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Effect of poultry manure conjugated with NPK on soil properties, growth and yield attributes of cluster bean (*Cyamopsis tetragonoloba* L.) cv. Radha desi

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Abstract

The present investigation entitled “Effect of poultry manure conjugated with npk on soil properties, growth and yield attributes of clusterbean (*Cyamopsis tetragonoloba* l.) cv. radha desi” was carried out at the Soil Science Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the kharifi season of 2022. The area of Prayagraj district comes under subtropical belt in the South east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46°C – 48°C May – June and seldom falls as low as 4°C – 5°C in winter December – January. The relative humidity ranged between 20 to 94 percent. The average rainfall in this area is around 1100 mm annually. Soil samples were taken from 0-15 and 15-30 cm soil depth randomly prior to tillage operations, air dried and passed through 2mm sieve. Then the composite soil sample was taken for mechanical, physical and chemical analysis. The experiment was conducted in 4x4 factorial randomized block design with four level of NPK and Poultry manure. The treatments were replicated three times and were allocated at randomly in each replication. On the basis of findings it is concluded that the treatment combination T₁₆ @105%NPK+@pm30 t ha⁻¹ i.e, Treatment T₁₆ was found best result on growth and yield of cluster bean in comparison to other treatment combination. From the economical point of view, the treatment gave maximum C:B ratio is 1:29 Followed by treatment T₁₂ @105%NPK+@pm0 t ha⁻¹ is 1:27. Since the findings are based on the research done in one of season further experiments with more than one season will help in better to study the effect of NPK and Poultry manure on growth and yield by cluster bean (*Cyamopsis tetragonoloba* L.) Cv. Radha Desi. The minimum bulk density (mg m⁻³), particle density (mg m⁻³), pH and EC dSm⁻¹ was noted in T₁₆ @105%NPK+@pm30 t ha⁻¹ which was significantly superior over T₀ Control. Whereas the maximum pore space (%), organic carbon, available nitrogen (kg ha⁻¹), available phosphorus (kg ha⁻¹) and available potassium (kg ha⁻¹), was noted in T₁₆ @105%NPK+@pm30 t ha⁻¹ which was significantly superior over T₀ Control.

Keywords: NPK, Poultry manure, Cluster bean, etc.

Introduction

Soil is a medium for plant growth. Crop production is largely based on soils. Some of the soil properties affecting plant growth include: soil texture (coarsefine), aggregate size, porosity, aeration (permeability), and water holding capacity, pH, bulk density, particle density. The rate of water movement into the soil (infiltration) is influenced by its texture, physical condition (soil structure and tilth), and the amount of vegetative cover on the soil surface. Organic matter tends to increase the ability of all soil store tain water, and also increases infiltration rates of fine textured soils” Brady and Weil (2016) [9]. It is generally 50-100 cm tall and bears 4 to 10 branches (branch type). However, non-branch type varieties have main stem only, which is heavily clustered with pods.

India is one of the major cluster bean producing countries of the world contributing around 75 to 80% of the world’s total production. Rajasthan is the largest cluster bean producing states in the world as it dominates the Indian production scenario contributing to over 70% of the total production in India. In food industry Guar gum is used as Gelling, viscosifying, thickening, clouding, and binding agent. It is also used for stabilization, emulsification, preservation, water retention, enhancement of water-soluble fibre content etc. Cluster bean is grown especially in the arid regions of India (Rajasthan, Haryana, Gujarat and Punjab) for

gum purpose, whereas it is grown for vegetable purpose in other parts of India. India is largest producer of cluster bean in the world with an annual production of 1.849 million tonnes and productivity of 451 kg/ha (DE&S 2018). Major cluster bean producing states in India are Rajasthan, Haryana, Gujarat, Uttar Pradesh, Punjab and Madhya Pradesh. India is the major exporter of guar gum to the world. It exports various forms of guar to a large number of countries. The country has exported 5.13 lakh tonnes of guar gum to the world for the worth of Rs. 4707.10 crores during the year 2018-19 (APEDA 2018-19).

It is one of the best legume crop for the climatic situation of Rajasthan because of hardy and drought tolerant nature (Kherawat *et al.*, 2013) [12]. In India, cluster bean is mostly grown in Rajasthan, Haryana, Punjab, Uttar Pradesh and Madhya Pradesh. Rajasthan occupies first position in India both in area and production. It accounts for almost 82.1 percent area and 70% production in India. Haryana and Gujarat has second and third position respectively. Rajasthan has an area of 30 lakh hectare, production of 15.46 lakh tones with a productivity of 515 kg/ha. (Anonymous 2010- 11). Guar occupies an important role in Indian economy because of its industrial importance mainly due to the presence of gum in its endosperm (35 to 40%). It had been grown since ancient era for various purposes *viz.*, vegetable, green fodder, manure and feed. Green and tender pods of cluster bean are being used as a favorite vegetable in many parts of the country. It is also grown as a forage crop (Ayub *et al.*, 2012) [6]. It also heals stomach ulcers, high blood pressure, obesity, plague, arthritis, inflammation, sprains and liver enlargement, among other problems (Pathak, 2015) [14]. Available outstanding nutritional value used as a feed for livestock and poultry (D'mello, 1992) [10]. It provides nutritional concentrate and fodder for cattle and adds to the fertility of soil by fixing considerable amount of atmospheric nitrogen (Singh and Usha, 2003) [15].

Materials and Methods

A field experiment conducted at the Soil Science Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the *Rabi* season of years (2023-2024) growing cluster bean *Var.* radha desi applied four levels of NPK and poultry manure NPK = 0%, 35%, 70%, 105% and Poultry manure = 0%, 10%, 20%, 30% is lead to observe the physical and chemical parameters. In physical parameters like that bulk density, particle density, pore space and water holding capacity through method by 100 ml graduated measuring cylinder and process by Muthuvel *et al.*, 1992.

In chemical parameters through method by

1. Soil pH – method given by (Jackson, M. L. 1958) [11] through using digital pH meter.
2. Soil EC (dSm⁻¹)-method given by (Wilcox, 1950) [19] through using digital EC meter.
3. Organic Carbon (%) - Wet oxidation method given by (Walkley and Black, 1947) [18].

4. Available Nitrogen (kg ha⁻¹)-Kjeldhal Method (Subbiah and Asija, 1956) [16].
5. Available Phosphorus (kg ha⁻¹)- Colorimetric method by using Jasper single beam U.V. Spectrophotometer at 660 nm wavelength given by (Olsen *et al.*, 1954) [13].
6. Available Potassium (kg ha⁻¹)- Flame photometric method by using Metzer Flame Photometer given by (Toth and Prince, 1949) [17].

Table 1: Treatment combinations of experiment

S. No.	Treatment Combination
T ₁ .	@0%NPK+@PM0 t ha ⁻¹
T ₂ .	@0%NPK+@PM10 t ha ⁻¹
T ₃ .	@0%NPK+@PM 20 t ha ⁻¹
T ₄ .	@0%NPK+@ PM30 t ha ⁻¹
T ₅ .	@35%NPK+@ PM0 t ha ⁻¹
T ₆ .	@35%NPK+@ PM10 t ha ⁻¹
T ₇ .	@35%NPK+@ PM 20 t ha ⁻¹
T ₈ .	@35%NPK+@ PM30 t ha ⁻¹
T ₉ .	@ 70%NPK+@ PM0 t ha ⁻¹
T ₁₀ .	@ 70%NPK+@ PM 10 t ha ⁻¹
T ₁₁ .	@ 70%NPK+@ PM 20 t ha ⁻¹
T ₁₂ .	@ 70%NPK+@ PM30 t ha ⁻¹
T ₁₃ .	@105%NPK+@ PM 0 t ha ⁻¹
T ₁₄ .	@105%NPK+@ PM10 t ha ⁻¹
T ₁₅ .	@105%NPK+@ PM 20 t ha ⁻¹
T ₁₆ .	@105%NPK+@ PM30 t ha ⁻¹

Results and Discussion

Physical Properties of Soil

The data presented in table 1 clearly shows the bulk density (Mg m⁻³) of soil as influenced by NPK and poultry manure. The minimum bulk density (mg m⁻³) 1.173 & 1.438 mg m⁻³ was recorded in treatment T₁₆ @105%NPK+ 30 t ha⁻¹ poultry manure and maximum 1.199 & 1.629 mg m⁻³ was recorded in T₁ (0.00%NPK+0.00 t ha⁻¹ poultry manure. Similar results were also reported by (Adesodun *et al.*, 2005, Aluko, Oyeleke, 2005 and Badshah *et al.*, 2018) [1, 2, 7].

The minimum particle density (Mg m⁻³) 2.157 and 2.437 mg m⁻³ was recorded in treatment T₁₆ @105%NPK+ 30 t ha⁻¹ poultry manure and maximum 2.723 and 2.870 Mg m⁻³ was recorded in T₁ (0.00%NPK+0.00 t ha⁻¹ poultry manure. The similar findings were also reported by (Aluko and Oyeleke, 2005 and Badshah *et al.*, 2018) [2, 7].

The maximum water holding capacity (%)59.740 and 63.370 was recorded in treatment T₁₆ @105%NPK+ 30 t ha⁻¹ poultry manure and minimum 48.307and 50.973 was recorded in T₁ (0.00%NPK+0.00 t ha⁻¹ poultry manure. The similar findings were also reported by (Adesodun *et al.*, 2005, Aluko and Oyeleke, 2005) [1, 2, 1].

The maximum pore space (%)48.370 and 49.350 was recorded in treatment T₁₆ @105%NPK+ 30 t ha⁻¹ poultry manure and minimum 45.123 and 44.027 was recorded in T₁ (0.00%NPK+0.00 t ha⁻¹ poultry manure. The similar findings were also reported by (Adesodun *et al.*, 2005 and Badshah *et al.*, 2018) [1, 7].

Table 2: Influence of NPK and poultry manure on bulk density (Mg m^{-3}), particle density (Mg m^{-3}), pore space (%) and Water holding capacity (%) of soil

Treatment	Bulk Density (Mg m^{-3})		Particle Density (Mg m^{-3})		Pore Space (%)		Water Holding Capacity (%)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
NPK								
NPK 0%	1.199	1.629	2.723	2.870	45.123	44.027	48.307	50.973
NPK 35%	1.197	1.624	2.810	2.830	45.293	44.070	49.203	51.653
NPK 75%	1.197	1.617	2.767	2.859	45.343	44.330	49.367	51.517
NPK 105%	1.198	1.610	2.760	2.857	45.377	44.740	49.740	51.960
C.D. at 5%	0.001	0.009	0.019	0.015	0.084	0.083	0.331	0.333
S.E(d) \pm	0.00	0.004	0.009	0.007	0.041	0.040	0.161	0.162
F-Test	S	S	S	S	S	S	S	S
PM								
PM 0 t ha ⁻¹	1.199	1.629	2.723	2.870	45.123	44.027	48.307	50.973
PM 10 t ha ⁻¹	1.196	1.598	2.550	2.773	46.120	46.060	50.277	53.907
PM 20 t ha ⁻¹	1.188	1.587	2.343	2.2570	47.307	46.377	50.423	53.783
PM 30 t ha ⁻¹	1.178	1.502	2.297	2.547	48.243	47.160	50.583	53.903
C.D. at 5%	0.001	0.009	0.019	0.015	0.084	0.083	0.331	0.333
S.E(d) \pm	0.000	0.004	0.009	0.007	0.041	0.040	0.161	0.162
F-Test	S	S	S	S	S	S	S	S
Interaction (NPK X PM)								
C.D. at 5%	0.002	0.018	0.039	0.029	0.168	0.166	0.662	0.665
S.E(d) \pm	0.001	0.009	0.019	0.014	0.082	0.081	0.322	0.324
F-Test	S	S	S	S	S	S	S	S

Conclusion

On the basis of findings it is concluded that the treatment combination T₁₆ @105%NPK+@pm30 t ha⁻¹ i.e, Treatment T₁₆ was found best result on growth and yield of cluster bean in comparison to other treatment combination. From the economical point of view, the treatment gave maximum C:B ratio is 1:29 Followed by treatment T₁₂ @105%NPK+@pm0 t ha⁻¹ is 1:27. Since the findings are based on the research done in one of season further experiments with more than one season will help in better to study the effect of NPK and Poultry manure on growth and yield by cluster bean (*Cyamopsis tetragonoloba L.*) Cv. Radha Desi. The minimum bulk density (mg m^{-3}), particle density (mg m^{-3}), pH and EC dSm^{-1} was noted in T₁₆ @105%NPK+@pm30 t ha⁻¹ which was significantly superior over T₀ Control. Whereas the maximum pore space (%), organic carbon, available nitrogen (kg ha^{-1}), available phosphorus (kg ha^{-1}) and available potassium (kg ha^{-1}), was noted in T₁₆ @105%NPK+@pm30 t ha⁻¹ which was significantly superior over T₀ Control.

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