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GROWTH AND YIELD RESPONSE OF THREE CHICKPEA CULTIVARS TO VARYING NPK LEVELS

Abdur Rashid[1], M. Ishaque[2], Kiran Hameed[3], Muhammad Shabbir[4] and Muhammad Ahmad [4*]
[1]Department of Agronomy, [2] Department of Forestry, [3]CABB,
University of Agriculture, Faisalabad, Pakistan
[4]Agriculture Adaptive Research Complex, Dera Ghazi Khan, Pakistan

ABSTRACT

There is a wrong perception with the farmers that gram being a legume crop does not need any nutrition. They usually grow it without supplying any fertilizer and get very low yield. The study was planned to observe the effects of NPK fertilizer on growth, yield and quality of gram cultivars to exploit their full genetic potential. The experiment was carried out at the Agronomic Research Area, University of Agriculture, Faisalabad, Pakistan during the winter season of 2007-08. It was laid out in randomized complete block design with split plot arrangement having three blocks keeping gram cultivars (Punjab-2000, Paunjab-91 and Paidar-91) in main plot and fertilizer application levels (0,0,0; 25,0,0; 25,50,0; and 25,50,25 Kg NPK ha^{-1}) in sub plot. It was observed that Paidar-91 surpassed other two cultivars in grain yield, when it fertilized with NPK @ 25,50,0 Kg ha^{-1} due to taller in height, more number of seeds per pod, number of pods per plant, biological yield, seed protein content and profitable. However, exceeding above this fertilizer combination of NPK proved to be uneconomical.

Keywords: Gram, Cultivars, NPK Fertilizer application, Yield, Contributing parameters

INTRODUCTION

Chickpea (*Cicer arietinum* L.) commonly known as gram is an important conventional pulse of Pakistan. During 2010-11, gram was cultivated on 1094 thousand hectare with total production of 760 thousand tons, which was 60% higher as compared to previous year (Anonymous, 2011). This low average seed yield of gram in Pakistan is low as compared to other gram growing countries of the world like China (3333 kg ha^{-1}), Lebanon (2310 kg ha^{-1}), Tunisia (1968 kg ha^{-1}) and Egypt (1790 kg ha^{-1}) (Anonymous, 2010). This is probably due to the fact that gram is cultivated on marginal lands. The use of varieties/cultivars with low yield potential also limits gram yield to a considerable extent (Nazir et al., 2004). There is considerable difference among different cultivars of gram regarding yield potential due to response of NPK fertilization. High yielding cultivars usually have extensive root system, taller in height (Sundaram et al., 1999; Kasole et al., 2005), relatively more number of pods and grains per pod (Islam and Islam, 2004). These cultivars consequently give higher grain (Minhas et al., 2007, Kumpawat et al., 2000) and biological yield (Takankhar et al. 2008 and Singh and Jagdish, 2007) with better protein contents (Singh et al., 2003; Sharar et al., 2000). If we just replace our present cultivars with high yield potential cultivars which are very response to heavy fertilization and may enhance our yield per unit area up to 8-12 %, it can play a pivotal role in increasing the grain yield per unit area (Nazir et al., 2004; Ghaffar, 2000).

There is also a wrong perception with the farmers that gram being a legume crop does not need any nutrition. They usually grow it without supplying any fertilizer, where as it is evident from the literature that application of NPK have beneficial effect on gram yield (Verma and Pandya, 2003; Saeed et al., 2004). But the question that how much NPK should be applied to which cultivar still remains unquenchable. This depends upon the final grain yield (Ruhul et al., 1998) and it's contributing components (Islam and Islam, 2006) whether it is profitable combination or not (Singh *et al*., 2003).

Present study was, therefore, planned to study the effect of NPK fertilizer on growth, yield and quality of gram cultivars under the irrigated conditions of Faisalabad.

**Corresponding author:* e-mail: mahmada2003@yahoo.co.uk

MATERIALS AND METHODS

Investigations to see the effect of varying levels of NPK on growth, yield and quality performance of three chickpea cultivars were carried out at the Agronomic Research Area, University of Agriculture, Faisalabad, Pakistan during the winter season of 2007-08. The experiment was laid out in randomized complete block design with split plot arrangement having three blocks keeping gram cultivars (Punjab-2000, Paunjab-91 and Paidar-91) in main plot and fertilizer application levels (0,0,0; 25,0,0; 25,50,0; and 25,50,25 Kg NPK ha^{-1}) in sub plot. Net plot size was 1.6 m x 7.0 m.

Crop was sown on 9th October, 2001using seed rate of 40 kg ha^{-1} with the help of single row hand drill at 40 cm spaced rows. A fertilizer dose of N @ 25 Kg ha^{-1} along with different levels of PK were side dressed after sowing. All other agronomic practices were kept uniform for all the treatments. As far as the observations taken, plant height was taken by selecting ten plants randomly from each plot and measured from base up to tip of the plant at maturity and then average was calculated. To determine the 1000-grain weight, three samples of 1000-seeds were selected at random from seed lot of each experimental unit and were weighed separately with the help of an electric balance. Then average of these readings was taken. The crop was harvested and sun-dried for five days in the field. After that its biological weight from each subplot was recorded and then converted on hectare basis. Seed yield of each plot was recorded by threshing harvesting plants manually and then converted into Kg ha^{-1}. For seed protein content, 500 seeds from each plot were taken and ground. Digestion of ground samples was done by Gunning and Hibbard's method of sulfuric acid (Jackson, 1962). Then distillation was done with micro Kjeldahl's apparatus and nitrogen in each sample was determined. Thereafter, N of each sample was multiplied by a factor 0.25 to calculate the seed protein contents. An economic analysis was carried out on the basis of variable and prevailing market prices of N, P, K fertilizers and maize grain yield. Net income was calculated by subtracting the total variable cost from the total benefits from each treatment combination.

The pooled data was analyzed by using the methodology described in CIMMYT (1988). Data collected were analyzed statistically by using Fisher's analysis of variance techniques, while significance of treatment means were tested by using least significant difference test at 5 % level of probability (Steel et al., 1997).

RESULTS AND DISCUSSION

The data revealed that cultivars differed significantly from one cultivar to another with respect to plant height. Significantly more plant height (104.7 cm) was recorded in variety Paidar-91 as compared to variety Punjab-2000 which gave a plant height of 84.02 cm. Previously similar results have been reported by Sundaram et al. (1999) and Kasole et al. (2005). Application of fertilizer affected significantly plant height of gram. Minimum plant height (91.57 cm) was recorded in the crop grown without fertilizer application. These results are similar to the findings of the Nazir et al. (2004) and Ghaffar (2000). Fertilizer levels and cultivars interaction was found to be non significant on plant height.

There was significant variation among gram cultivars and fertilizer levels regarding the parameters of number of seeds per pod. Among cultivars, Punjab-91 significantly produced the highest (1.76) number of seeds pod^{-1} than other cultivars. Similarly, the highest number of seeds pod^{-1} was produced (1.66) at fertilizer level of 25-50-25 kg NPK ha^{-1} while significantly the lowest (1.53) obtained without fertilizer application. The interaction between cultivars and fertilizer levels under study was observed to be non-significant to number of seeds per pod. Islam and Islam (2006) also reported that increasing levels of NPK increased settings of pods, number of seeds per pod, and finally number of seeds per plant.

There was significant variation among fertilizer levels on 1000-grain weight of gram cultivars. Gram cultivars showed the significant results in which Punjab-2000 produced the highest 1000-grain weight (281 g) while it was significantly decreased in Paidar-91 (170 g). The treatment fertilized @ 25-50-25 kg NPK ha^{-1} exhibited higher 1000-grain weight (236 g) which was statistically at par with the treatment given 25-50-0 kg NPK ha^{-1}. Significantly the lowest 1000-grain weight (229 g) was observed in control treatment. Similar results have been narrated by Islam and Islam (2006) and Saeed et al. (2004). Interactive effects of fertilizer

levels and cultivars on 1000-grain weight were non-significant.

There was significant variation among fertilizer levels and cultivars regarding biological yield. Paidar-91 surpassed other two varieties (Punjab-2000 and Punjab-91) in respect of biological yield (5032 Kg ha^{-1}). There was also significant variation among different fertilizer application levels regarding biological yield. The highest biological yield (5457 Kg ha^{-1}) was recorded, when 25, 50, 25 Kg NPK ha^{-1} was applied, which was statistically at par with biological yield (5427 Kg ha^{-1}), when 25,50,0 Kg NPK ha^{-1} was applied, while the lowest biological yield (4255 Kg ha^{-1}) was recorded in control. Interactive effects of gram hybrids and fertilizer application levels were found to be significant. The highest biological yield was recorded when Paidar-91gram variety was fertilized with 25,0,0 Kg NPK ha^{-1} was applied, whereas the lowest biological yield (4199 Kg ha^{-1}) was observed when Punjab-2000 was grown without any fertilizer. These results are in line with the observations of Takankhar et al. (2008) and Singh and Jagdish (2007).

There was significant variation among fertilizer levels and cultivars regarding grain yield. Paidar-91 surpassed other two varieties (Punjab-2000 and Punjab-91) in respect of grain yield (1921 Kg ha^{-1}). There was also significant variation among different fertilizer application levels regarding grain yield. The highest grain yield (2161 Kg ha^{-1}) was recorded, when 25, 50, 25 Kg NPK ha^{-1} was applied, which was statistically at par with grain yield (2125 Kg ha^{-1}), when 25,50,0 Kg NPK ha^{-1} was applied, while the lowest grain yield (1480 Kg ha^{-1}) was recorded in control. Interactive effects of gram hybrids and fertilizer application levels were found to be significant. The highest grain yield (2266 Kg ha^{-1}) was recorded when Paidar-91 gram variety was fertilized with 25,50,0 Kg NPK ha^{-1} was applied, whereas the lowest grain yield (1454 Kg ha^{-1}) was observed when Punjab-2000 was grown without any fertilizer. These results are in line with the findings of Minhas et al. (2007), Kumpawat et al. (2000), Verma (2004) and Vinay and Singh (2004) who stated that gram cultivars differed significantly in their genetic potential and this potential was further widened with application of chemical fertilizers (NPK) in different combinations.

There was significant variation among fertilizer levels and cultivars regarding seed protein content. Paidar-91 produced significantly higher seed protein content (21.47 %) than Punjab-2000, while the lowest seed protein content (20 %) were recorded by Punjab-91. There was also significant variation among different fertilizer application levels regarding seed protein content. The highest seed protein content (22 %) was recorded, when 25, 50, 25 Kg NPK ha^{-1} was applied, which was statistically at par with seed protein content (22 %), when 25, 50, 0 Kg NPK ha^{-1} was applied, while the lowest seed protein content (19%) was recorded in control. Interactive effects of gram hybrids and fertilizer application levels were found to be significant. The highest seed protein content (23%) was recorded when Paidar-91gram variety was fertilized with 25,0,0 Kg NPK ha^{-1} was applied, whereas the lowest seed protein content (19%) was observed when Punjab-2000 was grown without any fertilizer. Similar trends were noted by Singh et al. (2003) and Sharar et al. (2000).

There was significant variation among fertilizer levels and cultivars regarding net income. Paidar-91 produced significantly higher net income (Rs.46440 ha^{-1}) than Punjab-2000, while the lowest net income (Rs.42012 ha^{-1}) was recorded by Punjab-91. There was also significant variation among different fertilizer application levels regarding net income. The highest net income (Rs.51283 ha^{-1}) was recorded, when 25, 50, 25 Kg NPK ha^{-1} was applied, which was statistically at par with net income earned (Rs.51022 ha^{-1}), when 25, 50, 0 Kg NPK ha^{-1} was applied, while the lowest net income earned (Rs.34720 ha^{-1}) was recorded in control. Interactive effects of gram hybrids and fertilizer application levels were found to be significant. The highest net income earned (Rs.52955 ha^{-1}) was recorded when Paidar-91gram variety was fertilized with 25,0,0 Kg NPK ha^{-1} was applied, whereas the lowest net income was earned (Rs. 34720 ha^{-1}) was observed when Punjab-2000 was grown without any fertilizer. These results are in conformity with the findings of Verma and Pandya (2003) and Reddy and Ahlawat (2008).

Table: **Growth and yield response of three cultivars of gram to NPK levels**

Treatments	Plant height (cm)	No. of seeds plant^{-1}	1000-grain weight (g)	Grain yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Seed Protein content (%)	Net Income (Rs. ha^{-1})
Cultivar (C)							
C_1: Punjab-2000	84.02 c	72.26 a	280.08 a	1837.89 b	4956.14 b	20.92 b	44345b
C_2: Punjab-91	99.04 b	44.63 c	249.08 b	1744.60 c	4901.96 b	20.02 c	42012c
C_3: Paidar-91	104.74 a	64.20 b	169.92 c	1921.71 a	5032.54 a	21.47 a	46440a
LSD (a)	5.40*	7.25*	30.25*	83.258*	74.256*	0.537*	19865**
Fertilizer application (NPK kg ha^{-1}) (F)							
F_0: 0, 0, 0	91.57 c	49.51 c	229.11 b	1480.27 c	4255.49 c	18.68 c	37005c
F_1:25, 0,0	94.29 bc	56.93 b	231.22 b	1571.94 b	4753.38 b	20.01 b	38810b
F_2: 25,50, 0	97.58 ab	66.81 a	235.44 a	2125.62 a	5427.39 a	22.33 a	51022a
F_3: 25,50, 25	100.30 a	68.21 a	236.33 a	2161.11 a	5457.93 a	22.19 a	51283a
LSD (b)	2.7012*	9.820*	4.20*	90.635*	497.258*	1.32*	1804*
Interaction (C x F)							
C_1 x F_0	77.80	57.96 d	275.66	1452.80 g	4199.43 g	18.82 h	34720g
C_1 x F_1	82.73	68.13 bc	279.00	1561.83 e	4355.33 ef	18.08 i	37770e
C_1 x F_2	86.50	80.53 a	282.33	2151.56 bc	4211.70 fg	19.13 h	36730f
C_1 x F_3	89.06	82.43 a	283.33	2185.36 ab	4695.17 d	20.05 f	36958f
C_2 x F_0	94.10	38.67 f	245.67	1454.80 f	4455.47 d	19.54 g	34913f
C_2 x F_1	97.26	39.68 f	247.33	1473.83 fg	5109.53 c	20.46 e	50070b
C_2 x F_2	100.73	48.53 e	250.67	1958.36 b	5396.57 b	22.69 b	50290b
C_2 x F_3	104.06	51.65 e	252.66	2091.30 b	5409.53 b	21.68 b	45240d
C_3 x F_0	102.80	51.90 e	166.00	1533.23 fg	5476.06 b	23.11 a	50290b
C_3 x F_1	102.86	62.97 cd	167.33	2266.93a	5653.40 a	23.18a	52955a
C_3 x F_2	105.53	71.36 b	173.33	1680.03d	5387.53 b	21.27 d	49140c
C_3 x F_3	107.76	70.56 b	173.00	2206.66 ab	5332.86 b	22.12c	50823b
LSD (c)	N.S	5.423*	N.S	62.35*	210.368*	0.85*	930*

Means not sharing a letter differ significantly at 0.05 level of probability
*= Significant, N.S= Non significant

REMARKS

Seed yield value @ Rs.1000/ 40Kg,
Nitrogen @ Rs. 19.5/ Kg
Phosphorus @ Rs. 32.65/ Kg
Potassium @ Rs. 20.7/Kg
Seed @ Rs. 40 /Kg

CONCLUSION

It was found that gram cultivar Paidar-91 gave the highest yield when cultivated with fertilization of NPK at @ 25, 50, 0 Kg ha^{-1}and exceeding above this combination was found to be uneconomical.

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