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Dhananjay Kumar

Department of Agronomy, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan, India

Devi Lal Dhaker

Department of Agronomy, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan, India

OP Sharma

Department of Agronomy, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan, India

Nisha

Department of Agronomy, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan, India

Corresponding Author:

Dhananjay Kumar

Department of Agronomy, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan, India

Effect of nutrient management on growth and yield of clusterbean [*Cyamopsis tetragonoloba* (L). Taub.]

Dhananjay Kumar, Devi Lal Dhaker, OP Sharma and Nisha

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Abstract

A field experiment conducted at Research Farm, School of Agriculture, Suresh Gyan Vihar University, Jaipur (Rajasthan). The experiment was laid out in randomized block design with three replications. The treatments consisting ten levels of nutrients (T₁) Control, (T₂) 50% RDF, (T₃) 75% RDF, (T₄) 100% RDF, (T₅) Rhizobium, (T₆) Phosphorus solubilizing bacteria, (T₇) Rhizobium + PSB, (T₈) 50% RDF + Rhizobium, (T₉) 50% RDF + PSB and (T₁₀) 50% RDF + Rhizobium + PSB. The clusterbean variety used for study was RGC-1055.

The experimental results showed that application of (T₁₀) 50% RDF + Rhizobium + PSB produced significantly highest plant height and dry matter accumulation at 60 DAS and at harvest, number of branches plant⁻¹, chlorophyll content, number of pods plant⁻¹, number of seeds pod⁻¹, seed yield, straw yield and biological yield, net returns and B: C ratio of clusterbean over (T₁) control. Same trend was also observed for nitrogen, phosphorus and potassium content in seed and straw, their uptake and protein content in seed of clusterbean. While, different levels of nutrient management were failed to cause significantly variation on plant stand at 30 DAS and at harvest, plant height and dry matter accumulation at 30 DAS, 60 DAS and at harvest, test weight and harvest index of clusterbean.

Keywords: Clusterbean, rhizobium, RDF, PSB, growth and yield

Introduction

Clusterbean also known as guar belongs to the legume family. It is widely cultivated in arid and semi-arid regions around the world having deep-rooted systems. Among pulses crops clusterbean has a special contribution. It is a highly drought-resistant crop. It grows therefore easily in semi-arid regions Lal *et al.* (2020) [7]. Its seeds have an endosperm that roughly contains 30–33% gum and 18–28% protein, 32% fiber. India is the world's top producer of clusterbean seed, accounting for around 75–80% of global guar output. Clusterbean is a highly resilient and drought-tolerant crop.

It can fix 37-196 kg of atmospheric nitrogen/ha/year in soil. It is occasionally employed in the reclamation of saline and alkaline soils reported by Mahata *et al.* (2009) [8]. Rhizobium is a soil bacteria that fix nitrogen. Rhizobium species form an *f* nitrogen-fixing association with the roots of legumes and other flowering plants. Phosphate solubilizing bacteria (PSB) are beneficial bacteria becoming solubilized inorganic phosphorus from insoluble compounds. The *p*-solubilization ability of rhizosphere microorganisms was considered to be one of the most important traits associated with plant phosphate nutrition reported by Kumar *et al.* (2023) [6].

In India, clusterbean is grown on an area of 23.30 lakh hectares with a productivity of 428.0 kg per hectare. The maximum contribution concerning area is shared by Rajasthan, followed by Gujarat, Haryana, and Punjab in Rajasthan the area of (18.18 lakh ha) with the production of (19.85 lakh tones) reported by Bhuvad *et al.* (2023) [5]. Rajasthan is the principal guar-growing state accounting for about 87.7% of the production and 91.5% of the acreage (Anonymous 2023) [1].

Materials and Methods

A field experiment entitled “Effect of Nutrient Management on Growth, Yield and Quality of Clusterbean [*Cyamopsis tetragonoloba* (L). Taub.]” was carried out during *kharif* season of

2023 at Agronomy farm, School of Agriculture, Suresh Gyan Vihar University, Jaipur. Which is situated at an altitude of 432 meter above mean sea level with 26°48'35" N latitude 75°51'44" E longitude. This region falls under agro-climatic zone IIIA (Semi-Arid Eastern Plain Zone) of Rajasthan. The average annual rainfall of this tract ranges between 400-500 mm, most of which is contributed by the S-W monsoon during July and August. There is hardly any rain during winter and summers. The maximum and minimum temperatures during the crop season ranged between 30.2 °C to 35.2 °C and 9.9 °C to 23.0 °C, respectively. A total of 365.7 mm rainfall was recorded during the cropping season. The relative humidity fluctuated between 35.0 to 70.0%, while the average sunshine hours ranged between 2.9 to 9.7 hrs day⁻¹. The experimental fields were clay loam and the soil fertility status contained available nitrogen (137.8 kg ha⁻¹) by Subia and Asija (1996), available phosphorus (16.3 kg ha⁻¹) by Olsen *et al.* 1954 [12] and available potassium (250.12 kg ha⁻¹) by Jackson, 1973. The organic carbon content was from 0.34-0.38 per cent. All the plant protection measures were adopted to take healthy crop at maturity stage, after leaving two rows on each side, a net plot area was harvested separately for attribute of clusterbean were statistically analysed as guideline of Panse and Sukhatme (1985) [10]. The experiments were laid out in randomize block design (RBD) with three replications and ten treatments.

Results and Discussion

Growth: The growth attributes of clusterbean. Application of 50% RDF + Rhizobium + PSB recorded the highest plant height and dry matter accumulation at 60 DAS and at harvest and number of branches plant⁻¹ of clusterbean. The probable reason for increase plant height might due to 50% RDF + Rhizobium + PSB in that application plays crucial role in photosynthesis, respiration, protein synthesis, enzyme activation by Bagadkar *et al.* (2020) [2]. The dry matter production was found to be more with nutrient management which could be attributed to be the fact that nutrient management enhanced plant vigour and strengthens the stalk, further synergistic effect with RDF,

rhizobium and PSB resulted in better dry matter production Bagadkar *et al.* (2020) [2]. The improvement in chlorophyll content due to integrated nutrient management might be attributed as integrated nutrient management influences the process of photosynthesis at many levels, namely synthesis of ATP, activation of the enzymes involved in photosynthesis, CO₂ uptake, balance of the electric charges required for photophosphorylation in chloroplasts, thus integrated nutrient management application enhanced chlorophyll in the plant. Similar results that supported present experiment findings have also been reported by Meena *et al.* (2016) [9] and However, application of nutrient management 100% RDF, 50% RDF + Rhizobium and 50% RDF + PSB and remained statistically at par over control.

Yield: The Application of 50% RDF + Rhizobium + PSB recorded the highest seed yield (1603 kg ha⁻¹), straw yield (3896 kg ha⁻¹), biological yield (5300 kg ha⁻¹) and harvest index (30%) The favourable effect of nutrient management on yield attributes might be probably because root proliferation, higher root development, increased availability and uptake of nutrients, energy transformation and metabolic processes in plant. Application of integrated nutrient management might have enhanced the photosynthetic activity which resulted in more number of seeds per pod. The favourable effect of integrated nutrient management on yield attributes might be probably due to the effect of integrated nutrient management on partitioning of assimilates is also responsible in part for insufficient photosynthetic supply to the reproductive parts of the crops grown on integrated nutrient management deficient soils. Thus, application of integrated nutrient management might have reproductive parts of the plant, being the closest sink and hence, resulted in increased flowering, fruiting and seed formation. Similar resulted have been reported by Bhat *et al.* (2013) [3] and Singh *et al.* (2016) [9] However, application of nutrient management 100% RDF, 50% RDF + Rhizobium and 50% RDF + PSB and remained statistically at par over control.

Table 1: Effect of nutrient management on growth attributes of clusterbean.

Treatment	Plant height		Dry matter accumulation		No. of branches plant ⁻¹	Chlorophyll content at harvest (mg g ⁻¹)
	At 60 DAS (cm)	Plant height at harvest (cm)	At 60 DAS (g)	Dry matter accumulation at harvest (g)		
Control	31.27	43.66	8.65	15.03	6.63	1.70
50% RDF	36.03	50.79	9.25	16.13	7.83	3.03
75% RDF	36.67	51.08	9.45	16.07	8.1	3.43
100% RDF	38.27	53.39	10.75	18	8.97	4.60
Rhizobium	33.7	49.05	9.17	15.5	7.6	2.60
Phosphorus solubilizing bacteria (PSB)	31.63	46.36	8.8	15.17	7.03	2.53
Rhizobium + PSB	34.77	49.11	9.23	16	7.77	2.80
50% RDF + Rhizobium	37.60	52.26	10.25	17.8	8.73	4.40
50% RDF + PSB	37.33	51.41	9.53	16.8	8.17	3.87
50% RDF + PSB + Rhizobium	42.57	58.16	10.97	18.4	9.37	4.67
S. Em±	1.79	2.39	0.49	0.76	0.38	0.09
CD (P=0.05)	5.31	7.10	1.45	0.25	1.13	0.27

Table 2: Effect of nutrient management on seed, straw, biological and harvest index of clusterbean.

Treatment	Seed	Straw	Biological	Harvest Index (%)
Control	871	2485	3356	26
50% RDF	1165	2940	4106	28
75% RDF	1332	2959	4224	30
100% RDF	1412	3647	5059	28
Rhizobium	1132	2788	3920	29
Phosphorus solubilizing bacteria (PSB)	1310	2985	4261	30
Rhizobium + PSB	1378	3014	4272	30
50% RDF + Rhizobium	1519	3577	5096	30
50% RDF + PSB	1258	3292	4670	20
50% RDF + PSB + Rhizobium	1603	3896	5300	30
S. Em±	78.17	220.20	223.52	2.01
CD (P=0.05)	232.23	654.26	664.10	NS

Conclusion

Based on the results of one year experimentation, it may be concluded that the application of 50% RDF + Rhizobium + PSB was the most effective treatment in growth attributes and yield attributes of clusterbean.

Therefore, application of phosphorus 50% RDF + Rhizobium + PSB may be recommended for higher production and profitability of cowpea under semi- arid condition of Rajasthan.

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