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RESEARCH ARTICLE :

Investigations on effect of agro-chemicals on soil microflora and yield attributing characteristics of soybean

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SUMMARY : Soybean [*Glycine max* (L.) Merrill] is an important legume belong to family leguminaceae, sub –family fabaceae and genus *Glycine*.Being legume crop, it fix and utilize atmospheric nitrogen and improve soil fertility. Agrochemicals are potential threat for soil microorganisms and in the long term may alter their productive, protective and adaptive capacities (Soulas and Lors, 1999). The global drive for sustainable agricultural systems involves optimizing agricultural resources to satisfy human needs and at the same time maintaining the quality of environment and sustaining natural resources. The result in connection with efficiency of different agrochemicals on nodule count per plant and dry weight of nodule in soybean had temporarily effect and it was recovered at 50 DAS. Seed inoculation with Rhizobium @ 25 g/kg seed had increased effect from 30DAS to 50 DAS. The result with regard to bacterial population in soybean field were significantly influenced by bioinoculant *i.e.*Rhizobum. The bacterial population were inhibited by herbicides Alachlor in soybean and fungicide *i.e*. Thiramand carbendazim and insecticide endosulfan in soybean. After 30 days of spraying of chemicals the bacterial population were restored. With regard to Rhizobium population, the bioinoculants were significantly influenced the population in soybean field. The herbicides, fungicides and insecticide were significantly decreased bioinoculant population, maximum inhibition was observed in carbendazim treated plot at 30 DAS. The result with regards to Rhizobium population, bacterial population and fungi population were influenced by bioinoculant Rhizobium in field. While population were inhibited by alachlor, thiram, carbendazim and endosulfan in soybean field. The Rhizobium bacterial population and fungi population were restored after 30 days of sprying.

KEY WORDS :
Glycine max, Soybean,Rhizobium, DAS

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BACKGROUND AND OBJECTIVES

Soybean [*Glycine max* (L.) Merrill.] is an important grain legume, belong to family leguminaceas, sub-family fabaceae and genus Glycine. Being legume crop, it fix and utilize atmospheric nitrogen and improve soil fertility. Its importance is increasing day by day due to high nutritive value. It is truly a wonder

crop, as its vast multiplicity uses as food, fodder, industrial products and residues in soil. It is self pollinated short day plant.

Agrochemicals are a potential threat for soil micro-organisms and in the long term may alter their productive, protective and adaptive capacities. Due to increased use of chemicals in agriculture, the cost of production is increasing day by day. The residual effect of some chemicals is highly toxic, which directly or indirectly affect human welfare. We must be aware about effect of chemicals and its quality. Now time has come to study quantitative and qualitative study of chemicals and its beneficial and harmful effects. Therefore, this study was undertaken in soybean ecology with following objective.

– To study the effect of agrochemicals on Fungal, Bacterial and Rhizobium- Nitrifying bacterial Population

– To study the effect of agro chemicals on number of nodules dry weight of nodules and grain yield in soybean.

RESOURCES AND METHODS

A field experiment was conducted on field of AICRP on Weed Management, M.A.U. Parbhani during *Kharif* season of 2010-11 in Randomized Block Design replicated three times with seven treatments and spacing: 30cm x 10 cm (row x Plant). The soil samples were collected from rhizo-sphere for all the microbial and Physiological characters of plant at 3 stages of cropi.e.At vegetative growth stage (30 DAS), at flowering stage (50 DAS) and at harvest in soybean Variety: JS335 at 30 DAS, 50 DAS and at harvest. Total number of Nodule per plant and Nodule dry matter were calculated by selecting randomly five plants from each plot. Total number of fungi, Bacteria and Rhizobium were counted on the selective media by means of the serial dilution technique and pour plate method (Salle, 1995).

Experimental details :

Treatment details:

T_1–Seed treatment with Rhizobium @ 25 g/kg seed
T_2–Seed incoualtion with Thiram @ 3g/kg seed
T_3–Premergence spray of Alachlor 2kg/ha
T_4–Premergencespapry of Alachlor 4kg/ha
T_5–Spraying of Carbendazim (Bavistin) @ 0.1%
T_6–Spraying of Endosulfan 35 EC 0.1 %
T_7–Control

Calculation of total viable count:

After appropriate incubation period :

Observation regarding number of seeds germinated was recorded at 10 th days after placement of seeds.The germination percentage was calculated by using following formula.

$$\text{Germination (\%)} = \frac{\text{No. of seeds germinated}}{\text{Total No. of seeds placed for germination}} \times 100$$

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Physio-chemical characteristics of soybean field:

The soil was clay type in soybean field (sand 15.5%, silt 23.5%, clay 62.3%). The data presenter in below table revealed that the pH of soil is 7.6. Further the electric conductivity was 0.770 dsm^{-1}. From the data it was noticed that available N,P and K were 135, 19, 463 kg/ha in soybean field. The $CaCO_3$, organic carbon values of these field were 17 mg/100 g soil and 6.75 g/kg.

Table 1 : Physio-chemical parameters of the soil

Sr. No.	Parameters	Soybean
1.	pH	7.6
2.	EC (dsm^{-1})	0.770
3.	Available nitrogen (kg/ha)	135
4.	Available phosphorus (kg/ha)	19
5.	Available potassium (kg/ha)	463
6.	$CaCO_3$ (mg/100g of soil)	17.0
7.	Organic carbon (g/kg)	6.75

The data on bacterial population is presented in Table 1. The result at 30 DAS in various treatment indicated that in T_7 (control plot) had maximum bacterial count *i.e.* ($21.6x10^6$) which was significantly superior over rest of the treatment and was at par with T_6, *i.e.*, Endosulfan spray@ 0.1% ($21.5x10^6$).Whereas 50 DAS in T_1 (Seed inoculation with Rhizobium @ 25 g/kg) which showed highest bacterial count (34.6×10^6) followed by T_2 (Seed inovulated with Thiram @ 3 g/kg of seed) showed bacterial count (36.6×10^6) and T_7 (control plot) which showed highest bacterial count (29.3×10^6). At the time of harvest, T_7 (control plot) which showed highest bacterial count (48×10^6) whereas, T_3 recorded lowest bacterial count ($29.3 x10^6$).

The data regarding fungal population of soil in soybean is presented in Table 1. The result at 30 DAS in various treatment indicate that T_7 (control plot) has maximum fungal count ($15x10^3$) which was significantly superior and was at par with T_2 *i.e.* Thiram @ 3 g/kg showed (13.6×10^3) and followed by T_5 (Carbendazim) showed fungal count of ($13.5x10^3$). The significant lowest fungal count ($8x10^3$) was observed in Endosulfan spray *i.e.* T_6.

At 50 DAS T_7(control plot) recorded highest fungal count (52.33×10^3) than rest of treatment. While the data in connection with Rhizobium population of soil presented in Table 2. The result at after 30 DAS revealed that T_1 (Seed inoculation with Rhizobium @ 25 g/kg) indicated maximum Rhizobium count ($29.3x10^6$) and was at par with treatment T_4 and T_7 shows where the Rhizobium Population was $27x10^6$ in both the treatment.

In present investigation, the soil samples which were collected from agrochemicals treated soil showed less fungal, bacterial and rhizobium count at 30DAS whereas, population were recovered by the harvest time of crop.Bacterial population at 50 DAS in seed treatment with Rhizobium and control plot do not showed much adverse effect while carbendazim spray @ 0.1 % had reduced bacterial population. While highest bacterial count was observed in control plot followed by Rhizobium treated plot.

At the time of disease occurance (50 DAS) spraying of carbendazim @ 0.1% treated plot the fungal population was ($47.33X10^3$) while it was reduced 21% at the time of harvest. In regard to Rhizobium population at thetime of harvest, there was definitely recovered the total Rhizobium population in control and treatments plots. Seed treatment with Rhizobium decrease 19% Rhizobium population at 50 DAS followed by 14 % reduction in seed treatment with Thiram at 50 DAS, but later on it recovered at harvesting time, while 50 DAS pre-emergence spray of Alachlor @ 2 kg/ ha had 16 % reduced Rhizobium population while in T_4 at harvest it recovered.

Table 2 : Effect of agrochemicals on fungal, bacterial and rhizobium- nitrifying bacterial population of rhizospheric soil in soybean

Sr. No.	Treatments	Fungal count ($cfux10^3$)			Bacterial count ($cfux10^6$)			Rhizobium count ($cfux10^6$)		
		30 DAS	50 DAS	At harvest	30 DAS	50 DAS	At harvest	30 DAS	50 DAS	At harvest
T_1	Seed inoculationwith Rhizobium @ 25 g/kg seed	11.7	40.3	25.3	10.0	34.6	42.6	29.3	23.6	42.3
T_2	Seed treatmentwith Thiram @ 3g/kg seed	13.6	40.3	27.6	13.0	29.3	40.33	22.0	19.0	33.3
T_3	Pre-emergence spray of Alachlor 2kg/ha	10.2	32.6	22.6	16.3	28.3	36.6	26.3	22.3	35.3
T_4	Pre-emergence spray of Alachlor 4kg/ha	8.7	33.0	30.3	17.6	23.6	42.6	27.0	27.3	37.3
T_5	Spraying of Carbendazim@ 0.1%	13.5	47.3	37.6	10.3	15.3	42.33	18.6	23.0	25.3
T_6	Endosulfan spray@ 0.1%	8.0	41.3	33.6	21.5	18.3	40.00	18.6	27.0	25.0
T_7	Control	15.0	52.3	44.6	21.6	34.6	48.0	27.0	32.3	37.0
	S.E.±	1.06	3.3	3.6	2.4	3.47	2.97	4.24	3.7	4.1
	C.D. (P=0.05)	3.28	10.1	11.2	7.6	10.6	9.1	13.0	11.5	12.7

Table 3 : Effect of agrochemicals on yield and yield attributing characteristics of soybean

Sr. No.	Treatments	Number of nodules per plant			Dry weight nodules (g/plant)			Yield (q/ha)	Test weight (100seed)g
		30 DAS	50 DAS	At harvest	30 DAS	50 DAS	At harvest		
T_1	Seed incoualtion with Rhizobium @ 25 g/kg seed	6.00	31.6	21.6	0.65	37.2	0.21	23.7	14.25
T_2	Seed treatment with Thiram @ 3g/kg seed	5.26	31.0	17.5	0.26	15.0	0.18	21.14	13.58
T_3	Pre-emergence spray of Alachlor 2kg/ha	5.06	25.6	7.5	0.32	24.5	0.19	19.58	13.07
T_4	Pre-emergence spray of Alachlor 4kg/ha	4.26	28.4	10.3	0.33	24.4	0.15	18.50	13.20
T_5	Spraying of Carbendazim@ 0.1%	4.53	24.4	16.5	0.31	24.5	0.12	19.60	14.07
T_6	Endosulfan spray@ 0.1%	5.13	31.0	11.3	0.41	28.8	0.14	21.10	12.08
T_7	Control	5.33	41.3	9.5	0.25	42.4	0.13	21.20	12.01
	S.E.±	0.96	4.5	1.9	0.04	3.6	0.01	0.63	0.45
	C.D. (P=0.05)	2.94	1.4	5.7	0.14	11.0	0.05	1.88	1.37

Donderski. *et al* (1992) studied the effects of Atrazine on soil micro-organism population dynamics. The Atrazine resulted indecline the population density of bacteria actinomycetes and fungi to minimum at 14 days after treatment but thereafter raised in all plots accepts that treated with 5 kg/ha. In regards to fungal population the highest count was observed in control plot at 30 DAS, 50 DAS and at harvest.

Nodule has an inherent capacity to fix atmospheric nitrogen as it is rich source of Bacteroids. The result obtained with regard to nodulation, number of pods, number of branches, yield, test weight of soybean is clearly indicated that the Rhizobium inoculation have brought about the maximum number of nodules, pods, branches, test weight and yield of soybean. With regards to all seven treatments, the nodule count per plantand dry weight of nodules (g/plant) was maximum in seed treatment with Rhizobium @ 25 g/kg of seed *i.e.* 6 which is followed by nodule count per plant in the application of pre emergence spray of Alachlor @ 2kg/ka *i.e.* 5.06. Whereas, lowest count was observed in the pre - emergence spray of Alachlor @ 4 kg/ha *i.e.* 4.26 followed by nodule count per plant in the application of Carbendazim spray @ 0.1% at 50 DAS. At the time of harvest nodule count in seed treatment withThiram @ 3 gm /kg of seed recorded highest count *i.e.*17.5 than the other chemical treatments. The grain yield influenced by different agrochemicals was ranged from 18.50 to 23.70 q/ha. Highest yield was observed in the treatment which received seed treatment with Rhizobium @ 25g/ kg *i.e.* 23.70 q/ha which was superior to rest of the treatment.

The present investigation on efficiency of agrochemicals onnodule count per plant and dry weight of nodules (g/plant) clearly observed that inoculation with Rhizobium @ 25g/kg seed in soybeanexhibited positive effect at 50DAS and more in control plot (T_7) followed by rest of the treatments.The findings of present investigations are more or less similar as that of earlier workers by Mishra and Bhanu (2006) reported that the herbicide could affect root nodulation and also change effectiveness of Rhizobium especially after long term exposureto residues of persistent herbicides.

The grain yield (Table 3) and as influenced by different agrochemicals was ranged from 18.50 to 23.70 q/ha. The treatment (T_1) received seed treatment with Rhizobium @ 25 g/kg seed showed highest yield (23.70 q/ha) and superior to other treatments in the descending order of yield which were at par with each other.

The data presented in Table 3 clearly indicated that the inoculation of Rhizobium has resulted about maximum increase in test weight *i.e.* 14.25 g which was followed by carbendazimie. 14.07g. Minimum test weight recorded in control T_7 *i.e.* 12.01g.The result obtained in present investigation are in full agreement withthose reported in the past Wange *et al.* (1997) reported microbial inoculation increased number of pods, bunches, test weight and yield.The result with regard to the plant height yield and test weight of soybean influenced by Rhizobium inoculations have brought about the significant increase in plant height, test weight and yield.

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