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Research Article

Yield and Quality Response of Chickpea Cultivars to Different NPK Levels

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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 Agricultural Research Station, Harahan, Pakistan during the winter season of 2015-16. It was laid out in randomized complete block design with split plot arrangement having three blocks keeping gram cultivars (Karak-1, KC-98 and Punjab-2009) in main plot and fertilizer application levels (0,0,0; 30,0,0; 30,60,0; and 30,60,30 Kg NPK ha_{-1}) in sub plot. It was observed that Punjab-2009 surpassed other two cultivars in grain yield, when it fertilized with NPK @ 30,60,0 Kg ha_{-1} due to taller in height, more number of seeds per pod, number of pods per plant, biological yield and 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 [1]. 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}) [2]. 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 [3]. 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 [4,5], relatively more number of pods and grains per pod [6]. These cultivars consequently give higher grain [7] and biological yield [8,9] with better protein contents [10,11]. 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 [3,12].

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 [13,14]. But the question that how much NPK should be applied to which cultivar still remains unquenchable. This depends upon the final grain yield [15] and its contributing components [6] whether it is profitable combination or not [10]. 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.

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 Agricultural Research Station, Harichand, Pakistan during the winter season of 2015-16. The experiment was laid out in randomized complete block design with split plot

arrangement having three blocks keeping gram cultivars (Karak-1, KC-98 and Punjab-2009) in main plot and fertilizer application levels (0,0,0; 30,0,0; 30,60,0; and 30,60,30 Kg NPK ha_{-1}) in sub plot. Net plot size was 1.6 m x 7.0 m.

Crop was shown on 9th October, 2015 using 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 [16]. Then distillation was done with micro Kjeldahl's apparatus and nitrogen in each sample was determined. Thereafter, N of each sample was

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Table 1: Influence of NPK levels on yield and quality of gram cultivars.

Treatment	Plant height (cm)	No. of seed plant^{-1}	1000-seed weight (g)	Seed yield (kg ha^{-1})	Biomass yield (kgha^{-1})	Seed protein (%)	Net income (Rs. ha^{-1})
Cultivars (C)							
Karak-1	85.02c	73.26a	281.08a	1838.89b	4957.14b	21.92b	44345b
KC-98	100.04b	45.63c	250.08b	1745.60c	4902.96b	21.02c	42012c
Punjab-2009	105.74a	65.20b	170.92c	1922.71a	5033.54a	22.47a	46440a
LSD	5.40*	7.25*	30.25*	83.258*	74.256*	0.537*	19865**
Fertilizer application (NPK kg ha^{-1}) (F)							
F0: 0,0,0	92.57c	50.51c	230.11b	1481.27c	4256.49c	19.68c	37005c
F1: 30,0,0	95.29bc	57.93b	232.22b	1571.94b	4754.38b	21.01b	38810b
F2: 30,60,0	98.58ab	67.81a	236.44a	2126.62a	5428.39a	23.33a	51022a
F3: 30,60,30	101.30a	69.21a	237.33a	2162.11a	5458.93a	23.19a	51283a
LSD	2.7012*	9.820*	4.20*	90.635*	497.258*	1.32*	1804*
Interaction (C X F)							
$C_1 \times F_0$	78.80	58.96d	276.66	1453.80g	4200.43g	19.82h	34720g
$C_1 \times F_1$	83.73	69.13bc	280.00	1562.83e	4356.33ef	19.08i	37770e
$C_1 \times F_2$	87.50	81.53a	283.33	2152.56bc	4212.70fg	20.13h	36730f
$C_1 \times F_3$	90.06	83.43a	284.33	2186.36ab	4696.17d	21.05f	36958f
$C_2 \times F_0$	95.10	39.67f	246.67	1455.80f	4456.47d	20.54g	34913f
$C_2 \times F_1$	98.26	40.68f	248.33	1474.83fg	5200.53c	21.46e	50070b
$C_2 \times F_2$	101.73	49.53e	251.67	1959.36b	5397.57b	23.69b	50290b
$C_2 \times F_3$	105.06	52.65e	253.66	2092.30b	5500.53b	22.68b	45240d
$C_3 \times F_0$	103.80	52.90e	167.00	1534.23fg	5477.06b	24.11a	50290b
$C_3 \times F_1$	103.86	63.97cd	168.33	2267.93a	5654.40a	24.18a	52955a
$C_3 \times F_2$	106.53	72.36b	174.33	1681.03d	5388.53b	22.27d	49140c
C3 x F3	108.76	71.56b	174.00	2207.66ab	5333.86b	23.12c	50823b
LSD	NS	5.423*	NS	62.35*	210.368*	0.85*	930*

The means not sharing a letter differ significantly at 0.05 level of probability.
*: Significant; Ns: Not significant.

Remarks

Seed yield value @ Rs. 1000/40kg; Phosphorous @ Rs. 32.65/kg; Nitrogen @ Rs. 19.5/kg; Potassium @ Rs. 20.70/kg; Seed @ Rs.40/kg.

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 [17]. 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 [18].

Results and Discussion

The data revealed that cultivars differed significantly from one cultivar to another with respect to plant height. Significantly more plant height (105.7 cm) was recorded in variety Punjab-2009 as compared to variety Karak-1which gave a plant height of 85.02 cm. previously similar results have been reported by [4,5]. Application of fertilizer affected significantly plant height of gram. Minimum plant height (92.57 cm) was recorded in the crop grown without fertilizer application. These results are similar to the findings of the [3,12]. 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, KC-98 significantly produced the highest (2.76) number of seeds pod-1 than other cultivars. Similarly, the highest number of seeds pod-1 was produced (2.66) at fertilizer level of 30-60-30 kg NPK ha_{-1} while significantly the lowest (2.53) 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. [6] 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 Karak-1 produced the highest 1000-grain weight (282 g) while it was significantly decreased in Punjab-2009 (171 g). The treatment fertilized @ 30-60-30 kg NPK ha_{-1} exhibited higher 1000-grain weight (237 g) which was statistically at par with

the treatment given 30-60-0 kg NPK ha_{-1}. Significantly the lowest 1000-grain weight (230 g) was observed in control treatment. Similar results have been narrated by [6,14]. 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. Punjab-2009 surpassed other two varieties (Karak-1 and KC-98) in respect of biological yield (5033 Kg ha_{-1}). There was also significant variation among different fertilizer application levels regarding biological yield. The highest biological yield (5458 Kg ha_{-1}) was recorded, when 30, 60, 30 Kg NPK ha_{-1} was applied, which was statistically at par with biological yield (5428 Kg ha_{-1}), when 30,60,0 Kg NPK ha_{-1} was applied, while the lowest biological yield (4256 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 Punjab-2009 gram variety was fertilized with 30,0,0 Kg NPK ha_{-1} was applied, whereas the lowest biological yield (5000 Kg ha_{-1}) was observed when Karak-1 was grown without any fertilizer. These results are in line with the observations of [8,9].

There was significant variation among fertilizer levels and cultivars regarding grain yield. Punjab-2009 surpassed other two varieties (Karak-1 and KC-98) in respect of grain yield (1922 Kg ha_{-1}). There was also significant variation among different fertilizer application levels regarding grain yield. The highest grain yield (2162 Kg ha_{-1}) was recorded, when 30, 60, 30 Kg NPK ha-1 was applied, which was statistically at par with grain yield (2126 Kg ha_{-1}), when 30,60,0 Kg NPK ha_{-1} was applied, while the lowest grain yield (1481 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 (2267 Kg ha_{-1}) was recorded when Punjab-2009 gram variety was fertilized with 30,60,0 Kg NPK ha_{-1} was applied, whereas the lowest grain yield (1455 Kg ha_{-1}) was observed when Karak-1 was grown without any fertilizer. These results are in line with the findings of [7,10,13] 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 (Table 1).

There was significant variation among fertilizer levels and cultivars regarding seed protein content. Punjab-2009 produced significantly higher seed protein content (22.47%) than Karak-1, while the lowest seed protein content (21%) were recorded by KC-98. There was also significant variation among different fertilizer application levels regarding seed protein content. The highest seed protein content (23%) was recorded, when 30, 60, 30 Kg NPK ha-1 was applied, which was statistically at par with seed protein content (23%), when 30, 60, 0 Kg NPK ha-1 was applied, while the lowest seed protein content (20%) was recorded in control. Interactive effects of gram hybrids and fertilizer application levels were found to be significant. The highest seed protein content (24%) was recorded when Punjab-2009 gram variety was fertilized with 30,0,0 Kg NPK ha_{-1} was applied, whereas the lowest seed protein content (20%) was observed when Karak-1 was grown without any fertilizer. Similar trends were noted by [10,11]. There was significant variation among fertilizer levels and cultivars regarding net income. Punjab-2009 produced significantly higher net income (Rs. 46440 ha_{-1}) than Karak-1, while the lowest net income (Rs. 42012 ha_{-1}) was recorded by KC-98. There was also significant variation among different fertilizer application levels regarding net income. The highest net income (Rs. 51283 ha_{-1}) was recorded, when 30, 60, 30 Kg NPK ha_{-1} was applied, which was statistically at par with net income earned (Rs. 51022 ha_{-1}), when 30, 60, 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 Punjab-2009 gram variety was fertilized with 30,0,0 Kg NPK ha_{-1} was applied, whereas the lowest net income was earned (Rs. 34720 ha_{-1}) was observed when Karak-1 was grown without any fertilizer. These results are in conformity with the findings of [13,19].

Conclusion

It was found that gram cultivar Punjab-2009 gave the highest yield when cultivated with fertilization of NPK at @ 30, 60, 0 Kg ha_{-1} and exceeding above this combination was found to be uneconomical.

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