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Malathion Aerosols Applied in Conjunction with Vertically Placed Aeration for the Control of Insects in Stored Corn[1]

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ABSTRACT: Corn stored in circular metal bins equipped with vertically placed aeration systems was treated with malathion thermal aerosol applied in the grain overspace. The average number of live insects per 1000 g found in the malathion-aerosol treated corn was 0.24; in the untreated corn there was an average of 1.3 insects/1000 g. Corn taken after treatment was analyzed chemically for malathion indicated that most of the malathion was deposited in the top 1.52 m of corn. Largest amounts were found in the top .76 m of corn.

Malathion is the insecticide normally applied to stored grain, usually applied as a spray to bin walls and floors, to the grain surface, and/or as a protectant applied directly to the entire grain mass as it is moved into storage. The newest experimental method of applying the malathion protectant to the grain mass is as an aerosol. Thermally-generated malathion aerosol particles are pushed and/or pulled into the grain mass with air movement created by aeration or drying fans. The advantage of this type of treatment is that the malathion can be applied without moving the grain and at the convenience of the grain handlers.

Quinlan (1972a) demonstrated that the aerosol method of treatment distributed lethal amounts of malathion through grain to depths of 3.04 m. Other studies by Quinlan (1972b, 1977) indicated the value of a periodic surface spray to grain in inhibiting insects within the grain mass. However, it was possible that the aerosol treatment could be utilized even more effectively in applying a protectant to corn stored in metal bins equipped with vertical aeration or that such equipment would be more effective in distributing malathion in surface areas than conventional surface spraying.

Methods and Materials

The shelled yellow corn used in the test was stored in ten 114.53 m^3 circular metal standard USDA bins located at Watseka, Illinois. Each bin was 5.47 m in diameter and 4.57 m (15 ft) high. The corn, after being stored

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[1] This paper reports the results of research only. Mention of a pesticide does not constitute a recommendation for use by the USDA, nor does it imply registration under FIFRA as amended, also mention of a proprietary product does not constitute an endorsement by the USDA.

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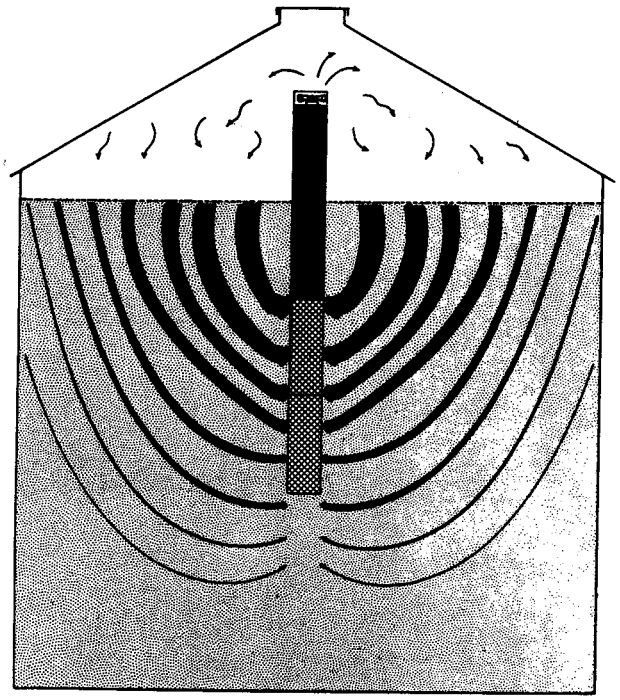

Fig. 1. Diagrammatic pattern of air flow through aerated corn stored in a 3,250-bushel (114.53 m^3) steel bin. Vertically placed aeration system with 100-cubic-feet-per-minute fan (Winter and Mayes, 1958).

on the farms as ear corn for one year, was shelled on the farm and then trucked to the bin site where it was augered into the bins. Each bin was filled with 86.8 m ton of corn of 13.5 to 14.0% moisture content. The grain depth was 4.27 m.

Each of the 10 bins was equipped with an aeration fan that was rated at 100 cfm, or 1/30 cfm/bu. the duct was 3.66 m long and consisted of a 45.72 cm diameter tube inserted vertically at the center of the bin. The top 1.83 m of the tube was solid and the bottom 1.83 m was perforated. About 91.44 cm of the solid tube extended above the surface of the corn. The fans were attached to the top of the tube so it was pulling air from the grain mass into the grain overspace. The fans were operated continuously through the observation period (see Fig. 1).

The thermal aerosol machine used in this study was the Dyna Fog Jr.® generator that employs the resonant pulse principle to produce hot gases flowing at high velocity. The machine was at No. 2 setting.

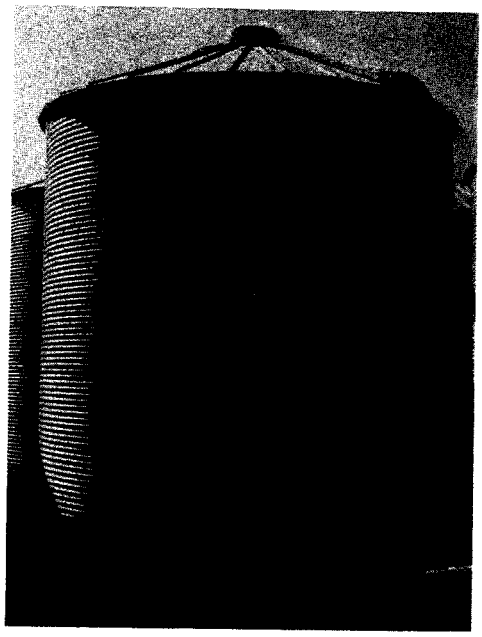

Fig. 2. Application of thermal aerosol to grain overspace.

Each 7.3 liter of malathion aerosol formulation contained the following: malathion 96.0%—.65 liter, No. 10 base oil—1.9 liter, and carbon tetrachloride—4.73 liter. The grain was treated during October, and sampling of the grain began one week after treatment.

The aerosol was applied into the overspace in each of the 5 bins while the aeration fan was operating by means of a 7.6 m, 10.16 cm dia. flexible

Table 1. Insect population trends in shelled corn treated in October with a thermal aerosol of malathion. Corn stored in 3,250-bushel (114.53 m^3) circular metal bins. Means of 5 bins.

Insecticide and dosage	Mean number of live insects per 1,000 grams of corn											
	1st year			2nd year								
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Malathion 10.0 ppm aerosol, aeration												
Mean	.2	.2	.4	0	.1	0	0	0	0	.1	.3	1.6
No-treatment controls aeration only												
Mean	.4	1.4	.2	.1	.2	0	0	.1	.4	1.5	6.2	5.7

Table 2. Distribution of malathion residues applied to aerated shelled corn as a thermal aerosol in 3,250-bushel (114.53 m^3), USDA circular metal bins. Malathion applied at 10.0 ppm.

Location in bin	Top 1.52 m		Middle 1.52 m	
	0–.76 m	.76–1.52 m	1.52–2.28 m	2.28–3.04 m
Center next to aeration duct	6.2	2.2	.5	0
Between center and bin wall	4.7	.8	.3	0
Next to bin wall	4.3	.6	0	0

metal tubing. A special plywood door cover was constructed with a hole just large enough for the flexible tubing to be inserted. The bins were sealed at the eaves and roof cap prior to treatment (see Fig. 2).

Corn samples were taken monthly for a period of 1 yr. A standard 1.52 m bin trier, equipped with extensions and handles, was used to obtain the samples. Each sample contained about 500 g of shelled corn. Five samples were taken from the top 1.52 m of the grain, four at the cardinal directions, 0.9 m from the wall and 0.9 m from the center, and one in the center. Two additional samples were taken from the center middle 1.52 m of corn and the center bottom 1.52 m of corn.

The samples were placed in plastic bags and taken into the laboratory for examination. Each sample was screened with a 0.47 cm grain dockage screen and the numbers of living insects found were recorded.

In November samples were taken vertically from 18 points within each bin for analyses of malathion residues. They were taken from the center top, middle, and bottom 1.52 m. Each sample was divided to represent 0.76 m of corn. A similar sampling method was used at 1.37 m from the center and 0.3 m from the bin wall. The individual samples were analyzed by the chemical unit of the Stored-Product Insect Research and Development Laboratory, Agricultural Research, SEA, USDA, at Savannah, GA.

Results

The treated corn contained fewer insects nearly every month after treatment, and the differences were especially great during the second year (Table 1). These differences in populations are clearly demonstrated when the number of insects per 1000 g is averaged over the 11-month observation period (Nov. through Sept.). The treated bins had an average of 0.24 insects, the untreated bins had an average 1.3 insects. The predominant insect was the rusty grain beetle, *Cryptolestes ferrugineus* (Stephens), which comprised ca. 62% of the population; the balance consisted largely of the foreign grain beetle, *Ahasverus advena* (Waltl).

Table 2 shows the residues of malathion found at various locations within

the grain mass. Malathion was recovered at all of the 0 to .76 m level locations; a higher concentration was present near the aeration duct. At the .76 m to 1.52 m level, less malathion was recovered, but with more was present near the aeration duct. No malathion was found below the 2.28 m levels.

Literature Cited

Quinlan, J. K. 1972a. Malathion aerosols applied in conjunction with aeration to corn stored in a flat storage structure. Proc. North Cent. Branch Entomol. Soc. Am. 27:63–65.

———. 1972b. Malathion surface sprays for controlling insect populations in stored shelled corn. Proc. North Cent. Branch Entomol. Soc. Am. 27:65–67.

———. 1977. Surface and wall sprays of malathion for controlling insect populations in stored shelled corn. J. Econ. Entomol. 70:335–336.

Winter, D. W., and H. F. Mayes. 1958. Aeration of shelled corn in CCC storages. U.S. Dep. Agr., Agr. Marketing Service, Transportation and Facilities Branch, Watseka, Illinois. T.&F.-5. 32 p.