

## Research Article

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# Yield and yield components of chickpea as affected by various levels of FYM and rhizobium inoculation

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### Abstract

The experiment was conducted at the Agronomy Research Farm, The University of Agriculture, Peshawar, Pakistan during winter 2015 in a simple randomized complete block design (RCBD) having three replications. Farmyard manure (FYM) application at four levels (0, 5, 10, and 15 ton ha<sup>-1</sup>) with variety (Inoculated and non-inoculated) were included in experiment. FYM application at the rate of 15 ton ha<sup>-1</sup> resulted in higher grain yield (2198.53 kg ha<sup>-1</sup>) as compared to control (1762.68 kg ha<sup>-1</sup>). Similarly inoculated seeds produced higher grain yield (2083.06 kg ha<sup>-1</sup>) as compared to non-inoculated seeds (1915.92 kg ha<sup>-1</sup>). The pods plant<sup>-1</sup> and thousand grain weight were significantly affected by FYM and inoculation while grains pod<sup>-1</sup> was significantly affected by only FYM. The grains were more pod<sup>-1</sup> in plots supplied with 15 tons FYM ha<sup>-1</sup> while less number of grains pod<sup>-1</sup> (1.48) resulted in control plots. Plants formed more pods (63.68) and maximum thousand grain weight (260.21 g) was calculated in plots treated with FYM at the rate of 15 ton ha<sup>-1</sup> as compared to other levels. In the same way more pods plant<sup>-1</sup> (58.44) and thousand grain weight (241.65 g) was observed in plots with inoculated seed sown. Hence application of FYM at the rate of 15 ton ha<sup>-1</sup> and inoculation of seeds with rhizobium strains is recommended for better yield of chick pea.

**Keywords:** ChickPea; Farm yard manure; Rhizobium Inoculation

### Introduction

Chickpea (*Cicer arietinum* L.) is an important winter pulse crop. It belongs to genus *Cicer* and family Fabaceae. "*Cicer*" is of Latin origin and the derivative of the Greek word 'kikus' meaning force or

strength [1]. The word "*arietinum*" is also of Latin origin. It is equivalent to Greek word 'krios' used for chickpea [2]. In grain legumes, it is ranked third after bean and soyabean growing in the world. The chickpea has agronomical significance

because of its high protein content (approx. 19.3–25.4%). It is used for the human and animal's diet. It is the alternative protein source. It originated in south-eastern Turkey [3]. The archaeological evidences show that earliest domestication of chickpea occurred in Middle East and Indo-Pak sub-continent. Chickpea is classified into two classes morphologically; kabuli and desi. Kabuli type is distinguished by large leaflets, white flowers, medium to tall (up to 1m) height, large, round and cream colour seeds. This type lack anthocyanin pigmentation. While desi type has small angular shaped seeds varying from black, brown, yellow to green. Plants are short with small leaflets, purplish flowers and also contain anthocyanin pigmentation [4, 5].

Chickpea seeds are consumed fresh as green vegetables, fried, roasted and boiled. Seeds are ground and the flour can be used as soup and to make bread [6]. It is also used as fodder for livestock.

In world, Pakistan ranked second (842 thousand tonnes) in the production of chickpea after India (5970 thousand tonnes) [7]. In total cropped area of Pakistan, 7% area is under the cultivation of pulses; 73% is under chickpea cultivation. Its production in Pakistan was 496 thousand tones. It was cultivated on 1055 thousand ha. The average yield was 471kg ha<sup>-1</sup> [7]. In Khyber Pakhtunkhwa the production was 21 thousand tons. It was cultivated on an area of 37.6 thousand ha with an average yield of 532kg ha<sup>-1</sup> [8]. In Khyber Pakhtunkhwa chickpea cultivation concerning 75% occurs in rainfed areas.

Plants need amino acid to form proteins. Nitrogen (N) is a key element for the production of amino acids. Nitrogen also helps in plant metabolism. Atmospheric nitrogen is not utilized by plants. Plants utilize it in ionic form either nitrate (NO<sub>3</sub><sup>-</sup>) or ammonium (NH<sub>4</sub><sup>+</sup>). The productivity of cropping system can be sustained by

chickpea due to the reason that it fix atmospheric nitrogen. Chickpea root system have specialized structures called nodules where *Rhizobium* inhabits. *Rhizobium* has the capability to fix atmospheric nitrogen to plants usable form. It is called biological nitrogen fixation (BNF). The N fixed through BNF is utilized by both crops; the present crop and the subsequent crop [9]. The maximum N fixation depends upon the cultivar, nodules number and the competent strain of the *Rhizobia* existing in the root nodules.

The actual yield of chickpea is very low in field conditions. It is due to minimum or unavailability of good quality seeds, lack of effective *Rhizobial* strain and severe injury caused by the attack of pod borer and blight. In addition, the soil of Pakistan is generally deficient in N; as its involvement is essential for plant metabolism and protein synthesis. Nitrogen deficiency in soil usually reduces crop yield. Inoculation of chickpea seeds by artificial means in such soils which are deficient in native effective *Rhizobia* is a very useful practice for improving root nodulation and yield of the crop [10].

Increasing and extending the role of biofertilizers such as *Rhizobium* can reduce the need for chemical fertilizers and decrease adverse environmental effects. As legume, chickpea can obtain a significant portion (4–85%) of its N requirement through symbiotic N<sub>2</sub> fixation when grown in association with effective and compatible *Rhizobium* strains [11–13]. Chickpea and *Rhizobium leguminosarum* sub spp. *Ciceri* association annually produces up to 176 kg N ha<sup>-1</sup> depending on cultivar, bacterial strain and environmental factors [14].

#### Materials and methods

The present study was conducted at Agronomy Research Farm, The University of Agriculture, Peshawar during the cropping season 2014-15. Chickpea variety (karak-03) was evaluated under inoculated

and uninoculated conditions subjected to four different farmyard manure levels. The experiment was plotted in RCB Design with four replications. Each Variety was planted in six rows of 3 m in length. Row-row distance was 30 cm and plant-plant was 10cm. All recommended practices and inputs were homogeneously applied to each experimental unit.

**Factor “A”**

FYM (0, 5, 10, 15tons ha<sup>-1</sup>)

**Factor “B”**

Rhizobium inoculated seeds and uninoculated seeds.

The below parameters were evaluated as;

**Number of pods plant<sup>-1</sup>**

Pods were taken from randomly selected plants and counted separately after harvesting. The data on pods of all the selected plants were added and then found its average.

**Number of grains pod<sup>-1</sup>**

The total number of grains in each pod were counted from ten randomly selected pods from indiscriminately chosen plants and then averaged.

**Thousand grains weight (g)**

A sample of thousand grains was taken from the unvaryingly selected plants and was

weighed on a balance to record its mass in grams.

**Grain yield (kg ha<sup>-1</sup>)**

Grain yield was recorded from randomly selected area of an m<sup>2</sup> and then converted to hectare.

$$\text{Grain yield (kg ha}^{-1}\text{)} = \frac{\text{Grain yield}}{\text{Row-row distance} \times \text{Row length} \times \text{No. of rows}} \times 10000$$

**Statistical analysis**

Data was analysed by using statistical package ‘Statistix 8.1’.

**Results and discussion**

**Pods plant<sup>-1</sup>**

Data regarding pods plant<sup>-1</sup> is expressed in Table 1. From analysis it was concluded that the response of farmyard manure (FYM) and inoculation were statistically significant. Farm yard manure applied at the rate of 15tons ha<sup>-1</sup> gave more number of podsplant<sup>-1</sup> (63.68) in response to control in which the pods plant<sup>-1</sup> decreased (52.72). Similarly inoculated variety formed more pods plant<sup>-1</sup> (58.44) than non-inoculated variety which was less in number (55.14). The augmentation of FYM developed more pods in plants due to more pronounced growth of the plant [15]. Rhizobium inoculation in chick pea quantify the pods in plants in momentous way [13, 16].

**Table 1. Number of pod per plant of chick pea as affected by farm yard manure and inoculation**

Farmyard manure (kg ha <sup>-1</sup> )	Inoculation	Non-inoculation	Mean
Control	48.23	57.2	52.72 b
5	52.32	55.45	53.88 b
10	58.32	55.45	56.88 b
15	61.7	65.67	63.68 a
<b>Mean</b>	55.14 b	58.44 a	

Means followed by different letters in the same category are significantly different using LSD test (P≤0.05)

LSD value for FYM = 4.66

LSD value for Inoculation = 3.29

**Grains pod<sup>-1</sup>**

Results of the data pertaining grains pod<sup>-1</sup> (Table 2) showed the significant response of FYM. The inoculation and non-inoculation of variety and the interaction between them

have no significant effect in statistical way. The submission of FYM at the rate of 15tons ha<sup>-1</sup> to the plots resulted in increasing the grains number pod<sup>-1</sup>(2.26) whereas control plot having no FYM gave fewer number of

grains pod<sup>-1</sup>(1.48). These results stated that with each increment in FYM the number of grains pod<sup>-1</sup> increases due to more

pronounced growth of the plant because FYM release nutrient specially nitrogen that enhances above ground plant growth [16].

**Table 2. Number of grain per pod of chick pea as affected by farm yard manure and inoculation**

Farmyard manure (kg ha <sup>-1</sup> )	Inoculation	Non-inoculation	Mean
Control	1.21	1.75	1.48 b
5	1.82	2.1	1.96ab
10	2.2	2.17	2.19 a
15	2.2	2.33	2.26 a
<b>Mean</b>	1.86	2.09	

Means followed by different letters in the same category are significantly different using LSD test ( $P \leq 0.05$ )  
LSD value for FYM = 0.52

### Thousand grain weight (g)

Statistical analysis of the data of Table 3 pointed out that FYM levels and inoculation caused significant variation in thousand grains weight. The interaction between them was found in significant. Heavier grains (260.21 g) formed in plots treated with 15 tons of FYM ha<sup>-1</sup> while lighter grains

(207.33 g) were formed in control plots. Likewise, the inoculated variety gave better performance and maximum weight of grains (241.65 g) was achieved than non-inoculated variety which has minimum grains weight (227.34 g). Our results are in conformity with [17] in which the inoculated variety has a positive impact on thousand grains weight.

**Table 3. Thousand grains weight of chick pea as affected by farm yard manure and inoculation**

Farmyard manure (kg ha <sup>-1</sup> )	inoculation	Non-inoculation	Mean
Control	194.41	220.25	207.33 b
5	225.33	220.78	223.05 b
10	233.45	261.37	247.41 a
15	256.2	264.22	260.21 a
<b>Mean</b>	227.344 b	241.656 a	

Means followed by different letters in the same category are significantly different using LSD test ( $P \leq 0.05$ )  
LSD value for FYM = 20.03  
LSD value for Inoculation = 14.16

### Grain yield (kg ha<sup>-1</sup>)

According to the statistical analysis of data, application of FYM and varietal inoculation and non-inoculation had a significant effect on grain yield (Table 4). The interaction among them was of no significant value. Lofty grain yield (2198.53 kg ha<sup>-1</sup>) was observed by FYM application at the rate of 15 tons ha<sup>-1</sup> while the control plot gave lower grain yield (1762.68 kg ha<sup>-1</sup>). These

results are in harmony with those of [18, 19] they observed positive effect of FYM application on yield of chickpea. The inoculated variety produced more grain yield (2083.06 kg ha<sup>-1</sup>) as compared to non-inoculated variety (1915.92 kg ha<sup>-1</sup>). Our results are supported by [20] in which inoculation improved grain yield in chick pea.

**Table 4. Grain yield of chick pea as affected by farm yard manure and inoculation**

Farmyard manure (kg ha <sup>-1</sup> )	inoculation	Non-inoculation	Mean
Control	1614.4	1910.96	1762.68 c
5	1887.96	1984.82	1936.39bc
10	2042.88	2157.83	2100.36ab
15	2118.44	2278.62	2198.53 a
<b>Mean</b>	1915.92 b	2083.06 a	

Means followed by different letters in the same category are significantly different using LSD test (P≤0.05)

LSD value for FYM = 175.005

LSD value for Inoculation = 123.74

### Conclusion and recommendation

Following conclusions were made from the findings of this research;

1. Farmyard manure applied at the rate of 15 t ha<sup>-1</sup> gave us high yield as compare to other levels.

2. Inoculated seed gave us better yield as compared to non-inoculated seed.

Application of FYM at the rate of 15 tons ha<sup>-1</sup> and inoculation with rhizobium strains is recommended for better yield of chick pea.

### Authors' contributions

Conceived and designed the experiment: N Khan & F Nawaz, Performed the experiments: F Nawaz, S Ullah, M Ali & A Liaqat, Analyzed the data: JA Shah, A Khan, & AUR Khalil, Contributed reagents/materials/ analysis tools: T Jan, S Ullah, M Ali & Sohail, Wrote the paper: N Khan.

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