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Comparison of Methyl Bromide and Other Nematicides for Control of Nematodes in Peanut

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Abstract: The efficacy of methyl bromide for control of *Meloidogyne arenaria* and to increase yields of 'Florunner' peanut (*Arachis hypogaea*) was studied in a field at the Wiregrass Substation near Headland, Alabama. Methyl bromide was applied in the row at a depth of 35 cm using a subsoiler-bedder 2 weeks before planting at rates of 0, 34, 50, 67, 101, and 118 kg a.i./ha. Methyl bromide treatments of 67 kg a.i./ha or higher resulted in significant ($P = 0.05$) yield increases similar to those obtained in the same experiment with at-plant applications of aldicarb (2.2 kg a.i./ha), EDB (1.55 ml a.i./m row), or 1,3-D (5.10 ml a.i./m row). The relation between yield (Y) and methyl bromide rate (x) was described ($R^2 = 0.97^{**}$) by the exponential function: $Y = 2{,}302.963e^b$, where $b = (-1.901 - \ln x)^2/169.482$. *M. arenaria* juvenile populations in soil in mid-August were too low to permit establishment of a relation between application rate of methyl bromide and size of the population.

Key words: aldicarb, *Arachis hypogaea*, chemical control, ethylene dibromide, methyl bromide, peanut, pest management.

Peanut (*Arachis hypogaea* L.) is an excellent host for the peanut root-knot nematode *Meloidogyne arenaria* (Neal) Chitwood (7,8). The nematode occurs in high frequency (2,6) in Alabama and elsewhere in the southern United States where it causes severe peanut yield losses (14). Traditionally, management practices for *M. arenaria* in Alabama have relied on rotations (9) and nematicides (10), since no commercially available peanut cultivars are resistant to the nematode and there is little likelihood that such will be available in the near future (4). The most effective nematicides on peanut, DBCP and EDB (5,11), have been suspended, and the future of some effective fumigant and nonfumigant nematicides (10) is uncertain. Therefore, alternative nematicides are desirable. Methyl bromide is an excellent broad-spectrum biocide when used at high rates (> 200 kg a.i./ha); because of its high vapor pressure, it is applied under a plastic tarp to reduce rapid dissipation from soil (15). Low rates of methyl bromide may be useful, however, to control nematodes on row crops like peanuts without a plastic tarp. The objective of this study was to determine the efficacy of applications of low rates of methyl bromide for control of *M. arenaria* and to increase peanut yields.

MATERIALS AND METHODS

An experiment was conducted in 1986 in an irrigated field that contained a natural infestation of *M. arenaria* (ca. 10 juveniles/100 cm^3 soil in mid-April) at the Wiregrass Substation near Headland, Alabama. The field had been in peanut for 8 years with hairy vetch (*Vicia villosa* Roth) planted as a winter cover crop. The soil was a sandy loam (58% sand, 27% silt, 15% clay) with less than 1% (w/w) organic matter and pH 6.2. Methyl bromide was applied 35 cm deep in the row 2 weeks before planting with a commercial in-row subsoiler ("ripper-hipper") fitted with bedding discs to seal the slits. Soil moisture at time of application was ca. 60% of field capacity, and the temperature 25 cm deep was 24 C. Methyl bromide (GLC-682, Great Lakes Corps., West Lafayette, IN) was injected in the row at rates of 34, 50, 67, 101, and 118 kg a.i./ha. Ethylene dibromide (EDB) and 1,3-D were applied in the row at plant with a gravity flow meter using two chisels per row set 43 cm apart and 30 cm deep with the seed furrow centered between the two chisels; a floating board followed the chisels to seal the application

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TABLE 1. Effect of pre-plant applications of methyl bromide compared to other nematicides on *Meloidogyne arenaria* populations and yield of 'Florunner' peanut (*Arachis hypogaea*) in a field at the Wiregrass Substation, Headland, Alabama.

Treatment	*M. arenaria* juveniles/ 100 cm³ soil	Yield (kg/ha)
Control	24	2,305
Methyl bromide		
34 kg a.i./ha	13	2,767
50 kg a.i./ha	13	2,739
67 kg a.i./ha	24	2,929
101 kg a.i./ha	27	2,929
118 kg a.i./ha	12	3,011
EDB 1.55 ml a.i./m row	8	2,875
1,3-D 5.10 ml a.i./m row	14	3,119
Aldicarb 2.2 kg a.i./ha	9	3,119
LSD ($P = 0.05$)	NS	599

slits. EDB and 1,3-D were applied at rates (ml a.i./m row) of 1.55 (36 liter a.i./ha overall) and 5.10 (119 liter a.i./ha overall), respectively. Soil moisture at application time for EDB and 1,3-D was ca. 60% field capacity, and the temperature 25 cm deep was 26 C. Aldicarb was applied with an electrically driven Gandy applicator (Gandy Company, Owatonna, MN) at a rate of

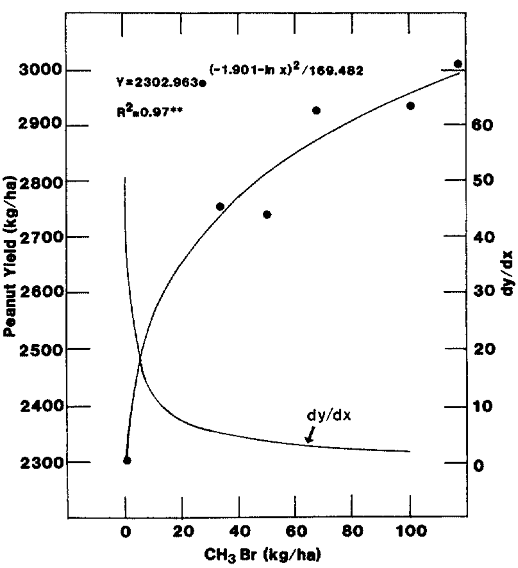

FIG. 1. Relation of 'Florunner' peanut yield (Y) and change in yield with respect to methyl bromide dosage (dy/dx), with preplant application rates of methyl bromide (x) in a field at the Wiregrass Substation, Headland, Alabama.

0.2 g a.i./m row (10 kg a.i./ha overall) in a 20-cm band with light incorporation (3–5 cm) into the soil by using spring activated tines. Eight replications of each treatment and the control were arranged in a randomized complete block design. Plots consisted of two rows each 0.9 m wide × 10 m long. Cultural practices and control of weeds, insects, and foliar diseases were as recommended for the area (1). The field was irrigated as needed.

'Florunner' peanut was planted on 7 May, and soil samples for nematode analysis were taken in mid-August to coincide with the period of maximal population development of *M. arenaria* (13). Samples consisted of a composite of 15–20 2.5-cm-d cores per plot taken 20–25 cm deep from the root zone in each row. A 100-cm³ subsample was used to determine nematode numbers (12).

Yield data were collected at maturity of the crop (17 October) by harvesting the entire plot area. All data were analyzed following procedures for analysis of variance (16); Fisher's least significant differences were calculated. Curve fitting was by the least square method (3). Unless otherwise stated all differences referred to in the text were significant at $P \leq 0.05$.

RESULTS AND DISCUSSION

Applications of 1,3-D, aldicarb, and methyl bromide at rates of 67 kg a.i./ha and above resulted in increased yields. There were no differences between these treatments for yield response (Table 1). Populations of *M. arenaria* juveniles in soil were drastically lower than is normal for August sampling (13) probably because the weather was dry and unusually hot. The field was under continuous irrigation from June through August; however, soil moisture was still less than optimal for development of peanut and root-knot nematode populations. Because of the low soil moisture, the plants did not develop well. It was not possible to sample again after August, and thus we were unable to establish a relationship between methyl bromide rate and *M. arenaria* juvenile populations.

The relation between yield (Y) and application rate for methyl bromide (x) was described ($R^2 = 0.97^{**}$) by the exponential equation:

$$Y = 2{,}302.963e^{(-1.901 - \ln x)^2/169.482}.$$

The model (Fig. 1) indicates that the rate of increase in yield in response to methyl bromide rate (dy/dx) decreased continuously, so that most of the yield gains obtained were with application rates in the range of 0–67 kg a.i./ha with small additional increases in yield in response to higher rates. Current market prices for peanut would permit profitable use of a 40–60 kg a.i./ha rate of methyl bromide without the use of a tarp.

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