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Residues of Dacthal and Metabolites in Field-Treated Chinese Cabbage

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The increasing oriental population in New York State has stimulated interest among growers in the culture of crops traditionally consumed by them. Chinese cabbage (Brassica rapa) is an example of such crops which can be grown in New York. Weed control is essential for successful production of this crop. Dacthal (dimethyl tetrachloroterephthalate) is a selective preemergence herbicide used for control of a number of weeds in a variety of ornamental, field and vegetable crops. In the work reported here, Dacthal was used for control of weeds in Chinese cabbage grown in Central New York and on Long Island. The harvested crops were analyzed for residues of the herbicide and its hydrolytic cleavage products, 1-methyl-4-carboxyl-2,3,5,6-tetrachloroterephthalate (Dacthal mono acid) and 2,3,5,6-tetrachloroterephthalic acid (Dacthal diacid).

MATERIALS AND METHODS

'Bok Choi' Chinese cabbage (Brassica rapa) was grown to the transplant stage (5 weeks old) in the greenhouse. On June 2, 1987, these plants were transplanted to the field at the University vegetable research farm in Freeville in Central New York in rows 6 meters long with a plant spacing of 30 cm. The soil was a Howard gravelly loam (pH 7.0, 3% organic matter). Dacthal (75% wp) was applied as a pre-plant (June 1) or post-emergence (June 4) application to the cabbage transplants. The application was made with a CO_2, hand-held, backpack sprayer. The rates of application were 0, 8 and 16 pounds/acre (0, 9 and 18 kg/hectare, respectively). On Long Island, the cabbage was planted on July 28 in Riverhead, New York. A preplant Dacthal application was made on the same day at 0, 9 and 18 kg/ha using the same type of application equipment and herbicide formulation. The soil was a Riverside sandy loam (pH 5.5, 2% organic matter). Each herbicide-treated row was replicated 4 times in each location. Four plants from each row were harvested June 26 and July 27 in Central New York and on September 23 on Long Island and analyzed for Dacthal and its monoacid and diacid metabolites.

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The method of analysis was a modification of that of Ballee and Stallard (1975). It involved extraction of the sample by blending with acidified acetone, filtering, extraction of the alkalified filtrate with petroleum ether, isolation of Dacthal by column chromatography on Florisil and determination by electron capture gas chromatography. The Dacthal monoacid and diacid metabolites were determined by extraction of the above acidified filtrate with petroleum ether, formation of the propyl ester derivatives, isolation of the latter derivatives using column chromatography on alumina and analysis by electron capture gas chromatography. The limit of detection of the method for Dacthal or either of its metabolites was 0.01 ppm. The recoveries of Dacthal and metabolites from cabbage are shown in Table 1.

Table 1. Recovery of Dacthal and its metabolites from Chinese cabbage.

Dacthal		Dacthal monoacid		Dacthal diacid	
ppm added	Recovery %	ppm added	Recovery %	ppm added	Recovery %
0.1	99	0.04	80	0.08	79
0.1	95	0.04	68	0.08	79
0.1	92	0.04	80	0.08	66
0.1	105	0.04	105	0.08	85
0.5	106	0.04	100	0.08	85
0.5	95	0.04	88	0.08	78
1.0	80	0.04	98	0.08	78

RESULTS AND DISCUSSION

The results of analysis of the cabbage samples from Freeville and Riverhead, New York for residues of Dacthal and its metabolites are listed in Table 2. The highest residues were those of Dacthal in the herbicide-treated cabbage harvested before maturity on June 26 in Freeville. The post-emergence treatment showed higher residues of Dacthal on the latter cabbage than the preplant application probably because of direct foliar contact of the herbicide by drift and vaporization. Mature cabbage harvest levels of Dacthal were nearly the same and very minute for either application method, however. Similarly, only residues of intact Dacthal were appreciable on the cabbage harvested in Riverhead. Harvest residues of Dacthal have been found to be very low on strawberries (Waldron 1973), radishes (Archer and Gauer 1980) and carrots (Gilbert and Lisk 1978) when pre-emergence applications of the herbicide were made.

It is possible that soil containing Dacthal could contribute to residues in cabbage if splashed into the foliage by rain during growth or contaminated by it during harvesting. However, the herbicide has been reported to decompose quite rapidly in soil (Mazyrina et al. 1979; Zhukova and Shirko 1979) especially if readily oxidizable organic matter is available (Hurto et al. 1979).

Table 2. Residues of Dacthal and its metabolites in Chinese cabbage.

Application type	Appl. rate (kg/ha)	Harvest interval (days)	Residue (ppm, fresh wt) Dacthal	Dacthal monoacid	Dacthal diacid
			Freeville, NY		
Preplant	9	25	0.29 ± 0.05[a]	0.02 ± 0.00	0.05 ± 0.01
Preplant	18	25	0.44 ± 0.06	0.03 ± 0.00	0.05 ± 0.01
Preplant	9	56	0.01 ± 0.00	0.02 ± 0.00	0.02 ± 0.01
Preplant	18	56	0.01 ± 0.00	0.03 ± 0.00	0.01 ± 0.00
Postemergence	9	22	1.05 ± 0.14	0.03 ± 0.00	0.06 ± 0.01
Postemergence	18	22	0.99 ± 0.20	0.05 ± 0.00	0.04 ± 0.02
Postemergence	9	53	0.02 ± 0.00	0.03 ± 0.00	0.01 ± 0.00
Postemergence	18	53	0.03 ± 0.00	0.04 ± 0.00	0.02 ± 0.00
Control[b]	0		0.01 ± 0.00	0.01 ± 0.00	0.01 ± 0.00
			Riverhead, NY		
Preplant	9	57	0.16 ± 0.07	nd[c]	0.02 ± 0.00
Preplant	18	57	0.47 ± 0.19	nd	0.02 ± 0.00
Control	0	57	0.01 ± 0.01	nd	nd

[a]Mean ± SEM
[b]Harvested July 27
[c]Not detectable (<0.01 ppm)

Residues of the monoacid and diacid metabolites of Dacthal were low or not detectable in the harvested cabbage. This is in agreement with the findings of Archer and Gauer (1980) who reported low to undetectable concentrations of these metabolites as harvest residues in radish roots and tops following pre-emergence treatment with Dacthal.

REFERENCES

Archer TE, Gauer WO (1980) Levels of DCPA, MTP, TPA, and Hexachlorobenzene in radish roots and tops. Hort Sci 15:146-147

Ballee DL, Stallard DE (1975) Dacthal. Diamond Shamrock, TR Evans Res Ctr, Painesville, OH

Gilbert M, Lisk DJ (1978) Residues of Dacthal herbicide in carrots. Bull Environm Contam Toxicol 20:180-183

Hurto KA, Turgeon AJ, Cole MA (1979) Degradation of Benefin and DCPA in thatch and soil from a Kentucky Bluegrass (Poa pratensis) turf. Weed Sci 27:154-157

Mazyrina MD, Patrykin AD, Potkina LI, Rozova LA (1979) Herbicide residues in soil and vegetables. Khim Sel'sk Khoz 17:59-61

Waldron AC (1973) Herbicide residues on strawberries: The effects of combinations of Dacthal and Sesone. Bull Environm Contam Toxicol 9:305-311

Zhukova PS, Shirko TS (1979) Herbicide residues in soil and vegetables. Khim Sel'sk Khoz 17:46-50

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