

EFFECT OF PESTICIDES ON NODULATION, YIELD AND N UPTAKE BY SOYBEAN *Glycine max*

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ABSTRACT

A field trial was conducted at Ranchi Agricultural College, Kanke, Ranchi to study the influence of various doses of six pesticides on nodulation, grain and straw yields and nitrogen uptake by grain and straw of soybean (*Glycine max* L. Merrill). It was observed that highest number of nodules, grain and straw yields was obtained with the application or recommended and double of the recommended doses of all pesticides except 2,4-D and butachlor decreased the straw yield even at the double the recommended dose. The adverse effect on number of nodules and grain and straw yield of soybean was observed at three and five times of the recommended dose, the lowest being with five times of the recommended dose of all pesticides. The highest nitrogen uptake by the grain and straw or soybean was observed with the application of carbofuran at recommended dose where as the application 2,4-D at five times of the recommended dose resulted in lowest nitrogen uptake by grain and straw of soybean.

KEYWORDS : Pesticides, Nodulation, Yield, N uptake, Soybean

In recent years, pesticides have played an important role in pest management. Use of correct pesticides at proper stages of crop growth in relation to pest appearance helps in minimising the loss due to pests. But the liberal and unrestricted use of pesticides may pose a serious problem by imbalancing soil microbial ecology which is responsible for higher crop production (Shree ramaraju and Rangaswamy, 1971)

This study was undertaken with a view to assess the effect of pesticides on the number of nodules, grain and straw yields and nitrogen uptake by grain and straw of soybean.

MATERIALS AND METHODS

A field trial consisting of six pesticides, namely, aldrin (30EC), BHC (10%), carbofuran (3G), 2,4-D(80 % a.i) fluchloralin (48% a.i.) and butachlor (30% a.i.) each at four levels (recommended, double of the recommended, three times of the recommended and five times of the recommended dose) was conducted in factorial randomised block design with three replication at Ranchi Agricultural College Farm, Kanke, Ranchi. The soil of the experimental plot was medium in per cent organic carbon and available phosphorus and high in potassium. The soil type was sandy loam with pH 7.9. The recommended doses of the above six pesticides were 1.5 l/ha, 25 kg/ha, 30

Table 1. Effect of pesticides at four levels on number of nodules of soybean / plant

Pesticides	Recommended dose	Double the recommended dose	Three times the recommended dose	Five times the recommended dose	Mean
	D ₁	D ₂	D ₃	D ₄	
Aldrin (T ₁)	164	169	162	128	156
BHC (T ₂)	189	172	162	124	162
Carbofuran (T ₃)	200	194	161	149	176
2,4-D (T ₄)	164	179	156	130	157
Fluchloralin (T ₅)	180	186	150	140	164
Butachlor (T ₆)	161	152	136	116	141
Mean	176	175	154	132	
Control	159				
SE _{TD} ± (T) = 3.84		CD (0.05) (T) = 10.89			
SE _{TD} ± (D) = 3.13		CD (0.05) (T) = 8.87			
SE _{TD} ± (T vs D) = 7.68		CD (0.05) (T vs D) = 21.78			
SE _{TD} ± (C vs T) = 1.56		CD (0.05) (C vs T) = 4.48			

Table 2. Effect of pesticides at four levels on grain yield of soybean (q/ha).

Pesticides		Recommended dose	Double the recommended dose	Three times the recommended dose	Five times the recommended dose	Mean
		D ₁	D ₂	D ₃	D ₄	
Aldrin	(T ₁)	31.12	29.28	23.40	20.13	25.98
BHC	(T ₂)	31.49	30.64	26.64	21.92	27.67
Carbofuran	(T ₃)	38.17	38.62	32.54	27.09	34.10
2, 4-D	(T ₄)	29.43	28.24	16.82	8.18	20.67
Fluchloralin	(T ₅)	29.65	26.14	26.13	20.28	25.62
Butachlor	(T ₆)	29.21	28.67	20.59	19.18	24.44
Mean		31.51	30.18	24.35	19.55	

Control : 25.14

SEm ± (T) = 0.43 CD (0.05) (T) = 1.21

SEm ± (D) = 0.35 CD (0.05) (T) = 0.99

SEm ± (T vs D) = 0.86 CD (0.05) (T vs D) = 2.43

SEm ± (C vs T) = 0.17 CD (0.05) (C vs T) = 0.49

kg/ha, 0.625 kg/ha, 1.5l/ha and 2 l/ha, respectively. The different pesticides were added as pre-sowing application in moist soil 48hr before sowing. A uniform dose of 20 kg N, 80 kg P₂O₅ and 40 kg K₂O in the forms of urea, single super phosphate and muriate of potash were added in each plot. The soybean seeds of Punjab-1 variety was inoculated with *Rhizobium* inoculant.

Three plants were uprooted from each plot 45 days after sowing. The roots were washed carefully and number of nodules was recorded. The crop was harvested at maturity stage and grain and straw yield was recorded. Nitrogen uptake of grain and straw was estimated as per method of Jackson (1958).

RESULTS AND DISCUSSION

Number of Nodules

The data on number of nodules per three plant of soybean are presented in Table 1. There was

significant variation among different treatments and their different doses. The application of carbofuran gave the highest number of nodules and was significantly superior to the rest of the treatments followed in order by fluchloralin, BHC, 2,4-D and aldrin. The lowest number of nodules was recorded in treatments receiving butachlor of the different doses, that recommended and double of the recommended doses resulted in highest number of nodules and was significantly superior to all other treatments.

The lowest number of nodules was found at five times of the recommended dose of pesticides. The interaction effect of pesticides with different doses was found significant. It was observed that carbofuran gave the highest number of nodules, whereas lowest number of nodules was obtained with the application of butachlor at five times of

Table 3. Effect of pesticides at four levels on straw yield of soybean (q/ha).

Pesticides		Recommended dose	Double the recommended dose	Three times the recommended dose	Five times the recommended dose	Mean
		D ₁	D ₂	D ₃	D ₄	
Aldrin	(T ₁)	56.55	50.72	38.59	35.03	45.22
BHC	(T ₂)	57.77	56.18	53.35	31.11	49.60
Carbofuran	(T ₃)	58.47	61.99	54.06	48.20	55.68
2, 4-D	(T ₄)	62.71	38.54	36.26	21.01	39.63
Fluchloralin	(T ₅)	70.32	68.34	59.49	37.91	59.01
Butachlor	(T ₆)	52.66	47.59	38.33	32.00	42.64
Mean		59.74	53.89	46.68	34.21	

Control : 50.1

SEm ± (T) = 0.76 CD (0.05) (T) = 2.16

SEm ± (D) = 0.62 CD (0.05) (T) = 1.76

SEm ± (T vs D) = 0.5 CD (0.05) (T vs D) = 4.31

SEm ± (C vs T) = 0.31 CD (0.05) (C vs T) = 0.88

Table 4. Effect of pesticides at four levels on nitrogen uptake by grain and straw of soybean (kg/ha).

Treatment	Nitrogen uptake by grain of soybean			Treatment	Nitrogen uptake by straw		
	Nitrogen (%)	Yield (q/ha)	Nitrogen uptake (kg/ha)		Nitrogen (%)	Yield (q/ha)	Nitrogen uptake (kg/ha)
T ₁ D ₁	6.42	31.12	199.79	T ₁ D ₁	0.99	56.55	55.98
T ₁ D ₂	6.38	29.28	186.80	T ₁ D ₂	0.99	50.72	50.13
T ₁ D ₃	6.13	23.40	143.44	T ₁ D ₃	0.93	38.59	35.89
T ₁ D ₄	5.00	20.13	120.38	T ₁ D ₄	0.82	35.03	28.72
T ₂ D ₁	6.13	31.49	193.03	T ₂ D ₁	0.99	57.77	57.19
T ₂ D ₂	5.00	30.64	153.20	T ₂ D ₂	0.96	56.18	53.93
T ₂ D ₃	4.16	26.64	110.82	T ₂ D ₃	0.92	53.35	49.08
T ₂ D ₄	4.10	21.92	89.87	T ₂ D ₄	0.92	31.11	28.62
T ₃ D ₁	6.18	38.17	235.89	T ₃ D ₁	1.01	58.47	59.05
T ₃ D ₂	6.13	38.62	236.74	T ₃ D ₂	0.98	61.99	60.75
T ₃ D ₃	5.83	32.54	189.71	T ₃ D ₃	0.96	54.06	51.90
T ₃ D ₄	5.41	27.09	146.56	T ₃ D ₄	0.96	48.20	46.27
T ₄ D ₁	5.16	24.43	181.29	T ₄ D ₁	1.10	62.71	68.98
T ₄ D ₂	4.18	22.24	146.28	T ₄ D ₂	0.99	38.54	38.15
T ₄ D ₃	4.08	12.82	70.31	T ₄ D ₃	0.81	36.26	29.37
T ₄ D ₄	4.06	8.18	33.21	T ₄ D ₄	0.62	21.01	13.03
T ₅ D ₁	6.46	29.65	191.54	T ₅ D ₁	1.01	10.32	71.02
T ₅ D ₂	5.49	26.14	143.51	T ₅ D ₂	1.00	68.34	68.34
T ₅ D ₃	5.31	26.13	138.75	T ₅ D ₃	0.99	58.49	58.89
T ₅ D ₄	5.26	20.28	106.67	T ₅ D ₄	0.96	37.91	36.39
T ₆ D ₁	5.89	29.21	172.21	T ₆ D ₁	0.99	52.66	52.13
T ₆ D ₂	5.25	21.67	169.15	T ₆ D ₂	0.97	47.59	46.16
T ₆ D ₃	4.90	20.59	100.89	T ₆ D ₃	0.93	38.33	35.65
T ₆ D ₄	4.70	19.18	90.15	T ₆ D ₄	0.90	32.00	28.80
Control	5.80	25.14	145.81	Control	0.94	50.10	47.09

T₁ = AldrinD₁ = Recommended dose.T₂ = BHC 10%D₂ = Double of the recommended dose.T₃ = CarbofuranD₃ = Three times of the recommended dose.T₄ = 2, 4-DD₄ = Five times of the recommended dose.T₅ = FluchloralinT₆ = Butachlor

the recommended dose, which was at par with BHC applied at five times of the recommended dose.

In general, all pesticides showed stimulatory effect on the number of soybean nodules at recommended and double of the recommended doses except butachlor. The application at five the recommended dose of all pesticides resulted in decrease in number of nodules. This may be due to the presence of toxic substances which inhibited root growth and reduced plant vigour. Further, the herbicides could induce formation of lateral roots with fewer potential sites for nodulation. These results are in agreement with that of Kataria *et al.* (1975).

The interaction between control and treatment was also found to be significant. The number of

nodules of soybean obtained from control plot was at par with the number of nodules obtained from the plots receiving aldrin, BHC and 2, 4-D, but they gave significantly higher number of nodules over butachlor but showed lower number of nodules as compared to carbofuran and fluchloralin

Grain yield

Highest grain yield (Table 2) was recorded in treatment receiving carbofuran followed in order by BHC, aldrin, fluchloralin and butachlor. The lowest grain yield was recorded with all different doses of 2,4-D. As regards doses of pesticides, the highest grain yield recorded at the recommended dose which was at par with double of the recommended dose, the lowest being with five

times of the recommended dose. The interaction between pesticides and different doses was significant. The recommended dose of carbofuran gave significantly higher yield than other treatments. At double the recommended dose again, carbofuran gave highest yield of grain and fluchloralin gave the lowest yield. At three and five times the recommended dose, carbofuran gave the highest grain yield whereas 2,4-D gave the lowest grain yield. The interaction between control and treatments was found to be significant.

Application of all the pesticides resulted in increase in grain yield of soybean at recommended and double of the recommended dose over control. All pesticides at three and five times of the recommended doses showed decrease in grain yield over control except carbofuran which showed increase at both doses. At higher levels, the pesticides affect adversely the crop growth. At sub-lethal concentration, many pesticides are capable of stimulating plant physiological processes, which result in higher crop yield (Johnson, 1980).

Straw yield

Irrespective of consideration of different doses of application, fluchloralin gave significantly highest straw yield of soybean followed in order by carbofuran, BHC, aldrin and butachlor. The lowest straw yield was found with the application of 2, 4-D (Table 3). Highest straw yield of soybean was recorded at recommended dose, the lowest being at five times of the recommended dose. The interaction between pesticides and different doses was found to be highly significant. The recommended, double and three times of the recommended dose of fluchloralin gave highest straw yield. At five times of the recommended dose, carbofuran gave the highest straw yield while, 2, 4-D resulted in lowest straw yield.

The interaction between control and pesticides was found to be highly significant. It was observed that the straw yield of soybean obtained from fluchloralin and carbofuran was significantly higher than any other treatment in comparison to control. All pesticides increased the straw yield of soybean at recommended and double of the recommended dose except 2,4-D and butachlor which showed decrease in straw yield at double of the

recommended dose over control. It may be concluded that pesticides, in general, at higher levels adversely affect the straw yield of soybean as their higher concentration reduces plant growth and vigour. Pesticides may affect root and top anatomy of crops plants or may disturb metabolic processes specially in soybean cotyledons resulting in growth suppression (Johnson, 1980)

Nitrogen uptake by grain and straw of soybean

A perusal of table 4 revealed that aldrin, BHC 2, 4-D and butachlor resulted in increase in nitrogen uptake by grain soybean at recommended and double of the recommended doses as compared to control whereas at three and five times of the recommended dose, the above mentioned pesticides resulted in increase in nitrogen uptake by grain, the lowest being with five times of the recommended dose. But carbofuran continued to show the increase in nitrogen uptake by grain even at three times of the recommended dose. Fluchloralin only at recommended dose showed increase in nitrogen uptake.

Aldrin, 2-4-D and butachlor showed increase in nitrogen uptake by straw at recommended dose as compared to control. But these three pesticides at double, three and five times the recommended doses resulted in decrease in nitrogen uptake by straw of soybean as compared to control. The recommended, double and three times of the recommended doses of BHC, carbofuran and fluchloralin resulted in increase in nitrogen uptake by straw of soybean whereas five times of the recommended dose of these three pesticides resulted in decrease in nitrogen uptake by the straw of soybean. When the soil was treated with carbofuran, the highest nitrogen uptake was found at the recommended dose. The uptake decreased as the doses increased, the minimum being at five times of the recommended dose. Similar trend for uptake of nitrogen by grain and straw was found with rest of pesticides.

The highest nitrogen uptake by grain or soybean was obtained with application of carbofuran at recommended dose, the lowest being obtained at five times of the recommended dose of 2,4-D. The highest nitrogen uptake by straw was found with the application of fluchloralin at double

of the recommended dose and lowest with the application of 2, 4-D at five times of the recommended dose. In general, all the pesticides at recommended and double of the recommended dose resulted in more uptake of nitrogen by grain straw as compared to control.

One significant point emerges from the above findings is that major fractions of adsorbed pesticides are accumulated in the roots. The presence of these chemicals in the root of crop species may affect the levels of activity of various enzymes and it is possible that these variations may account for differential absorption of nutrients caused by pesticides, may be viewed as an outcome largely of variation in certain proteins which

are considered to be physiological carriers of cations and anions (Liechtenstein *et al.*, 1967).

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ORGANIC AMENDMENTS ON PROTEIN AND OIL YIELD OF GROUNDNUT UNDER *Theri* SOILS (TYPIC USTIPSAMMENTS)

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ABSTRACT

A pot experiment was conducted with the object of studying the different locally available organic amendments on yield, protein and oil content of groundnut under *theri* soils. Arecanut waste recorded the highest protein content (17.81 per cent). Biogas slurry applied treatment recorded the highest oil content (48.4 per cent). The treatment with the application of arecanut waste gave the highest pod yield (19.00 g/pot) and total oil yield (4.9 g/pot).

KEY WORDS : Amendments, *Theri*, Arecanut waste, Biogas slurry, Pressmud

The need for evaluating the soil resources (Rice, 1948; Sehgal, 1987) has become imperative, because the wealth of any nation lies in her soils and their intelligent use and management. *Theri* soils occur to the extent of 60,000 ha in Tirunelveli and Chidambaranar districts. *Theri* land soils are largely coarse textured, where establishment of tree species suffers due to lower level of available nutrients, poor buffering capacity, poor moisture retention and rapid drying of these soils. In these sandy soils, palmyrah and *Acacia* species are naturally growing. These soils are highly permeable with low water retentivity. These *Theri* soils are now being kept as wastelands. Hence an attempt was made to suggest suitable amendments for the retention of moisture and to put the land to proper use.

MATERIALS AND METHODS

A pot experiment was conducted with the object of studying the different locally available organic amendments, on yield, protein and oil content of groundnut under these *theri* soils. The details of the experiment conducted are given in Table 1. The nutrient content of amendments used is detailed in Table 2.

All the treatments received uniform doses of fertilisers viz., 17 kg N/ha in the form of ammonium sulphate, 34 Kg P₂O₅/ha in the form of super phosphate and 54 kg K₂O/ha in the form of potassium chloride. Gypsum 400 Kg/ha was applied 40 days after sowing.

Kernel protein content was estimated by multiplying the nitrogen content of kernel by the