High-energy ionizing treatment for potato sprout control

by Nora Olsen, Mary Jo Frazier, and Gale Kleinkopf

The current practice to inhibit or reduce sprouting in storage involves the use of chlorpropham (CIPC). Although this product received approval for re-registration in 1996, the Environmental Protection Agency must continue to evaluate pesticides for risk assessment as interpreted within the Food Quality Protection Act. In July of 2002, the Environmental Protection Agency issued a reduction requirement for residue tolerance of chlorpropham to 30 ppm. Just recently, the European Union lowered the allowable residue tolerance to 10 ppm. If CIPC becomes further restricted in the US in its use as a potato sprout inhibitor, effective alternatives must be available. An alternative method of sprout control for markets where CIPC is not permitted is also needed.

Sprout control using low doses of ionizing irradiation from Cobalt-60 sources has been extensively evaluated worldwide since the 1960's. These low doses of irradiation are effective in controlling sprout development for long term storage providing other storage parameters are maintained. The irradiation dose can also be applied via a linear accelerator where high-energy electrons are substituted for the radioactive cobalt. The electrons easily penetrate the tuber tissue and prevent sprout growth.

Today, the commercial use of irradiated potatoes for fresh market consumption is limited to a facility in Hikkedo, Japan that treats over 100,000 tons annually. Irradiated potatoes do not require additional chemical applications for effective sprout control. However, with the production of smaller, portable industrial linear accelerators, it may be possible to use high-energy electrons to control sprout development in commercially stored potatoes. A high-energy ionizing treatment for potatoes is similar to the process used in the irradiation of meat products, but at much lower doses (10 to 50 Gy compared to 1,000 to 1,500 Gy). These accelerator units could be portable to a grower's storage where treatment of potatoes traveling along a conveyor would take place. Employee safety is not a great concern since shielding around the accelerator would prevent exposure to stray electrons and remove any ozone produced by the irradiation process.

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. Reconditioning and manipulation of treatment timing and dose can somewhat alleviate this sugar affect. The sugar increase would not be a concern for fresh market destined potatoes and thus this technology may be easily adaptable. The following summarizes the University of Idaho Potato Storage Research Program experimental results using a liner accelerator for sprout control and the impact on tuber quality.

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Russet Burbank potatoes were treated with relatively low doses (25 Gy and 50 Gy) of ionizing irradiation applied with a high-energy linear accelerator. Doses of 25 and 50 Gy were effective for long-term sprout control at 45°F, although some sprouting, characterized by multiple sprouts in some of the eyes, occurred on the 25Gy treatment eight months after treatment (Fig. 1, 2). The 25 Gy dose is 20% of the effective dose for sprout inhibition previously reported in the literature. Doses of 40 to 50 Gy would be appropriate for long-term sprout control.

Both high-energy treatments increased glucose significantly compared to the control (Fig. 3). Immediately after treatment, all high-energy treatments resulted in increased fry-color, unacceptable to processors. However, fry-color and reducing sugar levels improved to acceptable levels with time in storage (6-months) or with reconditioning at 58°F for 2 to 4 weeks.

Other concerns

This method of sprout control could be of great benefit to the industry although many questions have yet to be answered. Occasionally, some tuber lots treated with high-energy electrons will show an increased tendency for disease development. This may be because the tuber lot has an unusually high level of pathogens on the tuber surfaces.

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. The USDA has approved irradiation as a method of sprout control in potatoes since the early 1950's. Now that this technology is available, would you be willing to accept irradiated potatoes as a primary high-value food source for you and your family?

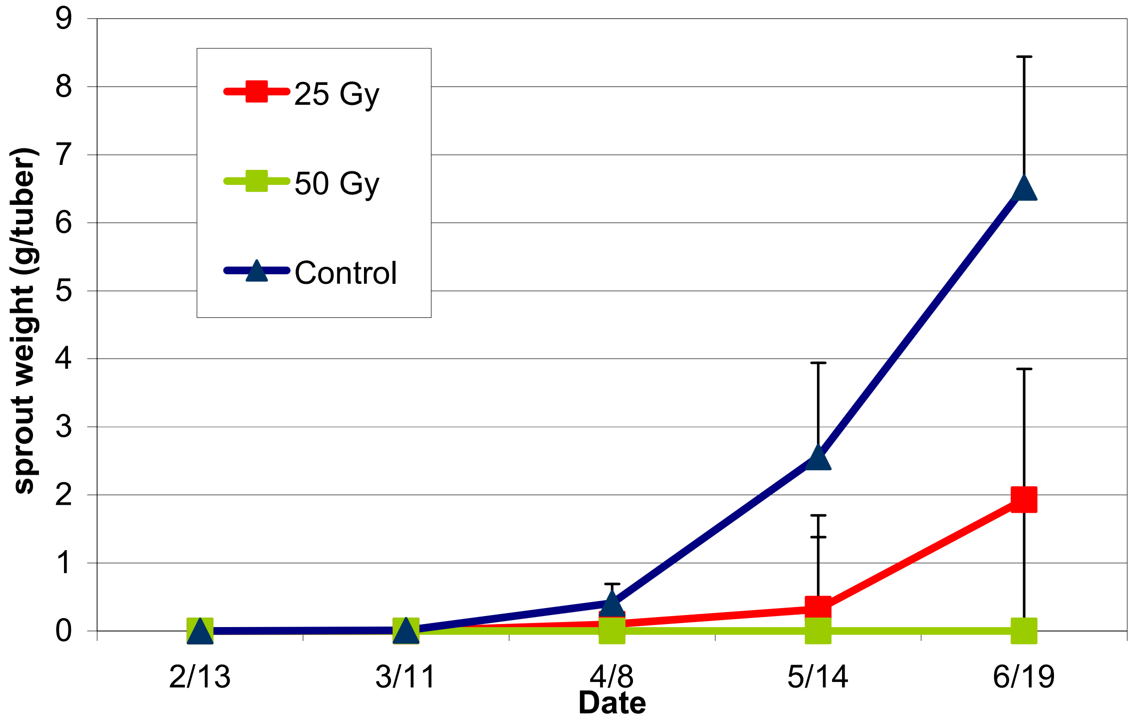

Figure 1. Sprout weight (g/tuber) in irradiated and untreated tubers on 5 dates

Figure 2. Sprout growth of treated and non-treated potatoes after 8.5 months storage at 45°F.

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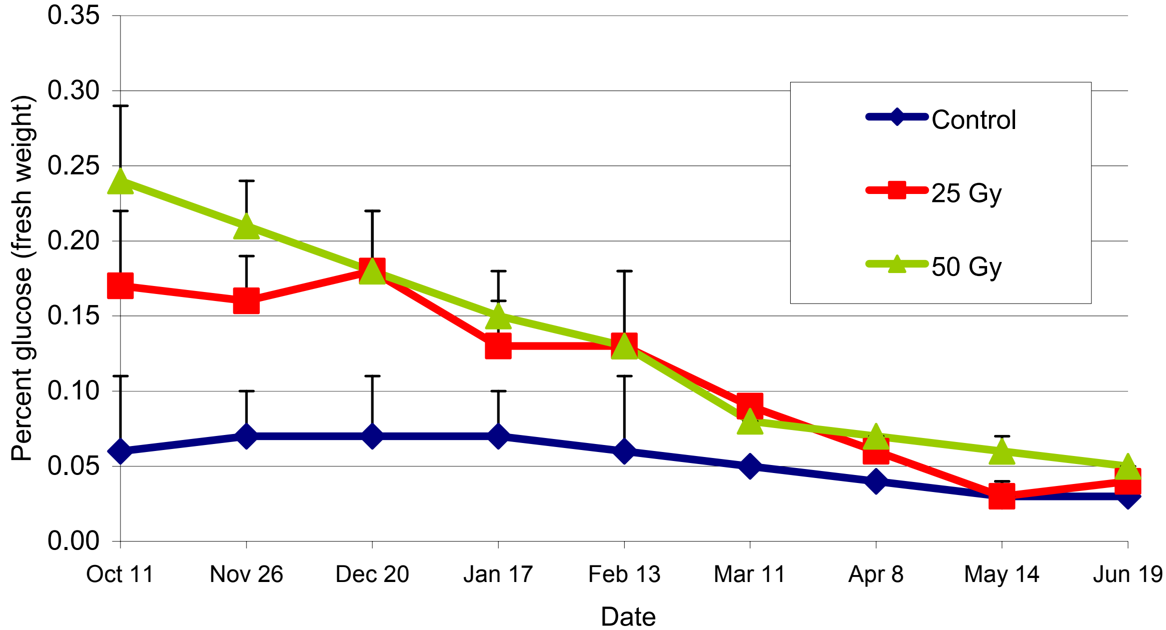

Fig. 3. Glucose concentration (percent fresh weight) for treated and untreated tubers held in standard storage temperature 45°F

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