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Effect of integrated nutrient management on growth and yield of black gram

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Abstract

The field experiment was carried out during the Kharif seasons of 2010 and 2011at the experimental farm of Amar Singh (P.G.) College, Lakhaoti (Bulandshahr) U.P. The experiment was laid out in Randomized Block Design with three replications keeping 10 treatments of integrated nutrient management viz. control, 100% RDF, 75% RDF, 75% RDF+Rhizobium, 75% RDF +PSB, 75% RDF + VAM, 75% RDF + Rhizobium +PSB, 75% RDF + Rhizobium + VAM, 75% RDF+PSB + VAM and 75% RDF + Rhizobium +PSB + VAM. The soil of the experimental field was poor in available N, medium in available P and K and neutral in reaction. A seed rate of 25 kg/ha was used for Black gram variety PU-19, sown at distance of 30 cm and at 5 cm depth. The results showed that the application of 75% RDF + Rhizobium +PSB + VAM inoculation to black gram crop produced maximum growth and yield attributes of black gram and produced at par yield of black gram to 100% RDF.

Key words : Integrated, nutrient management, Black gram.

Introduction

Pulses are the richest source of protein for the large section of vegetarian population of countries like India. Food legumes, therefore, are important constituents of their diet and obliviously should occupy a place of pride in cropping system. Pulses have unique ability to fix atmospheric nitrogen which is safe and economical for plants. These pulses constituted as an association with *Rhizobium* bacteria living in their root nodules symbiotically. Pulses leaves a considerable quantity (20-80 kg N/ha) of fixed atmospheric N depending upon the pulse crop species and environmental conditions of their growth.

Pulse production in the country has been more or less stagnated during last several decades resulting in gradual decrease in the availability of pulses/capita year after year with increasing population. The progressive decline in per capita availability of pulses (69 g in 1961 to 31.6 g in 2010) in India is a matter of great concern. This is attributed to the steady marginalization of their cultivation in the wake of the "Green Revolution" and burgeoning population. To alleviate protein energy malnutrition a minimum of 50 g pulses/capita/day is required in addition to other sources of protein such as cereals, milk, meat and eggs etc. To make up this shortfall in supply and further increasing demand of burgeoning population, about 20 million tonnes by 2020 (Masood Ali *et al.*, 2002). This can be realized only by adopting more productive technologies along with rigorous development efforts and favourable government policies. The total cultivated area under pulses during 2010 was 26.8 million ha with production of 18.09 million tonnes and average productivity of 689 kg/ha (Anonymous, 2011).

To maintain the system productivity, crop diversification coupled with integrated and efficient use of available resources including biodiversity has become inevitable. Inclusion of legumes and bio-fertilizers in conjunction with the fertilizer nutrients is an integral part of sustainable cropping. Continuous cropping of cereal crops with heavy use of fertilizers has resulted in declining crop productivity and native soil fertility. Inclusion of legumes in the system not only increases the yield of succeeding crop but also build up nitrogen status in the soil (Prasad, 2000).

Identification of microorganisms capable of solubilising the native and applied phosphorus had opened the new vistas in phosphorus nutrition and other important ion absorption. Vasicular Abuscular Mycorrhyza (VAM-fungi) and bacteria belonging to Pseudomonas and Bacillus genera are known to bring about dissolving the insoluble phosphate compounds in soil along with other nutrients eg. Ca, Zn, Mo, Cu

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etc. Several workers have also investigated the beneficial effect of phosphate solubilising bacteria (PSB) and VAM in solubilising the soil applied phosphorus and other nutrients for increasing the availability of P and Mo to legume crop (Jat and Ahlawat, 2006).

Several workers have also investigated that continuous growing of cereal crops in sequence had reduced the response of added fertilizer due to unbalanced nutritional status of soil and when legumes are included it improves the physical, chemical and biological properties of soil and enriched the soil fertility. Therefore, the present experiment is planned on Effect of Integrated Nutrient Management on growth and yield of Black gram.

Research Methodology

The field experiment was conducted during the *Kharif* seasons of 2010 and 2011at the experimental farm of Amar Singh (P.G.) College, Lakhaoti (Bulandshahr) U.P. The farm is located at a distance of 18 km. north of Bulandshahr on the Bulandshahr-Garh Road. Lakhaoti is situated at a latitude of 28.4° North and longitude of 77.1° East with an altitude of 201.4 meter above the mean sea level. The experiment was laid out in Randomized Block Design with three replications keeping 10 treatments of integrated nutrient management viz. control, 100% RDF, 75% RDF, 75% RDF+*Rhizobium*, 75% RDF +PSB, 75% RDF + VAM, 75% RDF + *Rhizobium* +PSB, 75% RDF + *Rhizobium* + VAM, 75% RDF+PSB + VAM and 75% RDF + *Rhizobium* +PSB + VAM. The nature and composition of soil sample from the depth of 0 to 20cm. representing the soil of the experimental field was collected. The sample so collected was subjected to mechanical and chemical analysis. The soil is poor in available N, medium in available P and K and neutral in reaction. A seed rate of 25 kg/ha was used for Black gram variety PU-19, sown at distance of 30 cm and at 5 cm depth. The seed was treated with thirum@ 3g/ kg seed. Rest of the practices were followed as per recommendation except nutrient management which was applied as per treatments.

Results and Discussion

Growth is a function of dry matter accumulation in plant which is governed by complimentary action of various growth parameters viz. plant height, number of branches and rate of dry matter accumulation etc. The beneficial effect of applied fertilizers and bio-fertilizers on growth characters have been clearly brought out in this investigation. Growth parameters viz. plant height, branches/plant, dry matter accumulation increased significantly with fertilizer application. Application of bio-fertilizers improved the performance of growth parameters. Application of 75% RDF + *Rhizobium* + PSB + VAM inoculation caused significant increase in plant height, branches/ plant and dry matter accumulation (Table-1) at all the stages of crop growth. It clearly indicates that the synergistic effect of all microorganisms on plant height may be because of improving the nitrogen and phosphorus availability to crop. Higher plant height in *Rhizobium* and PSB treated plot over control might be the effect of improvement in physic-chemical properties of soil which might have influenced the

Table 1: Plant height as influenced by different treatments at various stages of crop growth

Treatments	Plant height (cm)		No. of Branches/plant		Dry matter accumulation/plant (g)	
	2010	2011	2010	2011	2010	2011
Control	35.90	36.10	4.23	4.30	6.25	6.38
RDF-(20:50:40 kg N, P_2O_5, K_2O/ha)	42.93	43.10	5.72	5.88	9.17	9.33
75% RDF	40.77	40.97	4.61	4.71	7.98	8.05
75% RDF + Rhizobium	41.63	41.83	4.73	4.80	8.12	8.20
75% RDF + PSB	41.73	41.93	4.79	4.91	8.23	8.33
75% RDF + VAM	41.53	41.73	4.67	4.76	8.02	8.08
75% RDF + Rhizobium + PSB	42.27	42.50	5.04	5.10	8.73	8.83
75% RDF + Rhizobium + VAM	41.97	42.17	5.09	5.22	8.87	8.97
75% RDF + PSB + VAM	41.80	42.00	4.77	4.80	8.50	8.63
75% RDF+Rhizobium+PSB+VAM	42.43	42.63	5.52	5.70	9.05	9.18
SEm±	0.33	0.35	0.13	0.14	0.04	0.06
CD at 5%	1.00	1.05	0.38	0.43	0.14	0.18

RDF- Recommended dose of fertilizer, VAM- Vasicular Abuscular Mycorrhyza,
PSB-Phosphate solubilising bacteria.

Table 2: Number of nodules/plant, dry weight of nodules/plant (mg), nitrogen content in nodules and dry weight of root/plant (g) as influenced by different treatments at flowering stage.

Treatments	Nodules/ plant		Dry wt. of nodules /plant (mg)		Nitrogen content in nodule		Dry weight of root/ plant (g)	
	2010	2011	2010	2011	2010	2011	2010	2011
Control	65.00	69.00	16.22	16.78	0.24	0.26	0.11	0.15
RDF-(20:50:40 kg N, P_2O_5, K_2O/ha)	148.00	149.83	34.08	36.12	0.36	0.38	0.32	0.34
75% RDF	98.00	99.17	20.15	21.33	0.28	0.30	0.19	0.21
75% RDF + *Rhizobium*	117.00	119.17	27.12	30.00	0.30	0.32	0.21	0.27
75% RDF + PSB	105.67	110.00	23.08	25.33	0.29	0.31	0.23	0.23
75% RDF + VAM	102.00	103.83	22.52	23.17	0.27	0.30	0.21	0.23
75% RDF + *Rhizobium* + PSB	136.00	139.83	29.08	31.83	0.33	0.34	0.28	0.29
75% RDF + *Rhizobium* + VAM	127.00	134.00	29.92	30.92	0.32	0.33	0.27	0.29
75% RDF + PSB + VAM	114.33	117.67	26.42	27.28	0.31	0.31	0.26	0.27
75% RDF+*Rhizobium*+PSB+VAM	145.00	149.00	33.58	34.67	0.35	0.36	0.31	0.33
SEm±	2.16	1.83	0.22	0.82	0.006	0.01	0.01	0.01
CD at 5%	6.48	5.49	0.65	2.46	0.02	0.04	0.03	0.04

RDF- Recommended dose of fertilizer, VAM- Vasicular Abuscular Mycorrhyza, PSB-Phosphate solubilising bacteria.

Table 3: Pods/plant, pod length (cm), seeds/pod and test weight as influenced by different treatments at harvest stage.

Treatments	Pods/ plant		Pod length		Seeds/ pod		Test weight	
	2010	2011	2010	2011	2010	2011	2010	2011
Control	12.00	12.17	2.80	2.75	4.15	4.22	30.93	30.80
RDF-(20:50:40 kg N, P_2O_5, K_2O/ha)	19.50	19.77	3.90	4.15	6.35	6.47	35.07	35.00
75% RDF	14.50	14.63	3.02	3.13	4.60	4.80	32.60	32.47
75% RDF + *Rhizobium*	15.30	15.53	3.32	3.45	4.82	5.15	33.43	33.37
75% RDF + PSB	16.00	16.13	3.25	3.30	4.99	5.01	33.30	33.13
75% RDF + VAM	15.80	15.87	3.16	3.15	4.70	4.80	32.70	32.67
75% RDF + *Rhizobium* + PSB	18.00	18.23	3.75	3.86	5.65	5.77	34.35	34.30
75% RDF + *Rhizobium* + VAM	17.50	17.73	3.70	3.79	5.35	5.43	34.23	34.17
75% RDF + PSB + VAM	17.10	17.30	3.56	3.67	5.10	5.20	33.87	33.80
75% RDF + *Rhizobium* +PSB + VAM	19.10	19.40	3.80	4.10	6.21	6.36	34.90	34.87
SEm±	0.24	0.76	0.05	0.05	0.14	0.44	0.49	0.16
CD at 5%	0.73	0.25	0.16	0.15	0.41	0.15	0.16	0.49

RDF- Recommended dose of fertilizer, VAM- Vasicular Abuscular Mycorrhyza, PSB-Phosphate solubilising bacteria

microbial population. Similar findings were also reported by Singh and Parekh (2003) and Gupta and Sharma (2006).

Application of 100% RDF or 75% RDF + *Rhizobium* +PSB + VAM gave significantly higher values for number of root nodules/plant, dry weight of nodules/plant, nitrogen content in nodules and dry weight of roots/plant (Table-2) in black gram crop than other treatments during both the years. It may be due to beneficial effect of *Rhizobium,* PSB and VAM on growth parameters which affect the root growth and nodulation.

Number of pods/plant, pod length, number of grains/pod and test weight (Table-3) were increased significantly with the application of bio-fertilizers. It may be due to beneficial effect of *Rhizobium,* PSB and VAM on growth parameters which affect the yield attributing characters significantly. It also due to increased the nutrient and water uptake by plants resulted in to better growth and yield attributes. Similar findings are also reported by Ram *et al.* (2008) and Kumar and Sharma (2006).

The grain, straw and biological yields (Table-4) were significantly higher with the application of fertilizers and bio-fertilizers over absolute control in both the years. Application of recommended dose of fertilizer and 75% of RDF + *Rhizobium* + PSB + VAM increased the grain yield by 78.70 and 75.92 % and

Table 4: Biological, seed, straw yields (q/ha) and harvest index as influenced by different treatments at harvest stage

Treatments	Biological yield		Seed yield		Straw yield		Harvest index	
	2010	2011	2010	2011	2010	2011	2010	2011
Control	18.40	18.52	5.40	5.55	13.00	12.97	29.28	29.93
RDF-(20:50:40 kg N, P2O5, K2O/ha)	26.06	26.25	9.65	9.78	16.42	16.47	37.01	37.28
75% RDF	21.40	21.60	7.40	7.57	14.00	14.03	34.54	35.02
75% RDF + Rhizobium	22.20	22.33	7.80	7.97	14.40	14.37	35.12	35.69
75% RDF + PSB	21.90	22.00	7.65	7.73	14.25	14.27	34.93	35.16
75% RDF + VAM	21.70	21.77	7.40	7.43	14.30	14.33	34.06	34.12
75% RDF + Rhizobium + PSB	24.40	24.53	8.55	8.65	15.85	15.88	35.08	35.30
75% RDF + Rhizobium + VAM	24.20	24.38	8.30	8.40	15.90	15.98	34.32	34.48
75% RDF + PSB + VAM	24.05	24.18	8.10	8.22	15.95	15.96	33.70	34.02
75% RDF + Rhizobium +PSB + VAM	25.83	26.07	9.50	9.63	16.33	16.43	36.77	39.96
SEm±	0.29	0.20	0.20	0.18	0.18	0.13	0.60	0.58
CD at 5%	0.87	0.60	0.60	0.54	0.55	0.40	1.82	1.74

RDF- Recommended dose of fertilizer, VAM- Vasicular Abuscular Mycorrhyza, PSB-Phosphate solubilising bacteria

76.22 and 73.51 % over control during first and second year, respectively. Yield of crops depends on the pattern of nutrient supply during the growth cycle, vegetative and reproductive growth. As combination of inorganic and bio-fertilizers may ensure the optimum nutrient supply throughout the crop cycle. The vegetative as well as reproductive growth will proper and it has been evidenced by higher plant height, more branches and pods and higher test weight in those over the control. Collectively all these parameters are responsible for higher grain, straw and biological yields of black gram. Positive effect of inoculation on black gram has reported by Singh and Gupta (2006); Kide and Pathak (2008) and Dhyani *et al.* (2011).

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