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Vineyard Investigations

UNITED STATES DISTRICT COURT

EASTERN DISTRICT OF CALIFORNIA

FRESNO DIVISION

VINEYARD INVESTIGATIONS, a California corporation;

Plaintiff,

v.

E. & J. GALLO WINERY, a California corporation;

Defendant.

CASE NO. 1:19-cv-01482-NONE-SKO

FIRST AMENDED COMPLAINT FOR PATENT INFRINGEMENT

JURY TRIAL DEMANDED

Plaintiff Vineyard Investigations, for its First Amended Complaint against Defendant E. & J. Gallo Winery ("Gallo") requests a trial by jury and alleges as follows upon actual knowledge with respect to itself and its own acts and upon information and belief as to all other matters:

NATURE OF THE ACTION

1. This is an action for patent infringement. Vineyard Investigations alleges that Gallo infringes U.S. Patent Nos. 8,528,834 ("the '834 patent"), 6,947,810 ("the '810 patent"), and 10,645,881 ("the '881 patent") (collectively, the "Asserted Patents"), copies of which are attached hereto as Exhibits A, B, and C.

2. Dr. Paul Skinner is a prominent soil scientist, grape grower, and inventor. Nearly two decades ago, he had an idea and a vision for systems and methods of automatic, precision agriculture that he believed would transform vineyard management. His ideas would improve both yield and quality of grapes and other crops, while also saving water and other costs. Dr. Skinner and Vineyard Investigations patented his inventions and set about trying to interest growers and winemakers like Gallo in the new technology. Gallo repeatedly declined to license the inventions. But as Dr. Skinner later discovered, Gallo instead took and used the patented technology without permission. Since learning about Dr. Skinner's inventions, Gallo has built multiple variable rate drip irrigation systems in its vineyards that infringe on the Vineyard Investigations patents asserted in this lawsuit. And Gallo has published papers and articles about those infringing systems—taking credit for and championing the many benefits that Dr. Skinner had imagined and predicted relative to crop yields, grape quality, and reduced environmental impact.

3. Vineyard Investigations alleges that Gallo directly and indirectly infringes the Asserted Patents by making, using, and/or selling systems and methods for automating the irrigation and treatment of grapevines using data from sensors and external sources—including, without limitation, Gallo's various Variable Rate Irrigation ("VRI") systems installed in its vineyards, as well as Gallo's systems for using remotely sensed (*e.g.*, satellite) data in the modeling, scheduling, and control of irrigation. Vineyard Investigations further alleges that

Gallo induces and contributes to the infringement of others. Vineyard Investigations seeks damages and other relief for Gallo's infringement of the Asserted Patents.

THE PARTIES

4. Vineyard Investigations is a corporation organized under the laws of California with its principal place of business at 345 La Fata, Suite D, St. Helena, California 94574.

5. Vineyard Investigations provides consulting and scientific expertise to the wine industry in California and worldwide. For example, Vineyard Investigations has designed and overseen the development of vineyards on Long Island, New York and in Virginia, Washington, Oregon, throughout California, and in northern China—and has subsequently consulted on their soil management, irrigation requirements, canopy management, crop load, and fruit and wine quality management.

6. Vineyard Investigations also owns and manages a portfolio of patents, including the Asserted Patents, that are based on and claim the inventions of Dr. Paul W. Skinner.

7. On information and belief, Defendant Gallo is a corporation organized and existing under the laws of the State of California, having its principal place of business at 600 Yosemite Blvd., Modesto, California 95354. On information and belief, Defendant grows and sells grapes for use in its own and in others' wines, in vineyards in California and in the Eastern District of California, and does so using technology that infringes the Asserted Patents.

8. By registering to conduct business in California and by having facilities where it regularly conducts business in this district, Defendant has a permanent and continuous presence in California and a regular and established place of business in the Eastern District of California.

JURISDICTION

9. This is an action arising under the patent laws of the United States, 35 U.S.C. § 271, *et seq*. Accordingly, this Court has subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a).

10. This Court has personal jurisdiction over Gallo due, *inter alia*, to its continuous presence in, and systematic contact with, this judicial district and its registration in California and domicile in this judicial district. Gallo is subject to this Court's jurisdiction pursuant to due

process at least as a result of Gallo's substantial business in California and this judicial district, including at least part of its past infringing activities, regularly doing or soliciting business at and from its local facilities, and engaging in persistent conduct and/or deriving substantial revenue from goods and services provided in the State of California, including in the Eastern District of California. Gallo directly and/or through subsidiaries or intermediaries, has committed and continues to commit acts of infringement in this judicial district by, among other things, making, using, offering for sale, and/or selling systems and methods that infringe the Asserted Patents.

VENUE

11. Venue is proper in this judicial district pursuant to 28 U.S.C. §§1391(b), (c), (d) and 1400(b) because Gallo has a permanent and continuous presence in, has committed acts of infringement in, and maintains regular and established places of business in this district. In addition, a substantial part of the acts or omissions giving rise to Plaintiff's claims occurred in this district.

FACTUAL ALLEGATIONS

Dr. Skinner's Inventions for Improving Vineyard Yield and Quality

12. Dr. Paul Skinner is a PhD soil scientist, viticulturist, and grape grower who has been working in the wine industry since the 1980s. He holds a Bachelor of Science degree in Water Resource Management from the University of Wisconsin, a Master of Science degree in Agronomy from Colorado State University, and a Doctorate in Soil Science from the University of California at Davis. Dr. Skinner also produces and sells wine under the label Sequum, named for a soil science term describing the sequence of layers in a soil.

13. Dr. Skinner founded a consulting company, Vineyard Investigations (formerly known as Terra Spase, Inc.), in 1988. Vineyard Investigations focused on applying Dr. Skinner's scientific expertise to solve vineyard soil, vine growth, and vine nutrition issues. Since that time, Dr. Skinner's consulting work has remained on, and advanced, the forefront of technology in data collection, analysis, and interpretation for developing and improving vineyard management practices.

14. For example, in 1994 Dr. Skinner developed the first Geographic Information

System (GIS) and GPS enabled database to enable him to map vineyard soil variability in both new and existing vineyards with respect to both soil physical and chemical characteristics.

15. In 1997, Dr. Skinner participated in the CRUSH project with NASA and Robert Mondavi Winery to develop and commercialize a remote sensing product that is currently known as a Normalized Difference Vegetation Index ("NDVI"). NDVI is now widely used around the world to assess vineyard growth conditions and canopy development—for refining irrigation, fertilization, and harvest practices, as well as for vineyard management.

16. In 2004, Dr. Skinner partnered with John Deere, Inc. to test and utilize a new soil probe that could collect very detailed and spatially accurate measurements of soil physical and chemical properties in situ. This system, known as the Soil Information System ("SIS") has been used by Vineyard Investigations to describe soil variability on thousands of vineyard and other agricultural acreages.

17. Starting in 2006, Dr. Skinner was part of a consulting team tasked with identifying potential premium vineyard sites in China. Dr. Skinner was responsible for choosing 4 of those sites in northern China and then leading a team of 6 viticulture specialists to design and oversee the installation of a more than 1200-acre, state-of-the-art vineyard. One of the wines produced from the first vintage, a 2012 Syrah, was recognized as the Best Red Wine in China by Bettane+Desseauve, a wine rating organization based in France, at the 2016 Le Grand Tasting in Shanghai.

18. In addition to consulting, Dr. Skinner has also published and presented his various research. In 2013, Dr. Skinner and a colleague from the University of Wroclaw in Poland presented a research paper at the 18th GiESCO meeting in Oporto, Portugal on the use of a vineyard suitability model his team had developed, entitled "Evaluating Vineyard Suitability in Southwestern Poland Using A Knowledge-Based Indexing Model." This model has proven useful in evaluating existing and potentially new vineyard sites with regard to different economic and climate change scenarios. In June 2019, Dr. Skinner presented a research paper at the 21st GiESCO conference in Thessaloniki, Greece on work he did while at UC Davis in the 1980's. This paper was published in the May 2019 edition of the European Wine Journal, and is entitled

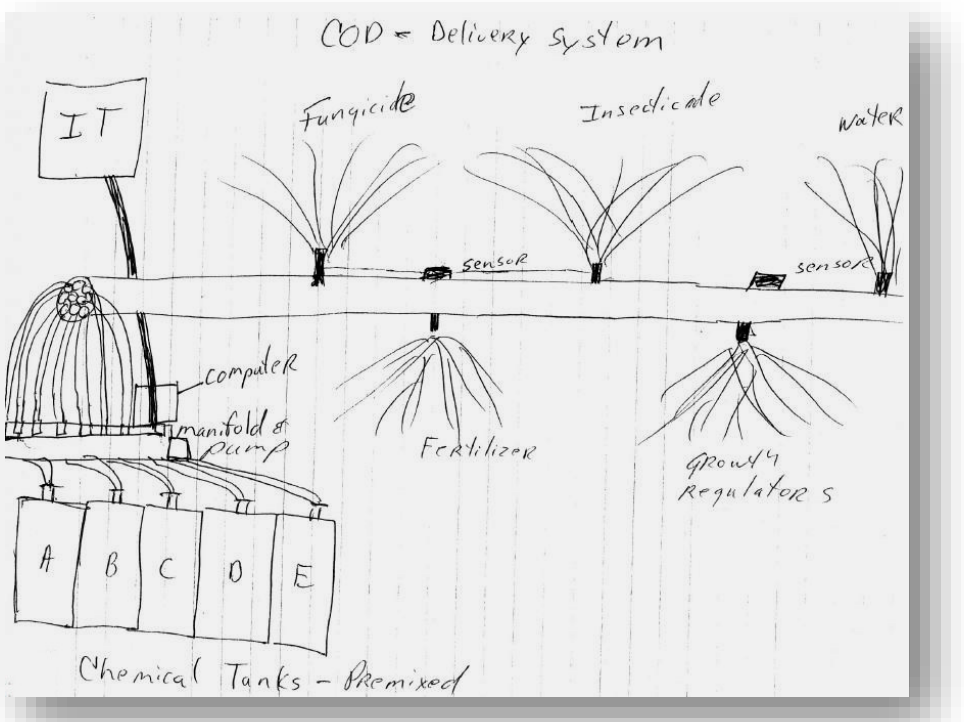
"Sensory Attributes of Wines Made From Vines With Differing Phosphorus Status." This was one of only a very few studies to provide direct evidence of a source of variation in wine sensory attributes that both occurs naturally and can be manipulated by the grower.

19. In addition to his consulting and various applied research projects, Dr. Skinner is also an inventor. He maintains a small, state of the art, sensor data driven vineyard at his home where he can experiment with and develop new growing techniques.

20. In 2000, while on a cross-country flight, Dr. Skinner had an idea, and he began developing what would eventually become an entire family of patents. Dr. Skinner had been working for many years on different ways to manage soil variability in his client's vineyards—variability that could mean the ideal growing conditions for one vine were completely different from the ideal for neighboring vines throughout the vineyard. It occurred to him to design an automated system to, in the best-case scenario, supply every vine with exactly what it needed from a nutrition, water, canopy vigor, and insect and disease prevention standpoint. He began to develop a "smart" drip irrigation system that would be controlled by an advanced system of sensing technology, along with vine growth and disease risk models, to apply water and potentially multiple other chemicals to individual vines when and where they needed them.

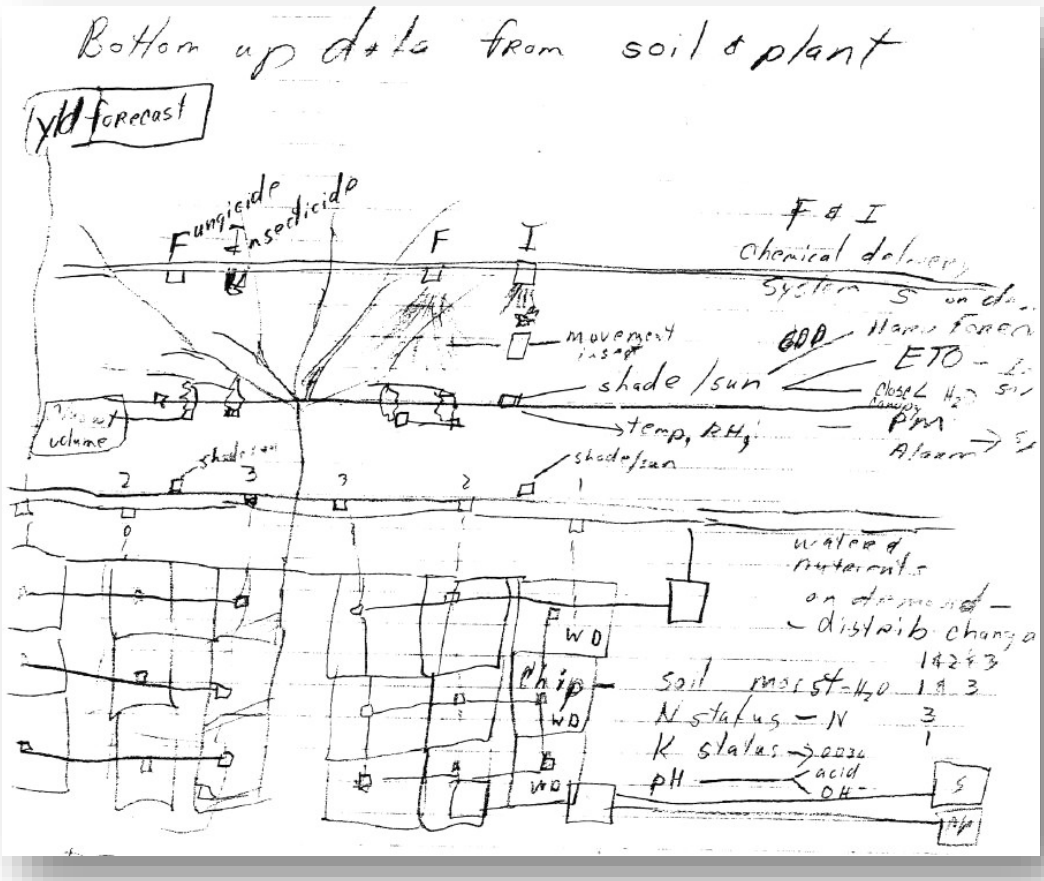
21. On that flight, Dr. Skinner began sketching his ideas for this automated vineyard management system, creating drawings and initial notes of the invention. For example, one diagram depicted a multi-channel conduit capable of delivering water, fertilizers, fungicides, and insecticides to individual or groups of vines depending on detected information about their needs:

<u>Delivery system for variable rate vine inputs</u>



see also Ex. A ('834 patent) at Figure 3. Dr. Skinner's original sketches contained core ideas that would eventually make up his invented system, including for example various sources for sensor and external data inputs on plant growth characteristics used to control the system. Dr. Skinner's contemplated data sources included sensors for soil moisture, soil N (nitrogen) and K (potassium) status, soil pH, as well as vine canopy density (sun/shaded area, *i.e.*, NDVI), vine evapo-transpiration (ET_o), vine microclimate (*e.g.*, temperature, relative humidity), vine insect populations, cluster volume, growing degree days (GDD), yield and harvest forecasts.

Sensors and external sources for monitoring soil and vine canopy growth conditions



Vineyard Investigations Patents

22. Vineyard Investigations owns a portfolio of patents and patent applications claiming inventions of Dr. Skinner in the field of intelligent automated monitoring and maintenance of growing crops. The inventions claimed in the patents have broad application in a variety of agricultural contexts, including particularly for improving vineyard management practices in the wine industry.

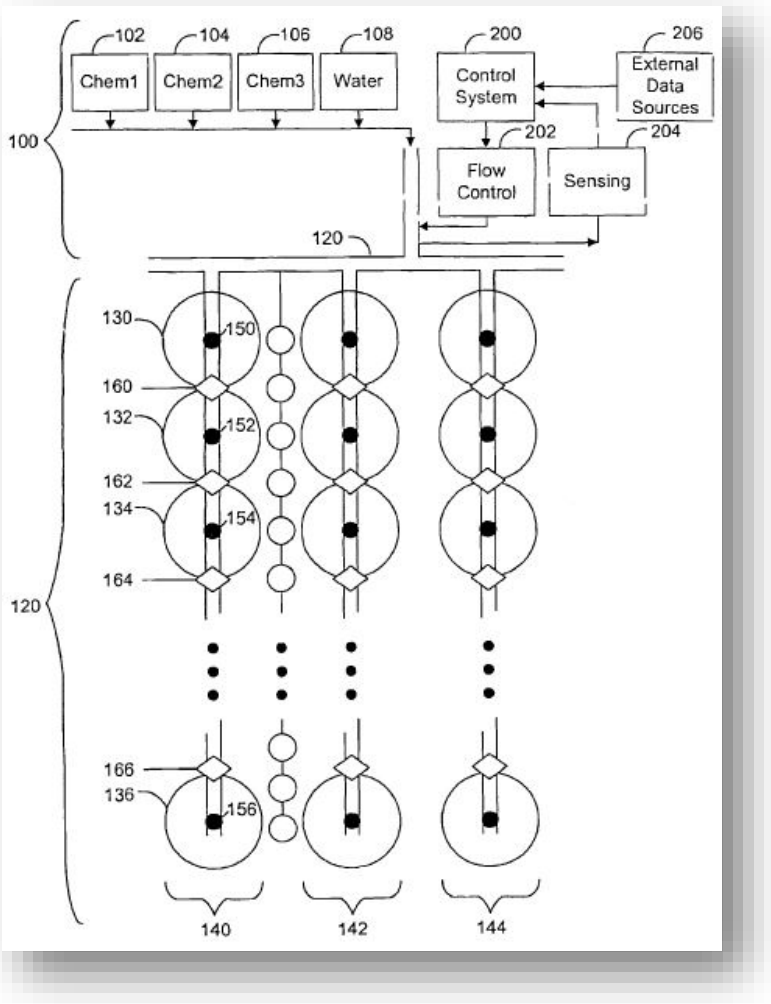
23. Each of Vineyard Investigations' patents and applications derives from, and shares patent specification disclosures with, parent United States Patent No. 6,874,707, which was filed on May 31, 2001 and was issued by the USPTO on April 5, 2005. United States Patent Nos. 8,528,834, 6,947,810, and 10,645,881 are asserted here.

24. United States Patent No. 8,528,834, entitled "Plant Growing System Using External Data and Having Sensors Associated with Plants," was duly and lawfully issued by the USPTO on September 10, 2013. Vineyard Investigations is the owner of all right, title, and

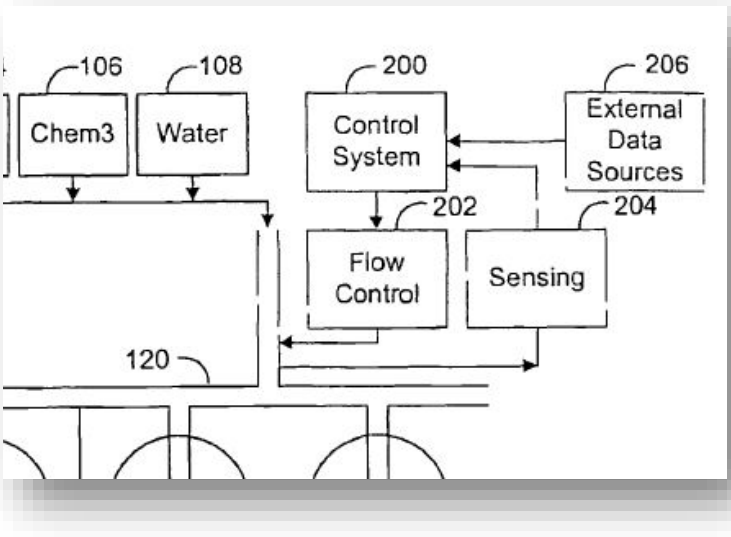
interest in the ’834 Patent. A true and correct copy of the ’834 Patent is attached hereto as Exhibit A.

25. The ’834 Patent describes and claims a “system for monitoring and managing plant growth” in which: “Combinations of data from sensors local to a vineyard, and from optional remote stations and sensors, is combined with a control system to accurately control the dispensing of water and chemicals such as insecticides, disease prevention fungicides and fertilizers.” ’834 Patent at Abstract, 1:15-17, 3:9-15. While the innovative systems of the patent could be advantageously applied to many different crops, some applications of the system are particularly adapted to improve the growing of grapevines in a vineyard. *Id.* at 3:9-10, 3:52-55. The systems and methods disclosed and claimed in the ’834 patent provide significant advantages in such an environment, where smart automation reduces the high cost of vine growth management, and where soil and vine growth variability need to be addressed to improve yield and fruit quality. *See, e.g., id.* at 6:19-26 (“growers can realize improvements in yield and quality of the high valued fruit.”).

26. An example configuration of the invented system, as shown in Figure 1 of the ’834 Patent below, contains various types of in-field sensors (numbered 160, 162, etc.) and emitters (numbered 150, 152, etc.) for dispensing water and other materials. In addition to real-time data from the in-field sensors, the controller (200) of the example system also can receive and utilize external data from a number of sources (206):



'834 patent at Figure 1. The "external data" in the invented system can include remotely sensed weather data, evapo-transpiration coefficients, crop development data, and other information. *See id.* at 5:1-9. Sensor and external data can be processed through a number of advanced modeling techniques described in the patent. *See id.* at 5:10-35. This data and modeling are then used as inputs into the automated, fine-grained control of the variable rate irrigation and nutrient application system. *See, e.g., id.* at Figure 1 (detail):



27. The inventions of the '834 Patent presented an important advance from existing vineyard drip irrigation systems at the time, which were manually controlled or were automated in simplistic ways with a timer or computer. *See* '834 Patent at 1:29-38. Such systems did not "provide a high level of automation" like the systems of the patented invention, and did not address soil variability problems by "selectively provid[ing] different amounts of water to different plants" or plant areas. *Id.* at 1:39-44. In addition, the invented system provided new and unconventional ways to automatically integrate "sophisticated information" about plant sizes, weather conditions and forecasts, and soil conditions—which previously had only been used in the growing process, if at all, via "human intervention" that was "prone to errors and inefficiencies." *Id.* at 1:44-57. Dr. Skinner's patented innovations advanced the field and solved these and other problems in the prior art—including through his use of real-time sensor and external data, processed according to various agricultural models, as control inputs to a variable rate irrigation system. *See, e.g., id.* at 8:13-22.

28. Dr. Skinner understood, at the time he developed his inventions, that the use of sophisticated sensor and external data to automate vineyard management would have significant positive effects and would be extremely valuable to growers. For example, Dr. Skinner knew that properly adjusting water and chemical application in response to weather data, soil moisture data, and other information can prevent crop failure, improve crop quality and yield, and save growing and harvesting costs. *See, e.g.*, '834 Patent at 2:13-24. In addition, the patented

systems and methods provide the benefit that "delivery of materials can be more precisely directed to where it is needed." *Id.* at 8:13-17.

29. Providing fine-grained variability in the manner of the claimed inventions leads to improvements in yield and grape quality, because each vine receives a more accurate and effective application of nutrients. These yield and quality improvements enable growers to harvest and sell more grapes, and to get a higher price for those grapes due to the premium placed on high quality grapes in the wine industry. In addition, improvements in yield achieved through use of the system allow growers to grow more grapes on the same amount of land. This enables growers to avoid significant capital costs for buying and developing land—costs which can run into hundreds of thousands of dollars per acre in prime growing areas of Napa, Sonoma, and elsewhere.

30. The claimed inventions provide improvements and address soil and vine variability in an efficient manner that decreases water use and lowers costs. *See, e.g., id.* at 8:13-22. Dr. Skinner understood the value in the efficient use of water that could be provided by his well-controlled variable rate irrigation system, particularly in drought-prone growing regions where water costs are a significant factor to profitability.

31. United States Patent No. 6,947,810, entitled "System for Automated Monitoring and Maintenance of Crops Including Sensors and Emitters Associated with Plants," was duly and lawfully issued by the USPTO on September 20, 2005. Vineyard Investigations is the owner of all right, title, and interest in the '810 Patent. A true and correct copy of the '810 Patent is attached hereto as Exhibit B.

32. The '810 Patent describes and claims inventions related to the overall system described above and includes specific claims relating to use of in-field sensors providing inputs to the smart automated control system. *See, e.g.*, '810 Patent at 9:28-41 (claim 2). These in-field sensors can be attached to the conduit providing water and/or other nutrients. *See id.* at 3:24-31. They can also be placed at other locations in the vineyard, such as for soil nutrient and moisture monitoring sensors that may need ground contact. *See id.* at 5:46-51. The patent also discloses that the control for the system can be centralized or distributed, and that control can be

associated with individuals or groups of sensors and emitters in order to assess and respond to variability in the vineyard. *See id.* at 5:52-67 ("With more finely-grained monitoring and control (achievable by either a centralized control system or distributed system) delivery of chemicals, water, and other materials can be made to only the exposed plants.").

33. The inventions claimed in the '810 Patent improved on the prior art and provided the same benefits as discussed above with respect to the '834 Patent. Individually and together, the claimed inventions provide new and unconventional techniques for intelligent monitoring and management of crops such as grapevines—and do so by enabling the system to variably and "accurately control the dispensing of water" and other chemicals and nutrients. *See, e.g.*, '810 Patent at Abstract.

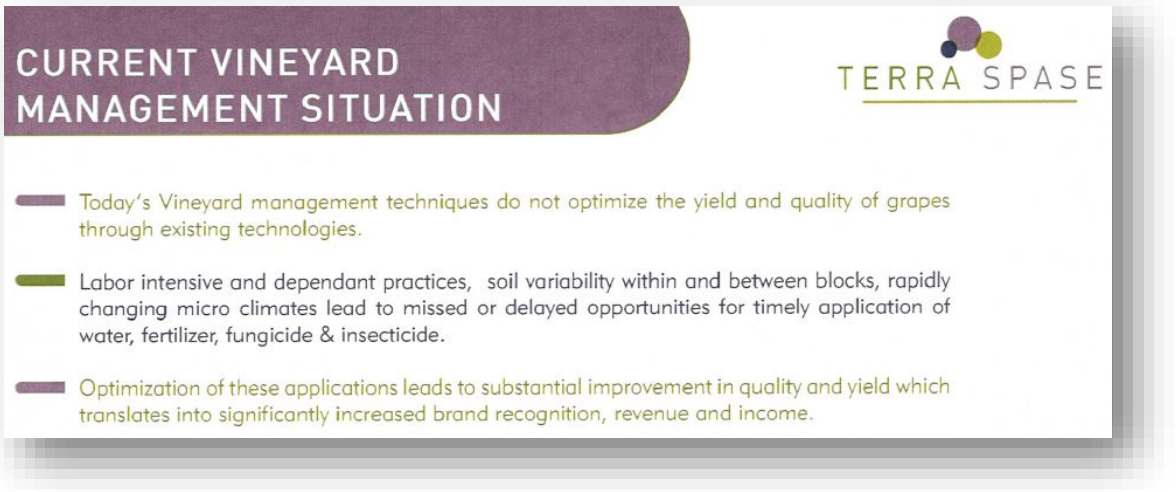
34. United States Patent No. 10,645,881, entitled "Plant Growing System Using External Data," was duly and lawfully issued by the USPTO on May 12, 2020. Vineyard Investigations is the owner of all right, title, and interest in the '881 Patent. A true and correct copy of the '881 Patent is attached hereto as Exhibit C.

35. The '881 Patent describes and claims inventions related to the overall system described above and includes specific claims relating to use of external data, such as from satellites or other remote sources. *See, e.g.*, '881 Patent at 14:14-26 (claim 1). The external data is based, at least in part, on a model that includes potential data, such as potential evapotranspiration. *See id.* at 14:25-26, 16:5-6. The patent discloses and claims various ways that such remotely-sensed external data and potential-based modeling can be integrated with irrigation control systems. *See id.* at 5:14-33. Variability, or granularity of control, can be addressed in the claimed inventions with division of larger sites into any size "plant areas." *See id.* at 14:14-15.

36. The inventions claimed in the '881 Patent improved on the prior art and provided similar benefits as discussed above with respect to the '810 Patent and '834 Patent. Individually and together, the claimed inventions provide new and unconventional techniques for intelligent monitoring, modelling, and management of crops such as grapevines—and do so by enabling the system to incorporate advanced remote-sensing data sources with intelligent controls to facilitate

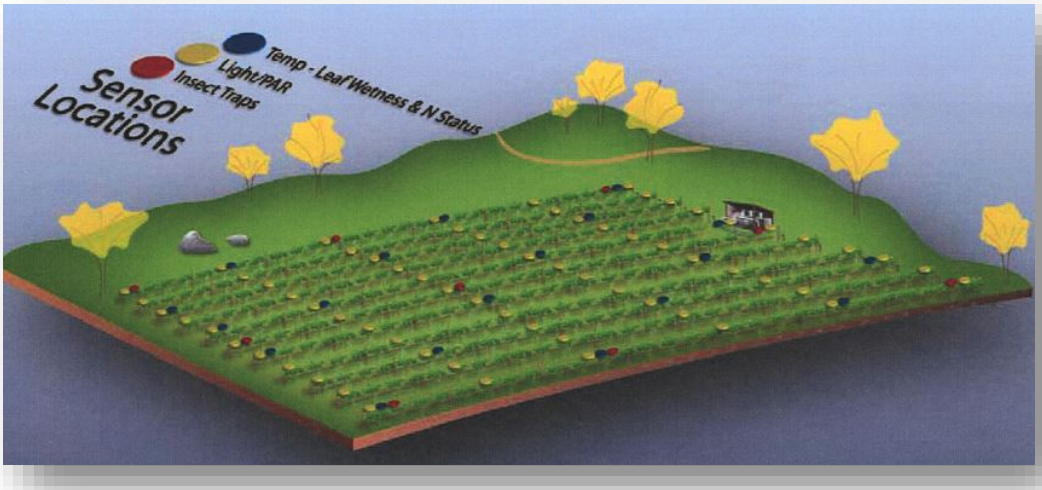
improvements in precision irrigation. *See, e.g.*, '881 Patent at Abstract, 1:55-61, 6:36-44.

37. Since obtaining patents on his inventions, Dr. Skinner and Vineyard Investigations have frequently discussed and advertised the benefits of the inventions to winemaking professionals—including, as discussed further below, to executives and viticulturists at Gallo. For example, Vineyard Investigations (then named Terra Spase) created a presentation to explain the need for the patented system, to demonstrate how it worked, and to list the many economic benefits of the patented system and methods:



Display of sensors placed in the vine canopy and soil root zone with the application of water and fungicides based on sensor and external data

Example placement of different types of sensors within a vineyard for monitoring vineyard growth conditions (light, PAR), disease risk (temperature/leaf wetness), vine vigor (N status) and insect infestations (traps)



38. This presentation by Vineyard Investigations highlighted many benefits of the inventions, including that the system: "Reduces water consumption, increases water use efficiency," "Improves sustainability of vineyard by increasing consistency of crops year after year," provides up to "50% improvement in low yielding areas over traditional management practices," provides "10% improvement in sugar and quality of grapes compared to traditional methods," gives "Granular control throughout vineyard of small numbers of individual vines," and "Reduces equipment and labor costs."

39. In summary, the claimed inventions of the Asserted Patents provide significant benefits to growers and winemakers like Gallo—as can be seen in Gallo's own discussions of its infringing systems discussed below. Those benefits include increased grape yield, leading to both greater sales and to significant capital cost avoidance. The inventions also increase grape quality, leading to higher prices for wine grapes grown with the patented systems and methods. And the deployment of Dr. Skinner's inventions can also significantly reduce water use and the cost of water for irrigation, as well as reducing other growing and management costs. *See, e.g.*, '810 patent at 6:30-38, 8:29-38 ("delivery is also performed as needed so care of the crops is more accurate and effective and there is less waste").

40. Each of the benefits discussed above would have been, and was, obvious to Gallo executives when they first learned of and reviewed Dr. Skinner's patents. Each of the benefits discussed above would have been, and was, obvious to Gallo executives when they declined to

license the patented technology. And each benefit was obvious to Gallo when it subsequently built, used, and advertised the benefits of infringing systems in Gallo's own vineyards. Yet Gallo built, used, and continues to benefit from these systems without permission from, or any compensation to, Dr. Skinner or Vineyard Investigations for Dr. Skinner's valuable inventions.

Gallo's Knowledge of the Patented Technology

41. Gallo has known of the Vineyard Investigations patents, including the Asserted Patents and the inventions therein, since at least April of 2010. At that time, a licensing intermediary for Dr. Skinner and Vineyard Investigations contacted Gallo. Gallo received information identifying the patents and their benefits, including a version of the presentation discussed and excerpted above. In addition, on May 18, 2010, Dr. Skinner personally contacted Alan Reynolds of Gallo concerning an automated vineyard system based on the Vineyard Investigations patents, including the '810 Asserted Patent.

42. Subsequently, and without license from Dr. Skinner or Vineyard Investigations, Gallo began and continued the use of variable rate irrigation systems in its vineyards that infringe the Asserted Patents, as described more fully below. For example, Gallo, in partnership with IBM, built, tested, and benefited from an infringing variable rate irrigation system in one of its vineyards from 2012 through at least 2015. And Gallo published papers and articles championing the benefits of the system. *See, e.g.*, "Variable rate irrigation to manage vineyard variability in California," *available at* http://proceedings.esri.com/library/userconf/proc15/papers/185_435.pdf. Gallo's system included each of the aspects of Dr. Skinner's inventions, including emitters, controllers, and sensors for managing variable rate irrigation—as can be seen for example in this photo of the system:

43. On April 8, 2016, Dr. Skinner further contacted an executive of Gallo about the Vineyard Investigations patents, noting their application to automation and vineyard practices. On June 3, 2016, Gallo responded and promised further follow-up, but none occurred.

44. On May 10, 2017, Dr. Skinner viewed certain Gallo vineyards at Borden and at Livingston Ranch on invitation from Gallo employees familiar with his soil science consulting work. On that occasion, Dr. Skinner observed variable rate irrigation systems in use that implicated aspects of the inventions of the Vineyard Investigations patents. For example, Gallo had installed conduit, emitters, sensors, and controllers for variable rate irrigation zones. *See* below:

Photo of multi-channel under-canopy conduit, used to deliver water and nutrients to Landsat pixel sized units of vines in the vineyard block

Photo of control box with valves for varying irrigation to individual units of vines in the vineyard

In addition, Dr. Skinner learned that Gallo was also using external data to derive important K_C crop coefficients. He observed in-field sensors for measuring various growth conditions as discussed and claimed in the Asserted Patents, including on sensor towers at the Borden location. These infringing sensors and systems were subsequently described by Gallo in several academic papers. *See, e.g.*, W. Kustas, *et al.*, "The Grape Remote Sensing Atmospheric Profile and Evapotranspiration Experiment" ("GRAPEX 2018"), Bulletin of the American Meteorological Society, 2018, at 1795 (describing sensor arrays for measuring, for example, "temperature under the vine canopy and across the interrow," "soil water content and temperature," and "soil heat flux"); *see also id.* at Figure 2:

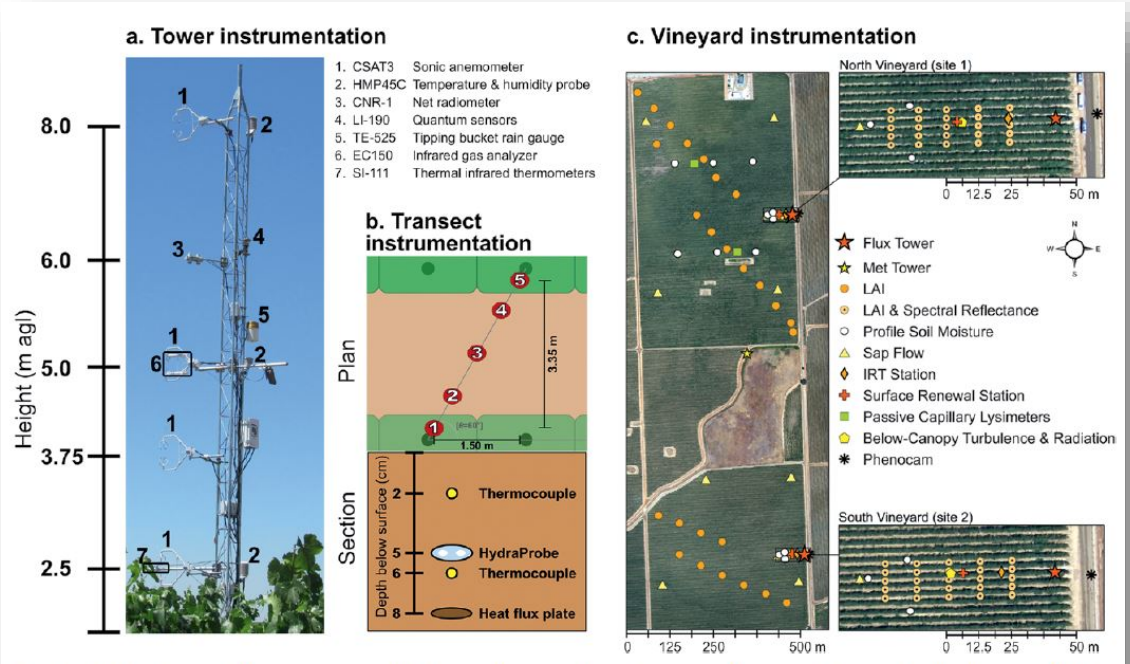


FIG. 2. (a) A photo of the tower installation and sensor locations on the tower is provided, along with (b) a schematic of the soil heat flux sensor measurement design (see text for details). (c) GRAPEX sensor locations in the north (site 1) and south (site 2) vineyards, along with leaf area sampling locations during the IOPs.

45. On the day after observing Gallo's unlicensed use of infringing systems in its vineyards, Dr. Skinner once again attempted to interest Gallo in licensing the Vineyard Investigations technology that Gallo was plainly using and benefiting from. On May 11, 2017, Dr. Skinner emailed an executive of Gallo to discuss the Vineyard Investigations patents and their potential use to address variability and increase yield. That email specifically attached the '834 and '810 Asserted Patents, and offered to continue discussions about the patent portfolio and its usefulness to Gallo.

46. Through their licensing intermediary at the time, Dr. Skinner and Vineyard Investigations again contacted Gallo about the patent portfolio in October of 2017. On October 21, 2017, Dr. Nick Dokoozlian, Vice President of Viticulture, Chemistry, and Enology at Gallo, responded asking for more information about the patents. On October 23, 2017, Vineyard Investigations again provided information about the patents, and specifically highlighted Claim 2 of the '810 Asserted Patent as an example claim that would be of interest to Gallo. At that time, Vineyard Investigations also provided Gallo and Dr. Dokoozlian with a

version of the presentation slides discussed and excerpted above.

47. On January 5, 2018, Dr. Dokoozlian responded further, noting that of the listed patents, "several looked interesting," and asking for additional information. At that time, Dr. Dokoozlian expressed that Gallo did not wish to pursue a license to the '810 Asserted Patent. Vineyard Investigations provided additional information on January 8, 2018. On February 14, 2018, Dr. Dokoozlian indicated that review of the patents had been completed and stated that while several patents were deemed "intriguing," Gallo was not interested in pursuing the Vineyard Investigations patents further. Subsequent communications with Gallo did not yield a different result.

48. On information belief, before and during many of the communications described above and at least as early as 2013, Gallo had employed in its vineyards and was benefiting from systems and methods that infringe the Asserted Patents. Gallo executives well understood the benefits of Dr. Skinner's inventions, and indeed were praising those benefits in stories and articles about Gallo's infringing systems. For example, in a Blog post written by Dr. Dokoozlian on August 9, 2016, he described an infringing Gallo system, which had already increased crop yield by "30 percent" while reducing water use by "16 percent":

> . . . we began looking at our vineyards in these same 30 by 30 meter areas. That basically means five or six vine rows wide, by about 20 to 25 vines long. Each water line is wrapped with sensors that wirelessly and continuously communicate environmental conditions and vine stress to a central computer. This hyper-localized information, and real-time unstructured data, like the satellite imagery and weather forecasts, is automatically processed. Then, the system provides recommended watering instructions.

IBM, "Client Success Field Notes: Smarter water, better wine at E. & J. Gallo Winery," available at https://www.ibm.com/blogs/client-voices/water-efficiency-better-wine-gallo-winery/. Gallo's infringing uses of Dr. Skinner's inventions are described further below.

49. Gallo had specific knowledge of the Vineyard Investigations patents, including the Asserted Patents, and knew of the application and usefulness of Dr. Skinner's inventions to Gallo's vineyard management efforts. Gallo also knew that Dr. Skinner and Vineyard

Investigations sought to license this technology to Gallo. Yet despite this knowledge, Gallo declined to take any license, and willfully began and continued its infringing use of Dr. Skinner's inventions, as further described below.

Gallo's Willful Use of the Patented Technology

50. Beginning at least as early as 2013, and with knowledge of Dr. Skinner's inventions, Gallo installed an infringing variable rate drip irrigation system in a 10-acre portion of one of its Central Valley Cabernet Sauvignon vineyards. *See, e.g.*, Brent Sams, Luis Sanchez, Maria Mar Alsina, Alan Reynolds, and Nick Dokoozlian, "Variable Rate Drip Irrigation for Vineyards," American Society of Agronomy, Proceedings of the 2017 California Plant and Soil Conference, Jan. 31 – Feb. 1, 2017, at 80. That system used a crop model based on external data from Landsat satellites, local weather data, and in-field sensors to automatically control variable rate drip irrigation in 140 different 15 x 15 meter irrigation zones. *Id.* at 80-82. This infringing system was operated for three years, after which Gallo began publishing papers describing the benefits Gallo had achieved through the unauthorized use of Dr. Skinner's inventions.

51. For example, Gallo reported that with the infringing system: "Yield and water use efficiency were higher in VRDI [Variable Rate Drip Irrigation] than CDI [Conventional Drip Irrigation] in all three years (10% and 12% on average respectively). *Id.* at 80. Gallo's own data from this infringing system showed a 16% yield increase in the plot for 2014, and in 2015 Gallo saw a 17% increase in water use efficiency:

Table 2. Average yield and water use efficiency of variable rate and conventional irrigation in all four years of the study

Year	Yield (tons/acre)		Gain VRDI/CDI (%)	WUE (tons/acre-foot)		Gain VRDI/CDI (%)
	VRI	CI		VRI	CI	
2012	8.9	8.9	0.0	5.93	5.93	0.0
2013	7.7	7.4	4.1	5.63	4.93	14.2
2014	10.1	8.7	16.1	7.43	7.08	4.9
2015	5.1	4.6	10.9	4.27	3.65	17.1
Average			10.3			12.1

Id. at 84. This increase in yield, described in the Asserted Patents and observed by Gallo through its infringement of the patents, can be seen in yield maps included in Gallo's paper:

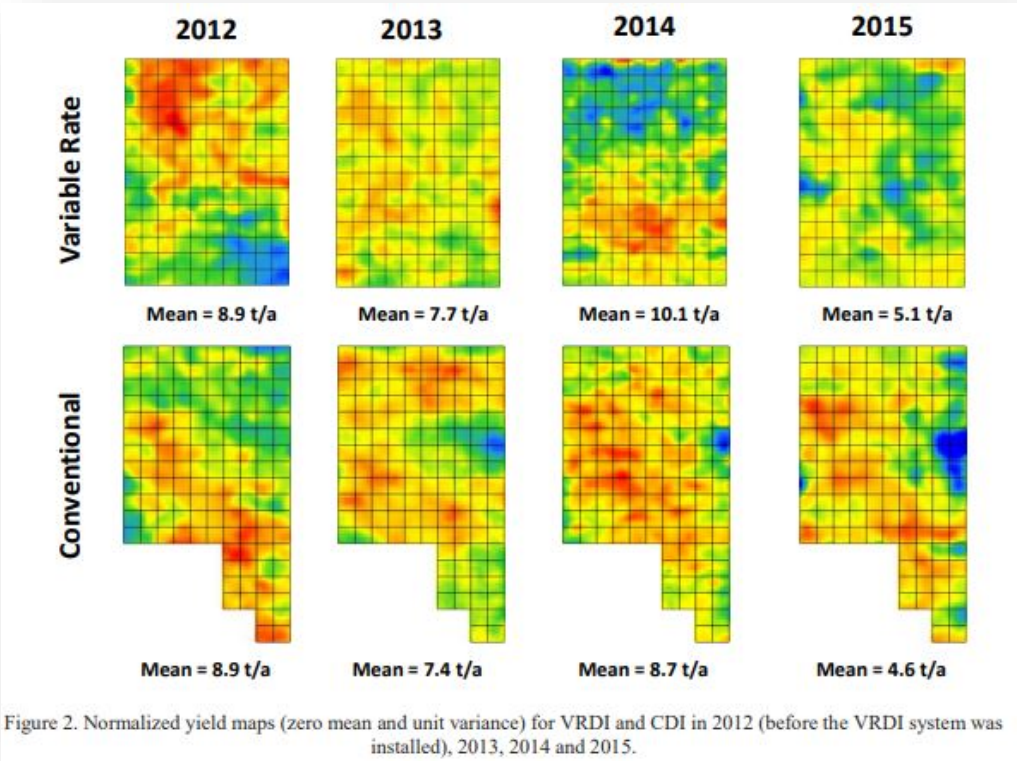


Figure 2. Normalized yield maps (zero mean and unit variance) for VRDI and CDI in 2012 (before the VRDI system was installed), 2013, 2014 and 2015.

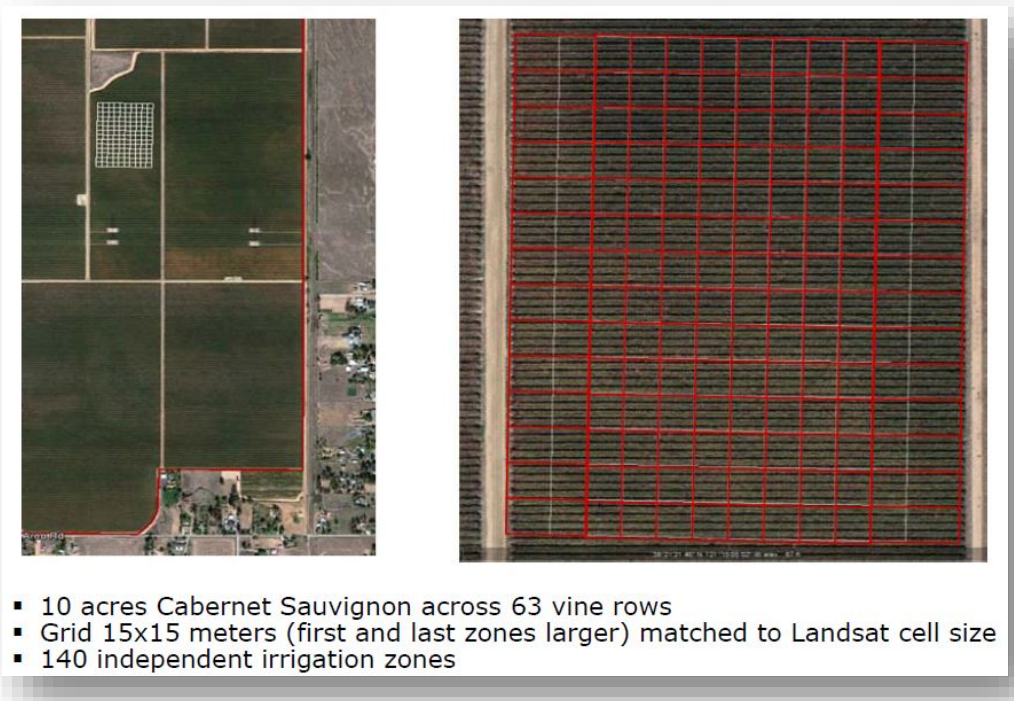
Id. at 85 (showing low yields in red with progressively higher yields in yellow, green, and blue, and demonstrating both higher yield and decreased variability versus "Conventional" drip irrigation for each year).

52. Other articles further described both the infringing features, and realized benefits, of Gallo's infringing system. *See, e.g.*, L. Sanchez, M. Mendez-Costabel, B. Sams, A. Morgan, N. Dokoozlian, et al., "Effect of a Variable Rate Irrigation Strategy on the Variability of Crop Production in Wine Grapes in California," *available at* https://www.ispag.org/proceedings/?action=download&item=1582, at 5 ("***Irrigation of the 140 zones is controlled by a computer network*** with a single master coordinating operation (Figure 2). The master and individual control nodes communicate using master-slave messaging protocol based on MODBUS (Modbus.org 2006). A read/write memory abstraction is used to issue commands to control nodes and retrieve information from ***attached sensors***.") (emphases

added); *see also id.* at 9-10 (noting decreased variability, and improvements related to yield and water use efficiency).

53. Gallo's original infringing system at Colony Ranch was implemented in consultation with IBM, which also published articles and presentations describing the infringing system and its benefits—including, for example, in a September 23, 2016 presentation titled "Precision Agriculture: Variable Rate Micro Irrigation in a Vineyard and Application of Big Data" from IBM's TJ Watson Research Center ("Precision Agriculture"). Just as Dr. Skinner had described in the Asserted Patents, IBM's presentation noted how "irrigation requirements from ***evapo-transpiration modeling*** can be coupled with a differential irrigation system and in field sensors measurements" of information such as "***soil moisture***," "canopy ***temperature***," and "nutrients." *Id.* at 2; *see also* '834 Patent at 5:1-9 ("Examples of external data include weather data, crop growth models, growing degree days, ET_o and ET_c (***evapo-transpiration coefficients***), . . ."), 7:32-35 ("Other sensors can report on the amount of rain, ***temperature*** and humidity, ***soil moisture conditions***, etc., so that delivery of nutrients and can be adjusted accordingly.") (emphases added).

54. The Precision Agriculture presentation described and showed pictures of Gallo's infringing system:



Precision Agriculture at 5-6. The presentation also described the many realized benefits of the infringing system, including yield increase of "26% in the [Variable Rate Irrigation (VRI)] area compared to the control area" and more uniformity of yield. *Id.* at 7. The area implementing Dr. Skinner's patented inventions also saw "20% less water used than in the control area." *Id.* at 9.

55. As mentioned above, Dr. Dokoozlian, who was responsible for viticulture, chemistry, and enology at Gallo, co-authored papers and wrote blog posts on Gallo's infringing system and its realized benefits. For example, in "Smarter water, better wine at E. & J. Gallo Winery," Dr. Dokoozlian wrote that:

> We started this project with 10 acres. After about six weeks of running the system, satellite imagery showed us that everything within the test grid was uniform. What previously looked like a checkerboard showing vines of all different stages of growth and water stress, now looks optimally healthy. Plus, after a single growing season, we found that ***water use in the test vineyard was reduced by 16 percent while crop yield increased by 30 percent***. Also important, the ***quality of our grapes improved, making our wine even better***.

(emphases added). Gallo used and continues to use grapes grown using the infringing system in its wines, including for example in its Darkhorse Wines Cabernet Sauvignon. *See, e.g.*, "How IBM is Bringing Watson to Wine," *available at* https://fortune.com/2016/01/09/ibm-bringing-watson-wine/, at 5-6.

56. Indeed, Gallo's own 2019 Sustainability Report championed several of the many benefits of this infringing system covered by the Asserted Patents, stating that:

> "We recently partnered with IBM Research on a "smart" irrigation system. This ***system fuses weather reports, satellite imagery and remote sensor data regarding soil conditions to deliver precisely the right amount of water to each vine***. This represents a revolutionary approach compared to the current technology that, at best, delivers water to a specific row of vines. The smart irrigation system ***reduced water use by 25%*** and ***produced better quality grapes***."

E. & J. Gallo, 2019 Sustainability Report, at 5, *available at* http://www.gallo.com/files/EJGallo_SustainabilityReport_2019.pdf (emphases added). Numerous Gallo vineyard locations (including those discussed herein) are certified by the California Sustainable Winegrowing Alliance, which lists Gallo's sustainable practices for "Vineyard Water Management" as including "soil moisture and plant water status is monitored weekly during growing season" and "irrigation scheduling is based on evapo-transpiration." *See* https://www.sustainablewinegrowing.org/certifiedparticipant/8/EJ_Gallo_Winery.html. These sustainable practices, and the benefits Gallo derives from them, are enabled by Gallo's unauthorized and infringing use of Dr. Skinner's patented inventions.

57. On information and belief, Gallo has continued to use and operate the infringing system in the Colony Ranch vineyard as described above, and has expanded its use of Dr. Skinner's patented inventions to other locations. For example, an article in the Electronic Engineering Times of India noted that as of 2017, Gallo had installed the smart irrigation system "in six different vineyard blocks encompassing nearly 250 acres in California." The article quoted Gallo stating that "these blocks are experiencing a 20% increase in water use efficiency." *See* EE Times India, "Vineyard turns to IoT to improve water use," April 18, 2017, *available at* https://www.eetindia.co.in/news/article/vineyard-turns-to-iot-to-improve-water-use.

58. Gallo has continued to publish articles and scholarly papers describing its expanding infringing use of Dr. Skinner's inventions as claimed in the Asserted Patents. For example, the GRAPEX 2018 paper excerpted above discusses systems installed in three Gallo vineyards across California:

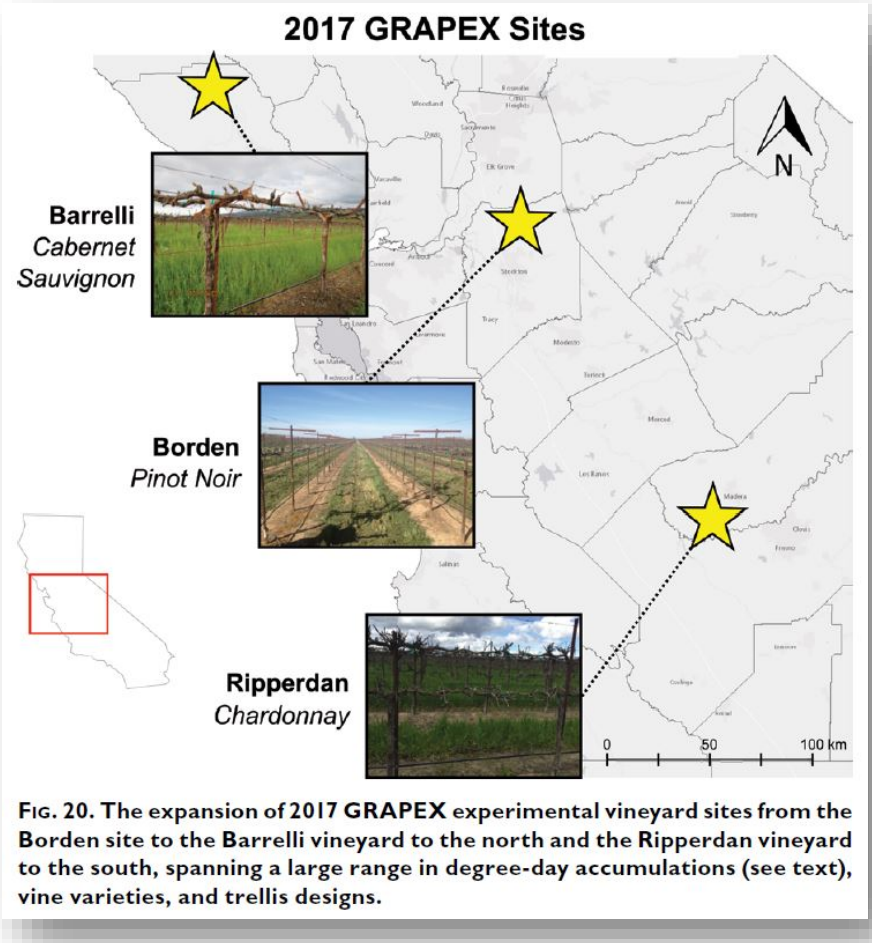


FIG. 20. The expansion of 2017 GRAPEX experimental vineyard sites from the Borden site to the Barrelli vineyard to the north and the Ripperdan vineyard to the south, spanning a large range in degree-day accumulations (see text), vine varieties, and trellis designs.

GRAPEX 2018 at 1809; *see also id.* at 1810 (acknowledging funding provided by Gallo and collection and processing of field data by Gallo's Viticulture, Chemistry, and Enology Division). Another paper detailing Gallo's work on the GRAPEX project identifies a fourth site at Livingston Ranch. *See* W. White, *et al.*, "Determining a robust indirect measurement of leaf area index in California vineyards for validating remote sensing-based retrievals," Irrigation Science, Vol. 37 (2019) at 271-72. As discussed above, Dr. Skinner visited Gallo's Livingston and Borden sites and observed aspects of the infringing systems there.

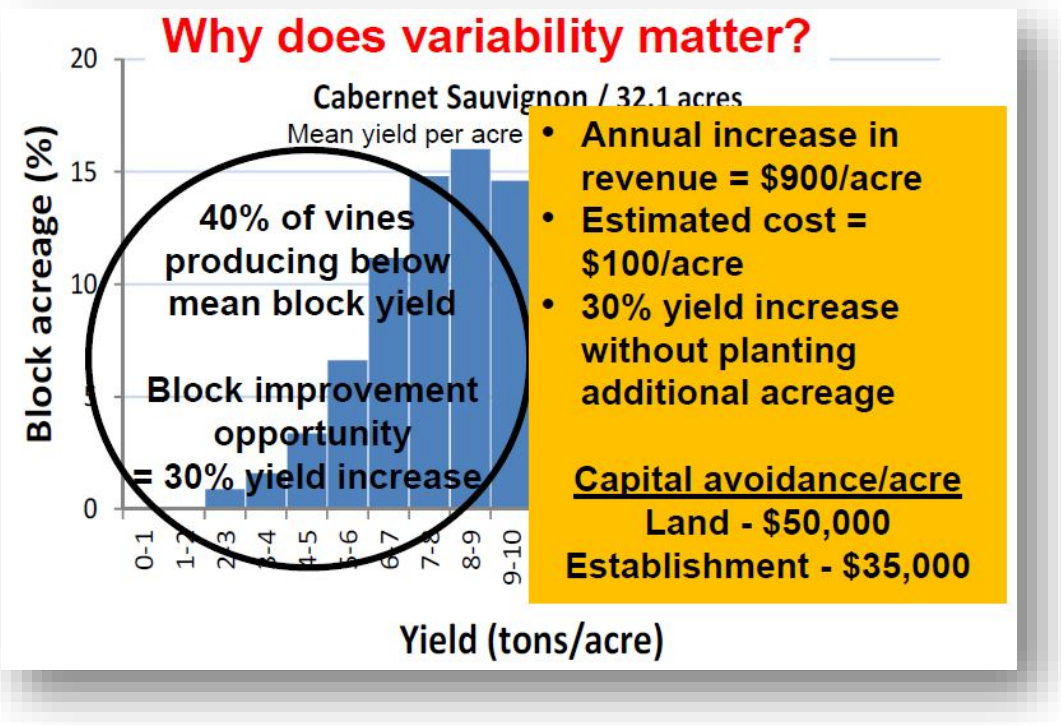
59. Gallo's published papers show its knowledge and experience of the many benefits of Dr. Skinner's patented inventions. For example, in GRAPEX 2018, the authors contemplate that "specific irrigation and water management decisions are to be triggered by this information," and Gallo estimates "considerable economic savings" per acre in water and pumping costs. See GRAPEX 2018 at 1810. The paper also noted that:

> Critical decisions in wine grape production include when to begin irrigating in the spring and the timing and amount of water to apply during the growing season that balances vine health with carefully timed periods of mild stress to improve berry quality for wine production. ***Spatially detailed information regarding vine stress variations across the field is also needed to ensure the judicious application of water only where it is needed***. The scientists at E. & J. Gallo Winery realized that accurate maps of evapotranspiration (ET) at daily to weekly increments and subfield spatial resolutions could help ***both reduce water use and enhance crop quality***.

Id. at 1792 (emphases added). These observations mirror those of the Asserted Patents many years earlier. *See, e.g.*, '834 Patent at 8:16-17 ("The delivery of materials can be ***more precisely directed to where it is needed***."), 6:19-23 ("Additionally, growers can realize ***improvements in yield and quality*** of the high valued fruit.") (emphases added).

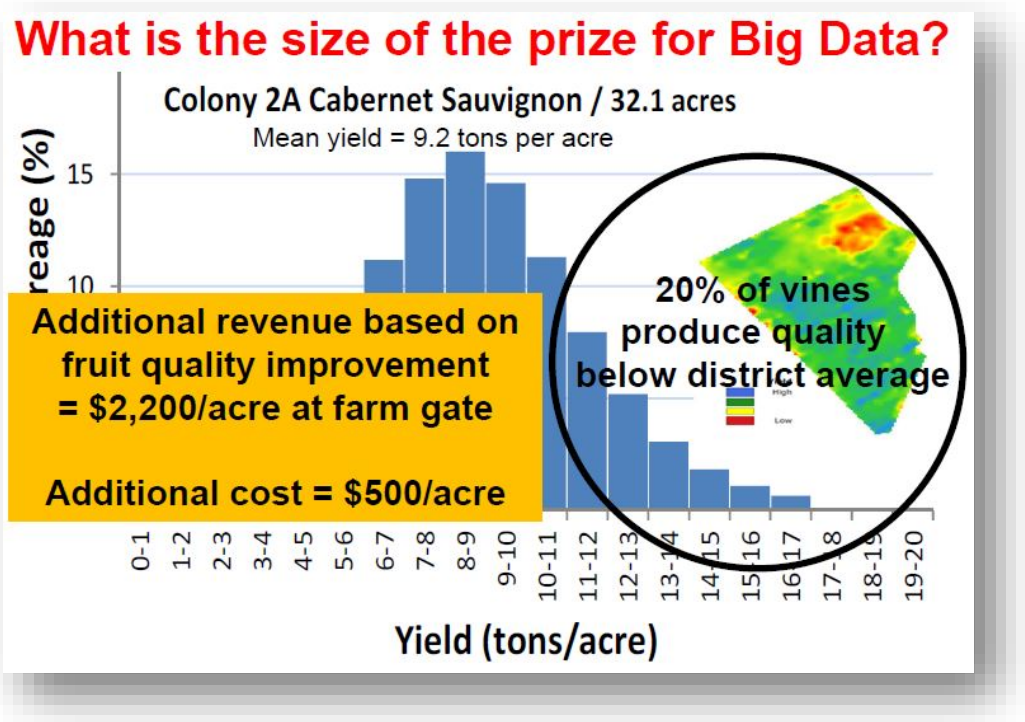
60. Gallo demonstrated and experienced the benefits of Dr. Skinner's inventions through its wrongful and willful infringement of the Asserted Patents. For example, as Dr. Dokoozlian explained in a 2016 presentation, accounting for variability within a vineyard through the patented techniques can provide an improvement opportunity of 30% increases in yield. *See* Nick Dokoozlian, "Big Data and the Productivity Challenge for Wine Grapes," Agricultural Outlook Forum, February 2016, *available at*

https://www.usda.gov/oce/forum/past_speeches/2016_Speeches/Dokoozlian.pdf, at 17. That increase manifests both in additional revenue from selling grapes, and capital cost avoidance because less land is required. *See id.* Dr. Dokoozlian provided estimates of these substantial per-acre savings for a Central Valley vineyard:



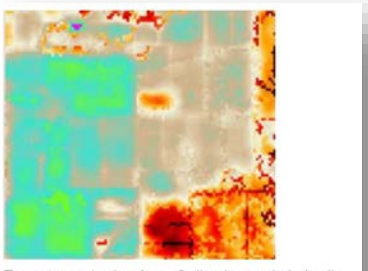
Id. at 17. In Napa and Sonoma counties, where grape and land prices can be at least an order of magnitude higher than in the Central Valley, Gallo's corresponding benefit from its infringement would also be equivalently higher.

61. Similarly, Gallo has acknowledged and quantified the potential grape quality increase it observed and experienced through its infringing use of Dr. Skinner's patented inventions. For example, in the same presentation, Dr. Dokoozlian explained the economic benefit of increasing quality through the patented techniques to address variability within a vineyard:



Id. at 19.

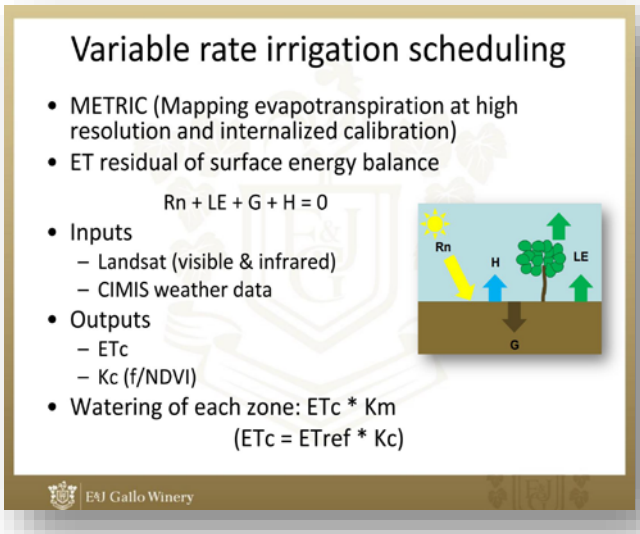
62. In addition to the construction and operation of highly granular variable rate drip irrigation systems described above, Gallo has substantially expanded its use of remotely sensed (such as from satellites) external data and modeling of potential evapotranspiration to schedule and control irrigation across its vineyards—using techniques described and claims in Dr. Skinner's patents. *See, e.g.*, https://www.usgs.gov/centers/fort/science/agriculture-landsat-imagery-a-unique-resource, "A pioneer of efficient water-management practices through Landsat, Gallo uses the imagery on approximately 20,000 acres of Gallo-owned vineyards from Southern California to Mendocino County."



Evapotranspiration from Gallo vineyards in Lodi, California, measured using an adjusted form of METRIC. Lower evapotranspiration is shown in red and higher is in blue. Courtesy of E. and J. Gallo.

Id.

63. Gallo uses satellite data and modeling to compute evapotranspiration (ET) and schedule irrigation applications across its entire portfolio of vineyards in California. *See, e.g.*, https://landsat.gsfc.nasa.gov/article/raising-glass-wine-country-better-water-management, "Dokoozlian's Gallo team, working with the USDA's Agricultural Research Service (USDA-ARS), uses an array of remote-sensing capabilities for mapping vineyard water use and water stress to improve irrigation scheduling and management. To do this, they've created an 'evapotranspiration (ET) Toolkit.' . . . This daily ET Toolkit data help the team make weekly irrigation decisions to ensure Gallo's fields are not too dry or too wet, saving time and money in irrigation costs across more than 100,000 vineyard acres." *See also* Landsat and Water—Case Studies of the Uses and Benefits of Landsat Imagery in Water Resources, available at https://pubs.usgs.gov/of/2014/1108/pdf/ofr2014-1108.pdf at 25-26 ("An adjusted form of METRIC is then used to map evapotranspiration of the vineyards (fig. 18). . . . Gallo developed an internal calibration of METRIC which is currently used by the company in vineyards."); "Precision Viticulture Tools for Wine Grape Vineyard Management in California" at 21:



64. More recently, Gallo has further developed and deployed its remote-sensing and ET modeling capabilities and deployed a system it calls Vineyard Data Assimilation or VIDA. *See, e.g.*, Abstract, H046-02 - High-resolution monitoring of root-zone soil moisture for vineyard

irrigation scheduling, AGU Fall Meeting 2020, *available at* https://agu.confex.com/agu/fm20/meetingapp.cgi/Paper/719854 ("We will describe the 2020 application of VIDA for operational soil moisture delivery within three E&J Gallo production vineyards (previously instrumented as part of GRAPEX field activities) and the planned 2021 expansion of operational production to >100 vineyards in the California Central Valley. Results demonstrate the feasibility of applying VIDA to vineyard irrigation scheduling and the potential for geographically scaling the approach over a broader area."). *See also*, Project: High Resolution Soil Moisture Monitoring for Improved Water Resource Management, *available at*, https://appliedsciences.nasa.gov/what-we-do/projects/high-resolution-soil-moisture-monitoring-improved-vineyard-water-resource:

> **Data Sources**: Satellite-based retrievals of surface soil moisture, derived from synthetic aperture radar (SAR) observations and surface evaporative fluxes, derived from thermal/infrared land surface temperature (LST), form the backbone of our approach. Thermal-infrared satellite data from the NOAA GOES and VIIRS, NASA MODIS, and USGS Landsat sensors are utilized to retrieve LST at a range of spatial scales.

Gallo researchers have published papers describing the infringing systems and their benefits. *See, e.g.*, Lei, F., Crow, W.T., Kustas, W.P., Dong, J., Yang, Y., Knipper, K.R., Anderson, M.C., Gao, F., Notarnicola, C., Greifeneder, F., McKee, L.M., Alfieri, J.G., Hain, C. and Dokoozlian, N., Data assimilation of high-resolution thermal and radar remote sensing retrievals for soil moisture monitoring in a drip-irrigated vineyard, Remote Sensing of Environment 239 (2020) 111622 ("Data Assimilation").

65. The benefits of these remotely-sensed irrigation control systems with respect to grape quality and yield are well documented:

> "Specifically, the accurate monitoring of the spring decline in plant available water is valuable for timing the start of intensive irrigation. ***Starting irrigation too early can waste water and reduce grape quality*** (especially for red wine varieties). Conversely, ***starting too late can negatively impact grape yield***."

AGU Fall Meeting 2020 (emphasis added). Accordingly, Gallo experiences significant benefits from its infringing use of Dr. Skinner's inventions across its thousands of acres of vineyards.

66. Gallo used advanced control systems, including remote controls as well as

automatic pump and valve controls, responsive to its remote-sensed satellite imagery and irrigation scheduling model data, to apply water in its vineyards. For example, in its variable rate irrigation systems installed across California, Gallo uses components (from *e.g.*, Netafim) to apply water to sub-blocks and rows according to derived schedules. *See, e.g.*, "Precision Viticulture Tools for Wine Grape Vineyard Management in California" at 29-30:

At Gallo's Colony site, "Irrigation schedules are generated on a weekly basis for each zone and transmitted to the central control computer." *See, e.g.*, Closed Loop Controlled Precision Irrigation Sensor Network, IEEE Internet of Things Journal, Vo. 5, No. 6, December 2018.

67. On information and belief, Gallo uses remotely operated and/or automatic control systems to apply water according to irrigation schedules derived from external data in its conventional drip irrigation vineyards as well. For example, Gallo uses a digital "irrigation management platform" to manage its vineyards. *See, e.g.*, Winery uses custom-built mobile apps to consolidate insights, *available at* https://www.computerworld.com/article/3210588/winery-uses-custom-built-mobile-apps-to-consolidate-insights.html.

68. In summary, Dr. Skinner and Vineyard Investigations repeatedly informed Gallo of the inventions claimed in the Asserted Patents—and of their substantial economic benefits with respect to yield, grape quality, and water use. While Gallo representatives, including Dr. Dokoozlian, described the Vineyard Investigations patents as "interesting," Gallo stated that it

was not interested in paying for any license to them. Meanwhile, Gallo built, operated, benefited from, and published papers taking credit for infringing variable rate drip irrigation systems. Gallo never paid for, or even acknowledged, Dr. Skinner's undeniably valuable and important inventions. Instead, Gallo has continued and expanded its willful infringement of Vineyard Investigations' Asserted Patents.

FIRST COUNT
(Infringement of U.S. Patent No. 8,528,834)

69. Vineyard Investigations incorporates by reference the allegations set forth in the above Paragraphs 1-68 of this Complaint as though fully set forth herein.

70. Gallo owns and operates at least 25,000 acres of vineyards in California and contracts with grape growers operating another approximately 200,000 acres. *See, e.g.*, Phys.org, "Bringing space technology to water needs in California vineyards," *available at* https://phys.org/news/2017-12-space-technology-california-vineyards.html.

71. Gallo, through its own acts and those of its subsidiary growers and wineries, makes, uses, sells, and/or offers to sell in the United States, systems and methods that directly infringe the '834 Patent, including the above identified 10-acre demonstration variable rate drip irrigation vineyard, subsequent expansion installations of that same system or similar systems in additional vineyard acres, and installations of Gallo's subsequent generation(s) of variable rate drip irrigation systems. Gallo's intelligent variable rate drip irrigation systems infringe at least claims 1 and 15 of the '834 Patent.

72. In addition, subsidiary growers and wineries of Gallo have directly infringed and are continuing to directly infringe one or more claims of the '834 Patent. Subsidiary growers and wineries of Gallo have made, used, offered for sale and/or sold in the United States systems and methods that infringe one or more claims '834 Patent. The subsidiary growers and wineries of Gallo continue to make, use, offer for sale, and/or sell in the United States systems and methods that infringe one or more claims of the '834 Patent, including at least claims 1 and 15 of the '834 Patent.

73. As an example, Gallo's infringing variable rate drip irrigation systems dispense water, and other materials, to grapevines in Gallo's vineyards. *See, e.g.*, L. Sanchez, B. Sams, M. Alsina, N. Hinds, L. Klein, and N. Dokoozlian, "Improving vineyard water use efficiency and yield with variable rate irrigation in California," Advances in Animal Biosciences: Precision Agriculture (ECPA) 2017, 8:2, at 574 ("The main objective of the study described herein was to develop a modular, proof-of-concept variable rate irrigation (VRDI) system prototype, operate it using NDVI and an energy balance model based on remotely sensed data and ***differentially deliver water to 140 equally sized irrigation zones to control vine growth and yield***") (emphasis added).

74. Gallo's expanded "second generation" installations also employ variable rate drip irrigation systems that dispense water, and other materials, to grapevines. *See, e.g.*, Knipper, *et al.*, "Using High-Spatiotemporal Thermal Satellite ET Retrievals for Operational Water Use and Stress Monitoring in a California Vineyard" ("Operational Water Use"), Remote Sensing (2019), Vol 11, 2124 at 4 ("The vineyard is equipped with a variable rate drip irrigation (VRDI) system (black grid; Figure 1) capable of applying specific amounts of irrigation on a 30 x 30 m gridded basis.").

75. As an additional example, Gallo's infringing variable rate drip irrigation systems include conduit with at least one channel positioned in proximity to the grapevines, typically under the vine canopy in order to provide drip irrigation. For example, the system installed at Gallo's Colony Ranch vineyard included such channels:

In addition, the systems observed by Dr. Skinner at Gallo's vineyards, including at its Livingston Ranch installations, included infringing channels. *See* ¶ 41 above; *see also* Operational Water Use at 4 ("each multi-hop drip irrigation bundle").

76. The conduit used in Gallo's infringing variable rate drip irrigation systems includes outlets or emitters coupled to the channel that convey water, and other materials, to the grapevines. These outlets or emitters are fixed in proximity to the grapevines, typically under the vine canopy in order to provide drip irrigation. *See, e.g.*, "Improving vineyard water use efficiency and yield with variable rate irrigation in California" at 575 ("the lower hose had ***drip emitters, two per vine***") (emphasis added); *see also id.* at Figure 2:

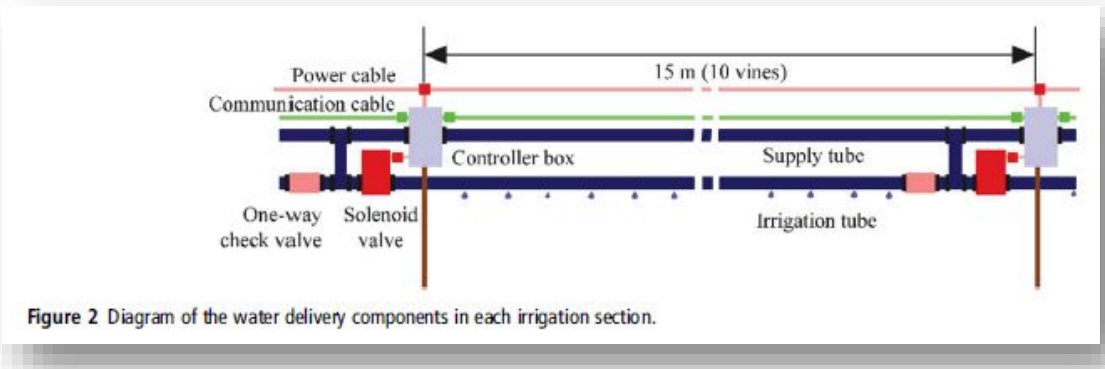


Figure 2 Diagram of the water delivery components in each irrigation section.

In a presentation titled "Precision Viticulture Tools for Wine Grape Vineyard Management in California," Brent Sams of Gallo included diagrams and pictures of the conduit and emitters used in the Colony Ranch system. *See* California Plant and Soil Conference, American Society of Agronomy, Fresno, February 1, 2017, *available at* http://calasa.ucdavis.edu/files/259645.pdf at 18. Gallo employed similar technology at other locations. *See, e.g.*, Operational Water Use at 4 ("irrigation line emitter").

77. As an additional example, Gallo's infringing variable rate drip irrigation systems include a controller that implements control of the various emitters for dispensing materials, and does so in response to external data. *See, e.g.*, "Precision Viticulture Tools for Wine Grape Vineyard Management in California" at 20 (showing control electronics), 21 (noting "Inputs" of "Landsat (visible & infrared)" data and "Outputs" of evapo-transpiration (ETc) and crop coefficient (Kc) data used in equations for "Watering of each zone"); *see also* "Improving vineyard water use efficiency and yield with variable rate irrigation in California" at 574 ("the system consisted of . . . electronics components as well as the ***central computer***, an antenna and a wireless modem for ***remote access and control***"), 575 ("Irrigation of the 140 zones was controlled by a computer network with a single master coordinating operation communicating through a MODBUS-based protocol . . . . Remote desktop operations, including uploading the weekly irrigation schedules and troubleshooting, were accomplished via cellular link with the central computer and its modem. Weekly ***irrigations were scheduled for each zone using the equation***: ETc = (ETref)*(Kc)*(Km)") (emphases added).

78. Gallo employed controllers responsive to external data at other locations as well. *See, e.g.*, Operational Water Use at 3 ("Satellite-based remote sensing of ET_a at 30-m resolution" and "Remote sensing enables mapping of the spatial variability in water demand, allowing better regulation of vine growth via irrigation over smaller areas").

79. In addition, Gallo's infringing variable rate drip irrigation systems include one or more sensors, placed in or near the vineyard in proximity to the grapevines. The one or more sensors are associated with one or more grapevines in the vineyard. *See, e.g.*, "Client Success Field Notes: Smarter water, better wine at E. & J. Gallo Winery," ("***Each water line is wrapped with sensors*** that wirelessly and continuously communicate environmental conditions and vine stress to a central computer. This hyper-localized information, and real-time unstructured data, like the satellite imagery and weather forecasts, is automatically processed. Then, the system provides recommended watering instructions.") (emphasis added).

80. Gallo employed sensors in proximity to the grapevines at other locations as well. *See, e.g.*, GRAPEX 2018 at 1795 (describing sensor arrays for measuring, for example, "temperature under the vine canopy and across the interrow," "soil water content and temperature," and "soil heat flux"); *see also id.* at Figure 2:

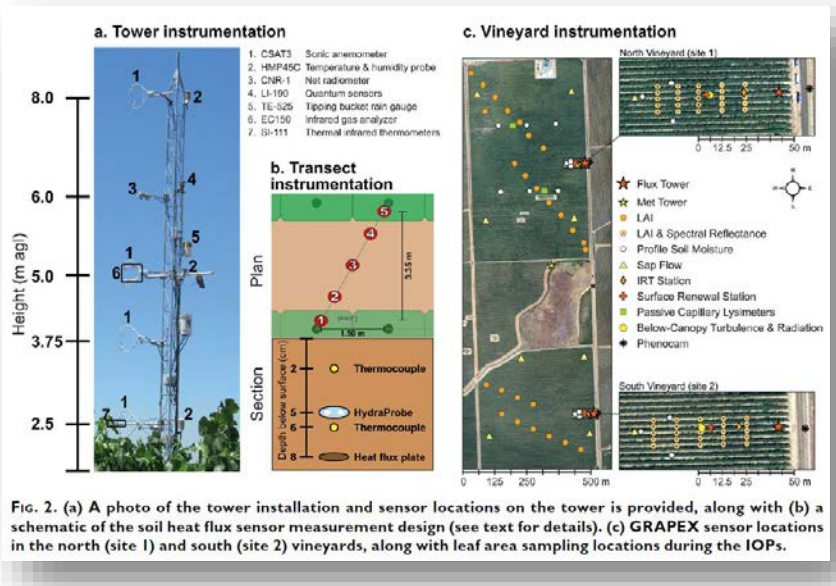


FIG. 2. (a) A photo of the tower installation and sensor locations on the tower is provided, along with (b) a schematic of the soil heat flux sensor measurement design (see text for details). (c) GRAPEX sensor locations in the north (site 1) and south (site 2) vineyards, along with leaf area sampling locations during the IOPs.

The GRAPEX 2018 article also explained that: "Beginning with the 2013 growing season, surface fluxes (including ET) and environmental conditions have been measured continuously at both vineyards using eddy covariance micrometeorological systems. These sensor systems are summarized in a schematic and photo of the tower configuration in Fig. 2." *Id.* at 1793. Other Gallo GRAPEX articles described the infringing systems consistently, for example, stating that: "To support irrigation management at that scale, we utilized a thermal-based multi-sensor data fusion approach to generate weekly total actual ET (ET_a) estimates at 30 m spatial resolution." Operational Water Use at 1; *see also id.* at 4-5 (describing in-field measurements and stating that: "Each of the four vineyard sections was equipped with identical micrometeorological instrumentation . . ."); GRAPEX 2018 at 1799 ("Daily mean soil moisture from the three profile sensors averaged over all depths is compared to measured daily ET from the tower normalized by potential or reference ET (ET_o)").

81. Gallo's infringing variable rate drip irrigation systems implement sensors that transmit information to the controller. *See, e.g.*, "Client Success Field Notes: Smarter water, better wine at E. & J. Gallo Winery," ("Each water line is wrapped with sensors that ***wirelessly and continuously communicate environmental conditions and vine stress to a central computer***.") (emphasis added); *see also* "Effect of a Variable Rate Irrigation Strategy on the Variability of Crop Production in Wine Grapes in California" at 5 ("A read/write memory abstraction is used to issue commands to control nodes and retrieve information from attached sensors").

82. Gallo's GRAPEX-related articles describe additional such systems, for example explaining that: "The ET_a-OP model provides an improvement to this approach by measuring actual plant water use at sub-field resolution." Operational Water Use at 15; *see also id.* at 4 ("We further divided the vineyard into four separate sections (blue grid; Figure 1), each equipped with a dedicated easy covariance flux tower (red dots), to test model response to varying stress levels within the vineyard."). Gallo's systems collect "micrometeorological and biophysical field measurements" from in-field sensors and use them in conjunction with remote-sensed external data to compute and validate modeling for irrigation management. *See,*

e.g., *id.* at 4 (measurements "serve as validation for modeled ET_a estimates, detect vine stress, and monitor biomass development and root zone soil water availability"), 5 (describing processing of sensed EC measurement data).

83. The sensors used in Gallo's infringing variable rate drip irrigation systems provide information that the controller uses to control the various emitters for dispensing water or another material to the grapevines. *See, e.g.*, "Client Success Field Notes: Smarter water, better wine at E. & J. Gallo Winery," ("This ***hyper-localized information***, and real-time unstructured data, like the satellite imagery and weather forecasts, is automatically processed. Then, ***the system provides recommended watering instructions***.") (emphases added); *see also* "Improving vineyard water use efficiency and yield with variable rate irrigation in California" at 575 ("Independent irrigation of the each of the four or five 10-vine sections of each irrigation zone was achieved with the opening of a solenoid valve . . . . A small enclosure (controller box in Figure 2) held by a metal stake contained an electronic control board as well as power and communication wiring").

84. Gallo's additional installations also instrument the vineyard with sensors in sections as described above, enabling "differential water delivery to sub-block within the field, allowing the tailoring of irrigation amounts to the specific water demands of each sub-block." *See, e.g.*, Operational Water Use at 3-5; *see also id.* at 7 (discussing use of "locally sourced reference ET value measured" in-field). "The vineyard is equipped with a variable rate drip irrigation (VRDI) system (black grid; Figure 1) capable of applying specific amounts of irrigation on a 30 x 30 m gridded basis." *Id.* at 4. In Gallo's infringing systems, "specific irrigation and water management decisions are to be triggered by this information" obtained from in-field and remote sensing sources. *See, e.g.*, GRAPEX 2018 at 1810. "Irrigation decision support driven by timely and accurate moderate resolution (30 m) satellite retrievals of actual ET have the potential for reducing water consumption in irrigated vineyards, while simultaneously improving yield and grape quality." Operational Water Use at 16.

85. By making, using, offering for sale, and/or selling in the United States systems and methods that infringe the '834 patent, Gallo has injured Vineyard Investigations and is

liable to Vineyard Investigations for directly infringing one or more claims of the ’834 Patent, including without limitation claims 1 and 15 pursuant to 35 U.S.C. § 271(a).

86. Gallo also infringes the ’834 Patent under 35 U.S.C. § 271(b) & (c).

87. Gallo knowingly encourages and intends to induce infringement of the ’834 Patent by making, using, offering for sale, and/or selling in the United States, systems and methods that infringe the ’834 patent, with knowledge and specific intention that such products will be used by others. For example, Gallo intends to and does induce its aforementioned subsidiary growers and wineries to infringe by, for example, providing components, instructions, and expertise for implementing infringing systems.

88. Gallo took active steps, directly and/or through contractual relationships with others, to cause infringement with both knowledge of the ’834 Patent and the specific intent to cause the abovementioned subsidiary growers and wineries to make, use, offer for sale and/or sell in the United States systems and methods that infringe one or more claims of the ’834 Patent. Such steps by Gallo included, among other things, advising or directing the abovementioned subsidiary growers and wineries to make, use, offer for sale, and/or sell such systems and methods in an infringing manner; advertising and promoting the use of these systems and methods in an infringing manner; providing components and expertise for subsidiary growers and wineries to make, use, offer for sale, and/or sell the infringing systems and methods; and/or distributing instructions that guide subsidiary growers and wineries to make, use, offer for sale, and/or sell the systems and methods in an infringing manner.

89. Gallo also contributes to the infringement of the ’834 Patent. Gallo makes, uses, sells, and/or offers to sell in the United States systems and methods that infringe the ’834 patent, knowing that they constitute a material part of the claimed invention, that they are especially made or adapted for use in infringing the ’834 Patent, and that they are not staple articles or commodities of commerce capable of substantial non-infringing use.

90. On information and belief, Gallo was aware of the ’834 Patent and related Vineyard Investigations patents, had knowledge of the infringing nature of its activities, and nevertheless continues its infringing activities. For example, on May 18, 2010, Dr. Skinner

notified Gallo of the existence of the Vineyard Investigations patent portfolio. In addition, beginning at least as early as April 8, 2016 and continuing as described above, Dr. Skinner and Vineyard Investigations had substantial and detailed communications with Gallo representatives about the Asserted Patents, their potential benefits, and their applicability to Gallo's vineyard management.

91. Gallo's infringement of the '834 Patent has been and continues to be deliberate and willful, and this is therefore an exceptional case warranting an award of enhanced damages and attorneys' fees pursuant to 35 U.S.C. §§ 284-285.

92. As a result of Gallo's infringement of the '834 Patent, Vineyard Investigations has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Gallo's infringement, but in no event less than a reasonable royalty with interest and costs.

SECOND COUNT
(Infringement of U.S. Patent No. 6,947,810)

93. Vineyard Investigations incorporates by reference the allegations set forth in the above Paragraphs 1-92 of this Complaint as though fully set forth herein.

94. Gallo, through its own acts and those of its subsidiary growers and wineries, makes, uses, sells, and/or offers to sell in the United States, systems and methods that directly infringe the '810 Patent, including the above identified 10-acre demonstration variable rate drip irrigation vineyard, subsequent expansion installations of that same system or similar systems in additional vineyard acres, and installations of Gallo's subsequent generation(s) of variable rate drip irrigation systems. Gallo's intelligent variable rate drip irrigation systems infringe at least claims 2 and 20 of the '810 Patent.

95. In addition, subsidiary growers and wineries of Gallo have directly infringed and are continuing to directly infringe one or more claims of the '810 Patent. Subsidiary growers and wineries of Gallo have made, used, offered for sale and/or sold in the United States systems and methods that infringe one or more claims of the '810 Patent. The subsidiary growers and wineries of Gallo continue to make, use, offer for sale, and/or sell in the United States systems

and methods that infringe one or more claims of the '810 Patent, including at least claims 2 and 20 of the '810 Patent.

96. As an example, Gallo's infringing variable rate drip irrigation systems apply one or more materials (such as water) to a plurality of plants. *See, e.g.*, L. Sanchez, B. Sams, M. Alsina, N. Hinds, L. Klein, and N. Dokoozlian, "Improving vineyard water use efficiency and yield with variable rate irrigation in California," Advances in Animal Biosciences: Precision Agriculture (ECPA) 2017, 8:2, at 574 ("The main objective of the study described herein was to develop a modular, proof-of-concept variable rate irrigation (VRDI) system prototype, operate it using NDVI and an energy balance model based on remotely sensed data and ***differentially deliver water to 140 equally sized irrigation zones to control vine growth and yield***") (emphasis added).

97. Gallo's expanded "second generation" installations also employ variable rate drip irrigation systems that dispense water, and other materials, to grapevines. *See, e.g.*, Knipper, *et al.*, "Using High-Spatiotemporal Thermal Satellite ET Retrievals for Operational Water Use and Stress Monitoring in a California Vineyard" ("Operational Water Use"). Remote Sensing (2019), Vol 11, 2124 at 4 ("The vineyard is equipped with a variable rate drip irrigation (VRDI) system (black grid; Figure 1) capable of applying specific amounts of irrigation on a 30 x 30 m gridded basis.").

98. As an additional example, Gallo's infringing variable rate drip irrigation systems include a plurality of sensors, each associated with and positioned in proximity to the grapevines. For example, the system installed at Gallo's Colony Ranch vineyard included one or more sensors, placed in or near the vineyard in proximity to the grapevines. The one or more sensors are associated with one or more grapevines in the vineyard. *See, e.g.*, "Client Success Field Notes: Smarter water, better wine at E. & J. Gallo Winery," ("***Each water line is wrapped with sensors*** that wirelessly and continuously communicate environmental conditions and vine stress to a central computer. This hyper-localized information, and real-time unstructured data, like the satellite imagery and weather forecasts, is automatically processed. Then, the system provides recommended watering instructions.") (emphasis added).

99. Gallo employed sensors in proximity to the grapevines at other locations as well. *See, e.g.*, GRAPEX 2018 at 1795 (describing sensor arrays for measuring, for example, "temperature under the vine canopy and across the interrow," "soil water content and temperature," and "soil heat flux"); *see also id.* at Figure 2. The GRAPEX 2018 article also explained that: "Beginning with the 2013 growing season, surface fluxes (including ET) and environmental conditions have been measured continuously at both vineyards using eddy covariance micrometeorological systems. These sensor systems are summarized in a schematic and photo of the tower configuration in Fig. 2." *Id.* at 1793. Other Gallo GRAPEX articles described the infringing systems consistently, for example, stating that: "To support irrigation management at that scale, we utilized a thermal-based multi-sensor data fusion approach to generate weekly total actual ET (ET_a) estimates at 30 m spatial resolution." Operational Water Use at 1; *see also id.* at 4-5 (describing in-field measurements and stating that: "Each of the four vineyard sections was equipped with identical micrometeorological instrumentation . . ."); GRAPEX 2018 at 1799 ("Daily mean soil moisture from the three profile sensors averaged over all depths is compared to measured daily ET from the tower normalized by potential or reference ET (ET_o)").

100. As an additional example, Gallo's infringing variable rate drip irrigation systems include a control system coupled to one or more of the sensors to receive signals from them. *See, e.g.*, "Precision Viticulture Tools for Wine Grape Vineyard Management in California" at 20 (showing control electronics); *see also* "Improving vineyard water use efficiency and yield with variable rate irrigation in California" at 574 ("the system consisted of . . . electronics components as well as the ***central computer***, an antenna and a wireless modem for ***remote access and control***"), 575 ("Irrigation of the 140 zones was controlled by a computer network with a single master coordinating operation communicating through a MODBUS-based protocol . . . . Remote desktop operations, including uploading the weekly irrigation schedules and troubleshooting, were accomplished via cellular link with the central computer and its modem. Weekly ***irrigations were scheduled for each zone using the equation***: ETc = (ETref)*(Kc)*(Km)") (emphases added).

101. Gallo's infringing variable rate drip irrigation systems implement sensors that transmit information to the controller. *See, e.g.*, "Client Success Field Notes: Smarter water, better wine at E. & J. Gallo Winery," ("Each water line is wrapped with sensors that ***wirelessly and continuously communicate environmental conditions and vine stress to a central computer***.") (emphasis added); *see also* "Effect of a Variable Rate Irrigation Strategy on the Variability of Crop Production in Wine Grapes in California" at 5 ("A read/write memory abstraction is used to issue commands to control nodes and retrieve information from attached sensors").

102. Gallo's GRAPEX-related articles describe additional such systems, for example explaining that: "The ET_a-OP model provides an improvement to this approach by measuring actual plant water use at sub-field resolution." Operational Water Use at 15; *see also id.* at 4 ("We further divided the vineyard into four separate sections (blue grid; Figure 1), each equipped with a dedicated easy covariance flux tower (red dots), to test model response to varying stress levels within the vineyard."). Gallo's systems collect "micrometeorological and biophysical field measurements" from in-field sensors and use them in conjunction with remote-sensed external data to compute and validate modeling for irrigation management. *See, e.g.*, *id.* at 4 (measurements "serve as validation for modeled ET_a estimates, detect vine stress, and monitor biomass development and root zone soil water availability"), 5 (describing processing of sensed EC measurement data).

103. The conduit used in Gallo's infringing variable rate drip irrigation systems includes outlets or emitters coupled to the channel that emit water, and other materials, to the grapevines. These outlets or emitters are associated with and fixed in proximity to the grapevines, typically under the vine canopy in order to provide drip irrigation. *See, e.g.*, "Improving vineyard water use efficiency and yield with variable rate irrigation in California" at 575 ("the lower hose had ***drip emitters, two per vine***") (emphasis added); *see also id.* at Figure 2.

104. In a presentation titled "Precision Viticulture Tools for Wine Grape Vineyard Management in California," Brent Sams of Gallo included diagrams and pictures of the conduit and emitters used in the Colony Ranch system. *See* California Plant and Soil Conference,

American Society of Agronomy, Fresno, February 1, 2017, *available at* http://calasa.ucdavis.edu/files/259645.pdf at 18. Gallo employed similar technology at other locations. *See, e.g.*, Operational Water Use at 4 ("irrigation line emitter").

105. The control system used in Gallo's infringing variable rate drip irrigation systems controls emission of material to one or more grapevines via associated emitters, and does so in response to signals from associated sensors. The sensors used in Gallo's infringing variable rate drip irrigation systems provide information that the controller uses to control the various emitters for dispensing water or another material to the grapevines. *See, e.g.*, "Client Success Field Notes: Smarter water, better wine at E. & J. Gallo Winery," ("This ***hyper-localized information***, and real-time unstructured data, like the satellite imagery and weather forecasts, is automatically processed. Then, ***the system provides recommended watering instructions***.") (emphases added); *see also* "Improving vineyard water use efficiency and yield with variable rate irrigation in California" at 575 ("Independent irrigation of the each of the four or five 10-vine sections of each irrigation zone was achieved with the opening of a solenoid valve . . . . A small enclosure (controller box in Figure 2) held by a metal stake contained an electronic control board as well as power and communication wiring").

106. Gallo's additional installations also instrument the vineyard with sensors in sections as described above, permit and "differential water delivery to sub-block within the field, allowing the tailoring of irrigation amounts to the specific water demands of each sub-block." *See, e.g.*, Operational Water Use at 3-5; *see also id.* at 7 (discussing use of "locally sourced reference ET value measured" in-field). "The vineyard is equipped with a variable rate drip irrigation (VRDI) system (black grid; Figure 1) capable of applying specific amounts of irrigation on a 30 x 30 m gridded basis." *Id.* at 4. In Gallo's infringing systems, "specific irrigation and water management decisions are to be triggered by this information" obtained from in-field and remote sensing sources. *See, e.g.*, GRAPEX 2018 at 1810. "Irrigation decision support driven by timely and accurate moderate resolution (30 m) satellite retrievals of actual ET have the potential for reducing water consumption in irrigated vineyards, while simultaneously improving yield and grape quality." Operational Water Use at 16.

107. By making, using, offering for sale, and/or selling in the United States systems and methods that infringe the ’810 patent, Gallo has injured Vineyard Investigations and is liable to Vineyard Investigations for directly infringing one or more claims of the ’810 Patent, including without limitation claims 2 and 20 pursuant to 35 U.S.C. § 271(a).

108. Gallo also infringes the ’810 Patent under 35 U.S.C. § 271(b) & (c).

109. Gallo knowingly encourages and intends to induce infringement of the ’810 Patent by making, using, offering for sale, and/or selling in the United States, systems and methods that infringe the ’810 patent, with knowledge and specific intention that such products will be used by others. For example, Gallo intends to and does induce its aforementioned subsidiary growers and wineries to infringe by, for example, providing components, instructions, and expertise for implementing infringing systems.

110. Gallo took active steps, directly and/or through contractual relationships with others, to cause infringement with both knowledge of the ’810 Patent and the specific intent to cause the abovementioned subsidiary growers and wineries to make, use, offer for sale and/or sell in the United States systems and methods that infringe one or more claims of the ’810 Patent. Such steps by Gallo included, among other things, advising or directing the abovementioned subsidiary growers and wineries to make, use, offer for sale, and/or sell such systems and methods in an infringing manner; advertising and promoting the use of these systems and methods in an infringing manner; providing components and expertise for subsidiary growers and wineries to make, use, offer for sale, and/or sell the infringing systems and methods; and/or distributing instructions that guide subsidiary growers and wineries to make, use, offer for sale, and/or sell the systems and methods in an infringing manner.

111. Gallo also contributes to the infringement of the ’810 Patent. Gallo makes, uses, sells, and/or offers to sell in the United States systems and methods that infringe the ’810 patent, knowing that they constitute a material part of the claimed invention, that they are especially made or adapted for use in infringing the ’810 Patent, and that they are not staple articles or commodities of commerce capable of substantial non-infringing use.

112. On information and belief, Gallo was aware of the ’810 Patent and related Vineyard Investigations patents, had knowledge of the infringing nature of its activities, and nevertheless continues its infringing activities. For example, on May 18, 2010, Dr. Skinner notified Gallo of the existence of the Vineyard Investigations patent portfolio. In addition, beginning at least as early as April 8, 2016 and continuing as described above, Dr. Skinner and Vineyard Investigations had substantial and detailed communications with Gallo representatives about the Asserted Patents, their potential benefits, and their applicability to Gallo’s vineyard management.

113. Gallo’s infringement of the ’810 Patent has been and continues to be deliberate and willful, and this is therefore an exceptional case warranting an award of enhanced damages and attorneys’ fees pursuant to 35 U.S.C. §§ 284-285.

114. As a result of Gallo’s infringement of the ’810 Patent, Vineyard Investigations has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Gallo’s infringement, but in no event less than a reasonable royalty with interest and costs. .

THIRD COUNT
(Infringement of U.S. Patent No. 10,645,881)

115. Vineyard Investigations incorporates by reference the allegations set forth in the above Paragraphs 1-114 of this Complaint as though fully set forth herein.

116. Gallo, through its own acts and those of its subsidiary growers and wineries, makes, uses, sells, and/or offers to sell in the United States, systems and methods that directly infringe the ’881 Patent, including the variable rate drip irrigation vineyards described above, additional installations of similar systems in additional vineyard acres, installations of Gallo’s subsequent generation(s) of variable rate drip irrigation systems, and Gallo’s conventional drip irrigation systems that manage and control irrigation applications in response to remotely sensed (i.e. satellite) external data and models. Gallo’s intelligent variable rate drip irrigation systems, as well as its conventional drip irrigation systems, infringe at least claims 1 and 10 of the ’881 Patent.

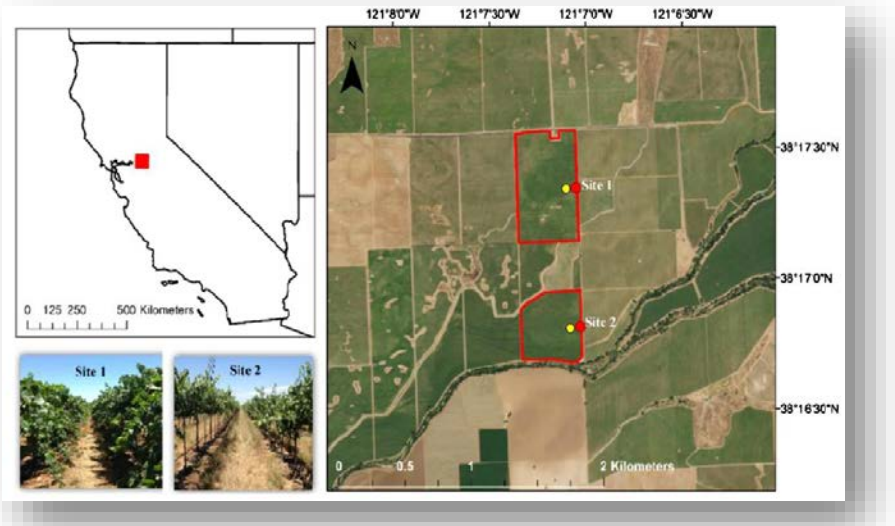
117. In addition, subsidiary growers and wineries of Gallo have directly infringed and are continuing to directly infringe one or more claims of the '881 Patent. Subsidiary growers and wineries of Gallo have made, used, offered for sale and/or sold in the United States systems and methods that infringe one or more claims of the '881 Patent. The subsidiary growers and wineries of Gallo continue to make, use, offer for sale, and/or sell in the United States systems and methods that infringe one or more claims of the '881 Patent, including at least claims 1 and 10 of the '881 Patent.

118. As an example, Gallo's infringing variable rate drip irrigation systems apply one or more materials (such as water) to a plurality of plants in a plant area. *See, e.g.*, L. Sanchez, B. Sams, M. Alsina, N. Hinds, L. Klein, and N. Dokoozlian, "Improving vineyard water use efficiency and yield with variable rate irrigation in California," Advances in Animal Biosciences: Precision Agriculture (ECPA) 2017, 8:2, at 574 ("The main objective of the study described herein was to develop a modular, proof-of-concept variable rate irrigation (VRDI) system prototype, operate it using NDVI and an energy balance model based on remotely sensed data and ***differentially deliver water to 140 equally sized irrigation zones to control vine growth and yield***") (emphasis added).

119. Gallo's expanded "second generation" installations also employ variable rate drip irrigation systems that dispense water, and other materials, to grapevines. *See, e.g.*, Knipper, *et al.*, "Using High-Spatiotemporal Thermal Satellite ET Retrievals for Operational Water Use and Stress Monitoring in a California Vineyard" ("Operational Water Use"), Remote Sensing (2019), Vol 11, 2124 at 4 ("The vineyard is equipped with a variable rate drip irrigation (VRDI) system (black grid; Figure 1) capable of applying specific amounts of irrigation on a 30 x 30 m gridded basis.").

120. Gallo's conventional drip irrigation systems also apply one or more materials (such as water) to a plurality of plants in a plant area. *See, e.g.*, https://www.usgs.gov/centers/fort/science/agriculture-landsat-imagery-a-unique-resource, "A pioneer of efficient water-management practices through Landsat, Gallo uses the imagery on approximately 20,000 acres of Gallo-owned vineyards from Southern California to Mendocino

County." *See also* "Relationships between soil water content, evapotranspiration, and irrigation measurements in a California drip-irrigated Pinot noir vineyard," Agricultural Water Management, Volume 237, 1 July 2020, 106186 ("The study site, part of the GRAPEX project, consists of two adjacent *Vitis vinifera L*. vineyards of the pinot noir variety in the California Central Valley near the city of Lodi . . . Both vineyards are drip irrigated with a dripper"*); see also id.* at Fig. 1:



See also evidence cited at paragraphs 62-64 above.

121. As an additional example, Gallo's infringing variable rate drip irrigation systems include emitters for emitting the material to the plant area, each associated with and positioned in proximity to the grapevines. For example, the conduit used in Gallo's infringing variable rate drip irrigation systems includes outlets or emitters coupled to the channel that emit water, and other materials, to the grapevines. These outlets or emitters are associated with and fixed in proximity to the grapevines, typically under the vine canopy in order to provide drip irrigation. *See, e.g.*, "Improving vineyard water use efficiency and yield with variable rate irrigation in California" at 575 ("the lower hose had drip emitters, two per vine"); *see also id.* at Figure 2.

122. In a presentation titled "Precision Viticulture Tools for Wine Grape Vineyard Management in California," Brent Sams of Gallo included diagrams and pictures of the conduit

and emitters used in the Colony Ranch system. See California Plant and Soil Conference, American Society of Agronomy, Fresno, February 1, 2017, available at http://calasa.ucdavis.edu/files/259645.pdf at 18. Gallo employed similar technology at other locations. *See, e.g.*, Operational Water Use at 4 ("irrigation line emitter").

123. Gallo employed emitters in proximity to and associated with the grapevines at its conventional drip irrigation vineyards as well. *See, e.g.*, "Relationships between soil water content, evapotranspiration, and irrigation measurements in a California drip-irrigated Pinot noir vineyard," Agricultural Water Management, Volume 237, 1 July 2020, 106186 ("Both vineyards are drip irrigated with a dripper ~ 0.35m distance on either side of each vine, and the vines are planted in east-west rows spaced 3.35m apart with 1.5m between vines along each row"); "Data Assimilation" at 4 ("Drip irrigation pipes run parallel with row trellis at 0.3 m a.g.l, with two drip emitters between each vine. Irrigation is recorded in gallons of water per vine per hour …"); "Improving vineyard water use efficiency and yield with variable rate irrigation in California" at 575-576 (describing a conventional "primary" drip irrigation system used in concert with the VRDI zones: "Applied irrigation amounts were monitored continuously in the VRDI and CI systems using inline flow meters and pressure switches").

124. As an additional example, Gallo's infringing variable rate drip irrigation systems include a control system coupled to the emitters for controlling the emission of the material to the plant area in response to external data. *See, e.g.*, "Precision Viticulture Tools for Wine Grape Vineyard Management in California" at 20 (showing control electronics); *see also* "Improving vineyard water use efficiency and yield with variable rate irrigation in California" at 574 ("the system consisted of . . . electronics components as well as the ***central computer***, an antenna and a wireless modem for ***remote access and control***"), 575 ("Irrigation of the 140 zones was controlled by a computer network with a single master coordinating operation communicating through a MODBUS-based protocol . . . . Remote desktop operations, including uploading the weekly irrigation schedules and troubleshooting, were accomplished via cellular link with the central computer and its modem. Weekly ***irrigations were scheduled for each zone using the equation***: ETc = (ETref)*(Kc)*(Km)") (emphases added).

125. Gallo's infringing irrigation management and control systems and methods permit "differential water delivery to sub-block within the field, allowing the tailoring of irrigation amounts to the specific water demands of each sub-block." *See, e.g.*, Operational Water Use at 3-5. "The vineyard is equipped with a variable rate drip irrigation (VRDI) system (black grid; Figure 1) capable of applying specific amounts of irrigation on a 30 x 30 m gridded basis." *Id.* at 4. In Gallo's infringing systems, "specific irrigation and water management decisions are to be triggered by this information" obtained from in-field and remote sensing sources. *See, e.g.*, GRAPEX 2018 at 1810. "Irrigation decision support driven by timely and accurate moderate resolution (30 m) satellite retrievals of actual ET have the potential for reducing water consumption in irrigated vineyards, while simultaneously improving yield and grape quality." Operational Water Use at 16.

126. Gallo's GRAPEX-related articles describe examples of Gallo's infringing systems, for example explaining that: "The ET_a-OP model provides an improvement to this approach by measuring actual plant water use at sub-field resolution." Operational Water Use at 15; *see also id.* at 4 ("We further divided the vineyard into four separate sections (blue grid; Figure 1), each equipped with a dedicated easy covariance flux tower (red dots), to test model response to varying stress levels within the vineyard."). Gallo's systems collect "micrometeorological and biophysical field measurements" from in-field sensors and use them in conjunction with remote-sensed external data to compute and validate modeling for irrigation management. *See, e.g.*, *id.* at 4 (measurements "serve as validation for modeled ET_a estimates, detect vine stress, and monitor biomass development and root zone soil water availability"), 5 (describing processing of sensed EC measurement data).

127. On information and belief, Gallo's conventional irrigation management systems include control systems and facilities for remotely and/or automatically controlling application of irrigation via emitters to associated vines. *See also* evidence cited at paragraphs 66-67 above.

128. The external data used in Gallo's infringing variable rate and conventional drip irrigation systems includes data derived using a model including potential data. *See, e.g.*, Operational Water Use at 7:

> Landsat-based maps of ET were fused with the daily MODIS ET maps using STARFM, creating daily 30 m resolution maps of ET with a two-day latency (determined by the MODIS ET time series). The final two days of the weekly composite (Wednesday and Thursday) were computed by preserving the ratio between modeled ET on the last available day and locally sourced reference ET. This ratio map was then multiplied by the locally sourced reference ET value measured over the final two days. Grass reference ET (ET_o) values were obtained from the local Fresno State CIMIS station (see further information in Section 3.3). All ET maps during that week were then summed to create a total weekly estimate of actual ET (ET_a). This process, and subsequent product, is henceforth referred to as ET_a-OP (operational) in the manuscript.

See also id. at 8 (describing the now standard practice of "Vegetation Index-Based ET_c Estimation" using potential ET_o data); Noa Ohana-Levi, *et al.*, Using Satellite Thermal-Based Evapotranspiration Time Series for Defining Management Zones and Spatial Association to Local Attributes in a Vineyard, Remote Sens. 2020, 12, 2436, at 1:

> Precision irrigation practices may benefit from the quantification of within-field spatial variability and temporal patterns of evapotranspiration (ET). A spatiotemporal modeling framework is proposed to delineate the vineyard into homogeneous areas (i.e., management zones) according to their ET patterns. The dataset for this study relied on ET retrievals from multiple satellite platforms, generating estimates at high spatial (30 m) and temporal (daily) resolutions for a Vitis vinifera Pinot noir vineyard in the Central Valley of California during the growing seasons of 2015-2018.

129. Gallo has previously employed these and other similar infringing techniques with remotely sensed external data and potential data models across its entire portfolio of vineyards in California, and has continued to use them through the 2020 and into the 2021 growing season in both variable rate and conventional drip irrigation vineyards. *See*, *e.g.*, https://www.usgs.gov/centers/fort/science/agriculture-landsat-imagery-a-unique-resource, "A pioneer of efficient water-management practices through Landsat, Gallo uses the imagery on approximately 20,000 acres of Gallo-owned vineyards from Southern California to Mendocino County."; *see also* P. Previtali, *et al.*, Crop Load and Plant Water Status Influence the Ripening Rate and Aroma Development in Berries of Grapevine (Vitis vinifera L.) cv. Cabernet Sauvignon, Journal of Agricultural and Food Chemistry, 2021 69 (27), 7709-7724 ("The main-plot factor was the irrigation regime, and the Standard Irrigation (STI) was compared to LSI.

Irrigation scheduling and monitoring were performed remotely through VRDI based on NDVI maps and updated biweekly following satellite data availability. STI vines were irrigated to 85% of vine evapotranspiration (ET), whereas the irrigation was increased to 135% ET for LSI vines starting at a TSS of 20 °Brix until harvest (26 °Brix).”). *See also* evidence cited at paragraphs 63-64 above.

130. By making, using, offering for sale, and/or selling in the United States systems and methods that infringe the ’881 patent, Gallo has injured Vineyard Investigations and is liable to Vineyard Investigations for directly infringing one or more claims of the ’881 Patent, including without limitation claims 1 and 10 pursuant to 35 U.S.C. § 271(a).

131. Gallo also infringes the ’881 Patent under 35 U.S.C. § 271(b) & (c).

132. Gallo knowingly encourages and intends to induce infringement of the ’881 Patent by making, using, offering for sale, and/or selling in the United States, systems and methods that infringe the ’881 patent, with knowledge and specific intention that such products will be used by others. For example, Gallo intends to and does induce its aforementioned subsidiary growers and wineries to infringe by, for example, providing components, instructions, and expertise for implementing infringing systems.

133. Gallo took active steps, directly and/or through contractual relationships with others, to cause infringement with both knowledge of the ’881 Patent and the specific intent to cause the abovementioned subsidiary growers and wineries to make, use, offer for sale and/or sell in the United States systems and methods that infringe one or more claims of the ’881 Patent. Such steps by Gallo included, among other things, advising or directing the abovementioned subsidiary growers and wineries to make, use, offer for sale, and/or sell such systems and methods in an infringing manner; advertising and promoting the use of these systems and methods in an infringing manner; providing components and expertise for subsidiary growers and wineries to make, use, offer for sale, and/or sell the infringing systems and methods; and/or distributing instructions that guide subsidiary growers and wineries to make, use, offer for sale, and/or sell the systems and methods in an infringing manner.

134. Gallo also contributes to the infringement of the ’881 Patent. Gallo makes, uses, sells, and/or offers to sell in the United States systems and methods that infringe the ’881 patent, knowing that they constitute a material part of the claimed invention, that they are especially made or adapted for use in infringing the ’881 Patent, and that they are not staple articles or commodities of commerce capable of substantial non-infringing use.

135. On information and belief, Gallo was aware of the ’881 Patent and related Vineyard Investigations patents, had knowledge of the infringing nature of its activities, and nevertheless continues its infringing activities. For example, on May 18, 2010, Dr. Skinner notified Gallo of the existence of the Vineyard Investigations patent portfolio. In addition, beginning at least as early as April 8, 2016 and continuing as described above, Dr. Skinner and Vineyard Investigations had substantial and detailed communications with Gallo representatives about the Asserted Patents, their potential benefits, and their applicability to Gallo’s vineyard management.

136. Gallo’s infringement of the ’881 Patent has been and continues to be deliberate and willful, and this is therefore an exceptional case warranting an award of enhanced damages and attorneys’ fees pursuant to 35 U.S.C. §§ 284-285.

137. As a result of Gallo’s infringement of the ’881 Patent, Vineyard Investigations has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Gallo’s infringement, but in no event less than a reasonable royalty with interest and costs.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff prays for judgment and seeks relief against Gallo as follows:

(a) For judgment that U.S. Patent Nos. 8,528,834, 6,947,810, and 10,645,881 have been and continue to be infringed by Gallo;

(b) For an accounting of all damages sustained by Plaintiff as the result of Gallo’s acts of infringement;

(c) For finding that Gallo’s infringement is willful and enhancing damages pursuant to 35 U.S.C. § 284;

(d) For a mandatory future royalty payable on each and every future sale by Gallo of grapes grown using technology that is found to infringe one or more of the Asserted Patents and using technology that is not colorably different from systems found to infringe;

(e) For an award of attorneys' fees pursuant to 35 U.S.C. § 285 or otherwise permitted by law;

(f) For all costs of suit; and

(g) For such other and further relief as the Court may deem just and proper.

DEMAND FOR JURY TRIAL

Pursuant to Rule 38(b) of the Federal Rules of Civil Procedure, Plaintiff demands a trial by jury of this action.

Dated: October 22, 2021

Respectfully submitted,

By: */s/ Corey Johanningmeier*
Corey Johanningmeier

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that on October 22, 2021, a copy of the foregoing was filed electronically. Notice of this filing will be sent to all counsel of record by operation of the Court's electronic filing system.

/s/ Corey Johanningmeier
Corey Johanningmeier