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Effect of phosphorus and weed control measures on growth and yield of chickpea (*Cicer arietinum* L.)

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ABSTRACT : The field experiment was conducted during the *Rabi* season of 2005-06 at Agronomy Research Farm at Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj) Faizabad, U.P. to, study the effect of phosphorus and weed control measures on growth and yield of chickpea (*Cicer arietinum* L.) variety Udai (KPG-59). Sixteen-treatment combinations comprised of four levels of phosphorus (control, 20, 40 and 60 kg P_2O_5 ha^{-1}) and four treatments of weed control measures (weedy check, hand weeding at 30 DAS, pendimethline@ 1 kg ha^{-1} and rice straw mulch) were tested in Randomized Block Design with three replications. Growth and yield attributes as well as root length, number of nodules were affected significantly due to increase the phosphorus levels. However, weed density and weed dry weight were decreased significantly with increasing levels of P. Among the weed control measures, hand weeding at 30 DAS was found promising to reduce the weed density as well as weed dry weight. Hand weeding at 30 DAS proved its superiority over other methods of weed control in respect of all the growth characters and yield attributes as well as grain and straw yield of chickpea crop followed by pendimethlin@ 1.0 kg ha^{-1}. On the basis of economics the highest net return was recorded under hand weeding at 30 DAS alone and found most remunerative, which was recorded the highest net income in rupee invested of Rs 3.52.

Key Words : Chickpea, Phosphorus levels, Weed control measures

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The pulses in the dietary to the mankind make high edible protein which contains essential amino acid to meet the optimum protein requirement of vegetation population.The pulses fix the atmospheric nitrogen into the soil thereby enriching the soil with nitrogen at no extra cost among the winter season pulses. Chickpea has diversified uses such as dal, basan, fresh green seeds for vegetable and fresh green leaves for sag for human consumption and feeding to animals. It is considered to have medicinal effect and it is used for blood purification, chickpea contains 18- 22 per cent protein, 52- 70 per cent carbohydrate, 4- 10 per cent fat and sufficient quantity of minerals and vitamins. Besides, being a rich source of protein it is also considered important for sustainable agriculture, improves the physico- chemical characteristics as well as biological properties of soil and function as mini nitrogen factory.Chickpea is one of the important pulse crops of *Rabi* season. The chickpea is grown in India on an area of 8.81 mha. With production of 6.68 mtwhich amount 65 and 68 per cent of the global area and production, respectively. In Uttar Pradesh, it is cultivated on an area of 868 lakh hectares with an annual production of 828.4 lakh tonnes. Thus, the average productivity of chickpea in Uttar Pradesh is very low out of several reasons for low productivity, soil fertility status and inadequate weed management may be considered as major constraints. Phosphate fertilization of chickpea promotes growth nodulation and enhance yield. Phosphorus imparts hardiness shoots, improves grain quality, regulate the photosynthes is govern physico-biocamical processes and also helps in root enlargement, nodule production and there by increases nitrogen fixation (Chaudhary *et al.*, 1975). Weed control is achieved through direct methods and by adopting indirect methods such as altered land preparation, soil moisture regulation, planting methods and fertility management. Manual weeding at 25 and 40 days after sowing increased seed yield of chickpea by 170 per cent over weedy check. Mulch also increased the grain yield and straw yield of chickpea.

RESEARCH PROCEDURE

The field experiment was conducted during *Rabi* season, 2005-2006 at Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj) Faizabad (U. P.) India. The field study was planned and layout in randomized block design. Chickpea was sown in second fortnight of October and was harvested in the second fortnight of March. The soil of the experimental field was poor in available nitrogen and medium in phosphorus and potassium with alkaline in reaction. The organic carbon content in the soil was 0.34 per cent. During crop season, the maximum temperature varied from 21.8^{0}C to 35.0 ^{0}C. The maximum rainfall of 24.2 mm was recorded in the month of October and total rainfall received during the crop period was 69.5 mm. The sunshine hours ranges from October 2.6 to 9.9 hours. Relative humidity was the maximum 78 per cent in the month of October. Chickpeavariety Udai (KPG- 59) was sown in furrows opened by Kudal at the spacing of 30 cm apart using 80 kg seed ha^{-1}. Soil of the experimental site has been classified as sandy loam and field was drained and well leveled. Soil samples were collected at random from different parts of experimental field (16 places) with the help of a soil auger to a depth of 0-22.5 cm prior to the fertilizer application. The collected soil samples were mixed together and a composite sample was drawn and analyzed. A basal dose of 20 kg nitrogen through urea was applied uniformly to all plots. The observations pertaining to growth and dry matter accumulation were recorded at 30, 60, 90 DAS and at harvest. The value was averaged and expressed as height/plant (cm). Weed population was studied with the help of a quadrate (50cm x 50cm) placed in second row in the different corners of the plot in different observations. The populations counts were taken at different stages of crop growth *i.e.* 30, 60, 90 DAS and at harvest, sampled plants were dried in sun and subsequently into oven at 70^{0}C till constant weight were obtained and total dry matter accumulation of whole plant was recorded.

RESEARCH ANALYSIS AND REASONING

The results obtained from the present investigation have been discussed in the following sub heads:

Plant height:

Phosphorus levels per hectare and weed control measures markedly influenced the plant height at all the crop growth stages in the year (Table 1). The plants grow slowly upto 60 days and there after a fast growth rate was observed upto 90 days. Plant height was affected significantly by different phosphorus levels, except at 20 kg P_2O_5 ha^{-1} (P_1) at all the stages of crop growth except 30th and 60th day stages. At30th and 60th day stages plant height was recorded at par due to various phosphorus levels. Among all the phosphorus treatments, higher plant height was recorded at w_0(P_3) at all the stages and

Table 1 : Effect of phosphorus and weed control measures on plant height (cm)

Treatments	Plant height at various stages			
	30 DAS	60 DAS	90 DAS	At harvest
Phosphorus (kg P_2O_5)/ ha				
P_0	15.69	26.11	43.34	59.45
P_1	16.14	26.47	46.28	61.14
P_2	16.62	26.81	50.67	65.84
P_3	17.25	27.11	55.39	71.17
S.E.±	0.53	0.52	1.3	1.72
C.D. (P=0.05)	NS	NS	3.76	4.96
Weed control measures				
W_0	15.72	23.61	46.33	58.28
W_1	16.42	27.00	49.25	65.61
W_2	16.37	26.42	47.42	64.06
W_3	16.75	29.47	52.67	69.64
S.E.±	0.53	0.52	1.3	1.72
C.D. (P=0.05)	NS	1.5	3.76	4.96
Interaction PxW	NS	NS	NS	NS

NS=Non-significant

lowest with control (P_0). Phosphorus 60 kg P_2O_5 ha^{-1} (P_3) recorded significantly higher plant height on all the lower levels of phosphorus at 90 and at harvest stage of crop growth. The effect of different weed control measures on plant height is depicted. Plant height was affected significantly due to various weed control measures at all the stages of crop growth, except at 30th day crop stage. Among all the weed control treatments, plant height was recorded in mulch (w_3) and lowest in weedy check (w_0) treatments at all the stages of crop growth. All the weed control measures did not observe significant difference as compared to weedy check (w_0) at all the stages. Hand weeding (w_1) and pendimethalin @1.0 kg ha^{-1} (w_2) being at par with weedy check (w_0) at 90 day of crop growth. Mulch (w_3) recorded significantly higher plant height as compared to all the weed control measure at all the stages of crop growth except at 30 day stage.

Dry matter accumulation plant^{-1} (g):

Phosphorus levels per hectare and weed control measures markedly influenced the dry matter accumulation (g) at all the crop stages in the year (Table 2). In general, dry matter accumulation increased with increasing crop age. Lower doses of phosphorus resulted in substantially less dry matter as compared to all other treatments. Phosphorus at 20 kg P_2O_5 ha^{-1} (P_1) being at par with other higher level of phosphorus at 30thdays and at harvest recorded significantly more crop dry matter as compared to weedy check (w_0). Phosphorus 40 kg P_2O_5 ha^{-1} (P_2) being at par with 60 kg P_2O_5 ha^{-1} (P_3) recorded significantly more crop dry matter as compared to lower phosphorus levels at 60 DAS. At 60 kg P_2O_5 ha^{-1} (P_3) recorded significantly more crop dry matter as compared to lower

Table 2 : Effect of phosphorus and weed control measures on dry weight plant^{-1} (g)

Treatments	Dry weight plant^{-1} (g)			
	30 DAS	60 DAS	90 DAS	At harvest
Phosphorus (kg P_2O_5)/ ha				
P_0	0.37	1.51	3.36	19.12
P_1	0.41	1.67	4.23	22.77
P_2	0.43	1.85	4.52	23.03
P_3	0.44	1.98	5.43	23.71
S.E.±	0.01	0.05	0.13	0.35
C.D. (P=0.05)	0.03	0.14	0.37	1.01
Weed control measures				
W_0	0.39	1.53	3.67	19.35
W_1	0.43	1.88	4.80	23.91
W_2	0.42	1.82	4.71	23.69
W_3	0.41	1.78	4.66	23.08
S.E.±	0.01	0.05	0.13	0.35
C.D. (P=0.05)	0.03	0.14	0.37	1.01
Interaction PxW	NS	NS	NS	NS

NS=Non-significant

Table 3 : Effect of phosphorus and weed control measures on grain and straw yield and harvest index of chickpea

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)
Phosphorus (kg P_2O_5/ha)			
P_0	16.19	24.09	40.01
P_1	19.26	26.94	41.21
P_2	21.28	30.75	41.74
P_3	22.93	31.42	42.61
S.E.±	0.67	0.93	
C.D. (P=0.05)	1.94	2.67	
Weed control measures			
W_0	17.15	24.5	40.21
W_1	22.24	31.52	41.99
W_2	20.88	29.38	41.06
W_3	19.38	27.8	40.86
S.E.±	0.67	0.93	
C.D. (P=0.05)	1.94	2.67	
Interaction PxW	NS	NS	

NS=Non-significant

phosphorus levels at 90 DAS. Among weed control measures, weedy check (w_0) resulted in significantly less dry matter accumulation as compared to all other treatments, at all the stages of crop growth. All the weed control measures being at par resulted in significantly higher dry matter accumulation at all the stages of crop growth as compared to weedy check (w_0).

Effect on yield:

The perusal of the data revealed that phosphorus 40 kg P_2O_5/ha (P_2) being at par with 60 kg P_2O_5/ha (P_3) resulted in significantly higher grain yield as compared to lower phosphorus levels (Table 3). Among weed control measures, weedy check (W_0) resulted significantly less grain yield as compared to rest of the treatments. Among weed control measures, hand weeding (W_1) showed significantly higher grain yield as compared to other weed control measures.

The perusal of the data revealed that phosphorus 40 kg P_2O_5/ha (P_2) being at par with 60 kg P_2O_5/ha (P_3) resulted in significantly higher straw yield as compared to lower phosphorus levels. The control (P_0 recorded) the significantly less straw yield among all the treatments.Among weed control measures, weedy check (W_0) resulted significantly less straw yield as compared to all other weed control measures while hand weeding (W_1) treatments being at par with pendimethalin 1.0 kg/ha (W_2) showed significantly higher straw yield as compared to other weed control measures. The different levels of phosphorus and weed control measures did not influence the harvest index of chickpea.

Nitrogen depletion by weeds:

Nitrogen depletion consistently increased with increasing phosphorus levels (Table 4). Application of phosphorus at 40 kg P_2O_5/ha (P_2) being at par with 60 kg P_2O_5/ha (P_3) recorded significantly higher depletion of nitrogen by weeds as compared to lower levels of phosphorus. Phosphorus depletion consistently increased with increasing phosphorus levels. Application of phosphorus at 60 kg P_2O_5/ha (P_3) being at par with 40 kg P_2O_5/ha recorded maximum phosphorus depletion (0.128 kg/ha) by weeds, which was significantly higher over 20 kg P_2O_5/ha (P_1) fallowed by control. Application of 60 kg P_2O_5/

Table 4 : Effect of phosphorus and weed control measures on nitrogen and phosphorus depletion by weeds

Treatments	Depletion by weed kgha^{-1}	
	Nitrogen	Phosphorus
Phosphorus P_2O_5 kgha^{-1}		
P_0	1.60	0.110
P_1	1.66	0.117
P_2	1.86	0.124
P_3	1.89	0.128
S.E.±	0.06	0.003
C.D. (P=0.05)	0.17	0.009
Weed control measures		
W_0	1.90	0.118
W_1	1.67	0.114
W_2	1.68	0.121
W_3	1.77	0.127
S.E.±	0.06	0.003
C.D. (P=0.05)	0.17	0.009
Interaction (P x W)	NS	NS

NS=Non-significant

ha (P_3) being at par with 40 kg P_2O_5/ha (P_2) recorded significantly higher phosphorus depletion by weeds as compared to control. The weeds allowed to grow with crop for the entire season removed the highest quantity of nitrogen (1.90 kg/ha) from the field while lowest quantity of nitrogen removed was recorded with the hand weeding. Among weed control measures, all the treatment being at par significantly lower level of depletion by weeds as compared to weedy check. The weeds allowed to grow with crop for the entire season removed the highest quantity of phosphorus (0.118 kg/ha) from the field while lowest quantity of phosphorus removed was recorded with the hand weeding (W_1). Among weed control measures, hand weeding (W_1) recorded significantly lower as compared to mulch (W_3) and at par with other treatments.

Total dry matter production of weeds:

Dry matter production was decreased with increasing levels of phosphorus at all the stages of crop growth (Table 5). Dry weight of weeds was recorded at par at all the levels of phosphorus significantly less quantity of dry matter accumulation was recorded at all the growth stages.Weed dry matter was also depicted at various crop growth stages under the different weed control measures.All the weed control resulted significantly lower dry matter accumulation at all the stages of crop growth as compared to weedy check. Interaction between phosphorus levels and weed control increases found non- significant at all the stages of crop growth with respect to dry matter accumulation due to weeds.

Table 5 : Effect of phosphorus and weed control measures on weed dry weight accumulation (g/m^2)

Treatments	Crop growth stage (DAS)		
	60	90	At harvest (147)
Phosphorus (kg P_2O_5/ha)			
P_0	9.65	10.98	12.41
P_1	8.06	9.13	10.34
P_2	7.80	7.90	10.14
P_3	7.44	8.48	9.94
S.E.±	0.33	0.44	0.54
C.D. (P=0.05)	1.03	1.27	1.56
Weed control measures			
W_0	9.82	11.13	12.49
W_1	7.37	8.49	9.77
W_2	7.67	8.73	10.00
W_3	9.67	9.16	10.57
S.E.±	0.33	0.44	0.54
C.D. (P=0.05)	1.03	1.27	1.56
Interaction (P x W)	NS	NS	NS

$P_{0=0}$ kg P_2 O_5, $P_{1=}$ 40 kg P_2 O_5, $P_{3=}$ 60 40 kg P_2 O_5,
$W_{0=}$ weedy check, $W_{1=}$ Hand weeding 30 DAS,
$W_{2=}$Pendimethalin 1.0 kgha^{-1} (pre-Em.),
$W_{4=}$ Rice straw mulch 5 cm thick (post Em.)
DAS= Days after Sowing

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