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EFFECT OF BIO-FERTILIZER AND PHOSPHORUS LEVELS ON YIELD AND YIELD COMPONENTS OF CHICK PEA UNDER RAIN FED CONDITION

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ABSTRACT

A field experiment was carried out during the spring 2020 to evaluate the effect of phosphorus levels and bio-fertilizer on growth and yield of local variety of chick pea. It was conducted at the farm the College of the Agricultural Engineering Sciences, the experimental units laid out in Factorial arrangement using Randomize Complete Block Design with three replications, using three levels of phosphorus (0, 20 and 30 Kg P_2O_5 ha^{-1}) and three levels of bio-fertilizer (0, 4 and 6 Kg ha^{-1}). The results indicated that the effect of phosphorus, bio-fertilizer and interaction between them exhibited significant effect on all studied characters. The effect of interaction showed highest values for the pods height (36.06cm), percent of phosphorus in seed was (0.446), plant height (59.428cm), number of pods $plant^{-1}$ (64.16), seeds weight (5.583 ton ha^{-1}), number of primary and secondary branches $plant^{-1}$(4 and 15.50) respectively, number of nodules were (31.978) and the weight of nodules were (0.369g) obtained at the interaction effect of fertilizer levels 30 Kg P_2O_5 ha^{-1} and 6 Kg ha^{-1} bio-fertilizer in comparing with other interaction combinations and control. Also the results indicated that the percentage of the element efficiency under different phosphorus and bio-fertilizer levels, the efficiency of the element increased with initial increasing in phosphorus rate and recorded 70.72% comparing with control.

KEY WORD: phosphorus, bio-fertilizer, yield, chick pea, local variety

INTRODUCTION

Pulses are one of the major food item to be included in a vegetarian diet and are the cheapest source protein and are also considered as poor mains meat. Chick pea (*Cicer arietinum L.)* belongs to a leguminoceae or Fabaceae family, (Beza, 2017).

Phosphorus is one of the most important major nutrients of plant. Chick pea varieties respond significantly to the phosphorous application, because of its role in energy transfer, protein metabolism, which also associated with increasing root growth and early maturity of crops, (Siag, 1995).

Phosphorus is considered important nutrient for formation and translocation of carbohydrate, fatty acids, glycosteroids and other essential intermediate compound. The main effect of phosphorus application is observed in roots system of plants. Phosphorus induces the lateral and root fibrous formation, which results in more nodule bacteria and finally increases the rate of nitrogen fixation in leguminous crops. (Siphiwe *et al*., 2017).

Prajapati, 2014, reported that, a large portion of phosphorus converts to insoluble form soon after its application to the soil, the phosphorus solubilizing microorganisms like bacteria have the ability to solubilize the insoluble phosphates and convert it available for plants. Bio-fertilizer is selected strain of beneficial soil microorganisms which are cultured in the laboratory and packed in a suitable carrier. They can be used either for seed treatment or soil application. After application it helps in solubilizing plant essential nutrients such as phosphorus from unavailable form plant available forms gradually (Prajapati, 2014).

Gull *et al*., 2004. Obtained that the phosphorus solubilizing bacteria (PSB) aids in converting the insoluble phosphate which is chemically fixed into a variable from that eventually results in higher crop yields.

Shabeer *et al*., 2015; Kumar, 2014; Thenua and Ravindra, 2011 and Ali *et al*., 2010,

examined that an application of phosphorus at different rates showed significant impact on growth and development of chick pea plant and also they found that application of phosphorus in different form was better with respect to plant height, pod height, nodule plant^{-1}and nodule dry weight when compared with control. Many researchers (Tagore et al., 2013; Amar, 2012 and Thenua and Ravindra, 2011), have been found that an application of Bio-Fertilizer to chick pea, Was effective and positively enhanced most growth parameters including yield, grain and straw.

McDonald et al., (2001) measured the plant efficiency as the relative yield of crops grows at low and high levels of nutrient availability. Otherwise, it is the ability of plant to grow and yielding when it grows in a soil deficient in nutrient availability. The 'nutrient efficiency' term is used usually for measuring the plant capacity for nutrients acquiring and utilizing for timber, crops or forages production (Gourley et al., 1994).

Roberts, (2008) and Imtiaz et al. (2010) found that the definition of nutrient efficiency is differing and usually depended on the viewpoint of the use. The efficient adopted mechanisms of nutrient absorption and mobilization by plants are very important for utilizing the added phosphorous fertilizer at high levels, (Neumann, 2007).

The aim of this study is to find out the suitable dose of phosphorus, the appropriate bio-fertilizer and study the interaction effect of phosphorus and bio-fertilizer on growth, yield and yield components.

MATERIALS AND METHODS

The effect of phosphorus levels and bio-fertilizer were investigated in an experiment conducted at the farm of College of Agricultural Engineering Sciences, Duhok University, Kurdistan region-Iraq at latitude, longitude (36˚51 40.9 N), (42˚51 54.6 E) respectively at elevation above sea level about 510 m, during spring 2020. The experiment units were laid out in the factorial arrangement using randomized complete block design (RCBD) with three replications. The experiment units consist 27 treatments units (plots) combined with three levels of phosphorus (0, 20 and 30) Kg P_2O_5 ha^{-1} (P_0, P_{20} and P_{30}) respectively and three levels of bio-fertilizer (0, 4 and 6) Kg ha^{-1} (B_0, B_4 and B_6) respectively, with three replications. A readily mixture of bio-fertilizer (Corabac G) composed from (Azotobacter chroococcum, Bacillus megaterium and Pseudomonas putida) were obtained from Corax-bioner biotechnology company, Hungaria production, and applied all of them together at one time. The phosphorus levels was applied at the time of sowing, the seed of chick pea (local variety) were sown in rows, the area of each line in experimental units was (0.30m*3m), each plots having three lines, the number of seeds sown in each lines was 12, and the gap between each plots was 0.4m. Bio-fertilizer was applied in banding, between rows at the time of sowing. All agronomic practices were carried out uniformly for whole experiment when need. To study plant parameters were selected ten plants from meddle line randomly when the plant reach maturity stage following plant traits were studied (plant height cm, pod height cm, number of nodulation, main and secondary branches, weight of nodulation, phosphorus percent in plant and seed weight (yield)). The climatic information of the experimental field location during growing season (rainfall and air temperature), were obtained from the meteorological Sumel station presented in **(Table 1)**. The obtained data analyzed according to GLM procedure to estimate the significant effect of studies traits at probability 0.05 and 0.01 using SAS 9.1 version software. Dunncan's Multiple Range Test (DMRT) used to identify significance between mean treatments. McDonald et al., (2001) used below formula for the element efficiency:

$$\textbf{Element} - \textbf{Efficiency}\ (\mathbf{P}) = \frac{\textbf{grain yield without fertilizer}}{\textbf{grain yield with fertilizer}} \times \mathbf{100}\ \ \textbf{.....(1)}$$

Soil samples were analyzed for some chemical and physical properties before planting and presented in **Table 2.** Which included (The pH- value and the EC-value) of the soil were measured in (1:1) soil extracts, according to (Rhoades, 1996). The cation exchange capacity of the soil was measured using ammonium replacement method, and soil organic matter content was determined using (Walkley-Black, 1945) method. The available soil nitrogen was determined by Kjeldahl method. Soluble ($Ca^{2+}$and Mg^{2+}) ions were determined in soil extract, titrimetrically using EDTA-2Na (0.01 N), and the soluble (potassium and sodium) in soil were measured using Flame photometer, according to (Ryan et al., 2003). The percentage

of $CaCO_3$ in the soil was determined by calcimeter method using (1 N HCl) as mentioned by (Loeppert and Suarez, 1996). The available soil phosphorous in bulk soil samples before and after planting were extracted from soil using Olsen's method (NaHCO3 0.5 M adjusted the pH at 8.5), then determined by spectrophotometer at (882 nm). Available micronutrients (Fe, Zn, Mn and Cu) in bulk soil sample were extracted using diethylene triamine pent acetic acid (DTPA, 0.005 M) and ammonium bicarbonate (NH_4HCO_3 1 M), buffered at pH 7.6 according to (Soltanpour, 1979) method, then their concentrations were measured by (AAS, model GBC 7600A). The soil samples were analyzed for particle size distribution to obtain (soil texture), using hydrometer method, and the bulk density of soil was determined by core method according to (Ryan et al., 2003).

Table (1): the average of the rainfall and air temperature climatic information of the experiment field location.

years	months	rainfall mm	temperature C°	
			Max.	Min.
2019	Oct.	3	30.8	18.2
2019	Nov.	30	22.1	9.3
2019	Dec.	107	14.6	6.9
2020	Jan.	89.5	10.6	4.1
2020	Feb.	76	11.7	4.3
2020	Mar.	310	18.6	9.8
2020	Apr.	55	19.8	10.7
2020	May	16.5	21.2	11.6

Table (2): Some physical and chemical properties of the studied soil before planting.

RESULTS AND DISCUSSION

Table 3, shows the ANOVA Table of factorial analysis examination for the effect of phosphorus levels and bio-fertilizer on growing and yield of chick pea. The analysis revealed that the phosphorus rate show significant effects on all studied traits, the bio-fertilizer exhibited highly significant effect in plant height, phosphorus in seeds, pod height, seed weight ton ha^{-1}, number of pods plant^{-1}, main and secondary branches plant^{-1}, and number of nodulation and weight of nodulation. Regarding to the interaction between phosphorus rate and bio-fertilizers, the results indicates that the interaction exhibited highly significant effect on all traits. Similar findings have been reported by Siphiwe *et al*., 2017; Beza, 2017 and Seid *et al*., 2015.

Table (3): Analysis of variance for yield and its components of chick pea crop under different levels of phosphorus and bio-fertilizer.

Source	M S									
	DF	**Pod height cm**	**%Phosphorus in seed**	**Plant height cm**	**Seeds weight ton/ha.**	**Number of pods plant^{-1}**	**number of main brunch**	**number of secondary brunch**	**Number of nodulation**	**Weight of nodulation g/plant**
Block	**2**	**2.83***	**0.00009**	**1.89**	**0.01489***	**6.73**	**0.036 ***	**1.17****	**2.43****	**0.0000055**
A	**2**	**64.45****	**0.11004****	**266.41****	**7.8038****	**1248.53****	**0.361 ****	**96.13****	**322.98****	**0.075****
B	**2**	**125.08****	**0.1224****	**142.95****	**2.3798****	**354.79****	**0.0288**	**26.28****	**75.187****	**0.032****
A*B	**4**	**7.87****	**0.02127****	**8.27****	**0.17467****	**25.97****	**0.0555****	**1.434****	**47.67****	**0.0041****
Error	**16**	**0.53**	**0.00013903**	**0.86**	**0.02072**	**2.37**	**0.0095**	**0.145**	**0.373**	**0.000071**
Total	**26**									

*, ** significant effect at probability at 0.05 and 0.01 respectively.

Bio-fertilizer Effect

Depending on the data in **Table 4,** it appear that the maximum pod height was recorded with the highest dose of bio-fertilizer (6Kg ha^{-1}), also the maximum phosphorus percent in seed was (0.324) recorded at the same rate. An application of (6Kg ha^{-1}) of bio-fertilizer increased plant height 10.87cm over control. Regarding the main effect of bio-fertilizer, the results in **table 4** exhibited that the highest pod value (32.60cm) was obtained at the rate (6Kg ha^{-1}), which exceeded the control unit by 22%. The data in same table indicate that the application of bio-fertilizer recorded significantly highest plant height (56.27cm), seeds weight (5.145ton ha^{-1}), number of primary branches plant^{-1} (4.00), secondary branches plant^{-1} (13.68), number of pods plant^{-1} (58.73), number of nodules per plant (30.93) and weight of nodules (0.325g) at the rate of (6Kg ha-^{1}). From the results above, the bio-fertilizer was effective in estimating plant growth and contribute in improvement of the ecosystem, and they also play an active role in biological control of plant pathogen, (Tilk *et al*., 2005).

Table (4): effect of different levels of bio-fertilizer on yield and yield components of chick pea.

Treat.	Means								
	Pod height cm	**%Phosphorus in seed**	**Plant height cm**	**Seeds weight ton/ha.**	**Number of pods plaant^{-1}**	**number of main brunch**	**number of secondary brunch**	**Number of nodulation**	**Weight of nodulation g.plant^{-1}**
control	**27.48 c**	**0.105 c**	**45.40 c**	**3.289 c**	**35.71 c**	**3.62 c**	**7.28 c**	**20.45 c**	**0.145 c**
4 kg	**28.69 b**	**0.244 b**	**50.39 b**	**4.075 b**	**42.90 b**	**3.72 b**	**9.30 b**	**30.72 b**	**0.262 b**
6 kg	**32.60 a**	**0.324 a**	**56.27 a**	**5.145 a**	**58.73 a**	**4.00 a**	**13.68 a**	**30.93 a**	**0.325 a**

Mean bearing different letter within each column different significantly at 0.05 level.

Phosphorus Fertilizers Effect

The results in relation to yield and some growth traits of chick pea as influenced by different phosphorus levels presented in **Table 5,** the plant height was affected by the different phosphorus levels, the maximum values was (54.40cm), pod height (32.65cm), phosphorus percent in seed (0.325), number of pod plant^{-1} (51.41), number of primary branches (3.78), number of secondary branches (11.69), seeds weight (4.676ton.ha^{-1}), number of nodulation (29.33) and the weight of nodulation (0.29g), these highest values was recorded from applied of 30 Kg P_2O_5 ha^{-1}. Except the number of main branches was recorded (3.84) at the applied of 20 Kg P_2O_5 ha^{-1}, while the lowest values for all studies traits was observed in the control. The results showed that increasing phosphorus levels up 20 Kg P_2O_5 ha^{-1} increase all studies parameters. The possible reason may be the adequate supply of phosphorus that played avital role in physiological and developmental process in plant life and the favorable effect of these important nutrients might have accelerated the growth processes that increase the biomass yield of the crops. These results was supported by the finding of Beza, 2017; Murad, 2018 and Chala *et al*., 2020.

Table (5): Effect of different phosphorus levels on yield and yield components of chick pea**.**

Treat.	Means								
	Pod height cm	**%Phosphorus in seeds**	**Plant height cm**	**Seeds weight ton.ha^{-1}**	**Number of pods plant^{-1}**	**number of main brunch**	**number of secondary brunch**	**Number of nodulation**	**Weight of nodulation g.plant^{-1}**
control	**25.44 c**	**0.097 c**	**46.47 c**	**3.648 c**	**39.01 c**	**3.72 b**	**8.29 c**	**24.05 c**	**0.18 c**
20 kg	**30.68 b**	**0.251 b**	**51.20 b**	**4.186 b**	**46.91 b**	**3.84 a**	**10.28 b**	**28.72 b**	**0.26 b**
30 kg	**32.65 a**	**0.325 a**	**54.40 a**	**4.676 a**	**51.41 a**	**3.78 ab**	**11.69 a**	**29.33 a**	**0.29 a**

Mean bearing different letter within each column different significantly at 0.05 level.

Phosphorus Levels and Bio-fertilizer Interaction

The effect of interaction between phosphorus levels and bio-fertilizer on yield and some growth parameters of chick pea have been presented in **Table 6.** Among the studied traits which significantly influenced by 30 P_2O_5 Kg ha^{-1} phosphorus level and 6 Kg of bio-fertilizer are, [highest values for pod height (36.06cm), percent of phosphorus in seeds (0.446), plant height (59.428cm), number of pods (64.160), seeds weight (5.583ton.ha^{-1}), number of primary branches (4.00), number of secondary branches (15.501), number of nodulation (31.978) and weight of nodulation (0.369g)], in comparing with interaction combination and control treatment. From the results in the same table, an application of phosphorus levels in combination with bio-fertilizer might have an advantage in enhancing studied parameters. An increases in the most studied yield component when treated with the combination rate of phosphorus and bio-fertilizer levels significantly enhanced all studied growth traits, may be related to effect of these levels in improving almost all growth and yield contributing characters, that mainly enhanced the root growth of chick pea. The same results were found by of Ali et al., 2010; Kumar, 2014; Siphiwe et al., 2017 and Chala et al., 2020, who confirm the results obtained during study the effect of phosphorus levels and bio-fertilizer on yield of the chick pea.

Table (6): effect of the combination between bio-fertilizer and phosphorus levels on yield and yield components of chick pea.

Combination B*P	Pod height cm	%Phosphorus in seed	Plant height cm	Seeds weight ton/ha.	number of pods	number of main brunch	number of secondary brunch	number of nodulation	weight of nodulation g/plant
B_0P_0	**23.466 d**	**0.077 g**	**39.289 e**	**2.528 f**	**28.004 g**	**3.501 c**	**6.008 g**	**11.835 e**	**0.033 f**
B_0P_{20}	**29.769 c**	**0.093 g**	**47.264 d**	**3.575 e**	**39.538 e**	**3.834 ab**	**7.832 e**	**24.673 d**	**0.196 e**
B_0P_{30}	**29.201 c**	**0.145 e**	**49.633 c**	**3.766 de**	**39.566 e**	**3.501 c**	**8.008 e**	**24.835 d**	**0.207 e**
B_4P_0	**23.170 d**	**0.098 fg**	**46.235 d**	**3.567 e**	**34.178 f**	**3.661 ab**	**7.170 f**	**30.345 bc**	**0.210 e**
B_4P_{20}	**30.202 c**	**0.249 d**	**50.823 c**	**3.979 d**	**44.004 d**	**3.668 bc**	**9.167 d**	**30.628 bc**	**0.274 d**
B_4P_{30}	**32.688 b**	**0.385 c**	**54.109 b**	**4.679 c**	**50.512 c**	**3.835 ab**	**11.566 c**	**31.171 ab**	**0.302 bc**
B_6P_0	**29.674 c**	**0.114 f**	**53.880 b**	**4.848 bc**	**54.844 b**	**4.000 a**	**11.692 e**	**29.955 c**	**0.291 c**
B_6P_{20}	**32.060 b**	**0.411 b**	**55.486 b**	**5.004 b**	**57.173 b**	**4.000 a**	**13.835 b**	**30.854 bc**	**0.315 b**
B_6P_{30}	**36.062 a**	**0.446 a**	**59.428 a**	**5.583 a**	**64.160 a**	**4.000 a**	**15.501 a**	**31.978 a**	**0.369 a**

Mean bearing different letter within each column different significantly at 0.05 level.

Efficiency of the Element

The data in **Table 7**, indicating the element efficiency percent under different application of phosphorus and bio-fertilizer levels. The data indicated to that the efficiency of element increased with the increasing the phosphorus rate to 30 Kg $P_2O_5ha^{-1}$ which recorded (70.72) in comparing with control, this may be due to reducing of the efficiency of element (67.17). Concerning the bio-fertilizer with phosphorus the higher value of element efficiency was recorded at B_2P_{20} rate and reduced at applied rate B_2P_{30}. From the obtained results it found that chick pea obtained adequate element.

Table (7): Element efficiency % of the study chick pea under supplying different P fertilizer levels with different levels of bio-fertilizers.

Treatment	B_0P_0	B_0P_{20}	Efficiency %	B_0P_{30}	Efficiency %
Rate	18.964	26.816	70.72	28.245	67.14
Treatment	**B_1P_0**	**B_1P_{20}**	**Efficiency %**	**B_1P_{30}**	**Efficiency %**
Rate	26.755	29.841	89.66	35.090	76.25
Treatment	**B_2P_0**	**B_2P_{20}**	**Efficiency %**	**B_2P_{30}**	**Efficiency %**
Rate	36.358	37.532	96.87	41.873	86.83

Element Availability

The information in **Table 8**, represented the quantity of phosphorus in soil before sowing and the phosphorus rate and bio-fertilizer after harvesting. An increases in soil phosphorus concentrations were proportionally related with the application of phosphorus levels to the soil. The available phosphorus in the bulk soil was significantly increased with increasing the applied P-rates and biological activity. The data indicated that the B_2P_{30} rate recorded the maximum quantity (12.58 mg P Kg^{-1} soil) this mean that the phosphorus transformation and mobility in the soil, plant system are controlled by a combination of chemical, physical and biological properties, the quantity of phosphorus effected by the number of soil factors including the soil texture, percent of soil carbonate, nutrient interaction, CO_2 liberation from plant roots and microorganisms activity, While in case of comparing the concentration of available P before cultivation (4.89 mg P. kg $soil^{-1}$), and after harvesting with control treatment cultivated by chick pea genotypes (4.93 mg P Kg^{-1} soil). These results were in agreement to finding of (Shabeer *et al*., 2015 and Siphiwe *et al*., 2017).

Table (8): Effect of bio-fertilizer, P- levels and their interactions on P availability in bulk Soil (mg P. kg^{-1} soil).

	Before sowing	After sowing
Control	**4.89**	**4.93**
B_0P_{20}	**4.89**	**5.07**
B_0P_{30}	**4.89**	**7.54**
B_1P_0	**4.89**	**4.97**
B_1P_{20}	**4.89**	**6.67**
B_1P_{30}	**4.89**	**8.52**
B_2P_0	**4.89**	**5.12**
B_2P_{20}	**4.89**	**9.75**
B_2P_{30}	**4.89**	**12.58**

CONCLUSION

Chick pea is the best most important crop for nutritional because of its high protein content, it may conclude that the application of bio-fertilizer and phosphorus fertilizer at adequate levels can enhance plant growth and yield of chick pea. In Kurdistan region-Iraq, soil is poor in phosphorus status because of higher rate of phosphorus fixation. Using bio-fertilizer will reduce the use of chemical fertilizer, probably may increase and improves the chick pea production.

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کارتێکرنا پەینێ زیندی و فسفوری لسەر دەرامەت و پێکهاتێن بەرهەمی یێن نوکێ لبن کاودانێن چاندنا دیمی

پوختە

تاقیکرن د ماوەیی وەرزێ بهارا سالا 2020ێ هاتیە بجهئینان ژبۆ هەلسەنگاندنا کارتێکرنا ئاستێن جیاواز ژ پەینێ زیندی و پەینێ فسفوری لسەر گەشە و بەرهەمێ نوکا خومالی. ئەڤ تاقیکرنە ل زەڤیێت ڤەکولینین کولیژا زانستێن ئەندازیاریا چاندنێ ل زانکویا دهوك هاتیە ئەنجامدان. و یەکەیێن تاقیکرنێ بۆ هاتینە تەرخانکرن لگور تاقیکرنێن جیهانی ب بکارئینانا کەرتێ هەرەمەکی و ب سێ جاری دووبارەکرن. تاقیکرن ژ سێ ئاستێن پەینێ فسفوری (0، 20، 30) کگم P2O5/ هێکتار و سێ ئاستێن پەینێ زیندی (0، 4، 6) کگم/هێکتار بکارئینا بوون. ئەنجام دیاربوون کو کارتێکرنەکا راماندار هەیە بۆ ئاستێن فسفوری و پەینێ زیندی وتێکهەلهاتنێن دناڤبەرا وان دا لسەر هەمی ساخلەتێن هاتینە بکارئینان د ڤەکولینی دا و هەروەسا تێکهەلهاتنێن دناڤبەرا وان دا ئاشکراکر کو ئەڤ فاکتەرێن هە بلندترین بها بۆ ئێکەم قەلپیشکێ نوکێ (36.06 سم) و رێژەیا فسفوری د دندکا وێ دا (0.44%) و بلنداهیا رووەکی (59.428%) و هژمارا قەلپیشکێن نوکێ ب رووەکی ڤە (64.16) و متایی گشتی یی نوکا (5.583 تە ن / هێکتار) و هژمارا تاکین سە رە کی و لاوە کی(4 و 15.50) بوون لدویف ئێك، لدەمێ هژمارا گرێکێن بەکتریایێ (31.978) و بارستەی (0.369 کگم) ل ئاستێ 30 کگم P2O5/ هێکتار و 6 کگم / هێکتار ژ پەینێ زیندی وەك هەڤبەرکرن ب یە کا کونترول و ئالوز، هەروەکی ئەنجامان دیارکری کو رێژەیا سەرەدەریکرنا توخمی لژێر ئاستێن جیاوازدا بوون ژ زێدەکرنا پەینێ فوسفوری و پەینێ زیندی، ئەڤ زێدەکرنە هەر لدەستپێکێ بۆ توخمێن فوسفوری زێدەبوو کو 70.72% هاتە تۆمارکرن وەك هەڤبەرکرن دگەل سەرەدەریێن دی بێی زێدەکرن .

شوکەپەیڤ: فسفور، پەینێ زیندی، بەرهەم و نوکا خومالی.

تأثيرالسماد الحيوي ومستويات الفسفورعلى محصول ومكونات الحاصل للحمص تحت ظروف الزراعة المطرية

الخلاصة

طبقت تجربة خلال الموسم الربيعي لعام 2020 لتقيم تأثير مستويات مختلفه من السماد الفسفور والسماد الحيوي على نمو وحاصل صنف محلي من الحمص. زرعت التجربة في حقل تجارب كلية الهندسة الزراعية في جامعة دهوك. وضعت الوحدات التجريبية في نظام التجارب العاملية باستخدام تصميم القطاعات العشوائية وبثلاث مكررات. شملت التجربة ثلاثة مستويات من الفسفور (0, 20 و30 كغم P_2O_5 للهكتار) وثلاثه مستويات من السماد الحيوي (0, 4 و6 كغم للهكتار). أظهرت النتائج تأثير معنوياً لمستويات الفسفور والسماد الحيوي والتداخل بينهما على جميع الصفات المدروسة وأظهر التداخل بين هذين العاملين أعلى قيم لارتفاع اول قرنه (36.06 سم) ونسبة الفسفور في البذور (0.44%) وارتفاع النبات (59.428 سم) وعدد القرنات بالنبات (64.16) ووزن البذور (5.583طن في الهكتار) وعدد التفرعات الاولية والثانوية (4 و 15.50) على التوالي, في حين بلغ عدد العقد البكتيرية (31.978) ووزنها (0.369غم) عند مستوى 30 كغم P_2O_5 للهكتار و6 كغم للهكتار من السماد الحيوي بالمقارنه مع جميع التوليفات السمادية ومعامله المقارنه، كما أظهرت النتائج النسبة المؤية لكفاءة معامل العنصرتحت المستويات المختلفة من اضافه السماد الفوسفاتي والسماد الحيوي اذ زاد هذا المعامل بالزيادة البدائية لعنصر الفسفور حيث سجل 70.72% بالمقارنه مع معامله بدون اضافه.

الكلمات الدالة: فسفور، سماد الحيوي، حاصل والحمص صنف محلي.