PERFORMANCE OF PIGEONPEA (CAJANUS CAJAN L. MILLSP.) VARIETIES UNDER NUTRIENT MANAGEMENT GROWN IN KHARIF SEASON

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ABSTRACT

The field experiments were conducted at Agronomy Department Farm, College of Agriculture, Dapoli. Dist. Ratnagiri during *Kharif* seasons 2012 and 2013 to study the "Response of pigeonpea (*Cajanus cajan* L. Millsp.) varieties to nutrient management grown in *Kharif* season". The experiment was laid out in a split plot design with three replications. The main plot treatments were four varieties, namely, Konkan Tur-1, ICPL-87, Vipula and BSMR-736. The sub plot treatments comprised six nutrient management treatments *viz.*, Control (F_1-No application of nutrients), RDF (F_2-25:50:00 NPK Kg ha^{-1}), RDF + Biofertilizers - *Rhizobium* + PSB (F_3), 75 % RDF + Two foliar sprays of nutrients (Potassium nitrate 1% + DAP 1% + Boron 500 ppm at flowering and 20 days after first spray) + Biofertilizers - *Rhizobium* + PSB (F_4), 100 % RDF + Two foliar sprays of nutrients (Potassium nitrate 1% + DAP 1% + Boron 500 ppm at flowering and 20 days after first spray) + Biofertilizers - *Rhizobium* + PSB (F_5) and application of major and micronutrients based on soil test (NPK through soil + micronutrients (Cu, Zn, B and Mn) through foliar spray) + Biofertilizers - *Rhizobium* + PSB (F_6). Results revealed that BSMR-736 variety of pigeonpea produced maximum and significantly higher grain and stalk yields during individual years as well as in pooled data as compared to rest of the varieties. The grain and stalk yields of pigeonpea during individual years as well as in pooled analysis were significantly higher when the crop was supplied with major and micronutrients based on soil test (25:75:00 $N:P_2O_5:K_2O$ kg ha^{-1} through soil and micronutrients 0.075 : 0.75 : 0.25 : 0.50 % Cu:Zn:B:Mn through foliar spray) along with seed inoculation of *Rhizobium* and PSB @ 25 g each kg^{-1} seeds. (F_6) as compared to other treatments.

Keywords* : *Pigeonpea, Nutrient Management, Growth, Yield

I INTRODUCTION

Pigeonpea (*Cajanus cajan* L. Millsp.) is one of the important pulses crop of India and ranks second after chickpea in area and production. It is commonly known as 'Redgram' or 'Arhar'. Endowed with several unique characters, pigeonpea finds an important place in the farming systems adopted by the farmers in the large number of developing countries including India. It is grown on a wide range of soil with varying physical and chemical properties. Pigeonpea being a legume, it fixes atmospheric nitrogen. The leaf fall at maturity adds organic matter to the soil. The outstanding deep root system allows for optimum moisture and nutrients utilization which enables it to tolerate drought, the deep root system breaks the hard pans and hence it is often called as "biological plough". The yield of any crop depends on the production potential of the cultivar and climatic, edaphic and management practices to which the cultivar is exposed. The cultivars recommended earlier in the region or in different agro-climatic conditions be tested with newly introduced or developed cultivars so as to understand the production potential of different cultivars to that region. The main reason for low productivity of pigeonpea is its cultivation in marginal and sub marginal lands under poor management. Yield is the manifestation of various physiological processes occurring in plants and these are usually modified by management practices in an environment. Among the management practices fertilization is the most important factor in determining yield of pigeonpea. Low production of pigeonpea attributed to the facts that, the crop is usually grown during rainy season on marginal and less fertile soils. Further, lack of proper nutrient management is one of the major causes of low yield. The decline in application of seed treatment of Biofertilizers nutrients and foliar spray of potassium nitrate, DAP and boron that can regulate the nutrient availability and sustain the productivity along with numerous other known advantages need to be refocused in conjuction with micronutrients (Cu, Zn, B, Mn). The use of micronutrients in pigeonpea is one of the way to boost up the productivity and to improve the seed quality parameters. Since pigeonpea crop is selected for the study, the knowledge of cost, returns and its profitability useful for the farmers who want to substitute this crop for the traditional crop grown in the area, the finding of study would be helpful to economic management of pigeonpea. It will also provide the probable combinations of chemical fertilizers, biofertilizers and micronutrients on the basis of soil test approach. The information on nutrient requirements of pigeonpea to be supplied through inorganic fertilizers is available, however, the information on differential response of pigeonpea varieties to integrated nutrient management is lacking.

II MATERIAL AND METHODS

The field experiments were conducted at Agronomy Department Farm, College of Agriculture, Dapoli. Dist. Ratnagiri during kharif seasons 2012 and 2013 to study the Response of pigeonpea (Cajanus cajan L. Millsp.) varieties to nutrient management grown in Kharif season. The experiment was laid out in a split plot design with three replications. The main plot treatments were four varieties, namely, Konkan Tur-1, ICPL-87, Vipula and BSMR-736 to evaluate their response to nutrient management. Whereas sub plot treatments comprised six nutrient management treatments viz., Control (F1-No application of nutrients), RDF (F2-25:50:00 NPK Kg ha-1), RDF +

Biofertilizers - Rhizobium + PSB (F3), 75 % RDF + Two foliar sprays of nutrients (Potassium nitrate 1% + DAP 1% + Boron 500 ppm at flowering and 20 days after first spray) + Biofertilizers - Rhizobium + PSB (F4), 100 % RDF + Two foliar sprays of nutrients (Potassium nitrate 1% + DAP 1% + Boron 500 ppm at flowering and 20 days after first spray) + Biofertilizers - Rhizobium + PSB (F5) and application of major and micronutrients based on soil test (NPK through soil + micronutrients (Cu, Zn, B and Mn) through foliar spray) + Biofertilizers - Rhizobium + PSB (F6). The sub- plot treatments within the main plot were allotted by using random number table. The experiment was conducted at the same site during both the seasons without changing the randomisation of the treatments. The soil analysis indicated that the soil of the experimental plot was sandy clay loam in texture, moderately high in organic carbon (0.95 %), medium in available nitrogen (376.80 kg ha-1), low in available phosphorus (9.20 kg ha-1), medium in available potassium (309.74 kg ha-1), high in available copper (1.89 mg kg-1), low in available zinc (0.44 mg kg-1) and boron (0.25 mg kg-1), medium in available manganese (56.04 mg kg-1) and slightly acidic in reaction (pH 5.80).

The quantity of major nutrients, foliar spray of nutrients and micronutrients dose was calculated and applied in the plots as per the treatments. Nitrogen and phosphorus were applied in the form of urea (46 % N) and single superphosphate (16 % P2O5), respectively as per the treatments as a basal dose at sowing. The foliar application of nutrients was done at flowering and 20 days after first spray as per the treatments. Sowing of different varieties of pigeonpea was done on 8th June 2012 and 2nd June 2013 by using the seed rate of 18 to 20 kg ha-1 as per the treatments during both the years. Required quantity of healthy, bold, unbroken and fully developed seeds of pigeonpea varieties was inoculated with Rhizobium + PSB biofertilizers @ 25 g each kg-1 seeds as per the treatments before sowing of the crop. Rows were marked on the field with the help of marker and biofertilizers treated and untreated seeds were sown at the spacing of 60 x 30 cm as per the treatments. Two seeds were dibbled at each spot at about 3 cm depth. To assess the effect of treatments on the growth and development of crop plants, periodic observations were recorded.

III RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads:

3.1 Effect on growth

Performance of pigeon pea varieties

Variety BSMR-736 produced significantly taller plants, produced significantly more number of branches plant^{-1}, recorded maximum and significantly higher root nodule count plant^{-1} and accumulated significantly higher dry matter plant^{-1} as compared to Vipula, Konkan Tur-1 and ICPL-87 at harvest during both the years. The reason for high dry matter accumulation in BSMR-736 may be traced to the significant increase in morphological parameters *viz*., plant height, number of branches plant^{-1} and number of root nodules plant^{-1} which are responsible for the

photosynthetic capacity of an individual plant. Similar results were also reported by Johansen *et al*. (1992), Bhongle *et al*. (2005).

3.2 Effect of nutrient management

Application of nutrients recorded maximum and significantly higher plant height, number of branches plant^{-1}, root nodule count plant^{-1} and higher dry matter plant^{-1} of pigeonpea over no application of nutrients (F_1- Control) at harvest during both the years.

Among the nutrient management treatments application of major and micronutrients based on soil test (NPK through soil + micronutrients through foliar spray) along with biofertilizers (F_6) produced maximum and significantly higher plants, number of branches plant^{-1}, root nodules plant^{-1} and accumulated maximum and significantly higher dry matter plant^{-1} over rest of the treatments at harvest during both the years may be attributed to the supply of balanced nutrition in available forms of essential primary, secondary and micronutrients in sufficient quantities through soil pool and foliar sprays to the crop due to this nutrient management treatment. Further, the effect observed with the dual inoculation of both the bioinoculants alongwith inorganic sources of nutrients might be due to the fixation of nitrogen by *Rhizobium* and possible solubilization of fixed P (as alumina and iron phosphates) as well as applied P besides synthesis of growth promoting substances like auxins, gibbrellins and produced vitamins which augmented plant growth by phosphorus solubilizing species, might have improved vigour and resulted in recording higher values of morphological parameters which increased photosynthetic capacity of plants thereby increasing the biological yield in terms of dry matter production plant^{-1}. Foliar sprays of copper, zinc, boron and manganese micronutrients might have been used more efficiently by the plant resulting in enhanced growth and development of plants because of their active role in plant metabolic processes such as photosynthesis, respiration and carbohydrate and amino acid synthesis which contributed for increase in various growth parameters. These results conoborates the findings of Abd-El-Lateff *et al*. (1998), Sharma *et al*. (1999).

3.3 Effect on yield

Performance of pigeonpea varieties

Variety BSMR-736 produced maximum and significantly higher grain yield, stalk yield and harvest index as compared to rest of the varieties during both the years as well as in pooled data.

On the basis of pooled data the grain yield (16.08 q ha^{-1}) of BSMR-736 was 19.77, 26.92 and 33.89 per cent higher over Vipula, Konkan Tur-1 and ICPL-87, respectively. On the basis of two years pooled data, the stalk yield (61.21 q ha^{-1}) of BSMR-736 was 8.47, 9.87 and 33.82 per cent higher over Vipula, Konkan Tur-1 and ICPL-87, respectively. These increased yield attributes of BSMR-736 might be due to increased growth parameters. Similar results have been reported by Reddy *et al*. (1985).

3.4 Effect of nutrient management

Application of nutrients produced significantly higher grain yield, stalk yield and harvest index than no application of nutrients (F_1- Control) during both the years and in pooled data.

Pigeonpea supplied with of major and micronutrients based on soil test (NPK through soil + micronutrients through foliar spray) along with biofertilizers (F_6) produced maximum and significantly higher grain yield, stalk yield and harvest index over rest of the nutrient management treatments during both the years. Further, 100 % RDF + Two foliar sprays (Potassium nitrate 1% + DAP 1% + Boron 500 ppm at flowering and 20 days after first spray) with biofertilizers (F_5) produced significantly higher grain yield, stalk yield and harvest index over RDF alone (F_2), RDF along with biofertilizers (F_3) and 75 % RDF + Two foliar sprays (Potassium nitrate 1% + DAP 1% + Boron 500 ppm at flowering and 20 days after first spray) with biofertilizers (F_4) during both the years. Application of RDF along with biofertilizers (F_3) and 75 % RDF + Two foliar sprays (Potassium nitrate 1% + DAP 1% + Boron 500 ppm at flowering and 20 days after first spray) with biofertilizers (F_4) were at par with each other and both the treatments recorded significantly higher grain yield, stalk yield and harvest index than RDF alone (F_2) during both the years. However, when the data were pooled over the seasons, all the nutrient management treatments *viz*., F_6, F_5, F_4, F_3 and F_2 differed significantly from one another in descending order.

On the basis of two years pooled data the grain yield (16.99 q ha^{-1}) obtained under F_6 treatment was 11.53, 21.07, 25.48, 39.78 and 48.67 per cent higher over F_5, F_4, F_3, F_2 and F_1, respectively. Similarly, in the pooled analysis the increases in grain yield due to F_5 was 10.77, 15.76, 31.99, and 41.98 per cent higher compared to F_4, F_3, F_2 and F_1, respectively. The marked improvement in yield attributes was due to the significant improvement in growth parameters which favourably reflected on the yield attributes of the pigeonpea due to the application of major and micronutrients based on soil test (NPK through soil + micronutrients through foliar spray) along with biofertilizers (F_6). Further, foliar application of micronutrients at flowering and 20 days after first spray would have helped for reducing flower drop and contributed more for reproductive parts resulting in increased number of pods $plant^{-1}$. The results are in agreement with those of Chittapur *et al*. (1994), Dixit *et al*. (2007).

IV CONCLUSION

Pigeonpea variety BSMR-736 be grown to obtain higher grain and stalk yields in lateritic soils of south Konkan conditions. To obtain higher grain and stalk yields from pigeonpea, the crop be fertilized with application of major and micronutrients based on soil test (25:75:00 N:P2O5:K2O kg ha-1 through soil and micronutrients 0.075 : 0.75 : 0.25 : 0.50 % Cu:Zn:B:Mn through foliar spray) along with seed inoculation of Rhizobium and PSB @ 25 g each kg^{-1} seeds.

Table 1. Mean growth parameters of pigeonpea as influenced by different treatments

Treatments	plant height (cm)		number of branches plant^{-1}		root nodules plant^{-1}		dry matter accumulation plant^{-1} (g)	
	2012	2013	2012	2013	2012	2013	2012	2013
Variety								
V_1 - Konkan Tur- 1	186.41	184.40	21.82	19.73	28.76	27.97	112.51	109.89
V_2 - ICPL- 87	124.03	121.95	20.50	18.56	29.14	27.47	73.49	70.82
V_3 - Vipula	187.63	185.58	22.78	20.71	29.42	28.12	113.30	110.66
V_4 - BSMR-736	193.96	192.88	25.50	23.06	38.56	36.28	124.08	121.86
S.Em. ±	0.36	0.37	0.29	0.33	0.11	0.15	0.24	0.23
CD at 5%	1.26	1.29	1.02	1.14	0.37	0.51	0.83	0.78
Nutrient management								
F_1 - Control	167.29	165.45	18.14	16.02	27.03	25.63	101.34	98.74
F_2 - RDF	171.08	169.28	21.08	18.97	29.41	27.85	103.72	101.38
F_3 – RDF + Biof.	172.62	170.81	22.34	20.24	30.94	29.39	105.34	102.76
F_4 – 75 % RDF + 2 FS + Biof.	173.99	172.19	23.42	21.32	32.06	30.59	106.45	103.88
F_5 – 100 % RDF + 2 FS + Biof.	175.62	173.82	24.81	22.64	33.73	32.19	108.22	105.66
F_6 – STCR approach + Biof.	177.47	175.68	26.13	23.90	35.65	34.11	110.01	107.46
S.Em. ±	0.51	0.53	0.44	0.41	0.40	0.51	0.46	0.48
CD at 5%	1.45	1.52	1.25	1.18	1.13	1.46	1.31	1.36
Interaction								
S.Em. ±	1.02	1.06	0.88	0.83	0.79	1.02	0.92	0.95
C.D. at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
General mean	173.01	171.20	22.65	20.51	31.47	29.96	105.84	103.31

Table 2. Mean grain, stalk yield and harvest index of pigeonpea as influenced by different treatments

Treatments	Grain yield (qha^{-1})			Stalk yield (qha^{-1})			Harvest Index (%)	
	2012	2013	Pooled	2012	2013	Pooled	2012	2013
Variety								
V_1 - Konkan Tur- 1	12.27	11.22	11.75	56.16	54.32	55.24	17.54	16.63
V_2 - ICPL- 87	11.14	10.13	10.63	41.48	39.64	40.56	20.89	20.02
V_3 - Vipula	13.33	12.47	12.90	56.94	55.10	56.02	18.72	18.17
V_4 - BSMR-736	16.53	15.64	16.08	62.10	60.31	61.21	20.92	20.47
S.Em. ±	0.34	0.37	0.50	0.34	0.39	0.52	-	-
CD at 5%	1.16	1.28	1.73	1.18	1.36	1.80	-	-
Nutrient management								
F_1 - Control	9.27	8.17	8.72	49.73	47.88	48.81	15.61	14.44
F_2 - RDF	10.73	9.73	10.23	51.96	50.11	51.04	17.01	16.09
F_3 – RDF + Biof.	13.14	12.18	12.66	53.67	51.83	52.75	19.70	19.04
F_4 – 75 % RDF + 2 FS + Biof.	13.89	12.94	13.41	54.79	52.95	53.87	20.22	19.61
F_5 – 100 % RDF + 2 FS + Biof.	15.51	14.55	15.03	56.57	54.73	55.65	21.58	21.04
F_6 – STCR approach + Biof.	17.35	16.62	16.99	58.31	56.55	57.43	22.96	22.73
S.Em. ±	0.49	0.52	0.14	0.57	0.54	0.15	-	-
CD at 5%	1.40	1.48	0.39	1.64	1.54	0.43	-	-
Interaction								
S.Em. ±	0.98	1.04	0.56	1.14	1.08	0.61	-	-
C.D. at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	-	-
General mean	13.32	12.36	12.84	54.17	52.34	53.26	-	-

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