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RESPONSE OF FABA BEAN YIELD AND YIELD COMPONENTS TO DIFFERENT LEVELS OF NANO FERTILIZER

MOHAMAD **A**LI **H**USSAIN[*], **R**EZAN **E**SA **M**OSA[**] and **M**URADJAN **M.M. N**OORI[**]
[*]Dept. of Field Crops, College of Agricultural Engineering sciences, University of Duhok, Kurdistan Region–Iraq
[**]Dept. of Soil and Water Science, College of Agricultural Engineering sciences, University of Duhok, Kurdistan Region–Iraq

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ABSTRACT

Todays, the Nano fertilizers have become apioneer approach in farm of agriculture. A field experiment wasConducted at the farm Collage of Agricultural Engineering Science, University of Duhok, during the growing winter season 2019-2020 to investigate how Nano fertilizer affects the growth and yield of a local faba bean variety, the experiment units were arranged in a Randomize Complete Block Design with three replications. The result exhibited high significant effect of phosphorus and nitrogen and their interaction on all studied traits. The application ofphosphorus and nitrogen interactions increased plant height 153.4cm, first pod height 85.9cm, main brunches 3.6, number of pod plant^{-1}, 38.3, seed pod^{-1} 4.6,100 seed weight 189.4g and seed yield 294.5g at rate of108 P_2O_5 kg ha^{-1}. We can conclude from this study that the application of proper amount of nitrogen and phosphorus increased the most growth traits and yield components. Furthermore, the findings revealed a substantial and positive correlation among seed yield and plant height. 0.96, first pod height 0.91, number of main brunches 0.56, number of pod plant^{-1} 0.92, number of seed pod^{-1} 0.90 and 100 seed weight 0.91. These results emphasize the role of these traits in selection of faba genotypes when putting in breeding program for improving faba bean production.

***KEYWORD*:** Yield, Faba Bean, Nano Fertilizer, Nitrogen, Phosphorous

INTRODUCTION

In Iraq and neighboring Mediterranean nations, the faba bean (*Vicia fabaL.*) is one of the most popular leguminous crops; faba bean is available food legume rich in protein and carbohydrate, Abdel-Salam (2018).There are three main reasons for growing Faba bean, the first used cash crop through marketing dry seed, second, Faba bean is used as part of a winter or summer cereal crop rotation, and third, as a green manure in soils that have lost their organic and physical fertility, Rad*et al.,* (2014).

The Nano fertilizer showed an initial burst and subsequent slow release even on day 60 compared to commercial fertilizer, which released heavily early followed by the release of low and non-uniform quantities until around days 30 (Fujinuma and Balster, 2007).

Nanotechnology may hold the key to enhancing the value of agricultural products while also addressing environmental concerns. The use of Nano fertilizers increases their efficacy, reduces soil toxicity, reduces the frequency of administration, and minimizes the potential negative consequences associated with overdosing. Naderi and Danesh-Shahraki (2013) reported that, Nanotechnology has a great deal of potential for making agriculture more sustainable, especially in underdeveloped countries.

Sadek*et al.*,(2007) and Sultan *et al.*,(2009)revealed that when nutrients are scarce, crops exude carbonaceous molecules into the rhizosphere, allowing biotic mineralization of N and P from soil organic matter and inorganic colloids. Since these root exudates can be used as environmental signals, they were chosen to develop Nano biosensors that will be useful in the future. Fertilizer with nanotechnologywas also state by Tarafdar *et al.,* (2014)in which they reported that grain production at crop maturity was

boosted by 37.7% as a result of the use of zinc Nano fertilizer.

Farnia *et al.,* (2015); Jhanzab *et al.,*(2015); Vafa*et al.,*(2015) and Gomaa*et al.,*(2016), have found that the maximum plant height, leaf fresh and dry weight, number of leaves per plant and chlorophyll content were grained with Nano fertilizer treatment at rate of 100 mg per 600 liters, whilst the minimum plant height, leaf fresh and dry weight, number of leaves per plant and chlorophyll content were obtained with control treatment.

The major goal of this study was to determine how varying quantities of Nano fertilizers affected yield and yield components of a local faba bean variety.

MATERIALS AND METHODS

The field experiment was conducted at farm of field crops, College of Agricultural Engineering Sciences, University of Duhok, during the winter growing season 2019-2020 to study the effect of Nano fertilizer on growth and yield of local variety of faba bean under Duhok condition, Treatments were arranged in Randomize Complete Block Design with three replications. Each replication consists of, 3 meters in length, (40 cm) between rows and (20 cm) between each plant, which makes 1.20m and 15 plant per 1 line.The Nano fertilizer (N 6%, P 3%, K 17%, Fe 4%, Zn 4%, Mn 2%, Cu 0.5%, B 0.5% Mo 0.1%, Ca 1%, Mg 3% and S 6%) were applied at vegetative stage, at flowering stage and at seeds filling stage

Before planting process representative soil samples (0-30)cm were taken to identify some physical and nutritional properties of the experiment site (Table1).

Plant height (cm), pod length (cm), first pod height, number of pods. plant^{-1}, number of seed. Pod^{-1}, 100-seed weight (g), seed yield, and number of nodules per plant were recorded by (visual observation) in season 2019-2020. The harvesting process was done by taking ten plants of each different treatment as well as the yield was putted in separated bags, then they were air dried and weighted.

All measured parameters were subjected to analysis of variance in a randomize complete block design using SAS software version 9.1 (SAS: Analytics, Artificial Intelligence and Data Management, 2021). Duncan's Multiple Range Test (DMRT) was used to test the comparison of means at both 5% and 1% levels of probability.

Table (1):- Some Soil (Physical and Chemical) Properties of the Studied Site (at Duhok in season 2019-2020) before sowing

Soil Texture	Unit	Results
Sand	g.kg^{-1}	73.856
Silt	g.kg^{-1}	427.781
Clay	g.kg^{-1}	498.363
Textural Class	-	Silty Clay
Bulk density ρb	Mg. m^{-3}	1.392
O.M	g.kg^{-1}	1.633
pH		7.95
EC	dS. m^{-1}	0.454
$HCO_3^=$	mmol$_c$ L^{-1}	2.33
$CO_3^=$	mmol$_c$ L^{-1}	Trace
$CaCO_3$	g.kg^{-1}	217.6
Available N	mg.kg^{-1}	105.95
Available P	mg.kg^{-1}	4.88
K^+	mmol$_c$ L^{-1}	0.20
Available Fe	mg.kg^{-1}	2.74
Available Zn	mg.kg^{-1}	0.62
Available Cu	mg.kg^{-1}	2.83
Available Mn	mg.kg^{-1}	4.91

RESULTS AND DISCUSSION

According to the results obtained in Table 2, high significant effects exhibited for phosphorus and nitrogen levelsfor plant height, first pod height, days to 75% flowering, number of main branches, number of nodulations plant^{-1}, number of pods plant^{-1}, number of seeds pods^{-1}, 100-seed

weight (g) and seed yield, also highly significant observed between phosphorus and nitrogen levels interaction for all studied traits. These results within line of finding by Shahram and Peymam, 2016; Adak and Kibritci, 2016 and Farnia *et al.,* 2015.

Table (2):- Analysis of Variance of Faba bean traits as influence by different phosphorus and nitrogen levels

S.O.V	d.f.	MS.								
		Plant height (cm)	First pod height (cm)	Days to 75% flowering	No. of main branches	No. nodulation plant	No. pods plant^{-1}	No. seed pod^{-1}	100-seed weight (g)	Seed yield (g)
Block	2	1.2	1.81	0.18	0.12	13.11	1.46	0.01	0.30	8.9
P	2	5088.3**	188.99**	618.17**	0.11*	2954.43**	392.02**	4.88**	2355.4**	36664.3**
N	3	1078.6**	84.32**	177.36**	2.61**	194.04**	288.34**	1.46**	3436.5**	15175.9**
P*N	6	63.3**	1.19**	28.18**	0.11**	120.83**	43.42**	0.29**	76.7**	1554.9**
Error	22	0.2	0.12	0.39	0.26	2.54	0.26	0.009	0.30	1.5
Total	35									

*,** significant at 0.05 and 0.01 respectively

The effect of phosphorus levels on faba bean traits were presented in Table 3. The results displayed that phosphorus increased plant height in comparison to control; the highest value of plant height (141.3) was recorded by rateof 108 P_2O_5kg.ha^{-1}. For the first pod height, the maximum value was obtained by the same rate. The minimum days to 75% flowering exhibited in control treatment with value of 88.30 while, the maximum value was recorded at the rate of 108 kg ha^{-1}. Concerning to main branchesper plant,the phosphorus levels increasedthese traitsand the value ranged 2.7 to 2.9.According to this results of this study, the main branches increasedat 108 kg.ha^{-1}.

According to the results in the same Table, highest number of nodulations was counted at 108 kg ha^{-1}, in which 38% of undulation were enhanced compared with control. For number of pods plant^{-1}and number of seed pod^{-1}, the highest values(29.9) and (4.7) at rate 108 kg ha^{-1}, while the lowest values(48.8) and (2.7) were recorded at controlunits. Regarding100-seed weight, the highest value (176.6) gwas obtained at rate 108 kg ha^{-1},while; the lowest value obtained at control, the percent increase result in application of phosphorus and the value was 16% compared with control. The seed yield was affected by various phosphorus rate, the rate 108 kg ha^{-1} gave the maximum value (252) and followed by 88 kg ha^{-1} for days to 75% flowering compared with control. From the results above, its observed that the increasing of seed yield is due to the increasing in most yield components of faba bean. It can be concluded that phosphorus is effective in improving plant growth and seed yield, and that this application of phosphorus has positive effect on plant root development. Phosphorus also plays a significant role in several physiological and biochemical plant activities such as photosynthesis, sugar to starch transformation, and genetic trait transport. These results are in agreement with the results recorded by Rasul, (2018); and Gomaa*et al.*,(2016).

Table (3):- Effect of phosphorus levels on faba bean traits

Phosphorus level	Plant height (cm)	First pod height (cm)	Days to 75% flowering	No. of main branches	No. nodulation plant	No. pods plant^{-1}	No. seed pod^{-1}	100-seed weight	Seed yield (g)
P_0	97.6 c	15.1 c	88.30 c	2.7 b	52.6 c	18.8 c	2.7 c	148.6 c	141.9 c
P_1	115.5 b	16.7 b	100.0 b	2.8 ab	71.8 b	26.7 b	3.3 b	163.3 b	204.8 b
P_2	141.3 a	22.6 a	101.4 a	2.9 a	83.1 a	29.9 a	4.0 a	176.6 a	252.1 a

Mean bearing different letter within each column differ significantly at 0.05 and 0.01 probability level

All estimated traits were increased significantly by nitrogen fertilizer as compare with control (zero nitrogen) as shown in table 4. Adding 80 kg ha^{-1} increased plant height, first pod height, days to 75% flowering, number of pod per plant, number of seed per pod, 100 seed weight and seed yield by 19%, 34%, 10%, 34%, 43%, 24%, 24% and 40%, respectively, compare with the control treatment,the nitrogen application stimulated plant growth. This may be attributed to the fact that faba bean plants could obtain its nitrogen requirement. The previous results agreed with the finding of Ajirloo*et al.,* 2015; Drostkar *et al.,* 2016; Gomaa*et al.,* 2016 and Shang*et al.,* 2019.

Table (4):- Effect of nitrogen levels on faba bean traits

Nitrogen level	Plant height (cm)	First pod height (cm)	Days to 75% flowering	No. of main branches	No. nodulation plant	No. pods $plant^{-1}$	No. seed pod^{-1}	100-seed weight	Seed yield
N_0	102.8 d	14.0 d	90.8 d	2.3 c	63.1 c	17.0 d	2.8 d	135.6 d	143.3 d
N_1	118.3 c	18.2 c	96.1 c	2.4 c	74.4 a	25.9 c	3.2 c	162.0 c	199.8 c
N_2	123.3 b	19.1 b	98.0 b	3.0 b	69.84 b	27.8 b	3.5 b	174.3 b	215.4 b
N_3	128.1 a	21.3 a	101.4 a	3.5 a	69.5 b	29.9 a	3.7 a	179.4 a	240.0 a

Mean bearing different letter within each column differ significantly at 0.05 and 0.01 probability level

According to the results of this study, significant differences were obtained between phosphorus and nitrogen levels interaction (P_2O_5 * N), for plant height and first pod heights, after application, the highest and lowest values of these traits were as follow, plant height 153.4, 85.9 cm and 26.2, 11 cm for first pod height. These values were obtained at P_2N_3 levels. For days to 75% flowering and number of main branches, the maximum values were 104.9and 3.6 were produced at rate P_2O_5 while the lowest values of these traits 81.4 and 2.0 were exhibited at rate P_0N_0. The highest number of nodulations was counted in P_2 * N_1 treatment, the P_2O_5 level slightly increased the nodule number.

Concerning to the number of pod $plant^{-1}$ and number of seeds pod^{-1} the highest values(38.3) and (4.6)were obtained at rate P_2N_2 whilst, the lowest value for these traits were noted at rate P_0N_0 with values 16.2 and 2.5 respectively. Regardingto 100-seed weight and seed yield, the results in the Table 5 exhibited that, the maximum values (189.4) and (294.5) were obtained by rate P_2N_3 while the minimum values were recorded at rate P_0N_0 with values 125.3 and 116.2 respectively. From the results in Table 5, an alleviation effect happened due to application of nitrogen and phosphorus fertilization at the different rates of this study this could be due to the fact that nitrogen and phosphorus were required in significant quantities in shoot tips, where metabolism is high and cell division is quick, indicating the faba bean plant used nitrogen and phosphorus fertilizer sparingly during the growth and development process (Fouda, 2017). We can conclude from this study that nitrogen and phosphorous fertilization has brought a significant effect on yield attributes. The plant height as a yield attribute was increased with increasing nitrogen and phosphorous fertilizer. Finally, application of a proper amount of nitrogen and phosphorous will increase the most growth traits and yield components in faba bean plant. This result with in line of finding by Edris *et al.,* 2016; Gomaa*et al.,* 2016 and Vafa *et al.,* 2015.

Table (5):- interaction between phosphorous and nitrogen levels on faba bean traits

Treatment	Plant height (cm)	First pod height (cm)	Days to 75% flowering	No. of main branches	No. nodulation plant	No. pods plant^{-1}	No. seed pod^{-1}	100-seed weight	Seed yield
P_0N_0	85.9 s	11.0 i	81.4 g	2.0 e	42.9 g	16.2 g	2.5 f	125.3 k	116.2 j
P_0N_1	95.8 i	14.8 h	84.9 f	2.2 de	54.9 f	19.0 f	2.8 e	143.1 i	126.8 i
P_0N_2	99.8 h	16.4 g	89.0 e	3.1 ab	59.7 e	19.5 ef	2.7 ef	157.1 g	135.9 h
P_0N_3	109.8 g	18.2 ef	97.9 c	3.5 a	52.9 f	20.6 e	2.8 ef	168.7 e	188.9 g
P_1N_0	96.8 h	12.0 i	96.0 d	2.5 cde	62.3 de	18.5 f	2.8 e	135.7 j	124.7 i
P_1N_1	121.3 f	17.6 f	101.4 b	2.6 cd	83.2 ab	27.9 d	2.9 de	159.9 f	226.3 f
P_1N_2	122.9 e	17.6 f	101.1 b	2.9 bc	65.9 d	29.7 c	3.7 c	177.8 d	231.4 e
P_1N_3	121.0 f	19.6 d	101.3 b	3.3 ab	75.9 c	30.8 c	3.8 c	180.0 c	236.7 d
P_2N_0	125.8 d	19.0 de	94.9 d	2.5 cde	84.0 ab	16.5 g	3.1 d	145.9 h	188.9 g
P_2N_1	137.8 c	22.1 c	101.8 b	2.5 cde	85.1 a	30.9 c	3.9 c	183.0 b	246.2 c
P_2N_2	148.4 b	23.2 b	103.9 a	3.1 ab	83.6 ab	34.1 b	4.2 b	187.9 a	278.9 b
P_2N_3	153.4 a	26.2 a	104.9 a	3.6 a	79.8 bc	38.3 a	4.6 a	189.4 a	294.5 a

Simple correlation coefficient between traits

The resultsTable 6 revealed the simple correlation coefficient between the studied traits.The resultsindicated that high and positive significantcorrelation were observed among these traits.Seed yield exhibited a strong positive correlation with plant height, first pod height, number of main branches, number of pod plant^{-1}, number of seeds pod^{-1} and 100-seed weight with values R= 0.96, 0.91, 0.56, 0.92, 0.90 and 0.91 respectively and, also 100-seed weight recorded R= 0.85 with plant height, 0.88 with first pod height, 0.70 with main branches, 0.90, with number of pod plant^{-1} and 0.85 with number of seeds pod^{-1}. The obtained results emphasizes the role of these traits in selection of faba bean genotypes when putting in a good breeding program to improve faba bean genotypes.

Table(6):- Simple correlation coefficient between Faba bean traits

Correlation	Plant height (cm)	First pod height (cm)	No. of main branches/plant	No. pods plant^{-1}	No. seed pod^{-1}	Seed yield	100-seed weight	Days to 75% flowering	No. nodulation plant
First pod height (cm)	0.949 **								
No. of main branches/plant	0.486 **	0.615 **							
No. pods plant^{-1}	0.857 **	0.829 **	0.551 **						
No. seed pod^{-1}	0.911 **	0.878 **	0.495 **	0.918 **					
Seed yield	0.961 **	0.917 **	0.564 **	0.929 **	0.906 **				
100-seed weight	0.852 **	0.889 **	0.702 **	0.903 **	0.859 **	0.914**			
Days to 75% flowering	0.856 **	0.775 **	0.604 **	0.823 **	0.773 **	0.895**	0.843 **		
No. nodulation plant	0.84 **	0.741 **	0.219 *	0.642 **	0.687 **	0.773**	0.616 **	0.776 **	

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