Effect of planting dates and spraying with zinc and boron sulfate on some yield traits of two broccoli hybrids (*Brassica oleracea* L. var. italica)

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Abstract

The experiment was conducted in the vegetable field/ Department of Horticulture and Landscape Engineering/ College of Agriculture and Forestry/University of Mosul during the 2018-2019 agricultural season. To study the effect of planting dates 9/20, 5/10 and 15/10, and spraying with zinc sulfate at a concentration of 300 mg. L^{-1} and boron at a concentration of 60 mg.L^{-1} and zinc + boron in addition to the control treatment (water spray only) in the growth and yield of two hybrids of broccoli Parasio and Danar. The experiment was designed according to the Spilt-plots-System-within the randomized complete block design (RCBD) and with three replications, and the averages were compared with Duncan's polynomial test at the probability level of 0.05. The results confirmed that the planting date of 20/9 for the hybrid Parasio and spraying with zinc gave the most length of the stem of the flowering disc was 41.20 cm and that the planting date of 20/9 for the hybrid Danar and spraying with zinc and boron gave the largest circumference of the flowering disc 47.86 and 46.73 cm, respectively. The seeding date was 20/9 for the Parasio hybrid and the spraying with zinc + boron gave the most weight to the main flowering disc 380.00 g. The most crown length of the main flowering was 7.24 cm, and the total yield of the main flowering was 16.938 tons. ha^{-1} and that the planting date is 20/9 and the Danar hybrid and spraying with boron gave the most number of secondary flowering discs 8.33 discs. $plant^{-1}$.

Key words: seedling date - zinc - boron - yield - flowering disc - broccoli.

تأثير مواعيد الشتل والرش بكبريتات الزنك والبورون في بعض صفات الحاصل لهجينين من البروكلي (*Brassica oleracea* L. var. italica)

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الخلاصة

نفذت التجربة في حقل الخضراوات/ قسم البستنة وهندسة الحدائق/ كلية الزراعة والغابات/ جامعة الموصل في الموسم الزراعي 2018-2019، لدراسة تأثير مواعيد الشتل 9/20 و10/5 و10/15، والرش بكبريتات الزنك بتركيز 300 ملغم. لتر$^{-1}$والبورون بتركيز 60 ملغم.لتر$^{-1}$والزنك + البورون بالإضافة الى معاملة المقارنة (رش الماء فقط) في نمو وحاصل هجينين من البروكلي Parasio و .Danarصممت التجربة وفق نظام الألواح المنشقة المنشقة Spilt-plots-System ضمن تصميم القطاعات العشوائية الكاملة ((RCBD وبثلاث مكررات، وقورنت المتوسطات باختبار دنكن متعدد الحدود عند مستوى احتمال0.05 اكدت النتائج بان موعد الشتل 9/20 للهجين Parasio والرش بالزنك اعطى اكثر طول للساق القرص الزهري بلغ 41.20 سم وان موعد الشتل 9/20 وللهجين Danar والرش بالزنك و البورون اعطتا اكبر محيط للقرص الزهري 47.86 و 46.73 سم على التوالي وان موعد الشتل 9/20 وللهجين Parasio والرش بالزنك + البورون اعطى اكثر وزن للقرص الزهري الرئيسي 380.00 غم واكثر طول لتاج القرص الزهري الرئيسي بلغ 7.24 سم واكثر حاصل كلي للأقراص الزهرية الرئيسية 16.938 طن. هكتار$^{-1}$وان موعد الشتل 9/20 وللهجين Danar والرش بالبورون اعطتاكثر عدد من الأقراص الزهرية الثانوية 8.33 قرص. نبات.$^{-1}$

Introduction

Broccoli (*Brassicea oleracea* var. Italica) is one of the vegetable crops belonging to the cruciferous family (Brassicaceae). It is cultivated for its inflorescences, which are eaten while they are in the vegetative flowering stage with their thick, juicy bearer. The flower tablets are eaten cooked, boiled, or in their natural state, or they may be used in pickles (25).It is one of the most nutritious crops of this family and the most widely used medicinally, where it contains many minerals and vitamins, as well as rich in beta-carotene and beta-carotene. The leaves of the plant are a source of polyphenols, fats and fibers (24). Broccoli has a high therapeutic nutritional value that is not available in any other plant. It is a regulator and a powerful antibiotic for many common diseases. It lowers high blood pressure, helps regulate blood sugar, lowers cholesterol, builds bones, increases physical strength and helps protect diseases of the heart, urinary and reproductive tracts, and reduce the incidence of cancer,It is a rich source of Glucosinoldes, which has been proven to reduce cancer, and that eating more than one meal per week from the pink tablets of this plant reduces the risk of cancer by 45%, in addition to that it helps prevent retinal diseases (14).Recently, the demand for broccoli consumption has increased, and global markets have witnessed this demand due to its high nutritional value and good taste, and this was confirmed by the remarkable increase in the cultivated area of broccoli and the increase in production in recent decades in all global markets (13).Plant breeders aim to obtain hybrids and cultivars with desirable agricultural characteristics for important agricultural crops through breeding and improvement programs and to know the extent to which they are adapted to the environmental conditions prevailing in the area in which the plant grows. This requires the provision of new hybrids or cultivars. Broccoli is still cultivated in Iraq in limited areas within the scope of research and public and private nurseries, but there is a high desire to increase the cultivated areas of it by introducing some cultivars and hybrids that can be adopted in agriculture in the future, especially since Iraq is characterized by the appropriate conditions for its cultivation due to its multiple uses and nutritional value high, It was found (18) in a study of a number of broccoli cultivars grown for the seasons VIZ, KTIS Packman, Aiswarya and Puspa, the excelled of the Packman cultivar in the total yield of flower disk 20.26 tons. ha-1 and the weight of the flower disk 357.3 g compared to other cultivars.Some studies conducted in Iraq indicated the success of early cultivation of this crop using some hybrid cultivars, which were characterized by their low need for the low temperatures necessary for the formation of flower disks.A study of the effect of three genotypes of broccoli (Nahar, G4, and Sold) was conducted by Al-Shammari et al. (2016) that the Nahar hybrid was significantly excelled on the average main pod weight 2.05 kg and the average main pod diameter 31.70 cm (5),Thus, determining the appropriate planting date is in order to avoid the occurrence of any environmental stresses on the plant, which may cause damage to one of these main components (6), and it was found (6) when planting broccoli (Italica), with three seeding dates: 9/20 and 28/ 9 and 4/10, the plants grown in the second date significantly excelled 28/9 in the circumference of the flower disk (35.067) cm, the yield of one plant (186.46 g.plant^{-1}) and the total yield of the flower disk (12.43 tons.ha^{-1}).Foliar spraying means spraying nutrient solutions on the vegetative system in limited concentrations and at a specific time that enables the plant to absorb them through the stomata, cell walls and membranes to participate in the vital processes of the plant. We need foliar nutrition to ensure a quick and effective response by the plant and to treat the shortage of nutrients (12).Foliar nutrition is important in preventing the depletion of the necessary nutrients in the leaves, where its deficiency leads to a decrease in the amount of dry matter in the plant as a result of the low efficiency of carbon metabolism (19).

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(21) stated that spraying broccoli plants with borax at an average of 2% and 3%, after 30 and 60 days of sowing, led to a significant increase in the length and diameter of the stalk flower, the total yield of the plant, and the yield of heads 13.37 tons. ha^{-1} and average head weight.

research aims :

1- Determining the best date for planting seedlings to obtain good growth and yield in quantity and quality under the conditions of Nineveh province.

2- Knowing the best hybrids used in the study and obtaining the highest yield and the best quality of heads under the conditions of Nineveh province.

3- Improving plant growth and increasing the quantitative and qualitative yield by spraying with zinc and boron sulfate.

4- Knowing the best bi and triple interactions to obtain good vegetative growth, good yield of discs, and of good quality.

Materials and methods

The experiment was conducted in the vegetable field / Department of Horticulture and Landscape Engineering / College of Agriculture and Forestry / University of Mosul - during the agricultural season 2018-2019. Soil samples were taken from the field and from different areas before starting the experiment from the surface of the soil at a depth of 30 cm and they have analyzed to know some chemical and physical properties of the field soil (Table 1). The maximum and minimum temperatures, average wind speed and rainfall were recorded during the study period (Table 2).

Table (1): Some physical and chemical properties of field soil before cultivation.

Traits	**values**	**units**
EC	**0.25**	**Mmho.cm^{-1}**
pH	**7.42**	**———**
TDS	**170**	**ppm**
nitrogen	**0.126**	**%**
phosphorous	**9.54**	**ppm**
potassium	**125.173**	**ppm**
soil texture	**Sandy loam**	
Clay	**14**	**%**
Silt	**16**	**%**
Sand	**70**	**%**

The chemical and physical properties of soil were analyzed in Kirkuk Agriculture Directorate / Laboratories of the Water and Soil Management Division.

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Table (2) Average maximum and minimum temperatures, average wind speed and rain during the study period from September - end of March 2018-2019

Date	climatic elements			
	Rainfall average (mm)	wind speed average m.s	minimum temperature Average (°C)	Maximum temperature average (°C)
September / 2018	10.2	0.0	26.6	40.4
October	5.2	21.1	21.8	32.1
November	4.6	129.8	13.0	20.8
December	3.7	94.0	9.3	15.8
January 2019	5.2	46.2	5.8	14.7
February	11.3	37.9	7.1	16.0
March	5.4	117.6	8.6	18.2

General Directorate of Meteorology - Department of Agriculture and Climate / Nineveh province.

The land was divided into three replicates to include each replicate 24 experimental units, each experimental unit 3 m long and 1 m wide. The experimental unit area was 3 m 2, leaving a distance of 1 m between one Terrace and another, and leaving a distance of 0.75 m between each experimental unit and another to prevent mixing spray materials between treatments with the cultivation of an experimental unit at the beginning and end of each replicate as guard plants. The drip irrigation system was installed and then the soil and all experimental units were covered with black plastic cover.The experiment was designed according to the Split-plots-System Spilt system within the Randomized Complete Block Design (RCBD) and with three replications. Sub-sub-plots.

Experimental treatments :

The experiment included a study of three factors:

The first factor: planting dates, which are:

First date 9/20

Second date 5/10

Third date 10/15/15

treatments were conducted when the seedlings reached 3-4 true leaves.

The second factor: the hybrid: Two hybrids of broccoli were grown:

Parasio and Danar

Hybrid Prasio produced by (TAKII) Japan and Hybrid Danar produced by (TOKITA) Australian company, seed purity 99%, seed germination rate 85%.

The third factor: spraying with zinc and boron sulfate:

1- spray water only

2- Zinc sulfate at a concentration of 300 mg.L-1

3- Boron at a concentration of 60 mg. L-1 (Boric acid 17% boron)

4- Zinc sulfate + boron (300 mg.l-1 + 60 mg.l-1)

The spraying was coundected a month after the planting date, 15 days between one spraying and another, and the number of sprays per appointment was 4 sprays.

studied traits

1: stem length of the disc (cm):

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The stem length of the five flowering discs was calculated using metric tape and extracting the average.

2: Circumference of the main disc (cm):

The circumference of the mature major flowering discs was calculated by metric tape measure for the circumference of the five major flower discs and the average extracted.

3: Average weight of the main disc (g. plant^{-1}):

It was calculated by taking the weight of the mature main flowering discs of five plants per unit of the experimental unit and extracting the average.

4: Crown length for main flowering disc(cm):

The crown length of the flowering disc was calculated by metric tape measure for five plants per experimental unit and the rate extracted.

5: The total yield of the main flowering discs (ton. ha^{-1}):

The yield of one experimental unit was calculated and then due to the hectare using the following equation:

$$\textbf{total yield(tons. ha}^{-1}\textbf{)} = \frac{Yield\ of\ experimental\ unit\ (tons)\ x\ 10000}{Experimental\ unit\ area}$$

The total yield of one experimental unit was calculated by calculating the cumulative yield of each experimental unit and then attributed to the hectare using the following equation:

6: Number of secondary discs (disc.plant^{-1}):

The number of secondary flowering discs on the main stem of the experimental unit plants was calculated and the average was extracted.

After recording the data, it was statistically analyzed using the (22) system and Duncan's polynomial test was conducted at the probability level of 0.05 (4).

Results and discussion

1: Stem length of the main flowering disc (cm):

It is noted from the results in Table (3) that the transplant date 9/20 was significantly excelled on the stem length of the flowering disc compared to the other two dates, which amounted to 27.30 cm. As for the effect of hybrids, the Parasio hybrid gave more stem length of the flowering disc 26.55 cm with a significant difference compared to the hybrid Danar 19.66 cm. In the spray treatments, it is noticed that spraying with zinc and boron and with zinc + boron gave the most length of the stem of the flowering disc 24.02, 23.64 and 24.80 cm, respectively, and with significant difference with the treatment of spraying with water only, which gave the lowest length of the stem of the flowering disc 19.16 cm. In the bi-interaction between the seeding dates and the hybrid, it is noted that the planting date in the hybrid Parasio 20/9 gave the most length of the stem, the flowering disc, 35.34 cm,It differed significantly with all treatments. The minimum stem length of the flowering disc was found at the planting date 5/10. The Danar hybrid was 17.00 cm.In the bi-interaction between the dates of seedlings and spraying, it is noted that the time of transplanting is 20/9 and spraying with zinc gave the most length of the stem of the flowering disc30.56 cm,It did not differ significantly with the treatments of the same date, spraying with boron and spraying with zinc + boron, and it differed significantly with the rest of the treatments.In the bi-interaction between hybrids and spraying, it was noted that the treatments of the hybrid Parasio, spraying with zinc, spraying with boron and zinc + boron gave the most length of the stem of the flowering disc 29.76, 27.06 and 27.35 cm, respectively, and they differed significantly with the rest of the treatments, and the least length of the stem of the flowering disc was 16.28 cm in the treatment of hybrids Danar and spray with water only. In the triple interaction between the studied factors, it is noted from the same table that the seeding date 20/9 for the hybrid Parasio and spraying with zinc gave the most length of the stem of the was 41.20 cm

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and it differed significantly with all treatments except for the treatment of the planting date of 20/9 for the hybrid Parasio and spraying with boron and the least length of the stem of the flowering disc found in seedling date 5/10 of hybrid Danar and spraying with water only 13.40 cm.

2: Circumference of the flowering disc (cm):

It is noted from the data in Table (11) that the seeding date 20/9 gave the largest circumference of the flowering disc 42.99 cm and it differed significantly with the seeding dates 5/10 and 15/10, and the minimum circumference of the flowering disc was 19.05/10 at the time of seedling.There was no significant difference between Parasio and Danar hybrid in this trait. It is noted from the same table that spraying with zinc and boron and spraying with zinc + boron gave the most circumference of the flowering disk and it reached 28.19, 30.35 and 30.82 cm, respectively, and they differed significantly only with the treatment of spraying with water, which gave the lowest circumference of the flowering disk 24.19 cm.In the bi-interaction between the seeding dates and hybrids, it is noted that the seeding date is 20/9 and for the two hybrids Parasio and Danar gave the largest circumference of the pink disc 42.80 and 43.1 cm, respectively, and it differed significantly with all treatments, and the lowest circumference of the pink disc was found at the seeding date 10/15 and for the Parasio hybrid it was 17.5.In the bi-interaction between the seeding dates and spraying, it is noted that the transplanting date 20/9 and spraying with zinc and boron gave the largest circumference of the flowering disc 45.43 and 45.51 cm, respectively, and the lowest circumference of the flowering disc found when spraying with water only at the time of seedling 15/10 was 16.66 cm.In the bi-interaction between hybrids and spraying, it is noted that Parasio hybrid, spraying with zinc + boron, hybrid Danar, spraying with boron and zinc + boron gave more circumference of the flowering disc 30.60, 30.82 and 30.04, respectively, and they differed significantly with the treatments of hybrid Danar and spraying with water only, and treatments of hybrid Parasio and spraying with zinc and water only Which gave the minimum circumference of the pink disc and was 24.08 cm. In the triple interaction between the studied factors, it is noted that the planting date of 20/9 for the Danar hybrid and spraying with zinc and boron gave the largest circumference of the flowering disk 47.86 and 46.73 cm, respectively, and they differed significantly with most of the treatments, and the lowest circumference of the flowering disk was found at the time of seedling 15/10 for the Parasio and spray hybrid with water only and reached 14.70 cm.

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Table (3): Effect of planting dates, hybrids and spraying with zinc, boron, and zinc + boron sulfates and the interaction between them on stem length (cm) of the main flowering disk of broccoli.

hybrid average	planting dates X hybrid	Spraying Treatments mg.L^{-1}				hybrid	planting dates
		Zinc 300+ boron 600	boron 600	Zinc 300	water only (control)		
26.55 a	35.34 a	34.26 bc	37.40 ab	41.20 a	28.50 cd	Parasio	20/9
	20.90 bc	21.80 d-i	20.60 i-e	24.66 e-d	16.46 g-j		5/10
	23.42 b	26.00 cd	23.10 d-j	23.43 d-f	21.13 e-i		15/10
19.66 b	19.25 bc	19.66 e-j	21.13 e-i	19.93 e-j	16.26 h-j	Danar	20/9
	17.00 c	22.00 d-i	16.93 f-i	15.66 ij	13.40 j		5/10
	22.73 b	.06 25 de	22.60 d-g	24.06 de	19.20 e-j		15/10
	The average of planting dates 27.30 a	26.96 a-c	29.26 ab	30.56 a	22.38 d-f	20/9	Spraying Treatments X planting dates
	18.95 c	21.90 d-f	18.80 fg	20.16 eg	14.93 g	5/10	
	23.08 b	25.53 b-d	22.86 c-f	23.75 c-e	20.16 ef	15/10	
		27.35 a	27.06 a	29.76 a	22.3 b	Parasio	Spraying Treatments X hybrid
		22.24b	20.22b	19.88b	16.28c	Danar	
		24.80a	23.64a	24.02a	19.16b	Spraying Treatments average	

Means with the same letter or letters within the individual factors or their interactions do not differ significantly between them according to Duncan's polynomial test at the 0.05 probability level.

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Table (4): Effect of planting and hybridization dates and spraying with zinc, boron, and zinc + boron sulfates and the interaction between them on the circumference of the flowering disc (cm) of broccoli.

hybrid average	planting dates X hybrid		Spraying Treatments mg.L^{-1} Zinc 300+ boron 600 .	boron 600	Zinc 300	water only (control)	hybrid	planting dates
27.69 a	42.80 a		44.00 a b	44.00 a b	43.00 a b	39.93 a b	Parasio	20/9
	22.71 b		29.26 c d	25.60 c- e	18.40 e- g	17.60 e – g		5/10
	17.55 b		18.53 e- g	19.73 e- g	17.23 f g	14.70 g		15/10
29.44 a	43.16 a		40.33 a b	46.73 a	47.86 a	37.73 b	Danar	20/9
	24.63 b		30.26 c	25.13 c – f	22.26 d- g	20.86 e- g		5/10
	20.53 b		22.53 c- g	20.60 e- g	20.40 e- g	18.60 e- g		15/10
	The average of planting dates	42.99 a	42.16 a b	45.51 a	45.43 a	38.83 b	20/9	Spraying Treatments X planting dates
		23.67 b	29.76 c	25.36 c d	20.33 d e	19.23 e	5/10	
		19.05 b	20.53 d e	20.16 d e	18.81 e	16.66 e	15/10	
			30.60 a	29.87 a- c	26.21 b-d	24.08 d	Parasio	Spraying Treatments X hybrid
			30.04 a	30.82 a	30.17 a b	25.73 c d	Danar	
			30.82 a	30.35 a	28.19 a	24.19 b	Spraying Treatments average	

Means with the same letter or letters within the individual factors or their interactions do not differ significantly between them according to Duncan's polynomial test at the 0.05 probability level.

3: Main flowering Disc Weight (g):

It is noted from Table (5) that the planting date of 20/9 gave the most weight to the main flowering disc and reached 281.20 g, and it differed significantly with the seeding dates 5/10 and 5/10, and also significantly excelled on the date 5/10 on the date of 15/10, and the lowest weight for the main flowering disc at the time of seedling it was 10/15 37.60 g. It is noted from the table that there is a significant difference between the two hybrids, where the Parasio hybrid gave the most weight to the main flowering disc amounted to 140.73 g, with a significant difference compared to the hybrid Danar, which gave 115.84 g.In the effect of spraying, it was found that spraying with zinc + boron gave the most weight to the main flowering disk 156.33 g and differed significantly from the rest of the treatments, and

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the lowest weight of the main flowering disk was found when spraying with water only and it amounted to 104.17 g. In the bi-interaction between the seeding dates and hybrids, it is noted that the seeding date is 20/9 and for the Parasio hybrid, the main flowering disc weight was 321.98 g and it differed significantly with the rest of the treatments. In the bi-interaction between the dates of seedlings and spraying, we note from the table that the seeding date 20/9, spraying with boron and spraying with zinc + boron gave the most weight for the main flowering disc 306.37 and 316.77 g, respectively, and differed significantly from the rest of the treatments, and the lowest weight for this trait at the time of seeding 15/ 10 and spraying with water only 33.70 g. In the bi-interaction between the hybrid and spray, it is noted from the table that the hybrid Parasio and spraying with zinc + boron gave the most weight to the main flowering disc 174.29 g and differed significantly with all treatments, and the lowest value for this trait was found by treating the hybrid Danar and spraying with water only, and it amounted to 89.33 g. In the triple interaction, it is noted that the planting date of 20/9 for the Parasio hybrid and spraying with zinc + boron gave the most weight for the main flowering disc and it amounted to 380.00 g and it differed significantly with all treatments, while the planting date was given 15/10 for the hybrid Parasio and spraying with water only the lowest values for this trait amounted to 26.33 g .

Table (5): Effect of planting dates, hybrids and spraying with zinc, boron, and zinc + boron sulfates, and the interaction between them on the weight of the main flowering disk (g) of broccoli.

hybrid average	planting dates X hybrid		Spraying Treatments mg.L^{-1}				hybrid	planting dates
			Zinc 300+ boron 600 .	boron 600	Zinc 300	water only (control)		
140.734 a	321.98 a		380.00 a	313.20 b	321.40 b	273.33 b c	Parasio	20/9
	70.82 c		108.67 f	59.87 g h	57.33 g h	57.40 g h		5/10
	29.40 c		34.20 e	29.47 h	27.61 h	26.33 h		15/10
115.844 b	240.43 b		253.53 c d	299.53 b c	222.27 d e	186.40 e	Danar	20/9
	61.25 c		105.73 f g	52.37 h	46.37 h	40.53 h		5/10
	45.85 h		55.87 h	39.00 h	47.47 h	41.07 h		15/10
	The average of planting dates	281.20 a	316.77 a	306.37	271.83 b	229.87 c	20/9	Spraying Treatments X planting dates
		66.00 b	107.20 d	56.12 e	51.85 e	48.97 e	5/10	
		37.6 c	45.03 e	34.23 e	37.54 e	33.70 e	15/10	
			174.29 a	134.18 b	135.45 b	119.02 b c	Parasio	Spraying Treatments X hybrid
			138.38 b	130.30 b c	105.37 c d	89.33 d	Danar	
			156.33 a	132.23 b	120.40 b c	104.17 c	Spraying Treatments average	

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4: Crown length of the main flowering disc (cm):

It is noted from Table (6) that the sowing date of 20/9 gave the most length of the crown of the main flowering disc was 5.60 cm and it differed significantly with the transplant dates of 5/10 and 15/10, and the least length of the crown of the main flowering disc was 2.49 cm at the time of transplanting 10/15. There were no significant differences between Parasio and Danar hybrids in this trait. It was found that spraying with zinc + boron gave the most crown length of the main flowering disc, which was 4.41 cm, and it differed significantly with the treatment of spraying with zinc and water only, which gave the minimum crown length of 2.95 cm. In the bi-interaction between the seeding dates and hybrids, it is noted from the same table that the seeding date is 20/9 for the Parasio hybrid, which gave the most length of the crown of the main flowering disc 6.28 cm and it differed significantly with all treatments except for the treatment of the seeding date 20/9 in the hybrid Danar, and the lowest length was found at the time of planting 15/10 and for the Parasio hybrid it reached 2.08 cm and the bi-interaction between the dates of seedling and spraying, it is noted that the sowing date of 20/9 treatments of spraying with zinc and boron and spraying with zinc + boron gave the most crown length of the main flowering disc 6.04, 5.64 and 6.19 cm, respectively, and they differed significantly with all treatments in this interaction, and the least length of the crown The main flowering disc was found at the time of seeding 15/10 and sprayed with water only and reached 2.08 cm. In the bi-interaction between the hybrid and spraying, it is noted that the hybrid Danar and spraying with zinc + boron gave the most crown length of the main flowering disc 4.51 cm and it differed significantly with the treatment of hybrid Danar and spraying with water only and the treatments of the hybrid Parasio and spraying with zinc and water and the latter gave the lowest crown length of the main flowering disc 2.89 cm. In the triple interaction, it is noted that the seedling date 20/9 and the Parasio hybrid and spraying with zinc + boron gave the most length of the crown of the main flowering disc reached 7.24 cm and it differed significantly with most of the treatments, and the lowest length of the crown of the main flowering disc was found in the treatment of seedling date 10/15 and for the hybrid Parasio and spraying with water It was 1.70 cm.

5: The total yield of the main flowering discs (ton. ha^{-1}):

From the data in Table (7), it is noted that the planting date of 9/20 gave the most total yield of the main discs amounting to 13.859 tons. ha^{-1} and significantly differed with the seeding dates 5/10 and 15/10, and the lowest yield of the main flowering discs was found at the planting date 10/15 1.621 tons. ha^{-1}. There was no significant difference between the two hybrids and spray treatments in this trait.In the bi-interaction between the seeding dates and the hybrids, it was found that the sowing date was 20/9 and the Parasio hybrid gave the most total yield of the main flowering discs amounting to 14,883 tons. ha^{-1} and differed significantly with all treatments. It is also noted that the planting date of 20/9 for the Parasio hybrid was significantly excelled on the rest of the treatments, and the planting date of 15/10 for the Parasio hybrid gave the lowest total yield of the main flowering discs 1.369 tons. ha^{-1}.In the bi-interaction between the dates of seedlings and spraying, it was found that the planting date of 20/9 and spraying with zinc gave the most total trait of the main flowering discs amounted to 15,914 tons. ha^{-1} and differed significantly with all treatments except for the two treatments of planting date 20/9, spraying with boron and spraying with zinc + boron, and a waffle total yield of the main pink discs was found at the time of seedling 10/15 and spraying with distilled water only 1.072 tons. ha^{-1}.In the bi-interaction between the hybrid and the spray, it is noted from the same table that the hybrid Parasio and spraying with zinc + boron gave the most total yield of the main pink discs amounted to 7.821 tons. ha^{-1} and differed

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significantly only with the treatment of hybrid Danar and spraying with water only, which gave the lowest yield of the main flowering discs 4.108 tons. ha^{-1}.In the triple interaction, it is noted from the same table that the treatments of sowing date 20/9 for the hybrid Parasio and spraying with zinc + boron and spraying with zinc for the hybrid Danar gave the most total yield for the main flowering discs 16.938 and 16.830 tons. ha^{-1}, respectively, and they differed significantly with most of the treatments, and the lowest total yield of the main flowering discs was found in the treatment of seedling date 10/15 for hybrid Danar and spraying with water only 0.959 tons. ha^{-1}.

Table (6): Effect of planting dates, hybrids and spraying with zinc, boron, and zinc + boron sulfates and the interaction between them on the crown length of the main flowering disk (cm) of broccoli plant.

hybrid average	planting dates X hybrid		Spraying Treatments $mg.L^{-1}$				hybrid	planting dates
			Zinc 300+ boron 600 .	boron 600	Zinc 300	water only (control)		
3.73 a	6.28 a		7.24 a	6.52 a b	6.31 a- c	5.04 b- d	Parasio	20/9
	2.82 c d		3.46 e- h	3.46 e- h	2.43 g- i	1.93 h i		5/10
	2.08 d		2.23 h- i	2.43 g i	1.96 h i	1.70 i		15/10
3.92 a	4.92 a b		5.13 b – d	4.70 c- f	5.78 a- c	3.99 d- g	Danar	20/9
	3.95 b c		5.20 b- d	4.80 c e	3.23 e- h	2.56 g- i		5/10
	2.90 c d		3.20 f- i	2.96 g i	3.00 g i	2.46 g -i		15/10
	The average of planting dates	5.60 a	6.19 a	5.64 a	6.04 a	4.52 b	20/9	Spraying Treatments X planting dates
		3.38 b	4.33 b	4.13 b	2.83 c	2.25 c	5/10	
		2.49 b	2.71 c	2.70 c	2.48 c	2.08 c	15/10	
			4.31 a b	4.14 a b	3.57 b c	2.89 c	Parasio	Spraying Treatments X hybrid
			4.51 a	4.17 a b	4.00 a b	3.00 c	Danar	
			4.41 a	4.16 a b	3.78 b	2.95 c	Spraying Treatments average	

Means with the same letter or letters within the individual factors or their interactions do not differ significantly between them according to Duncan's polynomial test at the 0.05 probability level.

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Table (7): Effect of planting dates, hybrids and spraying with zinc, boron, and zinc + boron sulfates and the interaction between them on the total yield of the main flowering discs (tons. ha^{-1}) of broccoli.

hybrid average	planting dates X hybrid		Spraying Treatments mg.L^{-1}				hybrid	planting dates
			Zinc 300+ boron 600 .	boron 600	Zinc 300	water only (control)		
6.518 a	14.883 a		16.938 a	14.053 a- c	14.998 a- b	13.547 a- c	Parasio	20/9
	3.303 c		5.071 e	2.794 e	2.673 e	2.675 e		5/10
	1.369 c		1.453 e	1.375 e	1.463 e	1.185 e		15/10
5.854 a	12.833 b		11.050 b c	13.978 a c	16.830 a	9.476 c d	Danar	20/9
	2.856 c		4.934 d e	2.444 e	2.160 e	1.888 e		5/10
	1.873 c		2.501 e	1.820 e	2.215 e	0.959 e		15/10
	The average of planting dates	13.859 a	13.994 a b	14.016 a b	15.914 a	11.511 b	20/9	Spraying Treatments X planting dates
		3.080 b	5.003 c	2.619 c d	2.416 c d	2.282 c d	5/10	
		1.621 b	1.977 c d	1.597 c d	1.839 c d	1.072 c	15/10	
			7.821 a	6.074 a b	6.378 a b	5.802 a b	Parasio	Spraying Treatments X hybrid
			6.162 a b	6.081 a b	7.068 a b	4.108 b	Danar	
			6.991 a	6.077 a	6.722 a	4.955 a	Spraying Treatments average	

Means with the same letter or letters within the individual factors or their interactions do not differ significantly between them according to Duncan's polynomial test at the 0.05 probability level.

6: Number of secondary flowering disks (disc. plant^{-1}):

It is noted from Table (8) that the seeding date 9/20 and 5/10 gave the most number of secondary flowering discs 5.64 and 4.54 disc. plant^{-1}, respectively, and differed significantly with the seeding date 10/15, which gave the lowest number of secondary flowering discs 3.22 disc. plant^{-1}. No significant difference was observed between the two hybrids in this trait.It is noticed that the treatments of spraying with zinc, boron and zinc + boron gave the most number of secondary flowering discs 4.62, 5.05

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and 5.03 disc. plant^{-1}, respectively, and they differed significantly compared to spraying with water only, which gave the lowest value for this trait and amounted to 2.90 flowering disc. plant^{-1}.In the bi-interaction between seedling dates and hybrids, it was found that the two treatments of seeding date 20/9 for Parasio and Danar hybrids gave the most number of secondary flowering discs 5.52 and 5.75 disc. plant^{-1}, respectively, and they differed significantly only with the treatments of seedling date 15/10 in Parasio and Danar hybrids, and the latter gave the lowest number for this trait and amounted to 3.00 disc. plant^{-1} In the bi-interaction between the seeding dates and spraying, it is noted that the treatments of sowing date 20/9 and spraying with zinc and spraying with boron gave the most number of secondary flowering disks 6.83 and 6.61 disks. Plant-1, respectively, and they differed significantly with all treatments of this interaction, except for seedling date 5/10 and spraying with zinc + boron, and the lowest value for this trait was 2.30 flowering disc. plant^{-1} in the treatment of seedling date 10/15 and spraying with water only.In the bi-interaction between hybrids and spray, it was found that the hybrid Danar and spraying with boron gave the most number of secondary flowering disks, which reached 5.92 disc. plant^{-1} and it differed significantly with most of the treatments. Parasio hybrid treatment and spraying with water only gave the lowest number of flowering discs 2.85 disc. plant^{-1}.In the triple interaction, it is noted that the sowing date of 20/9 for the Danar hybrid and spraying with boron gave the most secondary flowering discs 8.33 disc. plant^{-1}, and it differed significantly with all treatments, and the lowest number of flowering discs was found when treating for the seedling date A 5/10 and for the Danar hybrid and spraying with water only, and it amounted to 2.00 disc. plant^{-1}.

Means of the same letter or letters within the individual factors or their interactions do not differ significantly between them according to Duncan's polynomial test at the 0.05 probability level. The significantly excelled of the planting date of sowing 20/9 in the characteristics of the quantitative yield represented by the length of the stem of the main flowering disk (Table 3), the circumference of the main flowering disk (Table 4), the weight of the main pink disk (Table 5), the length of the crown of the main flowering disk (Table 6) and the total yield of the main pink disk (Table 7).) and the number of secondary disks (Table 8),It may be due to the suitability of the date to the weather conditions of the maximum and minimum temperatures (table 2) and thus led to an increase in vegetative growth and an increase in the building of carbohydrates in the leaves and their transfer to the active growth areas and the accumulation of manufactured materials, which encouraged an increase in the qualities of the quantitative yield, and this is in line with what Mentioned (16, 23 and 7). It is noted from the results of tables (3 and 5) that the Parasio hybrid is significantly excelled to the Danar hybrid in the stem length of the main disc and the weight of the main disc. It is noticed from tables (3, 4, 7 and 8) that spraying with zinc and spraying with zinc + boron significantly excelled the quantitative yield trait represented in the stem length of the main disc, the circumference of the disc, the total yield of the main flowering discs and the number of secondary flowering discs.The reason is due to the effectiveness of the elements and spraying them on the leaves, where boron facilitates the movement and transmission of photosynthesis products from the leaves to the active areas, and that the foliar feeding prepares the plant with the elements necessary for growth in accordance with what I mentioned (2)and the zinc element works on the transfer of active substances in the plant, such as the transfer of sugars, which is necessary for cell division, and boron has a basic role in the formation of cell walls, and works to facilitate the movement and transfer of photosynthetic products from the leaves to the active areas in the plant, such as the transfer of sugars, which is necessary for cell division. (26),It also enters into the formation of the amino acid tryptophan, which

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is responsible for the elongation of cells (3), and this is in line with what he mentioned (8, 21, 9, 20 and 11). The moral superiority of the two- and three-way interactions is due to the cumulative effect of the single factors in terms of the effect of tribute conditions, the influence of genetic factors, and the effectiveness of the elements.

Table (8): Effect of planting dates, hybrids and spraying with zinc, boron, and zinc + boron sulfates and the interaction between them on the number of secondary flowering discs (disc. plant^{-1}) of broccoli.

hybrid average	planting dates X hybrid		Spraying Treatments mg.L^{-1}				hybrid	planting dates
			Zinc 300+ boron 600 .	boron 600	Zinc 300	water only (control)		
4.35 a	5.52 a		6.88 a-c	4.88 c-g	6.66 a – c	3.60 d-j	Parasio	20/9
	4.11 a b		5.77 b d	4.11 d- j	4.33 d- i	2.20 h-j		5/10
	3.41 b		4.33 d- i	3.55 d- j	3.11 g- i	2.66 h- j		15/10
4.58 a	5.75 a		4.40 d-h	8.33 a	7.00 a- b	3.22 f-j	Danar	20/9
	4.97 a b		5.44 b- e	5.4 b-e	5.33 c-e	3.66 d-j		5/10
	3.00 b		3.33 e - j	4.00 d- j	2.77 g – j	2.00 j		15/10
	The average of planting dates	5.64 a	5.66 a-b	6.61 a	6.83 a	3.44 c-e	20/9	Spraying Treatments X planting dates
		4.54 a b	5.61 a b	4.77 b- c	4.83 b c	2.9 d e	5/10	
		3.22 b	3.83 b c	3.70 b c	2.90 d e	2.30 e	15/10	
			5.6 a b	4.18 c	4.70 b c	2.85 d	Parasio	Spraying Treatments X hybrid
			4.40 c	5.92 a	5.03 a-c	2.96 d	Danar	
			5.03 a	5.05 a	4.62 a	2.90 b	Spraying Treatments average	

Means with the same letter or letters within the individual factors or their interactions do not differ significantly between them according to Duncan's polynomial test at the 0.05 probability level.

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