Evaluation of two promising chickpea genotypes for yield and its components under different levels of bio-fertilizer.

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Abstract

Afield experiment was carried out at field of College of Agricultural Engineering Sciences, University of Duhok during winter season 2020 -2021 to investigate different bio-fertilizer and promising chickpea genotypes on yield and yield components.

The experiment designed in factorial experiments complete randomize block design with three replications. The results showed that the effected of chickpea genotypes, bio- fertilizer and their interaction between them on the most studied traits. The chickpea FLipo7- 245c was superior in the plant height (65 cm), first pod height (39 cm), number of nodules per plant (29.25), 100 seed weight (44.33 g) comparing with FLipo7-223c genotype. Concerning the bio – fertilizer, the rate 6 kg ha^{-1} recorded the highest values for all studied traits except number of pods per plant with increasing in yield 33.9% comparing with zero bio-fertilizer. Also the interaction between chickpea genotypes and bio-fertilizer were significant for all traits except number of nodules per plant and 100 seed weight (g). For these results, the chickpea was responded to different rate of bio-fertilizer and its important role in the most yield components. The simple correlation coefficient gave high value between yield and main branches (0.63) and first pod height 0.74 and also this study exhibited that the main branches per plant, number of pods per plant and plant height were the major contributed to seed yield.

Key word: Chick pea, bio-fertilizer, yield components, genotypes.

تقويم تركيبين وراثيين متفوقين من الحمص لحاصلهما وبعض مكونات الحاصل تحت مستويات مختلفة من السماد الحيوي

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الخلاصة

طبقت تجربة حقلية في حقل كلية علوم الهندسة الزراعية في جامعة دهوك خلال الموسم الشتوي 2020-2021 لتقويم تأثير مستويات مختلفة من السماد الحيوي على حاصل صنفين متفوقين من الحمص. نفذت التجربة في تجربة عاملية باستخدام تصميم القطاعات العشوائية الكاملة وبثلاثة مكررات اظهرت النتائج تأثيرا معنويا للتراكيب الوراثية والسماد الحيوي والتداخل بينهما على معظم الصفات. تفوق في ارتفاع النبات (65 سم) FLipo7-245 cوارتفاع اول قرنة (39 سم) وعدد العقد البكتيرية (29.25) ووزن 100 بذرة (44.33 غرام) بالمقارنة مع التركيب التركيب الوراثي
FLipo7-223 . اما بالنسبة للسماد الحيوي فكان المعدل 6 كغم/ هكتار اعطى اعلى المعدلات لجميع الصفات باستثناء عدد القرنات في النبات مع زيادة بالحاصل بلغت 33.9% ومن خلال النتائج تبين ان الاصناف قد استجابت الى المعدلات المختلفة من السماد الحيوي وكان له دور فعال ومهم في زيادة الانتاج ومكوناته كما اظهر معامل الارتباط بين الحاصل والفروع الرئيسية ارتباطا عاليا بلغ (6.63) وارتفاع اول قرنة (0.74) كما اظهرت الدراسة ان عدد الفروع الرئيسية وعدد القرنات وارتفاع النبات كان لهما دورا فاعلا في زيادة حاصل النبات.

كلمات مفتاحية: حمص، سماد حيوي، مكونات الحاصل.

Introduction.

Grain Legumes are the second most important corps in the national diet after cereal. Chickpea is one of the most important edible seed crops in Iraq. The seed of chickpea was a good source of protein (13 to 33%), 40-55% of carbohydrates and 4 to 10% of oil (Singh. *etal.*, 2018). The area cultivated by chickpea crop in Kurdistan Region in 2017 and 2018 ranged from 8000 to 9000 hectare with average yield ranged from 1 to 0.9 ton (Moawr., 2019).

Kenneday *etal.*, 2004 indicated that the bio-fertilizer may colonizes the rhizosphere and promotes growth by increasing the variability and supply of nutrients and simutation plant growth and also mentioned using some important strains as increase. the growth promoting rhizobacteria (PGPR) and that can be used as bio-fertilizer. Tike *etal.*, 2005 Studied the Effect of bio-fertilizer in chickpea when applied bio-fertilizer and they concluded that bio-fertilizer effects of chemical nitrogen fertilizer and nitrogen variability to plant effect their potential growth and yield and also the using bio-fertilizer stimulate plant growth synthesis of hormones and increase phosphorus intake and nitrogen fixation.

Namvar *etal.*, 2001, indicated that the bio-fertilizer can lessen the required chemical fertilizer and the adverse environmental contamination and worsening nature. The Productivity of chickpea can be increased through high productive genotypes with the application of the optimal agricultural practices. Many works on the effect of genotypes of chickpea on the highest for 1000 seed weight followed by seed number per plant and another studied chickpea revealed significant difference between genotypes for yield and its components, maximum variation was obtained for pod per plant, biological yield, seed yield and harvest index (Kamil and Kawa, 2021; Wolde *etal*., 2018; Tamene *etal*., 2017 and Fikre, 2016.

The objective of this study to evaluate the effect of bio-fertilizer on two promising chickpeas for yield and yield components.

Materials and Methods

Two promising chickpea genotypes were used in this study FIP07-223c and FIPO7- 245C to estimate yield and some growth parameters under four levels of bio-fertilizer (0, 3, 4.5, 6 kg ha^{-1}).

Bio-fertilizer was applied in bonding between lines according to the treatments at time of sowing. The treatments were laid out in factorial experiments using randomized complete block design (RCBD) with three replications, plot size was (1.5 x 2 m), each unit

consisting 3 rows, each row insisted three meters length and 0.25 m apart between rows and o.20 m within plant. The date at sowing 7/12/2020 at the field of College Agricultural Engineering Sciences, University of Duhok, each unit irrigation was also applied at different occasions (three irrigation through the season). All agronomic practices were carried out uniformly for whole experiment when need. The climatic formation of size of experiment during winter season 2020 - 2021 (rainfall and mean of temperature) we're obtained from the station of College of Agricultural Engineering Science, soil was analyzed for chemical and physical properties before planting is presented in Table 1. All parameters studied were selected randomly on five plants from middle rows when plant reach maturity stage and data recorded on plant height cm, first pod height cm, number nodulation per plant, main branches per plant, 100 seed weight and total seed yield, also the yield were recorded on plot basis. The obtained data analyzed according Mantab- 2017 program to estimate the significant effect of studied traits at probability 0.05 and 0.01. Duncan Multiple Range Test (DMRT) was used for means comparison at 0.05 probability level.

Table 1. Some soil properties and rainfall in season 2020-2021.

Soil	Unit	Depth(0-30)cm	Month	Rainfall mm
PH		7.97	11/2020	25.1
Ec	$Ds.m^{-1}$	0.45	12/2020	40.5
A variable N	$Mg.kg^{-1}$	105.95	1/2021	83.0
A variable P	$Mg.kg^{-1}$	4.84	2/2021	19.20
O.M.	$g.kg^{-1}$	17.4	3/2021	40.8
Sand	$g.kg^{-1}$	72.53	4/2021	2.0
Silt	$g.kg^{-1}$	430.17		
Clay	$g.kg^{-1}$	496.12		
Soil Texture		Silt clay	Mean	35.10

Results and Discussions.

Analysis of variance (ANOVA) for all the studied were presented in Table 2, and its clearly indicates significant effects of bio-fertilizer treatments on plant height, first pod height, number. of main branches, number of pods $plant^{-1}$, number of nodules per plant, 100 seed weight and seed yield, because the bio- fertilizer help to get a good health plant while the influences of chickpea genotypes was a significant effected for all studied traits. Regarding to interaction between bio-fertilizer and chickpea genotypes exhibited highly significant for number of main branches, number of pods per plant and seed yield per plant, and significant effect on plant height, first pod plant and non-significant for number of nodules per plant. And 100 seed weight (gm) The obtained results indicate with enhancing growth parameters of chickpea genotypes. the obtained results are in agreement with the reported by Fathi *etal*., 2021, Mustafizur Rahman and Siragam, 2018 and Balai *etal*., 2017.

Table 2 Analysis of variance for yield and some growth parameters under different bio-fertilizer levels.

S.O.V	df	M.S						
		Plant height cm	Pod height cm	No. main branches per plant	No. of pods per plant	No. nodules per plant	100 seed weight gm	Seed yield gm
Blocks	2	5.54	0.87	0.06	0.29	1.79	0.29	6.16
Bio-fertilizer (b)	3	231.59**	82.26**	0.21**	659.77**	541.04**	108.5**	144.48**
Varieties (v)	1	651.0**	459.37**	3.30**	322.66**	222.04**	37.5 **	45.37**
b x v	3	7.35*	8.81*	0.37**	165.33**	4.26	0.27	15.48**
Error	14	1.78	1.87	0.01	24.48	1.88	0.67	1.31
Total	23							

* and ** significant 0.05 and 0.01 probability level respectively.

Effect of bio-fertilizer, chickpea genotypes and their interaction on plant height and firs pod height are displayed in Table 3. FLIP07- 245-C genotype was superior in both plant height and first pod height and recorded 65cm and 35.25 cm compared to 54,58 cm and 26.50 cm for FLIP07-223C respectively. Bio-fertilizer effects, the rate 4.5 kg per ha. recorded the longest plant height (65.00 cm) and highest value (33.66 cm for first pod height). Concerning the interaction between bio-fertilizer and chickpea genotypes, the FLIP07-245Cgave the highest values (70.0 cm and 39.0 cm) for plant height and first pod height, while the lowest values 45.3 cm and 22.0 cm were obtained by FLIP07-214C. from the results obtained the genotypes and bio-fertilizer influence in both traits from the results in Table 3, the Bio-fertilizer are not chemical fertilizer but contain by beneficial microorganisms

and when incorporated in soil , enhance specific microbial growth in rhizosphere, ply vital in nutrient mineralization, increase nutrient accumulation ultimately increase plant height through the increase cell division . The current observations are in agreement with finding of Balai *etal*., 2017 and Kamil and Kawa, 2021.

Table 3. Effect of bio-fertilizer and chickpea genotypes on plant height and first pod height.

Bio-Fertilizer levels	Plants height cm			First pod height cm		
	Genotypes			Genotypes		
	Flipo7-223C	Flipo7-245c	Mean	Flipo7-223C	Flipo7-245c	Mean
0.0	45.3 e	56.37 c	50.83 c	21.90 f	29.33 cd	25.66 c
3.0	57.33 d	64.66 b	60.83 c	26.33	35.33 b	30.83 b
4.5	60.0 c	70.0 a	65.0 a	28.33 de	39.0 a	33.66 a
6.0	56.0 a	69.0 a	62.5 b	29.33 c	37.33 ab	33.33 a
mean	54.58 b	65.0 a	59.79		35.24	30.87

Mean that don't share a letter are significantly different.

The data in Table 4 indicated the effect of bio-fertilizer and chickpea genotypes and their interaction on the main branches per plant and number of pods per plant. FIP07-245C genotype significantly produce of main branches per plant (4.28) compared with FLIP07-223C. also, FIP07-245C was superior in number of pods per plant (41.83), while the FLIP07-223C gave the lowest value in this trait (3.54 and 34.5) respectively, for the bio-fertilizer effect the 4.5 kg ha^{-1} gave the higher value (4.08) while the 3.0 kg ha^{-1} recorded the highest value 51.33 for number of pods per plant. On the other hand, the interaction between bio-fertilizer and chickpea genotypes the combination 6kg ha^{-1} x Flipo7-245c exhibited the maximum value (4.60), whilst the combination 4.5kg ha^{-1} x Flipo7-223c recorded the highest value (53.66) in number pods per plant, also from the results in the same table, the all both chickpea genotypes gave the lowest value for both traits in zero bio-fertilizer application. This variation in main branches and number of pods per plant can be explained by genotypes of studied genotypes and also the chickpea genotypes varied significantly to response bio-fertilizer. Similar results were also obtained by many researchers Kamil., 2003, and Kamil and Kewa, 2021.

Table 4. influence of bio-fertilizer levels and chickpea genotypes on main branches and number of pods per plant.

Bio-Fertilizers levels	Main branches per plant			No. pods per plant		
	Genotypes			Genotypes		
	Flipo7-223c	Flip07-245C	Mean	Flipo7-223c	Flip07-245C	Mean
0.0	3.66 b	3.66 b	3.66 b	21.66 f	30.33 de	26.00 c
3.3	3.33 c	4.40 a	3.86 b	37.37 cd	42.00 bc	39.66 b
4.5	3.60 b	4.46 a	4.03 a	53.66 a	49.00 ab	51.33 a
6.0	3.56 b	4.60 a	4.08 a	25.33 ef	46.00 ab	35.66 b
mean	3.54 b	4.28 a		34.5 b	41.83 a	

Mean that don't share a letter are significantly different.

Data in table 5 refers that the number of nodules per plant and 100 seed weight. As shown in the same table, the number of nodules affected significantly by chickpea genotypes. The FLIP07- 245C had the higher value 29.25 and the FLIP07-223C recorded the lowest value (23.16) for the bio-fertilizer level the L_3 gave the maximum value 23-66 by increasing 51% compared with zero bio-fertilizer application. Regarding to interaction between chickpea genotypes and bio-fertilizer, the combination 6 kg ha^{-1} x Flipo7- 225 c gave the maximum value 38.66, while the minimum value recorded by L_0 x Flipo 7-223c (10.33). moreover, significantly variances were noticed between the mean of chickpea genotypes in number of nodules per plant, also the bio-fertilizers have basic role in plant body, bio-fertilizer is very essential at early-stage growth and helped on encourage root growth and better crop establishment (Dalal and Nandkar, 2010).

The mean 100 seed weight is indicated in Table 5. Mean 100 seed weight was highly significant (P0.001) affected by main effect of chickpea genotypes and bio-fertilizer levels Table 2. Significantly higher mean value (44.33 g) was recorded by Fip07-245C, while the higher value (47.16 g) was obtained by 6kg ha^{-1} with increase percent 47.16% compared with no application bio-fertilizer.

record the higher value 48.66 g lower value 36.66 g was observed from combination FLIO7,223 with zero bio-fertilize application. Similar results reported by Kamil and Kawa, 2021., and Dutta and Bandyo Padhyay, 2004. Similarly at early stage phosphorus helped on encouraging root and better and crop establishment.

Table 5 The effect of chickpea genotypes and bio-fertilizers levels and their interaction on number of nodules per plant and 100 seed weight.

Bio-Fertilizers	No. of nodules plant			100 seed weight (g)		
Levels kg ha^{-1}	Flipo7-223c	Fip07-245C	Mean	Flipo7-223c	Fip07-245C	mean
0.0	10.33 g	17.00 f	13.66	36.66 g	38.66 fg	37.66 c
3.0	21.33 e	27.00 d	24.16 c	40.66 ef	43.00 de	41.83 c
4.5	30.33 c	34.33 b	32.33 b	44.33 cd	47.00 ab	45.66 b
6.0	30.66 c	38.66 a	34.66 a	45.66 bc	48.66 a	47.16 a
Mean	23.16 b	29.25 a		41.83 b	44.33 a	

Mean that do not share a letter are significantly different

Table 6. clarified that the chickpea genotypes and bio-fertilizer and their interaction on seed yield per plant. For the genotypes effected, the FLIP 07- 245C genotype obtained the higher value (29.83 g), while the FLIP 7-223 C had the lowest value (27.08 g), this main that the highest yield genotype had higher ability of producing and transporting primary metabolites that created from form the vegetive organs to developing seed than the other genotypes used in this study. (Alametal., 2017). Also, the results in the same table indicated that, the influences of bio-fertilizer levels, the highest value (33.83 g) obtained by 6 kg ha^{-1} level comparing with the other and non-fertilizer, which recorded the lowest value (22.33g). the bio-fertilizer increase the seed yield per plant percentage 33.9%. the obvious progress in this treatment maybe duo to the application of bio-fertilizer and its content of useful bacteria, nitrogen fixing bacteria, also bacteria affected the plant growth and productivity through their ability to release some supporters plant growth regulators such as in dole acetic acid, ethylene, and cytokinin as well as increase essential nutrient supply nitrogen -phosphorus and potassium for plant growth, (Mahmoud and Mohammed, 2018). Also, the results in the same table showed that the chickpea genotypes interaction with bio-fertilizer, the combination 6 kg ha^{-1} x FLipo7-245c gave the maximum value (36.0 g), while the minimum vale (21.33 g) recorded from Flipo7-245c. From these results the bio-fertilizer enhance bacterial response to nitrogen fixation and soil fertility and release auxins to the root zone to promotes growth. (Fathi *etal*., 2021; Mustafizur Rahman *etal*., 2018 and Mahmoud and Mohammed, 2018.

Table 6. Influence of chickpea genotypes and bio-fertilizer and their interaction on seed yield per plant.

Bio-Fertilizers levels	Seed yield		
	Genotypes		
Level kg ha^{-1}	Flipo7-223c	Fip07-245C	Mean
0.0	23.33 de	21.33 e	22.33 d
3.0	25.33 d	29.00 c	27.16 c
4.5	28.00 c	33.00 d	30.50 b
6.0	31.66 b	36.00 a	33.83 a
	27.08 b	29.83 a	

Mean that do not shore a letter are significantly different.

Simple correlation coefficient between many traits of chickpea genotypes were presented in Table 7, the results indicated that significant and positive correlation of seed yield per plant with main branches (0.63**) and first pod height (0.74 **). On the contrary, plant height had significant and positive with main branches (0.73**), first pod height (0.9**) and seed yield (0.74**), while the number of nodules per plant showed significant and positive correlated with main branches, first pod heights, seed yield per plant and plant height with value (0.59**, 0.78**, 0.89**, 0.85*8. The number of pods per plant had a positive and significant correlation with main branches (0.45*), first pod height (0.76** and number of nodules per plant (0.65*). From the results in Table 7, the main branches, number of pods per plant , plant height, were the major contributed to seed yield. Therefore, the study of these traits can improve the chickpea genotypes when suggested that chickpea improvement program could be based on these traits, especially pods per plant and main branches. Similar observation was reported by Abbas etal., 2021 and Amare *etal*., 2020.

Table 7. simple correlation between yield and some agronomic traits of chickpea genotypes.

Characters	Main branches	First pod height cm	Seed yield plant-1	Plant height cm	No. of nodules plant
Seed yield plant	0.63**	0.74**			
Plant height cm	0.73**	0.90**			
No. of nodules plant	0.59**	0.78**	0.89**	0.85**	
Pods plant	0.45*	0.53**	0.46**	0.76**	0.65**
* Correlation significant at P < 0.05 ** Correlation significant at P < 0.01					

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

Conclusion:

It may conclude that with the application and balance nutrients along with suitable bio-fertilizer can enhance the growth and yield of chickpea crop, also the use of bio-fertilizer may reduce the application of chemical fertilizers and we get healthy and reduce the pollution.

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