Effect of Different Phosphorus Levels on Growth and Yield of Cowpea (*Vigna unguiculata*L.) Genotypes

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Abstract- An experiment was conducted at Bagusala farm of Centurion University of Technology and Management, Paralakhemundi, Gajapati, Odisha to determine the effect of four phosphorus levels on three cowpea genotypes and interaction of these two factors. The result obtained from the analysed data indicated that cowpea genotypes differed significantly in growth characters studied such as height of the plant, number of leaves and number of branches. In case of yield components and yield, the genotypes differed significantly in respect of number of pods/plant, length of pod(cm), average pod weight(g), average number of seeds per pod, seed weight per pod(g), pod yield (kg/ha), seed yield (kg/ha). The application of phosphorus equally influenced the growth and yield components as well as yield of cowpea. The interaction effect between genotypes and phosphorus levels showed that the genotype Baramasi(V3)gave the highest pod yield (5199kg/ha) of cowpea with the application of60 kg P_2O_5 /ha (T4).

Keywords: Cowpea genotypes, phosphorus levels, growth, yield attributes, yield.

1. INTRODUCTION

Cowpea (*Vigna unguiculata* L.), belongs to the family leguminaceae, is one of the most important vegetable crops, with chromosome number 2n=22 and originated from Central Africa. It is an annual legume adapted to warm conditions and sensitive to chilling hence, it is cultivated widely in tropics and subtropics during the warm season. Cowpea is an important crop because of its role in human and livestock nutrition. It reduces the shortage of food by making efficient use of water and nutrient. As a protein vegetable cowpea is of vital importance to the livelihood of several millions of people in developed countries. All growing plants require Phosphorus for their growth and development in significantly large quantity. Phosphorus deficiency is the most limiting soil fertility factor for cowpea production and qualitative improvement of seed. Legumes have been reported to have a high Phosphorus requirement and have been reported to stimulate root and plant growth, initiate nodule formation as well as the efficiency of the rhizobium-legume symbiosis. Earlier researches noted

the effect of genotype and phosphorus levels on growth and productivity of cowpea in different agro-climatic regions (Birari *et al.* 1993;Singh *et al*.2011;Chauhan *et al*.2016;Pardhi, 2016). However,there is insufficient research work on impact of phosphorus level on cowpea genotypes under this agro-climatic region. Hence,the present study has been conducted.

2. MATERIALS AND METHODS

The field experiment was conducted during summerseason of 2018 at Bagusala Farm (23°39' N latitude, 87°42' E longitude) of M. S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi, Gajapati district, Odisha under typical sub-humid and sub-tropical climatic conditions. During the period of experimentation, the maximum and minimum temperature ranged from 43 to 49 °C and 15 to 18°C respectively. Crops received negligible rainfall during February to May in 2018. The soil of the experimental plot was clay loam in texture. Thetreatments were comprised of three cowpea genotypes, namely, SB-2, Rawatiand Baramasi to four phosphorus levels, that is 0,20,40 and 60kgP_2O_5/ha. The treatments were laid using Factorial Randomized Block Design and replicated three times with 12 treatment combinations. Growth and yield parameters were recorded as per standard procedures and analysed statistically.

3. RESULTS AND DISCUSSION

3.1 Effect on growth attributes

Observations on plant height, number of branches per plant and number of green trifoliate leaves per plant were recorded at 30 and 60 DAS as influenced by genotypes and phosphorus levels and their interaction effects on above growth stages which are presented in table 3.1.

3.1.1 Plant height

At 30 DAS, maximum plant height (51.19cm) was recorded in SB-2 followed by Rawati (50.37cm) and application of 20 kg P_2O_5/ha recorded maximum height of the plant(55.24cm) followed by 60 kg P_2O_5/ha (49.74cm). The interaction effects,SB-2×20kg P_2O_5/ha produced maximum height of the plant (57.33cm) followed by Baramasi×20kg P_2O_5/ha compared of the plant (101.11cm) followed by Rawati (98.7cm) and the application of 40kg P_2O_5/ha recorded maximum height of the plant (102.08cm) followed by 20 kg P_2O_5/ha (99.9cm). Among the interaction effects, Baramasi×60 kg P_2O_5/ha produced maximum height of the plant (108.66cm) followed by Baramasi×40kg P_2O_5/ha.Pardhi (2016) found that significant effect of genotypes on plant height of cowpea at 30, 45 and 60 DAS and he recorded the maximum height of the plant of 37.72, 48.13 and 58.31 cm in genotype Pusa Sukomal at 30, 45 and 60 DAS, respectively. It was followed by Kashi Shyamal and Kashi Unnati in descending order at all the growth stages under study.

3.1.2 Number of branches per plant

At 30 DAS, the maximum number of branches per plant (11.35) was recorded in the genotype Rawati followed by Baramasi(10.71) and application of 60 kg P_2O_5/ha recorded maximum number of branches (10.89), followed by 20kg P_2O_5/ha(10.73). Among interaction effects, Rawati×40 kg P_2O_5/ha produced maximum number of branches (12.8) followed by Rawati×60kg P_2O_5/ha (12.6). At 60 DAS, the maximum number of branches per plant (22.1) was recorded in the genotype Rawati followed by SB-2 (21.7) and application of 40kg P_2O_5/ha recorded maximum number of branches (22.5), followed by60kg P_2O_5/ha (22.2). Among interaction effects, Baramasi×60kg P_2O_5/ha produced maximum number of branches (22.8) followed by SB-2×40kg P_2O_5/ha (21.9).Paithankar *et al*. (2016), revealed that enhancement of number of branches with increment in P doses. It might be due to the application of phosphorus through inorganic fertilizer and seed treatment with PSB, which increased the availability of phosphorus in root zone, which in turn resulted in better growth and development of roots and shoots and also helped in better nodulation.

3.1.3 Number of green trifoliate leaves

At 30 DAS, the maximum number of green trifoliate leaves per plant (34.6) was recorded in the genotype Baramasi followed by SB-2(33.4) and application of 40kg P_2O_5/ha recorded more number of green trifoliate leaves (34.3), followed by 20kg P_2O_5/ha (33.4). Among interaction effects, Baramasi×40kg P_2O_5/ha produced more number of green trifoliate leaves (39.2) followed by SB-2×20kg P_2O_5/ha (36.7). At 60 DAS, the

maximum number of green trifoliate leaves per plant (79.7) was recorded in the genotype Baramasi followed by SB-2(79.7) and application of 40kg P_2O_5/ha recorded more number of green trifoliate leaves (82.6), followed by20kg P_2O_5/ha (82.1). Among interaction effects, Baramasi×40kg P_2O_5/ha produced more number of green trifoliate leaves (87.6) followed by SB-2×20kg P_2O_5/ha (86).Pardhi(2016), reported that the number of leaves in cowpea was influenced significantly due to different treatments of genotypes and nutrient levels and among the genotypes, the maximum number of leaves per plant was observed in Pusa Sukomal at all the growth stages, whereas the minimum number of leaves per plant was noted with genotype Kashi Kanchan.

Table 3.1. Effect of genotypes and phosphate levels on growth attributes of cowpea at different growth stages

Treatment	Plant Height (cm)		Number of Branch		Number of green trifoliate leaves	
Genotypes	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS
SB-2	51.19	97.58	9.66	21.70	31.90	79.78
Rawati	50.37	98.71	11.35	22.16	31.73	79.7
Baramasi	50.2	101.11	10.71	21.59	34.63	80.78
SEm±	0.36	0.69	0.08	0.09	0.20	0.62
CD (P=0.05)	NS	2.03	0.24	0.29	0.59	NS
Phosphate levels (kg ha^{-1})						
0	49.06	94.93	10.03	20.74	30.97	73.77
20	55.24	99.93	10.73	21.8	33.42	82.08
40	48.09	102.08	10.65	22.50	34.35	82.66
60	49.24	99.6	10.89	22.44	32.26	81.82
SEm±	0.48	0.92	0.12	0.13	0.25	0.83
CD(P=0.05)	1.42	2.70	NS	0.39	0.79	2.45
Interaction of genotype X phosphorus level						
SEm±	1.45	2.77	0.32	0.39	0.80	2.50
CD(P=0.05)	4.27	8.12	0.96	1.17	2.37	NS
CV(%)	8.64	8.38	9.31	5.49	7.40	9.38

3.2 Effect on yield components

The data on number of pods per plant,length of pod (cm),average pod weight(g),number of seeds per pod,seed weight per pod(g),pod yield (kg/ha)and seed yield (kg/ha) as influenced by cowpea genotypes and phosphorus levels were recorded are presented in table3.2.a and table 3.2.b.

3.2.1 Number of pods per plant

Maximum number of pods per plant was noticed with the genotype Baramasi(10.13). The maximum numbers of pods per plant was noted with the application of 60kg P_2O_5/ha(11.55). Significantly maximum number of pods per plant (12.11) were noticed in Baramasi×60kg P_2O_5/ha as compared to rest of the treatment combinations. The results are in conformity with the observations of Shilpa (2013) and they stated that significantly maximum number of pods per plant was noticed with the genotype IT-38956-1 (16.78). The maximum numbers of pods per plant (13.17) was noticed with the application of 50 kg P_2O_5/ha. Singh *et al.* (2011)stated that there was no significant effect of the genotype on the number of pods per plant in their study;however, the genotype KVX303096 G recorded higher number of pods per plant (52) andsignificantly maximum pods per plant were recorded in plots applied with increase of P2O5 application. This clearly indicatedbeneficial impact of P_2O_5 application up to 60kg/ha.

3.2.2 Pod length

Maximum pod length (28.8cm) was noticed with the genotype Baramasi and application of 60kg P_2O_5/ha recorded the maximum pod length (27.8cm). Interaction effect between genotypes and phosphorus levels revealed the maximum pod length (30.7cm) in Baramasi×60kg P_2O_5/ha. Birari *et al.* (1993) noted similar type of variation among varieties.

3.2.3 Average pod weight

The effect of genotype on average pod weight per plant of cowpea was noticed and Baramasi (11.0) produced the maximum pod weightand the maximum pod weight per plant (10.4) was observed with the application of 60kg P_2O_5/ha. In interaction effect between genotype and phosphorus level,it was noted that Baramasi×60kg P_2O_5/ha recorded the maximum pod weight per plant (12.5). The results are in conformity with the works of Musa *et al*. (2017) as they found significant difference among genotypes in expression of average pod weight per plant of cowpea.

Table 3.2.a: Effect of genotypes and phosphate levels on number of pods/plant, length of pods(cm), average pod weight(g) of cowpea genotypes at different growth stages.

Treatment	Number of pods/ plant	Length of pods(cm)	Average pod weight(g)
Genotypes			
SB 2	9.87	25.30	9.10
Rawati	9.81	26.62	9.11
Baramasi	10.1	28.81	11.02
SEm±	0.06	0.12	0.04
CD (P=0.05)	0.17	0.37	0.14
Phosphate levels (kg ha^{-1})			
0	8.91	26.48	9.10
20	9.35	26.65	9.59
40	9.94	26.70	9.79
60	11.55	27.81	10.49
SEm±	0.08	0.16	0.06
CD (P=0.05)	0.23	0.49	0.18
Interaction of genotype X phosphorus level			
SEm±	0.24	0.50	0.19
CD(P=0.05)	0.71	1.49	0.56
CV(%)	7.30	5.67	5.94

Table3.2.b: Effect of genotypes and phosphate levels on number of seeds/pod, average seed weight/pod(g), pod yield(kg/ha), seed yield(kg/ha) of cowpea genotypes at different growth stages

Treatment	Number of seeds/pod	Average seed weight/pod (g)	Pod yield (kg/ha)	Seed yield (kg/ha)
Genotypes				
SB-2	10.92	1.22	4103.47	898.53
Rawati	9.34	1.17	3720.13	814.60
Baramasi	10.98	1.45	4354.85	964.81
SEm±	0.08	0.01	28.72	5.02
CD (P=0.05)	0.24	0.04	84.23	14.72
Phosphate levels (kg ha^{-1})				
0	8.94	0.99	3560.18	625.71
20	9.37	1.14	4145.36	776.02
40	11.53	1.42	4257.40	1020.04
60	11.82	1.57	4274.99	1148.81
SEm±	0.11	0.01	38.29	6.69
CD (P=0.05)	0.32	0.05	112.31	19.63
Interaction of genotype X phosphorus level				

SEm±	0.33	0.05	114.88	20.08
CD(P=0.05)	0.97	0.17	336.95	58.90
CV(%)	9.54	13.79	8.49	6.74

3.2.4 Number of seeds per pod

The number of seeds per pod is significantly influenced by the genotypes as well as phosphorus levels.Baramasiproduced the maximum seeds per pod (10.9) and application of 60kg P_2O_5/ha recorded the highestnumber of seeds per pod (11.8). The interaction effects between the genotypes and phosphorus levels showed that the maximum number of seeds per pod (13.4) was observed in Baramasi genotype with the application of 60kg P_2O_5/ha.Mawo *et al*. (2016) found that the number of seeds cowpea genotypes was influenced by phosphorus levels.

3.2.5 Seed weight per pod

The effect of genotype on seed weight per pod of cowpea was noticed to be influenced and Baramasi (1.45) produced the maximum seed weight. The maximum seed weight per pod (1.57) was also noted with the application of 60kg P_2O_5/ha. In case of the interaction effects between genotypes and phosphorus levels, the maximum seed weight per pod (1.81) wasobserved with the genotypeBaramasi when 60kg P_2O_5/ha was applied. Earlier Ezeaku (2013) recorded such variation among genotypes in expression of seed weigh per pod of cowpea.

3.2.6 Pod yield

Pod yield differed significantly amongcowpea genotypes. The genotype Baramasi produced significantly higher pod yield (4354 kg/ha) than other genotypes and the highest pod yield (4274 kg/ha) was recorded with the application of 60kg P_2O_5/ha. The interaction effects between the genotypes and phosphorus levels was maximumin enhancing pod yield (5199kg/ha) whenBaramasi cultivated with 60kg P_2O_5/ha. Satodiya *et al.* (2015) observed the significant effect of yield and yield attributes.

3.2.7 Seed yield

Seed yield differed significantly among genotypes.The maximum seed yield was recorded in genotype Baramasi(964.8kg/ha) and application of 60kg P_2O_5/ha registered the maximum seed yield(1148kg/ha).In case of the interaction effects between the genotypes and phosphorus levels, the maximum seed yield (1303kg/ha) was observed in Baramasi genotype with the application of 60kg P_2O_5/ha. The results corroborate with the findings of Pardhi (2016).

CONCLUSION

From the present study, it has been clearly observed that the genotype Baramasi performed better than SB-2 and Rawati. However, the best results in terms of yield attributes and yield were registered with 60kg P_2O_5/ha.

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