Methyl Bromide Fumigation of Pratylenchus brachyurus in Peanut Shells[1]

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Abstract: Five dosages of methyl bromide were used to fumigate peanut (*Arachis hypogaea* L.) shells and whole pods of peanuts in 1-liter flasks for 24 hr at 25 C. Methyl bromide dosages as low as 24.5 mg/liter killed all *Pratylenchus brachyurus* (Godfrey) Filip. & Sch. Stech. in peanut shells. Dosages of 44.6 and 50.9 mg/liter killed all but one or two nematodes in shells of whole pods. A 15% reduction in seed germination occurred at the 50.9-mg/liter dosage. *Key Words:* Lesion nematodes, *Arachis hypogaea* L.

Pratylenchus sp. was first reported on peanuts (*Arachis hypogaea* L.) in the United States in 1945 from Holland, Virginia (11). Nematodes belonging to this genera were later found in peanuts in Alabama (12) and in Georgia (3, 10). During recent years, *P. brachyurus* (Godfrey) Filip. & Sch. Stech. has been associated with peanuts in several other Southern States (1, 8). This nematode can attain high populations on peanuts, and can cause injury to roots, pegs and pods (2, 4, 9). Good *et al.* (7) found *P. brachyurus* in the roots, pegs and shells. Shells infested with dormant nematodes are a source of inoculum even after the peanuts are cured and stored over winter. *P. brachyurus* was present in fertilizer containing nematode-infested peanut shells as the conditioner, both immediately after mixing and seven months after mixing (6). These results show that peanut shells infested with this nematode can be a source of contamination for previously uninfested soil. The objectives of our research were to determine if *P. brachyurus* can be killed in empty peanut shells and in shells of whole pods by methyl bromide fumigation without seriously affecting germination of the seed.

MATERIALS AND METHODS

Nematode-infested whole peanut (*Arachis hypogaea* L.) pods (pods) and empty shells (shells) harvested in September 1970 were used. 'Starr' peanut pods were dried in the field for 5-6 days, machine harvested, bagged and stored. Peanut shells (variety, harvesting and curing procedure unknown) were obtained locally from a commercial shelling plant.

Eighteen 500-ml samples each of pods and shells were placed in plastic bags at Tifton, Georgia, 23 November 1970, and shipped by commercial carrier to the Agricultural Research Service Stored-Product Insects Research and Development Laboratory, Savannah, Georgia. Laboratory assays made at the time of shipping revealed an infestation of about 555 *P. brachyurus*/g of dry shells from the pod samples and 50/g of the shell samples.

Each 500-ml sample of pods and shells was fumigated separately with 0, 17.3, 24.5, 33.1, 44.6 and 50.9 mg/liter of methyl bromide for 24 hr at 25 C in a 1-liter flask. By using a gas-tight syringe, methyl bromide gas was applied into the flasks through a delivery tube sealed in the stopper of each flask. One-third of the samples were fumigated 7 January 1971, and the remainder 11 January. Each treatment was replicated three times. Fumigant dosages were confirmed by treating empty flasks and flasks with the peanut shells and pods and determining the resulting concentrations by gas chromatography at 0, 1, 6 and 24 hr after treatment. Concentration X time (CT) product for each dosage was calculated on the basis of these four sampling periods.

The gas chromatograph was equipped with a flame ionization detector and a 1.8-m X 6.4-mm stainless steel column packed with 10% QF-1 on 60/80 mesh chromosorb W, DMCS, AW. The operating conditions were as follows: (1) Gas flows: hydrogen–55 cc/min; air–1.2 cc/min; and nitrogen (carrier)–50 cc/min. (2) temperatures: detector–120 C, column oven–64 C, and sample valve–50 C; and (3) sample loop–0.25 cc.

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After fumigation the samples were aerated 48 hr, repacked in plastic bags and returned to Tifton where nematode assays were made. Both laboratory assays and bioassays of nematode kill were made on empty shells and on shells from fumigated pods. Seeds shelled from the pods were tested for germination.

In each laboratory assay, nematodes were recovered from 3 g of shells with two recovery trials from each replication. Shells were comminuted in a food blender for 30 sec and placed in Baermann funnels in a mist chamber to incubate. In the first trial, incubation was started 1 February 1971, and nematodes were collected after 24, 96, 264 and 360 hr. In the second trial, incubation was started 8 March 1971, and nematodes were collected after 96, 168 and 240 hr. The nematodes were collected on a 400-mesh screen, transferred to a counting dish and counted. Nematodes that did not indicate positive signs of life were touched with a needle to evoke movement. If the nematode failed to move, it was crushed and was judged to be dead if the body contents failed to gush out (5).

Bioassays were made on corn roots grown in soil containing peanut shells from each sample. Tifton sandy soil was steam sterilized and placed in 20.3-cm (8-inch) diam clay pots. Twenty grams of shells were mixed with the soil in each pot. The pots were placed in a greenhouse, 'Golden Cross Bantam' corn (*Zea mays* L.) planted in each pot 2 February 1971, and fertilizer and water applied as needed. On 3 May 1971, the corn roots were washed free of soil, chopped into pieces 1-2 cm long and a 5-g sample taken for nematode assay. The root samples were further comminuted in a food blender for 30 sec and placed in Baermann funnels in a mist chamber. Nematodes were counted after 120 and 336 hr.

Germination tests were made with the peanut seeds fumigated at each dosage of methyl bromide. Thirty-three seeds from two replications and 34 from the third replication of each fumigant dosage were placed in a seed germinator, and percentage germination determined after 7 days.

RESULTS

Based on methyl bromide concentration sustained in the empty flasks, small amounts of the fumigant were sorbed by or lost from the flasks. Decreases in concentration resulting from sorption or other causes were consistent for each dosage and ranged from 3% for the lowest to 4.7% for the highest. As indicated by the CT product (Table 1), relatively large amounts of fumigant were sorbed by the peanut shells and pods. The amount sorbed increased with an increase in fumigant dosage

TABLE 1. Number of live *Pratylenchus brachyurus* recovered from peanut shells[a] and percentage of seed germination after a 24-hr methyl bromide fumigation at 25 C.

Methyl bromide dosage (mg/liter)	CT[b] product	Sample fumigated	Nematodes per gram of - Peanut shell by laboratory assay: First trial	Peanut shell by laboratory assay: Second trial	Corn roots by bioassay	Germination of seed[c] (%)
17.3	216.5	Shells	0.4	0.4	14.0	
	214.0	Pods	0.0	0.3	105.7	95.3 a
24.5	404.7	Shells	0.0	0.0	0.0	
	351.2	Pods	0.0	0.1	7.9	95.3 a
33.1	538.7	Shells	0.0	0.0	0.0	
	442.1	Pods	0.0	0.0	2.2	91.0 b
44.6	704.7	Shells	0.0	0.0	0.0	
	610.2	Pods	0.0	0.1	0.0	92.0 b
50.9	786.1	Shells	0.0	0.0	0.0	
	703.6	Pods	0.0	0.0	0.1	81.0 c
Control		Shells	66.3	1.7	11.8	
		Pods	34.0	192.4	24.1	96.0 a

[a] Recoveries are based on 3 g of shells and 5 g of roots; data are averages of three replications.
[b] CT = concentration (mg/liter) × time (hr).
[c] Values in this column followed by a letter in common do not differ at the 1% level of probability.

and greater amounts were sorbed by the pods than by the shells.

Results of the laboratory assays showed that fumigant dosages greater than 17.3 mg/liter killed the nematodes in empty shells but not in shells of pods. In the first assay trial, no live nematodes were recovered from fumigated pod samples at any dosage. In the second trial, live nematodes were recovered from samples of both shells and pods fumigated at 17.3 mg/liter and one from a pod sample fumigated at 44.6 mg/liter.

Bioassays with corn roots confirmed that the methyl bromide dosages greater than 17.3 mg/liter killed all nematodes in shells but not in pods. Several live nematodes were recovered from pod samples fumigated at 24.5 and 33.1 mg/liter. One nematode was recovered from a pod sample fumigated with 50.9 mg/liter. Combined results of the two assay methods showed that one or more nematodes in shells of pods survived each fumigant dosage tested.

The seed germination test indicated that methyl bromide dosages of 17.3 and 24.5 mg/liter were not injurious to the peanut seeds. Dosages of 33.1 and 44.6 mg/liter decreased germination significantly (ca. 5%) at the 1% level of probability. The greatest decrease (ca. 15%) occurred at the 50.9-mg/liter dosage.

DISCUSSION

Our data indicate that a methyl bromide dosage as low as 24.5 mg/liter, applied under conditions that will provide a CT product at 25 C of about 400 will kill *P. brachyurus* in empty peanut shells. Also, a dosage of 44.6 mg/liter resulting in a CT product at 25 C of about 600 would be highly effective against this nematode in shells of whole pods. (Only one nematode survived fumigation at this level.) Although the 44.6-mg/liter dosage caused a reduction in seed germination (ca. 5%), this dosage should provide a maximum nematode kill with a minimum of damage to kernels that may be used for planting seed.

The presence of one nematode in some of the assayed samples was at first suspected of being contaminants. Because they occurred only in samples of fumigated pods, the pods may have afforded them some protection against the fumigant. Also, the wide range in CT values required to kill the nematodes in shells versus pods indicated that they were protected by the pods. Apparently, the methyl bromide concentration in the microenvironment of nematodes in shells of the pods was less than that which we measured in the free space among the shells and pods.

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