Bull. Environm. Contam. Toxicol. 23,797-799 (1979)

Screening Study for the Uptake of Monosodium Methanearsonate in the Blackberry Following Dosing at Four Application Rates

A. A. Abdelghani, A. C. Anderson, and J. W. Mason

Department of Environmental Health Sciences, School of Public Health and Tropical Medicine, Tulane University, New Orleans, La. 70112

The arsenical herbicide MSMA is used extensively in the southeastern United States for grass control in nonedible crops such as cotton and for chemical mowing along highway rights of way. Potential residues of the herbicide in edible products growing along roadsides may be of public health concern since these crops are readily accessible for harvesting by the unsuspecting public. This project focused on one such product by monitoring the effect of the herbicide on blackberry plants and noting the uptake of the arsenical into the fruit. The impetus for this research was based upon studies which demonstrated translocation of the herbicide from leaves to the seeds of broadleaf plants such as cotton and soybeans following foliar application (RUMBURG et al. 1960, SACHS & MICHAEL 1970, FOY & YAMAGUCHI 1964, EHMAN 1966, WILKINSON & HARDCASTLE 1969). MSMA and cacodylic acid are both transported from leaves to terminal buds of "Black Valentine" beans while transport of inorganic arsenic is negligible (SACHS & MICHAEL 1971). MSMA is also absorbed from soil and concentrated in the seeds of cotton, soybeans, corn and oats (JOHNSON & HILTBOLD 1969).

MATERIALS AND METHODS

Native blackberry bushes (Rubus sp.) were divided into four zones of approximately 20 square feet each, and sheltered with clear plastic to protect plants from rain and dew. Bushes were sprayed when fruit was in the earliest stage of maturation (green stage) with harvesting during the intermediate (red) and mature stages of development. Zones were sprayed (using a triple nozzle sprayer previously calibrated to deliver 55 mL per square foot) at the recommended application rate for grass control of 3 lb/acre and at rates of 2.25, 1.5 and 0.75 lb/acre. The lower rates were selected to simulate exposure of bushes by drift of herbicide downwind of the target site. Twenty fruit were taken from each zone 44 days after dosing when fruit were in the red and ripe stages. Samples were divided into two pools, and one washed with tap water to remove unabsorbed herbicide. The remaining portion was not washed. Each sample was then divided for analysis in duplicate. Samples were blended and 1.0 g aliquots (wet weight) digested using a volumetric mixture of concentrated nitric, sulfuric and perchloric acids in a ratio of 10:2:1. Digested samples were analyzed for total arsenic using the SDDC procedure (Standard Methods 1971).

0007-4861/79/0023-0797 $01.00

RESULTS AND DISCUSSION

Effects on Plants. Application of MSMA at 3 lb/acre heavily damaged leaves of blackberry bushes producing considerable necrosis (>90%) after 72 h. Only mature canes present at the time of spraying were affected. New shoots were not injured and bushes survived into the following year. Application at the green berry stage resulted in destruction of the plant before berries reached maturity.

Plants exposed to the lower concentrations of 2.25, 1.5 and 0.75 lb MSMA/acre showed 70, 54 and 27% leaf damage respectively after 72 h. Damage estimates were based on the average percentage of necrosis of individual leaves. Bushes sprayed during the green berry stage at these lower concentrations produced mature fruit approximately 44 days after spraying.

Effects on Fruit. Mean arsenic residuals found in fruit harvested at the red and ripe stages of maturation following application of 2.25, 1.5, and 0.75 lb/acre MSMA are given in Table 1.

TABLE 1

Mean Arsenic Residues in Blackberries 44 Days Following Application of MSMA at 0.75, 1.5, 2.25 and 3 Pounds MSMA per Acre

Application Rate (lb/acre)	Red Berries		Ripe Berries	
	Washed µg/g	Unwashed µg/g	Washed µg/g	Unwashed µg/g
0.75	1.2	1.7	1.6	2.3
1.50	1.3	4.0	2.8	3.4
2.25	1.9	7.0	3.8	5.4
3.0	X	X	X	X
Control	<0.1	<0.1	<0.1	0.2

X Bushes were destroyed before fruit reached maturity.

Both red and ripe berry stages show increasing uptake of herbicide with increasing application. This follows since one would expect flow of nutrients toward the berry during the maturation process. Fruit sprayed at 3 lb/acre did not mature due to plant destruction. However, concentrations in green berries approached 27 µg/g and 29 µg/g in washed and unwashed fruit, respectively, after 168 h of exposure. Fruit sprayed at lower concentrations also accumulated arsenic but not to the levels reached at the higher application rate. This indicates that absorption is passive with concentration

dependent on dose. At all application rates, arsenic levels were lower in washed samples than unwashed samples, which includes both absorbed and adsorbed MSMA. Comparing washed and unwashed sample values, however, reflects translocation of MSMA from leaves stems to ripening fruit.

Data obtained in these experiments indicates that blackberry plants are capable of concentrating MSMA in edible fruit following application of the herbicide when berries are in early stages of maturation. While low concentrations of MSMA produce only slight leaf injury, elevated concentrations in fruit from the lower levels do occur. Drift, overspray, may thus constitute a problem in fence rows adjacent to rights of way or fields sprayed with the herbicide and should be carefully monitored during application in those months when dewberries, mayberries, or blackberries are approaching ripeness.

REFERENCES

EHAMN, P.J.: Proc. Soc. Weed Conf. 19, 540 (1966)

FOY, C.L. and S. YAMAGUCHI: "Mechanism of Root Absorption of Organic Molecules": Am. Soc. Plant Physiol. Symposium, Emory U., p. 5-28 (1964)

JOHNSON, L.R. and A.E. HILTBOLD: Soil Sci. Soc. Am. Proc. 33, 279 (1969)

RUMBURG, C.R., R.E. ENGEL, and W. MEGGIT: "Effect of Temperature on the Herbicidal Activity and Translocation of Arsenicals": Weeds, Vol. 8, No. 4, pp. 582-588 (1960)

SACHS, R.M. and J.L. MICHAEL: Weed Sci. 19, 558 (1971)

Standard Methods for the Examination of Water and Wastewater, 13th ed. APHA, AWWA, WPCF (1971)

WILKINSON, R.E. and W.S. HARDCASTLE: Weed Sci. 17, 536 (1969)