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Influence of Phosphorus Levels on Green Fodder Yield and Quality of Fodder Cowpea Genotypes

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A field experiment was conducted to assess the impact of phosphorus levels *viz*., 30, 60 and 90 kg/ha on the performance of diverse genotypes of fodder cowpea *viz.,* MFC 08-14, IL-1177, UPC-9202, UPC-5286 and Bundel Lobia-1 under advance varietal trial during *kharif* season, 2012. The genotype IL-1177 recorded a maximum green fodder yield of 28.2 t/ha which is 16.7 % higher than UPC-9202, 13.5% higher than UPC-5286 and 6.7% higher than Bundel Lobia-1. Application of 90 kg P_2O_5 /ha had strikingly enhanced the green fodder yield to 27.0 t/ha. Cowpea genotype IL-1177 with application of 90 kg P_2O_5 /ha was found to be profitable.

Key words: Green fodder, Phosphorus levels, Cowpea genotypes, Crude protein, Benefit: Cost ratio

Supply of good quality fodder will fulfill the nutritional requirement of milch animals, which in turn could enhance the productivity per animal (Faruqui and Sunilkumar, 2009). Cowpea (*Vigna unguiculata* L.Walp*)* is one of the important leguminous fodder crops widely grown mainly during *kharif* season under tropical climatic conditions. It is an excellent source of protein and minerals such as phosphorus and calcium. It also offers economic means of incorporating nitrogen into the soil-plant-animal system (Mojumdar *et al*., 2010). Animal nutrition studies revealed the possibility of total replacement of costly concentrates, with calculated feeding of green legumes to milch animals, yielding up to 10 kg milk per day (Bose and Balakrishnan, 2001).

The crude protein content together with cell wall constituents such as NDF, ADF and lignin are the most important factors governing the voluntary intake and digestibility (Vansoest *et al.,* 1991) . Cowpea fodder is found to possess quite a good amount of crude protein and other quality parameters.The quality of certain forage crops is said to be improved when they were adequately supplied with phosphorus (Tisdale and Nelson, 1975). According to Shen *et al.* (2004) the increase of total N and P in soil due to fertilization has resulted in maintaining soil fertility. The fertilizer P maintained P balance or helped to built-up soil P pools. Hence, P-omitted fertilizer application increased soil P depletion compared with no-fertilizer treatment.

The main strategies of soil-P acquisition by plants are the development of roots and root hairs, establishment of concentration gradient over root membrane, root induced processes dissolving soil-P and association with mycorrhizae. Due to very low mobility of soil-P in relation to plant demand, it appears reasonable to look for differences among cowpea genotypes in their volume of soil exploited by roots and root hairs (Krasilnikoff *et al*., 2003). Phosphorus application increases not only the dry matter yield, but also the crude protein content of fodder and improves palatability (Bose and Balakrishnan, 2001 and Patel *et al*., 2009). The present study was initiated to assess the response of diverse genotypes of fodder cowpea under advanced varietal trial at varied levels of phosphorus for green fodder yield, quality and profitability.

Materials and Methods

A field experiment was conducted at forage farm, Tamil Nadu Agricultural University, Coimbatore under irrigated conditions during rainy season (*kharif*) of 2012. The experimental soil was sandy clay loam in texture, near neutral in reaction (pH 7.9), low in organic carbon (0.49%) and available nitrogen (233 kg/ha), medium in available phosphorus (21.4 kg/ ha) and high in available potassium (640kg/ha). Taxonomically (USDA) it belongs to *Typic Haplustalff* sub group. The treatment consisted of five fodder cowpea genotypes *viz.,*G_1 - MFC 08-14, G_2- IL-1177, G_3- UPC-9202 (Southern Zone Check), G_4- UPC-5286 (National Check) and G_5- Bundel Lobia-1 (National Check) and three phosphorus levels *viz.* P_1- 30, P_2– 60 and P_3- 90 kg/ha. The treatments were allocated randomly in a split-plot design having three replications. Farm yard manure @ 10 tonnes/ ha was incorporated at the time of last ploughing. At the time of planting, 25 kg of N (urea) and 20 kg of K_2O (muriate of potash) were applied as basal and full dose of P_2O_5 (single super phosphate) was applied as basal as per the treatment schedule. The seeds were treated with the bio-fertilizer *Rhizobium* sp. and sown on 24-06-2011 at 30 x 10

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cm spacing. The growth parameters and yield were recorded. The crude protein content was estimated following micro-Kjeldahl method (Jackson, 1973).

Results and Discussion

Application of higher dose of P @ 90 kg/ha had a marked effect on growth and plant grew taller (105.1 cm) under this treatment (Table 1). The cowpea genotypes varied at days taken to 50% flowering whereas, phosphorus levels did not contribute to this trait. The genotype UPC-9202 flowered on 55th day and IL-1177 took 61 days to flower. The leaf stem ratio was not influenced significantly due to different genotypes, while application of higher level of phosphorus (90 kg/ha) recorded a maximum value (0.42).

Table 1. Effect of phosphorus levels on growth, yield and quality parameters of promising genotypes of fodder cowpea

Treatment	Plant population / m^2	Plant height (cm)	DTT 50% flowering	Leaf stem ratio	GFY (t/ha)	DMY (t/ha)	CP (%)	CPY (t/ha)
Genotype								
G_1 - MFC 08-14	33.0	98.9	60.1	0.38	23.2	3.79	16.92	0.64
G_2 - IL-1177	32.7	103.3	60.7	0.38	28.2	4.71	14.44	0.68
G_3 - UPC-9202 (Southern Zone Check)	32.3	102.9	55.1	0.39	23.5	3.81	15.01	0.58
G_4 - UPC-5286 (National Check)	32.4	99.5	60.0	0.41	24.4	3.86	14.29	0.55
G_5 - Bundel Lobia-1 (National Check)	32.6	100.3	58.8	0.38	26.3	4.31	17.36	0.75
SEm±	0.2	2.5	0.2	0.01	0.5	0.14	0.50	0.03
CD (p=0.05)	NS	NS	0.7	NS	1.5	0.40	1.42	0.09
P levels (kg/ha)								
P_1–30	32.6	96.4	58.8	0.37	23.2	3.76	16.63	0.63
P_2–60	32.4	101.3	58.7	0.38	25.1	4.11	14.92	0.62
P_3–90	32.8	105.1	58.7	0.42	27.0	4.42	15.31	0.67
SEm±	0.12	1.9	0.2	0.01	0.4	0.11	0.41	0.02
CD (P=0.05)	NS	5.6	NS	0.02	1.1	0.31	1.12	NS
Interaction								
SEm±	0.4	4.3	0.4	0.01	0.9	0.24	0.86	0.06
CD (p=0.05)	NS	NS	NS	NS	2.6	NS	2.51	0.16

DTT-Days taken to; GFY-green fodder yield;DMY-dry matter yield; CP-crude protein; CPY-crude protein yield

Discernible variations in green fodder yield have been observed due to the raising of different fodder cowpea genotypes and phosphorus levels (Table 1). Significantly more quantity of green fodder yield was recorded with IL-1177 (28.2 t/ha). Application of 90 kg of P_2O_5 /ha had a striking effect on green fodder yield to the tune of 27.0 t/ha. The interaction effect is so vivid that a maximum green fodder yield of 31.1 t/ ha was recorded by raising IL-1177 with 90 kg of P_2O_5 /ha. Adequate supply of phosphorus positively contributed to phosphorylation, which would have resulted in lowering of activation energy barriers and prevails over, otherwise unfavorable thermodynamic conditions within the plant system. Thus, the number of reactions chemically possible in biological system is enormously increased (Tisdale and Nelson, 1975). Markedly higher dry matter yield (4.71 t/ha) was obtained due to the genotype IL-1177. Similarly, application of 90 kg of P_2O_5 /ha had a significant effect on dry matter yield (4.42 t/ha). The favourable effect of phosphorus on green fodder yield might be due to its role in the constitution of ribonucleic acid, deoxyribonucleic acid and ATP which regulate the vital plant functions, helping in root formation, nitrogen fixation and finally the yield. These results are also in agreement with Tripathi *et al.* (1977), Sheoran *et al.* (1994), Bose and Balakrishnan (2001) and Bhilare (2003). Secretion of exudates from pigeon pea roots containing malonic and piscidic acids solubilized phosphorus bound to Fe and Al (Otani *et al*.,1996), which ultimately increased the phosphorus availability (Pradhan *et al*.,2011). Similar phenomenon might have operated upon and positively influenced the growth and yield of fodder cowpea.

Relatively higher percentage of crude protein was exhibited by Bundel Lobia-1 (17.36) and MFC 08-14 (16.92) and were comparable with other leguminous forages such as lucerne (Mojumdar *et al.,* 2003), subabul and hedge lucerne, which are rich in crude protein. Among the phosphorus levels, application of 30 kg of P_2 O_5 /ha had a positive influence on crude protein (16.63%), however at higher levels, the crude protein content was found to be lesser. This effect could be explained on the basis that higher level of phosphorus nutrition might have enhanced the root growth and resulted in better absorption of nutrients. This would have stimulated the crop growth so much, so that nitrogen content got diluted, hence lesser crude protein at higher levels of phosphorus. Similar result has also been reported by Bose and Balakrishnan (2001) . The interaction effect reveal that the genotype MFC 08-14 with 30 kg P_2O_5 /ha had resulted in higher crude protein (19.7 %). Crude protein yield plays a significant role in enhancing quality and palatability of any forage crop. The crude protein yield ranged from 0.55 (UPC-5286) to 0.75 t/ha (Bundel Lobia-1). Significantly higher crude protein yield was obtained with Bundel Lobia-1 (0.75 t/ha) and IL-1177 (0.68 t/ ha). The genotypes *viz.* UPC-5286, UPC-9202 and MFC 08-14 were recorded with lower crude protein

Table 2. Economic evaluation of phosphorus levels to various fodder cowpea genotypes

Treatment	Av. Cost(₹/ha)	Av. gross returns(/ha)	Av. netreturns(/ha)	Benefit:Cost ratio
Genotypes				
G_1 - MFC 08-14	20220	34860	14640	1.72
G_2 - IL-1177	20220	42225	22005	2.10
G_3 - UPC-9202(Southern Zone Check)	20220	35280	15060	1.74
G_4 - UPC-5286(National Check)	20220	36660	16440	1.81
G_5 - Bundel Lobia-1 (National Check)	20220	39450	19230	1.95
P levels (kg/ha)				
P_1–30	21053	34830	13777	1.65
P_2-60	21885	37665	15780	1.72
P_3-90	22718	40590	17872	1.79

Cost of urea: 5.52 /kg; SSP: 4.44 /kg; MOP: 4.86/kg; Labour charge: 100/day Price of green fodder of cowpea: 1500 /t

yield. Adoption of varied levels of phosphorus did not influence the crude protein yield of cowpea genotypes during the course of study. However, the genotype Bundel Lobia-1 with 60 kg P_2O_5 /ha had positively contributed to a maximum crude protein yield of 0.91 t/ha.

Net returns were higher with the cowpea genotype IL-1177at 90 kg P_2O_5 /ha. The same trend is applicable with benefit cost ratio also (Table 2). Higher dose of phosphorus used in conjunction with nitrogen and potassium in a sound crop management programme greatly increased the green fodder yield and net income.

Growing the cowpea genotype IL-1177 with 90 kg of P_2O_5 /ha was economically competitive and productive under irrigated conditions. Hence, raising cowpea IL-1177 is sustainable and lucrative, which will ensure quantity and quality green fodder supply and help achieving desired growth rate in milk production.

Conclusion

From the results of this experiment, it could be concluded that raising cowpea genotype IL-1177 and application of 90 kg P_2O_5/ha will be more profitable and offer quality leguminous green fodder under irrigated condition.

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