IRRADIATION REPLACES METHYL BROMIDE FOR SWEETPOTATO EXPORTED FROM HAWAII

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Hawaii's vegetable growers produce several unique varieties of sweetpotatoes [*Ipomoea batatas* (L.) Lam.], including purple fleshed cultivars. Sweetpotato growers in Hawaii are unable to ship sweetpotatoes to California and the U.S. mainland without a quarantine treatment because of the presence of three regulatory pests: West Indian sweetpotato weevil, *Euscepes postfasciatus* (Coleoptera: Curculionidae), and sweetpotato vine borer, *Omphisa anastomosalis* (Lepidoptera: Pyralidae), and sweetpotato weevil, *Cylas formicarius elegantul*us (Coleoptera: Curculionidae). Until recently, growers have been exporting sweetpotatoes to the U.S. mainland using methyl bromide fumigation. Methyl bromide fumigation adversely affects root quality and has become costly. Irradiation treatment is an alternative to chemical fumigation for sweetpotato growers. The main advantage of irradiation as a phytosanitary treatment is that it is broadly effective against arthropod pests (insects and mites) at dose levels that do not cause injury to most types of fresh fruits and vegetables.

An irradiation treatment of 400 Gy for sweetpotatoes was published as an Interim Rule in the Federal Register on July, 26 2003 based on a technical report submitted to USDA-APHIS containing preliminary data on radio-tolerance of the insect pests and a recommendation for a high-dose. This was the first time APHIS considered the high-dose approach for controlling a pest complex until research is completed to confirm a lower dose. The irradiation treatment was published as a final rule in the Federal Register on February 18, 2004. Here, I discuss irradiation research in progress in my laboratory to lower the irradiation dose for the three quarantine insect pests of sweetpotato in Hawaii.

Tests were conducted with the sweetpotato vine borer and the West Indian sweetpotato weevil to determine the most tolerant stage occurring in the root, and to identify a dose to control the most tolerant stage. Fresh roots were irradiated at a high dose (450 Gy) to eliminate any natural infestation. For sweetpotato vine borer, roots were placed in a cage for 24 h with mated moths for oviposition. Roots with eggs were held in plastic containers for hatch and larval and pupal development, and at weekly intervals for 6 weeks a subset of roots was irradiated at 75 Gy then held for adult emergence. Roots selected for each age treatment started with roughly the same total number of eggs. No weevils emerged from irradiated roots in the 1-4 week old treatments. Six adults emerged from the 5-week old treatment (36-37 days old), and 341 adults emerged from the 6 week old treatment (42-44 days old). Development studies showed that most 5-6 week old weevils were in the pupal stage, in the 6-week old treatment a few adults had emerged at the time of treatment, which confirmed this. Therefore, the late pupa is the most

radiotolerant stage occurring in roots. Adults emerged from all the age groups in the unirradiated controls. Large-scale confirmatory tests are in progress. Thus far, 3,000 late pupae have been irradiated at 150 Gy in sweetpotatoes with no subsequent reproduction. This dose appears to also cause complete sterility when adult moths are treated.

For West Indian sweetpotato weevil, similar studies indicated that the adult stage was the most radiotolerant occurring in roots. Dose response tests suggested a dose >100 Gy would be necessary to prevent reproduction in adults. In large-scale confirmatory tests, mated adult weevils were transferred into sweetpotato roots with the centers bored out, and treated 24 h later with an irradiation dose of 150 Gy. Treated adults were then placed on uninfested roots to examine reproduction. Thus far, 50,000 weevils (sum of 12 replicates) have been treated at this dose with no successful reproduction. Large numbers of F_1 adults are emerging from unirradiated control roots.

Irradiation studies with sweetpotato weevil mirrored those with West Indian sweetpotato weevil. Previously, 165 Gy was shown to control sweetpotato weevil adults (Hallman 2001). We irradiated 60,000 adult weevils at 150 Gy (maximum absorbed dose) with no subsequent reproduction. The accepted dose of 165 Gy can be lowered to 150 Gy.

Since the publication of the Interim rule in July 2003, sweetpotato production in Hawaii has doubled and virtually all sweetpotatoes destined for U.S. mainland markets are irradiated before export. Sweetpotato exports are averaging 40,000-50,000 lbs per week or over 2.5 millions lbs per year and growing. Our data indicate the irradiation dose to control the sweetpotato quarantine pests can be lowered from 400 to 150 Gy. The dose uniformity ratio for sweetpotatoes irradiated at the Hawaii Pride (Keaau, HI) commercial x-ray treatment facility is about 2.0. Sweetpotato quality research indicates that roots irradiated at 600 Gy suffer no loss in quality (Wall 2004).

References

Hallman, G. J. 2001. Ionizing irradiation quarantine treatment against sweetpotato weevil (Coleoptera: Curculionidae). Fla. Entomol. 84: 415-417.

Wall, M. M. 2004. Compositional and sensory analyses of sweetpotatoes after x-ray irradiation quarantine treatment. HortScience 39: 574-577.