# Activity of Fosthiazate against *Meloidogyne arenaria*, *Frankliniella* spp., and *Sclerotium rolfsii* in peanut[1]

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**ABSTRACT**

The efficacy of fosthiazate, a new organophosphorus compound, against the peanut root-knot nematode (*Meloidogyne arenaria* (Neal) Chitwood), thrips (*Frankliniella* spp.), and southern stem rot (*Sclerotium rolfsii* Sacc.) in peanut (*Arachis hypogaea* L.) was studied for 2 years at Tifton, Georgia. Different rates and methods of applying granular and emulsifiable concentrate formulations of fosthiazate were compared with rates and methods of applying granular fenamiphos and aldicarb which were included as standard treatments. When compared with untreated controls, all treatments of all compounds increased peanut yield and reduced nematode galls on peanut roots, pods, and pegs and thrips damage to foliage significantly in both years. The treatments, however, varied in their effects on southern stem rot. Peanut yields from plots treated with equal rates of the granular and emulsifiable concentrate formulations of fosthiazate were similar. Yields of plots treated with fosthiazate at different rates compared favorably with those treated with comparable rates of fenamiphos and aldicarb. Fosthiazate increased peanut yield as much as 214% in 1990 and 64% in 1991, but yields varied with rates applied.

Key Words: *Arachis hypogaea*, fosthiazate, *Franliniella* spp., *Meloidogyne arenaria*, peanut, peanut root-knot nematode, *Sclerotium rolfsii*, southern stem rot, thrips.

Fosthiazate, [*O*-ethyl *S*-(methylpropyl) (2-oxo-3-thiazolidinyl)-phosphonothioate], a new organophosphorus compound discovered in Japan, has been reported to be effective against root-knot, potato cyst, and several other nematodes (12). This compound has also been reported to suppress certain soil and foliar insects, but its toxicity level against mammals is less than currently registered organophosphate nematicides. Fosthiazate has only recently become available for field testing in the United States, therefore little is known about its activity and optimal dosage against soil pathogens of peanut. Our objective was to determine the activity of fosthiazate on the peanut root-knot nematode (*Meloidogyne arenaria* (Neal) Chitwood), southern stem rot (*Sclerotium rolfsii* Sacc.), and thrips (*Frankliniella* spp.) on peanut (*Arachis hypogaea* L.) in the field.

## Materials and Methods

The experiments were conducted in 1990 and 1991 near Tifton, Georgia on a Tifton loamy sand (fine-loamy, siliceous, thermic Plinthic Paleudults, pH 5.9) infested with *M. arenaria* and *S. rolfsii*. Peanuts were grown in this field in 1989 and hairy vetch (*Vicia villosa Roth*) was grown in the fall and winter of 1989-1990 and 1990-1991. Rates, timing, and methods of applying both granular and emulsifiable concentrate formulations of fosthiazate were studied in 1990. In 1991 only granular fosthiazate was evaluated. Aldicarb (2-methyl-2-(methylthio) propionaldehyde *0*-(methylcarbamoyl)oxime) and fenamiphos (ethyl 4-(methythio)-*m*-tolyl isopropylphosphoramidate), currently registered as nematicides for use on peanuts, were included both years as standard treatments.

The seed bed was prepared 25 cm deep with a moldboard plow. Fertilizer and lime were applied as recommended for peanut production in Georgia (5). Gypsum (calcium sulfate) at the rate of 560 kg/ha was applied over the row at the early bloom stage. Florunner peanut was seeded at the rate of 123 kg/ha on 17 May 1990 and on 14 May 1991. The herbicides benefin (N-Butyl-N-ethyl-α, α, α,-trifluoro-2, 6-dinitro-p-toluidine) (1.5 kg ai/ha) and vernolate (S-propyl dipropylthiocarbamate) (2.4 kg ai/ha) were applied on 11 May 1990 and on 30 April 1991. Bentazon (3-isopropyl,1*H*-2, 1, 3-benzothiadiazin-4(3H)-one 2,2-dioxide) (1.1 kg ai/ha) was applied on 30 May and 5 June 1990 and on 28 May 1991. Paraquat (1, 1'-dimethyl-4, 4'-bipyridinium ion) (0.14 kg ai/ha) was applied on 20 May 1991 and pyridate (0-(6-chloro-3-phenyl-4-pyridazinyl)-*S*-octyl carbonothioate) (1.0 kg ai/ha) on 4 June 1991. The insecticide methomyl (S-methyl *N*-[(methylcarbamoyl)oxy]thioacetimidate) (0.5 kg ai/ha) was applied on 26 July, 2 August, 16 August, and 28 August 1990 and on 23 July, 14 August, and 11 September 1991 for control of leaf feeding insects. Propargite (2-(*p-tetra*-butylphenoxy)cyclohexyl 2-propynyl sulfite) was applied on 3 August and 16 August in 1990 for spider mite (*Tetrachyus urticae* Koch) control and chlorpyrifos (*0,0*-diethyl *0*-(3,5,6,-trichloro-2-pyridyl)phosphorothioate) (2.2 kg ai/ha) on 19 July 1990 for lesser cornstalk borer (*Elasmopalpus lignosellus* Zeller) control. Chlorothalonil (tetrachloroisophthalonitrile) (0.15 kg ai/ha) was applied on a 10-14-day schedule beginning 14 June 1990 and 5 June 1991 for early leafspot (*Cerospora arachidicola* Hori). and late leafspot (*Cercosporidium Personata* Berk. and Curt.) control. Eight applications of chlorothalonil were applied in 1990 and nine in 1991. PCNB (pentachloronitrobenzene) (5.6 kg ai/ha) was applied to all plots in a 30-cm band over the row on 13 July 1990 and on 22 July 1991 for southern stem rot control. The experiments were irrigated (2.5 cm per application) on 29 June, 30 July, 15 August, 22 August, 27 August, and 20 September in 1990 and on 6 and 16 September 1991.

Forty peanut leaflets per plot were randomly selected and numbers of leaflets showing thrips damage were recorded 12 June 1990 and on 19 June 1991. Ten cores of soil (2.5-cm diameter x 20.0 cm deep) per plot for nematode assay were collected at random from each plot before planting on 14 May 1990 and on 2 May 1991 and from the peanut root zone on 6 August 1990 and on 16 August 1991. Nematodes were extracted from a 150-$cm^3$ subsample by the centrifuge-flotation method (1). The number of *M. arenaria* second-stage juveniles (J2's) per sample was recorded. The plants were dug and inverted on 24 September 1990, and on 26 September 1991. Roots, pods, and pegs of 10 randomly selected plants from each plot were rated for galling on the same day plants were dug and inverted using a 1 to 5 scale: 1 = no galling, 2 = 1-25, 3 = 26-50, 4 = 51-75, and 5 = 76-100% of roots, pods, and pegs galled. Since control of southern stem rot was poor and all plots were uniformly treated with PCNB and chlorpyrifos in 1990 and 1991 and PCNB in 1991, the incidence of this disease was determined both years. The number of southern stem rot loci per 15.2 m linear row was also determined on the same day plants were dug. A southern stem rot locus was defined as one or more plants per 30 cm of row with visible symptoms (8). In 1990, phytotoxicity symptoms expressed as marginal leaf scorch were rated 56 days after planting using a 1-4 scale with 1 = no symptoms, 2 = very light, 3 = light, and 4 = moderate marginal leaf scorch. Peanuts were harvested from each plot, weighed at 9% moisture and yields

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are reported in hg/ha.

Rows spaced 0.9 m apart were 7.6 m long. A modified randomized complete block design was used in which an untreated two-row plot served as a control for two adjacent treated plots (two rows each). Each replication consisted of 5 sets of 3-plot units (two treated and one control) representing 10 treatments and 5 controls. The design allowed each treated plot to be compared with the adjacent untreated control in order to reduce the high coefficient of variability usually associated with high nematode distribution variability. There were six replicates of each treatment in 1990 and five in 1991.

Analysis of variance techniques were employed to compare the effect of fosthiazate to currently registered standard treatments and untreated controls. The matched-pairs analysis method involved expressing data from each of the two treated plot as deviations from their common control. These data were analyzed by paired t-test, to determine if deviations were significantly different from zero. Additionally, data from all untreated control plots within each replicate were combined to obtain one composite estimate for the untreated control within each replicate. Data were then analyzed as a randomized complete block design with 11 (including control) treatments and six (1990 data) or five (1991 data) replicates to compare treated plots with untreated control. The preliminary analysis had indicated no significant difference among untreated plots within each replication, thus data from untreated plots were pooled. If the treatment effect was significant ($P \leq 0.05$), the least significant difference (LSD) option of the mean or the pairwise t-test option of the least squares means (PDIFF) was used to compare treatment means with one-another and with the untreated control mean. Analyses of variance and mean comparisons were conducted using he GLM procedure of SAS (9, 10) and each year's data set was analyzed separately. These analyses were focused on the comparisons of fosthiazate with other standards and the untreated control. To determine the optimal rate of fosthiazate for use in peanut, polynomial regression of the third degree or lower was applied to determine the best equation expressing each dependent variable as a function of the rates applied.

## Results and Discussion

In 1990 (Table 1) and 1991 (Table 2) when data were expressed as deviations from adjacent untreated controls, results indicated significant ($P < 0.01$) yield increases when nematode-gall index and thrips damage were also reduced significantly for all treatments (excluding control) in both years. Comparisons among treatments showed that the split application treatments of fosthiazate increased yields significantly more than at-plant treatments of equal total rates in three of five instances over two years (Tables 1,2). Conversely, yield increases for at-plant treatments were not significantly greater than in split application treatments of equal total rates in any treatment.

Data comparisons of treated plots with matched-paired controls and pooled controls in Tables 3 and 4 corroborate the results of the analysis of deviation data presented in Tables 1 and 2. These results indicate that most treatments decreased nematode-gall indices and thrips damage but increased yields both years. Significant peanut yield increases for fosthiazate treatments ranged from 685 to 1332 kg/ha in 1990 (Table 1) and from 1104 to 1667 kg/ha in 1991 (Table 2). Yields of plots treated with equal rates of the granular and emulsifiable concentrate did not differ significantly in 1990 (Table 3). Yields of plots treated with fosthiazate rates similar to those of fenamiphos and aldicarb were comparable both years (Tables 3, 4). The highest yields in fosthiazate treatments were obtained with the split applications and/or

**Table 1. Effect of nematicide treatments, expressed as deviation (+ = increase, - = decrease) from an adjacent untreated control on yield, gall index, number of *Meloidogyne arenaria* juveniles (J2's), southern stem rot, thrips damage, and marginal leaf scorch in peanut in 1990.**

| Treatment | Rate (kg ai/ha) | Appli-cation method† | Peanut yield (kg/ha) | Gall index (1-5)‡ | *M. arenaria* (J2's/150 cm³ soil)§ | Southern stem rot loci‡ (No./16.6 m row) | Thrips damage (%)‡ | Marginal leaf scorch (1-4)‡ |
|---|---|---|---|---|---|---|---|---|
| Fosthiazate 7.5 EC | 2.2 | AP30 | + 725** | - 0.8 | - 5.0 | - 1.5 | - 9.6 | + 0.5 |
| Fosthiazate 7.5 EC | 3.4 | AP30 | + 974** | - 1.9* | + 2.7 | - 4.3* | -10.0 | + 0.8 |
| Fosthiazate 10 G | 2.2 | AP30 | + 827** | - 1.3* | + 4.6 | - 1.0 | -19.2* | + 1.2* |
| Fosthiazate 10 G | 3.4 | AP30 | + 685** | - 2.2** | - 4.4 | - 2.7 | -20.0** | + 2.7* |
| Fosthiazate 10 G + | 1.7 | AP18 | | | | | | |
| Fosthiazate 10 G | 1.7 | PP30 | +1282** | - 2.4** | -13.9* | - 2.5* | -15.4* | + 1.3* |
| Fosthiazate 10 G + | 2.2 | AP18 | | | | | | |
| Fosthiazate 10 G | 2.2 | PP30 | +1332** | - 3.1** | - 2.3 | - 7.2* | -18.8* | + 1.5* |
| Fenamiphos 15 G | 2.8 | AP30 | + 666** | - 1.4* | - 2.4 | - 2.3* | -19.2 | 0.0 |
| Fenamiphos 15 G | 2.8 | AP30 | | | | | | |
| Aldicarb 15 G | 1.7 | PP30 | +1166** | - 1.6** | - 4.9 | - 3.2 | -17.5** | 0.0 |
| Fosthiazate 7.5 EC | 4.4 | AP30 | +1066** | - 1.7** | -17.2* | - 4.5 | -24.2** | + 1.0 |
| Fosthiazate 7.5 EC | 6.7 | AP30 | +1216** | - 2.6** | - 6.5 | - 2.0** | -23.3** | + 2.3* |
| LSD 0.05 | | | 451 | 0.9 | 20.4 | 4.4 | 17.5 | 0.6 |

*,** = Mean significantly (* = P < 0.05 and ** = P < 0.01) different than paired control mean.

† AP30 = applied at planting in 30-cm wide band and incorporated 2.5 to 5.0 cm deep; AP18 = applied at planting in 18-cm wide band and incorporated 2.5 to 5.0 cm deep; PP30 = applied in 30-cm wide band over row 34 days after planting with no incorporation.

‡ Gall index based on a rating of 1-5 scale: 1 = no galling and 5 = 76-100% of roots, pods and pegs galled; southern stem rot locus = one or more plants per 30 cm of row with visible symptoms; thrips damage = 40 leaflets per plot examined for visible damage; marginal leaf scorch was rated on a 1-4 scale: 1 = no marginal leaf scorch, 2 = very light, 3 = light, and 4 = moderate marginal leaf scorch.

§ The original data transformed to square root (X + 1). Transformed data presented.

with high rates. These data suggest that: (1) the average yield of all treated plots were significantly ($P > 0.05$) greater than the average yield of the untreated control plot and (2) in soil with high root-knot nematode infestations, split applications or high rates may be necessary for maximum yields.

High mean root-gall indices in control plots were indicative of the damage potential of this nematode (Tables 3, 4). Gall indices were better indicators of fosthiazate effectiveness than were late season soil population densities of *M. arenaria* J2. Only fosthiazate 10 G applied in split applications (1.7 kg ai/ha plus 1.7 kg ai/ha and 2.2 kg ai/ha plus 2.2 kg ai/ha) and fosthiazate 7.5 EC applied at 4.4 kg ai/ha at planting reduced J2 population densities significantly in 1990 (Table 1). The relatively high population densities of J2's late in the growing season (Tables 3, 4) and the failure of several treatments to significantly reduce these populations were probably due to initial high populations and the relatively large number of nematodes that survived treatment. The mean J2 population densities per 150 $cm^3$ soil across all plots at time of planting were 3,027 in 1990 and 151 in 1991. The large variability in population distribution required square-root transformation to conform more closely to the assumption of normality of the distribution for statistical analysis. Aldicarb and fenamiphos did not reduce J2 population densities more than fosthiazate. Among the aldicarb, fenamiphos, and combination treatments of these materials, only the split application of aldicarb 15 G treatment (1.7 kg ai/ha plus 1.7 kg ai/ha) in 1991 reduced J2's significantly.

The southern stem rot infestation was low in 1990 (Table 3) and high in 1991 (Table 4) even though all nematicide treated and non-treated plots received PCNB both years and chlorpyrifos in 1990. Four fosthiazate treatments (at-plant applications of fosthiazate 7.5 EC at 3.4 kg ai/ha and 6.7 kg ai/ha and split applications of fosthiazate 10 G at 1.7 kg ai/ha plus 1.7 kg ai/ha and 2.2 kg ai/ha plus 2.2 kg ai/ha, Table 1) reduced southern stem rot significantly in 1990 but in 1991 only the split applications of fosthiazate 10 G at 2.2 kg ai/ha plus 2.2 kg ai/ha, gave a significant reduction (Table 2). All other fosthiazate treatments in both years, except the split application of fosthiazate 10 G (1.7 kg ai/ha) plus aldicarb 15 G (1.7 kg ai/ha) in 1991, reduced the incidence of southern stem rot but differences were not statistically significant from control (Table 2). Although reduction of southern stem rot by fosthiazate in these tests was not dramatic, the data suggest modest activity.

Differences between the two years may have been due to environmental conditions or possibly interactions with other pesticides applied that have activity on southern stem rot. However, all other treatments were applied uniformly across the test. The potential inhibition of southern stem rot is worth noting, especially since similar observations with fosthiazate have been noted at another location (Don Dickson, personal communication). Other reports showed that organophosphorus nematicides (fensulfothion, ethoprop) (6, 7, 11) suppressed *S. rolfsii* on peanut. In 1990, fenamiphos 15 G (2.8 kg ai/ha, Table 1) reduced southern stem rot significantly which was contrary to results of prior studies (2, 3).

**Table 2. Effect of nematicide treatments, expressed as deviation (+ = increase, - = decrease) from an adjacent untreated control, on peanut yield, gall index, number of *Meloidogyne arenaria* juveniles (J2's), southern stem rot, and thrips damage in peanut in 1991.**

| Treatment | Rate (kg ai/ha) | Application method† | Peanut yield (kg/ha) | Gall index (1-5)‡ | *M. arenaria* (J2's/150 $cm^3$ soil)§ | Southern stem rot loci‡ (No./16.6 m row) | Thrips damage (%)‡ |
|---|---|---|---|---|---|---|---|
| Fosthiazate 10 G | 2.2 | AP30 | + 477 | - 1.8** | 0.0 | - 2.4 | -25.0** |
| Fosthiazate 10 G | 3.4 | AP30 | +1297** | - 2.1** | + 0.7 | - 6.6 | -25.0** |
| Fosthiazate 10 G | 4.4 | AP30 | +1042** | - 2.3** | - 1.6 | - 0.8 | -33.0** |
| Fosthiazate 10 G + Fosthiazate 10 G | 1.1 / 1.1 | AP30 / PP30 | +1104** | - 1.4** | - 5.8 | - 1.2 | -18.0** |
| Fosthiazate 10 G + Fosthiazate 10 G | 1.7 / 1.7 | AP30 / PP30 | +1404** | - 2.8** | -11.3** | - 0.6 | -27.5** |
| Fosthiazate 10 G + Fosthiazate 10 G | 2.2 / 2.2 | AP30 / PP30 | +1667** | - 2.8** | -10.6* | - 5.0* | -28.5** |
| Fenamiphos 15 G | 2.8 | AP30 | + 591* | - 1.5* | - 1.9 | - 3.8* | -34.0** |
| Aldicarb 15 G | 3.4 | AP30 | +1182** | - 2.2** | - 2.2 | - 0.4 | -33.0** |
| Fosthiazate 10 G + Aldicarb 15 G | 1.7 / 1.7 | AP30 / PP30 | +1152* | - 2.4** | - 1.2 | + 1.6 | -19.5** |
| Aldicarb 15 G + Aldicarb 15 G | 1.7 / 1.7 | AP30 / PP30 | +1234** | - 1.7** | - 5.8** | - 2.0 | -30.5** |
| LSD 0.05 | | | 591 | 0.9 | 7.9 | 7.4 | 13.9 |

*,** = Mean significantly (* = $P < 0.05$ and ** = $P < 0.01$) different than paired control mean.

† AP30 = applied at planting in 30-cm wide band and incorporated 2.5 to 5.0 cm deep; PP30 = applied in 30-cm wide band over row 48 days after planting with no incorporation.

‡ Gall index based on a rating of 1-5 scale: 1 = no galling and 5 = 76-100% of roots, pods and pegs galled; southern stem rot locus = one or more plants per 30 cm of row with visible symptoms; thrips damage = 40 leaflets per plot examined for visible damage.

§ The original count transformed to square root (X + 1). Transformed data presented.

Thrips damage data reflect only the effects of the at-plant treatments since the data were collected before the post plant treatments were applied. In 1991, all fosthiazate, aldicarb, and fenamiphos treatments significantly reduced thrips damage (Table 2) and in 1990 all except two fosthiazate treatments (fosthiazate 7.5 EC applied at planting at 2.2 kg ai/ha and 3.4 kg ai/ha) and the fenamiphos treatment (fenamiphos 15 G applied at planting at 2.8 kg ai/ha) were effective (Table 1). The failure of the three treatments to effect significant responses in 1990 was apparently due to damage variability among replications of these treatments since the percentages of damage reduction were high. The reduction of thrips damage for all fosthiazate treatments in 1991 and most treatments in 1990 were equal to that for fenamiphos and aldicarb which have been shown to reduce damage by this pest when applied to the soil at planting (4).

A low level of fosthiazate phytotoxicity, expressed as marginal leaf scorch, was seen in 1990 but there was no apparent defoliation or stunting of plants. All fosthiazate treatments at planting, except three (fosthiazate 7.5 EC at 2.2 kg ai/ha, 3.4 kg ai/ha and 4.4 kg ai/ha, Table 1), increased leaf scorch symptoms significantly in 1990. Neither of the treatments that received fenamiphos at planting had leaf scorch symptoms. In general, the symptom severity was related to chemical rates. The relationship between damage rating due to southern stem rot (Y) and fosthiazate rate (X) applied in 1990 was cubic ($Y = 5.77 + 0.91X - 0.97X^2 + 0.114^3$), n = 54, $R^2$ = 29.2%, and P = 0.0006. Marginal leaf scorch (Y) increased linearly as chemical rate increased in 1990 ($Y = 1.178 + 0.32X$), n = 54, $R^2$ = 32.7%, and P + 0.0001. The rate of fosthiazate used in these equations ranged from 0 to 6.7 kg ai/ha. No phytoxicity was observed in 1991 which suggests treatment X year interaction for the symptom, and that symptom expression may be related to environmental conditions.

Both years, yield data showed a linear increase between the rates of 0 (no treatment applied) to 4.4 kg ai/ha fosthiazate. The relationship between yield (Y) and fosthiazate rate (0 to 6.7 kg ai/ha) in 1990 was quadratic ($Y = 603.98 + 449.93X - 42.40X^2$), n = 54, $R^2$ = 27.9%, and P = 0.0002, reaching the maximum at 5.3 kg ai/ha. However, the yield increased linearly in 1991 ($Y = 2456.5 + 295.97X$), n = 35, $R^2$ = 51.2%, and P = 0.0001, as fosthiazate rate increased from 0 to 4.4 kg ai/ha. However, when the rate was increased from 4.4 to 6.7 kg ai/ha in 1990, a slight decrease in yield was observed which resulted in a fit to a quadratic function.

Responses to gall index ($Y = 5.13 - 0.86X + 0.066X^2$; n = 54, $R^2$ = 49.1%, P = 0.0001 for 1990 and $Y = 4.38 - 1.157X + 0.139X^2$; n = 35, $R^2$ = 76.9% and P = 0.001 for 1991 data) and thrip damage ($Y = 47.13 - 8.26X + 0.68X^2$; n = 54, $R^2$ = 30.7%, P = 0.0001 for 1990 and $Y = 41.72 - 18.3X + 2.66X^2$; n = 35, $R^2$ = 54.0%, P = 0.0001 for 1991 data) were also quadratic showing a decreasing trend for both years.

Results of pairwise t-test and analysis of variance using pooled controls indicated that all treatments significantly increased peanut yield and reduced nematode-gall indices and thrips damage in peanuts both years. Effects on southern stem rot varied with treatments. The optimal rate of fosthiazate for the best nematode control and peanut yield increase appears to be within the range of the maximum rates approved for fenamiphos (2.8 kg ai/ha) and aldicarb (3.4 kg ai/ha) on peanut. Although higher rates of fosthiazate may provide additional nematode control, reduce thrips damage, and increase yield, the additional expense may not

**Table 3. Least square means (6 observations/mean) for peanut yield, gall index, number of *Meloidogyne arenaria* juveniles (J2's) and southern stem rot loci, percent thrips damage and leaf scorch rating of peanut treated with fosthiazate, fenamiphos, and fenamiphos plus aldicarb, 1990.**

| Treatment | Rate (kg ai/ha) | Application method† | Peanut yield (kg/ha) | Gall index (1-5)‡ | *M. arenaria* (J2's/150 $cm^3$ soil)§ | Southern stem rot loci‡ (No./16.6 m row) | Thrips damage‡ (%) | Marginal leaf scorch index‡ (1-4) |
|---|---|---|---|---|---|---|---|---|
| Fosthiazate 7.5 EC | 2.2 | AP 30 | 1346a‖ | 4.1a | 35.5 | 4.3 | 33.7a | 1.5 |
| Fosthiazate 7.5 EC | 3.4 | AP 30 | 1684a | 3.1a | 41.3 | 1.5a | 31.2a | 1.8a |
| Fosthiazate 10 G | 2.2 | AP 30 | 1385a | 3.7a | 52.6 | 5.2 | 33.3a | 2.2a |
| Fosthiazate 10 G | 3.4 | AP 30 | 1345a | 2.7a | 36.3 | 2.2a | 26.2a | 3.7a |
| Fosthiazate 10 G + | 1.7 | AP 18 | | | | | | |
| Fosthiazate 10 G | 1.7 | PP 30 | 1889a | 2.4a | 24.3a | 1.0a | 34.2a | 2.3a |
| Fosthiazate 10 G + | 2.2 | AP 18 | | | | | | |
| Fosthiazate 10 G | 2.2 | PP 30 | 1947a | 1.9a | 47.1 | 1.3a | 29.6a | 2.5a |
| Fenamiphos 15 G | 2.8 | AP 30 | 1389a | 3.6a | 46.9 | 3.7 | 30.0a | 1.0 |
| Fenamiphos 15 G + | 2.8 | AP 30 | | | | | | |
| Aldicarb 15 G | 1.7 | PP 30 | 1830a | 3.3a | 42.0 | 2.7a | 32.5a | 1.0 |
| Fosthiazate 7.5 EC | 4.4 | AP 30 | 1640a | 3.3a | 28.1 | 1.2a | 20.8a | 2.0a |
| Fosthiazate 7.5 EC | 6.7 | AP 30 | 1698a | 2.4a | 38.3 | 2.5a | 22.9a | 3.3a |
| Control | | | 621 | 4.9 | 46.8 | 5.7 | 47.1 | 1.0 |
| SE | | | 178 | 0.3 | 7.0 | 0.9 | 4.6 | 0.2 |
| LSD 0.05 | | | 505 | 0.8 | 19.8 | 2.7 | 13.2 | 0.6 |

† AP 30 = applied at planting in 30-cm wide band and incorporated 2.5 to 5.0 cm deep; AP 18 = applied at planting in 18-cm wide band and incorporated 2.5 to 5.0 cm deep; PP 30 = applied in 30-cm wide band over row 34 days after planting with no incorporation.

‡ Gall index based on a rating of 1-5 scale: 1 = no galling and 5 = 76-100% of roots, pods and pegs galled; southern stem rot locus = one or more plants per 30 cm of row with visible symptoms; thrips damage = 40 leaflets per plot examined for visible damage; marginal leaf scorch was rated on a 1-4 scale: 1 = no marginal leaf scorch, 2 = very light, 3 = light, and 4 = moderate marginal leaf scorch.

§ The original data transformed to square root (X + 1). Transformed data presented.

‖ Treatment mean followed by letter a is significantly different (P < 0.05) than untreated control mean.

**Table 4. Least square means (5 observations/mean) for peanut yield, gall index, number of *Meloidogyne arenaria* juveniles (J2's) southern stem rot loci, and thrips damage of peanut treated with fosthiazate, aldicarb, and fenamiphos, 1991.**

| Treatment | Rate (kg ai/ha) | Application method† | Peanut yield (kg/ha) | Gall index (1-5)‡ | *M. arenaria* (J2's/150 $cm^3$ soil)§ | Southern stem rot loci‡ (No./16.6 m row) | Thrips damage (%)‡ |
|---|---|---|---|---|---|---|---|
| Fosthiazate 10 G | 2.2 | AP 30 | 2951a‖ | 2.5a | 15.7 | 17.8 | 14.0a |
| Fosthiazate 10 G | 3.4 | AP 30 | 3410a | 2.5a | 17.7 | 13.8 | 12.5a |
| Fosthiazate 10 G | 4.4 | AP 30 | 3510a | 2.1a | 13.2 | 12.6 | 12.0a |
| Fosthiazate 10 G + | 1.1 | AP 30 | | | | | |
| Fosthiazate 10 G | 1.1 | PP 30 | 3526a | 2.3a | 9.3a | 13.2 | 25.0a |
| Fosthiazate 10 G + | 1.7 | AP 30 | | | | | |
| Fosthiazate 10 G | 1.7 | PP 30 | 3656a | 1.8a | 8.7a | 15.6 | 20.0a |
| Fosthiazate 10 G + | 2.2 | AP 30 | | | | | |
| Fosthiazate 10 G | 2.2 | PP 30 | 3777a | 1.7a | 8.4a | 12.0 | 11.5a |
| Fenamiphos 15 G | 2.8 | AP 30 | 2765a | 3.2a | 14.7 | 15.0 | 12.5a |
| Aldicarb 15 G | 3.4 | AP 30 | 3184a | 2.5a | 13.4 | 16.2 | 4.0a |
| Fosthiazate 10 G + | 1.7 | AP 30 | | | | | |
| Aldicarb 15 G | 1.7 | PP 30 | 3586a | 2.0a | 11.3 | 16.8 | 22.0a |
| Aldicarb 15 G + | 1.7 | AP 30 | | | | | |
| Aldicarb 15 G | 1.7 | PP 30 | 3770a | 2.2a | 8.7a | 13.8 | 9.0a |
| Control | | | 2299 | 4.4 | 16.7 | 16.8 | 41.7 |
| SE | | | 163 | 0.2 | 2.2 | 2.6 | 3.7 |
| LSD 0.05 | | | 466 | 0.7 | 6.3 | 7.4¶ | 10.6 |

† AP 30 = applied at planting in 30-cm wide band and incorporated 2.5 to 5.0 cm deep; PP 30 = applied in 30-cm wide band over row 48 days after planting with no incorporation.

‡ Gall index based on a rating of 1-5 scale: 1 = no galling and 5 = 76-100% of roots, pods and pegs galled; southern stem rot locus = one or more plants per 30 cm of row with visible symptoms; thrips damage = 40 leaflets per plot examined for visible damage.

§ The original data transformed to square root (X + 1). Transformed data presented.

‖ Treatment mean followed by letter a is significantly different ($P < 0.05$) than untreated control mean.

¶ F-test for treatment effect not significant ($P = 0.8417$).

justify further rate increase. Additionally, marginal leaf scorch in 1990 indicated a potential for damaging leaf scorch at higher rates. With its activity against both nematodes and thrips, and possible suppression of southern stem rot, fosthiazate is a viable candidate for use in peanuts.

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