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Full length Research Paper

Effect of phosphorus fertilizer on yield and yield components of Chickpea (*Cicer arietinum*) at Kelemeda, South Wollo, Ethiopia

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A field experiment was carried out to study the effect of varying levels of phosphorus ($T_{1=}$ 0kg/ha, $T_{2=}$ 30kg/ha, $T_{3=}$ 60kg /ha, T_4=90kg/ha and $T_{5=}$120kg/ha) on growth performance and yield of chickpea (Cicer – arietinum) variety Aratiy at the experimental field of Wollo University, Kelemmeda, during winter season in 2013. The results revealed that phosphorus levels significantly affected plant height, number of branches per plant and number of pods per plant. The maximum plant height (39.25cm) was recorded from plots that received 60kg P_2O_5 ha $^{-1}$, while the minimum plant height (32.5cm) was recorded from the control. Similarly, higher number of branches per plant was recorded from the same treatment. The maximum number of pods per plant (49) was observed from the application of 60kg P_2O_5 ha $^{-1}$. Generally the results revealed that the application of 60kg P_2O_5 ha $^{-1}$ gave better performance in all the parameters studied. However, this research was conducted using irrigation, in one location and one season. Thus, it should be replicated in multi locations and seasons so as to assure the results of the experiment.

Key words: Experiment, chickpea, phosphorus, pods per plant, Aratiy.

INTRODUCTION

Chickpea (*Cicer arietinum*) also known as Bengalgram and simply gram in English is popularly called as china in India because of cultivated area, it is the nineteenth most important crop grown in the world. About 70% of world production of chickpea comes from Asia. It is predominantly grown in cool, dry periods on receding soil moisture. Chickpea is known to have originated in Western Asia (probably Eastern Turkey). The cultivated chickpea is not found in the wild and *C. reticulatum* is its progenitor, while *C.exhinospernum* is a close relative. From West Asia, it spread to Europe and in more recent times, it was introduced in tropical Africa, Central and Southern America and Australia. Introduction of chickpea in India is from atransikhera in utter Pradesh and these dates back to 2000BC [Chaludhury et al, 1970]. Its introduction to peninsular India appears to be between 300 and 500 BC (Vishnu Mittre, 1974).

The yield potential of the crop varies according to the management practices given to it. Among these practices, fertilizer application especially that of Phosphorus has a key role on yield of chickpea .Phosphorus can be replaced rapidly enough for optimum crop production. In the case of nutrient, fertilizer addition is normally necessary for high yields to be attained. Phosphorus, in particular is an essential input and soil nitrogen levels need to be augmented in many cases. There is a need to use sufficient fertilizer input to allow the return of high yield but their utilization depends on the removal of other impediments to yield such as diseases, weed. In adequate 'p' nutrition affects various metabolic processes; plant are retarded in growth ,poor root system ,reddish color stems ,leaves fall prematurely ,impaired fruit setting.

Phosphorus is essential for health and vigor of plants. Some specific growth factors associated to phosphorus include root development, increase in stack and more stem strength, improvement in flower formation, and higher seed production with more uniformity while earlier crop maturity increase nitrogen fixing capacity of legumes and improve crop quality and resistant to plant diseases.

The major problems of developing countries in the area of crop production are low productivity which can be attributed to so many reasons. The productivity of a crop

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Table 1. Effect of Different Phosphorus Levels on Plant Height of Chickpea.

Treatment	Plant height
T_1	32.5^a
T_2	34.25^a
T_3	39.25^b
T_4	39^b
T_5	38^b

$T_{1=}$ 0kg/ha, $T_{2=}$ 30kg/ha, $T_{3=}$ 60kg /ha, T_4=90kg/ha and $T_{5\ =}$120kg/ha.

Table 2. Analysis of Variance of Plant Height of chickpea.

Source of variation	Df	Ss	Ms	Fcal	Ftab	
					0.05	0.01
Replication	3	40.55	13.5	3.47^{ns}	3.49	5.95
Treatment	4	153.3	38.32	9.85*	3.26	5.41
Error	12	46.1	3.89			
Total	19	240.55	12.66			

could be improved by using appropriate technologies such as recommended fertilizer rate. However, the recommended rate of fertilizer might vary according to crop type, location, soil type etc. So far a number of researches have been done on chickpea but the impact of Phosphorus fertilizer, especially on localities like KelemMeda is scanty. Thus, this research was initiated to identify the optimal level of Phosphorus fertilizer for localities which have similar agro ecology with that of KelemMeda.

RESEARCH METHODOLOGY

Description of the Experimental Site

The experiment was conducted in South Wollo Zone, Dessie town, Wollo University at KelemMeda which has an altitude of 2600 m.a.s.l, annual rain fall ranging from 900 – 1000 mm and temperature ranging from 12^oc – 26^oc. The soil type of the experimental site is heavy clayey soil and the weather condition of the area is under "Dega".

Experimental Design

The experimental design was a randomized complete block design (RCBD) with four replications and five treatments. The total experimental area was 4m x 5m $=20m^2$ and a total of 20plots and each plot has an area of 1m x $1.2m^2$ $=1.2m^2$ with 0.5m and 1m within and between rows, respectively. The treatments are designated as T_1, T2, T3, T4 and T_5 ($T_{1=}$ 0kg/ha, $T_{2=}$ 30kg/ha, $T_{3=}$ 60kg /ha, T_4=90kg/ha and $T_{5\ =}$120kg/ha)

Data Collected

Data were collected from randomly selected and tagged plants from the central rows excluding the border rows. Data were collected on plant height, number of branches and number of pods per plant.

RESULTS AND DISCUSSION

Effect of different phosphorus levels on the plant height of chickpea

Plant height (cm), as affected by various levels of P_2O_5 is shown in Table 1. Tactical analysis revealed that $p_2{}^0{}_5$ application significantly ($p<0.05$) affected plant height. Maximum plant height (39.25cm) was recorded from those plots that received 60kg $p_2{}^0{}_5$ ha^{-1} while minimum plant height (32.5) was observed in the control plots. Previous analysis of the soil showed that "p" content was slightly deficient. Thus, chickpea showed a positive response to its addition. These results are in conformity with those of (Dahiya et al.,1993) who reported that 46, 57 and 69kg $p_2{}^0{}_5$ ha^{-1} respectively increased plant height and number of branches.

Table 2 shows the Analysis of Variance for the plant height. There was significant increase in plant height with $p_2{}^0{}_5$ application which can be attributed to the fact that p_20_5 enhances plant vigor and strength of the stalk

Table 3. Effect of Different DAP levels on number of branches/ plant.

Treatment	Number of branches
T_1	6.75^b
T_2	7.75^a
T_3	9.37^b
T_4	7.75^a
T_5	8.75^b

$T_{1=}$ 0kg/ha, $T_{2=}$ 30kg/ha, $T_{3=}$ 60kg /ha, T_4=90kg/ha and $T_{5=}$120kg/ha.

Table 4. ANOVA table for Number of Branches per Plant.

Source of variation	Df	Ss	Ms	Fcal	Ftab	
					0.05	0.01
Replication	3	3.85	1.28	18.28*	3.49	5.95
Treatment	4	16.46	4.1	58.57*	3.26	5.41
Error	12	0.84	0.07			
Total	19	21.15	1.11			

Table 5. Effect of Different DAP Levels on Number of Pods per Plant.

Treatment	Pod number
T_1	30.75^a
T_2	33.5^b
T_3	49^b
T_4	33.75^b
T_5	30.75^a

$T_{1=}$0kg/ha,$T_{2=}$30kg/ha,$T_{3=}$60kg/ha,T_4=90kg/haand$T_{5=}$120kg/ha.

(Bahadur et al.,2002). This study corroborates the findings of (Jain and Trivedi, 2005) who reported an increase in plant height with $p_2{}^0{}_5$ application.

Effects of Different Phosphorus Levels on Number of Branches per Plant.

The number of branches per plant was significantly affected by various phosphorus levels (Tables 3 and 4). The application of p_20_5 at 60kgha^{-1} produced significantly higher number of branches per plant (9.37) than the control. All other fertilizer levels varied significantly among themselves for number of branches per plant. The minimum number of branches per plant (6.75) was recorded in control plots.

The comparison of the treatments showed that treatments T2 and T4 were not significant but there was significant difference between treatments T1, T3 and T5.Treatment T3 had the highest number of branches per plant. Application of phosphorus increased the availability of nitrogen and potassium (Saeed et al., 2004) which resulted in better plant growth and more number of branches per plant. Jain and Singh, 2003, also reported that number of branches per plant in pea increased with phosphorus application

Effect of Different Phosphorus Levels on Number of Pods per Plant.

Number of pods per plant is an important yield determinant in pulse crops. Data regarding number of pods per plant are presented in Table 5 and Table 6.The analysis of variance of the number of pods per plant showed significant differences among the treatment means

Table 6. ANOVA table for Number of Pods per Plant.

Source of variation	Df	Ss	Ms	Fcal	Ftab	
					0.05	0.01
Replication	3	224.6	74.86	166.3*	3.49	5.95
Treatment	4	99.8	24.95	55.44*	3.26	5.41
Error	12	5.4	0.45			
Total	19	329.8	17.3			

of treatments. The maximum number of pods per plant (49) was recorded in fertilizer at optimum application (60kg $p_2^0_5$ ha^1) and minimum number of pods per plant (30.75)were recorded in the control treatment. This increase in number of pods plant $^{-1}$ with the application $p_2^0_5$ might have resulted from more pronounced growth of the plant which in turn had increased number of pods per plant. Similar results were reported by Jain and Singh, 2003.

The minimum number of pods in the control might have been due to less availability of N and P and the stunted growth. The same trend of results was reported by Siag, 1995) who noticed that addition of $p_2o_5$at 60 kg ha^{-1} doubled the number of pods per plant. The application of phosphorus might have enhanced the photosynthetic activity which resulted in more number of seeds per plant. Similar results have been reported by Siag, 1995 who observed significantly higher number of seeds per pod with the application of phosphorus as compared to the control.

CONCLUSION AND RECOMMENDATIONS

The application of phosphorus fertilizer significantly affected all the parameters: plant height, number of branches per plant and number of pods per plant. The application of 60kg P_2O_5 resulted in better performance in all the parameters studied. However, this research was conducted in short period of time and did not include the most important parameter which is yield. Thus, it should be done in multi locations and seasons so as to assure the results of the present experiment and to include yield components.

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