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Nutrient uptake pattern of pigeonpea (*Cajanus cajan*) as influenced by integrated nutrient management

A.B. PATIL* AND D.R. PADMANI

Department of Agronomy, College of Agriculture, Junagadh Agricultural University, JUNAGADH (GUJARAT) INDIA

ABSTRACT

Field experiment was conducted during *kharif* 2001-02 to study the effect of integrated nutrient management on pigeonpea crop with the treatments comprised of biofertilizers, farmyard manure, recommended dose of fertilizers and their all possible combinations. The results revealed that the pigeonpea seeds inoculated with *Rhizobium* plus *P.striata* significantly increased the content as well as uptake of nitrogen, phosphorus and potassium by grain as well stalk over uninoculated control. Similar trend was also observed with application of FYM 5 t ha^{-1} over control (No manure). Pigeon crop fertilized with 75 and 100 % RDF ha^{-1} were found equally effective and significantly superior over 50 % RDF ha^{-1} and control with respect to content and uptake of nitrogen, phosphorus and potassium by grain as well as stalk. However the highest values of these parameters were recorded with 100 % RDF ha^{-1}.

Key words: Pigeonpea, INM, Nitrogen, Phosphorus, Potassium, Content, Uptake.

INTRODUCTION

Legumes are considered as soil recuperative crops and are generally grown without fertilization under rainfed conditions. Data collected on nutrient uptake however, reveals that sufficient amount of nutrients are removed by pulse crops. Pigeonpea occupies a prominent position as rainy season (*kharif*) pulse crop. Pigeonpea requires about 63.3 kg N, 15.8 kg P_2O_5 and 49.8 kg K_2O per hectare to produce 1 tonne of pigeonpea grains (Tamboli *et al*., 1995). In the schedule of fertilization, it is important to know the accumulation of nutrients in the crop, as most of the applied nutrients are lost through leaching, volatilization, denitrification and chemical fixation in soil. Practically very limited information is available on the concentration and uptake of nutrients by pigeonpea crop grown with variable levels of recommended dose of fertilizers, farmyard manure and biofertilizers. So it has been considered worthwhile to study the concentration and uptake of nutrients in pigeonpea as affected by integrated nutrient management.

MATERIALS AND METHODS

An investigation was carried out on clayey soil during rainy season of 2001-02 at Gujarat Agricultural University, Junagadh. Initially the soil of experimental plot had the following characteristics: pH 7.7, organic carbon 0.72%, total nitrogen 0.62% available phosphorus 37.80 kg $ha^{-1}$and available potassium 293.60 kg ha^{-1}. There were 16 treatment combinations consisting of two levels of Biofertilizers (with and without seed inoculation of *Rhizobium* plus *Pseudomonas striata*), two levels of FYM (with and without 5 ton FYM_{ha}^{-1}) and four levels of Recommended dose of fertilizers (0, 50, 75 and 100 % RDF_{ha}^{-1}). The experiment was laid out with factorial concept in randomized block design with four replication. Pigeonpea Cv. GT-1 was sown at 90cm x 20cm spacing with 15 kg seed/ha in first week of July. The recommended dose of fertilizers @ 25:50:0 kg N: P: K ha^{-1} was considered as 100% RDF.The crop was fertilized as per treatments with application of urea and diammonium phosphate at the time of sowing, while well decomposed FYM containing 0.5 % N, 0.2% P_2O_5 and 0.5 % K_2O was applied 10 days prior to sowing as per treatments. Seed was inoculated with a culture of Rhizobium plus *Pseudomonas striata* as per treatments before sowing. Other cultural operations were done as per recommendation and crop requirements. During crop growth period about 547.6mm rainfall was received in 41 rainy days. N content of grain and stalk was estimated adopting micro-kjeldahl method. Diacid (HNO_3 + $HClO_4$ in 10:4) digested grain and stalk samples were analyzed for P by vanadomolybdo-phosphoric acid method and K by flame photometry. Nutrient uptake was calculated using the grain and stalk yields.

RESULTS AND DISCUSSION

Effect on Nutrients Content :

The N, P and K content of grain as well as stalk were significantly increased by seed inoculation with *Rhizobium* plus *P. striata* over uninoculated control. Significantly the highest N (3.515 %), P (0.502%) and K (0.797%) content in grain as well as the highest N (1.128

* Author for correspondence.

Table 1 : Effect of biofertilizers, farmyard manure and recommended dose of fertilizers on nitrogen, phosphorus and potassium content by pigeonpea crop

Treatments	Nitrogen Content (%)		Phosphorus Content (%)		Potassium Content (%)	
	Grain	Stalk	Grain	Stalk	Grain	Stalk
Biofertilizers (*Rhizobium* + *P. striata*)						
B_0 No inoculation	3.385	1.078	0.483	0.161	0.750	1.550
B_1 Inoculation	3.515	1.128	0.502	0.167	0.797	1.639
CD (P = 0.05)	0.09	0.016	0.012	0.004	0.021	0.42
Farmyard manure (FYM)						
F_0 No FYM	3.397	1.088	0.485	0.161	0.719	1.484
F_1 FYM 5 t ha^{-1}	3.504	1.118	0.500	0.167	0.828	1.705
CD (P = 0.05)	0.09	0.016	0.012	0.004	0.021	0.042
Recommended dose of fertilizers (RDF)						
R_0 0% RDF ha^{-1}	3.193	1.020	0.456	0.152	0.726	1.484
R_1 50% RDF ha^{-1}	3.469	1.104	0.495	0.165	0.772	1.583
R_2 75% RDF ha^{-1}	3.534	1.131	0.505	0.168	0.791	1.622
R_3 100% RDF ha^{-1}	3.604	1.156	0.515	0.172	0.807	1.691
CD (P = 0.05)	0.12	0.023	0.017	0.006	0.030	0.059

%), P (0.167%) and K (1.639%) content in stalk were recorded when pigeonpea seeds were inoculated with biofertilizers over control (Table 1). This might be due to symbiotic nitrogen fixation by *Rhizobium* makes plant roots more efficient to absorb the nutrients and production of chelating compounds by *P. striata* which remove cations from insoluble phosphates and release soluble P which may be taken up by plants while the increase in potassium content due to microbial inoculation might be attributed to increased concentration of potassium in soil solution and its absorption by the plants. The results are in accordance with the findings Rana *et al.* (1998).

Manuring the crop with FYM 5 t ha^{-1} significantly increased the N,P and K content of grain as well as stalk as compared to control. The crop manured with FYM 5 t ha^{-1} resulted in significantly the highest N (3.504 %), P (0.500%) and K (0.828%) content in grain as well as the highest N (1.118 %), P (0.167%) and K (1.705%) content in stalk than control (Table 1). This improvement in N, P and K contents might be resulted due to the fact that, upon decomposition, FYM release these nutrients and increases their availability in the soil due to production organic acids. Saghin (1998) also reported similar results with application of FYM in horsebean crop.

Each incremental level of recommended dose of fertilizers significantly increased the N, P and K content of grain as well as stalk. However the highest values of these nutrients were recorded with 100% RDF ha^{-1}, it was found stastically at par with 75% RDF ha^{-1} in case of N, P and K content of grain (Table 1). It may be noted that fertilization increases the cation exchange capacity of plant roots and thus makes them more efficient in absorbing nutrients (Tamhane *et al.*, 1964). The findings are coroborate the report of Kene *et al.* (1990).

Effect on Nutrients Uptake :

The seed inoculation with biofertilizers significantly increased the uptake of N, P and K uptake by grain as well as by stalk over uninoculated control. Significantly the highest N (45.17 kg ha^{-1}), P (6.45 kg ha^{-1}) and K (10.25 kg ha^{-1}) uptake by grain as well as the highest N (30.48 kg ha^{-1}), P (4.52 kg ha^{-1}) and K (45.52 kg ha^{-1}) uptake by stalk were recorded with biofertilizers inoculation as compared to control (Table 2). This might be attributed to the reason that, due to bacterial activities, more of the nutrients were being made available to the crop by nitrogen fixation as well as release of native phosphates and potassium. Rana *et al.* (1998) also reported significant improvement in uptake of nutrients owing to biofertilizers inoculation.

Significantly the highest values of N, P and K uptake by grain as well as stalk were noted when the crop was manured with FYM 5 t ha^{-1} over control. Significantly the highest N (45.07 kg ha^{-1}), P (6.43 kg ha^{-1}) and K

Table 2 : Effect of biofertilizers, farmyard manure and recommended dose of fertilizers on nitrogen, phosphorus and potassium uptake by pigeonpea crop

Treatments	Nitrogen uptake (kg ha^{-1})		Phosphorus uptake (kg ha^{-1})		Potassium uptake (kg ha^{-1})	
	Grain	Stalk	Grain	Stalk	Grain	Stalk
Biofertilizers (*Rhizobium* + *P. striata*)						
B_0 No inoculation	41.85	25.34	5.98	3.81	9.29	36.52
B_1 Inoculation	45.17	30.48	6.45	4.52	10.25	44.52
CD (P = 0.05)	1.65	0.71	0.24	0.12	0.39	1.32
Farmyard manure (FYM)						
F_0 No FYM	41.95	25.94	5.99	3.88	8.88	35.36
F_1 FYM 5 t ha^{-1}	45.07	29.87	6.43	4.45	10.66	45.68
CD (P = 0.05)	1.65	0.71	0.24	0.12	0.39	1.32
Recommended dose of fertilizers (RDF)						
R_0 0% RDF ha^{-1}	34.66	24.29	4.95	3.60	7.91	35.60
R_1 50% RDF ha^{-1}	40.03	27.48	5.72	4.10	8.91	39.59
R_2 75% RDF ha^{-1}	48.67	29.44	6.95	4.38	10.88	42.33
R_3 100% RDF ha^{-1}	50.68	30.42	7.24	4.58	11.36	44.56
CD (P = 0.05)	2.33	0.99	0.33	0.17	0.55	1.87

(10.66 kg ha^{-1}) uptake by grain as well as the highest N (29.87 kg ha^{-1}), P (4.45 kg ha^{-1}) and K (45.68 kg ha^{-1}) uptake by stalk were recorded with application of FYM 5 t ha^{-1} than control (Table 2). The increased uptake of N, P and K might be due to more availability of nutrients coupled with favorable solubility action of organic acids produced during the mineralization of farmyard manure along with improved soil physical environment. Similar results were reported by of Rao and Dart (1980).

The crop fertilized with 75 and 100 % RDF ha^{-1} were found equally effective and significantly superior over 50 % RDF ha^{-1} and control with respect to uptake of nitrogen, phosphorus and potassium by grain as well as stalk. The highest uptake of N (45.17 kg ha^{-1}), P (7.24 kg ha^{-1}) and K (11.36 kg ha^{-1}) by grain as well as uptake of only nitrogen by stalk were recorded with 100% RDF ha^{-1}, but it was found stastically at par with 75% RDF ha^{-1} (Table 2).The increase in uptake of these nutrients with successive increase in fertilization was due to added supply of nutrients and proliferous root system developed under nutrient application resulting in better absorption of water and nutrients (Grewal and Trehan 1979).

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