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Response Of Almond Seedlings Growth To Foliar Spraying Of Amino Plasma, Zinc, Boron And Their Interactions

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Abstract

This investigation was carried out during growing season (2016) on Almond seedling belongs to Agriculture College, University of Duhok, to investigate the effect of amino plasma, Zinc, boron and their concentrations (0, 200, and 250 ml.L^{-1}), (0, 100, and 200 mg.L^{-1}), and (0, 300, and 400 mg.L^{-1}), respectively, on vegetative growth of almond seedlings. Accordingly the obtained results reveal that the amino plasma lead to enhance most studied parameters except of (No. of branch.$plant^{-1}$ and leaf fresh weight). Zinc and boron at (200 and 400 mg.L^{-1}), respectively cause significant increase in all studied parameters. The high level of Amino plasma, Zinc and boron in interactions among them lead to enhance all studied parameters. It concluded their spray of Amino plasma, Zinc and Boron was affectingly improved growth of Almonds.

INTRODUCTION

Almonds (*Prunus dulcis*) belong to Rosasea, family originated in the mountainous regions of Iran, Afghanistan, and the former Soviet Union ***[1]***. Accordingly the reviewer almond production in the world the first one is Asia, the second one is the Mediterranean basin and the third one is California ***[2].*** There is conditions favorable for almond planting include 100 to 400 h of chilling at temperatures below 7.2C ***[3].***, It's not tolerant to cold condition but it well adapted over warm climate ***[4].***. The climate that Almonds thrive in winters is mild, wet and in summer hot, dry. Almonds grow in deep loam soils consisting of clay, sand, humus or other organic material ***[5].***

Amino plasmas are essential compound, of proteins ***[6].***, that have an ideal role for stimulating the cell growth. Due to be contain of acids and basic groups and act as buffers, resulted in maintaining pH value make the plant cell ***[7].*** Amino plasmas can effect on the chemo-physiological activities in plant growth and development directly or indirectly such as the growth, yield and biochemical quality of squashes and garlic growth have been modulate by exogenous application of amino plasmas ***[8].***, and ***[9].***. Foliar spraying of amino plasmas can increase yield in nut fruit (Almond), because vegetative systems are able to use amino plasmas as nitrogen source. So it is very promising in case of application of amino plasmas on almond and pistachio seedlings ***[10].***and ***[11].***

[12] "Stated that Zn is taken up by plants as (Zn^{2+}). One of the common aspects of the fertilization program of nut fruits is Zinc (Zn). Small and narrow leaves, shortened internodes of new growth and poor fruit set are occurring from deficiency of Zn, it is more difficult to indicate the symptoms of Zn deficiency

[13]. The growth, development and production of almond are impaired in case of absence of Zn and B element. Moreover, Foliar spraying of boron is the most effective technique because it contacts directly with leaves and reached easily to the leaves than soil applications of B ***[14].*** Boron efficiency can be reduces the quantity of foliar spraying with boron fertilizer; it was derived that the application of boron caused be enhance the growth of almond and decrease the B deficiency in leaves ***[15]***. Thus, this research was laid out to investigate the effects of amino plasmas, Boron, Zinc and their interactions on vegetative seedling growth in Almond seedling; this experiment aims to decrease the harmful effects of environmental conditions. This study has not been studied to now in Kurdistan region-Iraq.

MATERIAL AND RESEARCH METHODS

This study was conducted out at college of Agriculture; University of Duhok in (2016) in one year old almond seedling to investigate the effect of amino plasma, zinc, boron and their interaction on the growth of almond seedling, the foliar spraying of studied elements was done in 15 may 2016. The amino plasma mixture of (20) free amino acids [hydroxyl proline (11.3,%), aspartic acid (4.5%), threonine (3%), serine (3.9 %), proline (8.4 %), Glutamic acid (0.9 %), glycine (11.34 %), alanine (13.21 %), arginine (8.4 %), methionine (4.2 %), soleucine (4.5 %), leucine (16.5 %), tyrosine (1.5 %), phenylalanine (5.1 %), lysine (5.1 %), histidine (3 %), valine (5.1 %), Cysteine (0.3 %), aspargine (0.3 %) and tryptophane (0.4 %) (Inagropars Co.)] were sprayed with three levels (0, 200, and 250 ml.L^{-1}), with three levels of Zinc (0, 300, and 400 mg.L^{-1}), and boron (0, 100, and 200 mg.L^{-1}). Treatments were consisted of 27 concentrations with three replicates; with (10) seedlings for each experimental unit treatment were distributed in factorial arrangement use's Complete Randomize Block Design (RCBD) ***[16]***. The data were analyzed statistically by using SAS system ***[17].***

RESULTS AND DISCUSSION

1- Plant length (cm)

As shown in table (1) spraying amino plasma cause significant increase in Plant length, the highest value was obtained from 200 mg.L^{-1} amino plasma that it was differed compared to control. Table (1) also illustrated that almond seedling sprayed with Zinc was proportionally enhancing Plant length with obtained significant effect, sprays with 400 mg.L^{-1} Zinc gave the highest value and the lowest value was show in control. It is obvious from the same table that there was significant effect of Boron on the Plant length particularly spraying at 200 mg.L^{-1} concentration which gave the highest value (101.63 cm). Concerning the interaction between amino plasma and Zinc it is declared that there was a significant effect on the Plant length, the treatment combination of 200 mg.L^{-1} amino plasma x 400 mg.L^{-1} Zinc gave the highest Plant length. In the interaction between amino plasma and Boron effected significantly on the Plant length compare to control that record lowest value (79.89). Table (1) points the significant effect of interaction between Zinc and Boron, and the maximum value was recorded by the combinations of 400 mg.L^{-1} Zinc and 200 mg.L^{-1} Boron compared with minimum Plant length from the 0 mg.L^{-1} Zinc and 0 mg.L^{-1} Boron.
The interaction among the three studied factors significantly affected on the Plant length. The maximum value (112.00 cm) was obtained from combination of 250 mg.L^{-1} amino plasma x 400 mg.L^{-1} Zinc and 200 mg.L-1 Boron compared to lowest value (65.00 cm) was obtained from 0 mg.L-1 amino plasma x 0 mg.L^{-1} Zinc and 0 mg.L^{-1} Boron.

2- Stem diameter (cm)

Table (2) indicated that the amino plasma and Zinc achieved significant effect on stem diameter; both 250 mg.L^{-1} amino plasma and 400 ml.L^{-1} Zinc gave the highest value. The Boron also affected significantly on stem diameter when sprayed at 200 mg.L^{-1} concentration. Regarding the combination between amino plasma and Zinc (table 2) shows that the interaction of 0 ml.L^{-1} amino plasma x 400 mg.L^{-1} Zinc had the

highest value of stem diameter (5.62 cm). Table (2) also indicated that the interaction of 250 ml.L^{-1} amino plasma x 200 mg.L^{-1} Boron and 400 mg.L^{-1} Zinc x 200 mg.L^{-1} Boron on stem diameter gave the highest value which significantly affected. Same table shows the interactions of the three factors, the highest value was recorded from the interaction of 0 ml.L^{-1} amino plasma x 400 mg.L^{-1} Zinc and 200 mg.L^{-1} Boron compared with the minimum value from 0 lL^{-1} amino plasma x 0 mg.L^{-1} Zinc and 0 mg.L^{-1} Boron.

Table (1) Response of Plants length (cm) of almond seedling to the amino plasma, zinc, boron and their interactions.

Amino plasma (ml.L^{-1})	Zinc (mg.L^{-1})	Boron (mg.L^{-1})			Amino plasma x Zinc	Amino plasma
		0	100	200		
0	**0**	65.00 k	92.33 d-i	94.33 d-h	83.89 d	91.30 b
	300	87.00 h-j	94.33 d-h	96.00 c-h	92.44 c	
	400	87.67 h-j	94.00 d-h	111.00 ab	97.56 a-c	
200	**0**	89.33 g-j	96.67 c-h	101.33 a-f	95.78 a-c	95.96 a
	300	89.00 f-j	93.33 d-i	94.67 d-h	92.33 c	
	400	90.33 e-j	102.00 a-d	107.00 a-c	99.78 a	
250	**0**	80.00 j	98.00 c-h	100.00 b-f	92.67 bc	94.59 ab
	300	80.00 j	98.33 c-h	98.33 c-h	92.22 c	
	400	82.00 ij	102.67 a-d	112.00 a	98.89 ab	
	Boron	83.37 c	96.85 b	101.63 a	**Zinc**	
Amino plasma x Boron	**0**	79.89 d	93.56 bc	100.44 a	**0**	90.78 b
	200	89.56 c	97.33 bc	101.00 a	**300**	92.33 b
	250	80.67 d	99.67 a	103.44 a	**400**	98.74 a
Zinc x boron	**0**	78.11 d	95.67 b	98.56 b		
	300	85.33 c	95.33 b	96.33 b		
	400	86.67 c	99.56 b	110.00 a		

Means of each factor and their interactions followed with the same letters are not significantly different from each other's according to Duncan's multiple range test at 5% level.

Table (2) Response of stem diameter (cm) of almond seedling to the amino plasma, zinc, boron and their interactions.

Amino plasma (ml.L^{-1})	Zinc (mg.L^{-1})	Boron (mg.L^{-1})			Amino plasma x Zinc	Amino plasma
		0	100	200		
0	**0**	3.18 i	3.50 hi	3.61 g-i	3.43 e	4.47 b
	300	3.90 f-i	3.83 f-i	5.33 b-e	4.35 cd	
	400	4.76 c-f	5.58 bc	6.52 a	5.62 a	
200	**0**	4.19 f-h	4.26 f-h	4.80 c-f	4.42 cd	4.42 b
	300	4.26 f-h	4.13 f-i	4.09 f-i	4.16 d	
	400	4.25 f-h	4.40 e-h	5.42 b-d	4.69 bc	
250	**0**	3.91 f-i	4.32 f-h	5.70 a-c	4.64 b-d	4.80 a
	300	3.88 f-i	4.59 d-g	5.69 a-c	4.72 bc	
	400	4.41 e-h	4.44 e-h	6.25 ab	5.03 b	
	Boron	4.08 b	4.34 b	5.27 a	**Zinc**	
Amino plasma x Boron	**0**	3.95 d	4.30 cd	5.15 b	**0**	4.16 b
	200	4.23 d	4.26 cd	4.77 bc	**300**	4.41 b
	250	4.07 d	4.45 cd	5.88 a	**400**	5.11 a
Zinc x boron	**0**	3.76 e	4.02 de	4.70 bc		
	300	4.01 de	4.18 de	5.04 b		
	400	4.47 cd	4.81 bc	6.06 a		

Means of each factor and their interactions followed with the same letters are not significantly different from each other's according to Duncan's multiple range tests at 5% level.

3- Number of branch.seedling^{-1}

Table (3) indicates that the spraying of amino plasma had no significant effect on the number of branch per seedlings of almond seedlings. Foliar application of Zinc caused a significant increase in number of branch per seedlings especially at (400 mg.L^{-1}) which gave the highest value (5.63). It could be found from the study the significant differences in number of branch per seedlings from the spraying of 200 mg.L^{-1} Boron that gave highest value (5.81). Means of each factor and their interactions followed with the same letters are not significantly different from each other's according to Duncans multiple range test at 5% level. Moreover, table (3) illustrated that significant effect of interaction between amino plasma and Zinc on number of branch per plant, as results of the interaction between 250 ml.L^{-1} amino plasma and 400 mg.L^{-1} Zinc which recorded the highest number of branch per seedlings. For the interaction between amino plasma and Boron, significant increase in number of branch per plant was obtained in 250 ml.L^{-1} amino plasma x 200 mg.L^{-1} Boron compare to control. The interaction between Zinc at 400 mg.L^{-1} and Boron had the highest value (6.89) and the lowest value was recorded from 300 mg.L^{-1} Zinc and 0 mg.L^{-1} Boron. Table (3) also shows that the interaction among amino plasma, Zinc and Boron, had significant effect on number of branch per seedlings. The interaction between 250 ml.L^{-1} amino plasma, 400 mg.L^{-1} Zinc and 200 mg.L^{-1} Boron gave the maximum number of branch per seedlings, which was significantly differed to some of other combinations.

Table (3) Response of No. of branch. Seedlings $^{-1}$ of almond seedling to the amino plasma, zinc, boron and their interactions.

Amino plasma (ml.L^{-1})	Zinc (mg.L^{-1})	Boron (mg.L^{-1})			Amino plasma x Zinc		Amino plasma
		0	100	200			
0	**0**	4.33	5.00 cd	5.00 cd	4.78 bc		5.00 a
	300	4.00 d	4.67 cd	5.33 b-d	4.67 c		
	400	4.33 cd	5.67 a-c	6.67 ab	5.56 ab		
200	**0**	4.67 cd	4.67 cd	5.67 a-c	5.00 bc		5.07 a
	300	4.00 d	5.33 b-d	5.00 cd	4.78 bc		
	400	4.00 d	5.33 b-d	7.00 a	5.44 a-c		
250	**0**	4.33 cd	4.67 cd	5.00 cd	4.67 c		5.19 a
	300	4.33 cd	5.00 cd	5.67 a-c	5.00 bc		
	400	5.33 b-d	5.33 b-d	7.00 a	5.89 a		
	Boron	4.37 c	5.07 b	5.81 a		**Zinc**	
Amino plasma	**0**	4.22 d	5.11 a-c	5.67 ab		**0**	4.81 b
x Boron	**200**	4.22 d	5.11 a-c	5.89 a		**300**	4.81 b
	250	4.67 cd	5.00 b-d	5.89 a		**400**	5.63 a
Zinc x boron	**0**	4.44 de	4.78 b-e	5.22 bc			
	300	4.11 e	5.00 b-d	5.33 bc			
	400	4.56 c-e	5.44 b	6.89 a			

Means of each factor and their interactions followed with the same letters are not significantly different from each other's according to Duncan's multiple range tests at 5% level.

4- Number of leaves.seedling^{-1}

Table (4) shows that the spraying Almond seedling with 250 ml.L^{-1} amino plasma and 400 mg.L^{-1} Zinc significantly increased the number of leaves per seedlings especially at maximum concentration. Same table indicated that the highest number of leaves per seedlings was obtained from 200 mg.L^{-1} Boron which was significantly different compared to another concentration. Regarding the interaction of amino plasma x Zinc, amino plasma x Boron, Zinc x Boron, maximum value (108.11, 110.56 and 105.44) was resulted from the interaction of 250 ml.L^{-1} amino plasma x 400 mg.L^{-1} Zinc, 250 ml.L^{-1} amino plasma x 200 mg.L^{-1} Boron and 400 mg.L^{-1} Zinc x 200 mg.L^{-1} Boron gave the maximum value respectively. In respect, the interaction of the three study factors, the interaction of 250 ml.L^{-1} amino plasma x 400 mg.L^{-1} Zinc x 200 mg.L^{-1} Boron gave the highest value (115.33) compared to lowest value (67.67) from the interaction of 0 ml.L^{-1} amino plasma, 0 mg.L^{-1} Zinc and 0 mg.L^{-1} Boron

Table (4) Response of No. of leaves. Seedling $^{-1}$ of almond seedling to the amino plasma, zinc, boron and their interactions.

Amino plasma (ml.L^{-1})	Zinc (mg.L^{-1})	Boron (mg.L^{-1})			Amino plasma x Zinc	Amino plasma
		0	100	200		
0	**0**	67.67 m	87.67 g-j	88.00 g-j	81.11 d	85.70 b
	300	70.00 m	85.00 ij	97.33 d-g	84.11 d	
	400	79.67 j-l	97.33 d-g	98.67 d-f	91.89 c	
200	**0**	72.33 lm	87.33 g-j	98.00 d-f	85.89 d	88.35 b
	300	74.50 k-m	80.00 j-l	95.00 d-h	83.17 d	
	400	92.33 e-i	93.33 d-i	102.33 c-e	96.00 bc	
250	**0**	82.50 jk	95.00 d-h	104.00 b-d	93.83 c	100.46 a
	300	85.00 ij	101.00 c-e	112.33 ab	99.44 b	
	400	100.00 c-e	109.00 a-c	115.33 a	108.11 a	
	Boron	80.44 c	92.85 b	101.22 a	**Zinc**	
Amino plasma	**0**	72.44 g	90.00 de	94.67 cd	**0**	86.94 b
x Boron	**200**	79.72 f	86.89 e	98.44 bc	**300**	88.91 b
	250	89.17 e	101.67 b	110.56 a	**400**	98.67 a
Zinc x boron	**0**	74.17 d	90.00 c	96.67 b		
	300	76.50 d	88.67 c	101.56 ab		
	400	90.67 c	99.89 b	105.44 a		

Means of each factor and their interactions followed with the same letters are not significantly different from each other's according to Duncans multiple range test at 5% level.

5- Leaf chlorophyll content (SPAD):

It's clear from Table (5) that spraying almond seedlings with amino plasma at 250 ml.L^{-1} significantly increased Chlorophyll content in the leaves compared to control. Spray with Zinc at 400 mg.L^{-1} gave highest chlorophyll content compared to lowest value at control. Same table shows that the Boron was dominated with 200 mg.L^{-1}. For the intention table (5) indicated that interactions of amino plasma x Zinc, amino plasma x Boron, Zinc x Boron were significantly differed from most of others interactions. The highest values (54.36, 54.89, and 57.11%) were with the interaction of 250 ml.L^{-1} amino plasma x 400 mg.L^{-1} Zinc, 250 ml.L^{-1} amino plasma x 200 mg.L^{-1} Boron and 400 mg.L^{-1} Zinc x 200 mg.L^{-1} Boron respectively. For the interaction between the three study factors in same table shows that the highest value was obtained with the combination among 250 ml.L^{-1} amino plasma, 400 mg.L^{-1} Zinc and 200 mg.L^{-1} Boron compared to the lowest Chlorophyll content at 0 ml.L^{-1} amino plasma, 0 mg.L^{-1} Zinc and 0 mg.L^{-1} Boron.

6-Leaf fresh weight (g)

Table (6) obviously indicates that foliar application of amino plasma had no significant effect on the leaf fresh weight in leaf of almond seedlings. While Zn grower significantly affected leaf fresh weight, there was (400 mg.L^{-1}) had the highest significant value of leaf fresh weight. Also results show that the spraying (200 mg.L^{-1}) of Boron had significant effect on leaf fresh weight and significantly overtopped the other concentrations. The interaction of amino plasma x Zinc affected significantly on vegetative dray weight, the maximum value was obtained from the interaction treatment (250 ml.L^{-1} amino plasma x 400 mg.L^{-1} Zinc). The effects of combination of amino plasma and Boron were the value of fresh weigh as shown in table (6). Almond seedling treated with 0 ml.L^{-1} amino plasma and 200 mg.L^{-1} Boron gave the highest significant value which significantly surpassed to the lowest value. Then, the combinations between Zinc and Boron also effected significantly on leaf fresh weight of almond seedling, since the maximum average was obtained from treatment combination (400 mg.L^{-1} Zinc x 200 mg.L^{-1} Boron). Therefore, the combinations among three factors significantly differed; the maximum average (1.98 g) was recorded from the combination of 0 ml.L^{-1} amino plasma x 400 mg.L^{-1} Zinc x 200 mg.L^{-1} Boron, while the minimum average (1.43 g) with control.

Table (5) Response of Chlorophyll (%) leaves content of almond seedling to the amino plasma, zinc, boron and their interactions.

Amino plasma ($ml.L^{-1}$)	Zinc ($mg.L^{-1}$)	Boron ($mg.L^{-1}$)			Amino plasma x Zinc	Amino plasma
		0	100	200		
0	**0**	41.40 l	44.67 k	47.00 i-k	44.36 d	49.40 c
	300	48.67 g-j	50.67 e-h	53.73 c-e	51.02 c	
	400	48.33 h-j	52.63 c-f	57.50 ab	52.82 ab	
200	**0**	46.57 jk	51.30 d-g	54.13 cd	50.67 c	51.03 b
	300	47.20 i-k	51.50 d-g	52.33 c-f	50.34 c	
	400	48.33 h-j	52.43 c-f	55.43 bc	52.07 bc	
250	**0**	48.77 g-j	51.67 d-g	52.73 c-f	51.06 c	52.28 a
	300	49.73 f-i	51.00 d-g	53.53 c-e	51.42 bc	
	400	51.33 d-h	53.33 c-e	58.40 a	54.36 a	
	Boron	47.81 c	51.02 b	53.87 a	**Zinc**	
Amino plasma	**0**	46.13 e	49.32 d	52.74 bc	**0**	48.69 c
x Boron	**200**	47.37 e	51.74 c	53.97 ab	**300**	50.93 b
	250	49.94 d	52.00 c	54.89 a	**400**	53.08 a
Zinc x boron	**0**	45.58 f	49.21 e	51.29 cd		
	300	48.53 e	51.06 d	53.20 b		
	400	49.33 e	52.80 bc	57.11 a		

Means of each factor and their interactions followed with the same letters are not significantly different from each other's according to Duncans multiple range test at 5% level.

Table (6) Response of leaf fresh weight (g) of almond seedling to the amino plasma, zinc, boron and their interactions.

Amino plasma ($ml.L^{-1}$)	Zinc ($mg.L^{-1}$)	Boron ($mg.L^{-1}$)			Amino plasma x Zinc	Amino plasma
		0	100	200		
0	**0**	1.43 o	1.62 kl	1.74 ef	1.60 g	1.69 a
	300	1.60 lm	1.62 kl	1.78 de	1.67 ef	
	400	1.68 g-j	1.71 f-i	1.98 a	1.79 b	
200	**0**	1.65 i-l	1.67 g-k	1.88 b	1.73 c	1.69 a
	300	1.63 j-l	1.63 j-l	1.66 h-k	1.64 f	
	400	1.66 h-k	1.72 f-h	1.73 e-g	1.70 d	
250	**0**	1.50 n	1.53 n	1.61 kl	1.55 h	1.70 a
	300	1.56 mn	1.70 f-h	1.81 cd	1.69 de	
	400	1.82 cd	1.86 bc	1.88 b	1.85 a	
	Boron	1.62 c	1.67 b	1.79 a	**Zinc**	
Amino plasma x	**0**	1.57 f	1.65 de	1.84 a	**0**	1.63 c
Boron	**200**	1.65 de	1.67 cd	1.76 b	**300**	1.67 b
	250	1.63 e	1.70 c	1.77 b	**400**	1.78 a
Zinc x boron	**0**	1.53 f	1.61 e	1.75 bc		
	300	1.60 e	1.65 d	1.75 bc		
	400	1.72 c	1.76 b	1.87 a		

Means of each factor and their interactions followed with the same letters are not significantly different from each other's according to Duncans multiple range test at 5% level.

As a discussion matter, the Foliar spray of amino plasma resulted to enhancing the vegetative trait which may attributed to the increase the amount of nitrate (NO-3) in leaves and its uptake by plant so that the plant length and diameter, number of leaves per shoot and number of branch per plant was improved, Amino acid possess functional group, vase, amine NH2- and carboxyl that transferred in to active region via vitamins as B1 and B6 ***[18]*** and ***[19].*** Amino plasmas can effect on the chemo-physiological activities in plant growth and development directly or indirectly such as the growth, yield and biochemical quality of squashes and garlic growth have been modulate by exogenous application of amino plasmas ***[8]*** and ***[9].***

Also foliar spraying of Zn and B has significant differences in improving the studied parameters this may due to the passively transferring of these elements (Zn and B) by almond seedling to the leaves rather than their amount in the soil in seedling stage, Zn and B act as cofactor with enzyme in bio chemical processes of cell ***[20]***and ***[21].***

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