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Effect of Different Natural Farming Treatments on Growth, Yield and Quality of Pigeon Pea in Inter-cropping System in Western U.P.

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The field experiment was conducted at the Crop Research Centre, Chiraodi farm of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) in order to study the effect of different natural farming treatments on growth, yield and quality of pigeon pea in inter-cropping system in western U.P. during the year 2018. The experiment was laid out in Randomized

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complete block design with 16 treatments comprising of different combinations of natural farming components (Beejamrutha, Jeevamrutha, Mulching and Green manure) which were replicated thrice. The results revealed that application of Beejamrutha + Jeevamrutha + Mulching + Green manure recorded significantly higher growth parameters *viz.,* higher plant height (165.70 cm), No. of primary branches per plant (25.81), no. of secondary branches per plant (30.81) and leaf area index (2.40) and yield attributing characters namely number of pods/plant (468.60), number of grains/pod (6.62), Pod weight per plant (277.68) and 100 seed weight (12.88) as compared to other treatment combinations. Application of Beejamrutha + Jeevamrutha + Mulching + Green manure recorded significantly higher grain yield (2286 kg ha^{-1}) as compared to rest of the treatments. However, treatments with Beejamrutha + Mulching + Green manure and Jeevamrutha Jeevamrutha + Mulching + Green manure recorded similar growth, yield parameters and yield.

Keywords: Pigeon pea; Beejamrutha; Jeevamrutha; mulching; yield; growth.

1. INTRODUCTION

“Pulses are an important source of high quality protein complementing cereal proteins for predominantly substantial vegetarian population of the country. Unique characteristics of pulses, viz. biological nitrogen fixation, carbon sequestration, soil amelioration, low water requirement and capacity to withstand harsh climate, pulses remain an essential component of sustainable production system, especially under rainfed areas. Its adaptability to low-input management conditions makes opportunities for crop diversification and intensification, especially in areas where the green revolution left various problems related to sustainability” [1].

“Pigeon pea [*Cajanus cajan* (L.) Millsp.] is the fifth prominent pulse crop in the world and second in India after chickpea. In India, pigeon pea is grown in an area of 4.53 m ha with a production and productivity of 3.89 million tonnes and 859 kg ha^{-1} respectively and in Karnataka, it is grown in an area of 0.88 m ha with a production of 0.73 m tonnes” [2]. “Pigeon pea is a popular pulse crop in India especially because of their suitability under dryland conditions and their adaptability for pure as well as mixed/intercropping systems. The low yield of pigeon pea is not only due to its cultivation on sub-marginal lands but also because of inadequate and imbalanced fertilization as well as continuous use of inorganic fertilizers which decreased the productivity, sustainability, soil health and finally affects the environment” [3].

The heavy use of chemicals after the "Green Revolution" has led to the degradation of soil, water and ultimately the quality of food materials [4]. “Therefore, at this moment awareness has started in all parts of India for the adoption of organic cultivation to cure the ills of modern chemical agriculture” [4]. “Organic farming relies on fertilizers of organic origin such as compost, manure, green manure and bone meal and emphasizes techniques such as crop rotation and companion planting. However, organic source of nutrients in crop production is becoming very crucial for the assurance of food security on sustainable basis, which in turn not only improve the soil fertility for sustained crop productivity and reduce the cost of inorganic fertilizers. Although the usage of organic sources of nutrients has huge benefits in terms of soil health, bulk amount of organic fertilizers is required which is the major constraint in adopting organic farming” [5]. One of the ways by which the ill effects of conventional agriculture can be reduced with the usage of less amount of organic sources is by adopting Zero Budget Natural Farming (ZBNF).

Zero budget natural farming is a holistic agricultural practice that counters commercial expenditure and market dependency of farmers for inputs like seeds, fertilizers and pesticides. The basic "toolkit" of ZBNF methods was put together by Padma Shri Subhash Palekar. In ZBNF, soil is supplemented with microbial consortiums like Beejamrutha and Jeevamrutha to accelerate the proliferation of soil microflora which is beneficial to soil enrichment [6]. Indigenous pesticide decoctions of leaves with cow urine, Neemastra and Bramhastra, etc. were introduced [7]. This practice involves locally available biodegradable materials and combines scientific knowledge of ecology and modern technology with traditional farming practices based on naturally occurring biological processes. It is pertinent to mention that if organic farmers have cow and their own seed materials, then there is a minimum expenditure,

hence he has coined a new name "Zero Budget Natural Farming". As of today, natural farming is practiced by large number of farmers in the production of cereals, pulses, cotton, sugarcane, banana, mango, coconut, areca nut, coffee and black pepper.

Keeping these points in view, the present investigation entitled “Effect of different natural farming treatments on growth, yield and quality of pigeon pea in inter-cropping system in western U.P.” carried out at Crop Research Centre, Chirauri of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) during *kharif* season of 2018.

2. MATERIALS AND METHODS

The field experiment was conducted at the Crop Research Centre, Chiraodi farm of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.), located at a latitude of 29^0 40’ North and longitude of 77^0 42’ East with an elevation of 237 meter above the mean sea level. The Meerut area lies in the heart of Western Utter Pradesh and has Sub-tropical climate. The experimental site had an even topography with good drainage facilities on the farm. The soil of the experimental field was sandy loam in texture and slightly alkaline in reaction. The soil was medium in organic carbon (0.51 %), available phosphorus (14.7 kg/ha) and available potassium (138.2 kg/ha) but low in available nitrogen (201.2 kg/ha). Certified seed of pigeon pea variety Pusa-2001 was sown @ 12-15 kg/ha with blackgram variety Shekhar-2 @ 12-15 kg/ha with a row to row distance of 30 cm. Sowing of crop (pigeon pea) was 27 June 2018 manually and sowing of crop (blackgram) 13 July 2018. The experiment was layout in a randomized block design with 16 treatments consisting of mulching, green manuring, Beejamrutha, Jeevamrutha and combination of these components, replicated thrice. pigeon pea and blackgram Seeds were treated with beejamritha before sowing and applied to soil at the time of sowing in the crop rows of pigeon pea and blackgram. Jeevamritha solution @ 10 % was applied to the soil at 30 DAS and sprayed on the foliage of pigeon pea and blackgram at 60 DAS. Diancha was used as an exsitu green manure crop in the experiment which was cut down at flowering stage and applied to the respective experimental plots. The data recorded during the course of investigation were subjected to statistical analysis as per method of analysis of variance.

3. RESULTS AND DISCUSSION

3.1 Effect of Different Natural Farming Treatments on the Growth of Pigeon Pea

Data on plant height, no of branches and leaf area index of pigeon pea as influenced by natural farming treatments is presented in Table 1.

Data revealed that significantly higher plant height (165.70 cm), No. of primary branches per plant (25.81), no. of secondary branches per plant (30.81) and Leaf area index (2.40) was recorded with the application of Beejamrutha + Jeevamrutha + Mulching + Green manure as compared to RDF treatment and control. The overall improvement in growth of pigeon pea with the application of natural farming treatments could be described as their vital role in several physiological and biochemical processes *viz.,* root development, photosynthesis, protein synthesis and symbiotic biological nitrogen fixation process [8]. It is reported that higher nutrient status of jeevamrutha formulation resulted in profuse growth in the form of plant height, leaf area index and higher dry matter accumulation. Similar observation about the strong impact of N status in cattle urine on yield of corn was recorded by Kaur et al. [9]. The results are in line with the findings of Sutar et al. [10] and Yogananda et al. [11] in Cowpea.

3.2 Effect of Different Natural Farming Treatments on Yield Attributes and Yield of Pigeon Pea

Data on yield attributes *viz.,* number of pods/plant, number of grains/pod and 1000-grain weight as influenced by intercropping and natural farming treatments and fertility levels have been presented in Table 2.

Natural farming treatments had marked influence on the yield attributes of pigeon pea. Application of Beejamrutha + Jeevamrutha + Mulching + Green manure recorded significantly higher number of pods/plant (468.60), number of grains/pod (6.62), Pod weight per plant (277.68) and 100 seed weight (12.88) over control and RDF treatment. Significant rise in all the yield attributing parameters with the Beejamrutha + Jeevamrutha + Mulching + Green manure might be due to favorable effects of IAA, GA3, macro and micronutrients and also due to the presence of beneficial microorganisms in the jeevamrutha (Yadav et al. [12]; Palekar [6]) and the beneficial effects of jeevamrutha which was attributed to

huge quantity of microbial load and growth hormones which in turn might have enhanced the soil biomass, thereby sustaining the availability and uptake of applied as well as native soil nutrients which ultimately have resulted in better growth and yield of crops. These findings are in conformity with the results of Dhomne et al. [13]. Siddappa [14] reported that yield parameters of field bean were higher with the application of jeevamruth @ 1500 l/ha.

Table 1. Effect of different natural farming treatments on growth parameters of pigeon pea

Treatments	Plant height (cm)	Primary branches per plant	Secondary branches per plant	Leaf area index
T1: Control	130.35	19.10	22.43	1.05
T2: RDF	137.36	19.60	26.44	1.20
T3: Beejamrutha	139.52	19.78	27.44	1.28
T4: Jeevamrutha	141.73	20.00	27.78	1.30
T5: Mulching	142.81	20.41	28.10	1.39
T6: Green manure	145.39	20.91	28.37	1.43
T7: Beejamrutha + Jeevamrutha	147.38	21.34	28.64	1.56
T8: Beejamrutha + Mulching	149.10	22.97	29.22	1.64
T9: Beejamrutha + Green manure	152.11	23.24	29.30	1.73
T10: Jeevamrutha + Mulching	154.28	24.19	29.78	1.81
T11: Jeevamrutha + Green manure	156.78	24.40	29.90	1.90
T12: Mulching + Green manure	159.45	24.71	30.10	2.08
T13: Beejamrutha + Jeevamrutha + Mulching	160.21	25.20	30.28	2.16
T14: Jeevamrutha + Mulching + Green manure	162.34	25.31	30.40	2.20
T15: Beejamrutha + Mulching + Green manure	164.31	25.61	30.62	2.28
T16: Beejamrutha + Jeevamrutha + Mulching + Green manure	165.70	25.81	30.81	2.40
SEm±	**5.47**	**0.83**	**1.04**	**0.07**
CD (P=0.05)	**15.56**	**2.37**	**2.97**	**0.19**

Table 2. Effect of different natural farming treatments on yield attributes of pigeon pea

Treatments	Yield attributes			
	No. of pods per plant	No. of seeds per pod	Pod weight per plant (g)	100 seed weight (g)
T1: Control	326.50	4.40	187.90	11.10
T2: RDF	350.60	4.64	194.37	11.43
T3: Beejamrutha	354.40	4.78	215.36	11.50
T4: Jeevamrutha	358.10	4.94	220.11	11.59
T5: Mulching	362.40	5.39	224.31	11.69
T6: Green manure	368.10	5.49	228.12	11.76
T7: Beejamrutha + Jeevamrutha	370.60	5.63	231.81	11.87
T8: Beejamrutha + Mulching	378.40	5.72	236.86	12.38
T9: Beejamrutha + Green manure	386.20	5.86	240.38	12.52
T10: Jeevamrutha + Mulching	408.30	6.00	246.71	12.60
T11: Jeevamrutha + Green manure	419.20	6.12	251.48	12.65
T12: Mulching + Green manure	430.20	6.22	256.31	12.71
T13: Beejamrutha + Jeevamrutha + Mulching	438.10	6.38	259.11	12.74
T14: Jeevamrutha + Mulching + Green manure	451.40	6.45	265.12	12.77
T15: Beejamrutha + Mulching + Green manure	460.40	6.54	272.34	12.80
T16: Beejamrutha + Jeevamrutha + Mulching + Green manure	468.60	6.62	277.68	12.88
SEm±	**14.48**	**0.21**	**8.72**	**0.44**
CD (P=0.05)	**41.19**	**0.60**	**24.80**	**1.26**

Table 3. Effect of different natural farming treatments on yield (kg ha^{-1}) of pigeon pea

Treatments	Yield (kg ha^{-1})		Harvest index	Protein content (%)
	Seed	Stalk		
Control	920	2316	0.397	22.50
RDF	1110	2847	0.390	22.83
Beejamrutha	1194	3630	0.329	22.90
Jeevamrutha	1238	4137	0.299	23.09
Mulching	1287	4836	0.266	23.14
Green manure	1371	4931	0.278	23.18
Beejamrutha + Jeevamrutha	1456	5036	0.289	23.25
Beejamrutha + Mulching	1572	5247	0.300	23.30
Beejamrutha + Green manure	1628	5510	0.295	23.34
Jeevamrutha + Mulching	1687	5591	0.302	23.38
Jeevamrutha + Green manure	1766	5639	0.313	23.41
Mulching + Green manure	1867	5844	0.319	23.45
Beejamrutha + Jeevamrutha + Mulching	1942	5931	0.327	23.48
Jeevamrutha + Mulching + Green manure	2061	6136	0.336	23.52
Beejamrutha + Mulching + Green manure	2174	6272	0.347	23.57
Beejamrutha + Jeevamrutha + Mulching + Green manure	2286	6398	0.357	23.64
SEm±	**60.69**	**190.69**	**0.01**	**0.84**
CD (P=0.05)	**172.67**	**542.53**	**0.03**	**NS**

Application of Beejamrutha + Jeevamrutha + Mulching + Green manure recorded significantly higher grain yield (2286 kg ha^{-1}) over control (920 kg ha^{-1}) and RDF (1371 kg ha^{-1}). Similarly, significantly higher stalk yield was also recorded with Beejamrutha + Jeevamrutha + Mulching + Green manure (6398 kg ha^{-1}) over control (2316 kg ha^{-1}) and RDF (4931 kg ha^{-1}). Significantly higher grain yield recorded with Beejamrutha + Jeevamrutha + Mulching + Green manure was due to better yield attributing characters like number of pods per plant, pod weight per plant, number of seeds per pod, seed weight per plant and test weight. Increased yield might be attributed to the beneficial effect of natural farming treatments which has been reflected in the form of higher plant height with a greater number of branches per plant and higher stalk yield per plant and also due to the higher number of effective root nodules and increased microbial activity which led to the better availability of nutrients throughout the crop growth. These findings are in accordance with Similar results was also reported by Somasundaram and Amanullah et al. [15] and Lokhande et al. [16].

The highest protein content of pigeon pea (23.64 %) was recorded with Beejamrutha + Jeevamrutha + Mulching + Green manure treatment. This might be due to favorable effect on root development, nodulation, photosynthesis and activity of protein synthase enzyme which ultimately resulted in higher protein content in pigeon pea. These findings are in line with Lokhande et al. [16] and Sornalatha and Esakkiammal [17] who reported that the quality of pigeon pea with the application of beejamruth, jeevamruth and panchagavya.

4. CONCLUSION

From the above results, it can be concluded that natural farming practices like treating the seeds with Beejamrutha, application of Jeevamrutha and mulching and green manuring the intercrop have positive and significant effect on growth and yield of pigeon pea crop. Results revealed that application of Beejamrutha + Jeevamrutha + Mulching + Green manure recorded significantly higher grain yield (2286 kg ha^{-1}) over control (920 kg ha^{-1}) and RDF (1371 kg ha^{-1}).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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