https://doi.org/10.29321/MAJ.10.A03361

Madras agric. J. 63 (11—12) : 646—650, Nov.—Dec., 1976

Effect of Certain Pesticides on Nodulation and Nitrogen Fixation by *Rhizobium* sp. in Groundnut

By

N. N. PRASAD[1] and C. E. RAMANI[2]

ABSTRACT

Treatment of *Rhizobium* inoculated groundnut seed with wet ceresan (1000 ppm) did not appreciably alter the dry matter weight, total nitrogen content, nodulation and leghemoglobin content of nodules of the plants. Although soil application of brassicol at 11 ppm (field rate) did not appreciably alter the efficiency of the groundnut-*Rhizobium* symbiosis, higher concentrations of 50 and 100 ppm proved to be harmful. Foliar application of Dithane Z-78 and copper oxychloride at the recommended levels of 0.2 and 0.3 per cent. respectively, did not affect the symbiotic relationship in plants.

Soil application of disyston and DDT at field rates increased significantly the dry weight, total nitrogen content, nodulation and leghemoglobin content. However, at 200 ppm, these insecticides exerted a harmful effect on the symbiosis. Foliar application of endrin (at 0.02 and 0.04 %) and parathion (0.025 %) caused a significant increase in the dry weight, total nitrogen, nodulation and leghemoglobin content of nodules of plants.

Pre-sowing soil application of Lasso and TOK E.25 at field rates caused a significant reduction in dry weight, total nitrogen, nodulation and leghemoglobin content of nodules. At 200 ppm these two herbicides have completely inhibited the nodule formation.

INTRODUCTION

The effect of plant protection measures on the efficiency of legume-*Rhizobium* symbiosis in fixing atmospheric nitrogen has been studied by several workers (Hofer, 1958, Abou-el Fadl and Fahmy, 1958; Pareek and Gaur, 1969, 1970; Balaraman and Prasad, 1973). The effect of certain fungicides, insecticides and herbicides on nodulation and nitrogen fixation in groundnut *Arachis hypogaea* L.) plants inoculated with *Rhizobium* sp. are reported in this paper.

MATERIALS AND METHODS

Groundnut seeds of variety TMV. 10 were surface-sterilized with 0.1 per cent mercuric chloride solution and washed with several changes of sterile water. They were then treated for 12 hr with the suspension of an efficient strain of *Rhizobium* isolated from root nodules of groundnut and dried in shade on filter paper

Effect of fungicides

The inoculated seeds were treated with 0.1 per cent wet ceresan solution (1 lit./kg of seeds) in a closed contai-

1-2 : Faculty of Agriculture, Annamalai University, Annamalainagar-608 101

ner. The seeds were sown in sterile soil.

Sterlized soil in pots was treated with Brassicol 75 WP (PCNB) at 10 kg/acre (11 ppm; field rate), 50 kg/acre (50 ppm) and 100 kg/acre (100 ppm). Surface-sterlized and *Rhizobium* inoculated groundnut seeds were sown in these pots.

Foliar sprays of Dithane Z-78 and Copper oxychloride at 0.2 and 0.3 per cent, respectively were given on 20th and 35th day after sowing.

Effect of insecticides

Sterilized soil in pots was treated with Disyston granules (5 % a. i.) at the rate of 12 (field rate of 11 kg/acre) 100 and 200 ppm and inoculated seeds were sown.

Inoculated seeds were sown in sterile soil treated with DDT 5 per cent at 20 (field rate 18 kg/acre), 100 and 200 ppm.

Foliar sprays of endrin at 0.2 and 0.4 per cent, and parathion at 0.025 and 0.05 per cent were given on 20th and 35th day after sowing.

Effect of herbicides

Sterilized soils were incorporated with Lasso at 11 (10 kg/acre field rate), 100 and 200 ppm and TOK E-25 at 7 (6.5 kg/acre, field rate), 100 and 200 ppm as presowing application and *Rhizobium* inoculated seeds sown.

The dry weight, total nitrogen content of plants (Bremner, 1960) and leghemoglobin content of nodules (Schiffman and Lobel, 1970) were recorded on 45th day in all the trials.

RESULTS AND DISCUSSION

The results on the effect of pesticides on certain plant parameters of groundnut inoculated with *Rhizobium* are presented in Table I.

Fungicides

Seed treatment of groundnut seeds inoculated with *Rhizobium* sp. with wet ceresan (0.1 %) did not adversely affect the symiosis, confirming the earlier reports of Balaraman and Prasad (1973). Sardeshpande *et al.* (1973), on the other hand, reported a reduction in dry weight, nodulation and leghemoglobin content of nodules due to seed treatment with ceresan or brassicol after inoculation of *Rhizobium* sp. The application of brassicol at the field rate of 11 ppm, has slightly reduced the dry weight, total nitrogen and nodulation and leghemoglobin content of nodules of plants raised from *Rhizobium* treated seeds. However, the reduction obtained for total nitrogen content was not statistically significant when compared to inoculated control. The non-injurious nature of Brassicol, at the field rate of application, to the symbiotic nitrogen fixation has been reported by Froscheiser (1966) and Sardeshpande *et al.* (1973). Brassicol at higher concentrations, of 50 and 100 ppm, adversely affected the symbiosis. At 20 ppm, it was reported to reduce the growth of alfalfa plants (Frorscheiser, 1966).

TABLE. Effect of pesticides on certain plant parameters of groundnut inoculation with *Rhizobium* sp.

Treatment	Dry weight (g/plant)	Total nitrogen (g/100g)		Number of nodules/plant			Leghemoglobin content (mg/g of fresh nodules
		Shoot	Root	Pink	White	Total	
FUNGICIDES							
Inoculated + ceresan (100ppm)	2.72	2.56	2.11	23	18	51	3.29
Inoculated + Brassicol (11 ppm)	2.45	2.48	2.05	17	18	35	3.14
Inoculated + Brassicol (50 ppm)	2.01	2.10	1.54	11	15	26	2.92
Inoculated + Brassicol (100 ppm)	1.73	1.61	1.40	4	8	12	1.42
Inoculated + Dithane-78 (0.2%)	2.46	2.48	2.10	20	20	40	3.20
Inoculated + Copper Oxychloride (0.3%)	2.50	2.66	2.03	22	20	42	3.24
INSECTICIDES							
Inoculated+Disyston (12 ppm)	3.12	3.29	2.35	30	26	56	3.36
Inoculated+Disyston (100 ppm)	2.50	2.41	2.06	18	21	39	3.24
Inoculated+Disyston (200 ppm)	2.29	2.17	1.61	6	15	21	3.02
Inoculated+DDT (20 ppm)	3.62	3.43	2.38	32	27	59	3.51
Inoculated+DDT 100 ppm)	2.18	2.17	1.89	12	20	32	2.70
Inoculated+DDT (200 ppm)	1.88	1.19	1.47	2	6	8	1.08
Inoculated+Endrin (0.02%)	3.48	2.94	2.80	28	24	52	3.56
Inoculated+Endrin (0.04%)	3.29	2.94	2.59	25	28	53	3.24
Inoculated+Parathion (0.025%)	3 61	3.14	2.67	29	30	59	3.62
Inoculated+Parathion (0.05%)	2.79	2.55	1.90	18	27	45	3.21
HERBICIDES							
Inoculated+Lasso (11 ppm)	1.92	2.13	1.75	11	15	26	1.67
Inoculated+Lasso (100 ppm)	1.52	1.47	1.16	2	3	5	0.97
Inoculated+Lasso (200 ppm)	1.41	1.37	1.05	—	—	—	—
Inoculated+TOK E.25 (7ppm)	2.15	2.31	1.95	12	19	31	2.45
Inoculated+TOK E.25 (100 ppm)	1.50	1.61	1.34	2	7	9	1.51
Inoculated+TOK E.25 (200 ppm)	0.98	1.19	1.06	—	—	—	—
Control (Inoculated)	2.52	2.52	2.10	21	22	43	3.24

Foliar spray of Dithane Z-78 at 0.2 per cent level or copper oxychloride at 0.3 per cent level did not appreciably alter the dry weight, total nitrogen, nodulation and leghemoglobin content of nodules of groundnut plants when compared to the control. While foliar spray of Dithane Z-78 caused a slight reduction in the nitrogen content, that of Copper oxychloride, on the other hand caused a slight increase. However, the increase or decrease in total nitrogen was not statistically significant.

Insecticides

Disyston at the field rate (12 ppm), has increased the dry weight, total nitrogen, nodulation and leghemoglobin content of nodules of groundnut plants. Similar results were obtained when parathion was sprayed at 0.025 per cent. The increases observed in nitrogen content due to the application of disyston and parathion were statistically significant. Naumann (1970) reported that organophosphorus insecticides strongly stimulated the N fixing bacteria. However, in the present study disyston has caused a reduction in dry weight at 100 to 200 ppm. These concentrations also decreased the total nitrogen content, nodulation and leghemoglobin content. The decrease in total nitrogen content at 100 ppm was not statistically significant while the decrease at 200 ppm was statistically significant. Parathion spray at 0.05 per cent caused a slight reduction in the total nitrogen content of inoculated plants. The results in the present study conclusively revealed that disyston and parathion were benefical to groundnut - *Rhizobium* symbiosis upto 12 ppm and 0.025 per cent, respectively.

Soil application of DDT at 20 ppm (field rate) increased the dry weight' total nitrogen, nodulation and leghemoglobin content of nodules of inoculated plants. DDT at 100 to 200 ppm adversely affected the symbiosis. Endrin spray at 0.02 and 0.04 per cent caused a significant increase in the efficiency of the symbiosis. The increase in nitrogen content of the plants with DDT (20 ppm) or Endrin (0.02 and 0.04 per cent) treatments was statistically significant. The non-injurious nature of chlorinated hydrocarbons at their recommended level to the symbiotic nitrogen fixation has been streassed by Abou-el Fedl and Fahmy (1958) and Pareek and Gaur (1969). DDT was reported to increase the leghemoglobin content of the nodules upto 10 ppm in greengram (Pareek and Gour, 1970). In the present study the leghemoglobin content of the nodules was increased by DDT up to 20 ppm. However, at 50 and 100 ppm this insecticide caused a reduction in leghemoglobin content. The adverse effect of high concentration of Chlorinated hydrocarbons on nitrogen fixation in legumes was streassed by Pareek and Gaur (1969, 1970), Diatloff (1970) and Selim *et al.*, (1970).

Herbicides

The herbicides Lasso and TOK E-25 have adversely affectedthe dry matter, total nitrogen, nodulation and leghemoglobin content at all the concentrations tested including their field

rates. At 200 ppm these two chemicals have completely inhibited the nodule formation and caused a poor root development. Fletcher *et al.* (1956), and Garcia and Jordan (1969) considered the lower number of nodules in the presence of toxic substances due to inhibition of root growth and reduction in plant vigour. It has been suggested that herbicides induced the formation of lateral roots with fewer potential sites for nodulation. The present work was done in sterile soil, wherein their phytotoxicity can evidently be pronounced in the absence of other soil microflora (Garcia and Jordan, 1969).

REFERENCES

ABOU-EL-FADL, M. and M. FAHMY. 1958. Effect of DDT, BHC and Toxephene on nodulation of legumes. *Agr. Research Rev. Min. Agr. Egypt* 36 : 339-50.

BALARMAN, K. and N. N. PRASAD. 1973. Influence of wet ceresan seed treatment on nitrogen fixation by *Rhizobium* in groundnut. *Pesticides* 7 : 11.

BREMNER, J. M. 1960. Determination of nitrogen by microkjeldahl method. *J. Agric. Sci.* 55 : 11-33.

DIATLOFF, A. 1970. The effects of some pesticides on root nodule bacteria and subsequent nodulation. *Aust. J. Exp. Agric. Anim. Husb.* 10 : 562-67.

FLETCHER, W. W., P. B. DICKENSON and J. C. RAYMUND. 1956. The effect of hormone herbicides on the growth and nodulation of *Trifolium repens sylvestre* in aseptic culture. *Phyton* 7 : 124-30.

FROSCHEISER, F. I. 1966. Effect of four fungicides on alfalfa seedlings and on controlling *Rhizoctonia solani* in sand. *Plant Dis. Reptr.* 50 : 435-38.

GARCIA, M. M. and D. C. Jordan. 1969. Action of 2,4-DB and Delapon on the symbiotic properties of *Lotus corniculatus* (Bird'sfoot trefoil). *Pl. Soil* 30 : 317-34.

HOFER, A. W. 1958 Selective action of fungicides on *Rhizobium Soil Sci.* 86 : 282-86.

NAUMANN, K. 1970. Dynamics of soil microflora after use of plant protection chemicals. I. Reaction of various soil microflora after use of parathion methyl in field tests. *Zentral. Bakteiorl. Abs.* II., 124 : 745-54.

PAREEK, R. P. and A. C. GAUR. 1969. Effect of Dichloro-diphenyl-trichloro-ethane (DDT) on nodulation, growth, yield and nitrogen uptake of *Pisum satium* inoculated with *Rhizobium leguminosarum. Indian J. Microbiol.* 9 : 93-100.

PAREEK R. P. and A. C. GAUR. 1970. Effect of dichloro- diphenyl-nitrogen ethane (DDT) on symbiosis of *Rhizobium* sp. with *Phaseolus aureus* (Greengram). *Pl. Soil.* 33: 297-304.

SARDESHPANDE, J. S., J. H. KULKARNI and D. J. BAGYARAJ. 1973. Influence of fungicidal seed treatment on the nodulation of groundnut inoculated with Rhizobium. *Pesticides.* 7 (11) : 11

SCHIFFMAN, J. and R. LOBEL, 1970. Haem oglobin determination and its value as an early indication of peanut *Rhizobium* efficiency. *Pl. Soil* 33: 501-12.

SELIM, K. G., S. A. J. MAHMOUD and M. T. MOKADAM. 1970. Effect of dieldrin and lindane on the growth and nodulation of *Vicia faba. Pl Soil,* 33: 325 - 29.