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RESPONSE OF COWPEA (*VIGNA UNGUICULATA*) GENOTYPES TO DIFFERENT LEVELS OF PHOSPHORUS DURING SUMMER UNDER NORTHERN DRY ZONE OF KARNATAKA

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***Abstract*— A field experiment was conducted during summer 2012, entitled with "Performance of cowpea (Vigna unguiculata) genotypes with different levels of phosphorus" under irrigated condition at the farmer's field (Mattihal Village of Basavan Bagewadi Taluk) in vertisols of Bijapur district. The experiment consists of twelve treatments including four cowpea genotypes (KBC-2, KM-5, IT-38956-1 and C-152) and three phosphrous levels (25, 50 and 75 P205 kg ha-1) in different combinations. Experiment laid out in factorial RCBD design with three replications. The results indicated that seed yield (1397 kg ha-1) and harvest index (0.51) higher with genotype IT-38956-1 owing to higher number of pods per plant (16.78), number of seeds per pod (13.89), seed yield per plant (12.74g) and 100 seed weight (12.92 g) as compared to other genotypes. Application of 50 kg P2O5 ha-1 recorded significantly higher seed yield (1087 kg ha-1) compared to 25 and 75 kg P2O5 ha-1, this might be due to higher yield contributing characters.**

Index Terms— Cowpea, Genotypes, Phosphorus.

I. INTRODUCTION

The important pulses grown in India are redgram, greengram, blackgram, cowpea, mothbean, horsegram, peas *etc*. Among arid legumes, cowpea [(*Vign aunguiculata* (L.) Walp] is of immense importance, as it is a multipurpose grain legume extensively cultivated in arid and semiarid tropics. The cowpea is used as grain, green pods and fodder. Cowpea is grown as a catch crop, mulch crop, intercrop, mixed crop and green manure crop. Cowpea contributes to the improvement of soil fertility by the atmospheric nitrogen fixation in the soil (60-70 kg N ha^{-1} to the subsequent crop) in association with symbiotic bacteria under favorable conditions.

In Karnataka, the crop is grown in an area of 1.5 million hectares with a production of 0.49 million tonnes. The productivity of cowpea in Karnataka is low (420 kg ha^{-1}) as compared to the national productivity of 567 kg ha^{-1}. This clearly indicates there is necessity to identify the reasons for low productivity in India in general and Karnataka in particular. The studies show that high yielding varieties of crop can contribute to an extent towards the improvement of crop yield (Yadav, 1986). Phosphorus (P) is one of the most needed elements for pulse production. Phosphorus, although not required in large quantities but is critical to cowpea yield because of its multiple effects on nutrition. All growing plants require phosphorus for growth and development significantly in large quantity. Role of phosphorus is well documented that, it increases root formation, number of root nodules and in turn contribute towards yield. Many workers have also reported that phosphorus application influences the content of other nutrients in leaves and seed. The deficiency can be so acute in some soils of the Northern dry zone of Karnataka, that plant growth ceases as soon as the P stored in the seed is exhausted.

In Northern Dry zone under irrigation in summer season ground nut is one of the major crops. There is a need to identify the suitable alternative crop for groundnut during summer season in the areas where water is withdrawn early in the command areas. Hence this investigation was conducted to know the performance of new genotypes of cowpea viz; KBC-2, KM-5 and IT-3895-1 in summer condition along with phosphorus fertilization.

II. MATERIAL AND METHODS

A field experiment was conducted to study the "Performance of cowpea genotypes with different phosphorus levels" under irrigated condition in vertisols at farmers field (Mattihal Village of Basavan Bagewadi Taluk) in Bijapur district during summer 2012. The experiment was laid out in a factorial RCBD design with three replications. The treatments comprised of 12 treatment combinations of four genotypes (KBC-2, KM-5, IT-38956-1 and C-152) and three phosphorus levels (25, 50 and 75 P_20_5 kg ha^{-1}). The soil of the experimental site was medium deep black soil. A composite soil sample was drawn from the experimental area before sowing to a depth of 30cm. The soil was analyzed for physical and chemical properties. The soil textural class of the experimental site was clayey in texture, low in organic carbon (0.49%), available nitrogen (111 kg ha^{-1}), medium in available phosphorus (14.50 kg ha^{-1}) and medium in available potassium (255 kg ha^{-1}). At the time of sowing, entire dose of fertilizers with 25:25:25, 25:50:25 and 25:75:25 kg of nitrogen, phosphorus and potash in the form of urea, single super phosphate, and muriate of potash were applied as a basal dose as per the treatment. Five competitive plants selected were tagged at random from each plot for recording observations number of growth parameters yield parameters at 30 DAS, 60 DAS and at harvest.

III. Results and discussion

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. During summer availabity of photoperiod is more that is reflected yield of genotypes. Among four genotypes, IT-38956-1 recorded significantly higher seed yield (1397 kg ha^{-1}) as compared to C-152 (1246 kg ha^{-1}), KBC-2 (835 kg ha^{-1}) and KM-5 (786 kg ha^{-1}). Earlier studies made by several workers also revealed the varietal differences in the seed yield of cowpea (Jadhav *et al.*, 1995; Nirmal *et al.*, 2001 and Purushotham *et al.*, 2001).

Seed yield is governed by number of factors which have direct or indirect impacts. Genotypes IT-38956-1 (12.74 g $plant^{-1}$) produced significantly higher seed yield per plant compred to C-152 (12.63 g $plant^{-1}$) KBC-2 (8.26 g $plant^{-1}$) and KM-5 (8.81 g $plant^{-1}$). Yield per plant is determined by other yield contributing components namely number of pods per plant, number of seeds per pod, 100-seed weight. Number of pods per plant was significantly higher in IT-38956-1(16.78) than C-152 (16.44). This improvement was mainly due to significantly higher photosynthetic efficiency, which might have led to formation of more number of pods per plant and number of seeds per pod (Table1). Similar results were also reported by Birari *et al.* (1993) and Jadhav *et al.* (1995). The genotypes IT-38956-1 (12.92g) and C-152 (12.87g) recorded significantly higher hundred seed weight than KBC-2 (10.82 g) and KM-5 (11.63g). Thus, owing to integration of all the favorable yield components such as more number of pods per plant. The uptake of nitrogen, phosphorus and potassium at harvest was maximum with IT-38956-1(131.36 14.26 and 52.67 kg ha^{-1}) than C-152 (134.32, 13.96 and 54.67 kg ha^{-1}). Seed yield differed significantly due to different levels of phosphorus application. Maximum yield of 1087 kg ha^{-1} was obtained with 50 kg P_2O_5 ha^{-1} as compared to application of 75 kg P_2O_5 ha^{-1} (1078 kg ha^{-1}) and 25 kg P_2O_5 ha^{-1}(1033 kg ha^{-1}). These results are in conformity with the findings of Rajput (1994), Okeleye and Okelana (1997). This might be due to higher magnitude of yield components like more number of pods per plant (13.17), number of seeds per pod (13.25), pod length (15.02 cm) seed weight per plant (10.82 g) and 100-seed weight (12.22 g). This indicates the positive correlation between seed yield and number of pods per plant, P is essential for photosynthesis, pod development and grain filling in leguminous crops. P is responsible for nodulation in cowpea. Thus higher nodulation resulted in higher nitrogen fixation and eventually the number of pods per plant. Author Osimane (1978) opined that phosphorus plays an important role in translocation of assimilates to the pods being a constituent of protoplasm, which may be responsible for increased length of pods, pod weight, number of seeds per pod and in turn seed yield. The higher number of seeds per pod could be due to increased pod length with phosphorus level (15.02cm) and it might have accommodated more number of seeds per pod (13.25). Higher numbers of seeds per pod and 100-seed weight have contributed to higher seed yield at application of 50 kg P_2O_5 ha^{-1}. The nutrients uptake was not significant. However higher uptake of nutrients (N,P_20_5 and K) was noticed with the application of 50 kg P_2O_5 ha^{-1} (123.34, 13.53 and 51.92 kg ha^{-1}) followed by application of 75 kg P_2O_5 ha^{-1} and 25 kg P_2O_5 ha^{-1}. Higher grain yield (1423 kg ha^{-1}) of IT-38956-1 was obtained with application of 50 kg P_20_5 ha^{-1} as compared to all the other treatment combinations, this was due to the higher nutrient availability with the use of 50 kg P_2O_5 ha^{-1}.

The maximum gross returns (42690 □ ha^{-1}), net returns (□ 28493Rs ha^{-1}) and B:C ratio (3.01) was realized with genotype IT-38956-1 compared to other genotypes. The application of 50 kg P_2O_5 ha^{-1} gave the higher gross returns, net returns and B:C ratio but differences were non significant.

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Table 1: Yield parameters and economics of cowpea as influenced by genotypes and phosphorus levels

Treatments	Number of pods per plant	Number of seeds per pod	Pod length (cm)	100 seed weight (g)	Gross income (□ ha^{-1})	Net income (□ ha^{-1})	B:C ratio
Genotypes (V)							
V_1-KBC-2	9.33	10.78	14.09	10.82	25053	10856	1.76
V_2-KM-5	9.44	11.22	13.27	11.63	23580	9383	1.66
V_3-IT- 38956-1	16.78	13.89	15.67	12.92	44586	27723	2.95
V_4-C- 152	16.44	13.78	15.88	12.87	38063	23199	2.63
SEm±	**0.30**	**0.30**	**0.30**	**0.22**	**734**	**734**	**0.05**
CD (P=0.05)	**0.88**	**0.88**	**0.89**	**0.65**	**2153**	**2153**	**0.15**
Phosphorus levels (P_2O_5 kg ha^{-1})							
P_1-25	12.83	11.92	14.45	11.63	31007	16910	2.20
P_2-50	13.17	13.25	15.02	12.33	33865	18418	2.30
P_3-75	13.00	12.08	14.71	12.22	32340	18043	2.26
SEm±	**0.26**	**0.25**	**0.26**	**0.19**	**636**	**635**	**0.04**
CD (P=0.05)	**NS**	**0.76**	**NS**	**0.56**	**NS**	**NS**	**NS**
Genotypes X Phosphorus levels							
V_1P_1	8.00	10.00	14.25	10.85	24410	10313	1.73
V_1P_2	11.33	12.00	14.08	10.91	26190	11993	1.84
V_1P_3	8.67	10.33	13.92	10.71	24560	10263	1.72
V_2P_1	9.00	10.00	13.03	11.21	22700	8603	1.61
V_2P_2	11.00	12.00	13.85	12.06	24640	10443	1.74
V_2P_3	8.33	11.67	12.94	11.60	23400	9103	1.64
V_3P_1	15.00	13.33	14.52	11.88	40740	26643	2.89
V_3P_2	17.33	15.00	15.99	13.44	42690	28493	3.01
V_3P_3	17.05	13.33	16.51	13.43	42330	28033	2.96
V_4P_1	17.00	14.33	16.01	12.56	36180	22083	2.57
V_4P_2	15.33	14.00	16.17	12.90	36940	22743	2.60
V_4P_3	17.00	13.00	15.47	13.14	39070	24773	2.73
SEm±	**0.52**	**0.52**	**0.53**	**0.39**	1271	1271	0.09
CD (P=0.05)	**1.54**	**NS**	**NS**	**NS**	NS	NS	NS

Table 2: Seed yield per plant and seed yield (kg ha^{-1}) of cowpea as influenced by genotypes and phosphorus levels

	Seed yield per plant(g)	Seed yield (kg ha^{-1})
Genotypes		
V1-KBC-2	8.26	835
V2- KM-5	8.81	786
V3-IT-38956-1	12.74	1397
V4-C-152	12.63	1246
SEm±	**0.09**	**24**
CD (P=0.05)	**0.26**	**71**
Phosphorus levels (P_2O_5 kg ha^{-1})		
P_1-25	10.47	1033
P_2-50	10.82	1087
P_3-75	10.54	1078
SEm±	**0.07**	**21**
CD (P=0.05)	**0.23**	**62**

Table 3: Interaction effects of grain yield per plant of cowpea as influenced by genotypes and phosphorus levels

Grain yield per plant (g)				
Genotypes	**Phosphorus levels**			
	P_1-25	**P_2-50**	**P_3-75**	**Mean**
V1-KBC-2	8.36	8.37	8.05	8.26
V2- KM-5	8.39	8.86	9.16	8.803
V3-IT-38956-1	12.29	13.05	12.88	12.74
V4-C-152	12.84	13	12.04	12.66
Mean	10.47	10.82	10.53	10.60
	SEm±		CD(P= 0.05)	
V	0.09		0.07	
P	0.26		0.23	
VXP	0.16		0.46	

Table 4: Interaction effects of seed yield (kg ha^{-1}) of cowpea as influenced by genotypes and phosphorus levels

Seed yield (kg ha^{-1})				
	Phosphorus levels			
Genotypes	**P_1-25**	**P_2-50**	**P_3-75**	**Mean**
V1-KBC-2	813	873	818	834.6667
V2- KM-5	756	821	780	785.6667
V3-IT-38956-1	1358	1423	1411	1397.333
V4-C-152	1206	1231	1302	1246.333
Mean	1033.25	1087	1077.75	1066
	SEm±		CD(P= 0.05)	
V	24		71	
P	21		62	
VXP	42		128	

Table 5: Uptake of total N, P and K in soil after harvest of cowpea as influenced by genotypes and phosphorus levels

	Major nutrients uptake(kg ha^{-1})		
Treatments	**N**	**P_2O_5**	**K_2O**
Genotypes(V)			
V_1-KBC-2	114.06	12.87	50.00
V_2-KM-5	115.18	12.53	48.44
V_3-IT- 38956-1	131.36	14.26	52.67
V_4-C- 152	134.32	13.96	54.67
SEm±	**1.75**	**0.16**	**0.86**
CD (P=0.05)	**NS**	**0.47**	**2.53**
Phosphorus levels(P_2O_5 kg ha^{-1})			
P_1-25	122.43	13.31	51.00
P_2-50	123.34	13.53	51.92
P_3-75	125.42	13.40	51.33
SEm±	**1.51**	**0.14**	**0.75**
CD (P=0.05)	**NS**	**NS**	**NS**
Genotypes X Phosphorus levels			
V_1P_1	111.17	12.18	48.67
V_1P_2	116.95	13.18	50.33
V_1P_3	114.06	13.26	51.00
V_2P_1	116.95	12.62	50.00
V_2P_2	112.28	12.52	45.33
V_2P_3	116.32	12.47	50.00
V_3P_1	133.32	14.32	53.33
V_3P_2	126.75	14.42	56.00
V_3P_3	134.02	14.05	53.67
V_4P_1	128.28	14.10	52.00
V_4P_2	137.39	13.99	56.00
V_4P_3	137.28	13.80	50.67
SEm±	**3.04**	**0.28**	**1.50**
CD (P=0.05)	**NS**	**NS**	**4.40**

V= variety, P= phosphorus levels