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Studies on Growth, Yield and Soil Fertility Status in Cluster Bean [*Cyamopsis tetragonoloba* (L.) Taub] cv. Pusa Navbahar under Natural Farming Practice in Comparison with Conventional Farming

A.B. Mastiholi, Suhasini Chikkalaki, Venkatesh Dasar, H.P. Maheswarappa, Sanjiv Duradundi, T. Shantappa, Arunkumar Bavidoddi, B. Sowmya

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ABSTRACT

Background: The cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] is a bushy annual herb having a deep rooted system and drought resilient leguminous crop grown on sandy soils of arid and semiarid regions. The production list of cluster bean is dominated by India as leading producers of the crop in the world contributing to around 75-82% of the total production.

Methods: Field experiment was conducted in Block-I at The Regional Horticulture Research and Extension Center, Kumbapur, Dharwad. The authentic source of Cluster bean seeds of Pusa Navbahar were purchased from Nadakatti seeds, Dharwad. Treatments are imposed as T_1 (Package of Practice: FYM @ 10 t/ha, 25:75:60 NPK Kg/ha), T_2 (Farmers Practice: FYM @ 10 t/ha, 12.5:37.5:30 Kg/ha), T_3 (Natural Farming: Ghanajeevamrutha @ 1000 Kg/ha and liquid jeevamrtha @ 500 l/ha every fortnightly interval, with organic mulching) and T_4 (Organic Farming: FYM @ 15 t/ha).

Result: Among four different farming practices, higher plant height at harvest was recorded in package of practice (80.0 cm). The higher number of pods per plant and higher dry biomass production was recorded in organic farming (102.3 and 2.14 t/ha) respectively. 26.8 per cent higher yield was recorded in organic farming (OF) over PoP. Nitrogen, phosphorus and potassium content and uptake in cluster bean was found significantly higher in PoP (2.13, 0.58 and 1.17 %) and (42.20, 11.51 and 23.11 Kg ha^{-1}) respectively. Natural farming treatment recorded significantly lower nutrients content and uptake.

Key words: Biomass production, Natural farming, Nutrient uptake, Organic farming.

INTRODUCTION

Vegetable cultivation plays an important role in achieving food security by relieving full stress on cereals, millets and pulse crops. The cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] is a bushy annual herb having a deep rooted system and drought resilient leguminous crop grown on sandy soils of arid and semiarid regions. Cluster bean is a rich source of proteins, dietary fiber and also contains minerals namely phosphorous, calcium, iron, potassium and with zero cholesterol and fats. Pusa Navbahar (Pusa Mausami × Pusa Sadabahar) is a PoPular variety of cluster bean for vegetable purpose that is grown for its young tender green immature pods with maximum yield. Pusa Navbahar is a single stem variety and the pods are of 15 cm with better quality. Gum obtained from cluster bean seeds is a choice of agrochemical in paper, food, cosmetics, textile, oil and pharmaceutical industries across the world (Bhatt *et al*., 2017).The variety was released from Indian Agricultural Research Institute, New Delhi. It matures at 45 to 50 DAS and attains height 50 to 60 cm. The average yield of variety is 10 to 15 q/ha. The vermiwash (5%), Panchakavya (5%) and cow urine (5%) can highly be recommended as foliar spray to reap high quantity clusterbean Cv Pusa navbhahar. and benefit the farmers as well as consumers (Selvarani, K. *et al*., 2021). The production list of cluster bean is dominated by India as leading producers of the crop in the world contributing to around 75–82 per cent of the total production. The use of inorganic fertilizers has been associated with reduced crop yield, soil acidity and nutrient imbalance, creates poor physical properties of the soil and nutrient retention characteristics; hence adversely affects crop growth and yield (Ballal and Kadam, 2016). Keeping the above facts in view, the experiment was conducted with

Natural Farming Project, Zone-8 (Hort.), Regional Horticulture Research and Extension Center, University of Horticultural Sciences, Dharwad-580 001, Karnataka, India.

Corresponding Author: Suhasini Chikkalaki, Natural Farming Project, Zone-8 (Hort.), Regional Horticulture Research and Extension Center, University of Horticultural Sciences, Dharwad-580 001, Karnataka, India. Email: suhasinisc92@gmail.com

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the objective to study the growth, yield and soil fertility status of cluster bean in different farming practices.

MATERIALS AND METHODS

Field experiment was conducted in Block-I of The Regional Horticulture Research and Extension Center, Kumbapur, Dharwad is situated at 15^{0}29' Northern latitude, 74˚57' Eastern longitude and at an altitude of 678 m above the mean sea level. Experiment was conducted during *Kharif* season of 2019, 2020 and 2021. The authentic source of cluster bean seeds of Pusa Navbahar were purchased from Nadakatti seeds, Dharwad. Treatments were imposed as T_1 (Package of Practice: FYM @ 10 t/ha, 25:75:60 NPK Kg/ ha), T_2 (Farmers Practice: FYM @ 10 t/ha, 12.5:37.5:30 Kg/ ha), T_3 (Natural Farming: Ghanajeevamrutha @ 1000 Kg/ ha and liquid jeevamrtha @ 500 l/ha every fortnightly interval, with organic mulching) and T_4 (Organic Farming: FYM @ 15 t/ha). Seeds for natural farming were treated with beejamrutha as per the procedure and organic farming seeds were treated with Rhizobium (33 g/Kg of seeds). Ghanajeevamrutha was prepared by spreading 100 kg of desi cow dung on ground uniformly in the form of layer and added 2 kg powdered Jaggery, 2 kg pulse flour, required quantity of cow urine (for easy mixing) and handful of undisturbed farm soil and mixed properly. This was covered with jute bag for 48 hours and allowed for fermentation. Next spread on the floor and dried in the shade. Thus dried ghanajeevamrutha was applied before planting. Jeevamrutha was prepared by mixing 10 kg desi cow dung, 10 litre cow urine, 2 kg local jaggery, 2 kg pulse flour and hand full of soil collected from farm. All these were put in 200 litre with watercapacity plastic drum and mixed thoroughly and volume was made up to 200 litre. The mixture was stirred well in clock wise direction and kept in shade covered with wet jute bag. The solution was regularly stirred clockwise in the morning and in the evening continuously and it was used after 3-5 days of preparation during summer and 5-7 days of preparation in winter season for soil application near the plant roots. Jeevamrutha was applied as per the treatments and schedule regularly.

The soil samples were collected from three representative points between crop rows at 0-30 cm depth and mixed thoroughly and made into one composite sample. The soil samples upon arrival in the laboratory were air dried, grounded and sieved through 2 mm sieve to separate the coarse fragments (>2 mm). The fine earth samples were stored in separate containers and used for further analyses. Soil reaction (pH) was analysed by Potentiometry and EC by conductometry method (Jackson, 1973), per cent soil organic carbon was analyzed by wet oxidation method (Walkely and Black, 1934), available N (kg ha^{-1}) was by Macrokjeldahl distillation (Subbiah and Asija, 1956), available phosphorus (kg ha^{-1}) was by Spectrophotometry method (Olsen *et al*., 1954) and available potassium (kg ha^{-1}) was by Flame photometry (Jackson, 1973). Plant samples were brought to laboratory and washed with 0.2 per cent dilute detergent and 0.1N HCl to remove wax, dust and any other metallic contaminants and washed with distilled water. The samples were dried in a hot air oven at 65 ± 5^{0}C till the constant weight was obtained. The dried samples were powdered and stored in air tight containers and used for further nutrient analysis. The nutrients in plant sample were estimated by following the standard protocols *viz*., per cent nitrogen by Kjeldahl method, per cent phosphorus by Vanadomolybdate method and per cent potassium by Flame photometry method (Piper, 1966). The field experiment was conducted under irrigated condition. Growth and yield observations were recorded at regular intervals.

RESULTS AND DISCUSSION

Pooled analysis of the three years data showed that, significantly the higher plant height was recorded in PoP treatment (80.0 cm) which was on par with OF (73.0 cm) and FP treatments (69.4 cm) at harvest. Significantly the lower plant height (63.9 cm) at harvest was recorded in NF treatment. Similar trend was noticed at 30 and 60 DAS. Significantly higher number of leaflets per plant were recorded at harvest in OF (29.49) and NF treatments (29.39) than PoP and FP, which corresponds to the findings of Rajan and Murugesan (2012). On pooled basis, significantly higher number of pods per plant were recorded in OF (102.3) and NF (98.9). Fresh pod weight was found significantly higher in OF (3.56 g) and PoP (3.42 g) treatments which were on par with NF (3.18 g) treatment in pooled data. The higher

Table 1: Growth and yield parameters in cluster bean as influenced by different farming practice.

Treatments	Plant height (cm)			No of leaflets			No of pods per plant	Fresh pod weight (g)	Yield (t/ha)	Dry biomass (t/ha)
	30 DAS	60 DAS	Harvest	30 DAS	60 DAS	Harvest	3 years pooled	3 years pooled	3 years pooled	3 years pooled
T_1: Package of practice	8.7^a	63.8^a	80.0^a	16.39^a	22.15	27.48^b	89.1^b	3.42^a	4.96^b	2.03^{ab}
T_2: Farmers' practice	7.5^b	59.3^b	69.4^{ab}	12.89^b	18.94	26.42^b	85.2^c	2.73^b	4.43^b (-10.7)	1.88^{bc} (-7.4%)*
T_3: Natural farming	6.9^b	55.5^c	63.9^b	13.73^b	19.51	29.39^a	98.9^a	3.18^{ab}	5.02^b (+1.2)	1.80^c (-11.3%)
T_4: Organic farming	8.4^a	60.7^{ab}	73.0^{ab}	17.06^a	21.48	29.49^a	102.3^a	3.56^a	6.29^a (+26.8)	2.14^a (+5.4%)
S.Em.±	0.19	1.18	3.27	0.66	1.82	0.56	3.72	0.14	0.19	0.05
CD (p=0.05)	0.59	3.64	11.30	2.04	NS	1.72	11.47	0.48	0.54	0.18
CV (%)	5.53	4.42	7.73	9.87	17.72	4.44	8.86	7.39	6.64	6.77

dry biomass production was recorded in OF treatment (2.14 t/ha) which was on par with PoP treatment (2.03 t/ha). Significantly the lower dry biomass was produced in NF treatment (1.80 t/ha). The pooled analysis of three years data of yield was taken into consideration. OF treatment was recorded significantly higher pod yield (6.29 t/ha) than the other treatments. The next higher yield was recorded in NF treatment (5.02 t/ha). The per cent increase in yield in NF compared to PoP was only 1.2 while, in OF it was 26.8 per cent higher than the yield recorded in PoP. However, 10.7 per cent lower yield in FP was recorded when compared to PoP treatment (Table 1). Significantly higher plant height, leaf dry weight, and more number of tillers were recorded 60 days after sowing, higher leaf area duration and higher straw yield were recorded for wheat seeds soaked in 10% cow urine (Shivamurthy and Patil, 2010), since jeevamrutha conatains the cow urine which might have influenced the growth and yield in cluster bean.

Pooled analysis of three years of data showed that there was a significant change in soil electrochemical properties under (Table 2). The pH was almost neutral in all treatments. Significantly lower pH was recorded in NF (6.56) treatment which was on par with OF (6.74) on pooled basis. Significantly higher pH was recorded in PoP. However, there was no significant change in electrical conductivity (EC) values both at flowering and after harvest in pooled data. On pooled basis significantly the higher OC content was recorded in OF treatment (0.60 and 0.66 % at flowering and after harvest, respectively). The next higher OC in soil was recorded in NF treatment. The decrease in soil pH might be attributed due to the release of organic acids during the microbial decomposition of added organic manures and increased the enzymatic activity in soil. These results are in conformity with those reported by Babu and Reddy (2000). EC of soil did not vary much due to incorporation of different organic manures and the results are in conformity with the findings of Amjad Ali *et al*. (2011). This might be due to build-up of higher amount of organic carbon in soil after harvest of crop which is due to addition of higher biomass to soil through farm yard manure, jeevamruthaand mulch material. Similar results were obtained by Tirupati *et al*. (2019) and Amjad Ali *et al*. (2011). Pooled analysis of three years of data were showed that there was a significant change in soil fertility status as influenced by different farming practices (Table 3). The available nitrogen, phosphorus and potassium status of the soils were significantly higher in PoP treatment (343.37 and 308.45, 49.37 and 39.28 and 277.63 and 223.35 kg/ha at flowering and after harvest, respectively). At flowering, the available nitrogen in FP treatment (330.42 kg/ha) was on par with PoP. The lower available nitrogen, phosphorus and potassium were noticed in NF and OF treatments. The increased availability of nutrients in soil in these treatments receiving both organic and inorganic sources of nutrients might be due to the direct addition through chemical fertilizers and slow release of these nutrients through organic manures, thus enriching the available nutrients pool of the soil (Thakur *et al*. 2011). The lower available nitrogen content in soil receiving only liquid

Table 2: Changes in soil electrochemical properties in cluster bean as influenced by different farming practices (Pooled of three years).

Treatments	Initial soil electrochemical values			pH		EC (dS m^{-1})		OC (%)	
	pH	EC (dS m^{-1})	OC (%)	Flowering	After harvest	Flowering	After harvest	Flowering	After harvest
T_1: Package of practice	6.75	0.50	0.52	7.11^{a}	6.94^{a}	0.37	0.32	0.52^{bc}	0.55^{c}
T_2: Farmers' practice	6.84	0.41	0.53	6.86^{b}	6.80^{ab}	0.35	0.31	0.50^{c}	0.54^{c}
T_3: Natural farming	6.70	0.45	0.50	6.70^{c}	6.56^{c}	0.31	0.26	0.57^{ab}	0.61^{b}
T_4: Organic farming	6.81	0.42	0.54	6.83^{bc}	6.74^{bc}	0.36	0.31	0.60^{a}	0.66^{a}
S.Em. ±				0.04	0.05	0.01	0.01	0.03	0.01
CD (p=0.05)				0.13	0.18	NS	NS	0.06	0.04
CV (%)				4.40	7.95	9.78	14.17	7.10	4.32

Table 3: Available soil nutrient status in cluster bean as influenced by different farming practices (Pooled of three years).

Treatments	Initial soil available nutrient status			N (kg ha^{-1})		P_2O_5 (kg ha^{-1})		K_2O (kg ha^{-1})	
	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})	Flowering	After harvest	Flowering	After harvest	Flowering	After harvest
T_1 : Package of Practice	264.00	38.20	141.00	343.37^{a}	308.45^{a}	49.37^{a}	39.28^{a}	277.63^{a}	223.35^{a}
T_2 : Farmers' Practice	253.00	37.20	155.00	330.42^{ab}	288.62^{b}	44.52^{b}	34.68^{b}	252.75^{a}	190.81^{b}
T_3 : Natural Farming	231.00	35.60	142.00	268.48^{c}	252.97^{d}	37.94^{d}	29.09^{c}	196.19^{b}	144.12^{c}
T_4 : Organic Farming	253.00	34.60	141.80	303.20^{b}	268.09^{c}	40.90^{c}	32.64^{bc}	210.06^{b}	158.97^{c}
S.Em. ±				10.90	4.88	0.79	1.49	10.90	9.89
CD (p=0.05)				47.08	15.07	2.44	4.58	33.60	30.48
CV (%)				7.82	6.90	4.11	9.81	10.41	12.33

Table 4: Major nutrient content (%) and uptake (Kg ha^{-1}) in cluster bean plants as influenced by different farming practices (Pooled of three years).

Treatments	Major nutrients concentration (%)			Major nutrients uptake (Kg ha^{-1})		
	N	P	K	N	P	K
T_1: Package of Practice	2.13^{a}	0.58^{a}	1.17^{a}	42.20^{a}	11.51^{a}	23.11^{a}
T_2: Farmers' Practice	1.97^{ab}	0.51^{b}	1.12^{a}	35.58^{ab}	9.08^{b}	20.08^{ab}
T_3: Natural Farming	1.65^{c}	0.32^{c}	0.81^{b}	30.57^{b}	5.96^{c}	14.87^{c}
T_4: Organic Farming	1.87^{b}	0.47^{b}	0.87^{b}	39.22^{a}	9.86^{b}	18.04^{bc}
S.Em. ±	0.08	0.03	0.04	2.29	0.31	1.17
CD (p=0.05)	0.22	0.09	0.13	7.05	0.93	3.59
CV (%)	8.46	14.75	9.52	13.87	7.45	13.70

organic manures namely beejamruth, jeevamruth and panchagavya might be due to lower content of nitrogen in them. Similar results were also reported by Singh *et al*. (2009) in maize-wheat cropping system grown on red loam soil.

Pooled analysis of three years data showed that there was a significant change in nutrient content and uptake (Kg ha^{-1}) in cluster bean after harvest (Table 4). Nitrogen, phosphorus and potassium content and uptake in cluster bean were found significantly higher in PoP (2.13, 0.58 and 1.17 %) and (42.20, 11.51 and 23.11 Kg ha^{-1}). However, per cent nitrogen content was on par with FP (1.97 %) and per cent nitrogen and potassium uptake was on par with FP (35.58 and 20.08 Kg ha^{-1}). NF treatment was recorded significantly lower nutrients content and uptake. Similar results were reported by Datt *et al*. (2003) in vegetable pea. Combined application of organic and inorganic fertilizers in equal proportion to supply the recommended level of nutrients not only increased yield of pea but also enhanced the nutrient availability in soil and their uptake by the crop. Similiarly, the lower uptake of N, P, K and S in the treatment receiving only liquid organic manures was recorded and it was attributed to the in adequate supply of these nutrients during the crop growth period. These liquid organic manures namely beejamruth, jeevamruth and panchagavya contain lower amounts of these nutrients. These results of the present investigation corroborate with the findings of Dikshit and Khatik (2002).

CONCLUSION

Over the three years, there was a significant increase in plant height, number of leaflets, number of pods per plant, fresh pod weight and dry biomass of cluster bean. Results showed improvement in yield of organic and natural farming systems. The increased availability of nutrients in soil in the treatments receiving both organic and inorganic sources of nutrients enriched the available nutrients pool of the soil. Hence thereby these factors contributed to increase in growth and yield of cluster bean.

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REFERENCES

Amjad Ali, S., Khanif, Y.M, Aminuddin, H, Radziah, O. and Osumanu, H.A. (2011). Impact of Potassium Humate on Selected Chemical Properties of An Acidic Soil. 19th World Congress of Soil Science. Soil Solutions for a Changing World. 119-122.

Babu, R. and Reddy, V.C. (2000). Effect of nutrient sources on growth and yield of direct seeded rice. Crop Research. 19: 189-193.

Ballal, A. and Kadam, A.S. (2016). Okra crop growth and yield responses to different organic sources of nitrogen. International Journal of Agricultural Sciences. 8(48): 2042-2044.

Bhatt, R.K., Jukanti, A.K, Roy, M.M. (2017). Cluster bean [*Cyamposi stetragonoloba* (L.) Taub], an important industrial arid legume: A review. Legume Research. 40(2): 207-214.

Datt, N., Sharma, R.P. and Sharma, G.D. (2003). Effect of supplementary use of farmyard manure along with chemical fertilizers on productivity and nutrient uptake by vegetable pea (*Pisum sativum* var. arvense) and build up of soil fertility in Lahaul valley of Himachal Pradesh. Indian. J. Agric. Sci. 73(5): 266-268.

Dikshit, P.R. and Khatik, S.K. (2002). Influence of organic manures in combination with chemical fertilizers on production, quality and economic feasibility of soybean in Typic Haplustert of Jabalpur. Legume Res. 25(1): 53-56.

Jackson, M.L. (1973). Soil Chemical Analysis. Prentice hall of India, pvt. ltd. New Delhi.

Olsen, S.R., Cole, C.V., Watanabe, F.S. and Dean, L.A. (1954). Estimation of available phosphorous in soil by extraction with sodium bicarbonate, USDA, Washington DC, Circular. 939.

Piper, C.S. (1966). Soil and Plant Analysis. Han's publication, Bombay.

Rajan, M.R. and Murugesan, P. (2012). Influence of vermiwash on germination and growth of cow pea (*Vigna ungiculata*) and rice (*Oryza sativa*). IOSR Journal of Pharmacy Research. 2(6): 31-34.

Selvarani, K., Anushavardhini, S., Jose, J.J. and Mariselvi, V. (2021) Effect of organic foliar sprays on yield of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub] cv. Pusa Navbahar. Academic Journals. 16(2): 8-14.

Shivamurthy, D. and Patil, B.N. (2010). Effect of method of planting and seed treatment on performance of wheat genotypes under rainfed condition. Karnataka Journal of Agricultural Sciences. 19(4). 781-784.

Singh. A.K, Sarkar, A.K., Arvind, K. and Singh, B P. (2009). Effect of long-term use of mineral fertilizers, lime and farmyard manure on the crop yield, available plant nutrient and heavy metal status in an acidic loam soil. J. Indian Soc. Soil Sci. 57(3): 362-365.

Subbiah, B.V. and Asija, G.L. (1956). A rapid procedure for the estimation of available nitrogen in soil. Curr. Sci. 25: 259-260.

Thakur, R., Sawarkar, S.D., Vaishya, U.K. and Singh, M. (2011). Impact of continuous use of inorganic fertilizers and organic manure on soil properties and productivity under soybean-wheat intensive cropping of a vertisol. J. Indian Soc. Soil Sci. 59(1): 74-81.

Tirupati M., Naik, A. and Bellakki, M.A. (2019). A study on effect of nutrient management practices on soil chemical properties in chickpea of Karnataka state. J. Pharmacogn Phytochem. 8(5): 581-583.

Walkley, A.J. and Black, I.A. (1934). An examination of the method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Sci. 37: 29-38.