Research Article

Genetic variability of Cowpea (*Vigna unguiculata*) genotypes to varied levels of phosphorus under rainfed condition of Jharkhand

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Abstract

A field experiment was conducted under AICRP on Forage Crops with the collaboration of Agrostology unit of the Ranchi Veterinary College under Birsa Agricultural University, Ranchi during *Kharif* season of 2011. The growth, yield and quality of cowpea genotypes influenced by Phosphorus levels. Genotype, Bundel lobia attended the maximum height plant / vine length, Leaf: stem ratio in green as well as under dry condition which were significantly better over all other genotypes and National check (UPC-622). While, maximum GFY (284.56 q/ha), DFY (49.57 q/ha), crude protein content (15.19%) and Crude protein yield (7.52 q/ha) were recorded under zonal check UPC-5286. Response of Phosphorus was recorded on plant length, GFY, DFY, CP and CPY up to 90 kg P_2O_5/ ha. Further, significant interaction effect of Phosphorus and Genotypes were recorded on growth, yield and quality of Cowpea.

Keywords: Cowpea, genotypes, Phosphorus levels, Variability and Crude protein

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Introduction

Although India holds top rank among milk producing countries in the world and produced 146.31 million tones of milk in 2014-15 which became possible with contribution of very large population of livestock with low milking ability compared to some of the other countries in the world. As malnutrition or under-nutrition, beside the low genetic potential of the animals is also prime factor for low milk productivity. The sufficient supply of qualitative fodder and concentrate is a crucial factor impacting the productivity and performance of the animals [1]. The main reasons for low productivity is insufficient and low quality fodder and feed including grazing facilities [2]. The country is highly deficit in availability of green fodder, dry fodder and concentrates. Future development and growth of livestock are highly associated with the availability of fodder from cultivable land, forest, pastures and development of grazing lands. As among the different annual and perennial fodder Cowpea (*Vigna unguiculata*), also called black-eyed pea or southern pea, annual plant within the pea family (*Fabaceae*) grown for its edible legumes. The plants are thought to be native to West Africa and are widely cultivated in warm regions around the world. In addition to their use as a protein-rich food crop, cowpeas are extensively grown as a hay crop and as a green manure or cover crop. It is most important annual leguminous fodder of summer to *Kharif* season in Jharkhand. Cowpea is a dual purpose crop like grain as well as fodder legume belonging to the family leguminesae. Its value lies in its high protein content green herbage and ability to tolerate drought. It has also got the ability to fix atmospheric nitrogen through its nodules and thereby grows well in even poor soils. Cowpea has been identified as one of the keys to crop-livestock. However, under rain fed condition in Jharkhand cowpea can only be grown during monsoon. It has wide range of adoptability, quick growing habit and high yielding, proteinases as well as palatable and also preferred by different animals. Being leguminous it provides protein and mineral rich and less fiber and also improves the soil fertility. Phosphorus deficiency is one of the major limiting factors in crop production. Role of phosphorus in nodulation and other enzymatic activity and also acts as yield limiting nutrient next to Nitrogen. Even though, soil possess medium to high in Phosphorus level but its availability is very less, due to its slow mobility and its fixing nature in soil, which identify the way and means of its judicious use for maximizing the quality green herbage production. Keeping the facts in view present study was under taken to optimize the Phosphorus levels as well as to study the genetic variability among different cowpea genotypes for sustaining yield and quality under rain in Jharkhand.

Materials and methods

The present field investigation was carried out during *Kharif 2011* at the Agrostology field situated at Ranchi Veterinary College, campus Kanke under Birsa Agricultural University, Ranchi. The soil of experimental plot was sandy loam in texture having under mentioned physical and chemical properties (**Table 1**)

Table 1 Physiochemical properties of the soil of experiment plot

Sl.No	Particulars	Value	Method used
I	**Physical properties**		
1.	Sand (%)	57.3	Hydrometer method [3]
2.	Silt (%)	23.7	
3.	Clay (%)	20.0	
	Texture	Sandy loam	
II	**Soil Moisture Constants**		
1.	Water holding capacity (%)	47.3	Keen Raczki modified [4]
2.	Field capacity at 0.33 bar (%)	20.3	pressure membrane plate apparatus [5]
3.	Permanent wilting	11.36	pressure membrane plate apparatus [5]
4.	Bulk density (Mgm^{-3})	1.53	Core sampler [6] as described in [4]
III	**Chemical properties**		
1.	Soil pH (1:2.5, soil: water ratio)	6.5	Glass electrode pH meter [7]
2.	Organic Carbon (g/kg)	3.79	[8] as described in [9]
3.	Available N (kg/ha)	252.0	Alkaline $KMnO_4$ [10]
4.	Available P_2O_5 (kg/ha)	31.8	Colorimetric estimation, Bray and Kurtz P_1 [9]
5.	Available K_2O (kg/ha)	178.7	Flame Photometer [7]

The experiment was laid out in Factorial Randomized Block Design (FRBD) with five cowpea genotypes (MFC-08-14, IL-1177, Bundel Lobia, UPC-622 (Zonal Check) and UPC-5286 (National Check) and four phosphorus levels (30, 60 and 90 kg/ha) which comprises total fifteen treatments. The crop was sown at middle of July at row spacing of 30 cm apart. The crop enjoyed the rainfall 230 mm mm, during total 17 rainy days in light of 230 hrs Sunshine. The average maximum and minimum humidity were 84.2 and 72.5 respectively. The recommended dose of Nitrogen 25 kg/ha and Potassium 30 kg/ha were applied in the form of Urea and Muriat of Potash while, Phosphorus was applied as per treatments through Single Super Phosphate (SSP). Full dose of fertilizer was applied at the time of sowing. Cultural as well as other recommendation Agronomical practices were carried uniformly to the different treatments. Observations were taken at 15 (for germination and population) days and growth, yield and quality parameter were taken at 50 % flowering stage. The significance of treatment differences were evaluated by F-test as outlined by [11]. To evaluate the significant of difference between two treatment means, critical difference (CD) at 5 per cent level was worked out. Data are arranged in group and represented in tabular form for discussion.

Results and Discussion

Genotypic variability

Genotypes of Cowpea were significantly influenced by phosphorus levels with respect to plant/vine length, leaf: stem ratio in green as well as dry condition, green fodder yield, dry fodder yield, crude protein content and crude protein yield. Genotype Bundel lobia attended the maximum height plant / vine length (184.0 cm), Leaf: stem ratio (0.66) in green as well as (0.62) under dry condition which were significantly better over all other genotypes as well as National check (UPC-622). While, maximum GFY (284.56 q/ha), DFY (49.57 q/ha), crude protein content (15.19%) and Crude protein yield (7.52 q/ha) were recorded under zonal check UPC-5286. Genotypes play an important role in determining the yield of a crop. The potential yield of genotypes within the genetic limit is set by the prevailing environment. Genotypes differ in their yield potential depending on many physiological processes, which are controlled by both genetic makeup of the plant and the environment. Earlier studies made by several workers also revealed the varietal differences in the seed yield of cowpea [12-14].

Table 2 Effect of phosphorous levels on growth, yield and quality of promising genotypes of cow pea

Treatments	Plant population/m^2	Plant Length (cm)	Leaf :Stem ratio		Fodder yield (q/ha)		Crude Protein	
			Green	Dry	Green	Dry	Content (%)	Yield (q/ha)
Genotypes								
MFC-08-14	32.89	162.44	0.56	0.49	229.52	37.53	14.51	5.44
IL-1177	34.88	177.44	0.67	0.54	234.77	44.86	13.89	6.16
UPC-622(ZC)	42.88	229.88	0.68	0.49	284.56	49.57	15.19	7.52
UPC-5286(NC)	37.11	160.89	0.51	0.52	211.6	34.54	14.45	5.03
Bundel. Lobia	39.56	184.00	0.66	0.62	230.21	41.77	14.88	6.38
S. Em ±	0.7	1.81	0.011	0.01	1.27	0.61	0.075	0.104
CD at 5%	2.037	5.26	0.032	0.043	3.68	1.75	0.219	0.303
P-Levels								
P1: 30 kg/ha	35.0	165.66	0.58	0.51	193.64	36.35	13.86	5.12
P2: 60 kg/ha	37.46	178.93	0.61	0.52	241.6	40.86	14.62	5.97
P3: 90 kg/ha	39.93	204.2	0.67	0.57	279.13	47.74	15.27	7.23
S. Em ±	0.54	1.4	0.01	0.01	0.98	0.47	0.158	0.081
CD at 5%	1.57	4.08	0.02	0.03	2.85	1.36	0.17	0.235
Entries x P-Levels								
S. Em ±		3.14	0.019	0.026	2.2	1.05	0.13	0.181
CD at 5%	NS	9.12	0.56	0.075	6.38	3.046	0.38	0.525

Phosphorus response

The response of P_2O_5 was recorded up to 90 kg/ha with regards to plant /vine length, leaf: stem ratio, GFY, DFY, CP % and CPY. The maximum plant/ vine length (204.2 cm), leaf: stem ratio (0.67) in green condition and (0.57) in dry condition, Green forage yield (279.13 q/ha), Dry fodder yield (47.74 q/ha), crude protein content (15.29 %) and Crude protein yield (7.25 q /ha) which were significantly superior over other levels of P_2O_5 *i.e* 30 kg/ha and 60 kg/ha. The high capacity of the soil to fix P in form largely unavailable to plant caused reduction in yield, thus its response up to 90 kg/ha for higher herbage yield were advocated by [15]. At higher levels of Phosphorus the availability of nitrogen and potash along with Phosphorus nutrient also increased which resulted into better plant stand which reflected into more growth and finely resulted into higher yield and improvement in quality with regards to crude protein content.

Interaction

Interaction of Genotypes and Phosphorus have interaction effect on plant/ vine length, L:S ratio, GFY, DFY, Crude protein content and CPY. Graf concerned reflects that P_2O_5 has significant and linearly related with the growth, yield and quality of fodder cowpea (Graf: 1a to 1f). The genotype UPC-622 (ZC) recorded highest response compare to other genotypes of cowpea tested.

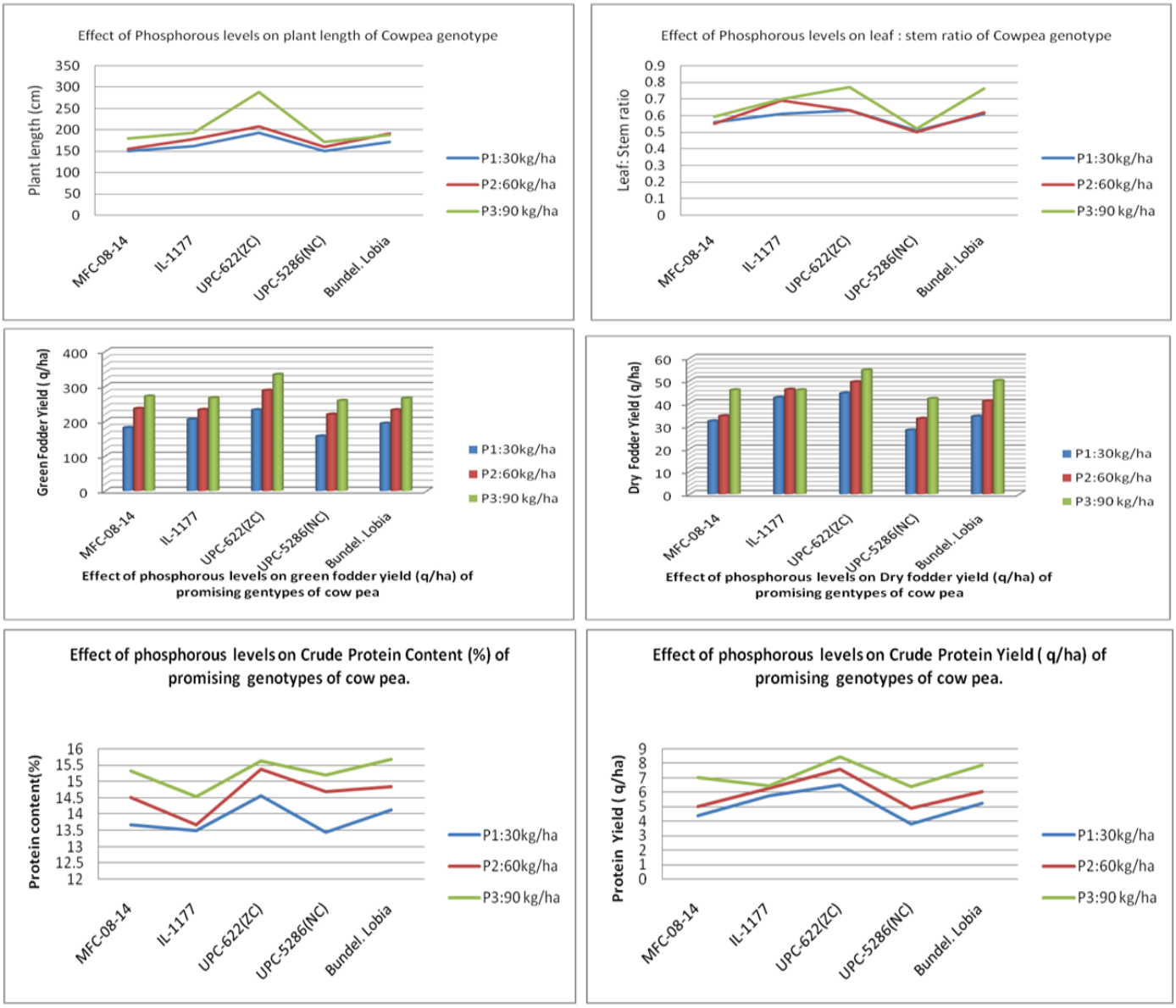

Figure 1(a-f) Graphical representation of growth, yield and quality parameter of cowpea genotypes under different levels of Phosphorus.

Conclusion

Different genotypes of cowpea tested under this experimentation responded differently, however on the basis of green herbage produced genotype zonal check UPC-5286 produced more quantitative as well as qualitative produced. P_2O_5 levels play role in overall development of the forage cowpea.

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