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Effect of Phosphorus Levels on Growth and Yield of Kabuli Chickpea (*Cicer kabulium* L.) Varieties

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Abstract

*A field experiment was conducted during winter (Rabi) season of 2018-19 at Agricultural Research Farm, Department of Agronomy, R.B.S. College, Bichpuri, Agra (U.P.) the investigation entitled "Effect of phosphorus levels on growth and yield of Kabuli chickpea (*Cicer kabulium *L.) varieties." The variables involve in this study three Kabuli chickpea variety such as Pragati (K-3256), Ujjawal (IPCK 2004-29) and Shubra (IPCK 2004-29) was sown with four phosphorus levels viz. P_0-(control), P_1-(30 kg P_2O_5), P_2-(60 kg P_2O5), P_3-(90 kg P_2O_5). Thus in all 12 treatments combinations were compared in a randomized block design having cultivars sown in main plots and phosphorus levels in sub plots with four replications. The experimental result revealed that Kabuli chickpea variety Pragati (K-3256) obtained significantly higher grain yield (10.95 q ha^{-1}) followed by Ujjawal and Shubhra cultivars fertilized with 90 kg P_2O_5 ha^{-1} and this was statistically at par with 60 kg P_2O_5 ha^{-1} in this investigation.*

Key words: Kabuli Chickpea, Phosphorus, Variety, Treatments, Yield

Introduction

Chickpea (*Cicer kabulium* L.) is the major pulse crop in India. At global level it ranks third in terms in area and production under legumes. It is grown with levels care and less manurial requirement. In India, total pulses area and production during 2018-19 has been 29.3 million hectares and 24.8 million tonnes respectively. Out of the total area, 7.3 million hectares is in Madhya Pradesh alone, earning a prime status in pulse production commodity registering a remarkable 25% of the country's pulse area with 33% production, thereby ranking first both in area and production. In India, Kabuli gram is the third most important winter pulse crop. The area, production and productivity during 2018-19 was 1.47 million hectares, 1.04 million tonnes and 705 kg/ha, respectively. Madhya Pradesh, Bihar, West Bengal, Rajasthan, Maharashtra and Haryana are the major Kabuli gram producing states. In this, Rajasthan and Madhya Pradesh both contribute 71.60 and 62.90% towards total national area and production, respectively. *(Source: DES, Ministry of Agri. & FW (DAC&FW), Govt. of India.2018-19.*

The applied research and efforts towards short duration varieties for bringing additional area in eastern India, abiotic and stress tolerance, machine harvestable and herbicide tolerant varieties, extra-large Kabuli chickpea for premium domestic and international market, diversification of rice wheat system, efficient cropping systems, varieties with enhanced phosphorus acquisition efficiency, management of pod borer (*Helicoverpa armigera*), incorporation of multi-racial and multiple disease resistance, nutritionally enhanced varieties, popularization of extra-large seeded Kabuli varieties and machine harvestable varieties among farmers etc. Phosphorus plays on important role in nodulation, nitrogen fixation, growth and yield of chickpea (Meena et al. 2005). The response of phosphorus are in leguminous crop like chickpea in higher than other crops for their root development metabolic activities. Phosphorus regulates protein synthesis in plants, because it is a component of the complex nucleic acid structure. Phosphorus is also important in cell division and development of new tissues. Hence, the present investigation was

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conducted in study the "Effect of phosphorus levels on growth and yield of Kabuli chickpea (*Cicer kabulium* L.) varieties.

Materials and Methods

The field experiment was carried out during winter (*Rabi*) season of 2018-19 at Agricultural Research Farm, Department of Agronomy, R.B.S. College, Bichpuri, Agra (U.P.). The soil was a sandy loam in texture with pH 8.2, organic carbon %, 0.31 available N 182.80 kg ha^{-1}, P_2O_5 27.95 kg ha^{-1} and Potash 291.20 kg ha^{-1}. The experiment was laid out in 'randomized block design' having 12 treatments. Levels of phosphorus (0, 30, 60, and 90 kg /ha) in sub plot and varieties (Pragati K-3256, Ujjawal (IPCK 2004-29), Shubra (IPCK 2002-29) in main plots with four replications. The different levels of P_2O_5 (0,30,60,90 and 120) kg ha^{-1} and 20 kg N and 20 kg K_2O ha^{-1} were applied at the time of sowing as a basal dressing through Single Super phosphate (SSP), Urea and MOP, respectively.

Results and Discussion

Growth and Development

Data pertaining to different growth and yield attributing traits and yield are presented in Table 1 & 2. The maximum number of germination count m^{-1} row length, plant height, dry matter accumulation in plants of 25 cm row length, days to 75 per cent flowering and days to maturity are obtained with crop fertilized with 90 kg P_2O_5 sown crop and it was considerably reduced with 60 kg (P_2O_5) and 30 kg (P_2O_5) at all the stages of crop growth. The dry matter accumulation in plants of 25 cm row length was increased continuously almost linearly up to harvest of the crop. However, the rate of dry matter accumulation was much faster after 30 days of seeding. The rapid increase in spike weight might be the principal reason for faster dry matter accumulation in plants of 25 cm row length.

Yield attributes

In case of Kabuli Chickpea the main yield contributing, characters are number and weight of pods $plant^{-1}$, number and weight of grains $plant^{-1}$, number and weight of grains pod^{-1} and 100 grain weight. The variations in these yield attributes due to treatment effect were measured and results so obtained were presented in Table 1 and subjected to statistical analyses.

Number of pods per plant

Exhibited that the effect of varieties and phosphorus levels on number of pods per plant were found significant but the interaction between them did not cause significant effect on this study. The variety Pragati (V_1) had significantly higher number of pods per plant as compared to Ujjwal and Shubhra cultivars. The number of pods $plant^{-1}$ increased significantly with every increase in the rate of phosphorus application up to 90 Kg P_2O_5 ha^{-1}. When the rate of phosphorus was increased with 60 Kg P_2O_5 ha^{-1} to 90 Kg P_2O_5 ha^{-1}, the number of pods $plant^{-1}$ increased with marginally and could not reach the level of significance.

Table 1: Yield contributing characters as influenced by varieties and levels of phosphorus application

Treatments	No. of pods $plant^{-1}$	Weight of pods $plant^{-1}$ (g)	Number of grains $plants^{-1}$	Weight of grains $plant^{-1}$	100 grain weight (g)
Varieties					
Pragati (V_1)	42.52	12.74	38.06	9.30	31.56
Ujjwal (V_2)	36.67	11.30	32.07	9.00	28.80
Shubhra (V_3)	34.12	10.32	27.71	9.10	27.79
SEm±	0.65	0.60	1.05	0.42	0.66
CD (p=0.05)	1.82	1.70	2.90	1.19	1.62
Levels of phosphorus (kg P_2O_5 ha^{-1})					
0 (P_0)	30.70	9.46	25.89	7.21	27.93
30 (P_1)	33.95	11.28	29.02	7.68	28.82
60 (P_2)	41.06	13.35	36.65	9.12	30.80
90 (P_3)	42.09	13.42	37.90	9.14	30.85
SEm±	0.75	0.70	1.18	0.48	0.66
CD (p=0.05)	2.10	1.97	3.35	1.38	1.91

Table 2: Biological, Seed, straw yield and harvest index as influenced by varieties and levels of phosphorus application

Treatments	Biological yield(q/ha^{-1})	Grain yield(q ha^{-1})	Straw yield(q ha^{-1})	Harvest index (%)
Varieties				
Pragati (V_1)	34.28	10.95	23.33	31.94
Ujjwal (V_2)	30.25	8.80	21.45	29.09
Shubhra (V_3)	29.70	8.50	21.20	28.61
SEm±	0.98	0.38	0.61	0.74
CD (p=0.05)	2.23	0.97	1.75	NS
Levels of phosphorus (kg P_2O_5 ha^{-1})				
0 (P_0)	24.54	6.60	17.94	26.89
30 (P_1)	34.20	8.10	24.10	29.53
60 (P_2)	34.54	10.50	24.04	30.39
90 (P_3)	35.65	11.15	24.50	31.27
SEm±	1.19	0.39	0.75	0.91
CD (p=0.05)	3.12	1.09	2.00	2.51

Weight of pods per plant

Table 1 shows that variety Pragati (V_1) had significantly higher weight of pods plant^{-1} than that of Ujjwal (V_2) and Shubhra (V_3). The weight of pods plant^{-1} increased with increasing levels of phosphorus application up to 90 kg P_2O_5 ha^{-1}, but significant variations were observed only up to 60 kg P_2O_5 ha^{-1}.

Number of grains pod^{-1}

The data summarized in Table 1 revealed that the varieties had significant impact on the number of grains pod^{-1}. However, variety Pragati (V_1) had maximum number of grains pod^{-1} followed by Ujjwal (V_2) and Shubhra (V_3). The application of phosphorus also had significant impact on number of grains pod^{-1}. However, number of grains pod^{-1} improved with every increase in the rate of phosphorus application up to 90 kg P_2O_5 ha^{-1}. When the rate of phosphorus was increased from 60 to 90 kg P_2O_5 ha^{-1} the number of grains plant^{-1} were improved marginally and could not reach the level of significance.

100 grains weight

Showed that the varieties and phosphorus levels have significant effect on 100 grains weight but varieties and phosphorus interaction csould not cross the levels of significant. The data presented in Table-1 indicated that the maximum 100 grain weight obtained with variety Pragti as compared to Ujjwal and shubhra. The application of phosphorus increased significantly 100 grains weight over control. The differences in 100 grains weight due to 30, 60 and 90 kg P_2O_5 ha^{-1} were marginal and could not reach the level of significance.

Yield (q/ha^{-1})

The data on biological, grain, straw yield and harvest index of Kabuli chickpea were influences by varieties and levels of phosphorus are summarized in Table 2.

Biological yield (qha^{-1})

Biological yield was significantly affected due to varieties (Table 2). Maximum biological yield was recorded with variety Pragati (V_1) which was significantly higher over Ujjwal (V_2) and Shubhra (V_3) respectively. That biological yield was significantly increased with every increase in the rate of phosphorus application up to 90 kg P_2O_5 ha^{-1}. When the rate of phosphorus application was increased from 60 to 90 kg P_2O_5 ha^{-1}, the biological yield was increased marginally. The magnitude of increase in biological yield with 30, 60 and 90 kg P_2O_5 ha^{-1} was to the tune of 9.56, 20.90 and 21.01 per cent, respectively over the control (P_0).

Grain yield (qha^{-1})

The data presented in Table 2 indicate that Kabuli chickpea varieties differed significantly among themselves in respect to grain yield. Variety Pragati (V_1) produced significantly higher grain as compared to Ujjwal (V_1) and Shubhra (V_3). The application of phosphorus significantly increased grain yield of Kabuli chickpea over the control. Further, grain yield was increased with every increase in the rate of phosphorus application upto 90 kg P_2O_5 ha^{-1}. When the rate of phosphorus was increased from 60 to 90 kg P_2O_5 ha^{-1}, the grain yield increased marginally and did not cross the level of significance.

Straw yield (qha^{-1})

A perusal of the data given in table-2 indicates that Kabuli Chickpea varieties exhibited significant variation in straw yield. Maximum straw yield was obtained with variety Pragati (V_1) which was significantly higher over variety Ujjwal (V_2) and Shubhra (V_3).However variety Ujjwal and Shubhra did not differ much and statistically at par among themselves. The application of phosphorus had significant influence on straw yield as compared with control. Further, application of 60 kg P_2O_5 ha^{-1} resulted in appreciably higher straw yield than 30 kg P_2O_5 ha^{-1} which in turn gave higher straw yield than that of control. When the rate of phosphorus was increased from 60 to 90 kg P_2O_5 ha^{-1}, the straw yield increased marginally.

Harvest index (%)

Different varieties of Kabuli Chickpea had significant effect on harvest index (Table 2). Variety Pragati (V_1) gave significantly higher harvest index as compared to all other varieties tested. Varieties Ujjwal (V_2) and Shubhra (V_3) did not differ statistically. The application of 90 kg P_2O_5 ha^{-1} was reported significantly higher harvest index when compared with control. The difference in harvest index due to 60 and 90 kg P_2O_5 ha^{-1} were nominal and could not reach the level of significance.

Conclusion

The experimental results revealed that Kabuli chickpea variety Pragati (K-3256) obtained significantly higher grain yield (10.95 q ha^{-1}) followed by Ujjawal and Shubhra cultivars fertilized with 90 kg P_2O_5 ha^{-1} and this was statistically at per with 60 kg P_2O_5 ha^{-1} in this investigation.

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