

Effect of fertility level and biofertilizers on seed yield and quality of cluster bean

B. M. Kalalbandi^{1*}, A. S. Lohakare² and P. N. Nanaware³

College of Horticulture, Vasantao Naik Marathwada Krishi Vidyapeeth, Parbhani

^{1,2}Assistant Professor, College of Horticulture, VNMKV, Parbhani 431 402 (MS)

³M.Sc. (Hort) Student, Department of Horticulture, VNMKV, Parbhani.

*Corresponding author email: kbaslingappa@yahoo.com

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Abstract

The field investigation was conducted to study the effect of fertility level and biofertilizers on seed yield and quality of cluster bean. On the basis of investigation, it was concluded that application of fertilizer level at 25:50 kg N:P/ha (F₃) found to be beneficial in recording seed yield and quality of cluster bean. As regard to the biofertilizers, application of rhizobium and PSB in combination was found to be beneficial in producing highest seed yield, straw yield and improved its quality *i.e.* gum content and viscosity profile as compared to rest of treatments. The interaction effect of fertility level and biofertilisers was significant for straw yield and biological yield.

Key words: *Guar gum, PSB, Rhizobium, and viscosity*

Introduction

Cluster bean (*Cyamopsis tetragonoloba* (L.) Taub) is commonly known as multipurpose, annual, legume vegetable. India is considered to be the centre of origin of cluster bean. India stands first in area and production *i.e.* 80% of total world (Anonymous, 2012). Seeds contain gum like mucilaginous substance called 'GUAR GUM' or galactomannan. It has various industrial applications due to some unique characteristics like grease resistant, thickening agent, capacity to bind water and high viscosity and functioning in low temperature. Due to which, it is used in multifarious, cosmetics, explosive, oil and mining industry, textile paper industries and also in dairy products like ice-cream, stabilizer in cheese. It is used as a glaze in candy products and in baking industry, (Raghu *et al*, 2008).

Materials and Methods

A field experiment was conducted at the field of Department of Horticulture, Vasantao Naik Marathwada Krishi Vidyapeeth, Parbhani during summer season of 2013-2014. The experiment was laid out in factorial randomised block design with three replication comprising three level of fertility [15:30 (F₁), 20:40 (F₂), 25:50 (F₃) kg N:P/ha] and four level of biofertilizers [control (B₀), Rhizobium (B₁), PSB (B₂), Rhizobium + PSB (B₃)] thereby involving twelve treatment combinations (table1) on cluster bean variety RGC- 936. The gross plot size was 3.6 m x 4.6 m and net plot size 2.7 m x 3.6 m, respectively.

Table 1. Details of treatment combination

Sr. No.	Treatment Details	
	Fertility level	Biofertilizers
T ₁	15:30 N:P kg/ha	[Control]
T ₂	15:30 N:P kg/ha	Rhizobium
T ₃	15:30 N:P kg/ha	PSB
T ₄	15:30 N:P kg/ha	Rhizobium + PSB
T ₅	20:40 N:P kg/ha	[Control]
T ₆	20:40 N:P kg/ha	Rhizobium
T ₇	20:40 N:P kg/ha	PSB
T ₈	20:40 N:P kg/ha	Rhizobium + PSB
T ₉	25:50 N:P kg/ha	[Control]
T ₁₀	25:50 N:P kg/ha	Rhizobium
T ₁₁	25:50 N:P kg/ha	PSB
T ₁₂	25:50 N:P kg/ha	Rhizobium + PSB

The weight of 1000 seed from each net plot was measured as the seed index expressed in grams. Five plants are taken for measuring seed yield per plant expressed in grams. At harvesting the threshing of plant of particular plots seed weighted and expressed in grams. Seed yield per hectare was calculated from seed yield per plot separately as for particular treatment, and expressed in kg per hectare. The harvested produce of each net plot was weight of produce was recorded as biological yield per net plot which was converted to in hectare basis, and expressed in kg per hectare. Straw yield was recorded by deducting the grain weight from the weight of total biological yield of respective net plot and also converted in to hectare basis. The guar gum or galactomanon have been isolated and purified by wet processing method at laboratory scale. The mature grains of cluster bean were cleaned and boiled in 2% alkali solution i. e. NaOH at 100⁰ C for 5-10 min to remove husk or hull portion. This was followed by washing the seed in running water, and neutralized with dilute acid (HCl) and again washing with water. Husk was removed and dried for night over. The grains were then pulverized to get gum splits. The splits were converted into powder known as crude gum. The crude gum was suspended in aqueous solution of iso-propanol and resultant precipitate was centrifuged at 5000 x for 15 min. The purified gum was vaccum dried and pulverized to 200-mesh size (Rodge *et al*, 2006). After extraction of gum (galactomanon), the viscosity profile was measured by "Brookfield's Viscometer" in laboratory.

Results and Discussion

The maximum 1000 seed weight (32.83 g) was recorded in treatment F₃ where 25:50 kg N:P/ha was applied, and which was at par with treatment F₂ (32.21) where fertilizer dose applied at 20:40 kg N:P/ha. The results are in agreement with Reddy and Reddy (2011) in cluster bean. The maximum 1000 seed weight (33.52 g) was recorded with application of both rhizobium and PSB. The treatment B₂ (PSB) and B₁ (rhizobium) are at par with each other. Jitender kumar (2011) was given similar type of result in pigeon pea. The interaction effect of fertility level and biofertilizers on seed index was found to be non-significant.

The maximum seed yield per plant (4.76 g) was observed with application of 25:50 kg N:P/ha. The treatments F₃ and F₂ were significantly superior over treatment F₁ (3.56 g) where fertilizer dose was applied 15:30 kg N:P/ha. This result was in confirmation with Yadav *et al* (2012) in cluster bean. Whereas the maximum seed yield per plant (4.81g) was recorded with application of rhizobium + PSB, which was significantly superior over B₀ (3.71g) where no bio-fertilizers were used. The treatments B₁

(rhizobium) and B₂ (PSB) were at par with each others. The interaction effect of fertility level and biofertilizers on seed yield per plant was found non-significant.

The application of fertilizer dose at 25:50 kg N:P/ha produced maximum seed yield per hectare (792.31 kg/ha), which was at par with treatment F₂ (701.95 kg/ha). The present findings are in accordance with results of Saxena and Verma (1995) and Reddy and Reddy (2011) in cluster bean. Similarly the biofertilizers significantly influenced the seed yield per hectare. The treatment B₃ (rhizobium + PSB) recorded maximum seed yield per hectare (800.48 kg/ha) over all other treatments. The application of rhizobium and PSB were at par with each other. Kumpawat (2006) reported similar results in cluster bean. The interaction effect between fertility level and biofertilizers for seed yield per hectare was found to be significant. The maximum seed yield per hectare (902.63 kg/ha) was observed in treatment F₃B₃ (25:50 kg N:P/ha + rhizobium + PSB). While minimum was observed in treatment F₁B₀. The result shown that, seed yield per hectare decreased with reduced fertility levels. Similar results were recorded by Patel *et al* (2009) in cluster bean.

The maximum straw yield per hectare was recorded with treatment F₃ (1635.41 kg/ha) where the fertilizer dose was applied at 25:50 kg N:P /ha, which was at par with treatment F₂ (1516.13 kg/ha) in which fertilizer dose was applied at 20:40 kg N:P/ha. Kumawat *et al* (2006) in cluster bean also found similar results supports present findings. Application of biofertilizers significantly influenced the straw yield per hectare. The maximum straw yield per hectare was obtained in treatment B₃ (1701.72 kg/ha) where both rhizobium and PSB were used for seed inoculation of crop over rest of biofertilizer treatments under study. The treatment B₂ (PSB) and B₁ (rhizobium) were statistically at par with each other. Similar results were reported by Meena *et al* (2003) in cluster bean. The interaction effect between fertility level and biofertilizers was found significant for straw yield per hectare. The maximum straw yield per hectare (1824.69 kg/ha) was recorded in treatment F₃B₃ (25:50 kg N:P/ha + rhizobium + PSB). The minimum straw yield per hectare (1197.46 kg/ha) was found in treatment F₁ B₀ (15:30 kg N:P/ha.). Present result was in close proximity with result of Tanwar *et al* (2003) in black gram.

The biological yield per hectare was found maximum in treatment F₃ (2406.12 kg/ha) where the fertilizer dose was applied at 25:50 kg N:P per hectare. The treatment F₃ was at par with treatment F₂ (2198.96 kg/ha). Meena *et al* (2003) reported similar results in cluster bean. The maximum biological yield was recorded in treatment B₃ (2480.40 kg/ha) where both rhizobium and PSB was used. The treatment B₁ (rhizobium) was at par with treatment B₂

(PSB). These results are on similar track with Sammauria *et al* (2009) in cluster bean. The interaction effect between fertility levels and biofertilizers for biological yield were found significant. The maximum biological yield was found in treatment F₃B₃ (2702.73 kg/ha). The minimum biological yield (1704.52 kg/ha) was observed in treatment F₁B₀ where fertilizer dose applied at 15:30 kg N:P/ha with no use of any biofertilizers.

The maximum gum content (28.29 %) was recorded in treatment F₃ (25:50 kg N:P/ha), which was at par with treatment F₂ (27.97%). These findings are in accordance with Ramawtar *et al* (2013) in cluster bean. The data revealed that the maximum gum content (28.84 %) was recorded in treatment B₃ where both rhizobium + PSB were used. The treatment B₂ (27.95 %) and B₁ (27.60 %) were at

par with each others. Similar results are found by Rathore *et al* (2007) in cluster bean. The interaction effect of fertility level and biofertilizer on gum content of cluster bean seed was found to be non-significant.

The viscosity profile of gum refers to the quality guar gum, which was influenced by application of fertility level. The maximum viscosity of gum (3251.99 cp) found with treatment F₃ (25:50 kg N:P/ha). The maximum viscosity profile (3228.59 cp) was recorded in treatment B₃ (rhizobium + PSB). The treatments B₃, B₂ and B₁ were significantly superior over treatment B₀ (3132.47 cp) where any biofertilizer was not used. The interaction effect of fertility level and biofertilizer on viscosity of gum of cluster bean seed was found to be non-significant.

Table 2. Seed yield and quality of cluster bean as influenced by fertility level and biofertilizers

FXB	1000 Seed weight (g)	Seed yield (g/plant)	Seed yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Gum content (%)	Viscosity profile of gum (cp)
Fertility level (F)							
F ₁	29.63	3.56	592.04	1364.49	1940.40	26.60	3099.93
F ₂	32.21	4.22	701.95	1516.13	2198.96	27.97	3178.98
F ₃	32.83	4.76	792.30	1635.41	2406.12	28.28	3251.99
SEm +	0.52	0.22	32.94	42.02	85.84	0.41	50.09
CD (at 5%)	1.52	0.64	95.76	122.85	254.10	1.20	148.52
Biofertilizers (B)							
B ₀	28.61	3.71	618.41	1298.82	1900.38	26.06	3132.47
B ₁	31.34	4.01	667.25	1450.66	2099.74	27.60	3150.66
B ₂	32.95	4.18	695.57	1570.17	2246.79	27.95	3196.13
B ₃	33.32	4.81	800.48	1701.72	2480.40	28.84	3228.59
SEm +	0.59	0.24	36.89	48.52	90.34	0.49	52.01
CD (at 5%)	1.76	0.71	107.39	142.31	266.78	1.43	154.27

Table 3. Seed yield and quality of cluster bean as influenced by interaction effect of fertility level and biofertilizers

(FXB)	1000 Seed weight (g)	Seed yield (g/plant)	Seed yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Gum content (%)	Viscosity of gum (cp)
F ₁ x B ₀	26.54	3.13	521.26	1197.46	1704.52	25.13	3062.7
F ₁ x B ₁	29.40	3.36	559.56	1287.27	1831.59	26.74	3077.35
F ₁ x B ₂	31.08	3.53	587.87	1402.91	1974.77	27.02	3114.35
F ₁ x B ₃	31.5	4.20	699.45	1570.31	2250.71	27.5	3145.7
F ₂ x B ₀	29.24	3.83	632.84	1305.76	1921.36	26.39	3125.73
F ₂ x B ₁	32.03	4.06	676.14	1457.76	2115.48	27.83	3162.54
F ₂ x B ₂	33.65	4.22	699.45	1590.86	2271.26	28.44	3200.2
F ₂ x B ₃	33.93	4.81	799.37	1710.15	2487.75	29.21	3227.5
F ₃ x B ₀	30.06	4.21	701.12	1393.24	2075.26	26.66	3209.02
F ₃ x B ₁	32.58	4.60	766.07	1606.96	2352.16	28.24	3212.1
F ₃ x B ₂	34.13	4.80	799.37	1716.74	2494.34	28.38	3274.1
F ₃ x B ₃	34.54	5.42	902.63	1824.69	2702.73	29.82	3312.58
SEm +	1.02	0.45	65.87	84.02	169.68	0.82	101.2
CD (at 5%)	NS	NS	191.51	245.05	498.96	2.41	292.03

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