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ORIGINAL ARTICLE

RESPONSE OF FABA BEAN CULTIVARS (*VICIA FABA* L.) TO PHOSPHORUS APPLICATION

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Abstract: A field experiment was conducted to investigate the impact of phosphorus fertilizer rates (P_0= 0, P_1= 35, P_2= 70 and P_3=105 Kg/ha) on some growth characteristics, yield component and grain yield of four faba bean cultivars (V_1= Luzde utono, V_2= Iquadolis, V_3= Iquadolge and V_4= local) during the winter season 2019-2020 at a private field in Al- Zubair district, Basrah, Iraq. A split plot design of three replications was used, the levels of phosphorus were allocated in the main plots while cultivars were in sub-plots. The results showed that application of 70kg /ha resulted in higher number of pods / plant (10.624), 100 seed weight (126.933g), seed yield about (847.891kg/h) over the unfertilized control treatments. Cultivar Luzde utono resulted in highest growth characteristics, and seed yield (734.307 kg/ha). All interactions were significant. Cultivars Local and Luzde utono with P_2=70 Kg/ha gave the highest seed yield 877.180 kg/ h and 874.370kg/ha, respectively.

***Key words*:** Faba Bean, *Vicia faba L.*, Phosphorus Application, Split plot design.

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1. Introduction

In Iraq, faba bean (*Vicia faba* L.) is one of the main crops of legumes which is grown in many regions, sometimes referred to as broad bean, horse bean, field bean, or tic bean [Singh *et al.* (2010)]. It is used as human food, also for most animal feeds. Its seeds contain a high percentage of protein, which is estimated to be 25-40% [Natalia *et al*. (2008)] in addition to the carbohydrate content of seeds, of which percentage in most cultivars reached 56% [Carmen *et al*. (2005)]. It also improves soil qualities by fixing it to atmospheric nitrogen in the soil if its roots contain root nodes [Mona *et al*. (2011)]. Generally, the lower yield is due to several factors, that contribute to increasing the productivity of this crop, including the good varieties that have the ability to invest the available resources, including the factors related to the soil, such as the abundance of nutrients in it. Phosphorous is one of the critical and determining nutrient. The optimum level of phosphorous in plant tissues leads to an increase in the activity and growth of the root system and its branching, as well as an increase in the growth of the vegetative parts, and it also helps in increasing the yield, early in the formation and ripening of crops, especially seeds, thus reducing the period of ripening [Havlin *et al.* (1999)]. The lack of available phosphorus in plant is reflected in the yield, as the quantity and quality decrease, the maturity stage is delayed and the chances of plant exposure to diseases increase. Ahmed (2017) found that the application of Phosphorus fertilizer increased seed yields of faba bean. Also, Negasa *et al*. (2019) showed that Phosphorus fertilizers increased growth parameter, yield and yield component. Therefore, the present study was conducted to evaluate the response of bean cultivars to different rates of phosphorous fertilizer in the southern of Iraq.

2. Materials and Methods

A field experiment was conducted during the winter season 2019-2020 at a private field in Al- Zubair district, Basrah, Iraq to study the effect of four P fertilizer

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(control(P_0), 35(P_1), 70(P_2) and 105 (P_4) kg P/ha) as calcium super phosphate (21% P) on growth, yield and yield components for four cultivars of faba bean (Luz de otono (V_1), Icuadolis (V_2), Icuadolge(V_3) and local (V_4)). The soil was sandy loam with a pH value of 7.66 and an organic matter content of 0.11% and available N, P, K of 77.23, 5.37 and 122 mg/Kg, respectively. The experimental design was randomized complete block design (RCBD) using split-plots arrangement with three replications in which P fertilizer treatments were placed in the main plots, while cultivars as sub-plots. Samples soil were analyzed according to the methods outlined by Black (1965) and Page *et al.* (1982). Each experimental plot had an area of 12 m^2 consisting of 5 rows each was 70 cm apart and 3 meter long. Faba bean seeds were planted at 1st of November putting 5 seeds in hills of 20 cm apart. The form of nitrogen fertilization as urea (46% N) applied with a quantity of 60 kg N/ha at three equal doses 15, 30 and 45 days after sowing and the Phosphorus was applied during the oil preparation and before sowing soil before sowing. Twenty days-later after sowing, plants were thinned to one plant/hill. All appropriate management practices were carried out. At harvest, five plants were randomly selected from the center row of each plot to measure as follows: plant height, number of branches/ plant, number of pods/plant, 100-seed weight, seeds yield and protein percentage. GenStat program was used to analyse data statistically using L.S.D. test at the probability level of 0.05.

3. Results

Data in Table 1 showed that all of the applied treatments of phosphorus fertilizer significantly increased vegetative growth characteristics of faba bean plants. It was observed that plants when treated with P_2 (70 Kg P/ha) gave the highest plant height (91.398 cm), branches/plant (8.707) while the control treatment P_0 gave the lowest 86.317cm , 7.763 branch/ plant, respectively. Data in Table 1 clarified that all of phosphor rates significantly increased yield and its components of faba bean plants, where P_2 was the superior for number of pods/Plant (10.624),100 seed weight(126.933g) seed yield (847.891 Kg/ha) and protein content (20.339%) as compared to the control, which gave the lowest were 8.595 pods/plant, 90.265 g and 445.795 Kg/ha and 16.132%, respectively, whereas the highest number of seeds per pod was obtained by P_3 with 8.215, while the lowest number of seeds with 7.186 seed/pod was found from control (7.186 seed/ pod). Several authors have reported significant increase in growth, yield components and yield of faba bean with increase in the rate of application of mineral phosphorus [Mahmoud (2010), Mousa and El-Sayed (2016), El-Sayed *et al.* (2017)]. Moreover, data given in Table 2 indicated that the highest plant height, number of branch/ plant and number of pods/plant were obtained by V_1 compared with the other cultivars with 101.275 cm, 9.165 branch/plant and 11.112 pod/plant, respectively, while V_4 gave the lowest values of plant height (81.090 cm) and number of pods/plant (9.375 pod/plant). The highest number of seeds/pods was found in V_2 (8.267

Table 1: Effect of different rates of phosphorus fertilizer on growth, yield and yield component of bean.

Phosphorus rates kg/ha	Plant height cm	Number of Branches/plant	Number of Pods/plant	Seeds/pod	seed-100 weight(g)	Seed yield Kg/ha	protein%
P_0	86.317	7.763	8.595	7.186	90.265	445.795	16.132
P_1	88.492	8.243	10.461	7.858	120.763	790.339	18.694
P_2	91.398	8.707	10.624	7.893	126.933	847.891	20.339
P_3	88.107	8.113	10.343	8.215	117.057	792.691	18.678
RLSD	0.925	0.363	0.114	0.169	1.472	20.211	0.328

Table 2: Effect of different rates of phosphorus fertilizer on growth, yield and yield component of bean.

Phosphorus rates kg/ha	Plant height cm	Number of Branches/plant	Number of Pods/plant	Seeds/pod	seed-100 weight(g)	Seed yield Kg/ha	protein%
V_1	101.275	9.165	11.112	7.233	113.765	734.307	18.174
V_2	88.258	8.028	9.951	8.267	106.282	713.751	18.605
V_3	83.692	7.786	9.586	7.807	117.866	725.595	18.664
V_4	81.090	7.847	9.375	7.845	117.106	703.063	18.400
RLSD	0.925	0.363	0.114	0.169	1.472	20.211	N.S.

Table 3: Effect of interaction of phosphor levels and cultivars on growth, yield and yield component of bean.

Treatment		Plant high(cm)	Number of branches/plant	Number of Pods/plant	Number of Seeds/pod	seed weight(g)	Seed yieldKg/ha	protein%
P_0	V_1	100.347	8.687	10.183	7.450	88.253	535.868	16.039
	V_2	85.363	7.763	8.443	7.353	86.113	427.735	15.811
	V_3	81.760	7.530	7.520	6.973	93.370	391.594	16.444
	V_4	77.800	7.073	8.233	6.967	93.323	427.983	16.233
P_1	V_1	101.513	9.167	11.343	7.043	116.530	744.748	17.695
	V_2	88.270	7.977	10.693	8.420	111.357	801.511	18.598
	V_3	83.547	7.833	10.107	8.133	129.337	850.388	19.447
	V_4	80.640	7.993	9.700	7.833	125.830	764.708	19.037
P_2	V_1	105.960	10.070	11.623	7.140	131.703	874.370	19.587
	V_2	90.940	8.110	10.453	8.160	114.723	782.800	21.218
	V_3	85.137	8.120	10.567	7.873	128.810	857.214	20.214
	V_4	83.557	8.527	9.853	8.400	132.497	877.180	20.336
P_3	V_1	97.280	8.737	11.297	7.300	118.573	782.241	19.375
	V_2	88.460	8.263	10.213	9.133	112.933	842.958	18.792
	V_3	84.323	7.660	10.150	8.247	119.947	803.183	18.550
	V_4	82.363	7.793	9.713	8.180	116.773	742.381	17.995
RLSD 0.05		1.600	0.486	0.228	0.337	2.943	40.422	0.657

seed/pod), while the lowest was found in V_1 (7.233 seed/pod), whereas V_3 was the superior for 100 seed weight (117.866 g). The highest seed yield was recorded from V_1 variety (734.307 Kg/ha) at par with V3 (725.595 Kg/h), while V_4 gave the lowest value (703.063 t/ha). There were no significant differences among the cultivars in the protein percentage.

Table 3 shows that the effect of the interaction between phosphor rates and cultivars was statistically significant for all traits. The combination of P_2V_1 was superior with plant high (105.96 cm) number of branch/ plant (11.623), while the combination of P_3V_2 was superior with seeds/pod (9.133), also the interaction between P_2V_4 gave highest 100 seed weight (132.497 gm) and seed yield (877.180 Kg/ha) with no difference with P2V1 (131.703 Kg/ha). The highest value of protein (21.218 was obtained from P_2V_2.

4. Discussion

Phosphorus application significantly influenced some growth parameters of faba bean. Application of 70 kg P/ha gave statistically an increase in plant height, number of branches. This increase may be attributed to the role of phosphorus in the growth of roots and the number of their branches, which led to an increase in the efficiency of the plant in absorbing water and nutrients and its reflection on plant growth [Tisdale *et al.* (1997)]. Also there was an increase in number of pods, 100- seed. This increase is attributed to the positive effect of Phosphorous which is one of the basic and necessary nutrients for plant growth. It can be attributed to the availability of nutrients and their contribution to increasing vegetative growth . Thus, improving the efficiency of photosynthesis and splitting of carbohydrates into a pod Yield. Also, its direct role to play in most vital biological processes. Thus, it is a major source of cell division and increasing plant growth, and as energy storage and transfer like ADP and ATP, photosynthesis respiration, protein and nucleic acid synthesis, and ion transport across cell membranes [Fageria (2009)]. Increasing the rate of phosphorus from 0 to 70 kg P/ha significantly increased seed yield. It might be as a result of the role of phosphorus in transporting sugars from the places of its formation to where the plants need it, which helps the transfer of Photosynthesis products to the seeds, and thus an increase in the seeds yield. Similar results were reported by Yohannes *et al*. (2014), Negasa *et al*. (2019). Also results showed that cultivars had significant effect on all parameter except protein percentage. The highest seed yield was obtained from Luzde utono cultivar (734.307 Kg/ha), while Local cultivar gave the lowest value (703.063 t/ ha). Thus, this cultivar is recommended for commercial and extensive faba bean farming in the region as a result of its capacity to give high seed yield . The higher seed yield can be attributed to an excess of some of its components

(Number of pods/plant, number of seed / pod and

100-seed weight). These results agreed with those of Ibrahem (2011), Kakahy *et al.* (2012), Al-Freeh *et al.* (2014), Dhary and AL-Baldawi (2017), Almosawy(2018) and Al-Shumary(2020)

Phosphor at the level of 70 Kg/ ha along with Luz de otono and Local cultivars was found to be the optimum level for yield and its component of faba bean. Weldua *et al.* (2012) confirmed the positive effect of application of phosphor levels on faba bean growth, and the variation of cultivars response to applied P fertilization levels**.**

5. Conclusion

The addition of phosphate fertilizer to the faba bean cultivars showed a significant increase in the production of seeds. Adding 70 kgP/ha was proved the productivity of faba bean indicating the importance of Phosphorus macronutrient in achieving high seed yield from faba bean and be recommended for faba bean production in the study area. Local cultivar was the best in growth, yield components and seeds yield compared to the other cultivars. Therefore, the production and productivity of faba beans could be enhanced by using cultivars with better yields as Luzde utono. However, it could be concluded that under the conditions of the experiment, planting Luz de otono and Local cultivars under 70 Kg P/ ha is recommended.

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