**UV technology for treatment of surface waters in produce fields**
**Executive Summary**

**1. Composition of the Team and roles (EL, PI, Mentor) of the members proposing to undertake the commercialization feasibility research.**

Entrepreneurial Lead (EL): Dr. Claire Zoellner

Dr. Zoellner is a Postdoctoral Research Associate in the laboratory of Dr. Ivanek (Principal Investigator (PI) for this application). She holds a PhD in Food Science and Technology. Dr. Zoellner has relevant knowledge about the food industry, produce food safety and the ultra-violet (UV) technology as applied in the production of foods, all of which are important to investigation of the commercial landscape surrounding our innovative use of UV technology to treat irrigation water in production of fruits and vegetables. Dr. Zoellner has a keen interest in an entrepreneurial career and is willing and capable to support the commercialization of this technology if proven viable through the I-FAST project.

I-FAST Team's Mentor (Mentor): Mr. Pete Hartman

Mr. Hartman, a MIT Engineering Graduate, is a retired business executive with 50+ years in various corporate roles focusing on the commercialization of new and emerging technologies in radio and wireless communication systems, digital communications equipment, computers and control systems, and ultimately, becoming President of an industrial automation firm, Retrotech, that supplies software and equipment to a large range of companies worldwide. In his retirement years, Mr. Hartman has continued to provide consultative services to small businesses engaged in commercializing new technologies, including Headwater Manufacturing, Inc. which, in 1998, designed initially for the cider and later, other juice markets, a UV purification system that is now FDA approved and validated by Cornell University, Food Science Department. Based on Mr. Hartman's involvement with Headwater, in 2015, Mr. Hartman was invited by Dr. Ivanek (PI), to work with the Cornell team in designing protocols and equipment for testing the efficacy of UV treatment on surface waters (explained below). His familiarity with the underlying UV technology, established relationship with Dr. Ivanek's research team, proximity to Cornell, decades of business experience and keen interest in mentoring strongly support Mr. Hartman's role as a Mentor to guide the I-FAST team forward.

Principal Investigator (PI): Dr. Renata Ivanek

Dr. Ivanek is an Associate Professor of Epidemiology at Cornell University. She is the PI in the current USDA NIFA grant under which the innovative use of UV technology underlying this proposed I-FAST application has been developed. Specifically, as part of the USDA NIFA grant, Dr. Ivanek's team designed an intervention trial to test the effectiveness of UV technology in treatment of surface waters used for irrigation of fruits and vegetables to control microbial hazards in water and therefore improve food safety and protect public health. A prototype of a UV processor used to treat water in the trial was built by Headwater Manufacturing, Inc. according to the specifications requested by Dr. Ivanek's research team. The preliminary results of the trial in spinach and cantaloupe fields indicated the effectiveness of the UV technology in reducing microbial hazards in irrigation water, supporting that the technology could play an instrumental role in securing microbial safety of ready-to-eat fruits and vegetables. However, the commercial viability of the technology is yet to be tested, which motivated this application. Dr. Ivanek has in-depth knowledge of the UV treatment and is willing to contribute as a team member. She will also take responsibility over administrative, budgetary, and reporting obligations as well as guide the EL and Mentor on technical aspects of the UV treatment food safety requirements.

**2. Point of Contact information for ALL of the members.**

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**3. Relevant current/previous NIFA award(s) including award number, Title of the Project, and the NIFA program the award was funded under.**

*Relevant current NIFA award:*

Award number: 2016-67017-24421
Title of the project: "Dissemination and fate of foodborne pathogens and indicators on produce post irrigation with surface water: an intervention trial".
NIFA Program: Foundational Program "Improving Food Safety"

**4. Brief description of the potential commercial impact**

Demand for fresh, safe food, grown under sustainable, environmentally responsible agricultural processes creates a market for novel solutions to optimize resources and uphold product quality and safety. UV light is a proven microbial disinfectant method in juices that is showing promise for treatment of irrigation water (as supported by our current USDA NIFA grant). The commercial value of UV treatment lies in its capability to give fresh produce farmers greater use of surface water for agriculture requiring irrigation. Specifically, it enables greater access to surface waters (e.g., rivers, streams, and ponds), which account for 58% of the total irrigation water source used in the USA (*1*). As surface waters are exposed to the environment, they are often contaminated with microorganisms (*2*) and thus do not comply with regulatory microbial water quality standards for use as irrigation or agricultural water (e.g., for frost protection). Therefore, the use of surface waters for irrigation of ready-to-eat produce may pose a food safety risk requiring farmers to delay harvest for a number of days after irrigation, use an alternative water source (such as municipal water or deep wells) or treat water before irrigation.

Treatment of surface water for irrigation to achieve microbial safety levels in compliance with current regulations not only gives a farmer greater flexibility in controlling the growing and harvest seasons, which is critical to shelf-life and marketability, but also provides cost-effective

assurance that the irrigation water is not a source of product contamination. Development of a unique, UV device for in-field irrigation water treatment provides a convenient, rapid and portable solution for fresh produce growers. The potential target markets include farms which are growing ready-to-eat produce and using predominately surface waters for irrigation. Examples initially include major fruit and vegetable producers across the United States, including in California, Virginia, Florida, Arizona, Colorado and Texas. Additionally, the interviews will include produce grower associations as they may influence the management standards in produce growing among their members. As UV treatment is scalable to any volume, it may be successfully applied to both small and large producers.

**5. Brief description of the current commercialization plans for the innovation**

Headwater Manufacturing, Inc. has been applying UV treatment for twenty years to accomplish pasteurization, initially of cider, and in more recent years, other juices, as well as a successful pilot with a prototype UV processor on irrigation water for the USDA NIFA funded intervention trial of Dr. Ivanek. The company's markets are both national across the United States and international (Mexico, China, Turkey, Malaysia, Thailand, and Canada). The UV units are all manufactured in Ontario, New York; tested for juice-specific and accurate performance by Cornell University's Agriculture Extension Service in Geneva, New York; shipped to the customer; and serviced through the years by Headwater Manufacturing staff or contractual arrangement.

The prototype machine prepared for testing of UV technology in treatment of irrigation water in the USDA NIFA project cited above spurred Cornell's and Headwater Manufacturing's interest to determine the potential for entering the market for UV treatment of irrigation water. UV treatment offers attractive performance parameters; to list a few: 1) capital costs (purchase of the equipment) at the front end are substantially offset by low operating costs through the life of the equipment, contributing to a good rate of return on investment; 2) for water treatment, the equipment can be capable of accommodating variable transmissions of UV light to eliminate the identified pathogens which is important in treatment of surface waters, which can have highly variable turbidity and other characteristics geographically and over time; 3) following UV treatment, the product is in ready-to-eat/ready-to-drink condition; and 4) the treatment is environmentally friendly and approved by the FDA.

As part of this project we propose an extensive market study that will include the following activities: 1) using specific selection criteria, conduct a "landscape scan" to identify producers in targeted geographic areas which would potentially benefit from using UV technology; 2) conduct a survey and follow-up interviews to determine strength of the market and farm specific needs, including affordability parameters; 3) determine most effective means and value proposition associated with bringing UV to market, e.g. direct market, utilization of equipment distributors, strategic partnerships with irrigation equipment manufacturers, etc.; 4) conduct a feasibility study to determine whether equipment can be manufactured at a cost that can be tolerated by the buyers and meet their performance standards.

**References:**

1. Kenny, J.F., N.L. Barber, S.S. Hutson, K.S. Linsey, J.K. Lovelace, and M.A. Maupin. 2009. Estimated use of water in the United States in 2005: U.S. Geological Survey Circular 1344, 52 p.
2. Benjamin, L., E.R. Atwill, M. Jay-Russell, M. Cooley, D. Carychao, L. Gorski, R.E. Mandrell. 2013. Occurrence of generic *Escherichia coli*, *E. coli* O157 and *Salmonell*a spp. in water and sediment from leafy green produce farms and streams on the Central California coast. Int J Food Microbiol. 2013 Jul 1;165(1):65-76. doi: 10.1016/j.ijfoodmicro.2013.04.003. Epub 2013 Apr 11.