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EFFECT OF INTEGRATED NITROGEN MANAGEMENT ON GROWTH, YIELD AND ECONOMICS OF SUMMER VEGETABLE CLUSTER BEAN

P.M. Solanki¹, J.V. Suthar^{2*}, A.D. Pal¹, M. Jangid¹ and K.J. Patel¹

¹Department of Agronomy, B. A. College of Agriculture, A.A.U., Anand, Gujarat, India.

²Department of Agricultural Sciences, College of Agricultural Information Technology, Anand Agricultural University, Anand – 388 110, Gujarat, India

*Corresponding author E-mail : jvsagron@aau.in

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ABSTRACT

A field experiment was carried out during summer season of the year 2024 at Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat to study the effect of integrated nitrogen management on growth, yield and economics of summer vegetable cluster bean. The soil of experimental site was loamy sand in with low in organic carbon and nitrogen while medium in available phosphorus and potassium. The experiment was conducted using Randomized Complete Block Design (RBD) with ten treatments replicated thrice. Application of 50% RDN through chemical fertilizers along with 25% RDN through FYM and 25% RDN through Vermicompost in conjunction with seed treatment of Bio NP consortium @ 5 ml/kg of seed and soil application @ 1 L/ha at 30 DAS increased the growth and yield attributes viz. plant height, no. of clusters per plant, no. of pods per cluster, total no. of pods per plant, green pod yield, stover yield as well as net returns and benefit: cost ratio of vegetable cluster bean. However, plant population, plant height at 30 DAS, dry weight of root nodules per plant and dry biomass of plant was found non-significant results due to different integrated nitrogen management treatments.

Key words : Cluster bean, FYM, Vermicompost, Bio NP consortium, Chemical fertilizer.

Introduction

Cluster bean (*Cyamopsis tetragonoloba* L.) is an important legume vegetable crop popularly known as a guar in India. In India, it is cultivated mainly in Rajasthan, Haryana, Gujarat, Punjab and Uttar Pradesh. In Gujarat, it was cultivated in an area of 0.44 lakh ha with production of 4.35 lakh MT green pods and productivity of 9.98 t/ha during the year 2023 – 24. Major cultivated areas of cluster bean in districts of Gujarat are Anand, Mehsana, Banaskantha, Kheda, Kutch, Vadodara and Dahod (Anonymous, 2024). Cluster bean is recognized for its drought resistance, deep root system and multipurpose applications, primarily cultivated for its tender pods and endospermic gum in the arid and semi-arid regions of India. Its immature green pods are consumed as a vegetable, seeds are utilized as pulses and the entire green plant is used for fodder and green manure crop. It

improves soil health by fixing atmospheric nitrogen through its symbiotic relationship with *Rhizobium* bacteria in its root nodules (Sen *et al.*, 2024). Green pods are used as vegetables, which also known for cheap source of energy (16 Kcal), protein (3.2 g), fat (1.4 g), carbohydrate (10.8 g), vitamin A (65.3 IU), vitamin C (49 mg), calcium (57 mg) and iron (4.5 mg) for every 100 g of edible portion (Patel *et al.*, 2018). Nutrients play an important role in growth, development and yield of crop plants. Among the nutrients required by the crops, nitrogen is the most deficient plant nutrient. Nitrogen is an important for chlorophyll and responsible for dark green colour in plants. An adequate supply of nitrogen is associated with vigorous vegetative growth and more efficient use of available inputs leading to higher productivity. The application of different doses of nitrogen improves plant growth and their yield (Yashraj *et al.*, 2023). Integrated Nitrogen Management play an important role in crop production.

Use chemical fertilizer, organic manures and biofertilizers in integrated manner gives higher production. It improves physical, chemical and biological properties of soil. No single source of nutrient is capable of supplying plant nutrients in adequate as well as in efficient amount and balanced proportion. Therefore, this study was carried out to study the effect of integrated nitrogen management on growth, yield and economics of cluster bean to supply plant nutrients in balanced proportion only possible through combined use of organic and chemical sources of plant nutrients with biofertilizer.

Materials and Methods

The field experiment was carried out at Agronomy Farm of B. A. College of Agriculture, Anand Agricultural University, Anand during summer season of the year 2024. The site of the experiment had a uniform topography with a gentle slope and efficient drainage. The field soil was loamy sand in texture, alluvial in origin, well-drained and possesses good moisture retention capacity locally called "Goradu". At a depth of 0 – 15 cm, the soil of experimental site was low in organic carbon (0.32%) and nitrogen (204 kg/ha), while medium in available phosphorus (34 kg/ha) and potassium (263 kg/ha). The experiment was laid out in Randomized Complete Block Design (RBD) with ten treatments and three replications. Different treatments of integrated nitrogen management were used in trial viz. T₁: 100% RDN (Recommended Dose of Nitrogen) @ 25 kg N/ha, T₂: 100% RDN through FYM, T₃: 100% RDN through Vermicompost, T₄: 75% RDN through Chemical fertilizers + 25% RDN through FYM, T₅: 75% RDN through Chemical fertilizers + 25% RDN through Vermicompost, T₆: 50% RDN through Chemical fertilizers + 50% RDN through FYM, T₇: 50% RDN through Chemical fertilizers + 50% RDN through Vermicompost, T₈: 50% RDN through Chemical fertilizers + 25% RDN through FYM + Bio NP consortium, T₉: 50% RDN through Chemical fertilizers + 25% RDN through Vermicompost + Bio NP consortium and T₁₀: 50% RDN through Chemical fertilizers + 25% RDN through FYM + 25% RDN through Vermicompost + Bio NP consortium. Gujarat Vegetable Guar 11 (Anand Bahar) was used in the field experiment. The recommended dose of fertilizer of cluster bean was 25:40:00 kg NPK/ha. Organic manures were incorporated 15 days before sowing in the respective treatments. Nitrogen from chemical fertilizer was applied through urea. Bio NP consortium was applied as a seed treatment @ 5 ml/kg of seed and soil application @ 1 L/ha at 30 DAS in respective treatments. Common application of phosphorus @ 40 kg P₂O₅/ha was applied through single

super phosphate (SSP) in all the treatments. Data regarding growth and yield attributes as well as yield were recorded as per the standard procedure and economics were calculated based on green pod yield. All the parameters underwent statistical analysis and interpretation according to the procedure described by Cochran and Cox (1967).

Results and Discussion

Effect of treatments on growth parameters

Plant population (per meter row length)

Data presented in Table 1 of plant population at 20 DAS and at harvest of cluster bean was found non-significant as various treatments of nitrogen did not exert any significant impact on plant population. Uniform plant population was maintained across all experimental plots throughout the growth period, indicating that any variations in the results were only due to the treatment effects.

Plant height (cm)

The periodical plant height was recorded at 30, 60 DAS and at harvest depicted in Table 1. At 30 days after sowing, there was no any significant difference observed in plant height. Treatment T₁₀ (50% RDN through Chemical fertilizers + 25% RDN through FYM + 25% RDN through Vermicompost + Bio NP consortium) resulted significantly higher plant height at 60 DAS as well as at harvest (95.13 cm and 125.42 cm, respectively) and it was remained statistically similar to treatments T₇, T₆, T₅ and T₄ at 60 DAS and treatments T₇, T₆, T₅, T₄, T₉ and T₈ at harvest. Significantly lower plant height (74.51 cm and 107.43 cm) was observed under treatment T₂ at 60 DAS and at harvest, respectively. The significantly increased in plant height may be attributed to nitrogen from chemical fertilizers, which promotes cell formation and plant vigor. FYM, vermicompost and biofertilizers promote nutrient mineralization and release growth promoting substances like auxins, gibberellins and cytokinins, enhancing stem elongation in cluster bean. Comparable findings were also reported by Neelima *et al.* (2017), Morya *et al.* (2018) and Parmar *et al.* (2019).

Dry weight of root nodule at 45 DAS (mg/plant)

According to result shown in Table 1 noted that dry weight of root nodules at 45 DAS was not significantly affected by the integrated nitrogen management treatments.

Plat dry biomass at 45 DAS (g/plant)

As per result presented in Table 1, application of different treatments did not show any significant effects on dry weight biomass of cluster bean plant.

Effect of treatments on yield attributes and yield No. of cluster/plant

Based on the results depicted in Table 1, treatment T₁₀ recorded significantly higher number of clusters per plant (11.42) and it remained at par with treatments T₆, T₇, T₄ and T₅. Combined application of FYM, vermicompost and Bio NP consortium release nutrients slowly, sustaining growth, while inorganic fertilizers offer immediate support for early development. This balanced nutrient supply enhances vegetative growth, photosynthesis, hormonal activity, boosting branching and flowering nodes, leading to increased cluster formation in plant. Similar findings were reported by Parmar *et al.* (2019), Seerangan *et al.* (2019) and Rolaniya *et al.* (2023).

No. of pods/cluster

From the data presented in Table 1, significantly higher number of pods per cluster (10.54) was found under treatment T₁₀ as compared to other treatments and it was at par with treatments T₇, T₆, T₅, T₄ and T₉. The improved yield may be due to the combination of chemical fertilizers with FYM, vermicompost and biofertilizers, which enhanced photosynthates assimilation and partitioning into reproductive organs, particularly clusters and resulting in more pods per cluster and better pod filling. Similar findings were also observed by Parmar *et al.* (2019) and Rolaniya *et al.* (2023).

No. of pods/plant

As per findings from Table 1, treatment T₁₀ achieved significantly higher number of pods per plant (125.38),

which was at par with treatments T₄, T₅, T₆, T₇, T₈ and T₉. The increase in pods per plant resulted from consistent nutrient supply through chemical fertilizers, FYM, vermicompost and Bio NP consortium, which met crop needs throughout growth. This supported the transition to reproductive phases, enhancing floral initiation, flowering and pod development. Similar results were reported by Lakshmipathy *et al.* (2017).

Green pod yield (q/ha)

According to the result presented in Table 2, application of 50% RDN through Chemical fertilizers + 25% RDN through FYM + 25% RDN through Vermicompost + Bio NP consortium through seed treatment and soil application (T₁₀) was recorded significantly higher green pod yield (100.43 q/ha) over the other treatments which was statistically at par with treatments T₇, T₆, T₅ and T₄. The increased green pod yield in cluster bean might be due to the integrated use of chemical fertilizers with organic inputs such as FYM, vermicompost and biofertilizers. These combinations enhanced microbial activity, promote nutrient mineralization and uptake and stimulated the release of plant growth regulators. These synergistic effects collectively supported better physiological performance, leading to improved pod development and higher overall yield. These results were similar to those achieved by Maruthi *et al.* (2014), Parmar *et al.* (2019) and Seerangan *et al.* (2019).

Stover yield (q/ha)

The data presented in Table 2 revealed that the treatment T₁₀ noted significantly higher stover yield (42.14

Table 1 : Effect of nitrogen management on growth parameters and yield attributes of cluster bean.

Treatments	Plant population/ meter row length		Plant height (cm)			Dry weight of root nodule (mg/plant)	Plat dry biomass (g/plant)	No. of cluster/ plant	No. of pods/ cluster	Total no. of pods/ plant
	20 DAS	At harvest	30 DAS	60 DAS	At harvest					
T ₁	10.90	9.87	23.22	78.15	113.56	21.38	21.59	9.70	9.19	110.20
T ₂	10.45	9.33	22.27	74.51	107.43	22.81	20.80	9.12	8.56	105.11
T ₃	10.63	9.65	22.92	75.44	110.03	22.53	21.39	9.46	8.73	108.41
T ₄	11.21	10.23	24.87	85.42	120.61	23.29	23.42	10.57	9.83	117.82
T ₅	11.30	10.32	25.35	88.93	121.83	23.51	24.16	10.79	10.12	122.15
T ₆	11.52	10.43	26.28	92.47	123.62	25.39	24.40	11.24	10.33	123.49
T ₇	11.76	10.64	26.63	93.30	124.16	26.17	25.01	11.35	10.49	123.63
T ₈	10.92	10.04	24.05	79.71	116.65	24.05	22.02	9.93	9.12	113.70
T ₉	11.06	10.11	24.29	82.20	117.07	25.18	22.50	10.02	9.46	115.40
T ₁₀	11.91	10.77	27.25	95.13	125.42	26.59	25.47	11.42	10.54	125.38
S.Em. ±	0.49	0.44	1.17	3.66	3.93	1.14	1.08	0.47	0.45	4.45
CD at 5%	NS	NS	NS	10.82	11.69	NS	NS	1.39	1.34	12.96
CV (%)	7.63	7.57	8.20	3.64	5.77	8.21	8.08	7.82	8.09	6.48

Table 2 : Effect of nitrogen management on yield and economics of cluster bean.

Treatments	Green pod yield (q/ha)	Stover yield (q/ha)	Total Cost of cultivation (`/ha)	Gross return (`/ha)	Net return (`/ha)	B : C ratio
T ₁	86.64	34.06	59555	173280	113725	2.91
T ₂	80.03	31.39	62186	160060	97874	2.57
T ₃	83.43	32.37	73652	166860	93208	2.27
T ₄	89.61	38.53	60213	179220	119007	2.98
T ₅	90.05	39.86	63081	180100	117019	2.86
T ₆	92.49	40.92	60872	184980	124108	3.04
T ₇	95.50	41.59	66606	191000	124394	2.87
T ₈	86.70	34.76	61445	173400	111955	2.82
T ₉	87.44	35.92	64313	174880	110567	2.72
T ₁₀	100.43	42.14	65059	200860	135801	3.09
S.Em. ±	3.67	1.88	-	-	-	-
CD at 5%	10.86	5.60	-	-	-	-
CV (%)	7.10	8.79	-	-	-	-

q/ha) than all other treatments, highlighting its effectiveness in promoting biomass accumulation, it was statistically at par with treatments T₇, T₆, T₅ and T₄. The increased stover yield in cluster bean may be attributed to the consistent nutrient supply from integrated use of organic manures, inorganic fertilizers and biofertilizers throughout the growth cycle. This sustained nourishment boosted biomass accumulation and enhanced the efficiency of chemical fertilizers. Additionally, nitrogen fixing bacteria improved the availability of applied nutrients, supporting overall crop development and productivity. Similar findings were also observed by Singh and Kumar (2016) and Neelima *et al.* (2017).

Economics

As per Table 2, maximum gross return (200860 ` / ha), net return (135801 `/ha) and benefit: cost ratio of 3.09 was attained through treatment T₁₀ followed by treatment T₆. While, minimum net return and benefit: cost ratio was recorded under treatment T₃.

Conclusion

From the results, it can be concluded that application of 50% RDN through chemical fertilizers combined with 25% RDN through FYM and 25% RDN through Vermicompost along with seed treatment with Bio NP consortium at 5 ml/kg of seed and soil application of 1 L/ha at 30 days after sowing significantly boosted the growth, green pod production and net returns in summer vegetable cluster bean.

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