PROBIT 9 MORTALITY ESTIMATE FOR BLUEBERRY MAGGOT EXPOSED TO GAMMA IRRADIATION

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Blueberry maggot, Rhagoletis mendax Curran, infests commercially-grown blueberries (Marucci 1966). Blueberries must be disinfested of blueberry maggot before the California Department of Agriculture will permit the berries into the state. The current postharvest disinfestation treatment is fumigation with methyl bromide (Anonymous 1991). Continued use of methyl bromide is uncertain. Also, blueberries for markets in Ontario and British Colombia must be certified free of blueberry maggot. Alternative quarantine treatments are needed to ensure that markets for blueberries remain open for consumers in California and Canada.

Infested highbush blueberries, Vaccinium corymbosum L. var. Elizabeth, collected manually in an abandoned blueberry orchard near Whitesbog, New Jersey and Vaccinium species collected manually near The Trevor Nichols Research Complex, Fennville, Michigan, were sent by overnight mail to the Subtropical Horticulture Research Station, Miami, Florida. Berries in plastic, zip-lock bags were weighed and then irradiated with cobalt 60 using a Gammacell 220 irradiator. Unirradiated berries served as controls and were used to estimate the number of treated larvae. Treated and unirradiated berries were put on hardware cloth fitted in separate plastic trays with open lattice bottoms. The trays loaded with berries were placed over sand. Mature larvae left the berries, fell into the sand and pupated. Sand was sifted three times each week until all pupae had been recovered. Dose-mortality data based on the number of pupae recovered from unirradiated berries and from berries irradiated at 120, 180, 200, 220, and 250 gray (Gy) were analyzed using logistic, Gompertz, and normal probit probability density functions with and without log 10 conversions (SAS Institute 1988).

Percentages for mortality of larvae irradiated at 120, 180, 200, 220, and 250 Gy were 37.9, 54.5, 74.2, 78.7, and 94.6, respectively. Logistic analysis without log 10 conversion estimated the most reasonable probit 9 (99.9968%) mortality dose (and lower and upper fiducial limits) at the 95%

confidence level needed to prevent larvae forming puparia. The dose was 348.2 Gy (306.2 - 426.5 Gy). Data are preliminary and based on 693 treated larvae.

Gamma radiation doses needed for probit 9 quarantine security for temperate fruit fly species that have an obligate diapause requirement such as blueberry maggot, western cherry fruit fly, Rhagoletis indifferens Curran, and Rhagoletis cerasi L. could be greater than 150 Gy, which is the dose recommended as a generic one by the International Consultative Group of Food Irradiation for controlling fruit flies (ICGFI 1994). In our study 348 Gy was estimated to prevent larval emergence from blueberries. Jona and Arzone (1979) reported that 300 - 500 Gy were not fully lethal for R. cerasi since one-third of the treated larvae survived. They recommended 1000 Gy to control the fruit fly in cherries because mortality was total and almost immediate. Burditt and Hungate (1988) reported that the LD 90 (90% mortality) dose needed to prevent larval pupation of western cherry fruit fly was estimated to be 200 Gy. Also they reported that exposure to 6000 Gy would be required to give 99.9968% mortality based on failure of larvae to form puparia.

REFERENCES

Anonymous. 1990. Plant Protection Import Operational Directive 013-1: 20 pp. Agriculture Canada. Ottawa.

Anonymous. 1991. The State of California Commodity Treatment Manual. Vol. I. Treatments. D. A. Fiskaali, (ed.). Published by the State of California Department of Agriculture, 1989. Revised 1991. 342 pp.

Burditt, Jr., A.K. and F.P. Hungate. 1988. Gamma irradiation as a quarantine treatment for cherries infested by western cherry fruit fly (Diptera: Tephritidae). J. Econ. Entomol. 81: 859-862.

International Consultative Group on Food Irradiation. ICGFI Document No. 17. A Report of the Working Group Convened by ICGFI. 40 pp. U. S. Department of Agriculture, Washington, D. C., U. S. A. 22 to 25 March 1994. International Atomic Energy Agency. Vienna, Austria.

Jona, R. and A. Arzone. 1979. Control of Rhagoletis cerasi in cherries by gamma irradiation. J. Horticultural Sci. 54: 167-170.

Marucci, P. 1966. Insects and their control, pp. 199-235. In: P. Eck and N. F. Childers (eds.). Blueberry Culture, Rutgers University Press. New Brunswick, N. J.

SAS Institute. 1988. SAS user's guide: statistics, release 6.03 ed. SAS Institute, Cary, N. C.