

Effect of Planting Date and Spraying with Sulfur on Growth and Yield of Broccoli in the Desert Lands of Southern Iraq

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Summery

The experiment was conducted during the winter season 2017-2018 on broccoli variety Paraiso under desert conditions in southern Iraq, as it nine factorial treatments in which three planting dates interacted (1/9/2017, 15/9/2017 and 1/10/2017) and the effect of spraying with different concentrations of sulfur (Zolfast) (0, 3 and 3.5 ml L⁻¹), by three sprays for each concentration, with a difference of two weeks between one spray and another, and for three replications. Randomized Complete Block Design (RCBD) was used for a split plot design, the mean results were analyzed statistically using Genstat, V. 10.3 (2011) and the Least Significant Difference Test (L.S.D.) was used to compare the averages at a probability level of 0.05, the results showed that the plants grown on the first date (1/9) were significantly superior in the vegetative growth indicators represented by plant height, stem diameter, number of leaves, leaf area, fresh and dry weights of the total vegetative, and in the yield indicators that included weight (666.15 g) and diameter of the main heahs, number and weight of lateral heads, plant total yield (0.789 kg) and total productivity (17.36 ton ha⁻¹), and in the qualitative and chemical characteristics of the yield that included the content of the main heads of total chlorophyll (mg 100 g⁻¹ fresh weight), the percentage of total soluble solids and vitamin C (mg 100 g⁻¹ fresh weight), total soluble carbohydrates (mg g⁻¹ dry weight), percentage of total nitrogen, phosphorous, potassium and sulfur, the plants grown on the first (1/9) and second (15/9) dates exceeded in percentage of dry matter, plants that were sprayed with sulfur at a concentration of 3.5 ml L⁻¹ achieved a significant increase in vegetative growth and yield indicators for the same mentioned characteristics , as the head weight was 586.23 g, plant total yield was 0.695 kg and total productivity was 15.29 ton ha⁻¹, while spraying with sulfur at a concentration of 3 or 3.5 ml L⁻¹ resulted in a significant increase in the fresh weight of the total vegetative with a non-significant difference between them, and the bilateral interaction between the two experimental factors achieved a significant effect on most of the characteristics under study.

Keywords: broccoli, planting date, spraying with sulfur (Zolfast)

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تأثير موعد الزراعة والرش بمستحضر الكبريت (الزولفاست) في نمو وحاصل البروكولي
Brassica oleracea var. Italica المزروع في الاراضي الصحراوية جنوبية العراق

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الخلاصة

اجريت التجربة اثناء الموسم الزراعي الشتوي 2018 – 2017 في مشروع تطوير زراعة الطماطة بالتقانات الحديثة التابع لمديرية زراعة البصرة في خور الزبير، بهدف دراسة انسب موعد للزراعة من بين ثلاثة مواعيد لزراعة النبات تحت الظروف الصحراوية جنوبية العراق، وتأثير الرش بتراكيز مختلفة من مستحضر الكبريت (الزولفاست) لمعرفة افضل تركيز تأثيراً في زيادة الإنتاج وتحسين نوعية الحاصل، إذ تضمنت تسعة معاملات عاملية تداخل فيها ثلاثة مواعيد للزراعة (1/9 و 15/9 و 1/10) وثلاثة تراكيز من الكبريت السائل الزولفاست (ZOLFAST 0 و 3 و 3.5 مل لتر⁻¹) بواقع ثلاث رشات لكل تركيز وبفارق أسبوعين بين رشة وأخرى، ولثلاثة مكررات، أستعمل تصميم القطاعات العشوائية الكاملة Randomized Complete Block Design (R.C.B.D). لتجربة عاملية منشقة لمرة واحدة Split Plot Design، حلت متوسطات النتائج إحصائياً باستعمال البرنامج الاحصائي

10.3.Genstat, V (2013). واستعمل اختبار اقل فرق معنوي معدل (Least Significant Differences Test (L.S.D). لمقارنة المتوسطات عند مستوى احتمال 0.05. أوضحت النتائج تفوق النباتات المزروعة بالموعد الاول (9 / 1) معنويا في مؤشرات النمو الخضري متمثلة في ارتفاع النبات وقطر الساق وعدد الأوراق والمساحة الورقية والوزنين الطري والجاف للمجموع الخضري، وفي مؤشرات الحاصل التي شملت وزن (666.15 غم) وقطر القرص الزهري الرئيس وعدد ووزن الاقراص الجانبية وحاصل النبات الواحد الكلي (0.789 كغم) والانتاجية الكلية (17.36 طن هكتار⁻¹)، وفي الصفات النوعية والكيميائية للحاصل التي تضمنت محتوى الاقراص الزهرية الرئيسة من الكلوروفيل الكلي (ملغم 100 غم⁻¹ وزن طري) والنسبة المئوية للمواد الصلبة الذائبة الكلية وفيتامين C (ملغم 100 غم⁻¹ وزن طري) والكربوهيدرات الذائبة الكلية (ملغم غم⁻¹ وزن جاف) والنسبة المئوية للنتروجين الكلي والفسفور والبوتاسيوم والكبريت. تفوقت النباتات المزروعة في الموعدين الاول (9 / 1) والثاني (9 / 15) في النسبة المئوية للمادة الجافة. حققت النباتات التي رُشت بمستحضر الكبريت (الزولفاست) بتركيز 3.5 مل لتر⁻¹ زيادة معنوية في مؤشرات النمو الخضري والحاصل للصفات المذكورة ذاتها وبلغ وزن القرص الزهري 586.23 غم وحاصل النبات الواحد الكلي 0.695 كغم والانتاجية الكلية 15.29 طن هكتار⁻¹، في حين ادى الرش بمستحضر الكبريت (الزولفاست) بتركيز 3 أو 3.5 مل لتر⁻¹ الى زيادة معنوية في الوزن الطري للمجموع الخضري وبفارقا غير معنويا فيما بينهما، وحقق التداخل الثنائي بين عاملي التجربة تأثيرا معنويا في معظم الصفات قيد الدراسة.

الكلمات الدالة: البروكولي، موعد الزراعة، الرش بالكبريت (الزولفاست)

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Introduction

Broccoli (*Brassica oleracea* var. *Italica*) belong to family Brassicaceae, known since the time of the Romans, and wild species of it were found growing in the Mediterranean and minor Asia regions, it is a winter annual herbaceous plant that is morphologically similar to cauliflower [1] broccoli have high nutritional and therapeutic value as it helps regulate blood sugar, lowers cholesterol and high blood pressure, helps build bones and is a rich source of Sulforaphan that has shown Anti-carcinogenic properties due to high levels of Glucosinolates [2] In Iraq, broccoli cultivation is still not widespread, as its production with cauliflower for the year 2018 reached 11,285 tons, compared with the countries of the world, China 10.668.866 million tons, India 8,800 million tons and the United States of America ranked third with 1.204.696 million tons of total world production [3]

The planting date is the most important factor among the factors affecting the growth and yield characteristics of different crops, as it determines the chance of success or failure of the crop, [4] Broccoli is classified from plants that need a moderate atmosphere that tends to warmth during the vegetative growth stage at the beginning of its life, and a moderate to cold atmosphere during the formation of cruds [5] thus the planting date plays a major role in

increasing growth and yield, [6] in a study conducted in Banbladesh find out the effect of four dates for planting broccoli which were 2/10, 27/10, 21/11 and 16/12, and the study showed the superiority of 21/11 date plants compared to 16/12 date plants, main heads weight (314.49 and 154.12 g), diameter (16.99 and 13.64 cm), number of lateral (3.73 and 2.40) and their yield (139.16 and 81.65 g), also the same date (21/11) exceeded in plant yield (453.64 g) and total yield (18.15 ton ha⁻¹), compared to lowest plant yield (242.46 g) and total yield (9.70 ton ha⁻¹) of 2/10 date plants. [7], in their study on broccoli in India, found that the most appropriate planting date was 12/10, as a significant increase was achieved in plant height 43.13 cm, stem diameter 48.10 mm, number of leaves 27.50 leaves, main heads weight 834 66 g and total plant yield 37.04 ton ha⁻¹, compared to 20/1 date plants that showed the lowest results for the mentioned characteristics as they were 36.64 cm, 44.45 mm, 24.06 leaves, 626.22 g and 27.48 ton ha⁻¹ each, respectively. In an experiment carried out by [8] to find out the effect of four planting dates on the growth and productivity of broccoli variety green head in India, which were 1/10, 15/10, 1/11, and 15/11, they found that the highest yield for the plant was at the first date. 1/10, reaching 221.73 ton ha⁻¹, while the fourth date 15/11 gave the lowest yield [9] found during

their experiment involving the cultivation of four varieties of broccoli (Palam Samridhi, Palam Vichitra, Pusa Broccoli KTS-1 and Palma Haritika) on three dates (1/12, 15/12 and 30/12) that the best planting date was 15/12, as the cultivated plants significantly exceeded at that date in terms of plant height and number of leaves in the plant compared to the lowest values found in 1/12.

Foliar feeding is one of the agricultural methods that complement the soil fertilization process and not a substitute for it to provide the plants with the necessary elements in the event that they are not ready in the soil as a result of washing or fixing, which is reflected in the increase in vegetative growth and yield [10]. Foliar feeding affects the improvement of the yield and its quality because it is in direct contact with the leaves without causing any damage to them and can penetrate into cells compared to adding them to the surrounding soil. [11] in a guide prepared by the [12].

Sulfur is one of the essential elements necessary for plant and is the ninth of the macronutrients and least abundant nutrients [13], the dry matter content of it in plant ranges from 15/1 of its nitrogen content, both of which are very necessary in the metabolic processes [14] and one of its most important functions is the formation of amino acids that include the sulfur in its composition, such as cysteine, cystine and methionine, which have an important role in the formation of proteins, enzymes and phospholipids [15], and the plants need it in the early stages of life [16]. [17] found when spraying kale (*Brassica oleracea* L. var.

Acephala) with different concentrations of sulfur at 0, 0.5, 1 and 2 mmol, by two days for each spray after transplanting until the plant reaches the age of 68 days, that the concentration 2 mmol exceeded in leaf length (23.4 cm), fresh weight (54 g) and dry weight (5.03 g) of the plant, [18] found when studying the effect of three concentrations of Zolfast, which were 0, 1 and 2 ml L⁻¹ on the growth of cauliflower, that there was a significant increase in plants that were sprayed at a concentration of 2 ml L⁻¹ as the values of plant height reached 39.72 cm, number of leaves 20.02 leaves, head diameter was 29.03 cm, plant yield was 1.45 kg, and head weight was 1.24 kg, compared to the lowest values of the comparison treatment plants.

The study was undertaken to determine effects of three date for planting the broccoli under the desert conditions in southern Iraq and spraying with different concentrations of liquid sulfur (Zolfast) in increasing production and improve yield quality broccoli.

Materials and Methods

The experiment was conducted during the winter agricultural season 2017-2018 in the project of developing tomato cultivation with modern technologies of Basra Agriculture Directorate in Khor Al-Zubair, random samples were taken from the soil of the field before planting to assess some of its physical and chemical characteristics (Table, 1), also the maximum and minimum temperatures and relative humidity (Table, 2).

Table (1) Chemical and physical properties, and textural class of soil of the experimental site

Soil Characteristics		Season: 2017 – 2018	Used Methods
EC conductivity (Des.m ⁻¹)		7.11	Page <i>et al.</i> (1982)
reaction degree pH		7.31	
soluble Ions (mmol L ⁻¹)	Na ⁺	24.00	
	Ca ⁺⁺	17.75	Richards (1954)
	Mg ⁺⁺	15.00	Page <i>et al.</i> (1982)
	SO ₄ ⁻⁻	19.62	
	Cl ⁻	67.00	Jackson (1958)
	HCO ₃ ⁻	2.6	Richards (1954)
Total Nitrogen	(mg Kg ⁻¹)	170	Page <i>et al.</i> (1982)
Available P		69.02	Murphy and Riley (1962)
Exchangeable K		201.00	Page <i>et al.</i> (1982)
organic matter (mg kg ⁻¹)		4.64	
Soil Separations (%)			
Sand		83.00	Black (1965)
Silt		13.40	
Clay		3.60	
Soil texture		Sandy Silty	
Irrigation Water			
Season	pH		EC (Des.m ⁻¹)
2017 /2018	6.15		3.83

Table (2) maximum and minimum temperature (c°) and relative humidity for the agricultural Season 2017-2018

: season 2018 – 2017			
date	temperature (c°)		Relative humidity (%)
	maximum	minimum	
10/09/2017	46.20	28.14	35.54
20/09/2017	45.18	26.26	29.95
30/09/2017	42.72	24.59	35.05
10/10/2017	38.32	21.55	40.14
20/10/2017	36.43	20.11	33.96
31/10/2017	36.08	18.84	59.89
10/11/2017	32.90	18.38	77.98

20/11/2017	26.94	11.98	59.46
30/11/2017	21.63	10.51	78.00
10/12/2017	20.66	7.23	66.21
20/12/2017	21.43	6.46	70.70
31/12/2017	24.82	9.56	74.88
10/01/2018	21.05	7.51	69.78
20/01/2018	21.30	6.08	73.46
31/01/2018	19.62	6.06	74.06
10/02/2018	24.02	5.28	57.84
20/02/2018	25.56	13.24	73.33
02/03/2018	23.39	13.41	89.34
12/03/2018	29.00	14.08	80.45
22/03/2018	28.58	14.08	63.39
02/04/2018	34.65	17.02	54.83

The experiment included nine factorial treatments in which three planting dates interacted (1/9, 15/9 and 1/10) and three concentrations of liquid sulfur Zolfast (0, 3 and 3.5 ml L⁻¹), by three sprays for each concentration, with a difference of two weeks between one spray and another, spray treatments were carried out for plants after two weeks of transplantation in the field, and the comparison treatment plants were sprayed with distilled water only. Randomized Complete Block Design (RCBD) was used for a split plot design, as the planting dates were considered the main plots and liquid sulfur concentrations were considered the sub-plots and by three replications so that the number of units would be 27 experimental units. The mean results were

analyzed statistically using Genstat, V. 10.3 (2011) and the Least Significant Difference Test (L.S.D.) was used to compare the averages at a probability level of 0.05 [19] The soil of the field was plowed twice, perpendicularly, smoothed and flattened, then divided into three blocks. Each block contained nine lines with a length of 30 m, width 40 cm, height of 15 cm, and a distance of 80 cm between one line and another, so that the number of experimental units became nine experimental units within each block. Seedlings were planted at a distance of 50 cm between one and another so that the number of plants in the line would be 60 plants, and the density 22000 plants per hectare, table (3) shows the start and end date of the main curds harvesting and the net duration for each date.

Table (3) the start and end date of harvesting and the net period from planting seeds in the nursery until the start of harvesting for the agricultural season 2017-2018

Season	The date of planting seeds in the nursery	Harvest Start	Harvest End	The net period from planting seeds in the nursery to the end of harvest (day)
2017 – 2018	1/ 9/ 2017	26/ 1/ 2018	17/ 2/ 2018	148
	15/ 9/ 2017	13/ 2/ 2018	21/ 2/ 2018	151
	1/ 10/ 2017	23/ 2/ 2018	28/ 2/ 2018	146

Broccoli hybrid seeds Paraiso which produced by Syngenta (Australia), The service operations were performed in a similar manner to all seedlings and were transferred to the field at the age of 45 days from planting for each date after the hardening process. the seedling contained an average of 4-6 leaves, and an average height of 10-12 cm. Field data were taken from five plants randomly selected from each experimental unit at the end of the harvest season for each date, the average was calculated for each plant and included plant height, stem diameter, number of leaves, leaf area, fresh and dry weights of the total vegetative, weight and diameter of main yield of heads, number, weight and diameter of lateral yield heads, plant total yield, total productivity, total chlorophyll, total soluble solids and vitamin C, percentage of dry matter and total soluble carbohydrates, percentage of nitrogen, phosphorous, potassium and sulfur.

Results & Discussion

Table (4) shows the effect of planting date and spraying with sulfur preparation (Zolfast) and their interactions on the vegetative growth characteristics of broccoli hybrid Paraiso, as the first date plants (1/9) significantly exceeded in plant height stem, diameter, number of leaves, leaf area, and the fresh and dry weight of the total vegetative. The plants that were sprayed with sulfur preparation exceeded the comparison treatment plants that were sprayed with distilled water only, and the effect increased as the concentration increased,

except for the fresh weight of the total vegetative, as both concentrations exceeded with a non-significant difference between them over the comparison treatment plants in this characteristic, Plants grown indicators on the first date sprayed with sulfur 3.5 ml L⁻¹ combination gave increase of plant height (60.52 cm), stem diameter (5.04 cm), number of leaves (24.45), leaf area (52.63 Dm²), and dry weight of the total vegetative (174.81 g) and the same date plants for both concentrations (3 and 3.5 ml L⁻¹) exceeded with an insignificant difference between them in the fresh weight of the total vegetative, as they both reached 1.15 g.

The results of table (5) show the superiority of the first planting date in the yield characteristics represented by the main heads weight (g), main heads diameter (cm), number of lateral heads, lateral heads weight (g), lateral heads diameter (cm), plant total yield (kg), heads total productivity (ton ha⁻¹).

Notes from a table 4 the sprayed at a concentration of 3.5 ml L⁻¹ showed a significant superiority in yield components.

The results of table (6) showed the effect of planting date and spraying with sulfur preparation (Zolfast) and their interaction on cruds qualitative and chemical characteristics of the hybrid Parasio, represented by total chlorophyll, total soluble solids, vitamin C, dry matter, total soluble carbohydrates, nitrogen, phosphorous, potassium and sulfur, as the plants grown on the first date (1/9) exceeded in the aforementioned characteristics followed by the

second and third dates plants respectively, also the plants that were sprayed with sulfur significantly exceeded the comparison treatment plants and the effect increased as the concentration increased, also the interaction between the two factors showed the superiority of the first date plants that were sprayed with sulfur at a concentration of 3.5 ml L^{-1} in the same characteristics, as the value for each of them was, $4.48 \text{ mg } 100\text{g}^{-1}$ fresh weight, 10.31%, $95.63 \text{ mg } 100\text{g}^{-1}$ fresh weight and 14.02% and 32.11 mg g^{-1} dry weight, 2.764%, 0.409%, 3.133%, and 0.428% respectively.

The results showed the superiority of first date plants (1/9) in the vegetative growth indicators (Table 4) and yield (Table 5) compared to the plants of the second (15/9) and third dates (1/10), this might be attributed to the suitability of climatic conditions, especially the temperature. (Table, 2) During the early stages of plant growth, which give plants with good vegetation and its reflection on increasing the total plant yield and total productivity, this is consistent with [20] that broccoli needs a moderate atmosphere that tends to warmth during the vegetative growth phase at the beginning of its life.

The significant increase in vegetative growth indicators as the concentration of spraying with sulfur (Zolfast) increased compared to the comparison treatment plants might be due to its high content of sulfur (82%), which is included in the formation of the amino acids necessary in the synthesis of auxins such

as the amino acid tryptophan and indole acetic acid. the tryptophan is considered the basic building block for building auxins that encourage cell division and elongation. as for indole acetic acid, it is the catalyst for increasing cell division and the flexibility of its walls, as well as the participation of sulfur in plant biotic reactions that are positively reflected on the vegetative growth indicators, increase the readiness of nutrients and increase the efficiency of the Photosynthesis process, enzymes efficacy and carbohydrates and proteins metabolism thus improving vegetative growth characteristics and increasing yield [21]

The superiority of the first date plants in heads qualitative and chemical characteristics (Table 6) might be attributed to good vegetative growth (Table 4) or to the role of sulfur in increasing the chemical and biological activity of iron in the leaves and thus increasing total chlorophyll in the plant [22] on cauliflower , and sulfur may work on growth, division, and increase of leaf area (Table 4) thus increases the amount of carbohydrates and dry matter by photosynthesis [23] or that spraying with sulfur increased the heads content of carbohydrates (Table 6), which is the main component of ascorbic acid and some other nutrients, thus increasing the heads content of vitamin C [24], also, the increase in heads content of nutrients (Table 6) might be attributed to the fact that spraying the leaves facilitates their absorption and accumulation in the tissues of the plant [10].

Table (4) effect of planting date and spraying sulfur with (Zolfast) and their interactions on the vegetative growth characteristics of broccoli hybrid Parasio

Planting date	spraying with sulfur (ml L ⁻¹)	plant height (cm)	stem diameter (cm)	number of leaves	leaf area (Dcm ²)	Fresh weight of the total vegetative(kg)	dry weight of the total vegetative(g)
First date 1/9/2017	0	58.30	4.83	20.15	49.96	0.89	141.67
	3	59.09	4.81	21.78	51.34	1.15	167.48
	3.5	60.52	5.04	24.45	52.63	1.15	174.81
Second date 15/9/2017	0	55.04	4.18	17.74	40.54	0.56	98.07
	3	56.88	4.65	19.89	47.00	0.62	105.50
	3.5	57.04	4.70	19.89	47.53	0.56	97.14
Third date 1/10/2017	0	55.08	4.29	18.30	41.41	0.48	84.00
	3	55.83	4.57	19.67	44.24	0.55	93.23
	3.5	56.82	4.73	19.96	47.59	0.56	95.31
R.L.S.D. 5%		0.27	0.06	0.56	0.53	0.03	4.15
Average date	First date	59.30	4.89	22.12	51.31	1.06	161.32
	Second date	56.32	4.51	19.17	45.02	0.58	100.24
	Third date	55.91	4.53	19.31	44.41	0.53	90.85
R.L.S.D. 5%		0.20	0.03	0.45	0.36	0.02	2.90
average spraying with sulfur	0	56.14	4.43	18.73	43.97	0.64	110.25
	3	57.27	4.68	20.44	47.53	0.77	117.98
	3.5	58.12	4.82	21.43	49.25	0.76	124.18
R.L.S.D. 5%		0.16	0.04	0.32	0.33	0.02	2.50

Table (5) effect of planting date and spraying with sulfur (Zolfast) and their interactions on yield characteristics of broccoli hybrid Parasio

Planting date	spraying with sulfur (ml L ⁻¹)	main head weight (g)	main head diameter(cm)	Number of lateral heads	lateral heads weight (g)	lateral heads diameter(cm)	plant total yield (kg)	heads total productivity (ton ha ⁻¹)
First date 1/9/2017	0	587.88	19.37	7.07	112.17	7.18	0.700	15.40
	3	651.53	20.30	8.48	126.41	8.20	0.778	17.12
	3.5	759.03	21.17	8.37	129.51	8.24	0.889	19.55
Second date 15/9/2017	0	310.79	14.81	5.15	52.23	5.33	0.363	7.99
	3	477.61	17.87	6.13	89.35	6.38	0.567	12.47
	3.5	503.54	18.32	6.59	99.86	6.74	0.603	13.27
Third date 1/10/2017	0	340.20	15.39	5.30	56.90	5.43	0.397	8.74
	3	412.96	17.10	5.81	76.57	6.19	0.489	10.77
	3.5	496.13	18.29	6.44	97.27	6.62	0.593	13.06
R.L.S.D. 5%		22.96	0.22	NS	2.84	NS	0.025	0.55
Average date	First date	666.15	20.28	7.98	122.70	7.87	0.789	17.36
	Second date	430.65	17.00	5.96	80.48	6.15	0.511	11.24
	Third date	416.43	16.93	5.85	76.91	6.08	0.493	10.85
R.L.S.D. 5%		21.95	0.20	0.32	1.81	0.16	0.024	0.52
average spraying with sulfur	0	412.96	16.52	5.84	73.77	5.98	0.487	10.71
	3	514.03	18.42	6.81	97.45	6.92	0.611	13.45
	3.5	586.23	19.26	7.14	108.88	7.20	0.695	15.29
R.L.S.D. 5%		9.93	0.10	0.18	1.77	0.10	0.011	0.24

Table (6) effect of planting date and spraying with sulfur (Zolfast) and their interactions on the cruds qualitative and chemical characteristics of broccoli hybrid Parasio

Planting date	spraying with sulfur (ml L ⁻¹)	total chlorophyll (mg 100g ⁻¹ fresh weight)	Total soluble solids (%)	vitamin C (mg 100g ⁻¹ fresh weight)	Dry matter (%)	total soluble carbohydrates (mg g ⁻¹ dry weight)	Nitrogen (%)	Phosphorous (%)	Potassium (%)	Sulfur (%)
First date 1/9/2017	0	3.94	8.96	80.56	12.64	26.28	2.557	0.335	2.886	0.386
	3	4.10	9.53	85.52	13.20	28.47	2.632	0.360	3.008	0.408
	3.5	4.48	10.31	95.63	14.02	32.11	2.764	0.409	3.133	0.428
Second date 15/9/2017	0	3.38	6.32	62.78	12.42	15.77	1.268	0.264	2.424	0.305
	3	3.77	8.15	74.30	13.49	22.75	2.126	0.307	2.718	0.360
	3.5	3.82	8.31	75.59	13.74	23.54	2.203	0.314	2.766	0.365
Third date 1/10/2017	0	3.40	6.58	63.82	12.47	16.81	1.533	0.270	2.467	0.315
	3	3.68	7.57	71.52	13.05	20.33	1.930	0.291	2.624	0.334
	3.5	3.77	8.40	74.78	13.35	23.63	2.476	0.308	2.743	0.357
R.L.S.D. 5%		0.05	0.14	1.62	0.22	0.54	0.058	0.012	0.032	0.004
Average date	First date	4.17	9.60	87.23	13.28	28.95	2.651	0.368	3.009	0.407
	Second date	3.66	7.59	70.89	13.22	20.69	1.866	0.295	2.636	0.343
	Third date	3.61	7.52	70.04	12.96	20.26	1.979	0.290	2.611	0.335
R.L.S.D. 5%		0.04	0.14	1.44	0.21	0.39	0.033	0.011	0.032	0.003
average spraying with sulfur	0	3.58	7.29	69.05	12.51	19.62	1.786	0.290	2.593	0.335
	3	3.85	8.42	77.11	13.25	23.85	2.230	0.319	2.783	0.367
	3.5	4.02	9.01	82.00	13.70	26.43	2.481	0.344	2.881	0.383
R.L.S.D. 5%		0.02	0.05	0.81	0.09	0.32	0.037	0.002	0.013	0.002

Conclusions

The date 1/9 with spraying sulfur (Zolfast) at a concentration of 3.5 ml L⁻¹ by three sprays with a difference of two weeks between one spray and another after two weeks of transplanting achieved the best results in most of vegetative growth indicators, yield and its components of broccoli variety parasio.

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