion of the Tenant Improvements.

(h) Tenant shall proceed with its work expeditiously, continuously and efficiently.

(i) Tenant shall furnish to Landlord "as-built" drawings of the Tenant Improvements within thirty (30) days after completion of the Tenant Improvements.

(j) Tenant shall impose on and enforce all applicable terms of this Exhibit against Tenant's contractors.

5. **Insurance And Indemnification**. In addition to any insurance which may be required under the Lease, Tenant shall secure, pay for and maintain or cause Tenant's contractors to secure, pay for and maintain during the continuance of the Tenant Improvements within the Building or Premises, insurance in the following minimum coverages and the following minimum limits of liability:

(a) Worker's Compensation and Employer's Liability Insurance with limits of not less than $500,000.00, or such higher amounts as may be required from time to time by any Employee Benefit Acts or other statutes applicable where the work is to be performed, and in any event sufficient to protect Tenant's contractors from liability under the aforementioned acts.

(b) Comprehensive General Liability Insurance (including Contractors' Protective Liability) in an amount not less than $1,000,000.00 per occurrence, whether involving bodily injury liability (or death resulting therefrom) or property damage liability or a combination thereof with a minimum aggregate limit of $2,000,000.00. Such insurance shall provide for explosion and collapse, completed operations coverage and broad form blanket contractual liability coverage and shall insure Tenant's contractors against any and all claims for bodily injury, including death resulting therefrom, and damage to the property of others and arising from its operations under the contracts whether such operations are performed by Tenant's Contractors or by anyone directly or indirectly employed by any of them.

(c) Comprehensive Automobile Liability Insurance, including the ownership, maintenance and operation of any automotive equipment, owned, hired, or non-owned in an amount not less than $500,000.00 for each person in one accident, and $1,000,000.00 for injuries sustained by two or more persons in any one accident and property damage liability in an amount not less than $1,000,000.00 for each accident. Such insurance shall insure Tenant's contractors against any and all claims for bodily injury, including death resulting therefrom, and damage to the property of others arising from its operations under the contracts, whether such operations are performed by Tenant's contractors, or by anyone directly or indirectly employed by any of them.

(d) "All-risk" builder's risk insurance upon the entire Tenant Improvements to the full insurable value thereof. This insurance shall include the interests of Landlord and Tenant (and their respective contractors and subcontractors of any tier to the extent of any insurable interest therein) in the Tenant Improvements and shall insure against the perils of fire and extended coverage and shall include "all-risk" builder's risk insurance for physical loss or damage including, without duplication of coverage, theft vandalism and malicious mischief. If portions of the Tenant Improvements are stored off the site of the Building or in transit to said site are not covered under said "all-risk" builder's risk insurance, then Tenant shall effect and maintain similar property insurance on such portions of the Tenant Improvements. Any loss insured under said "all-risk" builder's risk insurance is to be adjusted with Landlord and Tenant.

(e) All policies (except the worker's compensation policy) shall be endorsed to include as additional insured parties the parties listed on, or required by, the Lease and their respective beneficiaries, partners, directors, officers, employees and agents, and such additional persons as Landlord may designate. The waiver of subrogation provisions contained in the Lease shall apply to all insurance policies (except the worker's compensation policy) to be obtained by Tenant pursuant to this Paragraph. The insurance policy endorsements shall also provide that all additional insured parties shall be given thirty (30) days' prior written notice of any reduction, cancellation or non-renewal of coverage (except that ten (10) days' notice shall be sufficient in the case of cancellation for non-payment of premium) and shall provide that the insurance coverage afforded to the additional insured parties thereunder shall be primary to any insurance carried independently by said additional insured parties. Additionally, where applicable, each policy shall contain a cross-liability and severability of interest clause.

(f) Without limitation of the indemnification provisions contained in the Lease, to the fullest extent permitted by law Tenant agrees to indemnify, protect, defend and hold harmless Landlord, the parties listed, or required by, the Lease to be named as additional insureds, and their respective beneficiaries, partners, directors, officers, employees and agents ("Landlord's Parties"), from and against all claims, liabilities, losses, damages and expenses of whatever nature to the extent arising out of or in connection with the Tenant Improvements or the entry of Tenant or Tenant's contractors into the Building and the Premises, including, without limitation, mechanic's liens, the cost of any repairs to the Premises or Building necessitated by activities of Tenant or Tenant's contractors, bodily injury to persons (including, to the maximum extent provided by law, claims arising under the California Structural Work Act) or damage to the property of Tenant, its employees, agents, invitees, licenses or others. It is understood and agreed that the foregoing indemnity shall be in addition to the insurance requirements set forth above and shall not be in discharge of or in substitution for same or any other indemnity or insurance provision of the Lease. The foregoing indemnity shall not apply to the extent such matter arises out of or results from the sole negligence or willful misconduct of Landlord or Landlord's Parties or a breach of the Lease by Landlord.

6. **Tenant Allowance.**: Landlord agrees to reimburse Tenant for the TI Costs incurred by Tenant in connection with the Tenant Improvements in an amount not to exceed the Tenant Allowance; provided, however, that Landlord shall retain 5% of the TI Costs for the Tenant Improvements for the cost of Landlord's construction manager, who shall monitor Tenant's and its contractors' performance of the Tenant Improvements. Tenant must, in order to receive the Tenant Allowance, meet all of the following criteria:

Upon completion of the Tenant Improvements, Tenant shall provide Landlord with the following:

- Written proof (a fully signed "Building Final" from the appropriate governmental authority) the Tenant Improvements was completed to the satisfaction of the local building department,
- The original temporary (if applicable) and final certificate of occupancy issued by the local building department,
- The original as-built plans and specifications in electronic CAD format,
- A letter from Tenant acknowledging Tenant's satisfaction with its contractor's Tenant Improvements,
- A request for disbursement of the Tenant Allowance accompanied by paid receipts showing the requested sums were spent on the Tenant Improvements for the Premises.
- A detailed breakdown of the cost of the Tenant Improvements (AIA Form G702 - Application and Certificate for Payment or similar)
- Lien releases from Tenant's contractor, subcontractors and suppliers showing that they have been paid in full.

Within ten (10) days of Tenant's satisfaction of the foregoing conditions, Landlord shall pay the balance of the Tenant Allowance (after deduction of Landlord's 5% construction management fee).

If Tenant fails to satisfy all of the foregoing conditions and/or request reimbursement of the Tenant Allowance (or unpaid portion thereof) within twelve (12) months following the Expansion Commencement Date, then Tenant's right to receive the same shall be deemed waived and null and void, and Landlord shall thereafter have no obligation to pay the Tenant Allowance (or unpaid portion thereof) to Tenant.

7. **Mechanic's Liens**. Tenant shall pay when due all claims for labor or materials furnished or alleged to have been furnished to or for Tenant at or for use on the Premises in connection with the Tenant Improvements, which claims are or may be secured by any mechanic's or materialmen's lien against the Premises or any interest therein. Tenant shall give Landlord not less than ten (10) days' notice prior to the commencement of any work in, on, or about the Premises, and Landlord shall have the right to post notices of non-responsibility in or on the Premises as provided by law. If Tenant shall, in good faith, contest the validity of any such lien, claim or demand, then Tenant shall, at its sole expense, defend and protect itself, Landlord and the Premises against the same and shall pay and satisfy any such adverse judgment that may be rendered thereon before the enforcement thereof against the Landlord or the Premises. If Landlord shall require, Tenant shall furnish to Landlord a surety bond satisfactory to Landlord in an amount equal to one and one-half times the amount of such contested lien claim or demand, indemnifying Landlord against liability for the same, as required by law for the holding of the Premises free from the effect of such lien or claim. In addition, Landlord may require Tenant to pay Landlord's attorneys' fees and costs in participating in such action if Landlord shall decide it is to its best interest to do so.

8. **Subsequent Alterations**. Any subsequent alterations or improvements desired by Tenant after the completion of the Tenant Improvements shall be subject to the provisions of Paragraph 7.3 of the Lease.

EXHIBIT 23.1

CONSENT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

We consent to the incorporation by reference in Registration Statements No. 333-229047, 333-232858, and 333-235446 on Form S-1, Registration Statements No. 333-224061 and 333-224893 on Form S-3, and Registration Statement Nos. 333-204215, 333-210023, 333-216545, 333-223805, and 333-232072 on Form S-8 of our report dated March 25, 2020, relating to the financial statements of Arcadia Biosciences, Inc., appearing in this Annual Report on Form 10-K of Arcadia Biosciences, Inc. for the year ended December 31, 2019.

/s/ Deloitte & Touche LLP

Phoenix, Arizona
March 25, 2020

Exhibit 31.1

CERTIFICATION PURSUANT TO
RULES 13a-14(a) AND 15d-14(a) UNDER THE SECURITIES EXCHANGE ACT OF 1934,
AS ADOPTED PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002

I, Matthew T. Plavan, certify that:

1. I have reviewed this Annual Report on Form 10-K of Arcadia Biosciences, Inc.;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

   (a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

   (b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

   (c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

   (d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

   (a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

   (b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 25, 2020

By: /s/ MATTHEW T. PLAVAN
Matthew T. Plavan
President and Chief Executive Officer
(Principal Executive Officer)

Exhibit 31.2

CERTIFICATION PURSUANT TO
RULES 13a-14(a) AND 15d-14(a) UNDER THE SECURITIES EXCHANGE ACT OF 1934,
AS ADOPTED PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002

I, Pamela Haley, certify that:

1. I have reviewed this Annual Report on Form 10-K of Arcadia Biosciences, Inc.;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

   (a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

   (b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

   (c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

   (d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

   (a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

   (b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 25, 2020

By: /s/ PAMELA HALEY
Pamela Haley
Chief Financial Officer
(Principal Financial Officer)

Exhibit 32.1

CERTIFICATION PURSUANT TO
18 U.S.C. SECTION 1350, AS ADOPTED PURSUANT TO
SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002

In connection with the Annual Report of Arcadia Biosciences, Inc. (the "Company") on Form 10-K for the year ended December 31, 2019 as filed with the Securities and Exchange Commission on the date hereof (the "Report"), I certify, pursuant to 18 U.S.C. § 1350, as adopted pursuant to § 906 of the Sarbanes-Oxley Act of 2002, that:

(1) the Report fully complies with the requirements of section 13(a) or 15(d) of the Securities Exchange Act of 1934; and

(2) the information contained in the Report fairly presents, in all material respects, the financial condition and results of operations of the Company.

Date: March 25, 2020

By: /s/ MATTHEW T. PLAVAN
Matthew T. Plavan
President and Chief Executive Officer
(Principal Executive Officer)

Exhibit 32.2

CERTIFICATION PURSUANT TO
18 U.S.C. SECTION 1350, AS ADOPTED PURSUANT TO
SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002

In connection with the Annual Report of Arcadia Biosciences, Inc. (the "Company") on Form 10-K for the year ended December 31, 2019 as filed with the Securities and Exchange Commission on the date hereof (the "Report"), I certify, pursuant to 18 U.S.C. § 1350, as adopted pursuant to § 906 of the Sarbanes-Oxley Act of 2002, that:

(1) the Report fully complies with the requirements of section 13(a) or 15(d) of the Securities Exchange Act of 1934; and

(2) the information contained in the Report fairly presents, in all material respects, the financial condition and results of operations of the Company.

Date: March 25, 2020

By: /s/ PAMELA HALEY
Pamela Haley
Chief Financial Officer
(Principal Financial Officer)