Effect of Inorganic fertilizers, FYM and Nano Urea on Soil Health, Growth and Yield of Cluster bean (*Cyamopsis tetragonoloba* L.) Cv. HGS 563

ABSTRACT

An experiment was conducted to study the "effect of different level of N P K, FYM and Nano urea on soil health, growth and yield of cluster bean (*Cyamopsis tetragonoloba* L.) Cv. HGS 563" at research farm of Soil Science and Agricultural Chemistry. The experiment design laid out in randomized block design (RBD) with three replications. Cluster bean was taken for study with recommended doses of fertilizers (N, P_2O_5 and K_2O @ 20, 40 and 20 kg ha^{-1}) was applied with organic manure (FYM). The variety of cluster bean is HGS 563 was taken for research trial. Bulk density (Mg m^{-3}) and particle density was maximum in T_1 - [NPK @ 0% + NU @ 0% + FYM @ 0%] and soil pore space, water holding capacity, pH, EC**,** organic carbon, nitrogen, phosphorus and potassium were recorded maximum in T_9 - [NPK @ 100% + NU @ 100% + FYM @ 100%] respectively. In treatment T_9 the highest pod yield of Cluster bean 55.12 q ha^{-1} was obtained with C:B ratio of 1:2.48. Excessive nitrogen leaching can deplete the available nitrogen in the soil, leading to inadequate nutrient levels for crops. This can result in reduced crop productivity, stunted growth, and lower yields. To solve this problem of farmers that are facing leaching of Nitrogen due to direct apply of inorganic fertilizers in granule form for that use of Nano Urea can help in reducing leaching and get maximum yield. Use of different level of Nano Urea on crop and analyzing the effect of nano urea on soil physical as well as chemical properties of soil.

Keywords: Soil properties, FYM, Nano urea, Cluster bean, Yield, *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 (coarse fine), 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 soils to retain water, and also increases infiltration rates of fine textured soils" **(Brady *et al.*, 2016).**

Cluster bean is an important crop having high nutritive value. It is a drought-tolerant leguminous crop because of tap rooting system and has high capacity to recover from water stress. The root "Guar" represents it's originated from Sanskrit word "Gauaahar" which mean cow fodder of the livestock. It is a drought tolerant crop mainly cultivated in arid and semi-arid regions of the world. In India, it is mainly cultivated area under Uttar Pradesh and Maharashtra. The cultivated area under beans in India during 2018-2019 was 229 lakh ha with the production of 2324 MT. The cultivated area of gaur in Gujrat is 35.82 thousand ha with a production 365.11 thousand. In Rajasthan, cluster bean is commonly grown in Barmer, Churu, Sriganganagar, Nagaur, Jalore, Sikar, Jaisalmer, Bikaner, Jaipur and Alwar districts. Rajasthan occupies first position in India both in area and production. It accounts nearly 82.1 per cent area and 70 per cent production in India. Guar gum is also used in various medical applications such as treatment of atherosclerosis, osteoarthritis, diabetics and diarrhea. Guar gum has an important role as anticancer medicine in treatment of colorectal cancer because it has an excellent property of retarding drug release and sensitivity to microbial degradation in large intestine **(Mudgil *et al.*, 2014)**. "Nitrogen is an important nutrient for all crops. It increases yield nutrition also increases the protein content. Deficient plants may have stunted growth and develop yellow-green colour. It accelerates photosynthetic behavior of green plants as well as growth and development of living tissues specially tiller count in cereals" **(Azadi *et al.*, 2013). "**Phosphorus is the second most important nutrient that must be added to the soil to maintain plant growth and sustain crop yield. It stimulates early root development and growth and there by helps to establish seedlings quickly. Large quantities of Phosphorus are found in seed and fruit and it is considered essential for seed formation. It enhances the activity of rhizobia and increased the formation of root nodules. Thus, it helps in fixing more of atmosphere nitrogen in root nodules" **(Turner *et al.* 2007)**. "Potassium is one of the seventeen elements which are essential for growth and development of plants. Potassium is required for improving the yield and quality of different crops because of its effect on photosynthesis, water use efficiency and plant tolerance to diseases, drought and cold as well for making the balance between protein and carbohydrates" **(Singh *et al.*, 2003). "**Farm yard manure from cattle and other livestock is

an important source of nutrient in the livestock intensive regions. Farmyard manures are major source of nutrient supply also on small farm holdings Manure has long been considered a desirable soil amendment, and reports of its effects on soil properties are numerous. Different animal manure has been used as a source of nutrients for crops cultivated" **(Sharma *et al.*, 2011)**. "Nano Urea is a nanotechnology based revolutionary Agri-input which provides nitrogen to plants. When compared to conventional urea prill, it has a desirable particle size of about 20-50 nm and more surface area (10,000 times over 1 mm urea prill) and number of particles (55,000 nitrogen particles over 1 mm urea prill). In order to improve the N use efficiency by crops, several strategies have been suggested in the past few decades. Nano Urea is a source of nitrogen which is a major essential nutrient required for proper growth and development of a plant. Nitrogen is a key constituent of amino acids, enzymes, genetic materials, photosynthetic pigments and energy transfer compounds in a plant. Typically, nitrogen content in a healthy plant is in the range of 1.5 to 4%. Foliar application of Nano Urea at critical crop growth stages of a plant effectively fulfils its nitrogen requirement and leads to higher crop productivity and quality in comparison to conventional urea" **(Sharma *et al.*, 2022).**

MATERIALS AND METHODS

The experiment led at the Soil Science Research Farm of SHUATS, Prayagraj, and U.P., which is situated at 25 º 24'46.14" N latitude, 81 º 50'49.95" E longitude and 98 m over the mean ocean level. The soil of test region falls under Inceptisol and the plots is alluvial soil in nature. The dirt samples casually gather from five distinct locales in the trial plot before culturing activity from a profundity of 0-15 cm and 15-30 cm. The size of soil test diminishes by conning and quartering the composites the composites soil test is air dry and pass through a 2 mm strainer via setting up the sample for physical and synthetic analysis. Agro climatically, Prayagraj addresses the subtropical belt of the south East of Uttar Pradesh, and is supplied with Tincredibly blistering summer and genuinely cool winter. The Maximum temperature of the area comes to up to 46ºC-49ºC and only occasionally falls as low as 4ºC-5ºC. The general moistness ranges between 20-94%. The midpoints precipitation of this area is around 1100mm annually. It goes under subtropical environment getting the mean yearly precipitation of around 1100mm, significant precipitation from March to end May. Be that as it may, intermittent precipitation was additionally normal during winter. The cold weather months were cold while late spring months were extremely sweltering and dry. The base temperature

during the harvest season w as to be 21.38□ and the greatest is to be 37.82□. The base moistness was to be 46.42% and most extreme was to be 96.85%.

Table 1: Physical parameters

Particulars	Method
Soil Colour	Munsell soil Colour Chart, 1971
Soil Texture (Sandy loam)	Bouyoucous, 1927
Bulk density(Mg m^{-3})	Muthuaval *et al.* 1992
Particle density(Mg m^{-3})	Muthuaval *et al.* 1992
Water Holding Capacity (%)	Muthuaval *et al.* 1992
Pore Space (%)	Muthuaval *et al.* 1992

Table 2: Chemical parameters

Particulars	Methods
Soil pH (1:2)	Jackson, 1967
EC (dS m^{-1})	Wilcox, 1950
Organic carbon (%)	Walkley and Black, 1947
Available Nitrogen (kg ha^{-1})	Subbaih and Asija, 1956
Available Phosphorus (kg ha^{-1})	Olsen *et al.*, 1954
Available Potassium (kg ha^{-1})	Toth and Prince, 1949

Table 3: Treatment combination

Treatment	Treatment combination
T_1	NPK @ 0% + NU @ 0% + FYM @ 0%
T_2	NPK @ 0% + NU @ 50% + FYM @ 50%
T_3	NPK @ 0% + NU @ 100% + FYM @ 100%
T_4	NPK @ 50% + NU @ 0% + FYM @ 0%
T_5	NPK @ 50% + NU @ 50% + FYM @ 50%
T_6	NPK @ 50% + NU @ 100% + FYM @ 100%
T_7	NPK @ 100% + NU @ 0% + FYM @ 0%
T_8	NPK @ 100% + NU @ 50% + FYM @ 50%
T_9	NPK @ 100% + NU @ 100% + FYM @ 100%

Table 4: Recommended dose of fertilizers

100 % NPK = N @20 Kg ha^{-1}, P @40 Kg ha^{-1}, K @40 Kg ha^{-1}

50 % NPK = N @10 Kg ha^{-1}, P @20 Kg ha^{-1}, K @20 Kg ha^{-1}

0 % NPK = N @0 Kg ha^{-1}, P @0 Kg ha^{-1}, K @0 Kg ha^{-1}

100 % NU = NU @ 0.5 ml ha^{-1}

50 % NU = NU @0.25 ml ha^{-1}

100 % FYM = F @10 t ha^{-1}

50 % FYM = F @5 t ha^{-1}

0% FYM = F @ 0 t ha^{-1}

RESULT AND DISCUSSION

Physical and Chemical properties

In this finding research Bulk thickness, Particle thickness, pH and EC was found Non-significant. The critical varieties were seen in the event of pore space (%). The greatest (%) pore space of soil was found in T_9 [NPK @ 100 % + NU @100 % + FYM @ 100 %] and least was found in T_1 [NPK @ 0 % + NU @ 0 % + FYM @ 0 %] separately. The huge varieties were seen in the event of Water holding capacity (%). The most extreme water holding capacity limit of soil was found in T_9 [NPK @ 100 % + NU @100 % + FYM @ 100 %] and least was found in T_1 [NPK @ 0 % + NU @ 0 % + FYM @ 0 %] separately. In the event of soil properties, we see that there was tremendous distinction between Organic carbon (%). The greatest Organic carbon was kept in T_9 [NPK @ 100 % + NU @100 % + FYM @ 100 %] and least was found in T_1 [NPK @ 0 % + NU @ 0 % + FYM @ 0 %] separately. In the event of soil properties, we see that there was critical difference between Nitrogen (kg ha^{-1}) and Phosphorus (kg ha^{-1}). The greatest Nitrogen and Phosphorus was kept in T_9 [NPK @ 100 % + NU @100 % + FYM @ 100 %] and least was found in T_1 [NPK @ 0 % + NU @ 0 % + FYM @ 0 %] separately in the event of soil properties, we see that there was massive contrast between Potassium (kg ha^{-1}). The greatest Potassium was kept in T_9 [NPK @ 100 % + NU @100 % + FYM @ 100 %] and least was found in T_1 [NPK @ 0 % + NU @ 0 % + FYM @ 0 %] separately.

Table 5: Effect of Inorganic fertilizers, FYM and Nano urea on physical-chemical properties of Soil

Treatments	Depth (cm)	BD (Mg m^{-3})	PD (Mg m^{-3})	Pore Space (%)	WHC (%)	pH	EC (dS m^{-1})	OC (%)	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
T_1	0-15	1.39	2.35	44.81	42.81	7.55	0.23	0.48	179.96	18.61	207.57
	15-30	1.47	2.42	42.00	40.35	7.52	0.20	0.32	148.22	15.73	175.79
T_2	0-15	1.28	2.25	47.16	44.16	7.44	0.25	0.48	191.88	22.65	211.28
	15-30	1.38	2.32	44.24	42.99	7.48	0.22	0.39	160.92	18.17	179.45
T_3	0-15	1.26	2.15	48.95	46.95	7.35	0.25	0.51	193.65	21.93	213.51
	15-30	1.39	2.21	45.22	43.86	7.39	0.22	0.51	151.36	18.79	176.61
T_4	0-15	1.33	2.29	44.17	42.17	7.42	0.24	0.51	196.55	26.26	217.77
	15-30	1.39	2.46	42.39	40.68	7.42	0.21	0.45	156.76	22.18	184.61

T_5	0-15	1.25	2.25	46.98	43.98	7.39	0.25	0.53	221.08	26.04	228.55
	15-30	1.39	2.31	43.32	41.09	7.55	0.23	0.45	181.37	21.96	182.62
T_6	0-15	1.11	2.15	47.18	45.18	7.30	0.26	0.57	242.55	28.77	230.60
	15-30	1.23	2.42	44.56	43.19	7.30	0.23	0.51	184.58	23.99	187.22
T_7	0-15	1.30	2.34	45.01	43.01	7.18	0.24	0.52	278.69	27.17	249.00
	15-30	1.41	2.40	43.37	41.34	7.10	0.21	0.44	244.20	23.18	171.76
T_8	0-15	1.28	2.24	46.18	43.18	7.16	0.24	0.52	288.42	30.07	252.45
	15-30	1.33	2.41	44.66	41.63	7.17	0.21	0.53	257.38	26.69	185.40
T_9	0-15	1.17	2.18	48.20	45.20	7.13	0.27	0.54	314.22	30.72	262.65
	15-30	1.28	2.20	46.68	42.44	7.07	0.24	0.56	268.98	27.25	196.20
F-Test		NS	NS	S	S	NS	NS	S	S	S	S
		NS	NS	S	S	NS	NS	S	S	S	S
S.Em.		-	-	0.40	0.59	-	-	0.01	5.43	0.62	4.44
(±)				0.65	0.38			0.03	5.04	0.44	2.80
C.D.		-	-	1.17	1.73	-	-	0.02	16.29	1.84	13.32
at 5%											
		-	-	1.95	1.10	-	-	0.07	15.11	1.32	8.40

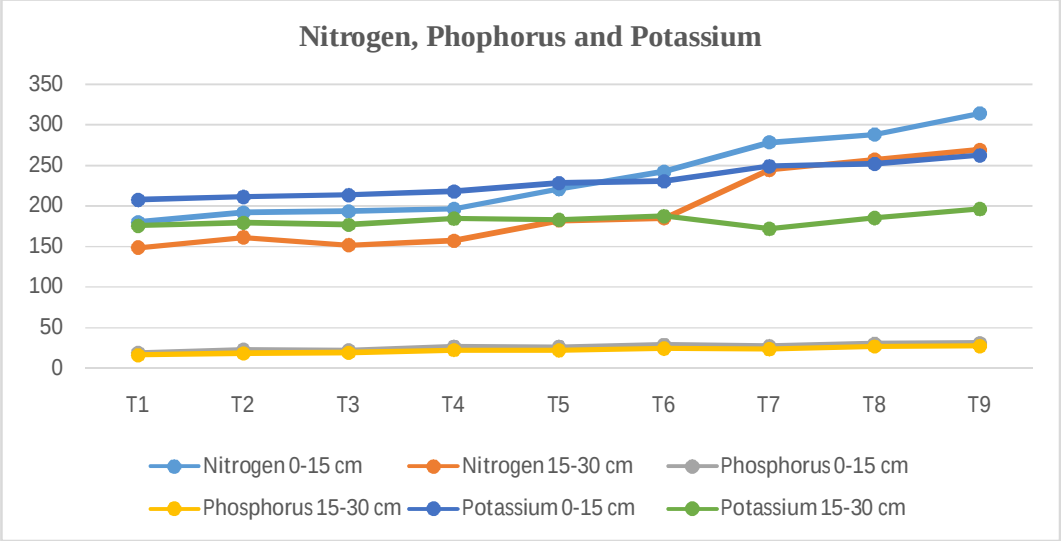

Fig 1: Effect of Inorganic fertilizers, FYM and Nano urea on different treatments on post- harvest Soil

Table 6: Effect of Inorganic fertilizers, FYM and Nano urea on growth and yield parameters of cluster bean

Treatments	Plant height (cm)			No. of Branches plant^{-1}	Pods plant^{-1}	No. of leaves plant^{-1}			pod yield (qha^{-1})
	30 DAS	60 DAS	90 DAS			30 DAS	60 DAS	90 DAS	
T_1	13.39	40.85	48.15	4.06	38.19	7.71	16.09	21.18	29.45
T_2	16.35	53.25	58.83	4.97	40.57	7.78	17.47	21.98	31.95
T^3	17.62	54.62	60.44	5.20	42.59	7.91	17.62	23.11	37.29
T_4	19.19	58.33	66.05	6.11	45.71	8.09	17.78	23.60	39.12
T_5	20.77	57.77	66.81	6.35	57.81	8.13	18.04	23.85	40.29
T_6	21.84	60.98	71.76	6.35	60.38	8.16	18.14	23.91	42.29
T_7	23.72	67.86	77.74	6.44	74.97	8.20	18.31	24.44	44.37
T_8	24.62	66.76	78.54	6.73	78.11	8.22	18.53	24.91	48.45
T_9	26.10	68.44	80.24	6.93	78.44	8.33	18.62	25.18	55.12
F-Test	S	S	S	S	S	S			S
S. Em. (±)	0.53	0.94	2.01	0.32	2.23	0.13	0.24	0.41	1.96
C.D. at 5%	1.58	2.82	6.03	0.96	6.68	0.39	0.72	1.22	5.86

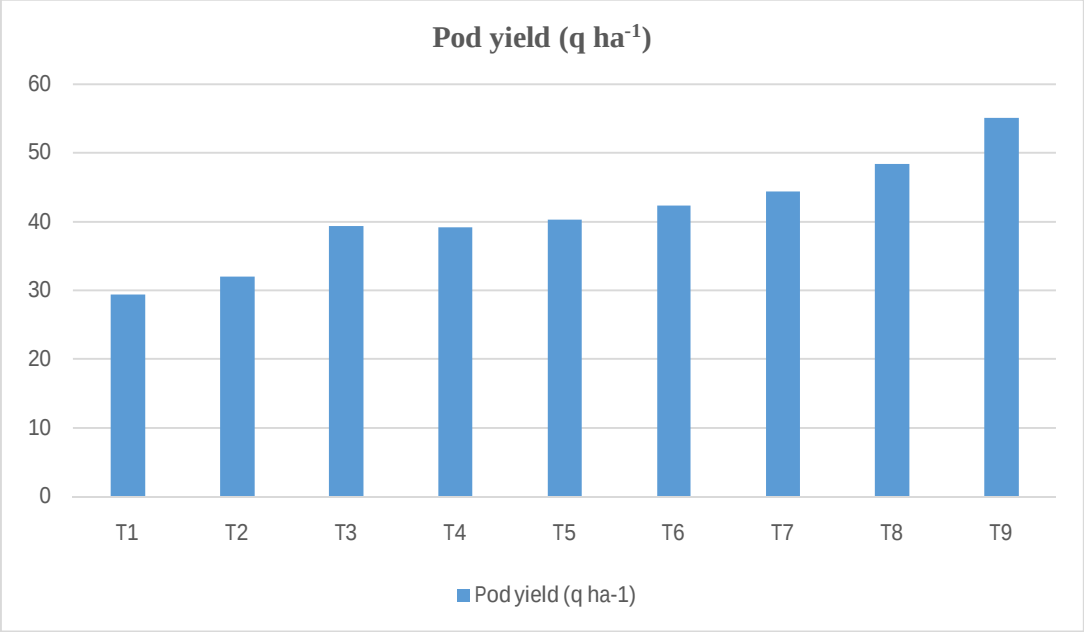

Fig 2: Total pod yield (q ha^{-1})

CONCLUSION

It concluded from trail that treatment T_9 - [NPK @ 100 % + NU @ 100 % + FYM @ 100 %] was best in all soil health parameters. T_9 also provide significantly highest vegetative growth as well as yield attributes and positive effect on net return up to ₹80,760 ha^{-1} with C:B ratio of 1:2.48 of cluster bean therefore, it is suggested that T_9 - found most suitable for sustainable soil health parameters, cluster bean to obtain higher yield and economic of the farmers, the trail was based on one season, so that the findings can be substantiate before recommendation.

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