Madras Agric. J., 86(4-6): 181 - 185 April - June 1999
https://doi.org/10.29321/MAJ.10.A00575

GROWTH, NODULATION AND YIELD OF CHICKPEA AS INFLUENCED BY PHOSPHORUS, BACTERIAL CULTURE AND MICRONUTRIENTS UNDER RAINFED CONDITION

S.K. SARAWGI, P.K. TIWARI AND R.S. TRIPATHI

Department of Agronomy, College of Agriculture,
Indira Gandhi Agricultural University,
Raipur (M.P) 492012.

ABSTRACT

Field experiments were conducted during 1995-96 and 1996-97 to study the effect of phosphrous, bacterial culture inoculation and micro-nutreints on growth, nodulation and yield of chickpea in rice based cropping systems of Chhattisgarph plain region of Madhya Pradesh. Grain and straw yield and yield attributes of chicpea increased with increasing levels of phosphorus. All these characters were further increased with the inoculation of PSB (Phospate solubilizing Bacteria) over their respective levels of Phosphorous. Inoculation of rhizobium culture further enhanced the grain yield over their respective levels of phosphorus and PSB. Maximum per cent increase in grain yield of chickpea over T1 (Control) was recorded under T12 (60 kg P2O5 + PSB + RC + Seed treatment with Mo and FE) followed by T9 (60 kg P_2O_5 + PSB + RC) and T6 (60 kg P_2O_5 + PSB). Maximum impact of PSB and RC (34.1%) was observed with the application of 30 kg phosphorus (T8) and it decreased with increasing the levels of phosphorus.

KEY WORDS: Chickpea, PSB, Molybdenum, Iron, Yield

Chhattisgarh is known as rice bowl of the country. In this region, chickpea is the main crop after rice which is generally grown on residual moisture. In chicpea crop, phosphorus is the main limiting input without which higher production is not possible. The efficiency of applied phosphorus seldom exceeds 15% (Roy et al. 1978). Since the P fixation is higher in vertisols, it is more important to know the quantity of P required in soil to raise P fertility. Phosphate dissolving micro-organisms are known to solubilize not only insoluble soil phosphates but also increase the efficiency of soluble form of phosphatic fertilisers applied to soils. Combined application of Rhizobium and PSB have synergistic action and stimulate this activity (Alagawadi and Gaur, 1988, and Poi et al, 1989). Information regarding phosphate fertilisation, single or combined application are scarce particularly under rained condition on chickpea. Therefore, the present experiment was undertaken to study the effect of phosphorus, bacterial culture and micronutrient as production potentials of chickpea under rainfed condition in rice based cropping systems.

MATERIALS AND METHODS

A field experiment was conducted during winter (Rabi) season of 1995-96 and 1996-97 at Research Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (Madhya Pradesh) in rice-based cropping systems. The soils of the experimental field was vertisol with 302 and 318: 13.4 and 12.7 and 450 and 441 kg/ha, available N, P and K during 1995-96 and 1996-97, respectively with neutral pH (7.3) in soil reaction. Twelve treatments viz., T1 - No phosphorus, T2 - 30 kg phosphorus/ha; T3-60 kg phosphorus/ha; T4 - T1 + PSB; T5-T2+PSB; T6 - T3 + PSB; T7 - T4 + RC; T8 + T5 + RC; T9 - T6 + RC; T9 - T6 + RC; T10 - 60 kg phosphorus (10% through FYM + 90% through SSP) + PSB + RC; T11 - 60 kg phosphorus (20% through FYM + 80% through SSP + PSB + RC); T12 - T9 + Mo + Fe, were tested in randomized block design with three replications using JG 74 cultivar. A common dose of N and potash each at 30 kg/ha was applied at sowing and the crop was sown on 10th and 13th Dec, 1995 and 1996, respectively, with light irrigation through sprinkler to ensure the germination. In treatment (T11) where FYM (0.5% N, 0.2% P205 and 0.5 K20) supplied full dose of N and K, therefore, urea and MOP not applied. But in T9 the quality of urea MOP was reduced by half. The seeds were treated with rhizobium and PSB each at 10 g/kg seed and/or 5 g ammonium molybdate and 15 g ferrous sulphate per kg seed as per treatment.

RESULTS AND DISCUSSION

Growth and Nodulation

Phosphorus application with increasing rates increased the growth characters viz., number of branches, dry matter accumulation, leaf area index and number and dry weight of nodules during both the years (Table 1). However, different phosphorus, bacterial culture and micronutrient treatments did not show any significant response on plant height during both the years. Increase in nodulation might be due to increased activities of native Rhizobium as they became motile and flagellate in the presence of phosphorus. Application of phosphate solubilizing bacteria and Rhizobium further increased all the above growth characters over their respective levels of phosphorus which might be due to increased solubilization of phosphorus by production of organic acids (Subba Rao 1986) and growth promoting substances like auxins and gibbereline produced by PSB. Application of 20 percent of 60 kg phosphorus through FYM (T11) resulted in lesser growth characters than the 30kg phosphorus + PSB (T5) as compared to which 10 per cent phosphorus was applied through it (T10). This might be due to poor availability of initial inorganic nitrogen, phosphorus, because it got fixed with presence of high amount of organic carbon.

Application of 60 kg phosphorus/ha along with PSB (phosphate solubiling bacteria), RC (rhizobium culture), and seed treatment with molybdenum and iron (T12) resulted in better growth characters. This was because of molybdenum and iorn were an integral part of nitrogenose, ferredoxin, leghaemoglobin and cellular enzyme systems in the nodules and especially in various cytochromes that were present in nodule bacteroids. They might have influence the sybiosis and nitrogen fixation and ultimately the formation of amino acids into the nodules which were transferred to the host and resulted with formation of branches and dry matter accumulation (Somani et.al., 1994). Tiwari et. al., (1989 b) also reported increased nodulation of chickpea due to rhizobium inoclulation along with phosphorus and molybdenum application. Bhanavase and Patil (1994) at Pune, recorded increased nodule number, nodule dry weight, dry

Table 1. Growth and nodulation of chickpea as influenced by phosphorus, bacterial culture and micronutrients

Treatments	Plant Height (cm)		Branches per plant		Dry matter accumulation		LAI		Nodule Nos.		Nodule Dry weight (mg)	
	95-96	96-97	95-96	96-97	95-96	96-97	95-96	96-97	95-96	96-97	95-96	96-97
T1 - 0 kg P205/ha	31.8	30.6	13.1	13.0	5.48	5.08	2.39	2.54	10.3	8.6	290	204
T2 - 30 kg P205/ha	32.8	30.8	13.7	13.7	5.98	5.67	3.14	2.88	12.8	10.3	331	288
T3 - 60 kg P205/ha	32.9	32.6	19.2	15.7	6.54	6.32	3.63	3.33	17.0	14.3	374	356
T4 - 0 kg P205 + PSB	33.6	30.7	15.5	14.7	5.83	5.60	2.53	2.67	12.6	9.3	328	256
T5 - 30 kg P205 + PSB	33.5	31.4	16.5	15.6	6.49	6.36	3.19	3.00	15.4	10.3	347	288
T6 - 60 kg P205 + PSB	33.4	32.3	19.0	17.8	7.39	7.20	3.95	3.85	19.9	15.6	405	378
T7 - 0 kg P205 + PSB + RC	33.6	31.7	18.3	16.6	6.24	6.30	2.89	2.93	17.8	10.2	385	266
T8 - 30 kg P205 + PSB + RC	34.6	31.9	19.2	18.3	6.83	6.96	3.43	3.31	20.0	11.6	429	310
T9 - 60 kg P205 + PSB + RC	35.1	33.7	20.8	19.3	8.87	88	4.36	3.89	20.4	15.8	462	390
T10 - 60 kg P205 (10% FYM + 90% SSP) + PSB + RC	34.5	30.4	16.7	16.7	7.84	6.46	3.60	3.32	22.4	11.5	487	306
T11 - 60 kg P205 (20% FYM + 80% SSP) + PSB + RC	34.1	31.3	14.1	11.3	6.91	6.00	3.22	3.17	17.6	10.6	384	300
T12 - 60 kg P205 + PSB + RC + Seed treat. No. & Fe	36.3	34.0	22.3	20.1	8.99	8.00	4.92	3.96	25.6	18.3	645	416
CD (P=0.005)	NS	NS	4.6	4.1	1.62	1.27	1.02	0.80	5.8	3.6	134	64

Table 2. Yield and yield attributes of chickpea as influenced by phosphorus, bacterial culture and micronutrients

Treatments	Pods per plant (No)		100 seeds weight (g)		Grain yield (q/ha)			% increase over T1	% increase over respec. level of P
	5-96	96-97	95-96	96-97	95-96	96-97	Mean		
T1 - 0 kg P205/ha	45	36	14.65	14.00	8.22	8.18	8.20	-	-
T2 - 30 kg P205/ha	50	42	14.98	14.32	9.26	8.59	8.92	8.8	-
T3 - 60 kg P205/ha	57	47	15.20	14.44	10.12	10.81	10.46	27.6	-
T4 - 0 kg P205 + PSB	46	40	14.76	14.32	8.82	9.78	9.30	13.4	13.4
T5 - 30 kg P205 + PSB	58	46	15.31	14.67	10.68	12.70	11.69	42.6	31.0
T6 - 60 kg P205 + PSB	69	52	15.85	15.02	12.50	13.41	12.95	57.9	23.8
T7 - 0 kg P205 + PSB + RC	54	42	15.09	14.58	9.47	10.96	10.21	24.5	24.5
T8 - 30 kg P205 + PSB + RC	63	54	15.55	15.10	10.97	12.96	11.96	45.8	34.1
T9 - 60 kg P205 + PSB + RC	79	58	16.26	15.46	13.82	13.18	13.50	64.6	29.1
T10 - 60 kg P205 (10% FYM + 90% SSP) + PSB + RC	76	50	16.20	15.00	13.25	11.93	12.59	53.5	20.4
T11 - 60 kg P205 (20% FYM + 80% SSP) + PSB + RC	74	44	16.11	15.00	12.90	10.82	11.86	44.6	13.4
T12 - 60 kg P205 + PSB + RC + Seed treat. No. & Fe	85	59	16.65	15.81	4.51	13.33	13.92	69.7	33.1
CD (P=0.005)	11	6	0.46	0.42	1.62	1.87	1.67		

matter of chickpea by application of molybdenum at different stages of crop growth.

Yield and Yield attributes

Pods per plant, 100 seed weight, grain and straw yield increased with increasing levels of phosphorus and significantly higher values were recorded with 60 kg phosphorus per hectare (T3) over no phosphorus (T1) during both the years (Table 2). These characters further increased with PSB and rhizobium inoculation over their respective levels of phosphorus. Combined inoculation of rhizobium and PSB increased the grain yield of chickpea which were more pronounced in the presence of added phosphatic fertilisers (Alagawadi and Gaur, 1988). The effect of PSB, on grain yield, clearly showed that about 13.4 per cent more grain yield was recorded with no phosphorus application (T4) and increase in grain yield was five times more under 30 kg phosphorus + PSB (T5) over when only 30 kg phosphorus was applied alone (T2), whereas it was tiwce in case of 60 kg phosphorus + PSB (T6) over 60 kg phosphorus applicantion alone (T3). This clearly showed that response of PSB was greater with lower level of phosphorus than higher level. Tiwari et al (1989, a) from Kanpur, reported that seed inoculation with PSB markedly increased the nodulation and yield of chickpea with or without P fertilisers.

When phosphorus and PSB were combined with rhizobium inoculation, the increase in grain yield was further increased and it was maximum with no phosphorus (T7) followed by with 60 kg (T9) and 30 kg phosphorus (T8). Significantly higher grain yield of chickpea was recorded in T12 during both the years, which was at par with T9, T10 and T11 during first year and with T5, T6, T8, T9, T10 during second year. However, the mean grain yield of both the years was at par with T6, T9 and T10, over rest of the treatments. Significantly higher straw yield of chickpea was also recorded under T12 during both the years, and which was at par with T9 and T10 during first year and with T6, T8 and T9 during second year. Significantly higher harvest index was recorded in T12 during first year only (Table 3).

Table 3. Straw yield, harvest index and economics of chickpea as influenced by phosphorus, bacterial culture and micronutrients

Treatments	Straw yield (q/ha)		Harvest index		Net Return (Rs./ha)		Mean	Cost:Benefit Ratio Rs./Rs. investment		Mean
	1995-96	96-97	1995-96	96-97	1995-96	96-97		1995-96	96-97	
T1 - 0 kg P205/ha	12.9	13.0	0.38	0.38	1060	1034	1047	1.17	1.17	1.17
T2 - 30 kg P205/ha	13.3	13.3	0.41	0.39	1439	903	1171	1.22	1.14	1.18
T3 - 60 kg P205/ha	13.6	14.3	0.43	0.43	1669	2263	1966	1.24	1.32	1.28
T4 - 0 kg P205 + PSB	13.1	13.7	0.40	0.41	1540	2339	1939	1.25	1.38	1.31
T5 - 30 kg P205 + PSB 1.51	58	14.0	15.2	0.43	0.45	2599	4276	3437	1.39	1.64
T6 - 60 kg P205 + PSB	13.7	17.3	0.47	0.44	3567	4475	4021	1.50	1.63	1.56
T7 - 0 kg P205 + PSB + RC	13.4	14.8	0.41	0.42	2063	3323	2693	1.33	1.54	1.43
T8 - 30 kg P205 + PSB + RC	14.0	16.8	0.44	0.44	2819	4549	3684	1.42	1.68	1.55
T9 - 60 kg P205 + PSB + RC	15.3	17.5	0.47	0.43	4689	4286	4487	1.66	1.60	1.63
T10 - 60 kg P205 (10% FYM + 90% SSP) + PSB + RC	15.2	15.3	0.47	0.44	4279	3230	3754	1.60	1.46	1.53
T11 - 60 kg P205 (20% FYM + 80% SSP) + PSB + RC	14.9	15.0	0.46	0.42	4040	2381	3210	1.57	1.34	1.45
T12 - 60 kg P205 + PSB + RC + Seed treat. No. & Fe	15.7	18.3	0.48	0.42	5209	4396	4802	1.72	1.61	1.66
CD (P=0.005)	0.7	2.0	0.06	NS	-	-	-	-	-	-

The response of PSB and RC was less pronounced when it was combined with organic manure (T10 and T11). The response decreased with increase in inorganic phosphorus applied through farm yard manure along with PSB and RC because of lack of initial inorganic NPK and whatever the nutrients are present in FYM they became available and utilized by the microbes for building their tissues. Similarly, Patel and Patel (1991) observed that there was no significant difference in yield and yield attributes due to FYM application.

The per cent increase over no phosphorus (T1) was maximum with T12 when 60 kg phosphorus applied along wtih PSB + RC and seed treatment with molybdenum and iron (Table 2). The response of Mo and Fe was only 5.1 per cent greater than T9 (Tiwari, et. al. 1989). When, the response of bacterial culture is considered over each of the phosphorus per hectare (T5) and it was further increased (3.1%) with the inoculation of RC along with PSB under the same level of phosphorus (T8).

Maximum net return (Rs. 4802/ha) was recorded from T12 where 60 kg phosphorus was applied along with PSB + RC and seed treatment with Mo and Fe, followed by T9 (Rs. 4487/ha), where 60 kg phosphorus was applied along with PSB + RC, T6 (Rs. 4021/ha). Similarly, cost benefit ratio was also higher under T12 (Rs. 1.66) followed by T9 and T6

REFERNECES

ALAGAWADI, A.R. and GAUR, A.C. (1988). Association effect of Rhizobium and PSB on the yield and nutrient uptake of chickpea. **Plant and Soil. 105** : 241 - 246.

BHANAVASE, D.B. and PATIL, P.L. (1994). Effect of molybdenum on nodulation in chickpea. **J. Maharashtra Agric. Univ. 19(1)** : 127 - 129.

PATEL, R.S. and PATEL, Z.G. (1991). Effect of organic, inorganic and biofertilizers on yield and quality of chickpea. **Indian J. Agron. 36 (3)** : 419 - 420.

POI, S.C; GHOSH, G. and KABI, M.C. (1989). Response of chickpea to combined inoculation with Rhzobium PSB and VAM. Zental bitt fiir. mikro biologie iuu (4) : 249 - 263.

ROY, R.V.; SEETHARM, S. and SINGH, R.N. (1978). Fertilizer use research; in India. Fertilizer News, 23: 20-22.

SOMANI, L.L; BHANDARI, S.C., : VYAS, K.K and SAXENA, S.N. (1994). Biofertilizers. Scientific Publishers Jodhpur pp. 85-112.

SUBBA RAO, N.S. (1986). Soil micro-organisms and plant grwoth. Oxford and IBH Publishign Co. Ltd. New Delhi. pp. 239.

TIWARI, V.N.; LEHRI, L.K. and PATHAK, A.N. (1989 a). Effect of inoculating crops with phospho microbes. Expt. Agric. 25(1) : 47-50.

TIWARI, V.N.; LEHRI, L.K. and PATHAK, A.N., (1989 b). Rhizobium inoculation of legume as influenced by phosphorus and molybenum fertilization. J. Indian Soc. Soil Sci. 37 : 712 - 716.

(Received: July 1998; Revised July 1999)

Madras Agric. J., 86(4-6): 185 - 187 April - June 1999

COMBINING ABILITY AND HETEROSIS FOR POD BORER DAMAGE IN SESAME

S.K. GANESH, N. NADARAJAN and S. RAGURAMAN
Agricultural College and Research Institute,
Madurai 625 104

ABSTRACT

An investigation was carried out with three sesame genotypes resistant to pod borer (*Antigastra catalaunalis* Dup.). The genotypes were crossed with ruling varieties to evaluate their combining ability and heterosis performance for the pod borer resistance. The parents Si 3315/11 and Co 1 could be utilised as donors in the hybridisation programme to infuse pod borer resistance. The immense valuable heterotic Si 3315/11 x Co 1 hybrid could be exploited in heterosis breeding programme to get desirable segregants with pod borer resistance since it registered high *per se* performance, SCA effect, high heterosis and involved parents of good combiners.

KEY WORDS: Sesame, Combining ability, Heterosis, Resistance, Pod borer

Sesame (*Sesamum indicum* L.) is attacked by many insect pests at various stages of its growth. Of these, shoot webber and pod borer (*Antigastra catalaunalis* Dup.), gall fly (*Asphondylia sesami*), sphingid moth (*Acherontia styx*) and hairy caterpillars (*Diacrisia obliqua* and *Amsacta morei*) are the most serious pests throughout India (Harvir Singh, 1985). Among these pests, shoot webber and pod borer were observed to cause 10-70 per cent damage of pods and 27-40 per cent yield loss (Singh, *et al.*, 1985). Use of plant protection measures by the farmers for the control of shoot webber and pod borer is very meagre, since the crop is predominantly raised as a rainfed crop. Hence, it is necessary to identify resistant/tolerant varieties or hybrids with appreciable yield. Identification of high yielding variety/hybrid with resistance/tolerance to insect pest in sesame will also improve the quality of oil. Hence, an attempt was made with seven sesame parents to study the nature of gene action involved in showing resistance to pod borer.

MATERIALS AND METHODS

The experimental materials comprised of three pod borer resistant lines *viz.*, Si 250, ES 22 and Si 3315/11 and four testers *viz.*, TMV 3, TMV 4, Co 1 and SVPR 1. Seven parents were raised during kharif 1994 and produced 12 hybrids after mating in a Line x Tester system. Seven parents and 12 hybrids were raised in randomised block design with three replications during Rabi 1994-95 to study the combining ability effects and heterosis for pod borer damage. Each genotypes was raised in five rows of three metre length per replication by adopting the recommended spacing of 30 x 30 cm. In each genotype, 10 plants were selected at random for recording observation on pest infestation. Since the pod borer larvae feed the internal content of the capsule, damaged capsules