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Response of different liquid biofertilizers and varying fertility levels together on nodules of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub]

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Abstract

A field experiment was conducted at research farm, RARI, Durgapura during two consecutive *kharif* seasons 2018 and 2019 to study the Effect of different liquid biofertilizers and varying fertility levels on growth, yield and quality of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub]. The experiment consists of twenty four treatment combinations consisting of three fertility levels (100% RDF, 75% RDF and 50% RDF) and eight liquid biofertilizers combination (control, Rhizobium, PSB, KMB, SSB, Rhizobium+PSB, Rhizobium+ PSB+ KMB and Rhizobium+ PSB+ KMB+ SSB), thereby making twenty four treatment combinations were replicated three times in randomized block design. Result showed that application of 100% NPKS proved significantly superior over 75% RDF and 50% RDF with respect to all quality parameters (gum content and protein content). Significantly higher gum content and protein content in seed were obtained in the combination of 100% NPKS with application of Rhizobium + PSB + KMB+SSB.

Keywords: Biofertilizers, maize, nitrogen, phosphorus, potassium

Introduction

Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub] or Guar is a drought tolerant legume of family Fabaceae (Leguminosae). It is grown for different purposes since ancient time *viz.*, vegetables, green fodder, green manure and for production of seeds. It is also cultivated for hay, silage and green manure (Grestaa *et al.* 2013) [4]. India contributes 80% to the global production of guar seed where it is grown on an area of 3.93 m ha, 1.62 m tonnes with a very low productivity of 413 kg/ha (NRAA, 2020) [7]. India is the leading exporter of guar seeds and guar gum. Today, this crop become the significant foreign exchange earners of our country. The major importing countries of Indian guar products are European Union, United States of America, China, United Kingdom, South Africa, and Japan. As a consequence, there has been a 75% jump in exports from India. Area, production and productivity of cluster bean in Rajasthan are 35.30 lakh hectare, 22.23 lakh tonnes and 398 Kg/ha respectively. Fungi, bacteria and cyanobacteria are the main source of biofertilizers. Fungi are non-green microorganisms; aside from making phosphorus available in the soil for plant uptake, they help to aggregate the soil structure. Cyanobacteria are symbiotically associated with Azolla and also known as blue-green algae. Species of blue green algae are Nostoc and Anabaena. Examples of fungal biofertilizers are Mycorrhiza, Fusarium species and Penicillium species. Examples of bacterial biofertilizers are Azotobacter, Azospirillum, Clostridium, Rhizobium, etc. A combination of biological and chemical sources of nitrogen seems to be cheap and impressive way of increasing production under limited resources (Ansari *et al.* 2015) [2]. Biofertilizers are applied as seed treatment or applied the soil. Biofertilizers in liquid formulation are easy to handle and applied @3-5 ml/kg seed just before sowing. Soil applied biofertilizers are mixed in compost or farm yard manure and kept it for over night and then incorporated in soil just before sowing. Now a days in addition to N, P and K fixing biofertilizer, liquid biofertilizers for sulphur, zinc and manganese are also available. These liquid biofertilizers are easy to handle and cost effective (Kumar *et al.* 2017) [5].

Materials and Methods

The field experiment entitled “Effect of different liquid biofertilizers and varying fertility levels on growth, yield and quality of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub]” was conducted during *Kharif* seasons of 2018 and 2019, at research farm of Rajasthan agricultural research institute, Durgapura (Jaipur). The details of experimental techniques adopted and criteria used for treatment evaluation during the entire course of investigation are described in this chapter.

For counting the number of root nodules per plant at 45 DAS, three plants in each plot were randomly selected in sampling rows and removed them carefully after wetting the soil and taking the soil upto 30 cm depth. The plants were removed with soil from the plot and the adhered soil was washed out with a fine jet of water. The nodules were removed with the help of forcep, counted and the mean of three plant nodules was recorded as number of nodules per plant.

- a. **Fresh and dry weight of nodules:** The total root nodules so obtained from the three plants from each plant were weighed for fresh weight and subjected to dried at 70°C till a constant weight is obtained. The weight was recorded and expressed as average dry weight of nodules in mg per plant.
- b. **Total number of effective nodules:** From five randomly selected plants the total number of effective nodules were counted at 45 DAS and averaged was worked out. The nodules which were pink, large sized and less bunched were separated and counted for considering total no. of effective nodules.

Result

Effect of fertility levels on effective root nodules

Increasing levels of RDF significantly improved the number of effective root nodules (No./plant) of cluster bean during both the years and in pooled data. The pooled data revealed

that 100% RDF increased the effective root nodules to the extent of 37.60 and 6.78 per cent over 50 and 75% RDF, respectively.

Effect of liquid biofertilizers on effective root nodules: It is apparent from data that application of different liquid biofertilizers significantly influenced the effective root nodules of cluster bean. The highest effective root nodules was noted in *Rhizobium* + PSB + KMB + SSB treatment which was at par with *Rhizobium* + PSB and *Rhizobium* + PSB + KMB. The treatments *Rhizobium*, PSB and KMB were also statistically at par with each other. The per cent increase in effective root nodules due to *Rhizobium* + PSB + KMB + SSB was 25.00 per cent over control on pooled mean basis.

Effect of fertility levels on nodule dry weight

Data indicated that nodule dry weight (g/ plant) increased significantly upto application of 100% RDF at all the growth stages during both years as well as in pooled data and represented an increase of 35.59 and 7.35 per cent over 50% RDF and 75% RDF on pooled basis.

Effect of liquid biofertilizers on nodule dry weight

A perusal of data revealed that various liquid biofertilizers had significant influence on the nodule dry weight (g/ plant) recorded at all the stages during both the years and in pooled analysis. The pooled mean indicated that *Rhizobium* + PSB + KMB + SSB significantly higher nodule dry weight over other liquid biofertilizer treatments which were at par with *Rhizobium* + PSB and *Rhizobium* + PSB + KMB. The increase in nodule dry weight on pooled basis due to application of *Rhizobium* + PSB + KMB + SSB was 24.94, 11.98, 15.30, 15.26, 21.95 per cent over control, *Rhizobium*, PSB, KMB and SSB, respectively.

Table 1: Effect of different liquid biofertilizers and varying fertility levels on effective root nodule per plant and nodule dry weight at 45 DAS of cluster bean

Treatments	Effective root nodule/ plant (No./plant)			Nodule dry weight (g/ plant)		
	2018	2019	Pooled	2018	2019	Pooled
Fertility levels						
100% RDF	19.41	20.54	19.98	25.25	25.27	25.26
75% RDF	18.13	19.28	18.71	23.21	23.85	23.53
50% RDF	14.06	14.97	14.52	18.66	18.60	18.63
SEm +	0.24	0.22	0.16	0.33	0.35	0.24
CD (P = 0.05)	0.68	0.64	0.46	0.93	1.01	0.68
Liquid biofertilizers						
Control	15.37	16.39	15.88	19.82	20.12	19.97
<i>Rhizobium</i>	16.63	18.23	17.43	22.31	22.25	22.28
PSB	16.95	17.99	17.47	21.39	21.88	21.64
KMB	16.57	17.73	17.15	21.36	21.81	21.59
SSB	15.47	16.55	16.01	20.29	20.62	20.46
<i>Rhizobium</i> + PSB	18.53	19.75	19.14	24.48	24.56	24.52
<i>Rhizobium</i> + PSB+ KMB	18.88	18.99	18.94	24.59	24.20	24.40
<i>Rhizobium</i> + PSB+ KMB + SSB	19.21	20.49	19.85	24.75	25.15	24.95
SEm ±	0.39	0.37	0.27	0.53	0.58	0.39
CD (P = 0.05)	1.10	1.04	0.75	1.51	1.64	1.10
CV (%)	6.77	6.02	6.39	7.13	7.67	7.41

Discussion

It is evident from results that application of liquid biofertilizers recorded significant increase in the numbers of effective root nodules per plant and nodules dry weight at 45 DAS. The application of *Rhizobium* + PSB was found equally

effective to *Rhizobium* + PSB + KMB and *Rhizobium* + PSB + KMB + SSB in enhancing the effective root nodules per plant and nodules dry weight at 45 DAS. The reasons for better growth and development under these treatments might be due to increased availability of nutrients to plant initially

through chemical fertilizers and laterally by biofertilizers. The effect of this improvement ultimately led to production of higher biomass by plant at successive crop growth stages and at harvest. The increase in nodulation might be due to synergistic effect of two types of microorganism for biological nitrogen fixation as against their individual application. Biofertilizers are microbial inoculants which contain living cell of efficient nitrogen fixing microorganism, which fix atmospheric nitrogen either free living or symbiotically with host plant. Phosphate solubilising/mobilizing microorganism as well as potassium mobilizers mobilize/release P_2O_5 and K_2O from soil. Rhizobium belongs to bacterial group and the classical example is symbiotic nitrogen fixation. The bacteria infect the root and form root nodule within which they reduce nitrogen to ammonia which is readily utilized by the plant to produce valuable protein, vitamins and other nitrogen containing compound. The percentage of nodule occupied, nodule dry weight and seed yield in plant by the multi strain inoculants was highly promising. Similar results reported by Akhtar *et al.* (2012)^[1], Tagore *et al.* (2013)^[8], Maheswari and Elakkiya (2014)^[6], Chogatapur and Chandranath (2017)^[3] and Venkatarao *et al.* (2017)^[9] also corroborates the similar findings.

Conclusion

On the basis of two-year experimentation, it may be concluded that fertility level of 100% RDF recorded highest effective root nodules and nodule dry weight which was closely followed by 75% RDF. Application of Rhizobium + PSB + KMB+SSB was found most suitable liquid biofertilizers combination. Therefore, the combination of 75% RDF (N:P:K:S-15:30:15:15) along with Rhizobium + PSB + KMB+SSB is recommended for higher cluster bean crop production in semi arid eastern plain zone (IIIa) of Rajasthan.

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