Future Tools in Postharvest IPM

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With the Food Quality Protection Act and continued pressure on the use of chemical tools to control insects and diseases in harvested perishables, what are some of the new and upcoming tools for postharvest insect and decay control?

Irradiation

For postharvest insect control, the use of irradiation is increasing. Generic doses for various fruit fly pests have been developed by USDA APHIS. These doses are based on prevention of adult emergence rather than sterilization or mortality of the fruit flies. There is continued interest in the use of irradiation for decay control on various fruits and vegetables. The current dosage of irradiation permitted on fresh fruits and vegetables is 1 kGray, which has limited efficacy for decay control. There is currently a petition to increase the limit to 4 kGray. If approved, the potential for effective decay control would be greater. However, product tolerance will be the limitation as many fruits and vegetables are damaged by irradiation, particularly at doses higher than 1 kGray.

There has been increased interest in applying radiation energy via X-rays or electron beams instead of with Cobalt^{60} gamma sources. The benefits of these systems are the absence of a continuous radiation source. The ability to turn the irradiator on and off results in reduced regulatory hurdles regarding placement and operation of the facility. However, electron beams can only penetrate approximately three inches into the commodity, limiting its applications. A new X-ray/electron beam facility has been built on the island of Hawaii for quarantine treatment of tropical commodities to be shipped to the mainland US.

Pulsed Ultraviolet Illumination

Pulsed Ultraviolet Illumination (PUV) has been under study as a tool for insect and decay control. Efficacy against a wide range of pathogens and

insects have been shown in the laboratory. PUV is a surface treatment and therefore limited in its effects on established disease infections and internal or hidden insect pests. Commercial systems for effectively illuminating the entire product surface are currently under development.

New Types of Heat Treatments

Heat treatments have been used for many years for insect and decay control on certain commodities. With increased interest in alternative treatments to replace traditional chemical controls, there has been renewed interest in heat treatments for a variety of crops. In recent years, the combination of heat treatments with controlled atmospheres has been explored. The combination treatment allows for a shorter exposure to the same temperature and shows promise for some crops such as apples and pears. The logistics and cost of treatment are the biggest hurdles to adoption. Radio frequency (RF) heating has also received renewed interest in recent years. RF heating is similar to microwave heating, but provides for more uniform heating within the product. RF heating is very rapid, and insects may absorb more energy from RF than fruits. This rapid method of heating may allow utilization of an on-line system for heating, thereby reducing the logistical issues involved in heat treatments. Commercial units are already in use by the bakery industry.

Heat treatments continue to be explored as a tool for decay control. Heat treatments are used for decay control on mangoes and some citrus fruit, and show efficacy for some other fruits and vegetables. The risk of product damage is generally an important issue. A new method of heating has been developed in Israel. Very high temperature [55 to 60°C (131 to 140°F)] water sprays are used in conjunction with brushes in an on-line system for very short durations. The results from Israel have been encouraging for a wide variety of fruits and vegetables and a large percentage of the industry in Israel has adopted this method.

Alternative Fumigants

There has been considerable research on the use of various volatile compounds for insect and decay control. For insect control, researchers are exploring the use of acetaldehyde, ethyl formate, methyl formate, volatiles from sagebrush, and others for control of a range of pests. For decay control, researchers are exploring ethanol, hexanal, acetic acid and acetaldehyde. Large-scale tests with acetic acid in fruit storages in Canada have yielded promising results. Additional work is needed in this area.

Ozone Gas

Fumigation with ozone gas for insect control has been explored to some extent, but does not show a lot of promise. For decay control, ozone gas at concentrations above 100 ppm for 80 to 160 minutes has been shown to prevent germination of some spores, but product tolerance is variable. Control is better at higher temperatures and with high relative humidity. Continual use and worker safety issues limit potential use of very low levels of ozone gas (0.3 ppm) can reduce the incidence of decay in fruit storages.

Biological Control/Salts

The Indian meal moth granulosis virus will soon be available as a tool for insect control in stored products. It has been shown to be particularly effective for control of Indian meal moth in stored walnuts and almonds. Biological control agents are available for decay control in citrus and pome fruits, and are used commercially to a limited extent. In general, decay control is not equivalent to that achieved with fungicides, and combination treatments appear more promising. Recent research is exploring the combination of biological control agents with salts (carbonate, bicarbonate, and others). Both the biological control agent and the salt solutions have decay control properties, and the combination appears to have a synergistic effect. Others are exploring combinations of biological control with controlled atmosphere storage and heat treatments.

New Fungicides and Fumigants

In the area of decay control, there are a surprising number of new, reduced risk fungicides nearing registration for citrus, stone, pome and kiwifruit (strobilurins, phenylpyrroles, and hydroxyanilides). For insect control, a variety of fumigants, some currently registered for nonfood uses or for durable products, are under investigation. These include sulfuryl fluoride, carbonyl sulfide and methyl iodide. None of these appear to be a complete replacement for methyl bromide, but may have application for particular crops and insects.

Despite the loss of registration of many of the traditional postharvest chemical tools used for decay and insect control, alternative treatments, including

new fungicides and fumigants, are under development. The adoption of these alternatives will depend on efficacy, ease of use and cost. In many cases, there does not appear to be a single solution for decay or insect control. A systems approach with multiple techniques appears to be the way of the future.