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

Noha Walid Qader Al-Zubaidi

Hussein Jawad Muharram Al-Bayati

College of Agriculture and Forestry - University of Mosul - Republic of Iraq

Email Noha.waleed@uomosul.edu.iq

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 9/20 and boron spraying for the Parasio hybrid differed significantly and gave the highest plant height 49.47 cm and the most leaf area 10511.4 cm². plant⁻¹, planting date 9/20 and spraying with zinc, boron, zinc + boron for the hybrid Parasio gave the most number of leaves 57.66, 63.00 and 58.26 leaves. Plant⁻¹, planting date 5/10 and spraying with zinc + boron for the hybrid Danar differed significantly and gave more chlorophyll content in leaves 83.76, The planting date 5/10 and spraying with water only for the hybrid Parasio gave the highest percentage of dry matter in the leaves 29.37%, and the planting date 20/9 and spraying with zinc for the hybrid Danar gave the lowest number of days for the formation of the main flowering disc 44.00 days.

Key words: seedling date - zinc - boron - stem - leaves - broccoli.

نهى وليد قادر الزبيدي قسم البستنة وهندسة الحدائق/ كلية الزراعة والغابات/ جامعة الموصل

Noha.waleed@uomosul.edu.iq

الخلاصة

نفذت التجربة في حقل الخضراوات / قسم البستنة وهندسة الحدائق / كلية الزراعة والغابات / جامعة الموصل في الموسم الزراعي 2018-2019، لدراسة تأثير ثلاث مواعيد للشتل 20/0 و2/10 و2/10 والرش بكبريتات الزنك 300 ملغم. لتر^T والبورون . 00 ملغم. لتر ¹ وبكبريتات الزنك + البورون بالإضافة الى معاملة المقارنة (رش الماء فقط) لهجينين من البروكلي Prasio و معمدت التجربة وفق نظام الألواح المنشقة المنشقة 2010 والرش بكبريتات الزنك 9 البورون بالإضافة الى معاملة المقارنة (رش الماء فقط) لهجينين من البروكلي Prasio و معمدت التجربة وفق نظام الألواح المنشقة المنشقة المنشقة 2010 والرش بكبريتات الزنك 9 البورون بالإضافة الى معاملة المقارنة (رش الماء فقط) لهجينين من البروكلي 2010 والبرق الكاملة وسمت التجربة وفق نظام الألواح المنشقة المنشقة المنشقة المائل 9/20 والرش بالبورون للهجين 2010 والرش بالزنك 9 العربين اعلى ورائلة العشوائية الكاملة والتواع المترات. اكدت النتائج ان موعد الشتل 20/0 والرش بالبورون للهجين 2010 والرش بالزنك والبورون والزنك + الرتفاع معاديا وأعطت أعلى ورائل البلات 9/20 سرون الهجين 2010 والرش بالبورون والزنك 9 العلمان أواعات العشوائية الكاملة الرتفاع النابات 70.20 والغربين 2010 معنوا وأعطت أعلى ورائون النبات 9/20 سرون الهران معاد من 2010 سم². نبات¹¹، وموعد الشتل 20/0 والرش بالزنك 9 الرتفاع البورون والزنك 9 البورون للهجين 2010 والرش بالزنك والبورون والزنك 9 البورون الهجين 2010 والرش بالزنك والبورون والزنك 9 البورون الهجين 2010 والرش بالزنك والبورون والزمن بالماء والورون للهجين 2010 والرش بالزنك والبورون والزمي بالماء وموعد الشتل 20/0 والرق 30.70 ور20.20 من 2010 والرش بالماء البورون الهجين 2010 المتين 2010 والر ماء والمادة البولي 2010 مالوراني 9 موعد الشتل 2010 والرش بالماء البورون الهجين 2010 الخليف والوراق 2010 والما معنوي الوراق والي ومويل في الأوراق 2010 والرش بالماء والرش بالماء البورون الهجين 2010 والرش بالماء ولوراق 40.20 والوراق 40.20 والوراق 2010 مالوراني 9 وموعد الشتل 2010 والرش بالماء والرون بالماء منوي ماليفة في الأوراق 2010 ماء وموعد الشتل 2010 والرش بالماء وقط للهجين 2010 والولي مالوراني 10 والولي مالولي والولي والي 10 والر مالولي 40.20 والر مالولي 10 والو مالولي والو 10 والولي 10 والي مالولي 10 والو والو 10 وا

Introduction

Broccoli Brassicea oleracea var. Italica is one of the vegetable crops belonging to the cruciferous family (Brassicaceae), wild species of it are found in the Mediterranean region, but it is little spread in Iraq and comes 31st in the world in terms of production, and was first planted in England in 1720 AD and its cultivation moved to the United States of America in 1806 AD (18). It is characterized by good nutritional value, as each 100 gm of the soft weight of the flowering disc contains 5.9 g of sugars, 0.3 fats, 3.6 g of protein, 32 calories and 89.1 g of water. It is considered one of the foods low in free fat, sodium and calories, a good source of many vitamins such as vitamin A, C, D, riboflavin, niacin, carotenoids, folic acid (17). It is characterized by containing antioxidants that help prevent the risk of cancer because it contains Glucoraphanin, which enhances the body's immunity against stomach cancer, and Indole-3-carbinol, which prevents breast and colon cancer and enhances liver functions (16). The broccoli plant in Iraq is still cultivated 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 that Iraq is characterized by the appropriate conditions for its cultivation due to its multiple uses and its high nutritional value. It was mentioned (5) in an experiment conducted on two hybrids of broccoli, Paraiso and Monaco, that the hybrid Paraiso surpassed in plant height (54.08) cm. The leaf area is (38.90)dm2 and one of the most important agricultural operations that lead to an increase in production average is the cultivation of any crop at different dates in one season. In order to prolong the presence of this crop in the market for the longest possible period of time, i.e. it is called successive planting, i.e. planting the same cultivars or other cultivars at different dates during the same growing season, with an emphasis on early cultivation (2). (8) In studying the effect of planting date on the growth and production of broccoli (Italica), the

648

study included three planting dates, 20/9, 28/9 and 4/10, the excelled of plants grown on the second date 28/9 significantly in the trait Plant height (35.427 cm) and number of leaves $(20.89 \text{ leaves. Plant}^{-1})$ The leaf area (182.236)cm plant-1), the percentage of dry matter for leaves (25.947%), the percentage of dry matter for the heads was 26.400%, and the circumference of the flowering disc was 35.067 cm. The growth and production of this crop are affected by fertilization treatments, especially foliar feeding, which is one of the most efficient methods of fertilization, as it prepares the nutrient element for the plant when there is a problem in absorbing elements from the soil (1). The Iraq soil is one of the basal soils that stabilizes many elements, especially the micronutrients, and thus reduces the nutrient availability of the plant. Then, foliar spraying of nutrients is the appropriate method to provide plants with micronutrients. Including zinc, where zinc is a catalyst for the enzyme Carbonic Anhydarse and cytochromes and cannot be replaced by another element. It enters the formation of the amino acid Tryptophane, which is the IAA hormone responsible for the elongation of cells and the fertilization process in the plant, where the formation of seeds decreases when zinc deficiency, so it is preferable to provide the plant with it during flowering (4). Boron, which plants need in small quantities, 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, and it is necessary for cell division (22).

And that its presence increases the plant's resistance to drought, and the lack of boron causes brown discoloration of the flowering discs and causes physiological imbalance as a result of nutritional imbalance (3).Boron has a great relationship with plant hormones that affect plant growth and its importance in the formation of plant hormones (auxins).Boron helps in the germination of pollen and the growth of pollen tubes, and the plant's need for it is greater in the flowering and fruiting stage,

so its importance in the formation of seeds and fruits becomes clear.Boron is usually found in the soil in limited quantities, where it is absorbed into the plant in the form of borate BO2, and the foliar spray process is useful especially under conditions where absorption through the soil is difficult for nutrients due to soil fixation of many elements necessary for plant growth, which reduces its availability (10) It was mentioned (12) that the use of boron with zinc at a level of 1.5 kg. ha-1 on broccoli plant led to an increase in stem length, it was noted (13) in the study of the response of broccoli to foliar spraying with boron, where four concentrations of 0, 0.25, 0.5 and 1% were used that the concentration 0.25% gave the highest plant height of 39.31 cm and at a concentration of 0.5%, it gave the most number of leaves 12.83, and the most leaf weight 10.17 g.

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).

Traits	values	units		
EC	0.25	Mmho.cm ⁻¹		
рН	7.42			
TDS	170	ррт		
nitrogen	0.126	•⁄₀		
phosphorous	9.54	ppm		
potassium	125.173	ppm		
soil texture	Sandy loam			
Clay	14	%		
Silt	16	%		
Sand	70	%		

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

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

	climatic elements									
Date	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						

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

General Directorate of Meteorology Department of Agriculture and Climate / Nineveh provinceThe 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 conducted 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

Plant Height (cm): Number of Leaves (Leaf. Plant⁻¹), Leaf Area (cm. Plant⁻¹)

The relative content of chlorophyll in leaves (spad), Percentage of dry matter in leaves, number of days for formation of the main flowering disc 50% of plants:

Results and discussion

1: plant height (cm):

the results in Table (3), we note that the planting date of 20/9 gave the most plant height 42.03 cm and it differed significantly compared to the second dates 5/10 and the third 15/10. It is noted that there is no significant difference between Parasio and Danar hybrids in plant height.In the effect of spraying, it is noted that the most plant height reached 34.16 cm when spraying with zinc + boron, and it differed significantly only with spraying with water only (control), which gave the lowest plant height 27.08 cm, and no significant differences were observed between the treatments of spraving with zinc, boron and zinc + boron. In the biinteractions, it is noted from the same table regarding the interaction between the seeding dates and the hybrids that the treatments of the seeding date 20/9 in the two hybrids Parasio and Danar gave the highest plant heights, which were 45.80 and 38.26 cm, and they differed significantly with all other treatments, and the lowest plant height was 21.21 cm observed at the planting date. 5/10 for the Danar hybrid.In the interaction between the dates of seedlings and spraying, it is noted that the planting date of 20/9with all spraying treatments significantly excelled in plant height 36.60, 42.93, 45.60 and 43.00 cm for spraying with water, zinc, boron, zinc + boron, respectively, and they differed significantly with all other treatments, and less The height of the plant reached 21.00 cm at the time of transplanting 15/10 and spraying with water only.In the interaction between hybrids and spraying, it is noted from the same table that the Parasio hybrid with zinc and boron spraying gave the most plant heights 37.02 and 37.24 cm, respectively, and they differed significantly with all spraying treatments in the hybrid Danar. The lowest plant height reached 24.80

cm in the hybrid Danar and sprayed with water only. In the triple interaction between the studied factors, it is noted from the same table that the seeding date of 20/9 for the Parasio hybrid and spraying with boron gave the most plant height 49.47 cm. It differed significantly with all the treatments in this interaction except for the treatments of seedling date 20/9 for hybrid Parasio, spraying with zinc and spraying with zinc + boron.

2: Number of leaves (leaf. plant⁻¹):

We note from the results in Table (4) the significantly excelled of the planting date 20/9 over the two planting dates 5/10 and 15/10, and it gave the most number of leaves 50.89 leaves. Plant-1, and the planting date 10/15 was excelled on the date 5/10 in this trait, and the lowest number of leaves found at the date of seeding 5/10 was 19.54 leaves. plant⁻¹.As for the effect of the hybrid, it was found that the Parasio hybrid significantly excelled on the Danar hybrid in the number of leaves, and it gave 35.60 leaves. plant⁻¹, while the Danar cultivar gave 29.85 leaves, plant⁻¹. As for the effect of spraying, it was found that all spraying treatments were significantly excelled on that of spraying with water only, and no significant difference was observed between them. The most number of leaves was 35.07 leaves. Plant⁻¹ was found in the boron spray treatment, and the lowest value for this trait in the water spray treatment was only 28.42 leaves. plant⁻¹. In the bi-interaction between the dates of seedlings and hybrids, we note that the date of seedlings is 20/9 and the hybrid Parasio and gave the most number of leaves 56.96 leaves. Plant⁻¹, and it differed significantly with all treatments, and the least number of leaves was 5/10 at the time of seeding for the hybrid Danar 16.81 leaves. plant⁻¹. and the bi-interaction between the planting dates and the spraying treatments found that the planting date 20/9 and spraying with boron gave the most number of leaves 56.00 leaves. Plant⁻¹ and it differed significantly with all treatments except for the treatment of

planting date 20/9 and spraying with zinc, and the least number of leaves was found at the time of transplanting 5/10, spraying with distilled water only 15.43 leaves. plant⁻¹. In the bi-interaction between hybrids and spray, we notice that the interaction treatments of the hybrid Parasio and spraying with zinc, boron, and zinc + boron gave the most number of leaves: 36.65, 38.33 and 37.04 leaves. plant ⁻¹. They differed significantly with the rest of treatments , and the lowest number of leaves was 26.26 leaves. Plant -1 in Danar hybrid treatment and spray with water only.In the triple interaction between the studied factors, it is noted from the same table that the treatment of planting date 20/9 for the Parasio hybrid and spraying with zinc, boron and zinc + boron gave the most number of leaves 57.66, 63.00 and 58.26 leaves. plant⁻¹.They differed significantly with all other treatments in this interaction, and the lowest number of leaves was 13.26 leaves. Plant -1 when treating seedling date 5/10 for hybrid Danar and spraying with water only.

Table (3): Effect of planting dates, hybrids and spraying with zinc sulfate, boron, zinc + boron,
and the interaction between them on plant height (cm) of broccoli.

			Spra	ying Trea	tments m	g.L ⁻¹		
hybrid	planting dates X hybrid		Zinc			water		
averag			300+	boron	Zinc	only	hybrid	planting dates
e			boron	600	300	(contr		
			600.			ol)		
	45.80		48.40	23.00	23.93	41.20		20/9
	8	a la	a b	g – i	f- i	c		2017
34.25	28.	.83	34.06	29.23	26.73	44.33	Parasio	5/10
а	ł)	d – f	e – g	e h	a- c	1 41 4510	5/10
	28.	.12	29.26	31.00	30.60	49.47		15/10
	l)	e- g	d- f	d- f	a		10/10
	38.	.26	37.60	24.33	18.06	32.00		20/9
	8	ì	c d	f- i	i	d e		-012
29.39	21.	.21	22.60	29.40	21.54	41.70	Danar	5/10
a	ł)	g- i	e-g	i	bc		
	28.	28.71		28.06	22.60	41.73		15/10
	l)	d e	e- h	g – i	bc		10/10
		42.03	43.00	45.60	42.93	36.60	20/9	
	The	a	a	a	a	a	2012	_
	average of	25.03	28.36	26.60	24.13	21.00	5/10	Spraying Treatments
	planting	b	c d	c d	d e	e	5/10	X planting dates
	dates	28.42	31 13 c	29.53	29.35	23.66	15/10	
		b	51.15 C	c	с	d e	13/10	
			37.24	37.02	33.36	29.37	Parasio	
	-		a	a	ab	ab	1 ui usio	Spraying Treatments
			31.08	30.80	30.91	24.80	Danar	X hybrid
	-		b	b	b	с	Danai	
			34.16	33.91	32.14	27.08	S	Tucctments areas
			а	а	a	b	Spraying Treatments average	

Table (4): Effect of planting dates, hybrids, spraying with zinc sulfate, boron, zinc + boron, and	
the interaction between them on the number of leaves (leaf. plant ⁻¹) of broccoli plant.	

			Spr	aying Tr	eatments	mg.L ⁻¹		
hybrid	planting	dates X	Zinc			water		
averag		hybrid	300+	boron	Zinc	only	hybrid	planting dates
e			boron	600	300	(cont		
			600.			rol)		
		56.96	58.26	63.00	57.6	48.86		20/0
		a	а	a	а	b		20/9
35.47		22.26	23.20	23.33	24.93	17.60	D	5/10
a		c d	f	c- e	c- e	e f	Parasio	5/10
		27.72	29.66	28.60	27.35	25.26		15/10
		c	c	c	c	c d		13/10
		44.81	43.06	48.93	45.66	41.60		20/0
		b	b	b	b	b		20/9
29.85		16.81	19.20	17.33	17.46	13.26	Danar	5/10
b		d	d- f	e- f	e- f	f	Danai	
		27.95	29.40	29.20	29.20	23.93		15/10
		c	c	c	c	c- e		15/10
	The	50.89	50.66	56.00	51.66	45.23	20/0	
	Ine	a	b	a	a b	c	20/9	<u>G</u> ungaring
	average	19.54	21.20	20.33	21.20	15.43	5/10	Spraying Treatments V
	nlanting	c	e	e	e	f	5/10	nlanting datas
	planning	27.84	29.53	28.90	28.30	24.60	15/10	planting uates
	uates	b	d	d	d	d e	15/10	
			37.04	38.33	36.65	30.57	D	с ·
			a	a	a	b	Parasio	Spraying
			30.55	31.82	30.80	26.26	Desc	I reatments X
			b	b	b	c	Danar	nybrid
			33.80	35.07	33.72	28.42	Spravir	a Trootmonts overage
			a	a	a	b	Spraying 1 reatments aver	

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: Leaf area (cm².plant⁻¹):

the results in Table (5), we notice that the planting date , as the planting date of 20/9 gave the most leaf area 7053.0 cm². Plant⁻¹, and it differed significantly with seeding dates 5/10 and 15/10, which gave the least leaf area 1482.0 and 2430.0 cm². Plant⁻¹, respectively.In the cross, it is noticeable that the Parasio hybrid is excelled on the Danar hybrid in the leaf area, which amounted to 4327.9 and 2982.7 cm².

Plant⁻¹for two consecutive hybrids In the spraying treatments, it is noted that the treatments of spraying with zinc and boron and spraying with zinc + boron gave the most leaf area 3528.1, 4199.2 and 4132.4 cm². Plant⁻¹, respectively, and they differed significantly with spraying with water only, which gave the least leaf area and amounted to 2761.5 cm². Plant⁻¹. In the bi-interaction between the seeding dates and hybrids, it is noted that the seeding date 20/9 for the Parasio hybrid gave the most

leaf area amounted to 8583.0 cm2.plant-1 and it differed significantly with the rest of the treatments, and the least leaf area was at the seeding date 5/10 for the hybrid Danar 1116.3 cm². Plant⁻¹. In the bi-interaction between the dates of seedlings and spraving, we note that the treatments of the date 9/20 for seedlings, spraying with boron and spraying with zinc + boron gave the most leaf area 8400.7 and 7694.0 cm². Plant⁻¹, respectively, and it differed significantly with all treatments, and the least leaf area was for the seedling date 5/10 when spraying with water only 1115.7 cm². Plant⁻¹ In the bi-interaction between hybrids and spraying, we note that the Parasio hybrid and boron spray gave the most leaf area amounted to 5100.4 cm^2 . Plant⁻¹It did not differ significantly with the treatments of spraying with zinc and spraying with zinc + boron, and it differed with the rest of the treatments. The least leaf area was for the hybrid Danar and sprayed with water only, and it amounted to 1992.5 cm². Plant⁻¹.In the triple interaction between the studied factors, it is noted from the same table that the seeding date 20/9 in the hybrid Parasio and spraying with boron gave the most leaf area amounting to 10511.4 cm². Plant⁻¹ and reached 858.6 cm². Plant⁻¹.

Table (5): Effect of planting dates, hybrids and spraying with zinc, boron and zinc + boron sulfates and the interaction between them on the leaf area (cm². Plant⁻¹) of broccoli.

hybrid	hybrid planting dates X			S	praying Tre				
average		hybrid	Zinc 300+ boron 600 .	boron 600	Zinc 300	water only (control)	hybrid	planting dates	
		8583.0	8519.9	10511.4	7990.4	7310.9		20/0	
		a	b	а	b	b		20/9	
4327.9		1847.8	2144.1	1987.8	1886.7	1372.7	Domocio	5/10	
а		c	g- i	g- i	g- i	hi	r arasio	5/10	
		2553.0	2754.0	2802.0	1271.9	1908.3		15/10	
		c	f- h	f- h	hi	g- i		15/10	
		5523.7	6880.4	6290.1	5077.5	3846.9		20/9	
		b	b c	b c	d e	f	-	2017	
2982.7		1116.3	1206.6	1086.1	1313.4	858.6	Danar	5/10	
b		c	hi	hi	hi	i	Danar		
		2308.0	3289.7	2517.7	2152.7	2747.6		15/10	
		c	fg	f- i	f- i	f- h		13/10	
		7053.0	7699.0	8400 7	6534.0	5578.9			
	The	7055.0 a	а	a	d	b	20/9		
	averag		1675.3	1	1600.2	1115.7			
	e of plantin	1482.0 b	d e	1536.9 d e	d e	e	5/10	Spraying Treatments X planting dates	
	g dates	0 4 2 0 0	3021.8	2650.0	2450.2	1590.1			
	_	2430.0 b	с	2659.9 c d	c d	d e	15/10		
			4472.5	5100.4	4208.2	3530.6			
			a b	a	a b	b d	Parasio	Spraying Treatments X	
			3792.2	3298.2	2848	1992.5	_	hybrid	
			b- d	c- d	d e	e	Danar		
			4132.4		3528.1	2761.6		1	
			a	4199.2 a	a	b	Spraying Treatments avera		

4: Chlorophyll content in leaves %:

We note from the results in Table (6) that there is no significant difference between the seeding dates and the two hybrids Parasio and Danar in the chlorophyll content in the leaves. In the spraying treatments, it was noticed that spraying plants with zinc + boron gave the most chlorophyll content in the leaves, which amounted to 72.47%. and it differed significantly with the rest of the treatments except for spraying with boron, and the lowest content of chlorophyll in the leaves was 57.74% in the treatment of spraying with water only. In the bi-interaction between the seeding dates and hybrids, it is noted that the two seeding dates 9/20 and 5/10 for the hybrid Danar gave the most chlorophyll content in the leaves 72.1 and respectively, and they differed 74.5%, significantly only with the two seeding dates 10/15 for the hybrid Parasio, which gave the lowest chlorophyll content in the leaves 56.22%. In the bi-interaction between the dates of seedlings and spraying, it is noted that the planting date of 5/10, spraying with boron and spraying with zinc + boron gave the most chlorophyll content in the leaves 76.80 % and 79.25%, respectively, and they differed significantly with the two seeding dates 10/15 and 10/5and spraying with water only and with all spraying treatments at the time of transplanting 10/15, and the lowest content of chlorophyll in the leaves was found in the treatment of planting date 10/15 and spraying with water only and it amounted to 49.45%. In the bi-interaction between hybrids and spray, it is noted that the hybrid Danar and spraying with zinc + boron gave the highest percentage of chlorophyll content in the leaves, which amounted to 76.91%. It differed significantly with all treatments except for the treatment of the same hybrid and spraying with boron, and the lowest content of chlorophyll in the leaves was 55.37% in the treatment of the hybrid Parasio and spraying with water only.

In the triple interaction between the studied factors, it is noted that the seeding date 5/10 for the hybrid Danar and spraying with zinc +

boron had the highest content of chlorophyll in the leaves 83.76 % and it differed significantly with most of the treatments

: Percentage of dry matter in leaves %:

Table (7) that there is no significant difference between the seeding dates in the percentage of dry matter in the leaves. In the effect of hybrids, the Parasio hybrid gave the highest percentage of dry matter in the leaves, 16.21%, with a significant difference compared to the hybrid Danar, which gave 11.40%. Regarding the effect of spraying treatments, it is noted from the same table that spraying with water only gave the highest percentage of dry matter in the leaves amounting to 16.59%, and it differed significantly with the treatment of spraying with boron, which gave the lowest percentage of dry matter in the leaves 11.84%. In the bi interaction between the planting dates and the hybrid, it is noted that the planting date 10/5 and for the Parasio hybrid gave the highest percentage of dry matter in the leaves amounting to 18.20% and it did not differ significantly with all the treatments except for the treatment of the planting date 10/10 and for the hybrid Danar, which gave the lowest value for this trait and amounted to 10.50 %. In the interaction between the dates of seedlings and spraying, it is noted from the same table that the seeding date 5/10 and spraying with water only gave the highest percentage of dry matter in the leaves amounting to 21.60% and it differed significantly with some treatments, and the lowest value for this trait was observed in the date of seedling 9/20 and spraying With zinc, it reached 10.78%. In the interaction between hybrids and spraying, it is noted that the Parasio hybrid and spraying with water only gave the highest percentage of dry matter in the leaves 21.4% and it differed significantly with all treatments, and the lowest value for this trait reached 10.7% in the treatment of hybrid Danar and spraying with zinc + boron.In the triple interaction between the studied factors, it is noted from the table that the planting date 5/10

and spraying with water only and for the Parasio hybrid gave the highest percentage of dry matter in the leaves amounted to 29.37% and it differed significantly with all treatments, except for the treatments of the seeding date 5/10 and 15/10 for the Parasio hybrid and spray

With water only and spraying with zinc + boron and spraying with zinc, the lowest percentage of dry matter in the leaves was found at the time of seedling 10/15 and for the Danar hybrid and spraying with water only 9.14%.

Table (6): Effect of planting and hybridization dates and spraying with zinc, boron and zinc +
boron sulfates and the interaction between them on the content of chlorophyll in leaves % of
broccoli plant.

		nlanting datas V		Spraying Treatments mg.L ⁻¹				
hybrid averag e	planting dates X hybrid		Zinc 300+ boron 600.	boron 600	Zinc 300	water only (cont rol)	hybrid	planting dates
	65.85		67.40	70.26	66.33	59.43		20/9
	a	b	b- e	a- e	b- e	d- g		
64.21	70	.57	74.73	75.30	72.46	59.80	Parasio	5/10
a	a	b	a- c	a- c	a- d	d- g		
	56	.22	61.96	56.36	59.66	46.90		15/10
	1)	c- f	e- g	d- g	g		
	72.	.14	77.86	74.30	74.13	62.26		20/9
(0.00		1		a- c	a- c	C- I		
69.33	74.	.52	83.76	78.30	69.96	66.06	Danar	5/10
a	8	1	a		D- e	D- e		
	61	.34	69.10	62.96	61.30	52.00		15/10
	a	D	D- e	c- e	C- I	Ig		
	The	69.00	72.63	72.28	70.23	60.85	20/9	
	average	a 70.55			a- c			Spraving
	of	72.55	79.25	76.80	71.21	62.93	5/10	Treatments X
	planting	a = - = -	a	a	a- c	C d		planting dates
	dates	58.78	65.53	59.66	60.48	49.45	15/10	
		a	D- 0	d	d	e		
			68.03	67.31	66.15	55.37	Parasio	Spraving
				D	D C	a		Treatments X
			76.91	71.85	68.46	60.11	Danar	hybrid
			a		D			-
			72.47	69.58	67.31	57.74	Spraying 7	Freatments average
			a	ab	b	С	Spraying reachers average	

			Spray	ving Trea	tments n	ng.L ⁻¹			
hybrid averag e	planting dates X hybrid		Zinc 300+ boron 600.	boron 600	Zinc 300	water only (cont rol)	hybrid	planting dates	
	14.	70	14.95	13.54	11.90	19.28		20/0	
	a	b	b – e	b – e	с —е	$\mathbf{b} - \mathbf{d}$		20/9	
16.21	18.	20	21.91	9.28	12.37	29.37	Donacio	5/10	
а	8	l	a b	d e	b – e	a	Parasio	5/10	
	15.	60	11.57	14.26	20.83	15.78		15/10	
	a	b	c – e	b – e	a – c	b –е		13/10	
	10.	90	10.20	11.81	9.67	12.14		20/0	
	a	b	d e	c – e	d e	b – e		20/9	
11.40	12.	70	10.85	13.21	13.07	13.83	donor	5/10	
b	a	b	c – e	b – e	b – e	b – e	uallar		
	10.	50	11.20	9.42	12.31	9.14		15/10	
	b)	c – e	d e	b – e	e			
	The	12.88	12.58	12.42	10.78	15.71	20/9		
		a	b	b	b	a b	2017	Spraving	
	average	15.49	16.38	11.24	12.72	21.60	5/10	Trootmonts V	
	nlanting	a	a b	b	b	a	5/10	nlanting dates	
	dates	13.07	11.38	11.84	16.57	12.46	15/10	planting dates	
	uates	a	b	b	a b	b	13/10		
			16.14	12.36	15.03	21.47	Parasio	Snraving	
			b	b	b	a	1 a1 a510	Treatments V	
			10.75	11.48	11.68	11.70	Danar	hvhrid	
			b	b	b	b	Dallal	пургіа	
			13.45	11.84	13.36	16.59	Sproving T	rootmonte ovorago	
			a b	b	a b	а	Spraying Treatments average		

Table (7): Effect of planting dates, hybrids and spraying with zinc, boron, and zinc + boron sulfates and the interaction between them on the percentage of dry matter in leaves % of broccoli plant.

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 days for the formation of the main flowering disk (day):

Table (8) that the planting date 5/10 led to a significant reduction in the number of days for the formation of the main flowering disc 54.33 days and differed significantly with the other two dates, and the planting date 10/15 gave the most number of days for the formation of the main flowering disc and amounted to 78.17 days. In the crosses, it is noted that the Danar

hybrid gave the least number of days to form the main disc 59.33 days compared to the Parasio hybrid, which gave 67.47 days. It is noted that spraying with boron and spraying with zinc + boron gave the least number of days for the formation of the flowering disc 61.80 and 61.30 days, respectively, compared to the treatments of spraying with zinc and spraying with water only, which gave the most number of days for the formation of the main flowering disc 65.80 and 64.50 days, respectively. In the

bi-interaction between the seeding dates and hybrids, it was found that the flowering date of 9/20 and for the hybrid Danar gave the least number of days 47.3 days for the formation of the main flowering disc, while the planting date of 10/15 for the hybrid Parasio gave the most number of days amounting to 79.30 days. In the bi-interaction between the planting dates and spraying, it is noted that the planting date 10/5and spraying with boron gave the least number of days for the formation of the main flowering disc 51.33 days, while the planting date 10/10 and spraying with water only gave the most number of days, reaching 81.50 days. In the biinteraction between hybrids and spraying, it is noted that the hybrid Danar, spraying with zinc and spraying with boron gave the lowest number of days 57.22 and 57.33 days, respectively, and treatment of the hybrid Parasio and spraying with water only gave the most number of days for the formation of the main flowering disc 70.55 days.In the triple interaction between the studied factors, it is noted from the same table that the planting date of 20/9 for the Danar hybrid and spraying with zinc gave the least number of days for the formation of the main flowering disc 44.00 days and a significant decrease with all treatments and the most number of days for the formation of the main flowering disc was found when treating the seeding date 15 /10 for the Parasio hybrid and sprayed with water and it reached 83.66 days.

The planting date 9/20 was excelled in plant height, number of leaves and leaf area. This may be due to the appropriate weather conditions (Table 2) at this date for planting seedlings in terms of maximum and minimum temperatures, which led to increased vegetative growth, stem elongation and increased plant height (Table 3)) and thus the reason for an increase in the number of leaves per plant (Table 4), thus increasing the leaf area of the plant (Table 5), and this is in line with what was mentioned (21) and (11).The seedling on the date 20/9 led to a shorter number of days for

the formation of the main flowering disk (Table 8) and the reason is due to the favorable weather conditions on this date (Table 2), which led to the formation of good vegetative growth and then the formation of the main flowering disk compared to the other two dates In which the planting date in which the maximum and minimum temperatures were not suitable for the formation of good and rapid vegetative growth, and therefore the beginning of the formation of the main flowering disk was late compared to the date 20/9 and the formation of the main flowering disk with a date of fewer days (Table 8)It is noted from the results of Tables 4, 5 and 7 that the Parasio hybrid has significantly excelled in the number of leaves, leaf area of the plant, and the percentage of dry matter in the leaves compared to the hybrid Danar. for plants (Table 4)As there is a positive relationship between the number of leaves and the leaf surface of the plant and the increase in the percentage of dry matter in the leaves was from the increase in the leaf area of the plant, which led to an increase in the formation and accumulation of carbohydrates manufactured through photosynthesis and thus their accumulation in the leaves, which led to an increase in the dry matter in Papers (1) and (7) It is noted from Table (8) that the Parasio hybrid gave fewer days and with a significant difference in starting the formation of the main pink disc. This is in line with what was mentioned (15), ((11, (14), (23) and (9) It is noted from Table 3,4,5 the moral superiority of spraying with zinc and boron and the combination between them (zinc + boron) in the length of the plant, the number of leaves and the leaf area of the plant for the effectiveness and frailty of these materials and spraying them on the leaves and the reason is due to the effectiveness of these elements and spraying them on the leaves as boron works to facilitate The movement and transfer of photosynthetic products from the leaves to the active areas and that the foliar nutrition prepares the plant with the elements necessary for growth (1). and the zinc element works on the transfer of active substances in the plant, such as the transfer of sugars, and it is necessary for cell division (22). It also enters into the formation of the amino acid tryptophan, which is responsible for the elongation of cells (4). The reason for the significantly excelled of bi and triple treatments for some treatments is due to the cumulative effect of the significance of 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 sulfate, boron, zinc + boron, and the interaction between them on the traits of the number of days for the emergence of the main flowering disk (day) of broccoli plant.

	plant	ing		Spraying	Treatme	nts mg.L ⁻¹			
hybrid average	dates hybr	X id	Zinc 3004 boro 600	e boron - boron n 600	Zinc 300	water only (control)	hybr id	planting dates	
	68.0	8	69.3. d	3 67.00 d	66.66 d	69.33 d		20/9	
67.47	55 d		56.60	6 50.33	54.33	58.66	Para	5/10	
a	u 79.3	3	76.6	6 87.66	78.33	83.66	510	15/10	
	a 47.	3	b c 49.3	3 45.33	44.00	a 50.66		20/9	
59.33	53.0	6	56.60	$\frac{g-1}{6}$ 52.33	ي 52.00	53.66	dana	5/10	
D	77		78.60	1 - 11 - 11 - 11 - 11 - 11 - 11 - 11 -	75.66	79.33		15/10	
	The	57. 71 b	59.3. c d	3 56.16 d - f	55.33 e f	60.00 c	20/9		
	avera ge of planti	54. 33 c	56.1 d e	1 51.33 g	53.16 f g	56.16 d- f	5/10	Spraying Treatments X planting dates	
	dates	78. 17 a	77.60 b	6 76.50 b	77.00 b	81.50 a	15/1 0		
			67. 55 b	65.33 b	66.44 b	70.55 a	Para sio	Spraying Treatments X	
			61. 55 c	57.33 d	57.22 d	61.22 c	Dan ar	hybrid	
			61.3 0 b	61.80 b	65.80 a	64.50 a	Spr	Spraying Treatments average	

References

- 1- Abu Dahi, Youssef Muhammad and Muayyad Ahmad Al-Younes (1988). Plant Nutrition Guide. College of Agriculture, University of Baghdad. Ministry of Higher Education and Scientific Research. 411 p.
- 2- Al-Habbar, Muhammad Talal Abdul Salam and Al-Rashidi, Ayman Malallah Hussein (2014). Effect of planting dates, varieties and spraying with boron on the quantity and quality of yield in broccoli. Mesopotamian Agriculture Journal, 42 (1): 79-63.
- 3- Hassan, Ahmed Abdel Moneim (2004). Production of secondary and non-traditional vegetables. Vegetable crop chain production technology and advanced agricultural practices. part One. first edition. Arab House for Publishing and Distribution. 304 p.
- 4- Hassan, Nouri Abdel Qader, Hassan Yousef Al-Dulaimi and Latif Al-Ethawi (1990) Fertilizers and Soil Fertility / University of Baghdad / Iraq.
- 5- Hammoud, Nawal Mahdi, Najla Jabr Hanoun and Amjad Abdul Razzaq Muhammad (2018). Effect of nitrogen fertilization on the growth of two hybrids of Broccoli (Brassica oleracea var. italica) Plenck. And the content of the product from the elements of N P K. Dhi Qar University Journal of Agricultural Sciences, 7(1): 426-440.
- 6- Alrawi, khashie Mahmoud and Abdel Aziz, Muhammad Khaf Allah (2000). Design and analysis of agricultural experiments, Ministry of Higher Education and Scientific Research. College of Agriculture and Forestry. Dar Ibn Al-Atheer for printing.
- 7- Al-Sahhaf, Fadel Hussein (1989). Applied plant nutrition. Mosul University - Ministry of Higher Education and Scientific Research. House of books for printing and publishing.
- 8- Abdel-Rahman, Harith Burhan El-Din and Yassin, Reyam Abdel-Jabbar (2019). Effect of

planting dates and organic and chemical fertilization on growth and yield of Broccoli Brassica oleracea var. italica Plenck. . Kirkuk University Journal of Agricultural Sciences, 6(1): 541-548.

- 9- Muhammad, Qusay Hamid (2017). Effect of animal manure on the growth and yield of three broccoli crosses, a master's thesis. College of Agriculture and Forestry. Diyala University. Ministry of Higher Education and Scientific Research. The Republic of Iraq.
- 10- Al-Nuaimi, Abdullah Najm Abdullah.(2000). Principles of Plant Nutrition, University of Mosul, Iraq.

11- Abou El- Magd, M.M. (2013). Evaluation of broccoli cultivars growth, head yiled quality under different planting dates. Journal of Applied Sciences Research. 9 (11):5730-5736.

- 12- Agarawal, A.and Ahmed, Z. (2007). Response of cauliflower, (Brassica oleracea Var botrytis Sub variety cauliflora) to micronutrients application in high attributes cold desird of Ladakh. Indian Journal of Agricultural Sciences, 77(2): 104-105. USA . P.P.
- 13- Ain ,Q.G, Ayub.Ilyas ,M . A, Manzoor .B. , F . Luqman . S. , A . ; Khan , M. ,I . and Shah,K . (2016).Resopnse of Broccoli to Foliar Application of Zinc and Boron Concentration . 5(4):841-846.
- 14- Bhangre, K. K;Sonawane , P.C. and D.S Warade (2011)Effect of different varieties and spacing on growth and yield parameters of broccoli (*Brassica olerace* var . Italica Planck) under pine conditions. Asian Journal of Horticulture .6(1):41-74.
- 15- China, B.L.(1999). Broccoli varietal trail. Asian Regional Center AVRDS The world vegetable center http://www.are ardc.org.

- 16- Griffin G.E. (2006). World without Cancer: The Story of Vitamin B12. (First edit). American Media U.S.A.
- 17- Michaud, D.S., P. Pietinen; P.R. Taylor, M. Virtanen, J. Virtamo and D. Albanes, (2002). In states of fruits and vegetables, carotenoids and vitamin A, E, C in relation to the risk of bladder cancer in the ATBC cohort study, British Journal of Cancer, 87 (9): 960-965.
- 18- Ouda: B.A. and A.Y. Mahadeen: (2008). Effect of fertilizers on growth: yield: yield components: quality and certain nutrient contents in broccoli (*Brassica oleracea*). Int. J. Agric. Biol.: 10: 627-632.
- 19- Saieed, N. T. (1990). Studies of variation in primary productivity, growth and morphology in relation to elective improvement of broadleaved tree species. Ph D. Thesis. National Unv. Ireland.

- 20- SAS (2001). Statistical Analysis System . SAS Institute. Inc. , USA
- 21- Solunke, B.G., Wagh, A.P.,Dod, V.N.and Nagre, P.K. (2011) . Effect of Date of Planting and Spacing on Growth and Yield of Broccoli, Asian J.Hort., 6(2):294-296.
- 22- Travena, R. G. (2007). Seaweed fertilizer for the organic farmer biobauer. Bio Magic Priory gardens. Derby. DE 214 Tg.
- 23- Zaki, M.F.;S.A.;Saleh A.S Tantawy ,. And Y. Camilia EL- Dewiny.(2015). Effect of Different Ratesof Potassium Fertilizer on the Growth, Productivity and Quality of Some Broccoli Caltivars under New Rrclaimed Soil Condition International Journal of Chem Tech Research (8)12:28-39.