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Effect of Potassic Fertilizer, FYM and Vermicompost on Growth Parameters, Yield Attributes and Yield of Pigeon Pea (*Cajanus cajan*) Crop in Chitrakoot Area

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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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Original Research Article

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ABSTRACT

A field experiment was conducted during *Kharif* season of 2022-2023 at Rajoula Agriculture farm, of Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot, Satna (M.P.) to evaluate the effect of potassic fertilizer, FYM and vermicompost on growth parameters, yield attributes and yield of pigeon pea. The present experiment having 11 treatment combinations replicated thrice in randomized block design. Pigeon pea variety Rajeshwari Phule-12 was grown with recommended agronomic practices. On the basis of the results emanated from present investigation, it could be concluded that application of T_{11} [100 % N & P, K- 0 % + 100 % K through Vermicompost]

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significantly recorded maximum growth parameters such as plant population plot^{-1} (138.42), plant height (211.38 cm), number of leaves (208.6) and number of branches plant^{-1} (32.8) and maximum yield attributing characters such as number of pod plant^{-1} (103.6), number of seed pod^{-1} (4.4) and seed index (9.68 g). The result showed highest grain yield (17.69 q ha^{-1}) and straw yield (52.64 q ha^{-1}), with 100% RDF + soil application of treatment T_{11} [100 % N & P, K- 0 % + 100 % K through Vermicompost] in comparison to all the treatments.

Keywords: FYM; pigeon pea; yield and vermicompost.

1. INTRODUCTION

"Pulses are rich source of protein, vitamins, fibres and minerals (iron, zinc, magnesium) and some essential amino acids which is play a vital role in human's health. Pulses the second most importance food crops after cereals in food security. Pulses are a good source of dietary protein. Significant part of protein in Indian diet come from pulses. Pulses improve human health as well as soil health by improves its nitrogen content through symbiotic nitrogen fixation from atmosphere and mushrooming the soil microorganism population in soil" [1].

"Madhya Pradesh is the largest producer of pulses accounting for 16.95 % of total pulses production. In Madhya Pradesh, pulses grown in an area about 48.67 lakh hectare with a production of 5.30 mt and the average productivity is 1084 kilogram per hectare". (Agricultural Statistics at a Glance, 2021). "In Madhya Pradesh, pigeon pea grown in an area about 4.04 lakh hectare with a production of 4.72 lakh ton and the average productivity is 1170 kilogram per hectare". (Annual Progress Report 2021-22, DPD Bhopal)

Pulses are blessed with an unique natural process of biological nitrogen fixation through which inert nitrogen present in atmosphere is converted into plant usable form. It is assumed that available soil nitrogen and fixed nitrogen by pulse crop is sufficient to meet out its major nitrogen requirement and minimum is required to be supplemented through chemical fertilizer [2].

"Nitrogen is most important plant growth promoting element. It increases the leaf area production that results in higher photosynthetic activity. The carbohydrates produced through photosynthesis provide energy to rhizobia bacteria. Poor nitrogen supply will affect the plant growth and there by photosynthesis which affect symbiosis" [3].

"Phosphorus is a component of adenosine triphosphate (ATP), which is the primary energy currency in cells. ATP stores and transfers energy within the plant, supporting essential processes like photosynthesis, respiration, and nutrient uptake. Phosphorus is essential for cell replication and the formation of new tissues, supporting overall plant growth. Phosphorus is crucial for root development in pigeon peas. Adequate phosphorus levels promote the growth of strong and healthy roots, enabling better absorption of water and essential nutrients from the soil" [4].

Potassium helps regulate the osmotic balance in plant cells. It plays a crucial role in maintaining cell turgor pressure, which influences cell expansion, water uptake, and overall plant hydration. Adequate potassium levels ensure proper water uptake and help plants withstand drought conditions. Potassium is required for the activation of numerous enzymes involved in various metabolic pathways within the plant. These enzymes are essential for photosynthesis, respiration, protein synthesis, and other vital cellular processes. Garg & Manchanda [5].

"FYM contains many species of living organisms which release phytohormones as GA3, IAA and CYT which stimulates plant growth, absorption of nutrients. There is a growing interest among the farmers to cultivate crops under organic farming because of the escalating cost of inorganic fertilizers, decreased soil fertility, environmental and health concerns due to pesticide usage and expected premium prices for organically grown crops" [6] "One of the important aspects of organic farming is the soil fertility or nutrient prepared from farm wastes is an important way of recycling nutrients to the management to optimize the crop productivity". Ramesh et al [6].

"Vermicomposting is a type of composting in which certain species of earthworm used to enhance the process of organic waste conversion and produce a better end-product. Vermicomposting is a mesophilic process utilizing microorganisms and earthworms. Earthworms feeds the organic waste materials and passes it through their digestive system and gives out in a granular form which is known as

vermicompost. The use of manures from livestock and the composts soil" [7]. Vermicompost enhances the availability of oxygen, soil porosity and water infiltration, maintains soil temperature, influences soil microbial activity, and improves soil water holding capacity. It also promotes plant growth, yield and quality [8].

Keeping in view the significance of potassic fertilizers in combination with organic manures on growth parameter, yield components and yield of pigeon pea present investigation was undertaken at Rajoula Agriculture farm, of Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot, Satna (M.P.)

2. MATERIALS AND METHODS

2.1 Experimental Site

The experiment was carried out at Rajaula Agriculture farm, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot, Satna (M.P.) which lies in the semi- arid and sub-tropical region of Madhya Pradesh between 25.148° North latitude and 80.855°East longitude. The altitude of town is about 190-210 meter above mean sea level.

2.2 Edaphic Condition

The soil was moist, well drained with uniform plane topography. The soil of the experimental field was alluvial in origin, sandy loam in texture and slightly alkaline in reaction having pH 7.25 (1:2.5 soil: water suspension method given by Jackson, [9] low in organic carbon percentage in soil is 0.22 per cent (Walkley and Black's rapid titration method given by Walkley and Black 10], low in available nitrogen 98.95 kg ha^{-1} (Alkaline permanganate method given by Subbiah and Asija [11], medium in available phosphorus as sodium bicarbonate-extractable P was 16.32 kg ha^{-1} (Olsen's calorimetrically method [12], high in available potassium was 262.99 kg ha^{-1} (Flame photometer method given by Hanwey and Heidel, [13].

2.3 Experimental Details

The experiment was laid out in randomized block design and replicated thrice comprising with 11 treatment combinations.

2.4 Fertilizer Application

FYM and vermicompost were applied as basal dose as per treatment. After the layout of experimental plot, the fertilizers were weighed and applied in the plots and thoroughly mixed with soil. As per the experimental recommended doses of Nitrogen, Phosphorus, Potassium and Sulphur were applied to all the plots. Recommended dose of Nitrogen, Phosphorus and Potassium were applied through Urea, DAP and MOP (20:60:40 kg ha^{-1}).

2.4.1 Seed and sowing

A seed rate of 12 kg per hectare of pigeon pea variety Prakhar (K 1055) was used and sowed on 28th July 2022. Row to row distance was 60 cm.

2.4.2 Harvesting

When the plants turned yellow and dried up, on 24th January, 2023, the crop was harvested. "After measuring the weight of the air-dried bundles with a spring balance, the harvested crop was tied in labelled bundles and threshed using a tractor-drawn thresher. Plot-by-plot records of the grain and straw yields were made and translated to q/ha" [14].

Table 1. Treatment details

Treatment	Treatment combination
T_1	100 % RDF
T_2	100 % N & P or 50 % K through MOP + 50 % K through FYM (Toxicity of K)
T_3	100 % RDF + 100 % K through FYM
T_4	100 % N & P + 50 % K MOP + 50 % K through Vermicompost (Toxicity of K)
T_5	100 % RDF + 100 % K through Vermicompost
T_6	100 % N & P, K- 50 % + 50 % K through FYM
T_7	100 % N & P, K- 50 % + 50 % K through Vermicompost
T_8	100 % N & P, K- 0 % + 50 % K through FYM
T_9	100 % N & P, K- 0 % + 100 % K through FYM
T_{10}	100 % N & P, K- 0 % + 50 % K through Vermicompost
T_{11}	100 % N & P, K- 0 % + 100 % K through Vermicompost

2.5 Observations Recorded

2.5.1 Grain yield (q ha^{-1})

"The total weight of clean and dried grains from each plot was weighed with the help of electronic balance in kg/ha and converted into q/ha" [14].

2.5.2 Straw yield (q ha^{-1})

"Straw yield of each plot can be obtained by deducting the grain yield from the respective biological yield and expressed in q/ha" [14].

2.6 Statistical Analysis

"The data on various characters studied during the course of investigation were statistically analyzed for randomized block design. Wherever treatment differences were significant ("F" test), critical differences were worked out at five per cent probability level. The data obtained during the study were analyzed statistically using the methods" advocated by Gomez and Gomez [15].

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

Data pertaining to growth parameters mainly no. of plants plot^{-1}, plant height (cm), number of leaves and number of branches plant^{-1} are presented in Table 2. clearly revealed that application of inorganic fertilizers and organic manures in different modes increased these attributes significantly over control. The results revealed that the plant population plot^{-1} varied in between 128.33 to 132.96 and all the treatments were non-significantly superior to treatment T_1 [100 % RDF]. The treatment combination T_{11} [100 % N & P, K- 0 % + 100 % K through Vermicompost] gave the maximum plant population plot^{-1} (132.96). Number of leaves of pigeon pea varied in between 165.2 to 208.6 and all the treatments were significantly superior to T_1 [100 % RDF]. The treatment combination T_{11} [100 % N & P, K- 0 % + 100 % K through Vermicompost] gave the maximum no. of leaves (208.6). Number of branches plant^{-1} of pigeon pea varied in between 22.4 to 32.8 and all the treatments were significantly superior to T_1 [100 % RDF]. The treatment combination T_{11} [100 % N & P, K- 0 % + 100 % K through Vermicompost] gave the maximum no. of branches plant^{-1} (32.8). These findings are further supported by Brar et al. [16] Verma et al. [17] and Gupta et al. [18].

3.2 Yield Components

Data pertaining to yield attributing parameters mainly no. of pod plant^{-1}, no. of seed pod^{-1} and seed index (g) are presented in Table 3. clearly revealed that application of inorganic fertilizers and organic manures increased these attributes significantly over control except seed index (g). Maximum no. of pod plant^{-1} (103.6), no. of seed pod^{-1} (4.4) and seed index (9.68 g) were recorded under the treatment T_{11} [100 % N & P, K- 0 % + 100 % K through Vermicompost] followed by treatment T_9 [100 % N & P, K- 0 % + 100 % K through FYM] with the value 100.5, 4.3 and 9.42 g respectively and the minimum no. of pod plant^{-1} (85.6) no. of seed pod^{-1} (3.5) and seed index (8.60 g) was recorded under the treatment T_1 (100 % RDF). These findings are further supported by Beena et al [19] Achakzai et al. [20] and Mishra et al. [21]

Table 2. Effect of different treatment combinations on growth parameters of pigeon pea

Treatment	Plant population plot^{-1}	Plant height (cm)	No. of leaves	No. of branches plant^{-1}
T_1	128.33	191.62	165.2	22.4
T_2	129.35	193.48	168.9	23.1
T_3	130.89	196.85	176.5	24.2
T_4	130.25	195.49	173.6	23.6
T_5	131.41	198.43	180.3	24.8
T_6	133.71	204.79	193.2	28.0
T_7	134.90	206.34	197.3	29.1
T_8	132.42	200.31	184.6	25.3
T_9	136.53	209.94	202.5	30.7
T_{10}	132.96	202.46	189.4	26.5
T_{11}	138.42	211.38	208.6	32.8
S.E.m±	1.34	5.29	3.58	1.75
C.D. (P= 0.05)	NS	15.87	10.74	5.26

Table 3. Effect of different treatment combinations on yield attributes of pigeon pea

Treatment	No. of pods plant^{-1}	No. of Seed pod^{-1}	Seed index (g)
T_1	85.6	3.5	8.60
T_2	87.9	3.5	8.71
T_3	90.6	3.7	8.85
T_4	88.5	3.6	8.79
T_5	92.4	3.8	8.91
T_6	96.7	4.1	9.15
T_7	98.9	4.2	9.26
T_8	93.5	3.9	8.97
T_9	100.5	4.3	9.42
T_{10}	95.4	4.0	9.05
T_{11}	103.6	4.4	9.68
S.E.m±	3.58	0.09	0.08
C.D. (P= 0.05)	10.75	0.27	NS

Table 4. Effect of different treatment combinations on yields of pigeon pea

Treatment	Grain yield (q ha^{-1})	Stover yield(q ha^{-1})
T_1	11.25	43.65
T_2	11.89	43.99
T_3	13.48	45.92
T_4	12.26	44.58
T_5	14.95	46.35
T_6	16.25	49.63
T_7	16.89	50.21
T_8	15.28	47.52
T_9	17.06	51.87
T_{10}	15.97	48.90
T_{11}	17.69	52.64
S.E.m±	0.81	2.05
C.D. (P= 0.05)	2.38	6.16

3.3 Productivity Parameters

It was observed that application of different inorganic fertilizers and organic manures both enhanced the grain yield and straw yield of pigeon pea significantly over its present in Table 4. Maximum grain yield (17.69 q ha^{-1}) was recorded under the treatment T_{11} [100 % N & P, K- 0 % + 100 % K through Vermicompost] followed by treatment T_9 [100 % N & P, K- 0 % + 100 % K through FYM] with the value 17.06 q ha^{-1} and the minimum grain yield (11.25 q ha^{-1}) was recorded under the treatment T_1 (100 % RDF). Maximum stover yield (52.64 q ha^{-1}) was recorded under the treatment T_{11} [100 % N & P, K- 0 % + 100 % K through Vermicompost] followed by treatment T_9 [100 % N & P, K- 0 % + 100 % K through FYM] with the value 51.87 q ha^{-1} and the minimum stover yield (43.65 q ha^{-1}) was recorded under the treatment T_1 (100 % RDF). These findings are further supported by the findings of Gaikwad et al. [22] Chaudhary et al. [23]and Pradeep et al. [24].

4. CONCLUSION

The experimental results indicated that superiority in regard to growth parameters, yield components and productivity parameters *viz,* grain yield (q ha^{-1}), straw yield (q ha^{-1}), with the use of treatment combination 100 % N & P, K- 0 % + 100% K through Vermicompost gave in soil ensure highest growth parameters, yield components and productivity, of barley crop as comparison to all the treatments.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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