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Residues of Dacthal Herbicide in Carrots

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Dacthal (dimethyl-2,3,5,6-tetrachloroterephthalate) is an effective preemergence herbicide for control of grass and broadleaf weeds in cotton and a variety of vegetable and ornamental crops. The compound probably undergoes hydrolytic ester cleavage to yield the corresponding monoacid (monomethyl-2,3,5,6-tetrachloroterephthalate) or diacid (2,3,5,6-tetrachlorophthalic acid) derivatives (GERSHON and MCCLURE, 1966). In the work reported possible residues of Dacthal and its monoacid or diacid metabolites were determined in carrots treated pre- or post-emergence with the herbicide in plots located throughout the United States.

EXPERIMENTAL

Carrots were treated both pre- and post-emergence with Dacthal in plots in several states representing various soil types (see Table 1). The method of analysis was performed as described below. Harvested carrots were cleaned in water with a vegetable brush and subdivided using a food cutter. The material was mixed and a 50-gram subsample was blended with two 100 ml portions of 95:5 (v/v) acetone:50% sulfuric acid. The combined puree was then mechanically agitated for 4 hours. The mixture was filtered and the filtrate volume made to 250 ml with acetone. A 125 ml portion of the filtrate was neutralized with 100 ml of 10% sodium carbonate. The acetone was evaporated using heat (35° C) and a gentle air stream. The resulting aqueous solution was partitioned successively with three 10-ml portions of hexane. The combined hexane extracts containing Dacthal were evaporated to 10 ml. The remaining aqueous solution was acidified with 6.5 ml of 50% sulfuric acid. Possible monoacid and diacid metabolites of Dacthal were extracted from this acidified aqueous solution using three 20-ml portions of diethyl ether. The combined ether extracts were evaporated to 5 ml and a 2.5 ml portion was reacted overnight at room temperature with 2.5 ml of 0.18% 1-n-propyl-β-tolyl-triazine in ether to yield the propyl derivatives of the mono- and diacid metabolites. Forty ml

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TABLE 1.
Residues of Dacthal in carrots

Plot location	Soil type	% OM[a]	Formulation	Rate of application (lb/A)	Harvest interval (days)	Dacthal, ppm (fresh weight)
Clayton, DE	sandy	<1	6% F[b]	10 Pre[c]	150	0.43 ± 0.15[d] (4)[e]
				20 Post[f]	121	0.78 ± 0.07 (2)
				20 Pre	150	0.67 ± 0.09 (2)
				0 (control)		nd[g] (1)
College Park, MD	sandy loam	1.2	75% WP[h]	18 Pre	145	0.10 ± 0.06 (4)
			6% WDL[i]	18 Pre	145	0.07 ± 0.05 (4)
			75% WP	9 Pre	145	0.03 ± 0.01 (4)
			6% WDL	9 Pre	145	0.05 ± 0.04 (4)
			75% WP	7.5 Pre	170	0.08 ± 0.03 (8)
			75% WP	10.5 Pre	170	0.11 ± 0.04 (8)
				0 (control)		0.02 ± 0.0 (2)
El Centro, CA	clay loam	1	75% WP	7.5 Pre	132	0.04 ± 0.02 (2)
			75% WP	15 Pre	132	0.06 ± 0.02 (2)
				0 (control)		0.02 ± 0.0 (2)
Lamont, CA	loamy sand	0.2	75% WP	7.5 Pre	175	nd (1)
			75% WP	15 Pre	175	nd (2)
				0 (control)		nd (1)

Napoleon, OH	sandy loam	2.5	75% WP	10.5 Pre	146	0.04 ± 0.01 (7)
				21 Pre	146	0.13 ± 0.04 (8)
				10.5 Post	119	0.04 ± 0.01 (8)
				0 (control)		nd
Painesville, OH	silt loam	1.8	75% WP	10.5 Pre	95	nd (4)
			75% WP	21 Pre	95	nd (4)
			6% F	10.5 Pre	95	nd (4)
			6% F	21 Pre	95	nd (4)
				0 (control)		nd (1)
San Juan, TX	clay loam	1	6% F	15 Pre	172	0.10 ± 0.07 (2)
			15% WP	15 Pre	172	nd (2)
				0 (control)		nd (1)

a organic matter
b flowable
c preemergence herbicide application
d average ± standard deviation
e number of replicates
f post-emergence herbicide application
g not detectable, i.e., less than 0.02 ppm
h wettable powder
i water dispersible liquid

of distilled water was added to the reaction mixture and the propyl derivatives were extracted with three 5 ml portions of isopropyl ether. The hexane solution containing Dacthal and the ether solution were analyzed by gas chromatography using an electron affinity detector. The gas chromatograph was a Varian Aerograph Model 705 equipped with a nickel-63 electron affinity detector. The column was 1.2m X 2mm and contained 3% OV-225 on 100/120 mesh Gas-Chrom Q. The temperatures of the injector, column and detector were 205°, 175° and 265° C, respectively.

RESULTS AND DISCUSSION

Table 1 summarizes data on the field treatment of carrots with Dacthal and the harvest residues as determined by the method. The magnitude of the residues appears to be related to application rate rather than the type of herbicide formulation, timing of application, harvest interval or the content of soil organic matter. The method was sensitive to 0.02, 0.08 and 0.2 ppm of Dacthal, and its mono- and diacid metabolites, respectively, in carrots on a fresh weight basis. The average recoveries ($\pm$ standard deviation) of 0.5 ppm of Dacthal, and its mono- and diacid metabolites from carrots were 84 $\pm$ 6%, 75 $\pm$ 4% and 82 $\pm$ 9%, respectively. Traces (about 0.1 ppm) of the monoacid metabolite of Dacthal were only detected in certain of the carrot samples from Clayton, Delaware and Napoleon, Ohio. Residues of the diacid metabolite were not detected in any carrot samples. It is possible that further metabolism of the diacid metabolite occurred to yield products such as methyl 2,3,5,6-tetrachlorobenzoate, 2,3,5,6-tetrachlorobenzoic acid and 1,2,4,5-tetrachlorobenzene (GERSHON and MCCLURE, 1966).

SUMMARY

Residues of Dacthal and its monoacid and diacid hydrolytic ester cleavage metabolites were determined in carrots to which the herbicide was applied on seven plot locations throughout the United States. Residue levels of Dacthal appeared more closely related to the rate of application than to other field parameters. Traces of the monoacid metabolite were found in a few samples. The diacid metabolite was not detected in any of the samples.

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