 / **Bob Mueller,** Director, Process Chemicals, Airgas, Inc., **Todd Forbush,** Engineer, Techmark, Inc., **Jonathan Caisley,** Managing Director, BioFresh

Using Ethylene

New sprout inhibitor system offers possible CIPC alternative

Sprouting has always been a major challenge for the fresh potato industry. Although sprouting is a natural process, its unattractive nature frequently turns off shoppers, ultimately resulting in revenue loss for the industry.

> **"[Ethylene] is not harmful or toxic in any way, and has been used for many years as a means of speeding up and controlling the ripening process in crops such as bananas."**

For nearly 50 years, chloropropham, or CIPC, has been considered the standard anti-sprouting agent. But today, the future of the compound is uncertain. Due to health concerns, the U.S. EPA has classified CIPC as a carbamate and has placed increasingly strict limits on the amount of CIPC residue that can remain on potatoes sold to consumers. Other countries have established even stricter limits on residue levels—some have even imposed zero tolerance policies.

As a result, many in the industry are actively seeking alternative sprout suppressors that offer the same level of effectiveness as CIPC. Growers who sell to organic markets and export markets with stricter limits have already begun seeking alternative options. However, the entire U.S. potato growing industry will benefit from a new economical and effective replacement to CIPC as the EPA limits its use even further.

A SEARCH FOR ALTERNATIVES

Several studies have been conducted in an effort to identify effective alternatives to CIPC. In a study titled "Organic and Alternatives Methods for Potato Sprout Control in Storage" (CIS1120), the College of Agricultural and Life Sciences at the University of Idaho tested the effects of essentials oils, such as clove and mint oil, on sprout suppression. The oils were applied directly to the potatoes and compared to the effectiveness of CIPC. While the results were promising, the study's authors did note some concerning limitations:

1) For best results, the oils needed to be applied to the potatoes in high concentrations;

2) The oils needed to be reapplied frequently, as often as several times a month, depending on the concentration level;

3) Some of the oils were found to alter the taste and/or color of the potatoes;

4) In large potato storages, it was necessary to close fresh air inlets and re-circulate storage air for one to two days.

Timing of the application was critical, and most effective when applied at peeping, or before the sprouts were one-eighth of an inch long.

The University of Idaho also examined the effectiveness of sprout control using low doses of ionizing irradiation from Cobalt-60 sources. This method has been extensively evaluated worldwide since the 1960s, but today, the commercial use of irradiated potatoes for fresh market consumption is limited to a facility in Hokkaido, Japan, that treats more than 100,000 tons annually. In an article by University of Idaho researchers Nora

Olsen, Mary Jo Frazier and Gale Kleinkopf, titled "High-energy ionizing treatment for potato sprout control," the pros and cons of this method are reviewed:

"Ionization from a linear accelerator is very effective at sprout control, although an increase in reducing sugars and darker colored fries can be a deterrent for the processing sector. The ultimate question surrounding the use of this technology in the potato industry may be consumer acceptance. Although high energy irradiation is safe, leaving behind no radiation products or chemical residues, favorable reception by buyers in the market will need to be determined."

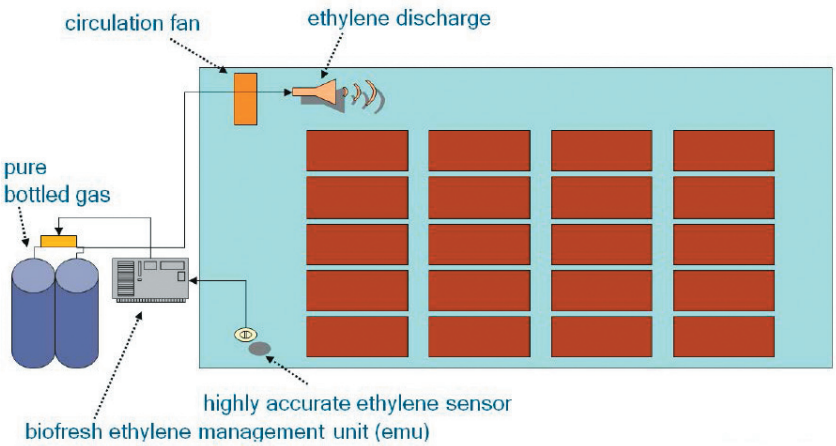
ETHYLENE'S EFFECTIVENESS

Given the stricter limits placed on CIPC in other countries, and the growing demand for chemical-free produce around the world, it isn't surprising that one of the most promising anti-sprouting alternatives was developed in the United Kingdom. A UK company called BioFresh developed an injection system that introduces the gas ethylene into the potato storage environment to suppress the sprouting process.

Ethylene is a natural plant hormone produced in small quantities by most plants, fruits and vegetables as they ripen. It is not harmful or toxic in any way, and has been used for many years as a means of speeding up and controlling the ripening process in crops such as bananas. In addition, the unique properties of ethylene have been found to naturally inhibit sprouting in potatoes. The careful introduction of trace amounts of ethylene into potatoes in storage can delay the sprouting process significantly.

BioFresh's ethylene management system provides store managers and potato growers with an easy-to-operate method of inhibiting sprouting in the stored potato crop. The system uses sensors to control the correct level of ethylene in the storage area, leaving no discernable residues on treated potatoes. Because there is no residue in the storage or on the boxes, seed crops can also be held in the same environment. The system is safe, and has proven to be highly effective.

Also, running the system is very cost effective. For an average storage, the costs to use BioFresh over the course of five years are comparable to CIPC methods; however, the bigger the storage, the more cost effective the system.



BioFresh has had major impact in global markets that are ahead of the U.S. in terms of CIPC restrictions and bans. For example, as a result of a 2002 ban on CIPC, Japanese potato growers were facing enormous costs and quality issues from manual removal of potato sprouts. Since introducing their ethylene systems in Japan in 2008, BioFresh has expanded to 70 storages throughout the country, with customers reporting a 75 percent reduction in customer claims.

BioFresh systems are sold as single, twin and multi-chamber units to meet the needs of any storage's size or configuration. The system is easy to install, requiring only a hard standing for a safety cage, bottled gas and a standard electrical supply. Installation of the system—including piping, regulators and fittings to deliver ethylene into the storage, the sampling and monitoring equipment—normally takes about a half day. It is easily coupled to any existing storage ventilation system.

The BioFresh system logs the ethylene concentrations, and the data can be downloaded wirelessly onto a computer or tablet.

BEST PRACTICES FOR ETHYLENE USE

U.K. Pesticides Safety Directorate (PSD) guidelines recommend the use of 99.9 percent pure ethylene for potato storage applications. The cylindered gas supplied with the BioFresh system meets with these required purity standards. Ethylene should be introduced into the storage after the potatoes have cured and once the long-term storage target temperature has been achieved. Then, ethylene should be introduced at low levels to cured potatoes, followed by a gradual build up over two months until a target concentration of 10ppm is reached.

Ethylene-enriched storages should be ventilated on a regular basis to avoid unacceptable levels of CO2 that may affect process color, taste or texture of the potatoes. Some varieties have shown adverse process quality responses to CO2 levels higher than 5,000 ppm in the presence of 5 ppm ethylene in an experimental potato storage environment. Specific application of ethylene as a sprout inhibitor should be evaluated on a case-by-case basis to assure that commercial usage of the product will not be affected.

To utilize ethylene as a sprout inhibitor in the U.S., registration with the EPA is necessary. Airgas, the largest U.S. distributor of industrial, medical and specialty gases, was granted this registration in the fall of 2012 and is currently the only company in the country permitted to sell ethylene for this application. Airgas has partnered with Techmark, Inc., a Michigan-based company that represents BioFresh for sales of the technology in the U.S.

While CIPC continues to be the primary anti-spouting agent in the U.S., many in the industry are preparing for a time when the compound could be more strictly limited or even banned by the EPA. In the search for alternative sprout inhibitors, BioFresh is a promising replacement candidate and solves issues in meeting residue legislation and testing throughout the distribution chain. PG