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EFFECT OF PHOSPHOROUS APPLICATION ON CHICKPEA NODULES PRODUCTION AND SOME FERTILITY PROPERTIES OF CALCAREOUS SOIL OF DUHOK-KRG- IRAQ

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ABSTRACT

Afield experiment was carried out during spring season of 2020 at research station of the College of Agricultural Engineering Sciences to evaluate the effect of different phosphorus levels on chickpea nodules production, soil physical and chemical after phosphorus application. A randomized complete block design was used, with three replications, five application rates of P_2O_5 ,0,15,30,45,60 Kg.ha^{-1}. The results revealed that the phosphorus levels were have highly significantly affected on number of nodules plant^{-1},seed yield, plant heigh, number of main and secondary branches per plant, first pod height and number of pods plant^{-1},and also, results showed the maximum number of nodules per plant(43.33) yield (667.7) Kg.ha^{-1} ,plant height (54.33)cm, main and secondary branches (4) and 2.3 respectively, first pod height (26.17cm) and maximum pods plant^{-1} 27.67 was recorded at maximum rate of phosphorus, (60 Kg.ha^{-1}) Regarding agronomic efficiency percent, the results exhibited maximum value of this percent was recorded at 60 Kg.ha^{-1} P_2O_5, the results indicated application of 60 Kg.ha^{-1} gave the highest values for all studied traits and recorded highest value of coefficient determination (R^2) 0.95,0.94,0.91 and 0.99, for plant height, secondary branches per plant, pod height and number of pod plant^{-1} respectively. The results exhibited highly significant and positive correlation for seed yield 0.92,0.90,0.87 and 0.84 with number of pods plant^{-1}, plant height, number of main and secondary branches plant^{-1}respectively. Application of phosphorus the soil increases some physical and chemical properties of soil such as pH, EC, available of phosphorus, organic matter and cation exchange capacity.

KEY WORD: chickpea, production, phosphorus, local variety.

INTRODUCTION

Phosphorus is considered an important nutrient for formation and translocation of carbohydrate, fatty acid, and other essential inter compound. An application of phosphorus has been found to improve the roots system of plant. Phosphorus caused increase in the lateral and fibrous roots, which results in more nodule bacteria increase in the rate of nitrogen fixation in leguminous crops. (Siphiwe *et al.*,2017)

Chick pea (*Cicer arietinum L*) is an important pulse crop, it recognized as legume with source of protein, nutrients, and carbohydrates (laranjo ,2014). It is adaptable to wide climate variation, has low production cost and promotes biological fixation of atmospheric nitrogen. (Nascimento, 2016 and Bala, 2017).

Khan *et al.*,2010 indicated the production is limited by lack of plant nutrient available in the soil because majority of farmers hardly use of fertilizer for legume cultivation, However, there is a possibility to enhance the productivity through optimum fertilization and management, as there is a wide gap between the average yield production and yield potential of crop. Plant nutrition, suitable cultivars and correct fertilizer has

significant effect on yield and yield components.

Phosphorus effect on the number of nodules, number of pods, weight of pods, green pods yield and protein content(percent) were markedly increased with increasing phosphorus levels up to 60 Kg.ha^{-1} over control (Dotaniya et *al.,* 2014).

Phosphorus fertilization is among the main practices of crop management, yet, it is considering complex in tropical soils because of the high capacity of phosphorus for covalent adsorption to soil (Gazola *et al.,* 2013) and because of low natural availability of P to plant. In chickpea balanced phosphorus nutrition in fundamental for establishing symbiosis with nitrogen fixing rhizobacteria and it stimulates nodulation, in development of roots, plant growth and seed yield and quality (Balai *et al.,* 2017).Also phosphorus variability in optimum quantities is needed for early growth stage, development of the reproductive parts, root growth, reduced disease incidence and early maturity compare to vegetative growth. Phosphorus availability in considerable quantities is critically need for seed yield. (Gidagoe *et al.,* 2012)

The aim of this study was to evaluate chickpea yield and soil chemical and physical attributes under different application rates of phosphorus.

MATERIALS AND METHODS

The influence of phosphorus levels on yield and some growth parameters were estimated in an experiment carried out at the field of College Agricultural Engineering Sciences- Dohuk University Iraqi Kurdistan Region. The experiment units were laid out in randomize complete block design (RCBD) with three replicates. The experiment units consist four rows with four-meter length and the distance between rows 0.30 m (with plot size 3.6 m^2).

Local variety of chickpea and five triple super phosphate P_2O_5 doses (0,15,30,45and60 Kg.ha^{-1}) were applied before planting date with planting lines. Experimental managed in accordance with the recommended cultural and other field management practices such as hand weeding, nitrogen application. The data were recorded randomly on five plants and these plants at the end of flowering and it was washed with water and then the counting process started for the number of nodule per plant seed yield Kg.ha^{-1},plant height cm, number of main and secondary branches per plant, first pod height and number of pod plant. The agronomic efficiency was calculated by using the following formula

$$AE = \frac{YFT - YCT}{ARFT}$$ (MC Donald *et al.*, 2001)

Where,

AE= Agronomic efficiency in Kg of seeds per Kg nutrient applied

YFT= Yield in treatment fertilized with P, Kg. ha^{-1}

YCT= Yield in control treatment Kg. ha^{-1}

ARFR= Application rate in treatment fertilizer with P, Kg. ha^{-1}

The monthly climatology information was obtained from the station of College Agricultural Engineering Sciences, Table 1.

Table:(1): The climatic of the experimental field location during growing season 2020- 2021, (rainfall and air temperatures).

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

The important physico-chemical properties of these soils (pH, EC. organic matter, particle size distribution, CEC, Available phosphorus, etc.) were determined by following methods described by Jackson (1973). The data were subjected to analyzed of variance with (mantab analysis program, 2017) and using Duncan's Multiple Range Test (MRT) to determine the superiority of treatment means.

RESULTS AND DISCUSSION

The analysis of variance for the studied traits of chickpea under varying levels of phosphorus presented in Table 2. The results revealed that the phosphorus levels have significant effected on number of nodules plant^{-1}, seed yield, plant height, number of main and secondary branches, first pod height and number of pods plant^{-1}. These results are similar to finding of Lopes, 2016 and Oliveira *et al.,* 2017. Who reported that the phosphorus application enhances growth as well as yield contributing growth parameters of the chickpea.

Table (2): Analysis of variance for studied traits chickpea under different levels of phosphorus.

S.O.V	d.f	No. of nodule	yield Plants Kg	Plant height cm	No. of main branch Plant^{-1}	No. of secondary branch Plant^{-1}	Pod height cm	No. of pod Plant^{-1}
Replication	2	114.87	286	95.76	0.0667	1.8000	27.950	0.600
Treatments	5	236.90**	75742**	140.13*	1.6000**	7.9333**	8.942**	130.500**
Error	10	32.45	230	92.94	0.1500	0.6333	2.992	3.850
Total	17							

* significant at probability 0.05, ** significant at probability 0.01.

Effect of different phosphorus levels on studied traits were presented in Table, 3. The results showed that, the maximum number of nodules plant^{-1} was (43.33) recorded when fertilizer with (60 Kg P_2O_5 ha^{-1}) and the minimum number of nodules per plant 20.67 recorded at fertilizer treatment 15 Kg P_2O_5 ha^{-1}). The result in

relation relying on to the grain yield Kg. ha^{-1} of chickpea as under the effect of various phosphorus levels, grain yield value was (667.7 $Kg.ha^{-1}$) was obtained by (60 Kg P_2O_5 ha^{-1}) application while, the lowest value 315.2 Kg. ha^{-1} was recorded in control with no phosphorus application. Depending on the plant height the maximum plant height (54.33cm) was observed at fertilizer treatment (60 Kg P_2O_5 ha^{-1}) whilst, the minimum plant height (38.03 cm) was noted in control treatment.

The number of main and secondary branches per plant increased with increasing phosphorus rate. Maximum numbers branches (4.00) and 8.33 recorded at fertilizer treatment 60 Kg P_2O_5 ha^{-1}, minimum number of branches plant (2) and (4) respectively were obtained by zero phosphorus application. Regarding to first pod height the highest value (26.17) were recorded at 60 Kg P_2O_5 ha^{-1} while, lower value (22.33) was recorded at control treatment. The data in Table (2) showed that the number of pod per plant increasing when plant received to 60 Kg P_2O_5 ha^{-1} , pods per plant (27.67) were recorded at the maximum rate of phosphorus and the minimum value (11) was obtained in zero phosphorus application on the basis of the results in the Table (3), thus can it concluded that the application of phosphorus rate 60 Kg P_2O_5 ha^{-1}, significantly improved agronomic traits, plant height, number of main and secondary branches, number of nodules per plant and number of pods $plant^{-1}$, 100 seed weight and grain yield because phosphorus helped to increase the size of the root system, which led to an increase the absorption the nutrients from soil. Observations confirmations these founding by Bala. 2017, Seid *et al.,* 2015 and Laranjo *et al.,* 2014.

Table (3): Mean of the studied traits of the chickpea under different phosphorus levels.

Treatments	No. of Nodules $plant^{-1}$	Seed yield $kg.ha^{-1}$	Plant height Cm	No. of main branches $Plant^{-1}$	No. of secondary branches $Plant^{-1}$	First pod height cm	No. of pods. $plant^{-1}$
control	25.670b	315.200d	38.030a	2.000b	4.667c	22.330a	11.000d
15	20.670ab	346.500d	51.330a	2.667b	4.667c	23.000a	14.670cd
30	23.330b	394.200c	52.670a	2.667b	6.000bc	24.500a	18.670bc
45	28.330b	600.700b	54.000a	3.000ab	7.333ab	26.000a	23.000ab
60	43.330a	667.700a	54.330a	4.000a	8.333a	26.170a	27.670a
p. value	0.009	0.000	0.278	0.003	0.002	0.088	0.000

Means that do not share a letter are significantly different at p value <0.05.

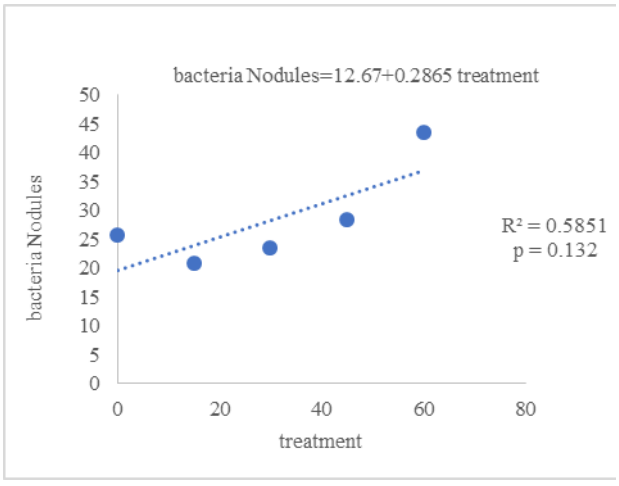
The data in Table (4) indicating the agronomic efficiency percent under different levels of phosphorus application. The results exhibited that the maximum value was recorded at 60 Kg P_2O_5 ha^{-1} and was 1.469 %, while the lower value 5.22% was obtained at 15 Kg P_2O_5 ha^{-1},fertilizer level so, it necessary to use an adequate amount of plant nutrients at balanced rates for improving plant growth, yield and yield components. Similar results were obtained by Prajapati *et al.,* 2017.

Table (4): Agronomic efficiency under different levels of phosphorus.

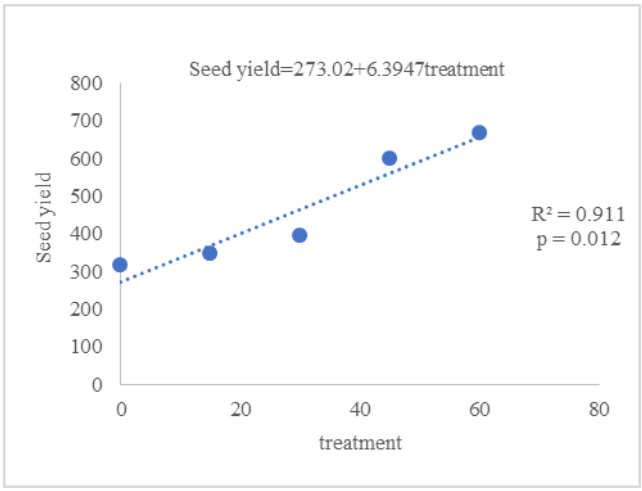
treatment	YFT	YCT	ARFT	AE
15	346.5	315.2	60	0.522
30	394.2	315.2	120	0.658
45	600.7	315.2	180	1.586
60	667.7	315.2	240	1.469

Where,
YFT= Yield in treatment fertilized with P, Kg. ha^{-1}
YCT= Yield in control treatment Kg. ha^{-1}
ARFR= Application rate in treatment fertilizer with P, Kg. ha^{-1}
AE= Agronomic efficiency in Kg of seeds per Kg nutrient applied

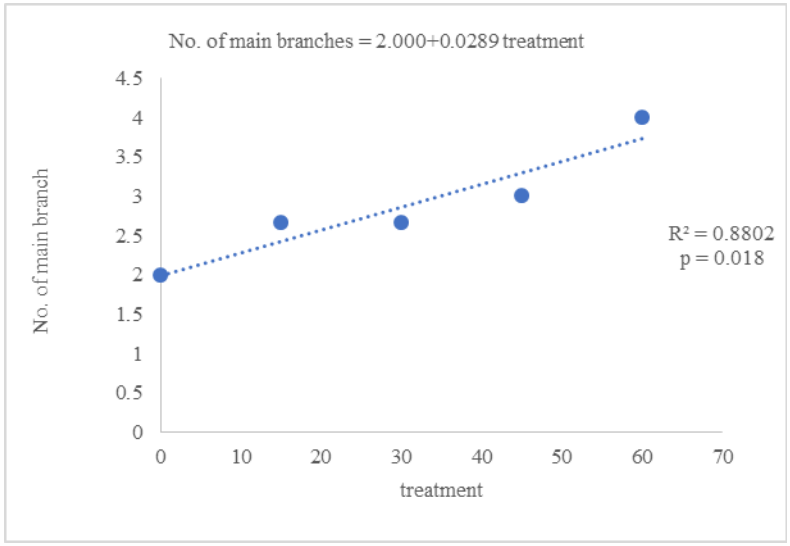
Fig.1(A to G) the application of 60 Kg P_2O_5 ha^{-1} gave the highest value of all studied traits and the same figure showed that the plant height, secondary branches, also the figure show, first pod height and number of pod $plant^{-1}$, was most components of chickpea attributes the seed yield after phosphorus application and recorded the correlate between yield and some of the traits by adding the phosphorus element were high and here the effective role of phosphorus in different traits appears at high doses to get the best growth and productivity. the highest value of coefficient determination (R) 0.95, 0.94, 0.94, and 0.99 respectively.



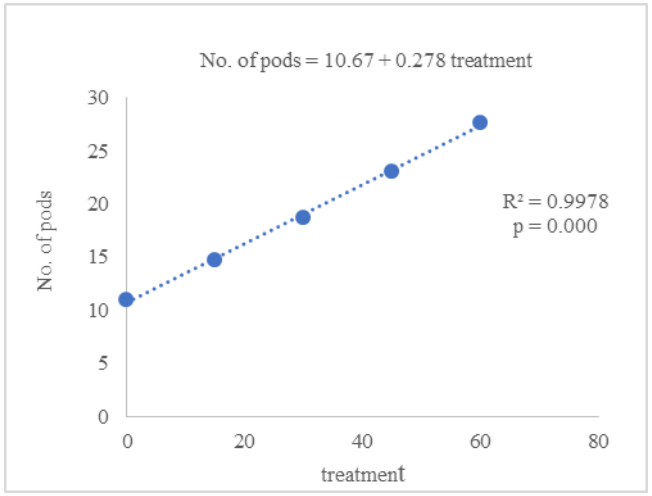
(A)



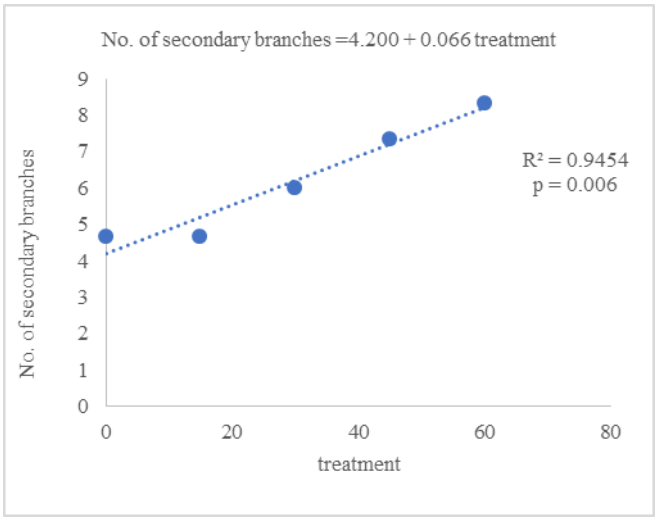
(B)


No. of main branches = 2.000+0.0289 treatment
No. of main branch
treatment
R² = 0.8802
p = 0.018

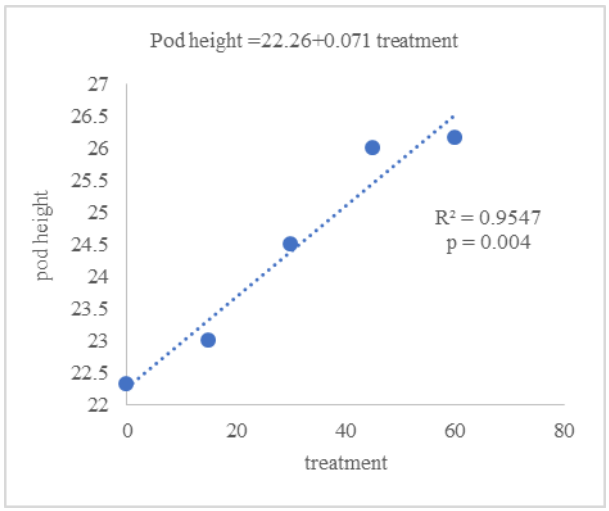
(C)


No. of pods = 10.67 + 0.278 treatment
No. of pods
treatment
R² = 0.9978
p = 0.000

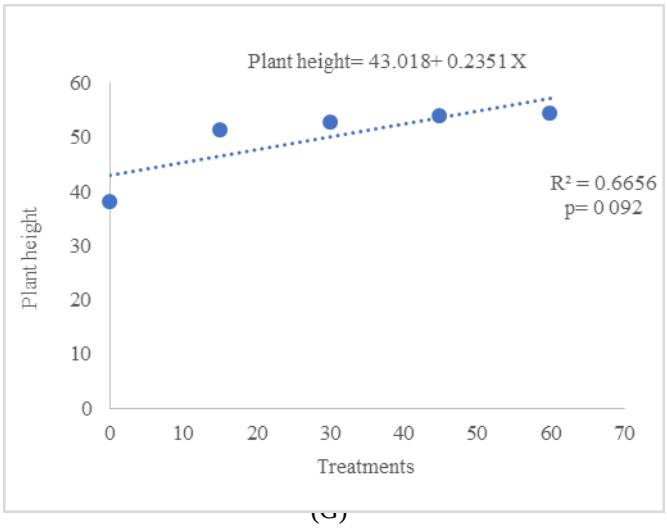
(D)


No. of secondary branches =4.200 + 0.066 treatment
No. of secondary branches
treatment
R² = 0.9454
p = 0.006

(E)


Pod height =22.26+0.071 treatment
pod height
treatment
R² = 0.9547
p = 0.004

(F)


Plant height= 43.018+ 0.2351 X
Plant height
Treatments
R² = 0.6656
p= 0 092

(G)

From the data in Tables 5, the results indicated highly a significant and positive correlation among studied parameters of chickpea. For seed yield were 0.922, 0.90, 0.87, and 0.84 with number of pods plant^{-1}, plant height, number of main and secondary branches plant^{-1} respectively. For the number of nodules plant^{-1} also observed highly significant and positive correlation with seed yield and the value was 0.84, while the secondary branches plant were positively correlated with number of nodules plant (0.79) and seed yield (0.89) and (0.79) with plant height. Similar results were also confirmed by many researches Jakhar, 2014, and Amare *et al.,* 2020.

Table (5): simple correlation coefficient between yield and some growth parameters in chickpea.

Parameters	No. of Nodules	Seed yield kg.ha^{-1}	Plant height cm	No. of main branches	No. of secondary branches	Pod height
Seed yield kg. ha^{-1}	0.879**					
Plant height cm	0.784**	0.923**				
No. of main branches	0.829**	0.806**	0.757**			
No. of secondary branches	0.793**	0.890**	0.793**	0.702**		
Pod height	0.571*	0.562*	0.592*	0.462	0.568*	
No. of pods	0.849**	0.922**	0.909**	0.871**	0.842**	0.447

Thus, application to soil in this study increase some physical and chemical properties of soil in Table 6. the results in the same table exhibited that reduction of pH from 7.9 to 7.61 and EC from 0.557 to 0.520 while the increase of phosphorus application rates change in physical and chemical attributes and increased in a variable phosphorus, organic matter, cation exchange capacity, and recorded values 4.08, 18.8, 32.4 respectively. this relation was considered positive for plant development. This is in line with finding of Rodinel *et al.,* 2018 and Dotaniya *et al.,* 2014.

Table (6): The chemical and physical properties of soil experimental site.

Parameters	Units	(Depth 0-30) Before planting		(Depth 0-30) After planting
Ph	1:2	7.96		7.61
EC	$ds.m^{-1}$	0.557		0.520
Ca^{2+}	$mmol_c.L^{-1}$	2.50		2.42
Mg^{2+}	$mmol_c.L^{-1}$	2.30		2.08
Na^{+}	$mmol_c.L^{-1}$	0.34		0.42
K^{+}	$mmol_c.L^{-1}$	0.19		0.20
HCO_3^{-}	$mmol_c.L^{-1}$	3.80		3.68
$CO_3^{=}$	$mmol_c.L^{-1}$	Appear		Appear
Cl^{-}	$mmol_c.L^{-1}$	0.74		0.72
$SO_4^{=}$	$mmol_c.L^{-1}$	0.70		0.66
Available phosphorus P	$Mg.kg^{-1}$	3.89		4.08
Organic matter	$g.kg^{-1}$	17.5		18.8
Cation exchange capacity	$Cmol.kg^{-1}$	29..8		32.4
Total calcium carbonate	$g.kg^{-1}$	212		218
Sand	$g.kg^{-1}$	84	Soil texture **silty clay**	78
Silt	$g.kg^{-1}$	432		430
Clay	$g.kg^{-1}$	484		492
Bulk density	$g.cm^{-3}$	1.29		1.23

Phosphorous Applications

Treatment		Available phosphorous (mg.kg)
Control	0	3.89
	15	4.88
	30	6.9
	45	7.7
	60	7.92

REFERENCES

Amare. T, Asnake. F and Bantayhu. M. (2020). Genetic variability and association analysis of Desi-type chickpea advanced lines under potential environmental in north Gondar Ethiopia. Congent food and Agriculture 6(1): 1-36.

Bala. L. K. (2017). Effect of phosphorus and zinc on growth, yield and economics of chick pea. Inter. of current microbiology and applied sciences. 6 (3): 1174-1181.

Balai.K, sharma.Y, Jajoria.M, Deewan.P and R. Verma. (2017). Effect of phosphorus and zinc on growth, yield and economics of chickpea. International Journal of current microbiology and applied sciences. 6 (3) 1174-1181.

Dotaniya. Ml,pingoliya. K. K, M. Lata, R, Vema, K. L. Decwan, P. Dolanyia.

(2014). Role of phosphorus in chick pea production. African. J. of Agric. Research. 9(51):3736- 3743.

Gazola. P.N. moria and A. condido (2013). Efeito residual do aplicacao de fosfato monoamonio revestido por differents polimeros nacultura de milho . Revista Ceres. 60 (6) 876-884.

Gidago G, S. Beyene and W. Worku. (2012). The response of haricot bean (Phaseolus vulgaris L.) to phosphorus application on ultisols at Areka, Southern Ethiopia. J. Biol. Agric. Healthc. 1(3):38-49.

Jackson, M.L. (1973). Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd, New Delhi.

Jakhar, D.A, N. S. (2014). Genetic diversity studies in chickpea. Bangladesh. J. of Botany 45(3) :459-464.

Khan, H.R. (2010). Response of chickpea (Cicer arietinum L.) to zinc supply and water deficits. Ph.D. Decertation. Span. J. Agric. Res. 8(3): 797-807.

Laranjo. M, A. Alexander and Solivira. (2014). Legume growth-promoting rhizobia: an overview on the Meso rhizobium genus. Microbiological research. 169(1): 2-17.

Lopes. J. F. (2016). Productive ecomposicao meineral do feilao em respota as aduabaco es mibedinio enianel Revista Cereas 63 (3): 419-426.

McDonald, G.K., Graham, R.D., Lloyd, J., Lewis, J., Lonergan, P., Khabaz-Saberi, H. (2001). Breeding for improved zinc and manganese efficiency in wheat and barley. Proceeding of the 10th Australian Agronomy Conference. Department of Plant Science, Waite Institute, Glen Osmond, SA, Hobart.

Nascimentos. W. M. And A.Bala (2016). Hortalicas Leguminosa. Brasilia Empresa Brasileira de pesquisa Agro pecuaria 5,(2):232-237.

Oliveira. C. (2017). Producao de sementes de soja enriqueuecidas com phosphorus. Revista C eres, 64 (3):282-290.

Prajapati. B. J, Nitin. G. A. Gamit and H.J. chhaganiya. (2017). Effect of integrated phosphorus management on growth, yield attributes and yield of chickpea. Forming and management 2(1):36-40.

Rodinel. F. P., N. Maria, A. candido and M. Rodrigues. (2018). Chick pea production and soil chemical attributes after phosphorus and molybdenum fertilization. Ciancia Agrotechologia.42(5) 474-483.

Seid. H., Yirga. F and F. Tibebu. (2015). Effect of phosphorus fertilizer on yield and yield components of chick pea. International J. of Agri. Extension and Rual Development studies. (1) (1) : 29-35.

Siphiwe. G.Z, Jude. J. O and B.O. John. (2017). Growth, yield and water efficiency of chick pea (Cicer arietinum): response to biochar and phosphorus fertilizer application. Archives of Agronomy and soil science. 10 (1):1-15.

كارتێكرنا زيدەكرنا فوسفورى ل سەر بەرهەم ئينانا گرێكێن نوكا و هندەك تايبەت مەندييت فيزيايى و كێميايى يێن ئاخييێن كلسى دهوك - هەريما كوردستانا عيراقى.

پوختە

تاقيكرنەكا زەقێ د ماوەيێ بوهارا 2020 ێ دا ل وێزگەهێ ڤەكولينێن كوليژا زانستێن ئەندازياريا چاندێ هاتە ئەنجامدان ژبۆ هەلسەنگاندنا كارتێكرنا ئاستێن فوسفورى يێن جودا جودا لسەر گرێكێن بەرهەمى و تايبەتمەندى يێن فيزيايى و كێميايى يێن ئاخێ پشتى زێدەكرنا فوسفورى. ديزاينا كەرتێن هەرەمەكى هاتە بكارئينان، دگەل سێ دووبارەبويان، و پێنج رێژەييێن زێدەكرنێ ژ 0) P2O5، 15، 30، 45، 60 كيلوگرم/ هێكتار).

ئەنجام هوسا دياربوون كو ئاستێن فوسفورى كارتێكرنەكا مەزن هەبوو لسەر هژمارا گرێكێن رووەكى-1، بەرهەمێ تۆڤى، بلنديا رووەكى، هژمارا چەقێن سەرەكى و لاوەكى، بلنديا كێليكێت ئێكێ و هژمارا كێليكێت رووەكى -1، و هەروەسا دياربوو كو بلندترين هژمارا گرێكان لسەر رەهێن هەر رووەكەكى (43.33) نە، بەرهەم (667.7) كيلوگرام/هێكتار، بلنديا رووەكى (54.33) سم، چەقێن سەرەكى و لاوەكى (4) و (2.3)، و بلنديا كێليكا ئێكێ (26.17). و بلندترين ئاستێ كێليكا رووەكى-1 (27.67) تومار كر ل بلندترين رێژەيا فوسفورى، و ئەوا گرێداى رێژەيا سەدى يا شيانێن چاندنێ، ئەنجام دياربوون كو بلندترين بهايێ ڤێ رێژەيى هاتە تومار كرن ل (60) P2O5 كيلوگرام/هێكتار-1. ئەنجام دياردكەن كو زێدەكرنا (60) P2O5 كيلوگرام/هێكتار-1 دا بلندترين بهاى بۆ هەمى تايبەتمەندى يێن خواستى ددەت و بلندترين بها يێ دەستنيشانكرنا پيڤەرى (R)؛ (0.95، 0.94، 0.91 و 0.99) بۆ بلنديا رووەكى و چەقێن سەرەكى و لاوەكى و هژمارا كێليكان-1 لدويڤ ئێك. ئەنجامان دياركر كو هەبوونا پەيوەندى يێن ئەرێنى و رامانداربا بلند هەيە يا بەرهەمێ تۆڤى (0.922، 0.90، 0.87و 0.84) دگەل هژمارا كێليكێن رووەكى-1، بلنديا رووەكى، هژمارا چەقێن سەرەكى و لاوەكى يێن رووەكى-1 لدويڤ ئێك. زێدەكرن (هاڤێتنا) فوسفورى بۆ ئاخێ دبيتە ئەگەرێ زێدەبوونا هندەك تايبەتمەندى يێن فيزيايى و كێميايى يێن ئاخێ مينا: (هژمارا هايدروجينى -pH، گەهاندنا كارەبێ - EC ، و فوسفورێ ڤەگوهۆڕ - VP، و ماددەييێن ئەندامى - O.M و شيانێن لێككوهۆڕينا كاتئەيونان - CEC.

شوكە پەيڤ: نۆك، بەرهەم، فوسفور،جورێ نافخويى

تاثير الفسفور المضاف على انتاج العقد البكتيرية للحمص وبعض الخصائص الخصوبية للتربة الجبسية . دهوك- اقليم كوردستان العراق

الخلاصة

طبقت تجربة حقلية خلال الموسم الربيعي لعام 2020 في حقل كلية علوم الهندسة الزراعية –جامعة دهوك لدراسة تأثير مستويات مختلفة من الفسفور على تكوين العقد البكتيرية وخصائص التربة الفيزياوية والكيمياوية باستخدام تصميم القطاعات العشوائية الكاملة وبثلاث مكررات.

أظهرت النتائج وجود فروقات عالية المعنوية للفسفور على عدد العقد البكتيرية في النبات وعدد التفرعات الرئيسة والثانوية وارتفاع اول القرنة وحاصل البذور وعدد القرنات في النبات كما اظهرت النتائج قيم عالية لعدد القرنات في النبات (43.33) وحاصل البذور (666.7) كغم /هكتار وارتفاع اول قرنه 26.17 سم وعدد القرنات في النبات (27.67). أما بالنسبة الى معامل الاقتصادي ممثلا كنسبة مئوية فان أعلى القيم سجلت عند معدل 60 كغم /هكتارP_2O_5 ولجميع الصفات المدروسة. كما اشارت النتائج الى حصول قيم عالية لمعامل التحديد اذ بلغت (R^2) 0.95،099،0.94،0.94 لارتفاع النبات وعدد الفروع الثانوية وارتفاع النبات وارتفاع اول قرنه على التوالي وعند دراسة الارتباط بين الحاصل والصفات الاخرى فقد كان الارتباط موجبا ومعنويا لصفات عدد القرنات في النبات 0.922 وارتفاع النبات 0.90 وعدد الفروع الرئيسة 0.87 والثانوية 0.84 كما ادى اضافة الفسفور الى حصول تغيرات في بعض الخصائص الكيمياوية للتربة شملت درجة الحموضة والتوصيل الكهربائي والفسفور الجاهز والمادة العضوية وسعة التبادل الكاتيوني .

كلمات مفتاحية: حمص، انتاج، فسفور، صنف محلي