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EFFECT OF ORGANIC AND INORGANIC SOURCES OF NUTRIENTS ON GROWTH, YIELD AND ECONOMICS OF PIGEONPEA

SATEESH KUMAR MISHRA, S.S PARIHAR AND K.N. NAMDEO*

Department of Chemistry, Govt. Girls P.G. College, Rewa (M.P.) 486 001
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ABSTRACT

A field experiment was conducted during rainy-cum-winter seasons of 2013-14 and 2014-15 at the Private Research Farm, Benda-Semaria Road, Rewa (M.P.) to study the effect of organic and inorganic sources of nutrients on growth, yield and quality of pigeonpea (Cajanus cajan L.). Amongst the applied organic sources of nutrients, farmyard manure (10 t FYM ha^{-1}) resulted in maximum growth (plant height 174.78 cm, primary, secondary and tertiary branches 24.1, 63.1 and 49.3/plant, respectively, triafoliates 255.9/plant, dry matter 37.75 g/plant, root nodules 8.46 and its dry weight 0.23 g/plant), yield attributes (pods 222.4/plant, pod length 2.25 cm, grains 4.52/pod and 100-grain weight 13.25 g). Application of 10t FYM ha^{-1} produced. The maximum grain and straw yield (11.83 and 57.14 q ha^{-1}) with additional net income of Rs.16704 ha^{-1} over control. Application of 100% RDF ($N_{20}P_{60}K_{20}$) produced maximum grain and straw (11.18 and 48.92 q ha^{-1} , respectively) giving extra net income of `13487 ha^{-1} over control.

Key words: Inorganic sources, nutrients, organic, pigeonpea

INTRODUCTION

Pigeonpea known as red gram or arhar is one of the major pulse crops only next to chickpea in India. It is cultivated in the 19% (3.63 m ha) of the gross cropped area under pulses and providing 23% (2.76 m tonnes) of the national pulse production. Its sustainable productivity depends on the balanced and nutritional management. The long term use of chemical fertilizers is known to degrade physico-chemical and biological properties of soil. The use of organic manures, vermicompost, biofertilizers, etc. improves the soil properties, its health and fertilizer use efficiency, mitigates short supply of micronutrients, stimulates the proliferation of diverse group of soil micro-organisms and plays an important role in the maintenance of soil fertility and improves the ecological balance of rhizosphere. Worm casts contain five times more N, seven times more P, and 11 times more K than ordinary soil, the main minerals needed for plant growth (Sharma and Agrawal, 2004). Vermicompost application to different field crops has been known to reduce the requirement of chemical fertilizers without any reduction in crop yield (Giraddi, 2000). Organic manures viz., FYM, poultry and pig manures are the store house of plant nutrients (Channabasavanna and Biradar, 2002). Biofertilzers are well known to increase the availability of nitrogen and phosphorus in the soil. So far no work has been done on the effect of organic and inorganic sources of nutrients on pigeonpea in Kymore plateau of M.P., hence the present experiment was taken up.

MATERIALS AND METHODS

The field experiment was conducted at the Private Agriculture-Research Farm, Benda-Semaria Road Rewa (M.P.) during 2013-14 and 2014-15. The soil was sandy-loam having pH 7.4, electrical conductivity 0.32 dS m^{-1}, organic carbon 6.0 g kg^{-1}, available N 220 kg ha^{-1}, available P_2O_5 23.8 kg ha^{-1}, available K_2O 372 kg ha^{-1} and available S 12.6 kg ha^{-1}. The total rainfall received from June to January was 759.8 and 794.2 mm in 2013-14 and 2014-15, respectively. The treatments comprised six organic sources (control, FYM, vermicompost, poultry manure, farm compost and *Rhizobium* + PSB + VAM biofertilizers) and four levels of NPK fertilizers (0, 50, 75 and 100% RDF ($N_{20}P_{60}K_{20}$). The experiment was laid out in randomized block design with three replications. Pigeonpea var. ICPL 87 was sown on 16 July @ 20 kg seed ha^{-1} in rows 60 cm apart in both the years. As per treatments, N, P and K were applied through urea, single superphosphate and muriate of potash, respectively. Before sowing seeds were treated with thirum fungicide and biofertilizers as per recommended procedure. Pigeonpea was grown as per package of practices. The crop was harvested in the last week of March in both the years. Growth and yield attributes as well as grain and straw yields were recorded at harvest. Economics of the treatments were calculated as per existing market rates of the inputs and the produce.

RESULTS AND DISCUSSION

Growth parameters

The data (Table 1) reveal that application of 10 t FYM ha^{-1} resulted in maximum plant height (174.78 cm), primary, secondary and tertiary branches (24.1, 63.7 and 49.3/plant, respectively), trifoliate leaves (255.9/plant) and dry matter (37.75 g/plant). This was followed by 5 t vermicompost ha^{-1}

**Email-drknnamdeo@gmail.com. College of Agriculture, Rewa 486 001 (M.P.) India*

and 5 t poultry manure ha^{-1} and 10 t compost ha^{-1}. The higher growth parameters with FYM over other organic manures may be owing to the fact that FYM is the cattle manure having multiple plant nutrients in their more beneficial proportion and availability for better plant growth and development. Moreover, the variable growth response to different organic sources depends on the variation in their nutrient contents, decomposition of organic residues, C:N ratio, nutrient release pattern, climate and soil characteristics. The performance of biofertilizers (*Rhizobium*, PSB and VA mycorrhiza) was not upto that extent owing to the fact that their activities facilitated to supply only nitrogen and phosphorus to the plants. The maximum plant growth parameters due to organics have been reported by Singh *et al.* (2013) and Saket *et al.* (2014). The increase in inorganic sources of nutrients upto 100% RDF ($N_{20}P_{60}K_{20}$) also significantly increased the growth parameters over control. The boosted vegetative growth and dry matter accumulation may be attributed to increased supply of major nutrients which ultimately promoted root growth and higher number of greener leaves (photosynthetic surface) with increased photosynthesis. These results corroborate with the findings of Patel *et al.* (2012), Singh *et al.* (2013) and Saket *et al.* (2014).

Table 1: Growth parameter of pigeonpea as influenced by organic and inorganic sources of nutrients (Mean of 2 years)

Treatments	Plant height (cm)	Primary branches / plant	Secondary branches / plant	Tertiary branches / plant	Trifoliate leaves/ plant	Dry matter/ plant (g)	Root nodules/ plant	Dry weight of nodules/ plant (g)
Organic sources								
Control	164.42	18.4	56.5	34.1	243.8	30.46	4.83	0.18
10 t FYM ha^{-1}	174.78	24.0	63.7	49.3	255.9	37.75	8.46	0.23
10 t Compost ha^{-1}	167.77	20.8	59.5	39.4	248.5	33.19	6.37	0.19
5 t Poultry manure ha^{-1}	171.61	21.6	60.1	41.9	250.7	35.05	6.46	0.20
5 t Vermicompost ha^{-1}	173.01	23.0	62.3	45.9	253.8	36.53	7.51	0.21
Biofertilizers	165.40	19.5	58.0	34.5	246.1	32.22	8.67	0.23
C.D. (P=0.05)	0.08	0.19	0.26	0.19	0.60	0.19	0.20	0.01
Inorganic sources								
Control	168.08	20.5	58.6	38.4	247.1	32.58	6.95	0.19
50% ($N_{10}P_{30}K_{10}$)	169.16	20.9	59.4	39.9	248.9	33.86	6.98	0.20
75% ($N_{15}P_{45}K_{15}$)	169.97	21.6	60.5	41.4	250.8	34.63	7.08	0.21
100% ($N_{20}P_{60}K_{20}$)	170.79	22.0	61.5	43.6	252.4	35.73	7.19	0.23
C.D.(P=0.05)	0.06	0.15	0.21	0.15	0.49	0.16	NS	0.01

Yield attributes and yield

Application of 10 t FYM ha^{-1} recorded significantly higher yield attributes (viz., pods/plant, pod length, grains/pod and 100-grain weight as well as grain and straw yields (11.83 and 57.14 q ha^{-1},) over the other organic sources. This was followed by 5 t vermicompost ha^{-1} and 5 t poultry manure ha^{-1} and 10 t compost ha^{-1} (Table 2). The higher yield and yield attributes may be owing maximum growth parameters including leaves (photosynthetic surface area) recorded with these organics. A high rate of photosynthesis is always associated with higher productivity (Sanwal *et al.*, 2007). The higher yield response due to organics ascribed to improvement in the physical and biological properties of soil which resulted in better supply of plant nutrients and led to good crop growth and yields. Biofertilizers recorded the lower yield attributes owing to lower growth parameters as a result of supplying only N and P to the plants. These results are in accordance with the findings of Shad and Namdeo (2009), Singh *et al.* (2013) and Saket *et al.* (2014).The increasing NPK levels upto 100% RDF increased the yield attributes and yield of pigeonpea significantly, the grain and straw yields being upto 11.18 and 48.92 q ha^{-1}, respectively. The increased supply of NPK might have increased multi-role activities in plant and soil which, in turn, resulted in greater accumulation of carbohydrates, protein and their translocation to the reproductive organs i.e. yield components. These results corroborate the findings of Singh *et al.* (2013) and Saket *et al.* (2014).

Economics

Application of 10 t FYM ha^{-1} gave the maximum net income (`.31384 $ha^{-1}$), followed by 5 t vermicompost $ha^{-1}$ (`. 27455 ha^{-1}) and then 5 t poultry manure ha^{-1} (`.21612 ha^{-1}). The minium values of net returns and B:C ratio were realized with poultry

manure on account of high cost of poultry manure (Tyagi and Upadhyay, 2015). The B:C ratio was 1.94,

Table 2: Yield and yield attributing parameters of pigeonpea as influenced by organic and inorganic sources of nutrients (Mean of 2 years)

Treatments	Pods/ plant	Pod length (cm)	Grains/ pod	100-grain weight (g)	Grain yield (qha^{-1})	Straw yield (qha^{-1})	Harvest index	Net income (`.ha^{-1})	B:C ratio
Organic sources									
Control	159.8	1.84	3.18	10.18	6.88	37.49	15.39	14680	1.63
10 t FYM ha^{-1}	222.4	2.25	4.52	13.25	11.83	57.14	17.11	31384	1.94
10 t Compost ha^{-1}	182.8	1.94	3.63	11.49	9.68	43.62	18.07	19281	1.58
5 t Poultry manure ha^{-1}	193.9	2.03	3.90	11.93	10.05	48.31	17.14	21612	1.64
5 t Vermicompost ha^{-1}	205.6	2.10	4.24	12.40	11.14	52.32	17.49	27455	1.82
Biofertilizers	171.7	1.87	3.49	10.57	8.12	39.74	16.78	18869	1.74
C.D. (P=0.05)	2.12	0.04	0.022	0.044	0.32	0.10	0.15	--	--
Inorganic sources									
Control	181.5	1.96	3.64	11.33	8.18	44.11	15.53	15970	1.54
50% ($N_{10}P_{30}K_{10}$)	186.7	2.00	3.78	11.56	9.05	45.71	16.37	19488	1.63
75% ($N_{15}P_{45}K_{15}$)	192.8	2.02	3.89	11.71	11.02	47.00	17.51	23938	1.77
100% ($N_{20}P_{60}K_{20}$)	196.8	2.03	3.98	11.95	11.18	48.92	18.57	29457	1.94
C.D.(P=0.05)	1.70	0.03	0.018	0.036	0.26	0.08	0.12	--	--

1.82 and 1.64, respectively. The increase in net income under these treatments was owing to similar increases in grain and straw yields. Similarly 100% RDF ($N_{20}P_{60}K_{20}$) gave the maximum net income of `. 29457 ha^{-1} with B:C ratio 1.94. This was due to maximum productivity under this treatment.

It may be concluded that the application of 10 t FYM ha^{-1} as well as 100% RDF ($N_{20}P_{60}K_{20}$) recorded maximum growth, yield and net income from pigeonpea var. ICPL-87 in Kymore plateau of Madhya Pradesh.

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