Plant Archives Vol. 17 No. 2, 2017 pp. 1549-1553 ***ISSN 0972-5210***

EFFECT OF DIFFERENT LEVELS OF POTASSIUM ON GROWTH, YIELD ATTRIBUTES AND YIELDS OF CHICKPEA VARIETIES

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Abstract

The present study was conducted with the objective to know the effect of potassium levels and different varieties on growth, yield attributes and yield of chickpea. The present investigation consisted four levels potassium (K_1-0, K_2-30, K_3-60 & K_4-90 kg potash ha^{-1}) and three varieties (V_1=Udai, V_2= Awarodhi and V_3 = KWR-108) observation recorded on growth, yield attributes and yield. The present investigation revealed that the maximum number of primary and secondary branches per plant, fresh weight of plant, dry weight, number of pods per plant, number of seeds per plant, weight of pod per plant, biological, grain and straw yield were recorded in K_4 treatment (90 kg potassium ha^{-1}) and variety V_3 (KWR-108). However, maximum number of primary and secondary branches per plant, fresh weight of plant, dry weight, number of pods per plant, number of seeds per plant, weight of pod per plant, biological, grain and straw yield were recorded unfertilized plot K_1 (0 kg potassium ha^{-1}) and variety V_1 (Udai).

Key words : Chickpea, grain yield, potassium levels and varieties.

Introduction

Chickpea (*Cicer arietinum* L.) is the third most important legume in the world. India alone contributes more than 62-67% of the total global production. However, India generally imports 2 million tonnes of pulse every year from Turkey, Australia, Canada and USA. To make up this short fully supply besides of course, further demand from a burgeoning population, at least 23.38 million tonnes of pulses are required by 2015 which is expected to touch 29.30 million tonnes by 2020 (Anonymous, 2016). This necessitates an annual growth rate of 4.2 per cent in pulse production. Chickpea has low fat, low sodium, high fiber, no cholesterol and a good source of protein and minerals. One hundred grams of mature boiled chickpea grain contains 164 calories energy, 2.6 g fat (of which only 0.27 g is saturated), 7.6 g of dietary fibre and 8.9 g of protein. Chickpea also provide dietary calcium (49–53 mg per 100 g). Chickpea is used for human consumption as well as animal feed.

According to the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) chickpea seeds contain on average- 21.1% protein, 64% total carbohydrates (47% starch, 6% soluble sugar), 5% fat, 6% crude fibre and 3% ash. High mineral content has been reported for phosphorus (340 mg per 100 g), calcium (190 mg per 100 g) and magnesium (140 mg per 100 g), iron (7 mg per 100 g) and zinc (3 mg per 100 g). Recent studies have also shown that they can assist in lowering of cholesterol in the bloodstream (Pittway *et al.*, 2008).

Potassium is one of the three major essential nutrients required by crop plants. It is absorbed by the plants in large amounts than any other mineral element except nitrogen (Brady, 1990). Potassium is the utmost importance for water status of plant meristemetic tissues, enables the plant to resist pest and diseases and regulates enzymatic activities and translocation of photosynthates (Mengel and Kirkby, 1987). Within the realm of agriculture, importance of this element to crop growth physiology and yield formation has been detailed by several soils and plant nutrition specialists. It was called "The Third Fertilizer Element" (Mengel and Kirkby, 1982; Munson, 1985) based on the extent of its replenishment needed. Krauss (1997) call it "The Forgotten Nutrient" signifying the lowered priority bestowed towards research on potassium in certain agriculture zone of the world. Farmers and agricultural researchers have often resorted to blank application of K or have depended on native K

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in soil, and focused less towards detailed analysis of K in soil. Considering the wide array of biochemical and physiological activities in plant, for which potassium is essential, it was called “The Versatile Element” (Krauss, 1997).

Judicious use of fertilizers particularly potassium is essential for obtaining the maximum yield of chickpea. So, the present study was carried out to assess the effect of different levels of potassium and varieties on growth, yield attributes and yield on the irrigated soils under Gangetic plain of Uttar Pradesh, India.

Materials and Methods

The present experiment was carried out during *Rabi* 2014-15 at Students’ Instructional Farm (SIF), Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.), India. The field was well leveled and irrigated by tube well. The farm is situated in the west Northern part of Kanpur city under sub tropical zone in 5th Agro-climatic zone (Central Plain Zone). Farm is falling in alluvial belt of Gangetic plain of U.P. between 25^{0}56' N to 28^{0}58' N latitude and 79^{0}31' E to 80^{0}34' E longitudes and at an elevation of 125.9 meter from mean sea level. The treatments combination and their symbols have been shown in Table 1. The statistical analysis of data was carried out by “Analysis of Variance” method (Panse and Sukhatme, 1967).

Table 1 : Treatments combination and their symbols.

S. no.	Treatment combinations	Symbols
1.	0 Kg Potash ha^{-1} × Udai	K1×V1
2.	30 Kg Potash ha^{-1} × Udai	K2×V1
3.	60 Kg Potash ha^{-1} × Udai	K3×V1
4.	90 Kg Potash ha^{-1} × Udai	K4×V1
5.	0 Kg Potash ha^{-1} × Awarodhi	K1×V2
6.	30 Kg Potash ha^{-1} × Awarodhi	K2×V2
7.	60 Kg Potash ha^{-1} × Awarodhi	K3×V2
8.	90 Kg Potash ha^{-1} × Awarodhi	K4×V2
9.	0 Kg Potash ha^{-1} × KWR-108	K1×V3
10.	30 Kg Potash ha^{-1} × KWR-108	K2×V3
11.	60 Kg Potash ha^{-1} × KWR-108	K3×V3
12.	90 Kg Potash ha^{-1} × KWR-108	K4×V3

Results and Discussion

Effect of potassium doses on chickpea

It is evident from the table 1 that initial and final plant population per running meter of chickpea was almost same in all treatment. It indicates that there was no effect of potassium doses neither on germination of seed nor in mortality of plants. Almost similar result was reported by Girma (2015).

Effect on growth

Plant height, number of branches plant^{-1} (primary and secondary branches) (table 2) were significantly maximum in application of 90 kg potassium ha^{-1} at all stage of growth may be due to availability of nutrients than reduced doses of potassium. Significant increased fresh weight and dry matter accumulation at 60 DAS and at harvest of crop (table 3) by application of 90 kg potassium ha^{-1} than 60 and 30 kg ha^{-1} of potassium. The plant height, number of branches per plant, fresh weight and dry matter accumulation could be attributed to the fact that potassium enhances plant vigour and strengthens the stalk, further synergistic effect with nitrogen and phosphorus resulted in better plant growth characters (DAS, 1999). Almost similar results were reported by Sekeroglu *et al*. (1991), Khan *et al*. (1997), Deolenkar (2005) and Tak *et al.* (2013).

Effect on yield contributing character

The various yield attributing characters viz. number of pods per plant, number of seed per plant, seed weight per plant and weight of 100 seeds (tables 3 and 4) were recorded significantly maximum in application of 90 kg potassium ha^{-1} at all stage of growth observations might be due to enhanced availability of plant nutrients, photosynthetic activity, followed by efficient transfer of metabolites and subsequent accumulation of these metabolites in the seed with the resulting in the all yield attributing character. Almost similar results were reported by Rajiv *et al*. (2005), Tomar *et al*. (2001) and Sharma (2001).

Effect on yield

It is clear from the table 4 that significantly maximize the grain and straw yield was with the application of 90 kg potassium ha^{-1} (K_4) 18.80 and 19.13 q ha^{-1}, which was significant and superior to other potassium level treatments like, K_3 (15.46 & 15.74 q ha^{-1}) and K_2 (14.00 & 14.46 q ha^{-1}). The magnitude of increase in yield average was to be 37.02 per cent over the control. However, the significantly minimum grain and straw yield (11.84 & 12.58 q ha^{-1}) was recorded in the control K_1 (0 kg potassium ha^{-1}). Reduction of potassium doses reduced these yield may be supported by growth and yield parameter like plant population, plant height, number of branches, dry matter plant^{-1}, seed plant^{-1}, seed weight plant^{-1} and 100 seed weight, which are maximized at 90 kg potassium ha^{-1}.

It is also clear from that data that an application of

Table 2 : Mean plant population, plant height and number of branches of chickpea as influenced by potassium levels and varieties.

Treatment	Plant population (running meter)		Plant height (cm)		Number of branches plant^{-1}	
	At 30 DAS	At harvest	At 60 DAS	At harvest	Primary	Secondary
Potassium level						
K_1 – 0 kg	18.07	17.38	20.31	34.31	5.43	11.25
K_2 – 30 kg	18.45	17.60	21.93	35.91	6.38	12.37
K_3 -50 kg	18.15	17.80	23.02	37.54	7.34	13.43
K_4 – 90 kg	19.07	17.95	24.31	39.20	8.35	14.65
S. Em. ±	0.33	0.34	0.10	0.16	0.08	0.12
CD at 5%	N.S.	N.S.	0.30	0.47	0.25	0.35
Varities						
V_1 –UdaI	18.49	17.65	21.84	36.17	6.45	12.48
V_2 –Avrodhi	18.50	17.50	22.39	36.76	6.91	12.87
V_3 -KWR-108	18.85	17.90	22.96	37.30	7.27	13.42
S. Em. ±	0.28	0.29	0.09	0.13	0.07	0.10
CD at 5%	N.S.	N.S.	0.26	0.40	0.21	0.30
Intraction						
S. Em. ±	0.57	0.59	0.18	0.27	0.14	0.20
CD at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Table 3 : Mean fresh weight, dry weight, number of pod and pod weight plant^{-1} as influenced by potassium levels and varieties.

Treatment	At flowering stage		At maturity stage		Number of pods plant^{-1}	Pods weight plant^{-1} (g)
	Fresh weight (g)	Dry weight (g)	Fresh weight (g)	Dry weight (g)		
Potassium level						
K_1 – 0 kg	16.40	4.16	30.83	21.10	47.75	14.61
K_2 – 30 kg	17.64	5.24	34.94	24.27	49.96	16.58
K_3 -50 kg	19.17	5.8	38.93	25.67	54.68	18.24
K_4 – 90 kg	21.66	6.4	42.11	27.06	60.91	19.56
S Em ±	0.08	0.06	0.13	0.09	0.10	0.11
CD at 5%	0.26	0.18	0.38	0.28	0.32	0.33
Varities						
V_1 –UdaI	18.15	5.11	34.86	23.61	52.10	16.73
V_2 –Avrodhi	18.63	5.50	36.40	24.60	53.48	17.39
V_3 -KWR-108	19.37	5.63	38.84	25.36	54.40	17.62
S Em ±	0.07	0.05	0.11	0.08	0.09	0.09
CD at 5%	0.22	0.16	0.33	0.24	0.27	0.29
Intraction						
S Em ±	0.15	0.10	0.22	0.16	0.18	0.19
CD at 5%	0.45	N.S.	0.66	0.49	0.55	N.S.

potassium with increasing doses also increased grain yield. The yield increased in K_4 by margin of K_3 (3.34 q ha^{-1}), K_2 (4.80 q ha^{-1}) and K_1 (6.96 q ha^{-1}), respectively. Thus, this dose performed better in the respect of growth, yield attributes and yield of chickpea. The growth and yield attributes were significantly improved by application of different potash levels (Goud *et al.*, 2014). Similar finding have been reported by Deshmukh *et al.* (1993) and Sharma (2001).

Table 4 : Mean number of seed plant^{-1}, grain weight plant^{-1}, 100 grain weight, grain yield, straw yield and harvest index of chickpea as influenced by potassium levels and varieties.

Treatment	Number of seeds plant^{-1}	Grain weight plant^{-1} (g)	100 grains weight (g)	Grain yield (Q ha^{-1})	Straw yield (Q ha^{-1})	Harvest index (%)
Potassium level						
K_1 – 0 kg	66.59	11.92	17.50	11.84	12.58	47.74
K_2 – 30 kg	73.13	13.61	18.68	14.00	14.46	48.87
K_3 -50 kg	76.01	13.67	19.18	15.46	15.74	49.53
K_4 – 90 kg	80.91	14.87	19.21	18.80	19.13	49.49
S. Em. ±	0.05	0.11	0.04	0.17	0.27	0.38
CD at 5%	0.17	0.34	0.14	0.50	0.82	N.S.
Varities						
V_1 –UdaI	71.95	13.10	18.22	14.33	14.66	48.51
V_2 –Avrodhi	74.35	13.50	18.70	14.87	15.31	49.24
V_3 -KWR-108	76.17	13.95	19.01	15.87	16.46	49.38
S. Em. ±	0.05	0.10	0.04	0.14	0.24	0.33
CD at 5%	0.14	0.29	0.12	0.43	0.71	N.S.
Intraction						
S. Em. ±	0.09	0.20	0.08	0.29	0.48	0.66
CD at 5%	0.294	0.59	N.S.	N.S.	N.S.	N.S.

Effect of varieties

It is evident that initial and final plant population per running meter from the table 2 of chickpea was almost same in all treatment. It indicates that there was no effect of varieties neither on germination of seed nor in mortality of plants. Almost similar result was reported due to germination standards of maximum varieties are similar and viability and purity these three varieties of chickpea (Udai, Avarodhi and KWR-108). The plant height recorded at 60 DAS and maturity stage and it is clear that from Table 2 were higher plant height with the variety KWR-108 (22.96 cm) and (37.30 cm) over the variety Udai (21.84 cm) and (36.17 cm). These plant heights are varied due to varieties wise nutrients uptake efficiency with potassium.

It is clear from the table 2 that number of primary and secondary branches plant^{-1} also influenced variety to variety which was recorded at table. The variety KWR-108 have the maximum primary and secondary branches (7.27) and (13.42) than Udai (6.45) and (12.48), which have minimum primary and secondary branches. These primary and secondary branches plant^{-1}are different due to varieties wise nutrients uptake efficiency with different doses of potassium. It may be due to morphological characters of varieties.

It is evident that fresh and dry weight accumulation from the table 3 was significantly higher at both flowering and maturity stage in variety KWR-108 over Udai variety due to combination of variety with potassium levels. However, the minimum fresh and dry weight (18.15 g and 15.11g) was accumulated at flowering and maturity stage (34.86 g and 23.61 g) in Udai variety. The yield attributing characters like number of pods plant^{-1}, number of seed per plant, seed weight plant^{-1} and hundred seed weight in table 4 were significantly higher increased by variety to variety. The variety KWR-108 was bears maximum yield attributes i.e. number of pods plant^{-1} (54.40), number of seed plant^{-1} (76.17), seed weight plant^{-1} (13.95 g), hundred seed weight, (19.01) and the minimum value was recorded in Udai variety. It might be due to better growth characters of variety KWR-108.

It was obvious from the table 4 that the grain yield (15.8.7 q ha^{-1}), straw yield (16.46 q ha^{-1}) were significantly higher in KWR-108 variety. However, the minimum grain (14.33 q ha^{-1}) and straw (14.66 q ha^{-1}) yield were achieved in Udai variety. It was attributed by yield attributes is general and seed weight^{-1} in particular. Whereas, maximum harvest index (49.38 %) recorded in variety KWR-108 which did not affect significant each other. Similar results were reported by Sekeroglu *et al*. (1991) and Girma (2015).

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