Effect of Antioxidant (Tocopherol-α and Acetylsalicylic acid) and addition method on the growth and components of the green yield for broad bean plants cultivated in the south of Iraq

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Abstract

The experiment was conducted during the winter season 2019-2020 at the Agricultural Research Station - College of Agriculture, University of Basra, with the aim of knowing the effect of treatment α-Tocopherol and Acetylsalicylic acid and the method of addition on growth and yield and its components of green Broad bean (*Vicia faba* L.)cultivar "Luz de otono". The factorial experiment included fifteen treatment consisting of a combination of five treatments, namely α-Tocopherol at two concentrations of 50 and 100 mg. L-1 and Acetylsalicylic acid at two concentrations of 50 and 100 mg. L-1 in addition to the control treatment (distilled water) and three methods of addition: 1- Soaking the seeds 2- Soaking Seed + spraying plants 3-Spraying plants. Split Plot Design was used with three replicates, and the results showed that the treatment with α-Tocopherol and Acetylsalicylic acid, It led to a significant increase in the vegetative growth indicators, which are plant height, number of branches, leaf area, dry weight of the vegetative total, yield and its components, which is the length of the pod, number of pods per plant, pod weight, the productivity of pods, weight of 100 seeds, the yield of fresh seeds and the total soluble solids, vitamin C, dry matter percentage, and protein, compared to plants that were sprayed with distilled water. The method (seed soaking + spraying plants) gave the highest values in all studied indicators of vegetative growth compared to the two methods of soaking seeds and spraying plants. Soaking the seeds + spraying the plants) with Acetylsalicylic acid at a concentration of 100 $mg.L^{-1}$ gave the highest pods yield, which reached 44.532 $tons\ .ha^{-1}$.The method (seed soaking + spraying plants) with Acetylsalicylic acid a concentration of 50 $mg.L^{-1}$ gave the highest yield of fresh seeds reached 21,812 $tons.ha^{-1}$ compared to the lowest productivity of pods and fresh seeds of (21.348,8.768 $tons.ha^{-1}$), respectively when spraying treatment with distilled water and soaking with distilled water.

Key words: Broad bean , α-Tocopherol, Acetylsalicylic acid, adding method .

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تأثير مضادي الاكسدة (α-Tocopherol و Acetylsalicylic acid) وطريقة الاضافة في النمو و مكونات الحاصل الاخضر لنباتات الباقلاء المزروعة في جنوبي العراق

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الخلاصة:

أجريت التجربة خلال الموسم الشتوي2019-2020في محطة الابحاث الزراعية – كلية الزراعة جامعة البصرة ، بهدف معرفة تأثير المعاملة α- Tocopherol و Acetylsalicylic acid وطريقة الاضافة في النمو والحاصل ومكوناته لنباتات الباقلاء الخضراء *Vicia faba* L. صنف "Luz de otono".

تضمنت التجربة خمس عشرة معاملة عامليه عبارة عن التوافيق بين خمس معاملات هي α- Tocopherol بتركيزين 50 و100 ملغم.لتر$^{-1}$وAcetylsalicylic acid بتركيزين 50 و100 ملغم.لتر$^{-1}$إضافة الى معاملة السيطرة (الماء المقطر) وثلاث طرق للاضافة: 1- نقع البذور2-نقع البذور+رش النباتات3-رش النباتات. استعمل تصميم القطع المنشقة لمرة واحدةٍ Split Plot Design بثلاث مكررات وقد أظهرت النتائج ان المعاملة بكل منα- Tocopherol وAcetylsalicylic acid .

أدت إلى زيادة معنوية في مؤشرات النمو الخضري وهي ارتفاع النبات وعدد الافرع والمساحة الورقية والوزن الجاف للمجموع الخضري للنبات والحاصل ومكوناته وهي طول القرنة، عدد القرنات للنبات ووزن القرنة والإنتاجية للقرنات ووزن 100 بذرة وإنتاجية البذور الطرية، والمواد الصلبة الذائبة الكلية وفيتامينC ونسبة المادة الجافة% والبروتين قياسا بالنباتات التي رُشَّت بالماء المقطر. أعطت طريقة (نقع البذور+رش النباتات) أعلى القيم في جميع مؤشرات النمو الخضري المدروسة مقارنة بطريقتي نقع البذور ورش النباتات. ان (نقع البذور +رش النباتات) بـ Acetylsalicylic acid تركيز100ملغم.لتر$^{-1}$ اعطت أعلى إنتاجية قرنات الذي بلغ 44.532 طن هكتار$^{-1}$وأعطت طريقة (نقع البذور +رش النباتات) بـ Acetylsalicylic acid تركيز50 ملغم لتر$^{-1}$ اعلى انتاجية بذور طرية بلغت 21.812 طن هكتار$^{-1}$ بالمقارنة مع اقل انتاجية للقرنات والبذور الطرية بلغت(21.348, 8.768 طن هكتار$^{-1}$)، على التوالي عند المعاملة بالرش بالماءالمقطر والنقع بالماء المقطر.

كلمات المفتاحية :الباقلاء، α- Tocopherol ، Acetylsalicylic acid، طريقة الاضافة.
***البحث مستل من اطروحة الباحث الاول**

Introduction

Vicia faba L. is the fourth most important Leguminosae crop in the world, where it occupies an important place among food security crops in a number of countries. This importance comes as a result of its seeds' high protein content of 24-33% (22) as well as being a source of energy, each 100gm seed contains 72.6g water, 0.73g fat, 17.63g carbohydrates, 7.5g fiber, 1.55mg iron, 1.55mg magnesium, 129mg phosphorous, 332mg potassium, 3.7mg phytlimene C, 0.133mg Thiamin, 0.104 1 mg vitamin B6, 17 mg vitamin A, and 88 calories (21). The cultivated area of green pea crop for the 2018 agricultural season in Iraq was 17727 tons, with a production rate of 1450.4 kg.ha^{-1}, with a total production of 25711 tons (2).The need to cultivate the leguminous plant increased as a result of the increase in demand for consumption due to the high standard of living and the increase in health and nutritional awareness due to its high nutritional value. Therefore, its production must be expanded by increasing the productivity per hectare and by following the correct agricultural methods. Among the harmful effects of stress are Tocopherol-α (Vitamin E) and Acetylsalicylic Acid, as they are non-enzymatic antioxidants that eliminate free radicals caused by environmental stress. Tocopherol-α is an important plant compound that plays an important role in plant growth and plant yield (19).It has been observed (16) that spraying soybean plants (Glycine max L) α-Tocopherol at a concentration of 100 mg L-1 led to an increase in the growth and yield of soybean plants when irrigation with a salinity level less than 6.25 dsm^{-1}.It was found (11) that soaking the seeds of the sunflower (Helianthus annuus)) with α-Tocopherol at a concentration of 100 and 200 mg.L $^{-1}$ increased the fresh and dry weight of the vegetative and the weight of 100 seeds and an increase in the yield and the production of dry matter. It has a role in protecting plants from salinity, drought, high and low temperatures, as well as increasing the stability of membranes and eliminating free radicals (13) Acetylsalicylic Acid also increases the plant's tolerance to heat, cold and drought (20) and salinity (4) and a decrease in plant disease (15) It also has a role in accelerating the growth and plant yield(5.9). It was found (18) that spraying tomato plants (Solanum lycopersicum) exposed to salinity with Acetylsalicylic acid at a concentration of 50 mg.L $^{-1}$ led to an increase in the yield and dry weight of the vegetative and root groups.In view of the importance of the legume crop and working to increase its productivity in quantity and quality by moving away from materials with environmental

damage and replacing them with safe and stimulating materials for growth, which have an important role in overcoming the unfavourable conditions for growth, Therefore, this study aims to evaluate the effect of the antioxidant Tocopherol-α (Vitamin E) and Acetylsalicylic Acid on Broad bean and determine the optimal concentration of them and the method of addition.

Materials and methods

The experiment was conducted in the winter season 2019-2020 at the Agricultural Research Station - College of Agriculture, University of Basra in silty clay soil. The field soil was analyzed before cultivated by taking samples from different places with a depth ranging from 0-30 cm, and samples of irrigation water were also taken. Table 1 show some of the physical and chemical traits of these samples.

Table 1. Some physical and chemical traits of field soil and irrigation water for season 2019-2020

References	Values	Traits
(14)	7.33	The degree of electrical conductivity (E.C) dBsMs-1
	6.4	Soil reaction degree (pH)
	26.1	Total nitrogen (g / kg-1)
	9.2	avaavailability phosphorus (mg kg-1)
	18.17	availability potassium (mg kg-1)
	1.08	Organic matter (%)
	7.46	PH of irrigation water
	4.73	Electrical conductivity (E.C) for irrigation water
Soil separators (%)		
(3)	76.45	sand
	7.78	silt
	15.60	Clay
	sandy clay	Soil Texture

The field land was Tillage twice and in a perpendicular manner by a Moldboard plow. Then the soil was smoothed and divided into lines of 20 m length per line divided into five experimental units with 9 lines. The length of the experimental unit is 4 m, the lines are 0.75 m from each other, and the area of the experimental unit is 3 m 2. The drip irrigation system was established with a 2000 liter tank. It was placed at a height of 1 m above the soil surface and extended main plastic tubes connected to it, plastic branch pipes to distribute the water, there are 9 tubes at an average of one tube for each line placed in the middle of the

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lines, and the Tap water was used. The experimental unit contained 24 pits distributed alternately on both sides of the tube. The distance between the pit and the other 30 cm.In the experiment, Luz de otono cultivar "Turkish origin" was used, prepared from the Spanish company Semillas Fito. The seeds were cultivated directly on 10/8/2019 by placing 3 seeds in the pit on both sides of the line and were covered with soft clay. The thinning process was conducted 20 days after cultivation by leaving one plant in the seed bed to bring the plant density to 88888.88 plants.ha $^{-1}$. As for fertilization, the decomposing animal organic(cow manure) was added at a an average of 24 tons ha^{-1} to the lines when preparing the ground at a depth of 25 cm with fertilizer (DAP) NP addition(18:46) At an average of 100 kg ha^{-1}, the high-phosphorus fertilizer PRO.SOL(10-30-10) was added at the average of three sprays every four days at an average of 1.5 g.L^{-1}.Also, urea fertilizer (46% N) was added at an average of 100 kg.ha^{-1} by the trench method after a month of cultivated , and PRO.SOL neutral fertilizer (20-20-20) was added at an average of 150 g 100 L^{-1} water. The agricultural processes used were conducted including irrigation, weeding and hoeing of this crop, where drip irrigation was conducted according to the need of the plant, and weeding was conducted for the weeds, by uprooting them by hand whenever needed. A preventive program was followed to combat insects and fungal diseases.

The granular insecticide Diazinon 2.5 gm-2 was used, and it was added ground in the germination stage and the second one week after germination. The two fungicides Topsin-m were sprayed at a concentration of 1 g.L^{-1} from the Lippon Suda Company - Japan, RivaI pesticide at a rate of 2.5 ml 1 from Agria - Bulgaria, respectively, and FIash at a concentration of 1 ml.L $^{-1}$ was used to control Cutworm insects. The experiment included fifteen factor treatments which are a combination of five treatments, which are the control treatment (distilled water only) and α – Tocopherol produced by the German company (Pharmazeutischer Unternehmer und Hersteller) at a concentration of 50 or 100 mg.L $^{-1}$ and Acetylsalicylic produced by Bayer Bitterfeld GmbH. At a concentration of 50 and 100 mg.L^{-1}

The volume was completed with distilled water and three methods of use: 1- Soaking the seeds 2- Soaking the seeds + spraying the plants 3- Spraying the plants with one of the above concentrations of α-Tocopherol and Acetylsalicylic, and the number of experimental units reached 45 units. Aqueous solutions were prepared for the materials referred to at the required concentrations, As α-Tocopherol was dissolved in a few drops of hexane, Acetylsalicylic was dissolved in a few drops of ethyl alcohol and the seeds were soaked for a period of six hours (8) it was then cultivated. A few drops of washing liquid were added as a diffuser for the five spray treatments .Plants were treated by spraying the vegetative in the early morning until complete wetness and upon first drop by using a 2 liter hand sprayer.The vegetative was sprayed twice, the first after 30 days of cultivation and the second spraying 15 days after the first spray. The factorial experiment was applied as a split plot design experiment.The addition methods represent the main plot, while the concentrations of α-Tocopherol and Acetylsalicylic were considered the Sub plot, according to the Complete Block Design Randomized with three replicates. The results of the applied design were analyzed statistically and the arithmetic means of the treatments were compared using the least significant difference test, L.S.D, at a probability level of 0.05, using the Gen stat (7) program for statistical analysis. Indicators of vegetative growth were taken after 60 days of cultivation and included plant height (cm), number of branches of the plant, leaf area (cm2) and dry weight of the vegetative total (g).Harvesting began on 2/2/2020 and continued until 2/3/2020 by noting the appearance of the pods and their fullness with fresh seeds. Measurements were taken of number of pods

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per plant, pod weight (g), pod length (cm), pods yield and fresh seeds (1 ha^{-1}), 100 fresh seeds weight (g), total yield of fresh seeds, percentage of Total Soluble Solids (TSS), vitamin C (100 $mg.g^{-1}$ fresh seeds), percentage of dry matter, and percentage of protein.

Results and discussion

Table 2 show that Treatment with antioxidant α-Tocopherol and Acetylsalicylic acid had a significant effect on all indicators of vegetative growth (plant height, number of branches, leaf area, and both fresh and dry weight of the plant). The concentration of 100 $mg.L^{-1}$ excelled in the most traits, and the effect was increased when (soaking seeds and spraying plants). As for the interaction between the compounds and the method of addition, the effect was significant, where the treatment (seed soaking + spraying the plant) with Acetylsalicylic acid at a concentration of 100 $mg.L^{-1}$ gave the highest average of plant height reaching 39.33 cm and the treatment (soaking seeds + spraying plants) with α-Tocopherol with concentration. 50 $mg.L^{-1}$ significant in the most branched plants reached 7.33 $plant.branch^{-1}$ and treatment (seed soaking + spraying plants) with α-Tocopherol concentration of 100 $mg.L^{-1}$ The largest leaf area of the plant 3994.3 cm^2 , While the lowest values were given when treating seeds with distilled water, which amounted to 24.47 cm and spraying plants with distilled water 3.90 $branch^{-1}$ and 2777.3 cm^2, respectively, while the interaction between study workers had no significant effect on the dry weight of the Vegetative total. The significantly excelled of plant growth indicators when treating with the two compounds is due to their being non-enzymatic antioxidants that provide protection for tissues from free radicals that accumulate as a result of exposure to tension by stopping their effectiveness or scavengers, and their ability to prevent lipid peroxidation and maintain water and ionic balance in the plant and the increase in the activity of antioxidant enzymes (11.9), as well as their role in increasing the level of endogenous hormones that encourage growth within the plant, especially Auxins, gibberellins and cytokinins, and lower levels of Absisic acid (17.1). In the absorption of ions, the effectiveness of enzymes, and the building of protein and their role in increasing the efficiency of the photosynthesis process by increasing the absorption of CO2 in the chloroplasts, increasing the root system of the plant and its role in increasing the water content of the plant and reducing the leakage of ions for its role in controlling stomatal movement and reducing the speed of transpiration (12.16), which leads To provide the necessary materials for building new tissues and increasing vegetative growth. Table 3 shows that there is an increase in pod length, number of pods, pod weight, number of seeds per pod, pod yield, the weight of 100 fresh seeds, the yield of fresh seeds when α-Tocophero l and Acetylsalicylic acid, and α-Tocopherol treatments at 50 and 100 $mg.L^{-1}$ and Acetylsalicylic acid at 50 and 50 100 $mg.L^{-1}$ increased pods yield in plants by an increase of 52.592, 52.773, 61.002 and 63.972%, respectively, compared to control plants. Indicated that there were no significant differences between the concentrations of the treatments, and the plants of α-Tocopherol treatments at two concentrations of 50 and 100 $mg.L^{-1}$ and Acetylsalicylic acid at two concentrations 50 and 100 $mg.L^{-1}$ were significantly excelled in increasing the productivity of the fresh seeds of the plant with an increase of 78.664, 69.306, 84.071 and 78.348. %, respectively, compared to control-treated plants. The method of (seed soaking + spraying plants) was significantly excelled in increasing the productivity of the pods, with an increase of 29.470 and 28.226% compared to the two methods of soaking seeds or spraying plants only, respectively, which did not differ significantly between them. It also significantly excelled in the yield of fresh seeds, with an increase of 45,350 and 42,544% compared to the plants of the two methods of soaking the seeds or spraying plants only, respectively, and

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the interaction of the two experiment factors had a significant effect on all yield components except for the weight of 100 fresh seeds. Acetylsalicylic acid (soaking seeds + spraying plants) gave the highest pods yield of 44,532 tons.ha^{-1} compared to the lowest yield of 21,348 tons.ha^{-1} when spraying with distilled water, and the method (soaking seeds + spraying plants) Acetylsalicylic acid concentration of 50 mg.L^{-1} gave the highest yield of fresh seeds was 21.812 tons.ha $^{-1}$ compared to the lowest yield of fresh seeds 8.768 tons.ha $^{-1}$ when treated by soaking with distilled water. Table 4. shows that the treatment with the studied chemicals showed a significant increase in protein, dry matter of seeds, soluble solids and vitamin C specificity of seeds compared to the control treatment. The method (soaking seeds + spraying plants) gave the highest percentage of total soluble solids, protein and vitamin C. The addition method had no significant effect on the dry matter of the seeds. The interaction of the two experiment factors had a significant effect on all the qualitative traits of the seeds except for the dry matter. The increase in the yield, the improvement of its quality and the quality of the fresh seeds upon treatment α-Tocopherol and Acetylsalicylic acid is due to the fact that the treatment with these two compounds resulted in an increase in the number of branches and leaf area (Table 2) and an increase in the direction of larger quantities of the assimilates towards the pods and increased consumer strength of the pods to attract larger quantities of water and nutrients.

We conclude from the current study that soaking the seeds + spraying Broad Bean plants with Acetylsalicylic acid at a concentration of 100 mg.L^{-1} has more effect in increasing the yield of pods and the content of the fresh seeds of protein.

Table 2. The effect of the concentrations of antioxidants (α-Tocopherol and Acetylsalicylic acid) and the adding method and the interactions between them on the indicators of the vegetative growth of Broad bean plants.

Dry weight of total vegetative (g^{-1})	leaf area (cm^2 plant^{-1})	The number of branches Branch) (Plant^{-1}	Plant height (cm)	adding method	Treatments (mg.L^{-1})
5.83	2077.3	4.10	24.47	Seed soaking	Control (distilled water)
6.12	2077.3	4.10	26.47	Seed soaking + spraying of plants	
5.64	2077.3	3.90	26.20	Spraying plants	
6.79	2608.3	4.17	28.87	Seed soaking	α-Tocopherol 50
7.81	3059.7	7.33	34.80	Seed soaking + spraying of plants	
6.70	2714.0	6.33	28.13	Spraying plants	
8.37	2886.3	6.97	31.13	Seed soaking	α-Tocopherol 100
11.08	3994.3	7.00	36.60	Seed soaking + spraying of plants	

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8.05	**2814.3**	**6.00**	**32.13**	**Spraying plants**	
8.17	**2669.0**	**6.27**	**29.53**	**Seed soaking**	**Acetylsalicylic acid 50**
8.17	**2669.0**	**7.27**	**35.07**	**Seed soaking + spraying of plants**	
8.17	**2669.0**	**6.33**	**32.07**	**Spraying plants**	
8.39	**2736.7**	**5.37**	**31.73**	**Seed soaking**	**Acetylsalicylic acid 100**
9.29	**3969.3**	**7.07**	**39.33**	**Seed soaking + spraying of plants**	
7.51	**3780.7**	**6.47**	**33.33**	**Spraying plants**	
NS	**359.4**	**0.51**	**2.69**	**L.S.D. 0.05**	
5.86	**2077.3**	**4.03**	**25.71**	**Control (Distilled water)**	**Average effect of treatments**
7.10	**2794.0**	**5.94**	**30.60**	**α-Tocopherol 50**	
9.17	**3231.7**	**6.66**	**33.29**	**α-Tocopherol 100**	
8.17	**2669.0**	**6.62**	**32.22**	**AcetylAcetylsalicylic acid 50**	
8.39	**3495.6**	**6.30**	**34.80**	**Acetylsalicylic acid 100**	
0.88	**207.3**	**0.32**	**1.65**	**L.S.D. 0.05**	
7.51	**2595.5**	**5.37**	**29.15**	**Seed soaking**	**Average effect of adding method**
8.49	**3153.9**	**6.55**	**34.45**	**Seed soaking + spraying of plants**	
7.21	**2811.1**	**5.81**	**30.37**	**Spraying plants**	
0.28	**223.3**	**0.20**	**1.21**	**L.S.D. 0.05**	

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Table 3. The effect of the concentrations of antioxidants (α-Tocopherol and Acetylsalicylic acid) and the adding method and the interactions between them on the yield of the pods and the fresh seeds of Broad bean plants.

Fresh seed productivity (tonn.ha^{-1})	Weight of 100 fresh seeds(g (	productivity of Pod (tons ha^{-1})	Pod weight (g)	The number of pods per plant) Pod.Plant ($^{-1}$	Pod length (cm)	adding method	Treatments (mg.L^{-1})
8.768	190.6	21.900	19.26	12.8	18.7	Seed soaking	Control (distilled water)
8.92	120.4	22.156	21.66	11.54	19.5	Seed soaking + spraying of plants	
9.096	113.3	21.348	20.12	11.93	18.4	Spraying plants	
12.700	213.0	28.600	23.23	13.83	20.9	Seed soaking	α-Tocopherol 50
21.464	208.4	35.700	28.54	16.20	24.3	Seed soaking + spraying of plants	
13.684	179.4	30.184	23.91	14.20	20.6	Spraying plants	
13.004	191.3	30.692	20.94	16.52	21.6	Seed soaking	α-Tocopherol 100
17.58	187.5	35.728	26.77	15.04	24.7	Seed soaking + spraying of plants	
14.764	261.0	33.548	24.89	15.17	20.4	Spraying plants	
14.960	192.7	32.764	21.12	17.48	25.1	Seed soaking	Acetylsalicylic acid 50
21.812	175.0	43.740	27.32	18.00	26.9	Seed soaking + spraying of plants	
12.524	148.2	28.796	22.67	14.17	22.9	Spraying plants	
12.500	182.7	30.620	23.32	14.78	23.8	Seed soaking	Acetylsalicylic acid 100
21.056	253.0	44.532	28.75	17.43	25.9	Seed soaking + spraying of plants	
12.744	186.5	32.096	24.30	14.88	22.2	Spraying plants	
2.000	19.2	4.932	2.28	1.96	1.26	L.S.D. 0.05	
8.768	119.9	21.800	20.35	12.09	18.9	Control (Distilled water)	

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12.700	**192.8**	**33.268**	**25.23**	**14.74**	**22.0**	**α-Tocopherol 50**	**Average effect of treatments**
13.004	**220.5**	**33.324**	**24.20**	**15.58**	**22.2**	**α-Tocopherol 100**	
14.96	**171.5**	**35.100**	**23.70**	**16.55**	**25.0**	**AcetylAcetylsalicylic acid 50**	
13.056	**210.7**	**35.748**	**25.46**	**15.70**	**24.0**	**Acetylsalicylic acid 100**	
1.268	**11.0**	**2.884**	**1.31**	**1.17**	**0.79**	**L.S.D. 0.05**	
12.500	**182.7**	**28.916**	**21.57**	**15.08**	**22.0**	**Seed soaking**	**Average effect of adding method**

Table 4. The effect of the concentrations of antioxidants (α-Tocopherol and Acetylsalicylic acid) and the adding method and the interactions between them on the Qualitative traits of Broad bean seed.

Protein %	**Dry matter %**	**Vitamin C.)mg. 100 g^{-1} fresh seeds(**	**Total Soluble Solids %**	**adding method**	**Treatments ($mg.L^{-1}$)**
22.16	**14.25**	**10.83**	**9.03**	**Seed soaking**	**Control (distilled water)**
21.93	**14.01**	**13.33**	**9.13**	**Seed soaking + spraying of plants**	
21.84	**13.40**	**13.17**	**9.73**	**Spraying plants**	
27.12	**17.37**	**13.83**	**11.00**	**Seed soaking**	**α-Tocopherol 50**
31.47	**20.52**	**13.83**	**12.97**	**Seed soaking + spraying of plants**	
25.35	**17.91**	**13.83**	**11.13**	**Spraying plants**	
26.40	**23.40**	**15.50**	**11.83**	**Seed soaking**	**α-Tocopherol 100**
38.35	**23.79**	**19.83**	**12.97**	**Seed soaking + spraying of plants**	
25.99	**22.14**	**16.50**	**10.93**	**Spraying plants**	
28.35	**21.26**	**14.00**	**10.93**	**Seed soaking**	**Acetylsalicylic acid 50**
37.04	**21.47**	**17.50**	**12.97**	**Seed soaking + spraying of plants**	

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25.66	**18.05**	**14.50**	**11.04**	**Spraying plants**	
30.93	**21.03**	**14.50**	**13.93**	**Seed soaking**	**Acetylsalicylic acid 100**
40.10	**26.63**	**17.17**	**14.47**	**Seed soaking + spraying of plants**	
26.02	**20.51**	**17.83**	**10.87**	**Spraying plants**	
3.67	**NS**	**1.35**	**0.90**	**L.S.D. 0.05**	
21.98	**13.88**	**12.44**	**9.30**	**Control (Distilled water)**	**Average effect of treatments**
27.98	**18.60**	**13.83**	**11.70**	**α-Tocopherol 50**	
30.25	**23.11**	**17.28**	**11.91**	**α-Tocopherol 100**	
30.35	**20.26**	**15.33**	**11.65**	**AcetylAcetylsalicylic acid 50**	
32.35	**22.72**	**16.50**	**13.09**	**Acetylsalicylic acid 100**	
1.78	**2.71**	**0.78**	**0.58**	**L.S.D. 0.05**	
26.99	**19.46**	**13.73**	**11.35**	**Seed soaking**	**Average effect of adding method**
33.78	**21.28**	**16.33**	**12.50**	**Seed soaking + spraying of plants**	
24.97	**18.40**	**15.17**	**10.74**	**Spraying plants**	
3.12	**NS**	**0.83**	**0.23**	**L.S.D. 0.05**	

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