ROLE OF SPRAYING BORON AND SUGAR ALCOHOLS ON GROWTH, YIELD AND SEEDS PRODUCTION OF PEPPER

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ABSTRACT
The objective of this experiment was to investigate the effect of boron and sugar alcohols on the growth, yield and quantity of seeds produced from pepper cv. California wonder, A factorial experiment (3 × 7) was conducted according to randomized complete block design (RCBD) with three replications at the open field of the research station B, Coll. of Agri. Univ. of Baghdad during 20/12/2016 to 1/12/2017. The experiment included two factors, first one was boron which used boric acid (0, 50, 100 mg l^{-1}) and the second factor was sugar alcohols (sorbitol) (15, 25, 35 g, l^{-1}) and mannitol sugar (10, 20, and 30 g l^{-1}) in addition to control treatment (spraying with water), Results showed significant superiority of boron with concentration 100 mg l^{-1} in the plant high (58.60 cm), number of main branches $plant^{-1}$ (7.52 branch), leaves area (1129.9 dcm^2 $plant^{-1}$), number of fruits $plant^{-1}$ (49.43 fruit) and total yield (148.64 ton ha^{-1}). Significant superiority of mannitol with concentration 30 mg l^{-1} was found in the plant height (60.34cm), number of main branches (7.33 branch $plant^{-1}$), leaves area (1237.8 dcm^2), total chlorophyll content (302.11 mg g^{-1} fresh weight), fruit weight (96.27 g $fruit^{-1}$), number of fruits (50.84 fruit $plant^{-1}$), total yield (158.39 ton ha^{-1}) seeds germination (91.66%), speed of germination (4.67 day). The interaction between two variables was significant for all the studied traits, this showed that the response of pepper to first variable related to the other variable. It could be concluded that the best combination between two variable was boron (100 mg l^{-1}) and sugar alcohols (mannitol 30 g l^{-1}).

Key words: *Capsicum annuum* L, seed yield, fruits, sorbitol, mannitol, boric acid.
Part of Ph.D. Dissertation for the first author

دور رش البورون والسكريات الكحولية في نمو, حاصل وانتاج البذور لنبات الفلفل

منعم فاضل مصلح أيمان جابر عبد الرسول
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المستخلص
نفذت هذه التجربة لدراسة تاثير رش البورون والسكريات الكحولية قي نمو زحاصل وكمية البذور الناتجة لنبات الفلفل. طبقت تجربة عاملية (3×7) وفق تصميم القطاعات الكاملة المعشاة بثلاثة مكررات في الحقل المكشوف للمحطة البحثية B التابع الى كلية الزراعة/ جامعة بغداد للفترة من 2016/12/20 ولغاية 2017/12/1. تضمنت التجربة عاملين, البورون (0، 50 ،100ملغم لتر$^{-1}$) والسكريات الكحولية هي سكر السوربيتول (15، 25، 35 غم . لتر$^{-1}$)، وسكر المانيتول (10، 20، 30 غم. لتر$^{-1}$) أضافة الى معاملة المقارنة الرش بالماء، بينت النتائج ان رش البورون 100 ملغم لتر$^{-1}$ ادى الى زيادة معنوية في ارتفاع النبات (58.60سم)، عدد الافرع الرئيسية (7.00 فرع)، المساحة الورقية للنبات (1129 دسم^2)، عدد الثمار (49.43ثمرة)، الحاصل الكلي (148.64 طن هكتار$^{-1}$). اظهرت النتائج تفوق رش السكريات الكحولية المانيتول بالتركيز 30 غم. لتر$^{-1}$ في جميع الصفات المدروسة كارتفاع النبات (60.34 سم) وعدد الافرع (33.7 فرع للنبات) والمساحة الورقية (1237.81 دسم^2) ومحتوى الاوراق من الكلوروفيل 302.11 ملغم غم$^{-1}$ وزن طري) وزن الثمرة (96.27 غم) وعدد الثمار (50.84 ثمرة) والانتاجية الكلية (158.39 طن هكتار$^{-1}$) ونسبة الانبات (91.66%) وسرعة الانبات (4.67 يوم). كان التداخل بين المتغيرين معنويا لجميع الصفات المدروسة, هذا دليل على علاقة المتغيرين فيما بينهما. نستنتج من ذلك ان رش البورون بالتركيز 100 ملغم لتر$^{-1}$ مع المانيتول بالتركيز 30 غم لتر $^{-1}$ على نباتات الفلفل ادى الى تحسين النمو الخضري والجذري والثمري وجودة البذور الناتجة.

كلمات دالة: ***Capsicum annuum*** **L**, حاصل البذور, الثمار . السوربيتول , المانيتول, حامض البوريك
البحث مستل من اطروحة الباحث الاول

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INTRODUCTION

Pepper (***Capsicum annuum* L**) belongs to the Solanaceae family (25), which grown in Iraq at open fields during the beginning of spring and at protected agriculture during the beginning of fall. Many researchers were interested for improving growth, productivity and nutrition value of this crop. Pepper contains many chemical compounds, which are one of the most important antioxidants reduced the risk of chronic, cancer, anti-inflammatory, anti-allergic and cirrhosis, carotenoids which are component of the non-enzymatic system of antioxidants (12, 15, 22, 27). Pepper is characterized by a weakness of the root system which cause to the flowers fall and fruits. Environmental factors effect a very important role in accelerating the rate of transpiration, which leads to the lack of water in the tissues and fruits, although it is available in the soil because of its weak roots (16). Boron is an essential nutrient in plants, which needed more than other minor elements because of its important role in the physiological processes. The lack of this element appears on a large scale of crops so many efforts have been made to identify its role especially during cell wall building (10, 20, 24, 26). The boron spraying is the best way to control its deficiency. Mozafar (19) observed that the lack of boron caused increased infertility and reduced the growth of the pollen tubes, this reduced the quantity of seeds produced (11). AL Jawary (4) found that the spraying of micro-elements containing boron in the form of boric acid at a concentration of 2 g L^{-1} caused a significant increase in plant height, leaf area, number of flowers, fruit set and productivity. AL Tohafy (6) showed that spraying eggplant with boron (10 mg l^{-1}) caused an increase ratio of 15.8, 13.2, 17.6, 8.4, 22.5 and 24.8% for plant height, stem diameter, no. of fruit, fruit weight, length and fruit diameter, respectively than control treatment. Alcoholic sugar or polyols is a carbohydrate that is one of the most important products of the process of photosynthesis. Sugar alcohols moves freely and easily inside the plant. It was discovered in 1996 with natural boron and other micro elements inside xylem (13). Awuchl (9) was obtained an increase in boron movement within the xylem and increased growth and yield in the genetically modified tobacco plants that contain sorbitol compared to control treatment. AL Ibrahemy (2) observed that the interaction between spraying boron with a concentration of 5 mg L^{-1} and sucrose with concentration of 5 g L^{-1} on pepper plant caused significantly increased in most vegetative, flowers, fruits and yield traits of pepper plants. This study aimed to investigate the effect of boron and sorbitol, mannitol, which are a new generation of nutrients to rapid absorption and nutrient movement from the source to the sink on growth, yield and its influence quantity to the seeds produced from pepper plants.

MATERIALS AND METHODS

This experiment was carried out at the open field of the research station B / Coll. of Agri. - University of Baghdad – ALJadriya, during 20/12/2016 to 1/12/2017 to study the effect of spraying boron and sugar alcohols (Sorbitol and mannitol) on the growth, yield and quantity of seeds produced from pepper plants variety California wonder which Its plants are characterized by strong growth and medium size, its fruits cubic shape, dark green color, thick epidermis and sweet taste and good yield, production yield after 75 days of transplantation (16). Produced by US Agriseeds, with germination rate 86%, off type 1.00% and purity 99.00%, date of production 1/7/2015. Seeds were planted in cork dishes on 20/12/2016. The seedlings were transferred to the field on 20/2/2017. A factorial experiment included two factors, three concentrations of boric acid (B 17.4%) (0, 50. and 100 mg l^{-1}) and seven concentrations of sugar alcohols ($C_6H_{14}O_6$) which included Sorbitol with three concentrations (15, 20 and 35 g L^{-1}) (23) and Mannitol with three concentrations (10, 20 and 30 g. L^{-1}) In addition to the control treatment (spraying with distilled water were conducted). Plants were sprayed three times, the first at 30/3/2017, the second at 15/4/2017 and the third at 30/4/2017. The experiment was performed in RCBD with three replications consisted 63 experimental units each contained 15 plants grown in 6 m length furrows and 0.75 m width and 0.4 m between plants, A random sample of ten plants from each experimental unit was collected at the end of the season to study vegetative and yield

and seed production characters, such as plant height (cm.plant^{-1}), number of branches (branch plant^{-1}), leaves area (dcm^2.plant^{-1}) which was calculated using the digimizer program. chlorophyll concentration was estimated according to Ranganna (21) , radical length (cm), radical diameter (mm), fruit weight (g), number of fruits, total yield (ton ha^{-1}), germination (%) of seeds produced from fruits at the end of season, germination speed (day) and weight of 1000 seeds (g). The SAS system was used under Windows 2009 for statistical analysis, means were compared using a less significant differences (L.S.D 5%) (14).

RESULTS AND DISCUSSION

Vegetative traits

Results in Table 1 indicate a significant increases in plant height, when spraying boron at B_{100} and B_{50} which produced plant with 58.60, 57.77 cm respectively with no significantly differences with each other, but they were differed significantly from the control treatment which had 55.58 cm in plant height. Significant increases were found in the number of branches, when sprayed B_{100} then sprayed B_0, and B_{50}. Highest value reached to 7.52 branches plant $^{-1}$, while B_{50} had the lowest number of branches (6.76 Branch plant^{-1}.) (Table 1). Spraying B_{100} showed a significant increases in leaves area which had 1129.91 dcm^2, while the control treatment had the lowest leaves area (929.41dcm^2), This may be due to the role of boron in increasing availability and concentration of some major and minor nutrients (8), thus stimulating vegetative growth by increasing number of leaves, leaves area and number of branches. Boron also had a positive role in activating and increasing the growth regulators, especially auxins and cytokines (17), also had an important role in formation of proteins in the plant through the transcription of RNA (1), These results were in agreement with some previous reports (7). Results in Table 1 shows that spraying of sugar alcohols led to a significant increases in plant height of pepper, spraying manitol 30g l^{-1} produced the highest value plant height (60.34 cm) with an increase ratio to 12.47 % compared to the control treatment which had the lowest plant height (53.65 cm). All sugar alcohols were caused an increase in the number of branches of pepper plants, spraying sorbitol 35 g l^{-1} and manitol 30 g l $^{-1}$ gave the highest value 7.33 plant branches $^{-1}$, for each with an increase (24.66%) more than control treatment which had the lowest number of branches (5.88 branch plant^{-1}.). Manitol S_6 significantly superiored to most of the treatments in producing the highest leaves area (1237.81 dcm^2 plant^{-1} with an increases ratio to 55.57% however it did not differed significantly from sorbitol 35g l $^{-1}$ (S_3) which gave leaves area 1160.11 dcm^2 plant^{-1}, with an increases (45.80%) to control treatment which gave less leaves area (795.66 dcm^2 plant $^{-1}$). It may be attributed to the important role of sugar alcohols to transport the major and minor nutrients, especially the slow-moving elements such as calcium and boron through the xylem, they move freely and easily within the plant, and as we known Sorbitol and Mannitol one of the forms that facilitate the transfer of Boron element inside the xylem on a complex image dis- (Sorbitol) borate ester (23). The transfer of boron and the major and minor nutrients from the source to the sink may improve physiological and biochemical processes. These elements are important in the process of photosynthesis and respiration as they enter the synthesis of DNA and RNA which they are necessary for cell division in addition to its role in the synthesis of hormones including auxins, which leading to cell division and elongation thus increasing vegetative traits (3, 5). Result of interaction as shows in Table 1 interaction between different levels of variables were significant, this reveal that the activation of boron influenced with sugar alcohols. Interaction S_6+B_{100} revealed the highest mean of each plant height (62.12 cm), number of branches (7.33 branch plant^{-1}), leaves area of plant (1354.10 dcm^2 plant $^{-1}$) when compared with control treatment which gave the lowest values (5.33 branch plant^{-1} and 668.90 dcm^2 plant^{-1} respectively), while interaction of B_0 with S_1 gave lowest value of plant height (45.36 cm)

Chlorophyll and root traits

Data in Table 2 shows no significant effect of spraying boron to both leaves content of total chlorophyll and root diameter. While, spraying B_{50} and B_{100} significantly increased the length of the main root (37.33 and 37.23 cm

respectively) but, the differences did not significant between them, while significantly differed from the control treatment (35.23 cm). The increases in vegetative traits (Table 1) as a result of spraying with boron resulted in increased root length (Table 2). Spraying of sugar alcohols had a significant effect on leaf content of total chlorophyll, length and diameter of root, Mannitol S_6 had the highest value (302.11 mg100 g^{-1} fresh weight, 38.11 cm, and 8.05 mm, respectively). While the control treatment produced the lowest means (258.45 mg100 g^{-1} fresh weight, 35.22 cm and 6.68 mm respectively). Interaction of spraying boron with alcohols sugars was significant effect (Table 2). The highest total chlorophyll content was 312.49 mg100 g^{-1} fresh weight when sprayed boron B_{100} with S_6 Mannitol, while the lowest content was when boron B_{100} mixed with S_0, which (249.88 mg100 g^{-1} fresh weight), and the highest value of the main root length at B_{50} + S_6, which was 39.00 cm., While B_0 + S_0 and B_0 + S_1 produced the lowest value of the root length (34.66 cm for each one). The interaction between boron and sugar alcohols had a significant effect on the root diameter. The highest value was in S_6 + B_0, which produced 8.15 mm, while the lowest value of root diameter was 6.47 mm in control treatment (B_0 + S_0). Interaction between boron and alcohol sugars led to an increase in vegetative traits (Table 1). This results may be due to the importance role of boron in improving many physiological and biochemical processes by activating meristem tissue, increasing cell division and elongation, and the role of sugar alcohols in nutrients transport from leaves to the roots, stems and branches, thus improving the physiological and biochemical processes of the plant and increasing all growth traits (10).

Yield and its component

Results in Table 3 shows that the fruit weight did not significantly affected by boron while the number of fruits was significantly differed. B_{100} significantly superiors in number of fruits (49.43 fruits of plant $^{-1}$), while B_0 produced the lowest number of fruits (41.98 fruit plant $^{-1}$), B_{100} was significantly higher than B_{50} and B_0 in total yield (148.64 ton ha $^{-1}$), while B_0 had lowest total yield 126.20.ton ha^{-1}. The increases in the number of fruits $plant^{-1}$ may be attributed to the role of boron in improving the nutritional status of plants by increasing the strength of vegetative growth (Table 1) and root traits (Table 2), which had affected the process of photosynthesis and increased nutrients accumulation in the plant, so that increased number of flower and improve fruit set then increase the number of fruits. Data in Table 3 shows spraying of the alcoholic sugar significantly increased weight of the fruit. Mannitol S_6 produced the highest value of weight of the fruit, number of fruits $plant^{-1}$ and total yield in the area unit (96.27 g, 50.84 fruit and 158.39 ton ha $^{-1}$ respectively with an increase rate of 9.87 and 28.61 and 37.96 % respectively than S0 which gave the lowest value of fruit weight (87.62 g), number of fruits (39.53 fruit) and the total yield (114.81ton ha $^{-1}$). Spraying of sugar alcohols including mannitol on pepper plants contributed to the availability of the fertilizers balance of the major and minor nutrients, which achieved good vegetative and root growth (Tables 1 and 2) and this caused to increase in the weight of fruit and the number of $fruits\ plant^{-1}$, which reflected positively on productivity, This results were in agreement with some previous reports (2), where he concluded that the spraying of boron and sucrose on the pepper plant led to an increase in the vegetative , root and fruits traits. Results in Table 3 shows significant effects of the interaction between boron and sugar alcohols, But the interaction between B_{50} with mannitol S_6 produced the highest weight of fruit (98.93 g $fruit^{-1}$), while interaction between B_{50} with sorbitol S_2 gave a lowest weight (83.30 g $fruit^{-1}$), In addition, interaction between B_{100} with Mannitol S_5 significantly increased the number of $fruits\ plant^{-1}$ (55,997 fruit) compared with the control treatment (B_0+S_0), which produced the lowest value of number of fruit (36.167 fruit). While, the highest yield for unit area was from using B_{100} with mannitol S_6 (169.54 tons ha $^{-1}$), compared with control treatment (B_0+S_0) which had the lowest value of productivity (100.76 ha $^{-1}$).

Seeds production

Results in Table 4 shows significant differences between the concentration of boron, Spraying B_{50} and B_{100} resulted in a significant increases in the percentage of

germination in produced seeds. It was 89.38 and 89.09% respectively. While B_0 had the lowest value of germination (87.66%), Data in the same Table shows that B_{100} and B_{50} take less days to full germination of the seeds (4.82 days for each one), compared to B_0 which take 4.89 days to full germination. The results in the same table shows that B_{50} and B_{100} did not differed significantly between them in the weight of 1000 seeds (7.50 and 7.38 g respectively), but B_{50} and B_{100} gave significant differences with control treatment which produced the lowest weight of 1000 seed (7.20 g). Results Table 4 shows that sugar alcohols had a significant effect on the germination percentage of the seeds produced from fruits of peppers in the end of season, mannitol S_6 gave the highest percentage of germination (91.66%) with an increases ratio 7.42 % compare to the control treatment which gave 85.33%. Results in the same table shows that Mannitol S_6 was the best because it took less days to complete germination (4.67 days), while S_0 or Sorbitol S_1 had more days to complete germination (4.96, 4.94 days respectively), Mannitol S_6 produced the highest seeds weight (7.94 g 1000 seed^{-1}), while the control treatment had the lowest seeds weight (6.92 g). Data in Table 4 indicate that the interaction between boron and alcohol sugars had a significant effect on the percentage of germination. The highest seeds germination had resulted from B_{50} with mannitol S_6 (92.00%), while the lowest percentage from seeds of B_0+S_0 (83.00%). In addition interaction between B_{50} or B_{100} with mannitol S_6 was the better because they took less days until complete of germination (4.64 days for each one) comparison with the control treatment $B_0 + S_0$ or with interaction $B_0 + S_1$ which were had more days to complete the germination (4.98 days for each one). The treatment of the interaction between B_{100} and mannitol S_6 produced the highest increase in the seeds weight (8.11 g), while the control treatment ($B_0 + S_0$) produced the lowest value of the seeds weight (6.67 g1000 seed^{-1}). Increasing in the seed qualities may be due to increase in vegetative growth traits (Table 1), as well as increase in root and fruit traits (Tables 2 and 3), which positively affected the improvement of the quantity and seed quality produced from fruits at the end of the season when spraying with boron or alcohol sugars or interaction between them. This results may be due to the formation of hormones for flowering that increase the percentage of flowering (18) and increases the vitality of the pollen grains due to the role of boron in pollination and the pollen tube growth (5), and possibly due to the role of alcohol sugars in transport nutrients to the seeds quickly and then increase the weight of seeds as a result of the accumulation of elements in the form of proteins and carbohydrates (1). Therefore, it could be concluded that boron can be sprayed with concentration 100 mg l^{-1} and Mannitol with 30 g l^{-1} concentration on pepper plant to obtain the best growth and yield of the plant and the possibility of obtaining good seeds for planting in the following season.

Table 1. Effect of spraying boron and Sugar alcohols and their interactions on vegetative traits in pepper during 2017

Boron ml g^{-1} / Sugars alcohols g l^{-1}	Plant height Cm plant^{-1}			Mean of Sugar alcohols	Number of branches Branch Plant^{-1}			Mean of Sugar alcohols	Total leaf area Plant^{-1} dc^2			Mean of Sugar alcohols
	B_0	B_{50}	B_{100}		B_0	B_{50}	B_{100}		B_0	B_{50}	B_{100}	
S0 Control	51.72	54.36	55.01	53.65	5.33	6.00	6.33	5.88	668.9	837.4	880.7	795.66
Sorbitol 15 (S1)	45.36	56.62	57.17	56.05	6.33	6.33	7.00	6.55	886.2	997.7	1018.1	967.34
Sorbitol 25 (S2)	55.73	58.20	59.93	57.95	6.67	7.00	7.00	6.88	914.9	1073.6	1137.4	1041.99
Sorbitol 35 (S3)	57.85	59.52	60.71	59.36	7.33	7.33	7.33	7.33	1128.3	1159.9	1192.1	1160.11
Mannitol10(S4)	53.47	57.57	61.45	57.49	6.33	6.33	6.67	6.44	868.7	1238.4	1097.4	1068.18
Mannito20 (S5)	56.90	58.34	60.81	58.68	6.33	7.00	7.33	6.88	906.0	1140,3	1228.9	1091.70
Mannito30 (S6)	59.02	59.89	62.12	60.34	7.33	7.33	7.33	7.33	1133.1	1226.3	1354.1	1237.81
Mean of boron	55.58	57.77	58.60		7.00	6.76	7.52		929.4	1096.2	1129.9	
L.S.D 5 %	B		S	Interaction	B		S	Interaction	B		S	Interaction
	1.93		2.95	5.12	0.23		0.35	0.61	78.61		120.08	207.99

Table 2. Effect of spraying boron and sugar alcohols and their interactions on total chlorophyll content and root traits in pepper during 2017

Boron mlg-1 / Sugars alcohols g l^{-1}	Total chlorophyll content mg g fresh substance-1			Mean of Sugar alcohols	Length of main root cm plant-1			Mean of Sugar alcohols	Root diameter Ml m plant-1			Mean of Sugar alcohols
	B_0	B_{50}	B_{100}		B_0	B_{50}	B_{100}		B0	B_{50}	B_{100}	
S0 Control	256.98	268.52	249.88	258.45	34.66	35.00	36.00	35.22	6.47	6.95	6.63	6.68
Sorbitol 15 (S1)	270.54	277.46	282.87	276.95	34.66	36.33	35.33	35.55	7.09	7.40	7.02	7.17
Sorbitol 25 (S2)	289.42	281.19	285.53	285.38	35.66	37.66	37.66	37.00	7.37	7.63	7.19	7.40
Sorbitol 35 (S3)	301.79	292.67	288.88	294.44	36.66	38.66	38.00	37.77	7.87	7.55	7.32	7.58
Mannitol10(S4)	275.06	278.89	286.45	280.13	35.33	37.33	37.00	36.66	6.95	7.52	7.68	7.38
Mannito20 (S5)	281.91	284.65	306.96	291.17	36.00	37.33	3.00	37.11	7.33	7.43	7.88	7.55
Mannito30 (S6)	292.54	301.32	312.49	302.11	37.00	39.00	38.00	38.11	8.15	8.07	7.94	8.05
Mean of boron	281.17	283.52	287.58		35.23	37.33	37.23		7.32	7.51	7.38	
L.S.D 5 %	B	S	Interaction		B	S	Interaction		B	S	Interaction	
	NS	14.64	25.26		0.75	1.15	2.00		NS	0.42	0.74	

Table. 3 Effect of spraying boron and sugar alcohols and their interactions on yield traits in pepper during 2017

Boron mlg^{-1} / Sugars alcohols g l^{-1}	Weight of fruit g			Mean of Sugar alcohols	Number of fruit fruit plant^{-1}			Mean of Sugar alcohols	Total yield t h^{-1}			Mean of Sugar alcohols
	B_0	B_{50}	B_{100}		B_0	B_{50}	B_{100}		B_0	B_{50}	B_{100}	
S_0 Control	84.11	90.66	88.07	87.62	36.16	40.38	42.04	39.53	100.76	121.06	122.07	114.81
Sorbitol 15 (S_1)	90.40	91.31	86.83	89.51	40.15	45.82	45.63	43.86	116.69	134.42	131.09	127.40
Sorbitol 25 (S_2)	92.20	83.30	94.19	89.90	41.43	5159	48.21	47.11	125.30	142.89	149.87	139.35
Sorbitol 35 (S_3)	95.04	92.85	93.30	93.73	47.46	49.88	51.15	49.50	149.12	153.22	164.53	155.62
Mannitol10(S_4)	89.47	90.05	86.93	88.82	39.71	46.56	47.67	44.65	117.64	130.19	137.64	128.49
Mannito20 (S_5)	90.05	91.66	89.83	90.51	42.22	49.69	55.99	49.30	125.80	149.25	165.76	146.76
Mannito30 (S_6)	97.32	98.93	92.56	96.27	46.74	50.41	55.36	50.84	148.06	157.58	169.54	158.39
Mean of boron	91.23	91.25	90.24		41.98	47.77	49.43		126.20	141.31	148.64	
L.S.D 5 %	B	S	Interaction		B	S	Interaction		B	S	Interaction	
	1.95	2.99	5.18		1.40	2.14	3.70		3.63	5.55	9.62	

Table 4. Effect of spraying boron and sugar alcohols and their interactions on produced seeds traits in pepper during 2017

Boron mlg^{-1} / Sugars alcohols g l^{-1}	Germination %			Mean of Sugar alcohols	Speed of germination Day			Mean of Sugar alcohols	Weight of 1000 seeds g			Mean of Sugar alcohols
	B_0	B_{50}	B_{100}		B_0	B_{50}	B_{100}		B_0	B_{50}	B_{100}	
S_0 Control	83.00	86.33	86.66	85.33	4.98	4.95	4.95	4.96	6.67	6.94	7.13	6.92
Sorbitol 15 (S_1)	87.33	87.33	87.66	87.44	4.98	4.94	4.89	4.94	6.88	7.13	7.04	7.02
Sorbitol 25 (S_2)	87.66	89.33	88.33	88.44	4.88	4.85	4.87	4.87	7.28	7.39	7.39	7.36
Sorbitol315 (S_3)	90.33	90.00	89.33	89.88	4.87	4.71	4.77	4.78	7.59	7.73	7.54	7.62
Mannitol10 (S_4)	85.66	90.66	89.00	88.44	4.94	4.88	4.81	4.88	6.88	6.91	7.38	7.06
Mannitol20 (S_5)	88.33	90.00	91.00	89.17	4.82	4.76	4.76	4.78	7.37	7.51	7.89	7.59
Mannitol30 (S_6)	91.33	92.00	91.66	91.66	4.74	4.64	4.64	4.67	7.71	8.01	8.11	7.94
Mean of boron	87.66	89.38	89.09		4.89	4.82	4.82		7.20	7.38	7.50	
L.S.D 5 %	B	S	Interaction		B	S	Interaction		B	S	Interaction	
	1.36	2.08	3.60		0.04	0.06	0.11		0.18	0.27	0.47	

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