AFLATOXIN IN CORN: A NOTE ON INEFFECTIVENESS OF SEVERAL FUMIGANTS AS INACTIVATING AGENTS

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Periodic fumigation is often used to control the insect population in shelled corn stored in bins and silos. Vandegraft *et al.* (1) reported that some fumigants increased the production of mycotoxins in wheat inoculated with various fungal strains and other fumigants decreased the production. Here we wish to describe the effect of fumigation on the level of aflatoxin already present in corn prior to treatment. An apparent decrease of nearly 50% in the aflatoxin content of a 91-bushel lot of corn over a five-month period raised a question as to whether periodic fumigation with Phostoxin[1] contributed to the decrease. For this reason we investigated the effect of several fumigants on the aflatoxin content of corn. Fumigant dosage rates were 4 to 25 times the normal rate to accentuate the inactivation effect, if any should occur.

MATERIALS AND METHODS

From the 91-bushel lot of naturally contaminated white corn (12.5% moisture), a blended 13-bushel sublot was prepared. One 23-kg sample was taken, ground (approximately 98% passed through a 20-mesh U.S. standard sieve), blended, and 1 kg taken for aflatoxin assay. Quantitative aflatoxin determinations were done in triplicate by the "CB" method recommended for corn (2) on 50-g portions taken from the 1-kg sample. The sublot assayed 230 μg aflatoxin B_1/kg corn (std. dev. = 3).

The fumigation samples were prepared as described below. Two 9-kg samples taken from the sublot were placed in plastic bags (2 mil polyethylene). One pellet of the commercial fumigant, Phostoxin, was added to one bag and five pellets to the second bag. Each pellet releases 0.2 g of hydrogen phosphide gas. To 3.6-kg samples taken from the same sublot and placed in plastic bags were added chloropicrin, acrylonitrile, or a carbon tetrachloride-carbon disulfide mixture (CCl_4:CS_2, 80:20, v/v), all technical grade. Each bag was tied shut and held in individual sealed metal cans at 21°–32° C for seven days except for the high-dosage Phostoxin sample which was held 14 days.

After fumigation, the samples were aerated, ground to −20 mesh, blended, and 1 kg taken for aflatoxin analysis.

RESULTS AND DISCUSSION

None of the fumigants lowered the aflatoxin content of the corn (Table I). The standard deviations were well within the limits expected for aflatoxin assays (6).

[1]The mention of firm names or trade products does not imply that they are endorsed or recommended by the U.S. Department of Agriculture over other firms or similar products not mentioned.

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TABLE I
Effect of Fumigants on Aflatoxin Content of Corn

Fumigant	Normal Recommended Dosage[a]	Dosage Ratio Used[b]	Aflatoxin Content μg/kg[c,d]		No. of Aflatoxin Determinations
			B_1	B_2	
None	...	...	230 ± 3	26 ± 2	3
Phostoxin	10 pellets/ton	5	225 ± 5	26 ± 2	2
	10 pellets/ton	25	224 ± 14	25 ± 1	3
Chloropicrin	2.4 kg/100 m^3 space above grain for above 21° C	13	225 ± 37	26 ± 5	3
Carbon tetrachloride: carbon disulfide (80:20 mixture)	32 L/100 m^3 grain	4	263 ± 14	33 ± 2	4
Acrylonitrile	2.9 mg/L total vol	5	296 ± 16	39 ± 3	2

[a]Recommended dosage for Phostoxin was that given by mfgr. (3). Recommended dosage for chloropicrin and carbon tetrachloride:carbon disulfide mixture was taken from (4), and for acrylonitrile from (5) with the latter based on 100% mortality of black carpet beetles in vessel containing no grain.
[b]Ratio of actual to recommended dosage rate for control of beetles and moths in shelled corn stored in a silo that is gas tight except at the top.
[c]Samples were stored at 21°–32° C for seven days except for the high-level Phostoxin sample which was stored 14 days.
[d]Represents the mean and standard deviation for aflatoxin content.

We believe the increased aflatoxin values for samples treated with CCl_4:CS_2 or acrylonitrile were due to the use of samples of insufficient size (3.6 kg) to overcome the heterogeneity in aflatoxin content of this particular lot of corn. Heterogeneity of the lot is illustrated by the fact that a 23-kg sample taken from a blended, 29-bushel sublot prepared six months after completion of the above fumigant tests analyzed 370 μg B_1/kg (std. dev. = 33, based on two determinations). Information by Shotwell *et al.* (7,8), on the variation in aflatoxin content of individual kernels held together in a string by mold mycelium clearly demonstrates the heterogeneity that can be encountered in contaminated corn. Kwolek and Lillehoj (9) recently published information that can be used to predict the appropriate sample size, subsample size, and fineness of grind when dealing with contaminated corn.

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