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EFFECT OF FOLIAR FERTILIZERS SPRAY, BORON AND THEIR INTERACTION ON BROAD BEAN (VICIA FABA L.) YIELD

Ali Husain JASIM, Amir Sadiq OBAID

College of Agriculture, University of Babylon, Hillah, Babylon Province, Iraq

Corresponding author email: alihjassim@yahoo.com

Abstract

A factorial experiment was conducted to study the effect of six spray treatments of foliar fertilizer (neutral, high-phosphorus, high potassium, urea, extracts of seaweeds, in addition to control) with two levels of boron (spray and without spray) and its interaction on dry seeds yield of broad bean and some of its characteristics. The experiment was carried out in the farm Guidelines during the agricultural season 2012/2013 as factorial experiment according to complete randomized block design with three replications. The most important results of the experiment summarized as follows: all fertilizers treatments led to increase pod dry weight, number of seeds / pod, 100 seed weight, seeds yield/ plant, seeds yield per unit area and protein in the seeds significantly compared to control treatment. Boron treatment led to increase all the traits significantly except (100 seeds weight) compared to control. The interaction between the factors had a significant effect on pod dry weight, number of seeds / pod, weight of 100 seeds, seed yield/plant and unit area and protein in seeds. The interaction of urea with boron was superior on all other interactions with a percentage increases of (51.84 %, 56.9 %, 30.8 %, 10.88 %, 10.89 %, 64.1 %), respectively, compared to control.

Key words: *foliar fertilizers, boron, broad bean, seaweed*

INTRODUCTION

Faba bean (*Vicia faba* L.) is one the main leguminous crops grown in winter season in different of Iraq soils. Also, it is considered as one of the basic sources of protein for human consumption. It is nutritionally important vegetable, containing 20-36% protein for human and animal consumption. In addition, broad bean plants improve soil fertility by providing a substantial input of N fixation. So it enters in crop rotation to improve soil conditions (Carmen et al., 2005). Although introduced the cultivation and production of broad bean in Iraq, but its cultivation is still experiencing a lot of problems. The nutritional status of the plant and the lack of availability of some nutrients in the soil, especially during the period of flowering and the contract of the reasons that reduced crop yield by losing flowers and failed in pollination. South Iraq soil (pH 7.5-8.2) leads to a lack of elements availability and its absorption, which reflects negatively on the quantity and quality of the yield. Recently, using macro and micro nutrients through foliar fertilization is preferable to avoid not only nutrients fixation in the soil, but also leaching during irrigation. Foliar fertilizers can compensate for the constraining effects on nutrient availability and uptake (El-Habbasha et al., 2012). Many workers reported that spraying the plants with foliar fertilizers significantly improved the growth, yield and pods quality of legumes crops (El Fouly et al. 2010, Bozorgi et al. 2011 and El-Habbasha et al 2012).

Ayten (2011) found that foliar fertilization is an excellent way and help in giving the best yield of maize whether to add major or minor nutrients. Kocon (2010) found that broad bean yield increased by 14-15% when spraying with urea, compared to 2.4% at ground fertilization. Sharaf and others, (2009) found that foliar fertilization with boron led to increase the number of pods and plant seeds. Based on the foregoing, the study was conducted to know the effect of some foliar fertilizer alone or interaction with boron on dry seed yield of broad bean.

MATERIAL AND METHODS

A factorial field experiment was conducted at winter season 2012-2013 in the farm of

experiments extension (Al-mhannawia, 8 km northwest of Hilla, Babylon) in sandy-clay loam soil (Table 1) shows some of its characteristics) to study the effect of some foliar fertilizers and its interactions with boron on broad beans (*Vicia faba* L.) plants. The experiment was conducted according to the randomized complete block design (RCBD) with three replications, each replicates contained 12 experimental unit (each of it contained four ridges (3 m length and 75 cm width). The experiment included six foliar fertilizers (neutral fertilizer 2g/l, high phosphorus 2g/l, high potassium 2g/l, urea 1g/l, seaweed extract 1 ml/l, in addition to the control treatment) with or without boron sprayed at 25 mg/l.

Broad bean seeds of spanish *var*. were soaked in water for 24 hours and planted after calibration on one side of the ridges at 20 cm apart on 11 October 2012. After a month of germination, foliar fertilizers was done and after one month later the second spray was done. In the interactions, boron spray was done after one week later. The other service process to plant and soil was done as the same as it was recommended. After giving the pods and arrival to mature, dry pods of plants in two internal ridges were harvested, and from it, number of pods per plant, dry seeds per plant and unit area, the proportion of protein in the dry seeds, were calculated. Statistical analysis was performed according to the program Gen. Stat (Edition 3), the averages were compared according to Least (LS D $_{0.05}$).

Table 1. Some physical and chemical characters of field soil on (0-0.40 m) depth*

Property	unit	value
Soil texture	Sandy clay loam	----
Bulk Density	ugm.m^{3}	1.24
Organic matter	gm.kgm^{-1}	4.60
Available nitrogen	mg.kgm^{-1}	73.20
Available phosphorus	mg.kgm^{-1}	12.80
Available potassium	mg.kgm^{-1}	276
Available boron	mg.kgm^{-1}	1.04
Ec	dc.m^{-1}	3.00
pH	----	7.14

* Central Laboratory of Soil dept. Agric. Coll. Baghdad Univ.

RESULTS AND DISCUSSIONS

Table 2 shows the superiority of all fertilizers treatment significantly in increasing dry pod weight compared to control except for the treatment of (high phosphorus), also urea treatment was superior upon most of other treatments which reached 9.18 g with a percentage increase of 18.9% compared to control. The reason is attributed to the nitrogen that plants need at all stages of their life cycle is vital to the growth of plants and increase production (Chatzopoulou, 2006).

The increase derived from the increase in the number and size of endosperm cells in the seed in the first days after fertilization and thus get the efficiently accommodate a larger amount of food and the weight rises accordingly. This is consistent with the results of Odeleye et al., (2007) who found that foliar nitrogen fertilizer on bean plant led to an increase in the weight of pod. Also may be due to the important role of phosphorus in seed production (Ramadan and Adam, 2007), and the role of potassium in enhanced the photosynthetic activity and in translocation of photosynthesis and its ability to develop bold seeds (Ali et al, 2007).

Boron spray treatment achieved a significant increase in pod dry weight which reaching 8.89 g with a percentage increase of 7.75% compared to control. This is due to the role of boron to encourage vegetative growth and increase the rate of photosynthesis and gathering plant dry matter (Zahoor et al., 2011). The interaction had a significant effect and superior significantly compared to control. The interaction between urea and boron was superior on all other transactions (except high potash and neutral fertilizers with boron) with a

percent increase of (51.84%) compared to control.

Table 2. Effect of some foliar fertilizers and its interactions with boron on pod dry weight(g)

Fertilizers Boron	Control	Neutral	High P	High K	Urea	Seaweed extract	Mean of B
B0	6.50	8.73	8.23	8.57	8.50	8.65	8.25
B1	8.93	8.90	8.53	8.77	9.87	8.33	8.89
Fert. mean	7.72	8.82	8.38	8.67	9.18	8.65	
L.S.D. $_{0.05}$	Boron=0.48 Fertilizers=0.83 interaction=1.17						

Table 3 illustrates the superiority of all treatments significantly in increasing the number of seeds per pod compared the control(4.7), also the treatment of urea was superior upon most other fertilizers, which gave 5.8 seeds per pod with a percentage increase of (25.03%) compared to control. The reason is attributed to the nitrogen that led to an increase in plant height, number of branches and leaf area exposed to light and increase the efficiency of photosynthesis, which pushed for increased material representation and thus provided an opportunity to reduce the flower abortion as a result of reducing the state competition, including the food product during the growth and development of these flower, and nitrogen was needed by plants in all stages of their lives because of its vital to the growth of plants and increase production (Chatzopoulou, 2006). This was consistent with the results of Ayed (2012) on the beans. And it is attributed to potassium which enhanced the photosynthates activity which resulted in more number of seeds per pod (Ali et al, 2007).

Boron treatment achieved a significant increase in the number of seeds reaching 5.65 with a percentage increase of 10% compared to control. This is due to the positive role of boron in the transport of carbohydrate materials from the source to the sink, which gave a greater chance to reduce competition, (Barker and Pilbeam, 2006). This was consistent with Sharaf et al (2009) on broad beans when sprayed boron. The interaction between treatments had a significant effect, and all interactions were superior significantly compared to control. The interaction between urea and boron was superior on all others with a percentage increase of 56.9% compared to control. This was consistent with Shaaban et al (2006) that interaction of boron (25-50 mg/l) with nitrogen led to an increase in the number of seeds.

Table 3. Effect of some foliar fertilizers and boron on seeds no. per pod

Fertilizers Boron	Control	Neutral	High P	High K	Urea	Seaweed extract	Mean of B
B0	4.250	5.417	5.500	5.667	5.000	5.000	5.139
B1	5.083	5.333	5.750	5.833	6.667	5.250	5.653
Fert. mean	4.667	5.375	5.625	5.750	5.835	5.125	
L.S.D. $_{0.05}$	Boron= 0.196 Fertilizers= 0.341 interaction=0.482						

Table 4 showed the superiority of all treatments, and caused a significant increase in weight of 100 seeds compared to the control (121.3 gm) except seaweed extract and neutral fertilizer, urea treatment was superior upon most other transactions and reached 151.0 gm , with a percentage increase of (24.5%) compared to control. The reason is attributed to the role of nitrogen in vegetative growth and delay aging, or that the increase derived from the increase in the number and size of endosperm cells in the seed in the first days after fertilization and thus get a sink efficiently accommodate a larger amount of food and the weight rises accordingly. This is consistent with the results of Ayed (2012) on broad bean. It is attributed to P as a constituent of nucleic acids, phospholipids, coenzymes and the high emerge phosphate compounds, these aspects encourage dry matter accumulation and dry weight of seeds (El-Habbasha et al 2007). Also attributed to potassium in motivate and activate

plant enzymes, which led to an increase in the rate of 100 seed weight, or due to role of potash in translocation of photosynthates and its ability to develop bold seeds and this is consistent with Ali et al (2007).

Boron treatment had no significant effect in the 100-seed weight, it was consistent with Nel, (2001). The interaction had a significant effect compared to control (except the interaction of high-potash, neutral and seaweed extract with boron). The interaction between urea and boron was superior on all others (except high-phosphorus with boron) which gave a percentage increase of (30.8%) compared to control.

Table 4. Effect of some foliar fertilizers and boron in 100-seed weight (g)

Fertilizers Boron	**Control**	**Neutral**	**High P**	**High K**	**Urea**	**Seaweed extract**	**Mean of B**
B0	119.3	133.7	137.7	135.5	146.0	127.3	133.2
B1	123.3	135.3	139.3	136.7	156.0	130.7	136.9
Fert. mean	121.3	134.5	138.5	136.0	151.0	129.0	
L.S.D.$_{0.05}$	**Boron=** N.S.		**Fertilizers=** 13.49		**interaction=** 19.08		

Tables (5-6) showed that all treatments caused a significant increase in dry seed yield compared to control (except seaweed extract) in dry seed yield of plant and unit area. The treatment of urea was superior upon most of other treatments with a percentage increase of (37.85%, 37.80%), respectively, compared to control. It may be due to the role of nitrogen in improving vegetative growth and increase the number of branches and encourage the emergence of floral buds represented by increasing the number of inflorescences floral, or to influence the improvement of physiological plants operations such as photosynthesis and thus led to full of seeds fully and increase the yield (Kocon, 2010), and the transition from the vegetative stage to the reproductive stage requires the transfer of materials manufacturer in leafs to seeds formed and this process needs phosphorus (Ping and Li, 2005). These results are consistent with Ehsanipour et al, (2012). And also may be due the impact of phosphate fertilizer for its role in the improvement of plant growth and yield in broad bean (Abdalla, 2002), and in beans (Kandil et al, 2013), as well as spraying potassium on the vegetative works to increase vegetative growth and thereby increase yield. The table showed that boron treatment gave a significant increase in dry seeds of plant and unit area with a percentage increase of (10.88%, 10.89%), respectively, compared to control. The reason to outweigh the spray treatment boron in plant holds the dry seeds to its superiority in the average number of pods which constitutes a major component of winning (Sharaf et al, 2009). The reason of boron superior in yield due to its superiority in the average number of pods and seed per pod, which is a key component of yield (Sharaf et al, 2009). And also may be due to the positive role of boron in transport carbohydrate material from the source to the sink. These results are consistent with Zahoor et al, (2011). The interaction had a significant effect and all interactions were superior upon control (except seaweed extract with boron).

Table 5. Effect of some foliar fertilizers spray and boron in plant dry seeds yield (g)

Fertilizers Boron	Control	Neutral	High P	High K	Urea	Seaweed extract	Mean of B
B0	33.97	46.67	46.30	46.67	50.20	45.83	44.94
B1	43.33	51.63	52.70	49.50	56.33	45.50	49.83
Fert. mean	38.65	49.15	49.50	48.09	53.28	45.67	
L.S.D.$_{0.05}$			Boron= 4.78		Fertilizers= 8.28		interaction= 11.71

Table 6. Effect of some foliar fertilizers spray and boron in dry seeds yield (t/h)

Fertilizers Boron	Control	Neutral	High P	High K	Urea	Seaweed extract	Mean of B
B0	2.263	3.108	3.082	3.108	3.343	3.052	2.993
B1	2.886	3.438	3.509	3.296	3.751	3.030	3.319
Fert. mean	2.574	3.273	3.296	3.202	3.547	3.041	
$L.S.D._{0.05}$	**Boron**= 0.318		**Fertilizers**=0.551		**interaction**= 0.779		

Table 7 shows the superiority of all treatments significantly in increasing the proportion of protein in seeds compared to control. Urea treatment was superior upon all other treatments, which reached (26.88) with a percentage increase of (49%) compared to control. The reason is attributed to the role of nitrogen in the formation of nucleic acids needed to build proteins in plant and foliar fertilizer helped in processing plant directly with nitrogen to form amino acids, and this is consistent with Daur et al, (2008). It may also be due to the role of phosphorus in the composition of nucleic acids (RNA)which is important in the composition process of proteins (Gad, 2012), it consistent with Shafeek et al (2004). It also contributes to potassium in the process of photosynthesis and sugars transmission from the source to the sink and plays an important role in the formation of the protein, which was confirmed by the Radulov et al, (2010).

Boron treatment gave a significant increase in the proportion of protein (23.47) with a percentage increase of (7.37%) compared to control. This may be attributed to the role of boron in the process of protein synthesis through its importance in nitrogen fixation vital air as well as through its influence in the process of formation of RNA (Mahler, 2004) and this is consistent with Ziolek and Ziolek (1988). The interaction had a significant effect and all interactions were superior upon control. Urea and boron was superior compared with other interactions with a percentage increase of (64.1%) compared to control. These results are consistent with Gabal et al, (2005) when spraying nutrients (K and B) on leaves led to a significant increase in the percentage of protein compared to untreated plants.

Table 7. Effect of some foliar fertilizers spray and boron on seed protein percentage

Fertilizers Boron	Control	Neutral	High P	High K	Urea	Seaweed extract	Mean of B
B0	16.74	24.15	21.93	21.41	26.29	20.66	21.86
B1	19.34	25.40	23.38	23.36	27.47	21.88	23.47
Fert. mean	18.04	24.775	22.655	22.385	26.88	21.27	
$L.S.D._{0.05}$	**Boron**= 0.832		**Fertilizers**=1.441		**interaction**=2.038		

CONCLUSIONS

Foliar fertilizers of macro nutrients and urea alone or with boron caused an enhance in plant growth and increase seed yield of broad bean.

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