Original Research Article

Effect of different natural farming treatments on growth, yield and quality of pigeon pea in pigeon pea+black gram inter-cropping system in western U.P.

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 economics of pigeon pea in pigeon pea +black gram inter-cropping system in western U.P. during the year 2018. The experiment was laid out in Randomized complete block design with 16 treatments 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.

Key words: Pigeon pea, Beejamrutha, Jeevamrutha, Mulching, yield, growth

Introduction

Pulses are an important source of high quality protein complementing cereal proteins for pre-dominantly substantial vegetarian population of the country. Although, India being the largest pulse crop cultivating country in the world, pulses share to total food grain production is only 6-7 per cent. 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 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]. It is grown worldwide, mostly in tropical and subtropical countries for grain, green manuring, fodder and forage as sole crop, intercrop, mixed crop and in sequential cropping system. India ranks first with about 90 per cent of world area and 85 per cent of production, Pigeon pea is a popular pulse crop in India especially in view of their suitability under dry land conditions and their adoptability for pure as well as mixed/intercropping system. The low yield of pigeon pea is not only due to its cultivation on sub-marginal lands, but also because of inadequate and imbalance fertilization as well as continuous use of inorganic fertilizers which decreased the productivity, sustainability, soil health and finally affecting environment [3].

Organic production is a holistic system designed to optimize the productivity and fitness of diverse communities within the agro-ecosystem, including soil organisms, plants, livestock and people. The principal goal of organic production is to develop enterprises that are sustainable and harmonious with the environment. Organic source of nutrients in crop production is becoming very crucial for 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. Long term fertilizer experiments have indicated the need for application of FYM for maintaining optimum fertility status. Different kind of organic materials such as FYM, animal manures, crop residues, composts, cow urine etc. have been used in crops but the amount and availability of nutrients in organic material vary widely, which makes interpretation of the value of nutrient supplied. Increase in the available nitrogen with application of bio-compost and farmyard manures may be attributed to the incorporation of organic matter that enhances the multiplication of microbes by incorporation of different organic sources for the conversion of organically bound N to inorganic form [4].

The "Green Revolution", which was a massive shift in agricultural practices that found in the 1960’s, which involves the application of chemical fertilizers, pesticides, herbicides and fungicides. The heavy use of chemicals has led to degradation of soil, water and ultimately the quality of food materials. Therefore, at this moment a awareness has started in all parts of India for adoption of organic cultivation to cure the ills of modern chemical agriculture [5]. As a result of rapidly changing farming practices, organic farming emerged as an alternative agricultural system the 20th century. It relies on fertilizers of

organic origin such as compost, manure, green manure and bone meal and places emphasis on techniques such as crop rotation and companion planting. Biological pest control, mixed cropping and the fostering of insect predators are encouraged. Besides these ill effects, green revolution has also bought about debt and despair among farming community due to increased cost of cultivation and with these specified ingredients and processes, organic farming is still comparatively costly and poor farmers are unable to find it a sustainable model [6]. One of the ways by which we can amend the ill effects of conventional agriculture and make technology feasible for adoption by economically poor farmers 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 the microbial consortium like Beejamrutha and Jeevamrutha to accelerate the proliferation of soil micro flora 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 emphasizes on efficient use of on-farm biological resources for seed and seedling treatment. Being cost effective and cheap technique, it is being adopted by large number of farmers in the country. It is pertinent to mention that if organic farmers have cow and their own seed materials, then there is minimum expenditure, hence he has coined a new name as "Zero Budget Natural Farming". If farmer can manage cow at the farm then expenditure in natural farming is minimal, hence it is popularizing as "Zero budget farming". As on today, natural farming is practiced by large number of farmers in 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 economics of pigeon pea + blackgram 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.

Materials and method

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 in 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, available phosphorus and available potassium but low in available nitrogen. 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 randomized block design with 16 treatments consists of mulching, green manuring, Beejamrutha, Jeevamrutha and combination of these components, replicated thrice. The data recorded during the course of investigation were subjected to statistical analysis as per method of analysis of variance.

RESULTS AND DISCUSSION

Effect of different natural farming treatments on growth of pigeon pea

Data pertaining to 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) were recorded with the application of Beejamrutha + Jeevamrutha + Mulching + Green manure as compared to RDF treatment and control. The over all improvement in growth of pigeon pea with the application of natural farming treatments could be described to 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.

Yield attributes and yield of pigeon pea

Data pertaining to 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 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. Significantly 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 micro nutrients and also due to 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] who reported that yield parameters of fieldbean were higher with the application of jeevamruth @ 1500 l/ha.

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 beneficial effect of natural farming treatments which has 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 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].

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.

Conclusion

From the above results, it can be concluded that the natural farming practices like treating the seeds with Beejamrutha, application of Jeevamrutha and mulching and green manuring the inter crop has positive and significant effect on growth and yield of pigeon pea crop.

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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***