Int. J. Agricult. Stat. Sci. Vol. 18, Supplement 1, pp. 2325-2332, 2022 www.connectjournals.com/ijass
DocID: https://connectjournals.com/03899.2022.18.2325 ISSN: 0973-1903, e-ISSN: 0976-3392
ORIGINAL ARTICLE

STUDY OF THE EFFECT OF ZINC SPRAY ON SOME OF THE YIELD TRAITS OF TWO CULTIVARS OF BROAD BEAN CROPS *VICIA FABA* L.

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Abstract: A field experiment was coundected in the field of the Department of Field Crops, College of Agriculture, University of Baghdad during the winter season 2017-2018 to study the effect of spraying with zinc on some yield traits of two cultivars of broad bean (Spanish Loz de otono and Dutch Dolce star). Arrange the split-split Plot Design according to the R C B D with three replicates. The traits (Spanish Loz de otono and Dutch Dolce star) occupied the main plot and were denoted by the symbols (C1, C2), while the number of spraying (the first before flowering, the second at 25% flowering and the third after flowering 50%) occupied the sub plot and symbolized by the following symbols (M1, M2, M3), while the concentrations of zinc element spray occupied the sub-plot (20,10,0) mg. L^{-1} and symbolized by the symbols (Z0, Z1, A field experiment was coundected in the field of the Department of Field Crops - College of Agriculture - University of Baghdad during the winter season 2017-2018. To study the effect of spraying with zinc on some yield traits of two cultivars of broad bean (Spanish Loz de otono and Dutch Dolce star). Arrange the split-split Plot Design according to the R C B D with three replicates.The traits(Spanish Loz de otono and Dutch Dolce star) occupied the main plot and were denoted by the symbol (C1, C2), While the number of spraying (the first before flowering, the second at 25% flowering and the third after flowering 50%) occupied the sub plot and symbolized by the following symbols (M1, M2, M3),While the concentrations of zinc element spray occupied the sub-plot (20,10,0) mg. L^{-1} and symbolized by the symbols (Z0, Z1, Z2). The results showed a significant effect of the Spanish cultivar (C1) by giving it the highest mean in the number of seeds. Pod^{-1}, weight of 100 gm seeds, and the seed yield of the plant was (5.02 seeds. $Plant^{-1}$, 69.60 g and 53.22 g. $plant^{-1}$) while the Dutch cultivar (C2) gave the highest average in the number of pods per plant and the percentage of nitrogen in the leaves as it reached (22.23 pods. $Plant^{-1}$ and 2.09 N%). The spraying dates showed a significantly excelled, where the second date (M2) was superior to the number of pods per plant, the number of seeds. $plant^{-1}$, weight of 100 seeds, and the plant's seed yield amounted to (24.35 pods. $plant^{-1}$, 5.28 seeds.pod^{-1} and 63.98 g). The results showed a significant effect of spraying concentrations, where the highest concentration (Z2) in the following traits was the number of pods per plant, the number of seeds. Pod^{-1}. The weight of 100 seeds and the plant's seed yield amounted to (24.34 pods. $Plant^{-1}$, 5.09 seeds. Pod^{-1}, 70.98 g and 52.67 g. $Plant^{-1}$).

Keywords: Beans, Minor elements, Varieties, Foliar spray.

Cite this article

Ali Kareem Hussein Mohammed Malik Hamid and Abdulsattar Hashim Abdulghani (2022). Study of the Effect of Zinc Spray on Some of the Yield Traits of Two Cultivars of Broad Bean Crops *Vicia faba* L. *International Journal of Agricultural and Statistical Sciences.* DocID: https://connectjournals.com/03899.2022.18.2325

1. Introduction

Faba Vicia L. is a major legume crop in many countries of the world and Iraq. Its importance is that its seeds contain a high percentage of protein, estimated at 40-25% [Al-Issawi and Kharbit (2011)]. Iraqi soils tend to have a basicity in which the readiness of small elements, including zinc, decreases due to the presence of calcium carbonate that reduces its solubility. Therefore, producers resort to reducing negative impacts by adding them to the soil or spraying them on the green parts in order to improve growth. The plant increases the quantity and quality. Zinc has many physiological and biochemical processes within the plant, as it is involved in the metabolic reactions of carbohydrates, proteins, chlorophyll formation, energy production, and building amino, fatty and nucleic acids.

***Author for correspondence** **Received** October 08, 2021 **Revised** May 15, 2022 **Accepted** July 03, 2022

A decrease in the production of carbohydrates and proteins has also been observed when zinc deficiency is found in plant tissue [Mousavi (2011)]. Increasing pollination and decreasing flowering will definitely increase the yield of plants from seeds. Singh *et al.* (2012) showed that spraying pea plants with zinc increases the number of flowers and the number of pods per plant**.** Salon *et al.* (2001) showed that the period of seed filling in legumes is the critical period for nutrients as seeds become the major reservoir of nutrients and that the available stock from them in the vegetative parts or obtained from fixation of nitrogen may be insufficient during this period of what is required Accelerating nitrogen preparation for plants, on the other hand, a lack of microelements, especially iron, zinc and manganese, is likely due to a low concentration or readiness to absorb in the soil or improper agricultural processes and because leaf fertilization ensures rapid processing of these elements with a rationing in use, it has been widely used for this purpose. The study aims to know the foliar spray of the zinc component in some of the yield characteristics of two varieties of beans, and to determine the best concentration in which the best quotient is achieved, and whether the two varieties under study differ in the characteristics of the yield.

2. Materials and Methods

A field experiment was carried out in the field of Field Crops Department, College of Agriculture, University of Baghdad during the winter season 2020-2021 to study the effect of zinc spraying on some of the attributes of two cultivar varieties (Spanish Loz de otono and Dolce star Dutch). The experiment was conducted according to Randomized complete block design (RCBD) with three replicates,the first factor included three cultivars (Spanish, Loz de otono and Dutch Dolce star) symbolized by (C1, C2), while the second factor included number of sprays (the first before flowering, the second at flowering 25% and the third after flowering 50%). It is symbolized by (M1, M2, M3), while the third factor included concentrations of spraying zinc as (0,10,20) $mg.L^{-1}$ and symbolised by (Z0, Z1, Z2).

The experiment plot was prepared from plowing, smoothing and leveling before planting. The experiment plot was divided into three replicates. The experimental unit area was 3.2 m^2 and the cultivation was on a furrow long of 2.5 m. The distance between the spruce was 30 cm and 25 cm between one plant and another, leaving a distance of 1 m between each unit. The field soil was analyzed before planting by taking samples at a depth of (0-30 cm) (Table 1). Three seeds were planted in each grove. Then, the process of dilution was carried out five days after the seedlings dawned to one plant in each grove the seeds were planted on 10/17/2017. Phosphorous was added in the form of triple superphosphate (46% P_2O_5%) at 35 kg. ha^{-1} p one batch after tillage before smoothing. A 20 L dorsal sprinkler and 0.15 $ml.L^{-1}$ spreader (liquid detergent) was used to reduce the surface tension of the spray solution, as spraying was done on the basis of completely moistening the vegetative parts of the plant. The experiment ground was manually groomed and watered as needed.

2.1 Studied traits

Number of pods plant: The number of pods per plant for were calculated for ten plants from the mid line of each experimental unit after final maturity and taking the mean.

Number of seeds pod: The seeds were calculated in pods per experimental unit and the average was taken per $pod.Plant^{-1}$.

Weight 100 seeds (g): Took 100 seeds from the mid line of each experimental unit after plant harvest, the seeds were dried and weighed by the delicate scale.

Yield plant from seeds.$Plant^{-1}$: Ten plants were taken from the middle lines of each experimental unit after the signs of complete ripening of plants, such as yellowing of the leaves, stem coloration, and black-colored pods, after which the seeds were shifted and cleaned, then the seeds were dried appropriately, then collected, weighed and the medium extracted [Al-Hassani (2018)].

Table 1: Some physical and chemical properties of soil experiment.

Character	Value	Measuring Unit
sand	410	$g.km^{-1}$
Clay	340	$g.km^{-1}$
Silt	250	$g.km^{-1}$
Soil texture		Silty clay
Degree of electrical conductivity EC	4.06	Deci Siemens m^2
Phosphorus	7.9	$g.km^{-1}$
Nitrogen	2.95	$g.km^{-1}$
Potassium	40	$g.km^{-1}$
Organic matter	9.8	$g.km^{-1}$

Ratio of nitrogen in the leaf: A random sample of botanical leaves taken from the intermediate lines for each experimental unit is used to measure the characteristic of the foliar area, as the leaves were grinded to all the plants that were taken and the percentage of nitrogen, phosphorus and potassium was estimated in the graduate laboratory at the University of Baghdad using the Caldal device to estimate nitrogen [Al-Hassani (2018)].

3. Results and Discussion

3.1 Number pods plant (pod.Plant^{-1})

Table 2 data indicated that there was a significant effect of the items, spray dates and bilateral interventions, whereas the triple interaction did not have a significant effect in this trait. The results indicated the superiority of variety C2 by giving it the highest average of 22.23 pod.Plant^{-1}. While variety C1 gave the lowest average of 21.68 pod.Plant^{-1}. The reason for this may be attributed to the difference in the genotype composition of each variety and the extent of its response to the element zinc, and this is consistent with the findings of Issa *et al.* (2019), according to the different response of the varieties to the zinc spray. Manure spraying dates showed significant superiority, as giving the M2 appointment the highest average of 24.35 pod.Plant^{-1} while M1 was given the lowest average of 18.74 pod.Plant^{-1}. The fertilizer application concentrations showed a significant superiority, as they exceeded the Z2 concentration, and gave the highest average of 18.74 pod.Plant^{-1}, while the control treatment gave Z0 the lowest average of 18.99 pod.Plant^{-1}, the reason for the increase in the number of pods in a plant is the increase in the concentration of the elements used. This fertility was attributed to the largest number of flowers formed on the plant, which was reflected in the formation of a greater number of pods on the plant, and this was confirmed by the results of the research of Ibrahim (2011) who found a significant increase in the number of pods when using the elements zinc and boron on the bean plant. The results of the bilateral interaction between C, M showed a significant difference, as the combination C2, M2 gave the highest average of 24.53 pod.Plant^{-1}, while the combination gave V1 and M1 the lowest average of 16.39 pod.Plant^{-1}. The results of the same table showed a significant effect as the combination C2 and Z2 excelled by giving it the highest average of 24.95

Table 2: Effect of concentrations and dates of foliar fertilization and cultivars on the characteristic number of pods plant (pod. Plant^{-1}).

Varieties / Number of spray times		Zinc Concentrations (mg L^{-1})			Average
		Z0	Z10	Z20	M × C
C1	M1	15.51	16.44	17.22	16.39
	M2	20.41	25.82	26.30	24.18
	M3	19.79	25.94	27.67	24.47
C2	M1	19.81	21.42	22.03	21.09
	M2	21.11	25.43	27.04	24.53
	M3	17.33	20.16	25.77	21.09
L. S. D $_{(0.05)}$		N.S			0.88
Zinc Concentrations / Varieties		**Z0**	**Z10**	**Z20**	**average C**
C1		18.57	22.73	23.73	21.68
C2		19.42	22.34	24.95	22.23
L. S. D $_{(0.05)}$			0.90		0.40
Zinc Concentrations / number of Spry times		**Z0**	**Z10**	**Z20**	**average M**
M1		17.66	18.93	19.63	18.74
M2		20.76	25.63	26.67	24.35
M3		18.56	23.05	26.72	22.78
L. S. D $_{(0.05)}$			1.10		0.62
Average Z		18.99	22.53	24.34	
L. S. D $_{(0.05)}$			0.63		

pod.Plant^{-1} while the combination C1 and Z0 gave the lowest average of 18.57 pods.Plant^{-1}. The bilateral interaction between M and Z also had a significant effect on this trait, as the combination M3 and Z2 outperformed the rest of the combinations by giving it a higher average of 26.72 pod.Plant^{-1}, while the composition gave M1, Z0 the lowest average of 17.66 pods. Whereas, the triple interaction did not have any significant effect on this trait.

3.2 Number of seeds in the pod (seed.Pod^{-1})

The results of Table 3 showed a significant effect of the varieties, as variety C1 gave the highest mean of 5.02 seed.pod^{-1}. It was ahead of variety C2, which gave the lowest average of 4.72 seed.Pod^{-1}. This may be attributed to the genetic difference between the varieties, and this result was consistent with what was reported by AL-Shamma (2014) and Negash *et al.* (2015), who found a difference between the varieties in the number of seeds in the pod of the bean crop. The spraying dates had a significant effect, as the M2 date give the highest average of 5.28 seed.Pod^{-1} while the date M1 gave the lowest average of 4.54 seed.Pod^{-1} Perhaps the reason for this is due to the effect of zinc to reduce the rate of miscarriage of the ovaries and thus increase the number of seeds formed. This result is consistent with the results of Mehta *et al.* (2013) who indicated that the reason for increasing the number of seeds per pod as a result of spraying bean plants with zinc may be due to reducing the rate of miscarriage of seeds and increasing metabolism of both carbohydrates, proteins and some growth regulators, and thus increasing the number of seeds the results of the binary interaction between C and M showed a significant effect as the combination C1 and M2 outperformed by giving it the highest mean of 5.69 seeds.Pod^{-1}, while the combination C1 and M1 gave the lowest mean of 4.26 seeds.Pod^{-1}. The bilateral interaction between C and Z also showed a significant effect, as the combination C1 and Z1 gave the highest average of 5.33 seed.Pod^{-1}, while the combination C2 and Z1 gave the lowest mean of 4.46 seed. The same table data also indicated that there was no significant effect of bi-interaction between M and Z, as well as triple interaction between C, M and Z for this characteristics.

3.3 Weight of 100 seeds (g)

Table 3: The effect of concentrations and dates of foliar fertilization and varieties on the number of seeds in the pod (seed. pod $^{-1}$).

Varieties / number of spray times		Zinc Concentrations (mg L^{-1}) Z0	Z10	Z20	Average M × C
C1	M1	4.12	4.34	4.30	4.26
	M2	5.16	6.45	5.48	5.69
	M3	4.87	5.21	5.26	5.11
C2	M1	4.54	4.71	5.20	4.82
	M2	4.70	4.71	5.21	4.87
	M3	4.36	3.95	5.12	4.48
L. S. D $_{(0.05)}$			N.S		0.45
Zinc Concentrations / Varieties		**Z0**	**Z10**	**Z20**	**average C**
C1		4.72	5.33	5.01	5.02
C2		4.53	4.46	5.18	4.72
L. S. D $_{(0.05)}$			0.56		0.16
Zinc Concentrations / number of spray times		**Z0**	**Z10**	**Z20**	**average M**
M1		4.33	4.53	4.75	4.54
M2		4.93	5.58	5.34	5.28
M3		4.62	4.58	5.19	4.80
L. S. D $_{(0.05)}$			N.S		0.32
Average Z		4.63	4.90	5.09	
L. S. D $_{(0.05)}$			N.S		

Table 4: Effect of concentrations and dates of foliar fertilization and varieties on the characteristics of the weight of 100 seeds (g).

Varieties / Number of spray times		Zinc Concentrations (mg L^{-1})			Average
		Z0	**Z10**	**Z20**	**M × C**
C1	M1	62.25	68.03	74.40	68.23
	M2	57.73	66.36	83.53	69.21
	M3	64.11	75.12	74.87	71.37
C2	M1	52.43	57.13	66.45	58.67
	M2	53.50	57.22	65.53	58.75
	M3	49.52	58.59	61.07	56.39
L. S. $D_{(0.05)}$			5.32		N.S
Zinc Concentrations / Varieties		**Z0**	**Z10**	**Z20**	**average C**
C1		61.36	69.84	77.60	69.60
C2		51.82	57.65	64.35	57.94
L. S. $D_{(0.05)}$			N.S		4.17
Zinc Concentrations / Number of spray times		**Z0**	**Z10**	**Z20**	**average M**
M1		57.34	62.58	70.43	63.45
M2		55.62	61.79	74.53	63.98
M3		56.81	66.86	67.97	63.88
L. S. $D_{(0.05)}$			3.76		N.S
Average Z		56.59	63.74	70.98	
L. S. $D_{(0.05)}$			2.17		

Evidence from Table 4 indicates that there was a significant effect of the varieties, as the C1 variety exceeded and gave the highest average of 69.60 g, while the C2 variety gave the lowest average of 57.94 g. The reason may be due to the superiority of the variety in the seed weight to the nature of the genetic variety and to which the physiological processes are associated. And the vitality affecting the ability to exploit the products of carbon representation and increase the accumulation of these components in the seeds, which led to an increase in the weight of the seeds, in addition to the fact that the variety adapts to the Iraqi environmental conditions, likewise, the bean varieties differ in the weight of the seed, and these results are consistent with the results of Ibrahim (2011), Al-Musawi (2013) who found a difference in the bean varieties in the weight of the seeds. The spray concentrations showed a significant effect, as the concentration gave Z2 the highest average of 70.98 g, while the control treatment gave Z0 the lowest average of 56.59 g, the reason is that the trait of the weight of 100 seeds was affected by zinc-spraying treatments is due to the lack of competition between seeds for food produced inside the plant and thus the opportunity for miscarriage of seeds, which increased the number of pollinated flowers, as well as the lack of competition between pods for nutrients in their emergence and fullness within one pod, and this was confirmed by many researchers [Al-Isawi and Khrbeet (2011)] who indicated the increase in the weight of seeds in the pod with an increase in the zinc concentration, the results of the same table for the bilateral interaction between M and Z showed a significant effect, as the combination M2 and Z2 gave the highest mean of 74.53 g while the combination M2 with the control treatment Z0 gave the lowest average of 55.62 g. The results of the triple interaction in this trait showed a significant effect, as the combination C1, M2 and Z2 outperformed the rest of the combinations by giving it the highest average of 83.53 g while the combination C2, M3 and Z0 gave the lowest average of 49.52 g. There were no significant differences for spray time (M) as well as for bilateral interaction between C, M and C, Z in this trait.

3.4 Plant yield from seeds (plant.gm^{-1})

The data of Table 5 indicates a significant effect of the varieties, as it exceeded the variety C1 by giving it the highest average of 53.22 g. $Plant^{-1}$, while variety

Table 5: Effect of concentrations and dates of foliar fertilization and varieties on the yield of plants from seeds (g.plant^{-1}).

Varieties / Number of spray times		Zinc Concentrations (mg L^{-1})			Average
		Z0	**Z10**	**Z20**	**M × C**
C1	M1	42.55	46.86	55.84	48.42
	M2	49.40	57.87	53.12	53.46
	M3	53.07	58.16	62.15	57.80
C2	M1	43.73	52.21	56.22	50.72
	M2	41.50	44.34	48.48	44.77
	M3	40.49	40.07	40.20	40.25
L. S. D $_{(0.05)}$			5.68		1.96
Zinc Concentrations / Varieties		**Z0**	**Z10**	**Z20**	**average C**
C1		48.34	54.30	57.04	53.22
C2		41.91	45.54	48.30	45.25
L. S. D $_{(0.05)}$			N.S		2.00
Zinc Concentrations / Number of spray times		**Z0**	**Z10**	**Z20**	**average M**
M1		43.14	49.54	56.03	49.57
M2		45.45	51.10	50.80	49.12
M3		46.78	49.12	51.18	49.02
L. S. D $_{(0.05)}$			4.02		N.S
Average Z		45.12	49.92	52.67	
L. S. D $_{(0.05)}$			2.32		

Table 6: Effect of concentrations and dates of foliar fertilization and varieties on the characteristic nitrogen content in leaves.

Varieties / Number of spray times		Zinc Concentrations (mg L^{-1})			Average
		Z0	**Z10**	**Z20**	**M × C**
C1	M1	2.03	2.08	2.10	2.07
	M2	2.05	2.07	2.11	2.08
	M3	2.05	2.08	2.11	2.08
C2	M1	2.06	2.09	2.12	2.09
	M2	2.06	2.08	2.12	2.09
	M3	2.09	2.11	2.13	2.11
L. S. D $_{(0.05)}$			N.S		N.S
Zinc Concentrations / Varieties		**Z0**	**Z10**	**Z20**	**average C**
C1		2.05	2.07	2.10	2.07
C2		2.07	2.09	2.12	2.09
L. S. D $_{(0.05)}$			N.S		0.01
Zinc Concentrations / Number of spray times		**Z0**	**Z10**	**Z20**	**average M**
M1		2.05	2.09	2.11	2.08
M2		2.06	2.08	2.11	2.08
M3		2.07	2.09	2.12	2.09
L. S. D $_{(0.05)}$			0.008		0.008
Average Z		2.06	2.08	2.11	
L. S. D $_{(0.05)}$			0.004		

C2 gave the lowest mean, it reached 45.25 g.Plant^{-1}. The reason may be attributed to the difference between the varieties among them in the nature of their genotype. These results were consistent with the findings of Ayed (2012). Concentrated fertilizer concentrations showed a significant effect of spraying, as the concentration of Z2 exceeded by giving it the highest average of 52.67 g.Plant^{-1} while control treatment gave Z0 the lowest average of 45.12 g.Plant^{-1}. Perhaps the reason is due to its superiority in the number of pods per plant and the weight of 100 seeds. It also contributed directly and indirectly to increasing the yield of plant seeds. This result was in line with the results of other studies that showed the positive effect of potassium on seed yields and different legume crops [Khero (2009)]. The bilateral interaction between C and M showed a significant effect as the combination C1 and M3 excelled and gave the highest average of 57.80 g.Plant^{-1}, while the composition C2 and M3 the lowest average of 40.25 g.Plant^{-1}. The bilateral interaction between M and Z showed a significant effect, as the combination M1 and Z2 gave an average mean of 56.03 g.Plant^{-1} while the combination gave M1 with the control treatment Z0 the lowest average of 43.14 g.Plant^{-1}. The results of the triple interaction of this trait showed a significant effect, as the combination C1, M3 and Z2 excelled by giving it the highest average of 62.15 g.Plant^{-1} while the composition C2, M3 and Z0 gave the lowest average of 40.49 gm.Plant^{-1}. The results of the same table showed that there was no significant effect of spraying stages (M), as well as bilateral interaction between C and Z for this trait.

3.5 Ratio of nitrogen in the leaf

The results of Table 6 indicated that there were significant differences between the varieties, as the C2 variety outperformed by giving it the highest average of 2.09 N%, while the C1 variety gave the lowest average of 2.07 N%. This result was not consistent with what Khattab *et al.* (2016) found that there was no difference between the varieties in the nitrogen concentration in the leaf of the bean crop. The results of the same table showed a significant effect of spray dates, as M3 gave the highest average of 2.09 N%, while M2 and M1 gave the lowest average of 2.08 N%. The data of the same table indicate a significant effect of fertilizer spray concentrations, as the M2 concentration gave the highest average of 2.11 N%, while the control treatment gave Z0 the lowest average of 2.06 N%. The reason for the increase in the concentration of nitrogen in the leaves when fertilizing the fertilizer is due to the direct supply of the nitrogen component. This result agreed with Ahmed and EL-Abagy (2007) on the bean plant. The leaf content of the elements (N-P-K) showed that the bilateral interaction between M and Z showed a significant effect, as the combination R3 and H2 gave the highest mean of 2.12 N%, while the combination M1, Z0 gave the lowest average of 2.05 N%. C, M, C and Z, as well as the triple interaction between C, M and Z, which has no significant effect on this trait.

Acknowledgements

Authors are grateful to anonymous reviewer's fruitful comments which have led much improvement on the earlier draft of this paper.

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