Bionatura
Latin American Journal of Biotechnology and Life Sciences

Bionatura Issue 3 Vol 8 No 1 2023

Article

Combination effect of different levels of Nitrogen, Phosphorus and Potassium on the yield of Chickpea Plant *(Cicera rietinum* L.*)*

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Available from: http://dx.doi.org/10.21931/RB/CSS/2023.08.03.58

Abstract
This experiment was conducted at Grdarasha field of the College of Agricultural Engineering Science, Salahaddin University in Erbil, with a Clay Loam texture class. During the spring growing season of 2020, to study the effect of four levels of phosphorus TSP (0, 20, 40, 60) Kg P. ha-1. Three levels of K (0, 15, 30) Kg K. ha-1 and three levels of N (0, 15, 30) Kg N. ha-1. Besides, there was a combination of yield components and nutrient balance of the chickpea plant using a split-block design with three factors (K, N and P), where 36 treatment with 3 replicates was used.
The main results could be summarized as follows: The combination of potassium, nitrogen, and phosphorus levels affected the yield of the chickpea plant significantly. Also, the maximum yield recorded in the treatment combination (K2N1P2) was (1.55 Mg ha-1). In comparison, the lowest mean value (0.73 Mg ha-1) was recorded from the treatment combination (K0N0P0).

Keywords: Nitrogen, Phosphorus, Potassium, chemical and physical properties, chickpea yield

Introduction

Chickpea (Cicera rietinum L.) belongs to the Fabaceae family. Chickpea is a cool season legume crop grown worldwide as a food crop. The seed is the central edible part of the plant. It is also called garbanzo gram or Bengal gram. It ranks third among the food legumes after beans and peas. More than 50 countries are reported to grow chickpeas; 22 cultivate more than 20,000 ha, and 19 cultivate 10,000 to 20,000 ha. Majorchickpea-producing countries are India (65% of annual production), Pakistan (10%), Turkey (7%), Iran (3%), Myanmar (2%), Mexico (1.5%) and Australia[1] (1.5%) an annual and one of essential pulls crop. Chickpea is one of the critical pulse crops that contain high protein and starch percentages, and it is significant for human nutrition. Although it is one of the founder crops[2] with potential nutritional or medicinal qualities, chickpea has yet to receive the amount of research devoted to other founder crops such as wheat and barley. Humans have consumed it since ancient times due to its good nutritional properties. In addition, chickpea is of interest as a functional food with potential beneficial effects on human health. Chickpea is a source of zinc, folate and protein and has high protein content (20-22%). Also, it is rich in dietary fiber and a good source of carbohydrates for persons with insulin sensitivity.

The total content of carbohydrate fat and sugar in chickpeas is higher than in other pulses[3]. Cicer is suitable for regions with warm weather and semi-dry

conditions and is rich in minerals. It is the fourth largest grain legume crop in the world, with a total production of 10.9 million tons from an area of 12.0 million ha and a productivity of 0.91 t ha-1. Major producing countries are India, Pakistan and Iran[4]. Chickpea, being a leguminous crop, improves soil fertility by fixing atmospheric nitrogen up to 99 kg ha-1 is available from (NH3 and NH4) in the root through the phenomena of symbiosis[5]. Among the various agronomic practices, plant density is one of the essential agronomic factors that have a significant impact on growth and yield. High density initially provokes fast growth of canopy in area unit, which in turn ejects available stored water in soil through perspiration and causes the plant to encounter drought stress during flowering and grain-filling stages; therefore, under rainfed conditions suitable seed density must be considered for more absorption of solar energy, and improved utilization of water and soil[6].

The increased seed yield with higher plant density is primarily due to improved water use and water use efficiency. High plant density in chickpea production decreases soil water evaporation early in the growing season when plant canopy closure is low. In contrast, low plant density may allow weeds to develop more aggressively and limit crop yield potential. Plants grown at lower plant density are usually shorter and branchy, which increases losses during combined harvest[7]. Revealed[8] that the branch number of chickpea is affected by plant density and, thus, chickpea has a lower branch in high densities. Therefore, it is possible to obtain the maximum grain yield by managing the planting density to increase the main stem number and reduce the branch number per unit area. Chickpea contributes a significant amount of residual nitrogen to the soil and adds organic matter, thereby improving soil health and fertility[9]. There is also a wrong perception among the farmers that gram, being a legume crop, does not need any nutrition. They usually grow it without supplying any fertilizer, whereas it is evident from the literature that the application of NPK has a beneficial effect on gram yield[10,11]. However, the question of how much NPK should be applied to which cultivar remains sun quenchable. This depends upon the final grain yield[12] and its contributing components[13], whether it is a profitable combination or not[14]. The present study was, therefore, planned to study the effect of NPK fertilizer on growth and yield.

Materials and Methods

A field study was conducted at the Grdarasha farm field of the Agriculture College, Salahaddin University in Erbil, during the spring growing season of 2020. The soil texture class was silty clay loam, as specific properties of the studied soil were listed in Table 1. The (N, P and K) fertilizer was added before planting. Iron fertilizer was used in fixed level (6) kg ha-1 Chelated form, Urea fertilizer CO (NH2)2 which contain 46% nitrogen used in Three level of N (0, 15, 30) Kg N. ha-1, TSP tri-superphosphate Ca(H2PO4)2 which contain (46 – 47% P2O5) in Four level of P (0, 20, 40, 60) Kg P. ha-1 was used, KCl Fertilizer contains (60% K2O) used in three levels of K (0, 15, 30) Kg K. ha-1.

Soil Physical Properties	**Particle size distribution**	**Sand g.kg^{-1}**	**143.82**
		Silt g.kg^{-1}	471.77
		Clay g.kg^{-1}	384.43
	Texture class	Silty clay loam	
	Water content	0.33 bar	31%
		15 bar	19%

	Density	Bulk density *M*g.m^{-3}	1.33
		Specific gravity *M*g.m^{-3}	2.64
Soil Chemical Properties	Properties	Value	Unite
	pH	7.73	
	ECe	0.75	dS.m^{-1}
	Organic matter	11.76	g.kg^{-1}
	Calcium carbonate equivalent	310	g.kg^{-1}
	Active Calcium carbonate	14.30	g.kg^{-1}
	Total Nitrogen	0.28	g.kg^{-1}
	Available Phosphorus	3.10	mg.kg^{-1}
	Chloride	2.5	Meq.L^{-1}
	Bicarbonate	3.47	Meq.L^{-1}
	Carbonate	0.00	Meq.L^{-1}
	Cations		
	Calcium	4.30	Meq.L^{-1}
	Magnesium	1.70	Meq.L^{-1}

Table 1. Physical and chemical properties of the studied soil.

After soil preparation, the Chickpea seeds (Cicerarietinum L.)were planted on 25 February 2020 at a depth of (4 – 5 cm), the space between two lines was 30 cm, and the distance between two plants in each line was 10 cm. Two seeds were planted after two weeks of germination, thinned to one plant in each bed.

At the stage of flowering of the chickpea plant, samples were taken from four plants in the center of each plot by cutting off the necessary leaves for the analysis. The samples were weighed and oven-dried at 65 ºC for 72 hours; after drying, the samples were milled, and then chemical analysis was performed. Plants were harvested on (27-6-2020). The plants were taken in two lines at the center of each block.

The weight of the yield was determined for plants. Total nitrogen was determined using[15] approach, while phosphate was determined according to the colorimetric method using a spectrophotometer at 660 nm, as described by 16. Potassium was determined according to the method described by [17], using a Flame photometer—atomic absorption method used to determine iron. The data was collected, and we used the SPSS program for analysis.

Results

There was an excellent relation between levels of applied nitrogen, phosphorus, potassium, and yield of chickpea plants, as shown in Figure 1.

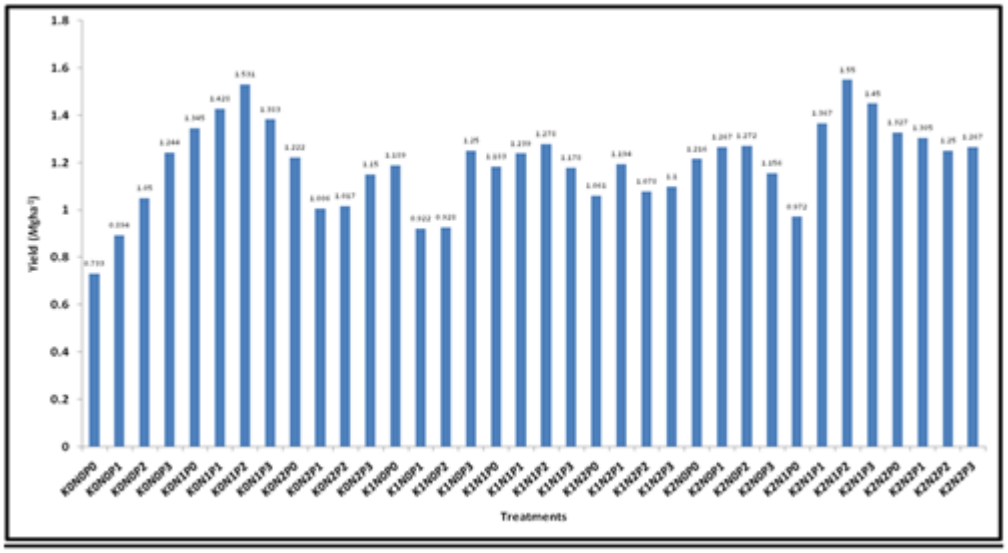

Figure 1. Combination effect between Nitrogen, Phosphorus and Potassium on grain yield Mg.ha-1.

Furthermore, Table 2., shows the effect of nitrogen, phosphorus and potassium levels and their combination of yield in the chickpea plant. Application of nitrogen, phosphorus, and potassium had a significant effect on yield in chickpea plants.

The highest mean value recorded in the treatment combination (K2N1P2) was (1.55Mg ha-1). Whereas the lowest mean value (0.73 Mg ha-1) was recorded from the treatment combination (K0N0P0)

Effect of different levels of nitrogen and phosphorus and their combination on the yield of Chickpea plant:

Table 3., shows that the application of nitrogen and phosphorus significantly increased the seeds of chickpea; the highest mean value (1.45 Mg.ha-1) was produced from the level (N1P2), whereas the lowest mean value (1.03Mg.ha-1), was recorded in (N0P1).

K	N	P	Mean
K 0	N0	P0	0.73 k
		P1	0.89jk
		P2	1.05 e-k
		P3	1.24 a-i
	N1	P0	1.34 a-f
		P1	1.43abcd
		P2	1.53 ab
		P3	1.38a-e
	N2	P0	1.22a-j
		P1	1.01 f-k
		P2	1.02 f-k
		P3	1.15 c-j
K	N0	P0	1.19 b-j

1		P1	0.92ijk
		P2	0.93hijk
		P3	1.25 a-i
	N1	P0	1.18 b-j
		P1	1.24 a-j
		P2	1.28 a-g
		P3	1.18 c-j
	N2	P0	1.06 e-k
		P1	1.19 b-j
		P2	1.08 e-k
		P3	1.10 d-j
K 2	N0	P0	1.22 a-j
		P1	1.27 a-i
		P2	1.27 a-h
		P3	1.16 c-j
	N1	P0	0.97 g-k
		P1	1.37a-e
		P2	1.55 a
		P3	1.45abc
	N2	P0	1.33 a-f
		P1	1.31 a-g
		P2	1.25 a-i
		P3	1.27 a-i

Table 2. The effect of different levels of nitrogen, phosphorus and potassium and their combination on the yield of chickpea plants.

N	**N0**				**N1**				**N2**			
P	P0	P1	P2	P3	P0	P1	P2	P3	P0	P1	P2	P3
Mean	1.05 of	1.03 f	1.08 def	1.22bcd	1.17def	1.34ab	1.45 a	1.34abc	1.20bcde	1.17cdef	1.12def	1.17cdef

Table 3. Effect of different levels of nitrogen and phosphorus and their combination on the yield of Chickpea plants.

The high value of the coefficient of determination (R2 =0.634) showed that there was a good relation between levels of applied nitrogen, phosphorus, and yield of chickpea plants, as shown in Figure 2.

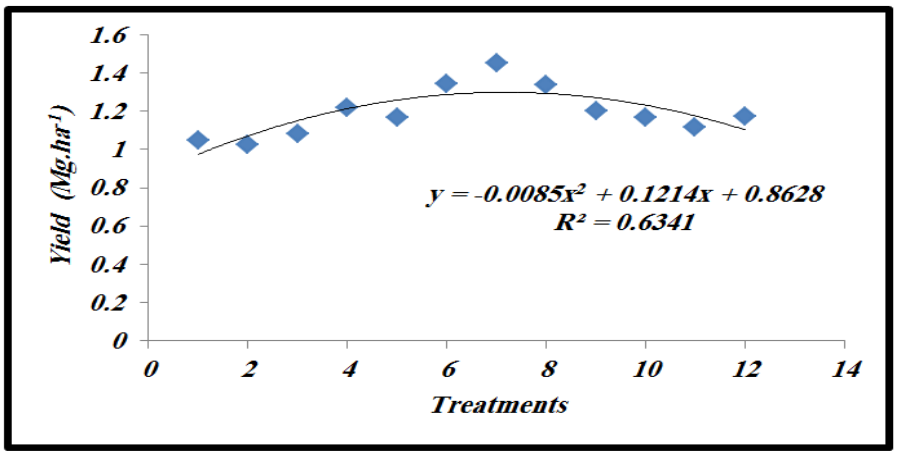

Figure 2. Relation between levels of applied nitrogen, phosphorus and yield (*M*g.ha^{-1}).

The effect of different levels of nitrogen and potassium and their combination on the yield of Chickpea plants:

Application of nitrogen and potassium was significant in the yield of chickpeas. Table 4., shows that the highest mean value (1.42*M*g.ha^{-1}) was produced from the level (K_0N_1), whereas the lowest mean value (0.98 *M*g.ha^{-1}) was recorded in (K_0N_0).

Figure 3., shows a combination of nitrogen and potassium levels affected significantly. The high value of the coefficient of determination (R2 =0.183) shows a good relation between levels of applied nitrogen and potassium in chickpea plants, as shown in these results.

K	K0			K1			K2		
N	N0	N1	N2	N0	N1	N2	N0	N1	N2
Mean	0.98d	1.42a	1.10 cd	1.07 d	1.22 bc	1.11 cd	1.23 bc	1.34 ab	1.29 ab

Table 4. Effect of different levels of nitrogen and potassium and their combination on the yield of chickpea plants.

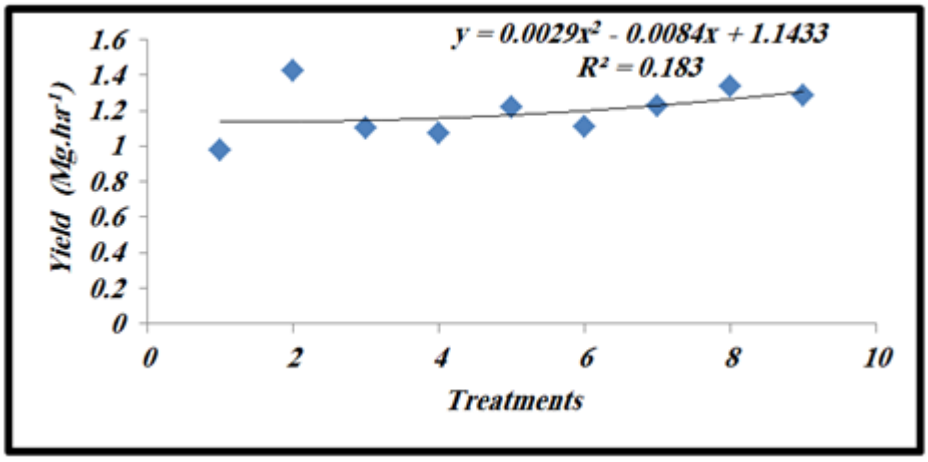

Figure 3. Relation between levels of applied nitrogen, potassium and yield (Mg.ha^{-1}).

The effect of different levels of phosphorus and potassium and their combination on the yield of chickpea plants.

Table 5., shows the highest mean value was (1.36*M*g.ha^{-1}) produced from the level (K_2P_2), whereas the lowest mean value was (1.09 *M*g.ha^{-1}) recorded in (K_1P_2). There was a good relation between levels of applied phosphorus, potassium, and yield of chickpea plants, as shown in Figure 4.

K	K0				K1				K2			
P	P0	P1	P2	P3	P0	P1	P2	P3	P0	P1	P2	P3
Mean	1.10 c	1.11 c	1.20abc	1.26abc	1.14 bc	1.12 c	1.09 c	1.18 bc	1.17 bc	1.31 ab	1.36 a	1.29 ab

Table 5. Effect of different levels of phosphorus and potassium and their combination on yield (*M*g.ha^{-1}) of Chickpea plant.

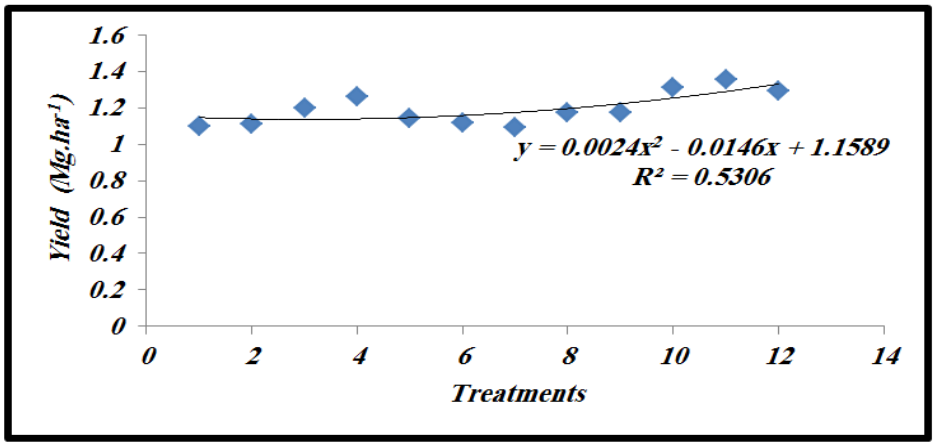

Figure 4. The combination of phosphorus and potassium levels significantly affected.

Discussion

Application of fertilizer significantly affected plant height, biological yield, grain yield bacteria nod per plant, pod weight, and protein percentage of chickpea. These results agree with[18] that reported that the highest yield of Chickpea plants when cultivated with fertilization of NPK.

Nitrogen and phosphorus and their combination on yield of Chickpea plant presented a good agreement with [19.] The combination of nitrogen and potassium levels was affected significantly. The high value of the coefficient of determination (R2 =0.183) shows a good relation between levels of applied nitrogen and potassium in chickpea plants, as shown in these results. Despite that, [19] confirms no significant interaction between genotypes and NPK fertilizer application levels on all yields and yield components' character.

Conclusion

This study aims to determine the effect of different levels of nitrogen (0, 15, 30) Kg N. ha^{-1}, phosphorus (0, 20, 40, 60) Kg P. ha^{-1} and potassium (0, 15, 30) Kg K. ha^{-1} and their combinations on yield component chickpea plant by using split split block design with three replications. It can be concluded that the application

of nitrogen, phosphorus, and potassium fertilizer leads to an increased yield of the chickpea plant. The obtained results highlight the significant effects of fertilization treatment and yield of chickpea plant, the addition of (15 Kg N ha^{-1}) of nitrogen with (40 Kg P ha^{-1}) of phosphorus with (30 Kg K ha^{-1}) of potassium in the treatment combination ($K_2N_1P_2$) as well as to increase the grain yield to (1.55 Mg ha^{-1}).

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Received: May 15, 2023/ Accepted: June 10, 2023 / Published: June 15, 2023

Citation: Kareem, A. R.; Alwaheb, A.M.; The Impact of the Socioeconomic Status(SES) on the Oral Health Status Among 15 Year-Old School Adolescents In Kerbala City/Iraq. Revis Bionatura 2023;8 (3) 58. http://dx.doi.org/10.21931/RB/CSS/2023.08.03.58