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THE EFFECTS OF PHORATE (THIMET) ON THE ROOT KNOT NEMATODE (*Meloidogyne incognita*) (Kofoid & White) CHITWOOD INFESTING SOYABEAN (*Glycine max* L. Merrill) AND RESULTANT EFFECTS ON SOME BIOCHEMICAL COMPONENTS OF SEEDS

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ABSTRACT

The effect of phorate (0,0-diethyl thiomethyl phosporo dithioate in controlling the root knot nematode Meloidogyne incognita (Kofoid & White) Chitwood infestation on Soyabean Glycine max (L.) Merrill and resultant effects on some biochemical components of the seeds were studied. Yield was tremendously improved by the phorate treatments in the 2 soyabean cultivars tested. Plants of cultivar TGm 80 treated with phorate at the concentrations of 1000 and 1500μg a.i./ml recorded more than double the seed weight recorded for the control plants. Significantly lower gall indices and nematode populations (P= 0.05) were recorded for treated plants when compared with the controls. Biochemical analysis of seeds from treated plants showed significantly (P = 0.05) higher crude fibre, fat/oil and phosphorus contents but lower protein and free fatty acids, contrasting with those of the controls. The values of free fatty acids, obtained for plants treated with 1500 and 1000μg a.i./ml were less than half of those obtained for the controls in both soyabean cultivars TGM 80 and TGM 344.8

Key Words: Soyabeans, Meloidogyne incognita, Phorate, Biochemical components of seeds.

INTRODUCTION

Phorate (O, O -diethyl thiomethyl phosporo dithioate) has been reported to control a number of nematode pests of agricultural importance and improve growth and yield of treated crops without the fear of harmful residues in such crops (Alam *et al*, 1988; Rodriguez-kabana and King, 1976; Oyedunmade and Adesiyan, 1990, 1994; Oyedunmade *et al*, 1992) but information on the possible effects of this chemical on the biochemical components of treated crops is lacking.

Soyabean has a wide range of utilization and nutritional values in Nigeria (Ogundipe and Oshe, 1990; Ogundipe and Weingnartner, 1992) and in several countries of the world (Ferrier, 1975). It has a great potential not only as a whole bean but as vegetable source of proteins, oils, vitamins and minerals (Taylor,1980). It is a cheap source of protein in the human diet in many developing countries and in the livestock feed industry worldwide.

This study was therefore undertaken to investigate the effects of phorate on the crude fibre, protein, fat, free fatty acids and phosphorus contents of soyabean seeds harvested from the plants that were treated with phorate against rootknot nematode attack.

MATERIALS AND METHODS

Seeds of two soyabean cultivars, Hernon 236 (TGM 344) and Bosier (TGM 80) were obtained from the International Institute for Tropical Agriculture (IITA) and planted separately on 2 adjacent pieces of land heavily infested with root knot nematode *Meloidogyne incognita* during the planting seasons of two consecutive years (1991 and 1992). The land was ploughed, harrowed, ridged and marked out into 16 plots in 4 blocks, each block made of 4 plots. Each plot comprised of 5 ridges, each measuring 4m long and 1 metre apart, thus each plot measured 20m2. Alleys of 1m between blocks and 1 ridge between adjacent plots were left unplanted to prevent treatment interactions. Using a randomized complete block design, there were 4 treatments replicated 4 times each.

The initial nematode populations in the soil were estimated from 200g samples taken from the soil collected randomly from the fields just before planting. Nematode extraction was done using the modified Baermann's technique (Whitehead and Hemming, 1965). The nematodes were identified and counted under a stereoscope.

Two weeks after planting, phorate solutions containing 500, 1,000 and 1,500 µa.i/ml were used as soil drench against the nematodes, while distilled water was used for the control. At the end of the growth period, yield data were obtained and root gall indices taken according to Daulton and Nasbaum (1961). Nematodes were again recovered from 200g samples of the soil collected randomly from the plots at harvest. The seeds were also analysed for possible effects of phorate treatments on the protein, fat/oil, crude fibre and phosphorus contents. The percentage protein content, fat/oil, free fatty acids and crude fibre were determined by the methods of A. O. A. C. (1975) while the phosphorus content was determined by the method described by Watanabe and Olsen (1965). The data for the 2 years were pooled together, averaged and subjected to analysis of variance, and where appropriate, the means were separated by Duncan's multiple range test.

RESULTS

Phorate treatments improved the yield of soyabean plants. This is shown by the significantly higher seed weight/plant recorded for treated plants in comparison with the controls in the 2 soyabean cultivars (TGM 80 and TGM 344) tested (Table 1). In TGM 80, treatment with the 2 higher phorate concentrations (1,500, 1,000µg a.i/m) resulted in more than 100% increase in seed weight/plant (45,39,30, 17g respectively for 1500, 1000, 500, 0 µg a.i./ml). However, in TGM 344, the 2 higher phorate concentrations (1500 and 1000 µg a.i./ml) produced more than 80% and 60% increase in seed weight/plant respectively (65,57,49,35g for 1500, 1000, 500, 0 µg a.i./ml respectively).

In the 2 soyabean cultivars, the phorate treatments significantly reduced galling indices and the populations of nematodes in the soil at harvest (Table 2). More reduction was recorded with increasing concentration of phorate.

Table 3 shows the effects of phorate on some food values of soyabean seeds. The protein and free fatty acids contents were significantly reduced following phorate treatments in the 2 soyabean cultivars. The values of free fatty acids observed for 1500 and 1000 µg a.i./ml were less than 1/2 of those in the controls in the 2 cultivars (0.32, 0.51, 0.85, 1.30 and 0.30, 0.53, 0.90, 1.10 for 1500, 1000, 500, 0 µg a.i./ml in TGM 80 and TGM 344 respectively). The crude fibre and fat contents of treated seeds were significantly increased as a result of the phorate treatments. However, in TGM 344, the crude fibre content of seeds at 500 µg a.i./ml phorate treatment was not significantly different from that of the control. Phorate at the 2 higher concentrations resulted in a significant increase in the phosphorus content of soyabean seeds as compared with the control.

DISCUSSION

The application of three different levels of phorate resulted in the control of the root-knot nematodes as evident in the higher yield, fewer nematodes and galls recorded in treated plants than in the control plants. Rodriguez-kabana and King (1976), Akinlade and Adesiyan (1988) and Oyedunmade and Adesiyan (1990) have reported that phorate controls plant parasitic nematodes by direct effect (killing) and indirect effect (inhibiting various nematode functions and behaviors). Higher nitrogen and consequently protein content was observed in the seeds of control plants than in the seeds of treated plats as detected by the micro Kjeldahl analysis in this study. More proteins are formed in nematode infected plants but they are soon hydrolysed to free amino acids (Singh *et al*, 1978). The decrease observed in the protein content of soyabean seeds from treated plants is probably due to reduced root-knot nematodes activity as indicated by lowered galling indices when compared with control plants.

Seeds from treated seeds had higher fat content than the seeds from control plants. The reduction in the fat content observed for the soyabean seeds from untreated plants may indicate that part of the fat/oil has been degraded into free fatty acids as shown by the higher percentage free fatty acids recorded for the seeds from untreated plants as compared with the seeds from treated plants. The different levels of phorate had an effect in increasing the net assimilation rate and consequently total yield output of soyabean plants as shown by an increase in the crude fibre content of treated seeds when compared with the control.

The reduction in the phosphorus content of untreated seeds when compared with that of treated seeds might have resulted from an impairment of phosphorus and other nutrients uptake from the soil by the plant as a result of the root-knot nematode infestation, thus making phosphorus content of infected plants lower than that of healthy plants. A control of these nematodes by phorate possibly enhanced phosphorus uptake and translocation. Another possible source of the increase in the phosphorus content of treated plants is from the phorate itself because it is a phosphorus rich chemical which is capable of breaking down to many other metabolites in the soil and plants (Bowman *et at*, 1969; Oyedunmade and Adesiyan, 1994). More phosphorus could have been released as a result of the breakdown of the molecule and this will subsequently affect the phosphorus content of the plant as more phosphorus becomes available in the immediate environment of the plant.

This study has shown that phorate at the concentrations tested (1500, 1000, 500 µg a.i./ml controlled the root-knot nematode *Meloidogyne incognita* on soyabeans and improved the quality of seeds (in terms of the crude fibre, fat and phosphorus contents) from treated plants. However, the reduction observed in the protein content of treated seeds as detected by the quantitative method of analysis used in this study calls for more research to investigate the quality of the proteins in the seeds from both treated and untreated plants.

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Table 1: Effect of Phorate Treatments on Seed Weight of two Soyabean Cultivars (TGm 80 and TGm 344).

Phorate Levels (µg a.i./ml)	Cultivar TGM 80 Seed wt(g)/ Plant	Mean Galling indices**	Cultivar TGM 344 Seed wt(g)/ plant	Mean galling Indices
0	17a*	7.2a*	35a	5.8a
500	30b	3.9b	49b	3.0b
1000	39c	2.8c	57c	2.0c
1500	45c	1.4d	65d	0.9d

* Means followed by different letters in the same column are statistically different at P = 0.05.

** Rating Scale 0 = No galling, 1 = 10% galling
2 = 20% galling, 3 = 30% galling
4 = 40% galling, 5 = 50% galling
6 = 60% galling, 7 = 70% galling
8 = 80% galling, 9 = 90% galling
10 = 100% galling, Host plant completely dead.

Table 2: Effect of Phorate Treatments on *Meloidogyne incognita* populations of soil before Planting (initial) two Soyabean cultivars and at Harvest (final)

Phorate levels (µg a. i./ml)	Nematode Population/Kg soil Cultivar TGM 80 Initial	Final	Cultivar TGM 344 Initial	Final
0	3953	5179a	4007	3665a
500	3575	2406b	3701	1901b
1,000	4001	1508c	3509	989c
1,500	3896 *N. S	830d	3869 *N. S	396d

N.S = Not Significant

* Means in the same column followed by different letters are statistically different at P = 0.05.

Table 3: Effect of Phorate Treatments on some Food Components of Seeds of two Soyabean Cultivars (TGM 80 and TGM 344)

Phorate Levels (μg a.i./ml)	Mean Protein (%) TGM 80	TGM 344	Mean Phosphorus (%) TGM 80	TGM 344	Mean fat (%) TGM 80	TGM 344	Mean Free TGM 80	Fatty Acids (%)) TGM 344	Mean Crude TGM 80	TGM 344
0	46.31d*	44.69^d	0.60^a	0.61^a	16.71^a	15.25^a	1.30^c	0.10^c	6.17^a	6.17^a
500	42.50^c	41.91^c	0.64^{ab}	0.65^{ab}	17.90^b	17.44^b	0.85^b	0.80^b	7.43^b	7.13^a
1,000	40.26^b	39.44^b	0.66^b	0.67^b	19.90^c	19.17^c	0.51^a	0.53^a	8.23^b	8.97^b
1,500	38.97^a	37.42^a	0.68^b	0.69^b	20.34^c	20.13^c	0.32^a	0.30^a	9.52^c	10.55^c

* Means followed by different letters in the same column are statistically different at P= 0.05.