Chemical Science Review and Letters ISSN 2278-6783

Research Article

Soil Properties and Economics Influenced by Different Varieties of Clusterbean [*Cyamopsis Tetragonoloba* (L.) Taub.] Along With Different Biofertilizers

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Abstract

The present investigation entitled **"**Soil Properties and Economics influenced by different varieties of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] along with different biofertilizers**"** was carried out during the summer season of the year 2014 in the open field at the Horticulture Instructional Farm, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. In this investigation total twelve treatment combinations comprising six varieties viz., Pusa Navbahar, RGC 1031, Goma Manjari, Thar Bhadvi, Guar Kranti and Kanchan Bahar with two biofertilizers viz., *Rhizobium* and PSB were tested in the Factorial Randomized Block Design with four replications. Significantly higher nitrogen estimation in soil after harvesting was observed by biofertilizer *Rhizobium* (b_1), whereas, higher phosphorus estimation in soil after harvesting was observed with biofertilizer PSB (b_2). With regards to economics, maximum gross return, net return and cost: benefit ratio was noticed under treatment combination of v_1b_2 *i.e.* variety Pusa Navbahar (v_1) with biofertilizer PSB (b_2).

Keywords: Cluster bean, Economics, Varieties, Bio-fertilizers

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Introduction

Cluster bean is an important *kharif* and summer season grain legume ideally suited for semi-arid and arid regions. The term '*guar*' derived from Sanskrit word "go or gay" which means the cow, broadly "*gau ahar*" means, food for the cattle/ animal. The crop is grown for various purpose viz. vegetable, green manure and seed. It is an erect annual growing plant; grow to a height of 2 m with stiff erect branches stems are angled, leaves trifoliate, ovate and serrate. The white or pink coloured flowers are small and borne on axillary raceme. Pods are compressed, linear, erect and clustered, double ridge on dorsal side, single ridge below, length 4-10 cm, 5-12 seeds per pod with white to grey or black in colour.

In India, it is cultivated mainly in Rajasthan, Gujarat, Punjab, Haryana, Uttar Pradesh, and Maharashtra. The cultivated area under *guar* in Gujarat is 39.77 thousand ha and average production of guar in Gujarat is 354.48 thousand M.T. In Gujarat, is cultivated in almost whole state. Area under cultivation of cluster bean in the district of Banaskantha is only 5518 ha with the production of 69580 M.T. [1].

Organic farming strategy is growing rapidly all over the world to conserve human health and the environment. Biofertilizers are formulations of beneficial microorganisms, which upon application can increase the availability of nutrients by their biological activity and help to improve the soil health. Biofertilizers are low cost, effective and renewable source of plant nutrients to supplement chemical fertilizers [2]. Bio-fertilizers play a vital role in maintaining long term fertility and sustainability. It may increase yield of crop by 10 -30 per cent [3].

Biofertilizers play an important role in increasing availability of nitrogen and phosphorus. They increase the biological fixation of atmospheric nitrogen and enhance phosphorus availability to the crop. The seeds treated with bacterial culture of *Rhizobium* increase nodulation and influence yield as well as economize the input cost of fertilizer to some extent. It also renders protection against soil deterioration and environmental pollution caused by heavy use of chemical fertilizers. The efficient strain of *Rhizobium* can fix about 90 kg of nitrogen per hectare in one season and enrich soil nitrogen.

Evaluation of the role of biofertilizers including *Rhizobium* and PSB (Phosphate Solubilizing Bacteria) to harness their effect in enhancing crop yields will be a challenging task. Bio fertilizers have become essential because of increasing cost of chemical fertilizer and their adverse effect on the soil health.

Keeping into consideration of above facts in mind the experiment entitled "Soil Properties and Economics influenced by different varieties of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] along with different biofertilizers" was planned with the objective to study the effect of varieties and biofertilizers on soil parameters and to work out the economics of the different combinations.

Materials and Methods

The investigation entitled "Soil Properties and Economics influenced by different varieties of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] along with different biofertilizers" was under taken during summer season of the year 2014 under field condition at Horticulture Instructional Farm, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar, Dist. Banaskantha, Gujarat.

Physico-Chemical Properties of Soil

The experimental field was even topography with gentle slope and good drainage for determination of the physico-chemical properties of experimental plot. Soil samples were drawn zig-zag method before commencement of the experiment from different spots in the field at a depth of 15-30 cm and a composite sample was prepared and analyzed for physical and chemical properties. The results obtained are presented in given **Table 1**.

Table 1 Physico-chemical properties of the experimental soil

Sr. No.	Properties	Soil depth (15-30cm)	Method employed
[A]	**Physical**		
	(a) Course Sand (%)	46.68	International Pipette method [4]
	(b) Fine Sand (%)	40.66	
	(c) Silt (%)	7.34	
	(d) Clay (%)	5.32	
	(e) Textural class	Loamy sand	
[B]	**Chemical**		
	(a) Soil pH (1:2.5, soil: water ratio)	7.66	Potentiometric method [5]
	(b) Electrical conductivity (dSm^{-1}) (1:2.5, soil: water ratio)	0.16	Schofield method [5]
	(c) Organic carbon (%)	0.21	Walklely and Black's rapid titration method [5]
	(d) Available N ($Kg\ ha^{-1}$)	215	Alkaline permanganate method [6]
	(e) Available P_2O_5 ($Kg\ ha^{-1}$)	37.11	Olsen method [5]
	(f) Available K_2O ($Kg\ ha^{-1}$)	185	Flame photometer method [5]

Experimental Details

The experiment was carried out in open field at Horticulture Instructional Farm, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (Gujarat).

Treatment particulars

Present experiment was laid out in Factorial Randomized Block Design keeping two factor *viz*., varieties and biofertilizers, the first factor with six varieties and second factor *i.e.* biofertilizers with two levels. Thus making twelve treatment combinations.

Treatment details

Factor – I
[a] Varieties (V)

Sr.No.	Name of variety	Notation
1	Pusa Navbahar	v_1
2	RGC 1031	v_2
3	Goma Manjari	v_3
4	Thar Bhadvi	v_4
5	Guar Kranti	v_5
6	Kanchan Bahar	v_6

[b] Bio-fertilizers (B)

- *Rhizobium* culture - b_1
- PSB (Phosphate solubilizing bacteria) - b_2

Note: Seeds were treated with *Rhizobium* culture and PSB @ 25 g per kg of seed before sowing.

Treatment Combinations

Therefore, making total twelve treatment combinations, which are given in **Table 2**.

Table 2 Treatment combinations

Sr. No.	Treatment No.	Treatment Combinations	Treatment detail
1	T_1	v_1b_1	Pusa Navbahar treated with *Rhizobium* culture
2	T_2	v_1b_2	Pusa Navbahar treated with PSB
3	T_3	v_2b_1	RGC 1031 treated with *Rhizobium* culture
4	T_4	v_2b_2	RGC 1031 treated with PSB
5	T_5	v_3b_1	Goma Manjari treated with *Rhizobium* culture
6	T_6	v_3b_2	Goma Manjari treated with PSB
7	T_7	v_4b_1	Thar Bhadvi treated with *Rhizobium* culture
8	T_8	v_4b_2	Thar Bhadvi treated with PSB
9	T_9	v_5b_1	Guar Kranti treated with *Rhizobium* culture
10	T_{10}	v_5b_2	Guar Kranti treated with PSB
11	T_{11}	v_6b_1	Kanchan Bahar treated with *Rhizobium* culture
12	T_{12}	v_6b_2	Kanchan Bahar treated with PSB

Layout of Experimental Plot

Experiment was executed with randomised block design with factorial concept.

Soil Analysis

N and P content in soil before sowing crop

To assess the chemical properties of soil at sowing, the representative soil sample (0-30 cm depth) from eight spots of experimental area was collected, composited and air dried. The samples were powered using a wooden morter and pestle and passed through 2 mm plastic sieve to avoid metallic contamination. The soil samples were analyzed for available nitrogen and phosphorus.

N and P content in soil after harvesting of crop

To assess the chemical properties of soil at harvest, the representative soil sample (0-30 cm depth) from three spots of net plot of each treatment at harvest of crop was collected, composited and air dried. The samples were powered using a wooden mortar and pestle and passed through 2 mm plastic sieve to avoid metallic contamination. The soil samples were analyzed for available nitrogen and phosphorus.

Economics

In order to evaluate the effectiveness of each individual treatment, the relative economics of each treatment

combinations was worked out in terms of net profit to find out the most effective and remunerative treatment combination.

The gross realization in terms of rupees per hectare was worked out on the basis of the yield for each treatment and the price of the produce prevailing in the market. The cost of cultivation of treatments was calculated considering the current rate of agricultural operations and market price of input involved. The total cost of cultivation was subtracted from the gross realization to obtain net realization. Cost Benefit Ratio (CBR) was worked out as follows.

$$CBR = \frac{\text{Gross realization (₹/ ha)}}{\text{Cost of cultivation (₹ / ha)}}$$

Statistical Analysis

The data collected for all the characters were subjected to statistical analysis by adopting 'Analysis of Variance' techniques [7]. Randomized Block Design with Factorial concept was used as method of analysis for experimental data. The appropriate standard error of mean (S.Em ±) was computed in each case. For the treatment effects which were found significant, the critical difference (C.D) at 5 % level of probability was worked out to compare the treatments. Coefficient of variation per cent was worked out for all the characters.

Result and Discussion

Response of varieties and biofertilizers on soil properties

The observations on nitrogen and phosphorus estimation in soil before and after harvesting (kg ha^{-1}) were recorded and presented as under.

Response of varieties and biofertilizers on nitrogen estimation in soil before and after harvesting (kg ha^{-1})

Data presented in **Table 3** revealed that nitrogen estimation in soil after harvesting was significantly influenced by biofertilizers, whereas varieties and interaction effect of both was found not significant.

Data clearly indicated that the biofertilizers exerted significant influence on nitrogen estimation. Significantly higher nitrogen estimation in soil after harvesting (219.96 kg ha^{-1}) was observed by the treatment *Rhizobium* (b_1). While lower nitrogen estimation in soil after harvesting (217.02 kg ha^{-1}) was recorded with treatment PSB (b_2).

Rhizobium inoculation significantly increased the available N and available P_2O_5, respectively after harvest of the clusterbean. Increase in available N and P_2O_5 status of soil after harvest may be due to continuous symbiotic fixation of nitrogen by *Rhizobium* through organic acids and reducing the soil pH [8-10].

Table 3 Response of varieties and biofertilizers on nitrogen estimation in soil before and after harvesting (kg ha^{-1})

Before 215.89 **After**			
Varieties (V)	**Biofertilizers (B)**		**Mean**
	***Rhizobium* (b_1)**	**PSB (b_2)**	
Pusa Navbahar (v_1)	220.74	217.26	219.00
RGC 1031 (v_2)	219.36	217.07	218.22
Goma Manjari (v_3)	220.64	216.73	218.69
Thar Bhadvi (v_4)	220.10	217.08	218.59
Guar Kranti (v_5)	219.69	216.55	218.12
Kanchan Bahar (v_6)	219.22	217.45	218.34
Mean	219.96	217.02	
	Varieties (V)	**Biofertilizers (B)**	**Interaction (V x B)**
S.Em.±	0.79	0.45	1.11
C.D. at 5%	NS	1.31	NS
C.V.%	1.02		

Response of varieties and biofertilizers on phosphorus estimation in soil before and after harvesting (kg ha^{-1})

Data presented in **Table 4** revealed that phosphorus estimation in soil after harvesting was significantly influenced by biofertilizers, whereas varieties and their interaction with biofertilizers was found not significant.

Results present in Table 4 showed that the different biofertilizers exerted significant influence on phosphorus estimation. Significantly higher phosphorus estimation in soil after harvesting (39.02 kg ha^{-1}) was observed with biofertilizer PSB (b_2) over biofertilizer (37.73 kg ha^{-1}) *Rhizobium* (b_1).

Application of PSB recorded maximum soil available phosphorus after harvest of cluster bean over their initial levels. The available phosphorus content of soil in plots treated with the inoculation of PSB improved significantly over inoculated with *Rhizobium* which may be attributed to the solubilization of insoluble phosphate into available phosphate in the soil by the PSB [8-10].

Table 4 Response of varieties and biofertilizers on phosphorus estimation in soil before and after harvesting (kg ha^{-1})

Before			
37.26			
After			
Varieties (V)	**Biofertilizers (B)**		**Mean**
	***Rhizobium* (b_1)**	**PSB (b_2)**	
Pusa Navbahar (v_1)	38.28	40.01	39.15
RGC 1031 (v_2)	37.11	38.76	37.93
Goma Manjari (v_3)	37.78	38.88	38.33
Thar Bhadvi (v_4)	37.90	39.35	38.62
Guar Kranti (v_5)	37.73	38.54	38.13
Kanchan Bahar (v_6)	37.56	38.58	38.07
Mean	37.73	39.02	
	Varieties (V)	**Biofertilizers (B)**	**Interaction (V x B)**
S.Em.±	0.36	0.21	0.51
C.D. at 5%	NS	0.59	NS
C.V.%	2.63		

Response of varieties and biofertilizers on economics

The economics indicating cost of cultivation, gross return, net return and cost: benefit ratio under various levels of varieties and biofertilizers are furnished in **Table 5**.

The results in Table 5, revealed that among the twelve treatment combinations, v_1b_2 (variety Pusa Navbahar with biofertilizer PSB) recorded maximum gross return of ₹ 343780 ha^{-1}, net return of ₹ 277830 ha^{-1} and cost: benefit ratio *i.e*. 5.21. Whereas, treatment combination v_2b_1 (variety RGC 1031 with biofertilizer *Rhizobium*) recorded minimum gross return of ₹ 91240 ha^{-1}, net return of ₹ 38590 ha^{-1} and cost: benefit ratio *i.e.*1.73.

Table 5 Economics as influenced by different treatment combinations

Treat. No.	Yield (kg) per hectare	Gross return ₹/ha	Cost of cultivation ₹/ha	Net return ₹/ha	C:B Ratio
v_1b_1	15777	315540	64150	251390	1:4.92
v_1b_2	17189	343780	65950	277830	1:5.21
v_2b_1	4562	91240	52650	38590	1:1.73
v_2b_2	5616	112320	52650	59670	1:2.13
v_3b_1	10820	216400	57750	158650	1:3.75
v_3b_2	11766	235320	59550	175770	1:3.95
v_4b_1	12994	259880	61850	198030	1:4.20
v_4b_2	15303	306060	63650	242410	1:4.81
v_5b_1	6119	122380	54450	67930	1:2.25
v_5b_2	8539	170780	54450	116330	1:3.14
v_6b_1	9104	182080	59050	123030	1:3.08
v_6b_2	9338	186760	59050	127710	1:3.16
Selling price of pod: ₹ 20/kg, Seed rate: 25kg/ha					

The treatment combinations of v_1b_2 (variety Pusa Navbahar with biofertilizer PSB) resulted in the maximum gross return, net return and cost: benefit ratio. The interaction between v_1b_2 (variety Pusa Navbahar with biofertilizer PSB) beneficial for economic return to catch early market [11].

General view of field experimental plot

Conclusion

The experimental evidences warrant the following specific conclusion which may be adopted for profitable cultivation of clusterbean during summer season.

Among the different varieties tested, better soil and net profitable income of clusterbean for vegetable purpose, variety Pusa Navbahar proved superior. Among biofertilizers, PSB was found better over *Rhizobium* in soil and economic parameters to catch good market under North Gujarat region.

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Publication History
Received 26th Mar 2017
Revised 14th Apr 2017
Accepted 15th Apr 2017
Online 30th Apr 2017