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Impact of Some Treatments on Improving the Growth, Yield and its Quality of Snap Bean (*Phaseolus vulgaris* L.) Under High Temperature Stress

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Abstract: Two field experiments were carried out in the experimental farm of Barrage Horticulture Research station of the Agricultural Research Center, Qalubia Governorateduring two late summer seasons of 2016 and 2017 to study the tolerance of three snap bean cultivars (Bronco, Valentine and Rivergaro) to high temperature stress in three late sowing dates (April 1st, 15th April and May 1st) with foliar spraying by Berelex $_{40\ SG}$ (1g/10 litter), potassium silicate (6g/ l) and EDTA (Ethylene di amine tetra acetic acid) (1g/l). The plants were sprayed three times. The first was after the appearance of four true leaves, the second was after two weeks from the first and the third after one week from the second spraying time. The results indicated that it could be recommended by sowing the Snap bean cultivars (*Phaseolus vulgaris* L.) , i.e Bronco and Valentino in the first and the second sowing dates (April 1st and 15 thApril) with foliar spraying by Berelex $_{40\ SG}$ (1g/10 litter) and EDTA (1g/l) to obtain the best vegetative growth ex., plant length, number of leaves/plant, number of branches/plant, leaf area, % dry matter and chlorophyll content, the highest green bean pod weight, concerning the early and total green pod yield it could be concluded that the Bronco cv. and Valentino cv. gave the highest early green pod yield and total green pod yield respectively at the date of April 1st with foliar spraying by Berelex $_{40\ SG}$ (1g/10 litter) and potassium silicate (6g/ l). So the results showed that foliar spraying Snap bean (*Phaseolus vulgaris* L.) cvs. Bronco and Valentino with Berelex $_{40\ SG}$ (1g/10 l) and potassium silicate (6g/ l) diminished the harmful effects of high temperature stress injuries at the late sowing dates, i.e 1st April and 15th April.

Key words: Snap bean · Sowing dates · High temperature stress · EDTA · Berelex and potassium silicate

INTRODUCTION

Among the ever-changing components of the environment, the high temperature (HT) stress is a major environmental stress that limits plant growth, metabolism and productivity worldwide on many plants consider. HT is now a major concern for crop production and approaches for sustaining high yields of crop plants under HT stress are important agricultural goals [1]. In food crops including legumes, heat-stress conditions occurring during reproductive development have marked negative effects on fruit/seed yield [2]. Plant responses to HT vary with the degree and duration of HT and the plant type. The main negative effects exerted by high temperature and radiation lead to reduction in growth, a decrease in photosynthetic rate, increased respiration and reduced water and ion uptake [3].

Plant growth and developmental processes are substantially affected, often lethally, by (HT) stress [4, 5]. Snap bean (*Phaseolus vulgaris L.*) has a great importance as one of most vegetable export crops in Egypt. Therefore, expansion in cultivation of snap beans is growing rapidly and could be expanded until the early summer. However, bean plants are relatively sensitive to high temperature stress that may occur in the field, especially when grown under delayed sowing dates such as in April and May, which negatively affects its growth, yield and even the quality of pods. The yield of snap beans is severely reduced under high temperature condition [6]. A rise of a few degrees above the optimum growing temperature can lead to a dramatic yield loss. Heat stress influences an array of processes including physiological, growth, developmental, yield and quality of crop. High temperature may slow down or prevent

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germination, depending on plant species and stress intensity and, at later stages, may adversely affect photosynthesis, respiration, water relations and membrane stability [7, 8]. More precisely, pollen quality is strongly affected by heat stress conditions. High temperature leads to a decrease of pollen viability which is directly correlated with a loss of fruit production. The reduction in pollen viability is associated with changes in the level and composition of several groups of metabolites, which play an important role in pollen development, for example by contributing to pollen nutrition or by providing protection to environmental stresses. Metabolic alterations caused by heat stress can lead to severe damage in sensitive plants compared to tolerant plants and the yield depression is partly due to flower and pod abscission [9]. High temperatures during the reproductive phase caused a reduction in pods and its set in green beans, due to enhanced abscission of flower buds, flowers and pods. Also, Omae*et al.,* [10]stated that high temperature more than (30^5C/26^5C), at the onset of flowering negatively affected both number of pods/plant and individual pod weight. Cultivars which had a higher yield under high temperature conditions showed high pollen fertility [11]. The Berelex $_{40\ SG}$ as a Gibberellic acid Gas had important role on stimulate seed germination, trigger transitions from meristem to shoot growth, juvenile to adult leaf stage, vegetative to flowering and significantly affected the yield characteristics Berelex $_{40\ SG}$ had also encourage for. Produced maximum number of pods per plant, seed yield, seed index and protein content in pea seeds [12]. GAs was most effective in promoting shoot growth, number of branches per plant was increased but chlorophyll contents were decreased by higher concentrations of GA [13]. The Potassium is one of the major plant nutrients and plays an essential role in a variety of physiological processes, i.e. photosynthesis, protein synthesis and maintenance of water status in plant tissues [14]. Potassium silicate enhanced potato vegetative growth parameters, yield components and mineral nutrients (N, P and K) concentration [15]. Also, Silicon has a substantial role in enhancing the growth and yield of maize as being also more beneficial nutrients under abiotic stress [15]. Potassium silicate is a source of highly soluble potassium and silicon so it is used in agricultural production system primarily as silicon amendment source and has utilized of supplying small amounts of potassium which help to improve the quality of yield [16]. Silicon is reported that it reduces multiple stresses including biotic and abiotic stresses in plants by maintaining plant water potential, photosynthetic activity, stomatal conductance and leaf erectness under high transpiration rates [17-20].Under stress using EDTA was more superior growth parameters such as plant height, number of branches and leaves, fresh and dry weigh as well as leaf area [21].

Therefor the aim of this experiment was to study the tolerance of some snap bean cultivars, i.e. Bronco, Valentine and Rivergaro to high temperature stress in the late sowing (1st April, 15th April and 1st May) as well as spraying the plants by some anti-compounds against to the high temperature during the late summer season to reduce the injury effect of that on the vegetative growth, yield and its quality.

MATERIALS AND METHODS

Two field experiments were carried out during the summer season of 2016 and 2017 at Barrage Horticulture Research station of the Agricultural Research Center (A. R. C.), Qalubia Governorate, Egypt. The soil was clay loam with pH 8.28 to study the effect of sowing dates and some treatments on plant growth characters, yield and its components and the chemical composition of leaves and pods of three snap bean (*Phaseolus vulgaris* L.) cultivars i.e., Bronco, Valanteino, Rivergaro.

The Sowing Dates: Seeds of snap bean cultivars were sowing in three planting dates i.e., 1st April, 15th April and 1st May.

Table 1: Maximum air temperature of Qalubia governorate region during the summer seasons of 2016 and 2017

Months	Max. air 2016	Temperature°C 2017	Min. air 2016	Temperature°C 2017
April	38.8	40.7	12.9	12.6
May	44.3	46.3	17.4	16.8
June	39.3	44.0	19.6	20.4
July	38.9	38.4	15.0	14.1
August	43.5	39.5	14.1	13.5
Mean	41.00	41.8	15.9	15.5

The Studied Cultivars: Three snap bean cultivars were used i.e., Bronco, Valentine and Rivergaro. The Bronco cv. seeds were obtained from Horticulture Research Institute, Giza, Egypt. The Valentine and Rivergaroobtained from Suez Canal Company Giza, Egypt.

The Tested Compounds: There are three compounds were used as sprayed with tap water as a control as the following:

- Berelex sG40 at the concentration 10ppm (1g/100L) as recommended.

- Potassium silicate (K2SiO3) contained 25% silicon (sio_2) and 10% K2o at the concentration 6 cm^3/L (as recommended).
- Ethylene di amine tetra acetic acid (EDTA) at the concentration 1g/L (as recommended).
- The control (with foliar spray by tap water).

The plants were sprayed three times the first one was after the appearance of four true leaves. The second was after two weeks from the first and the third was after one week from the second spraying time.

All agricultural practices for growing snap bean were followed as recommended by the Ministry of agriculture.

The Experimental Design: A split-split plot design with three replicates was adopted to distribute the thirty-six treatments of each experiment. The main plots were the three sowing dates. The sub plots were the three snap bean cultivars. The sub-sub plots were the test compounds. Each experimental plot area was 4.8m^2 where consisted of two rows (4m long and 0.60m width).

Data Recorded

Vegetative Growth Characters: Five plants from each plot were randomly taken after the third time of plant spraying (7 days) form each sowing date in the two seasons and the following data were recorded:

- Plant length (the length of main stem (cm).
- Number of leaves per plant.
- Number of branches per plant.
- Leaf area, (the leaf area was calculated according to the following formula of Wallace and Munger [22] (Leaf area (cm^2) leaves dry weight (gm) x disk area / disk dry weight).
- Total leaf chlorophyll (at flowering stage it was measured by using Minolta chlorophyll meter SPAD-501 as SPAD units).
- The dry matter percentage (calculated according to the following formula:
- Plant dry matter % = Plant dry weight x 100

Plant Fresh Weight

Green Pods Yield and its Components:

- The green pods were harvested at the marketable stage. Twenty pods randomly to determine the average of pod weight (g), pod length (cm), pod diameter (cm). In addition, protein percentage which determined according to A.O.A.C. [23].
- The Early yield (ton/fed): was calculated from the first harvest.
- Total pods yield (ton /fed): All green pods per plot were harvest and weighted then the total yield per Feddan were calculated.

Plant Chemical Analysis: The green leaves and green pods were cleaned and dried at 70°C in forced air oven for 72 hours, then finely ground to determine the following chemical analysis:

- Leaf chlorophyll content in the fourth upper leaf (three readings per leaf at different places) using Minlta chlorophyll meter (SPAD-501) as SPAD unitsYadava [24].
- Total nitrogen, potassium and phosphorus were determined in the dry leaves on the basis of dry according to Pregl [25], Brown and Lilleland [26] and Jackson [27] respectively. Total protein in the dry leaves calculated as multiplying nitrogen by 6.25.
- Total sugars were determined in green pods colorimetrically according to the method described by Dubois *et al.* [28].
- Fiber percentage in green pods was determined according to the method described by A.O.A.C [29].

Statistical Analysis: Data obtained were subjected to the proper analysis of variance (split- split plot design) as described by Snedecor [30] using 8 statistics. Averages between treatments were differentiated by using (Duncan's) at 5% level of probability.

RESULTS AND DISCUSSION

Vegetative Growth Characters

Effect of the Sowing Dates: Results presented in Table (2) show the effect of sowing dates on vegetative growth characters .i.e., plant length, number of leaves/ plant, number of branches/ plant, dry matter%, the leaf area and the chlorophyll content in leaves. The data indicated that the plant length gave the highest values in the second date (15th April) in the first and second season. While the first sowing date (1st April) gave a significantly increased in no. of leaves/ plant, no. of branches/plant and chlorophyll content in the both seasons. In this regard Cowling and Sage [31] on bean indicated decrease in growth and photosynthetic pigments at the late sowing. Regarding to the dry matter it is notice that the highest values of dry matter% were recorded in in case of the latter sowing date at (1st May) in the both seasons.

Table 2: Effect of the sowing dates, cultivars and some compounds on vegetative growth and leaf chlorophyll content ofsnap bean plants during the two seasons of 2016 and 2017

	Plant length (cm)		Leaves number/ plant		Number of branches/ plant		Plant dry mater %		Leaf area (cm^2)		Chlorophyll (SPAD)	
Treatments	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
						Date Sowing						
First date	36.39 b	37.46 b	17.72 a	17.86 a	7.00 a	6.97 a	28.14 a	27.85 a	287.30 a	279.75 a	42.72 a	43.08 a
Second date	39.19 a	40.81 a	15.64 b	15.28 b	6.25 b	6.00 a	19.00 b	18.94 b	268.40 a	262.50 a	42.14 a	43.19 a
Third date	30.49 c	38.35 ab	12.36 c	12.17 c	5.36 b	5.14 b	11.97 c	12.25 c	238.37 a	236.4 a	38.83 b	39.50 b
						Cultivars						
Bronco	35.60 b	36.69 b	13.58 b	13.33 c	6.03b	5.89 b	18.37 b	18.28 b	285.30 a	287.23 a	39.96 c	40.68 c
Valantino	33.03 c	34.38 c	16.06 a	15.94 b	6.22b	6.19 a	18.19 b	18.26 b	265.50 a	261.40 a	42.93 a	43.08 a
Rivergaro	37.43 a	46.55 a	16.08 a	16.03 a	6.36 a	6.33 a	22.56 a	22.70 a	262.20 a	260.04 a	40.80 b	42.02 b
						Compounds						
B	35.22 b	36.46 b	18.15 a	17.74 a	7.39 a	6.93 a	19.97 b	20.10 b	269.41 a	266.93 a	40.94 b	42.17 a
Si	37.31 a	37.61 b	15.37 b	15.85 b	6.63 b	6.48 a	20.79 ab	20.28 b	263.00 a	261.50 c	41.93 a	42.43 a
E	37.76 a	51.14 a	16.37 b	15.82 b	6.00 b	5.93 b	21.46 a	21.28 a	263.04 a	263.82 b	41.70 a	41.96 a
Control	31.13c	30.29 c	11.07 c	11.00 c	4.89 c	4.81 c	16.60 c	17.05 b	243.53 a	245.97 d	40.35 c	41.14 b

B = $Berelex_{40\ SG}$Si = potassium silicate E = Ethylene di amine tetra acetic acid (EDTA)

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significant according to Duncan's multiple range tests

This result agree with the results of Sohir *et al.* [32] on snap bean they reported that the increase in dry weight percentage was attributed to the reduction of water content of plant tissues at this sowing date as the plant suffered from high temperature stress. This is contrary to the results of Li *et al.* [33] who found a direct correlation between heat acclimation potential (ability of leaf cells to withstand injury at 50°C after exposure to 37°C for 24 h) and yield under heat stress in the field with cultivars of (*Phaseolu vulgaris* L.). Yield under heat stress may be affected by various aspects of the heat response: the ability to detect temperatures as stressful; the ability to respond to temperature shifts quickly; the extent of the response; and the tissue specificity of the response. Whereas response of leaf tissue to heat may be important in maximizing the biomass of the plant, which can affect its ability to support sink material such as seeds, it is more likely that a direct effect on yield (no. of beans/plant) is the result of heat stress on reproductive tissues. It has been reported that pollen development is particularly sensitive to extreme heat exposure [34]. High temperature causes loss of cell water content for which the cell size and ultimately the growth is reduced [35, 36].

Effect of the Cultivars: The results in Table (2) indicated that the Rivergaro cv. gave the highest values of plant length, no. of leaves/ plant, no. of branches/ plant and dry matter percentage in the both seasons with high significantly. However, Bronco cv. revealed highly increase on leaf area and the Valantino cv. gave higher chlorophyll in the leaves with significantly effect in the first and the second seasons.

Effect of Tested Compounds: Data in Table (2) clearly showed that the EDTA treatment increased plant length and the dry matter% in the first and second seasons without any significant but the Berelex treatment caused significant increase on No., of leaves/plant, No., of branches/plant and leaf area in the both seasons.

The Interaction Between the Studies Different Factors: Regarding to the effect of the interaction among the three studied factors for (sowing dates, the cultivars and the tested compounds) vegetative growth the data recorded in Table (3a) and (3b). That the highest plant length was detected from Valantino cv. which sowing in the third date (1st May) with foliar sprays by EDTA in the second season. Also the leaf area gave the highest value from Bronco cv. with EDTA treatment in the third sowing date but in the first season. While the number of leaves/ plant and number of branches/ plant significantly increased as a result of sowing the Bronco cv. in the first sowing date (1st April) with foliar spray by the Berelex treatment in the first season. These results are agree with Mani *et al.* and Um Habiba *et al*. [37, 38]on rapeseed (*Brassica napus* L.) showed that the application of EDTA improved the plant growth. This could be the addition, of EDTA probably occurred due toenhanced efficiency of gas exchange or due to chelate formation which reduced the stress effects. Green pods yield and its components:

Effect of the Sowing Dates: Data in table (4) presented that the first sowing date (1st April) showed significant increase in green pod weight, green pod length in the both growing seasons beside the green pods early yield

Table 3a: Effect of the interaction among, sowing dates, cultivars and some compounds onplant length (cm), number of leaves/plant and number of branches/ plant ofsnapbean plants during the two seasons of 2016 and 2017

Treatments								
			Plant length (cm)		No. of leaves/plant		No. of branches/plant	
Dates	Cultivars	Compounds	2016	2017	2016	2017	2016	2017
	Bronco	B	40.00 ab	39.67 c	26.00 a	21.67 a	9.00 a	8.33 a
		Si	40.33 ab	43.00 b	21.33 b	19.00 b	7.33 b	7.67 a
		E	38.67 ab	43.97 a	18.00 c	17.67 b	6.33 c	6.33 c
		Control	38.67 ab	39.00 c	15.00 d	14.67 c	6.33 c	5.67 d
		B	43.67 a	47.00 a	16.67 a	16.33 a	7.67 b	7.67 a
	Valanteino	Si	41.17 a	41.33 c	15.00 c	14.67 b	6.67 b	5.67 c
		E	41.33 a	41.33 b	15.67 b	14.67 b	6.00 c	5.33 c
First dates		Control	38.00 bc	35.00 d	12.00 d	12.67 c	4.67 d	5.00 c
		B	38.00 bc	39.17 a	14.00 a	15.00 a	6.67 b	5.00 c
	Rivergaro	Si	33.67 c	33.50 b	13.33 b	13.00 b	6.00 c	5.67 c
		E	30.67 c	32.00 b	13.67 b	13.33 b	5.67 c	5.33 c
		Control	25.00 c	23.97 c	12.00 c	11.67 c	4.00 d	4.67 d
		B	39.33 b	40.80 a	18.33 b	18.00 a	8.33 a	8.00 a
	Bronco	Si	38.33 b	36.92 b	19.67 a	19.33 a	7.00 a	6.67 b
		E	41.97 a	38.97 b	17.33 c	16.33 b	6.33 c	7.00 a
		Control	33.67 c	37.67 c	15.00 d	8.33 c	5.33 d	5.33 c
	Valanteino	B	41.00 a	43.67 b	16.67 c	18.00 a	7.33 a	7.00 a
		Si	40.93ab	44.33 a	17.67 b	17.00 a	6.33 c	7.00 a
Second dates		E	42.33 a	44.17 a	18.33 a	16.67 c	7.00 a	5.67 c
		Control	34.33 c	34.33 c	12.67 d	10.00 c	4.00 d	4.67 d
		B	23.67 c	24.67 c	13.33 c	12.33 a	6.00 c	5.67 c
	Rivergaro	Si	31.33 bc	31.00 b	18.33 b	9.33 b	5.30 c	5.60 c
		E	35.33 c	33.87 a	18.67 a	7.67 b	5.00 c	4.67 d
		Control	25.00 c	23.00 d	16.67 d	7.00 b	4.00 d	4.00 d
		B	29.67 c	29.67 c	22.00 a	21.67 a	7.67 a	8.00 a
	Bronco	Si	38.00bc	37.93 a	13.33 b	18.00 a	7.67 a	8.00 a
		E	34.00bc	34.00 b	22.00 a	22.33 a	7.00 a	8.00 a
		Control	24.00 c	23.33 d	11.67 c	9.33 b	5.67 c	4.67 d
		B	33.00 c	38.67 c	18.00 b	17.67 a	6.33 b	6.00 c
Third dates	Valanteino	Si	40.67ab	41.33 b	16.00 c	16.67 a	7.67 a	7.67 a
		E	40.67ab	46.33 a	18.33 a	16.33 a	5.67 c	5.67 c
		Control	33.17bc	31.83 d	13.33 d	12.67 a	5.33 c	4.67 d
		B	38.67 bc	38.41 a	16.33 a	15.00 a	6.67 b	6.67 b
		Si	31.33 c	31.67 c	13.33 b	13.00 a	5.67 c	5.00 c
	Rivergaro	E	34.83bc	33.67 b	16.33 a	16.00 a	5.00 c	5.33 c
		Control	28.33 c	27.83 d	12.33 c	12.67 a	4.33 d	4.67 d

B = Berelex $_{40\ SG}$ Si = potassium silicate E = Ethylene di amine tetra acetic acid (EDTA).

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significant according to Duncan's multiple range tests.

and the green pods of total yield in the second season. But the third sowing date (1st May) gave a significant effect on green pod diameter in the both seasons. In the same line, Yoldas and Esiyok [39] on green bean pointed that in late sowing, growth, yield and yield components decrease because of short vegetation period. Delayed planting decreased the number of days as well as the thermal time from emergence to harvest. The result shows similarity to the findings of Meinke [40]. Yield reduction was observed with the late planting date is advanced or delayed from the optimum. Late planting has negative consequences on yield because the reproductive stage occurs when weather condition is less favorable. The reproductive period of bean plants coincides with the highest summer temperatures and flowers that results in a significant decrease In common bean (*Phaseolus vulgaris* L.).

Table 3b: Effect of the interaction among, sowing dates, cultivars and some compounds on dry matter%, leaf area and chlorophyll contents of snap bean plants during the two seasons of 2016 and 2017

Treatments								
			Dry matter (%)		Leaf area (cm^2)		Chlorophyll (SPAD)	
Dates	Cultivars	Compounds	2016	2017	2016	2017	2016	2017
	Bronco	B	32.79 b	31.95 a	287.12 b	282.24 b	43.67 a	44.00 a
		Si	36.29 a	34.11 a	290.33 a	288.09 a	42.83 a	43.57 a
		E	32.25 b	33.00 a	286.64 b	292.20 a	40.30 a	42.67 a
		Control	23.07 c	26.42 a	200.32 d	259.43 b	41.40 a	41.80 a
		B	26.83 a	22.60 a	289.66 a	273.66 b	42.40 a	43.90 a
	Valantino	Si	25.91 a	24.75 a	270.47 b	264.82 c	42.07 a	44.63 a
		E	25.99 a	27.26 a	266.91 b	271.75 b	42.14 a	43.90 a
First dates		Control	22.99 a	24.29 a	247.12 c	245.82 c	41.17 a	41.63 a
		B	13.20 a	13.29 a	249.44 c	238.04 d	35.97ab	38.60 a
	Rivergaro	Si	12.44 a	12.27 a	235.52 d	230.84 d	39.93 a	42.17 a
		E	15.00 a	13.84 a	233.74 d	234.06 d	42.87 a	43.43 a
		Control	7.51 a	8.27 b	231.65 d	239.52 d	34.83ab	33.93 b
		B	28.39 a	27.12 a	279.67 b	291.00 a	41.53 a	43.77 a
	Bronco	Si	27.38 a	26.07 a	281.13 b	276.19 a	43.07 a	44.10 a
		E	27.81 a	27.13 a	283.25 b	286.83 a	42.70 a	42.50 a
		Control	21.48 a	21.67 a	255.11 c	252.89 c	42.73 a	44.00 a
	Valantino	B	16.22 a	15.39 a	263.33 b	264.09 b	38.80ab	39.27ab
		Si	17.00 a	16.73 a	260.14 b	257.86 c	42.60 a	43.67 a
Second dates		E	18.61 a	19.03 a	267.66 b	262.99 b	41.53 a	42.10 a
		Control	12.04 b	12.77 b	246.14c	247.29 c	42.30 a	43.43 a
		B	13.77 a	13.75 a	245.67 c	243.43 c	34.90 b	34.90 b
	Rivergaro	Si	13.50 a	13.20 a	236.67 d	234.85 d	38.53 a	37.90 a
		E	14.49 a	13.66 a	237.24 d	234.07 d	37.37 a	35.80 a
		Control	9.70 b	10.39 b	234.63 d	235.30 d	33.47 a	36.70 a
		B	27.30 a	27.53 a	290.18 a	291.79 a	44.83 a	45.40 a
	Bronco	Si	27.53 a	26.05 a	289.92 a	292.58 a	44.10 a	42.23 a
		E	27.96 a	28.17 a	292.53 a	287.85 a	43.03 a	39.93 b
		Control	24.95 a	24.93 a	255.64 c	255.89 c	42.47 a	43.00 a
		B	16.32 a	15.34 a	279.67 a	272.72 b	44.03 a	46.20 a
Third dates	Valantino	Si	16.98 a	17.07 a	271.90 b	272.09 b	42.23 a	42.77 a
		E	15.93 a	15.62 a	268.34 c	271.60 b	43.87 a	44.00 a
		Control	13.32 a	16.45 a	248.67 c	245.31 c	42.53 a	42.83 a
	Rivergaro	B	8.87 b	13.55 a	245.28 c	245.42 c	42.33 a	43.53 a
		Si	12.56 a	12.27 a	236.27 d	236.14 d	41.97 a	40.83 a
		E	15.06 a	13.84 a	235.15 d	233.08 d	41.47 a	43.27 a
		Control	7.51 b	8.27 b	239.11 d	232.31 d	42.27 a	42.90 a

B = Berelex $_{40\ SG}$ Si = potassium silicate E = Ethylene di amine tetra acetic acid (EDTA).

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significant according to Duncan's multiple range tests.

Effect of the Cultivars: Data illustrated in Table (4) show clearly that the cultivars had a significant difference in green pods weight and green pod length in the first and second seasons. On the other side the green pod diameter gave non-significant increase with all cultivars in both growing seasons. With regard to the early green pods yield the cultivars did not show significant values in the first season but in the second season Bronco and Rivergaro cvs. recorded significantly increased in the green pods early yield. On the other hand, the Valantino cv. had the highest total green pods yield in the first season while in the second season there was no significant between the studies cultivars. This is contrary to the results of Li *et al.* [33] They found a direct correlation between heat acclimation potential (ability of leaf cells to withstand injury at 50°C after exposure to 37°C for 24 h) and yield under heat stress in the field with cultivars of (*Phaseolus vulgaris* L.).Yield under heat stress may be affected by various aspects of the heat response: the ability to detect temperatures as stressful;

Table 4: Effect of the sowing dates, cultivars and some compounds on Green pods yield and its components ofsnapbean plants during the two seasons of 2016 and 2017

	Green pod length (cm)		Green pod weight (g)		Green pod diameter (cm)		Green pod early yield (ton/fed)		Green pod total yield (ton/fed)	
Treatments	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
						Dates Sowing				
First date	13.56 a	13.63a	4.66 a	4.53 a	0.66 c	0.66 c	1.26 a	1.26 a	3.77 a	3.75 a
Second date	12.48 b	12.54b	3.96 b	3.86 b	0.73 b	0.73 b	1.00 a	1.00 b	2.94 b	3.70 a
Third date	11.03 c	10.85c	3.77 c	3.70 c	0.76 a	0.75 a	0.93 a	0.90 c	2.81 c	2.94 a
						Cultivars				
Bronco	11.93 c	11.82c	4.05 b	3.99 b	0.80 a	0.78 a	1.47 a	1.17 a	3.25 b	3.59 ab
Valantino	12.06 b	11.98b	4.55 a	4.51 a	0.68 b	0.67 b	0.62ab	0.62 c	3.43 a	4.38 a
Rivergaro	13.08 a	13.22 a	3.79 c	3.59 c	0.68 b	0.68 b	1.10 b	1.08 b	1.84 c	1.83 b
						Compounds				
B	12.43 b	12.54 a	4.08bc	4.07 b	0.72 a	0.72ab	1.60 a	1.19 a	3.59 a	3.51 a
Si	12.26 bc	12.37a	4.29 a	4.22 a	0.72 a	0.72 a	1.06ab	1.05 b	3.59 a	3.11 b
E	12.61 a	12.53 a	4.17ab	4.11ab	0.72 a	0.70ab	0.94ab	0.93 c	4.01 a	2.80 c
Control	12.13c	11.915b	3.97 c	3.73 c	0.72 a	0.70 b	0.65 c	0.66 d	1.94 a	1.94 d

B = Berelex $_{40\ SG}$ Si = potassium silicate E = Ethylene di amine tetra acetic acid (EDTA).

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significant according to Duncan's multiple range tests.

the ability to respond to temperature shifts quickly; the extent of the response; and the tissue specificity of the response. High temperature causes loss of cell water content for which the cell size and ultimately the growth is reduced [35, 36].

Effect of the Tested Compounds: The obtained results in Table (4) showed that the all used compounds had on significantly difference in green pod weight, green pod length and green pod diameter in both seasons, also in the early green pods yield in the second season and the total green pods yield in the first season. However, the Berelex treatment had a significant effect on the early green pods yield in the second season and the total green pods yield in the first season. The improvement in yield under the influence of the growth regulators like Berelex as a Gibberellic acid might be due to the activation of various internal mechanisms related with plant growth and metabolism. This finding was agreement with Bora and Sarma [12] and Grewal [41] on pea.

The Interaction Studies Between the Different Factors: Data presented in Table (5a) and (5b) show clearly that the green pods weight and pod length were significantly affected as a result of sowing Bronco cv. in the first sowing date(1st April) with the Berelex treatment and the second date (15th April) with EDTA treatments respectively in the second season. Concerning to early yield as well as total yield the best treatments was sowing the Valantino cv. in the second sowing date (15th April) with Potassium silicate and in the first sowing date (1st April) with the Berelex respectively in the first season only.

Chemical Composition:

Effect of the Sowing Dates: Data in Table (6) indicated that the bean plants grown in the third sowing date (1st May) gave significantly increased in nitrogen, the protein contents in leaves and the fiber content in green pods in the first season. These results are in harmony with Savin *et al.* [42] which mentioned that the high heat stress cause induce a new types from protein which called Heat Shock Protein (HSP).while the first sowing date (1st April) gave the highest total sugars percentage in the second season.

Effect of the Cultivars: It is obvious from the data in Table (6) that the Rivergaro cultivar had significant differences in nitrogen and protein contents in the leaves but the Bronco cultivars gave the highest value of total sugars content in leaves in the first season only. In addition, there was no significant between the cultivars on the fiber content in bean green pods at the both seasons.

Table 5a: Effect of the interaction among, sowing dates, cultivars and some compounds ongreen pods (weight, length and diameter) on snapbean during the two seasons of 2016 and 2017

Treatments								
			Green pod weight (g)		Green pod length (cm)		Green pod Diameter (cm)	
Dates	Cultivars	Compounds	2016	2017	2016	2017	2016	2017
	Bronco	B	4.03 a	4.11a	13.26 a	13.23a	0.56 d	0.60 c
		Si	4.23a	4.36 a	13.16 a	14.40 a	0.67 b	0.70 a
		E	4.03a	3.82 a	13.33 a	13.30 a	0.63 c	0.60 c
		Control	4.27a	3.77 a	13.73 a	13.47 a	0.60 c	0.60 c
		B	4.42 a	4.34 a	12.97 a	13.67 a	0.77 a	0.80 a
	Valantino	Si	5.01 a	4.93 a	12.97 a	13.57a	0.80 a	0.80 a
		E	4.68 a	4.60 a	13.60 a	13.00 a	0.73 a	0.70 a
First dates		Control	4.94 a	4.56 a	13.80 a	13.57 a	0.80 a	0.70 a
		B	5.08 a	5.23a	13.27 a	13.23 a	0.60 c	0.60 c
	Rivergaro	Si	4.88 a	4.65a	14.17 a	14.40 a	0.60 c	0.60 c
		E	5.14 a	5.11a	14.17 a	14.40 a	0.60 c	0.60 b
		Control	5.22 a	4.87a	13.33a	13.30 a	0.60 c	0.67 b
		B	3.50a	3.30a	13.43 a	13.50 a	0.73 a	0.80 a
	Bronco	Si	3.93a	3.67 a	13.46 a	13.57 a	0.67 b	0.70 a
		E	3.73a	3.3 a	14.16 a	14.43 a	0.67 b	0.67 b
		Control	3.90a	3.6 a	12.53 a	12.67 a	0.67 b	0.63 b
	Valantino	B	3.77a	3.74 a	12.37 a	12.40 a	0.80 a	0.70 a
		Si	4.03 a	4.13 a	11.80 a	11.93 a	0.77 a	0.77 a
Second dates		E	4.17 a	4.20 a	11.53 a	11.47 a	0.83 a	0.83 a
		Control	3.81 a	3.63 a	12.30 a	12.30 a	0.80 a	0.87 a
		B	4.43 a	4.55 a	12.57 a	12.53 a	0.70 a	0.70 a
	Rivergaro	Si	4.57 a	4.38 a	11.80 a	12.07 a	0.70 a	0.70 a
		E	4.13 a	4.42 a	11.60 a	11.50 a	0.70 a	0.70 a
		Control	4.53 a	3.44 a	12.23 a	12.13 a	0.70 a	0.63 c
		B	3.50a	3.30 a	11.77a	12.27 a	0.77 a	0.77 a
	Bronco	Si	3.93 a	3.60 a	12.53 a	12.93 a	0.70 a	0.73 a
		E	3.50a	3.30 a	13.10 a	13.23 a	0.73 a	0.70 a
		Control	2.90a	2.88 b	11.55 a	11.60 a	0.70 a	0.70 a
		B	3.54 a	3.57 a	11.07 a	11.00 a	0.83 a	0.83 a
Third dates	Valantino	Si	3.57 a	3.56 a	9.13 a	11.87 a	0.87 a	0.83 a
		E	3.60 a	3.62 a	11.00 a	10.73 a	0.77 a	0.77 a
		Control	3.07 a	2.99 a	10.60 a	10.33 a	0.83 a	0.77 a
		B	4.46 a	4.47 a	11.13 a	11.00 a	0.70 a	0.70 a
		Si	4.49 a	4.64 a	10.33 a	10.60 a	0.70 a	0.70 a
	Rivergaro	E	4.58 a	4.57 a	11.00 a	10.73 a	0.77 a	0.70 a
		Control	4.05 a	3.80 a	9.13 b	7.87 b	0.80 a	0.77 a

B = Berelex $_{40\ SG}$ Si = potassium silicate E = Ethylene di amine tetra acetic acid (EDTA).

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significant according to Duncan's multiple range tests.

Effect of Using Compounds: The results in Table (6) reveal that there was no significant effect on nitrogen, phosphorus, potassium and protein contents in bean leaves and the fiber content in green pods in the first and the second seasons with all tested compounds. On the other hand, the potassium silicate treatment caused significantly increased on leaves total sugars content at the second season and this may be due to the potassium silicate which has a great role in accumulation of compatible osmolytes in plants tissues. Similar finding has been recorded by Hussain *et al.* [43] on mung bean and Abu-Muriefah [44] on common bean.

Table 5b: Effect of the interaction among, sowing dates, cultivars and some compounds ongreen pods early and total yield (ton/fed) on snapbean during the two seasons of 2016 and 2017

Treatments						
			Early yield (ton/fed)		Total yield (ton/fed)	
Dates	Cultivars	Compounds	2016	2017	2016	2017
	Bronco	B	1.73 a	1.70 a	2.70 b	2.77 b
		Si	1.72 a	1.68 a	2.77 b	2.83 b
		E	1.82 a	1.80 a	2.80 b	2.40 b
		Control	1.08 b	1.02 b	1.77 c	1.83 c
		B	1.52 a	1.55 a	5.17 a	5.03 a
	Valantino	Si	1.37 a	1.40 a	5.07 a	4.97 a
		E	1.62 a	1.60 a	5.40 a	5.33 a
First dates		Control	0.98 bc	1.05b	3.35 a b	3.33 a b
		B	0.92 bc	0.93 bc	4.52 a	4.53 a
	Rivergaro	Si	0.93 b c	0.95bc	4.02 a	4.13 a
		E	0.87 b c	0.82 bc	4.80 a	4.73 a
		Control	0.60 c	0.62 c	2.87 b	3.13 a b
		B	1.58 a b	1.57 a	1.67 c	1.78 c
	Bronco	Si	1.15 b	1.07 b	1.95 b	1.92 b
		E	0.78 c	0.75 c	1.53 c	1.60 c
		Control	0.80 c	0.85 c	1.47 c	1.53 c
	Valantino	B	1.40 b	1.43 b	4.67 a	4.63 a
		Si	1.98 a b	1.95a b	3.37 a b	4.27 a
Second dates		E	1.30 b	1.32 b	2.27 b	2.23 b
		Control	0.77 c	0.77 c	2.17 b	2.15 b
		B	0.53 c	0.62 c	4.13 a	4.23 a
	Rivergaro	Si	0.67 c	0.65 c	5.77 a	5.85 a
		E	0.52 c	0.55 c	4.77 a	5.27 a
		Control	0.50 c	0.52 c	2.57 b	2.28 b
		B	1.25 b	1.23 b	1.47 c	1.53 c
	Bronco	Si	0.47 d	0.50 c	1.43 c	1.33 c
Third dates		E	0.42 d	0.42d	1.43 c	1.30 c
		Control	0.42 d	0.42 d	1.07 c	1.07 c
		B	1.92 b	1.17 b	3.70 a	3.62 a
	Valantino	Si	0.77 c	0.78 c	3.38 a b	3.98 a
		E	0.67 c	0.65 c	1.25 c	1.25 c
		Control	0.33 d	0.32 d	1.23 c	1.23 c
		B	0.52 c	0.47 d	3.57 a	3.48 a b
		Si	0.50 c	0.45 d	2.27 b	2.00 b
	Rivergaro	E	0.48 d	0.48 d	1.97 b	1.93 b
		Control	0.37 d	0.37 d	0.93 d	0.93 b

B = Berelex $_{40\ SG}$ Si = potassium silicate E = Ethylene di amine tetra acetic acid (EDTA).

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significant according to Duncan's multiple range tests.

The Interaction Studies Between the Different Factors: Results of Table (7a) and (7b) reveal that the statistical analysis of the data indicated that the interaction between sowing date, cultivars and foliar spray of some compounds on % phosphorus in plant leaves was significantly increased as a results of Valantino cv. in the first sowing date (1st April) with potassium silicate treatment in the first season, meanwhile % Potassium in leaves significantly increased when sowing Rivergaro cultivar in the first sowing date (1st April) with foliar spray by EDTA in the both seasons. Regarding total sugars content as well as fiber in green pods the highest values recorded by sowing Valantino cv. in the second sowing date (15th April) with EDTA and in the third sowing date (1st May) with control treatment in both seasons respectively.

Table 6: Effect of the sowing dates, cultivars and some compounds on N%, P%, K% and protein% on leaves & total sugars % and fiber% on green pods ofsnap bean plants during the two seasons of 2016 and 2017

	N %		P %		K %		Protein %		Total sugars %		Fiber %	
Treatments	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
						Sowing Dates						
First date	2.18 b	2.15 b	0.60 a	0.57 a	2.82 a	2.62 a	13.63 b	13.44 b	3.58 a	3.56 a	0.96 b	0.96 c
Second date	2.15 b	2.13 b	0.42 a	0.42ab	2.54 a	2.03 a	13.44 b	13.31 b	4.16 a	3.11 b	1.05 b	1.05 b
Third date	2.28 a	2.29 a	0.48 a	0.39 b	2.69 a	2.70 a	14.25 a	14.25 a	3.57 a	2.47 c	1.81 a	1.60 a
						Cultivars						
Bronco	2.04 b	2.06 b	0.67 a	0.64 a	2.44 a	2.44 a	12.75 b	12.88 b	5.56 a	4.49 a	1.65 a	1.21 ab
Valantino	2.04 b	2.07 b	0.53 a	0.43 b	2.91 a	2.89 a	12.75 b	12.94 b	2.37 a	2.27 c	1.14 a	1.16 b
Rivergaro	2.53 a	2.44 a	0.41 a	0.42 b	2.71 a	2.03 a	15.81 a	15.25 a	2.38 a	2.39 b	1.23 a	1.24 a
						Compounds						
B	2.27 a	2.26 a	0.46 b	0.41 ab	2.75 a	2.77 a	14.19 a	14.13 a	3.05 a	3.05 c	1.22 a	1.17 bc
Si	2.30 a	2.33 a	0.61 a	0.55 a	2.61 a	2.59 a	14.38 a	14.56 a	3.68 a	3.58 a	1.20 a	1.22 b
E	2.31 a	2.32 a	0.50 b	0.50 a	2.70 a	2.68 a	14.44 a	14.50 a	3.18 a	3.19 b	1.70 a	1.80 a
Control	1.94b	1.85 b	0.34 b	0.34 b	2.01 a	2.44 a	12.13 b	11.56 b	3.85 a	2.38 d	1.24 a	1.24 b

B = Berelex $_{40\ SG}$Si = potassium silicate E = Ethylene di amine tetra acetic acid (EDTA)
Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significant according to Duncan's multiple range tests.

Table 7a: Effect of the interaction among, sowing dates, cultivars and some compounds onN%, P% and K%on leaves of snapbean during the two seasons of 2016 and 2017

Treatments								
			Nitrogen %		Phosphor %		Potassium %	
Dates	Cultivars	Compounds	2016	2017	2016	2017	2016	2017
	Bronco	B	2.59 a	2.48 a	0.46 a	0.48 a	2.49 a	2.48 a
		Si	2.18 a	2.17 a	0.45 a	0.45a	2.49 a	2.50 a
		E	2.48 a	2.52 a	0.43 a b	0.44 a b	2.34 a b	2.34 a
		Control	2.31 a	2.07 a	0.36 d	0.38 c	2.70 a	2.57 a
	Valantino	B	2.18 a	2.20 a	0.51 a	0.48a	2.41 a	2.37 a b
		Si	2.52 a	2.51 a	0.63 a	0.51 a	2.50 a	2.49 a
		E	2.23 a	2.22 a	0.53 c	0.54 a	2.41 a	2.39 a b
First dates		Control	1.49 a	1.46 a	0.39 c	0.41b	2.11 a b	2.13 b
	Rivergaro	B	1.67 a	1.66 a b	0.49 a	0.50 a	3.03 a	3.06 a
		Si	2.00 a b	2.02 a	0.47 a	0.50 a	2.96 a	2.87 a
		E	2.37 a	2.38 a	0.52 a	0.51 a	3.32 a	3.26 a
		Control	2.19 a	2.10 a	0.40 b	0.39 c	3.03 a	3.02 a
	Bronco	B	2.89 a	2.67 a	0.39 a b	0.39 c	2.75 a	2.82 a
		Si	2.73 a	2.77 a	0.44 a b	0.44 a b	2.38 a b	2.35 a b
		E	1.93 a	1.93 a b	0.51 a	0.52 a	2.37 a b	2.30 a b
		Control	2.37 a b	2.11 a	0.36 d	0.38 c	2.24 a b	2.26 b
	Valantino	B	1.99 a b	2.03 a	0.36 d	0.34 d	2.52 a b	2.52 a
		Si	2.13 a	2.14 a	0.40 b	0.42 a b	2.48 a	2.48a
Second dates		E	2.42 a	2.45 a	0.50 a	0.52 a	3.01 a	3.03 a
		Control	1.51 a	1.42 a	0.38 c	0.38 c	2.09 b	2.11 b
	Rivergaro	B	2.12 a	2.12 a	0.42 b	0.39 c	2.73 a	2.71 a
		Si	1.96 a b	2.09 a	0.46 a	0.44 a b	2.76 a	2.68 a
		E	2.22 a	2.21 a	0.48 a	0.47 a	2.92 a	2.90 a
		Control	1.58 a b	1.63 a	0.39 c	0.39 c	2.25 a b	2.20 b
	Bronco	B	2.99 a	3.03 a	0.39 c	0.39 c	2.62 a b	2.64 a
		Si	2.82 a	2.82 a	0.41 b	0.40 a b	2.77 a	2.78 a
		E	2.63 a	2.61 a	0.50 a	0.52 a	2.86 a	2.78 a
		Control	2.47 a b	2.09 a	0.26 d	0.24 d	2.50 a b	2.50 a
	Valantino	B	1.91 a	2.04 a	0.38 c	0.37 c	2.31 a b	2.31 a b
Third dates		Si	1.98 a	2.01 a	0.40 b	0.44 a b	2.50 a	2.27 b
		E	2.31 a	2.36 a	0.51 a	0.50 a	2.36 a b	2.37 a b
		Control	1.87 a b	1.92 a b	0.25 d	0.24 d	2.78 a	2.80 a
	Rivergaro	B	2.13 a	2.13 a	0.46 b	0.38 c	3.89 a	3.98 a
		Si	2.41 a	2.40 a	0.46 b	0.46 a	2.89 a	2.88 a
		E	2.15 a	2.19 a	0.52 a	0.51 a	2.96 a	2.95 a
		Control	1.70 a	1.84 a b	0.25 d	0.25 d	2.12 b	2.13 b

B = Berelex$_{40\ SG}$ Si = potassium silicate E = Ethylene di amine tetra acetic acid (EDTA).
Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significant according to Duncan's multiple range tests.

Table 7b: Effect of the interaction among, sowing dates, cultivars and some compounds onprotein% in leaves and total sugars % and fiber% in green pods of snapbean during the two seasons of 2016 and 2017

			Treatments					
			Protein %		Total sugars %		Fiber %	
Dates	Cultivars	Compounds	2016	2017	2016	2017	2016	2017
	Bronco	B	16.19 a	15.50 a	3.14 b	3.14 b	0.97 a	0.92 a
		Si	13.63 a	13.56 a	3.93 a	3.88 a	0.86 a	0.97a
		E	15.50 a	15.75 a	3.52 a	3.67 a b	0.90 a	0.97 a
		Control	14.44 a	12.94 a	1.94 c	1.85 c	0.98 a	0.92 a
		B	13.63 a	13.75 a	4.66 a	4.55 a	0.97 a	0.98 a
	Valantino	Si	15.75 a	15.69 a	4.78 a	4.65 a	0.97 a	0.91 a
			13.94 a	13.88 a	5.29 a	5.28 a	0.94 a	0.96 a
First dates		Control	9.31 b	9.13 b	4.19 a	4.21 a	0.98 a	0.68 a
		B	10.44 a b	10.38 a b	3.54 a	3.41 a b	0.98 a	0.96 a
	Rivergaro	Si	12.50 a	12.63 a	3.92 a	3.90 a	0.97 a	0.97 a
		E	14.81 a	14.88 a	2.55 b	2.77 b	0.96 a	0.96 a
		Control	13.69 a	13.13 a	1.48 c	1.41 c	0.99 a	1.00 a
		B	18.06 a	16.69 a	2.67 b	2.75 b	1.03 a	0.99 a
	Bronco	Si	17.06 a	17.31 a	2.68 b	2.74 b	1.10 a	1.03 a
		E	12.06 a b	12.06 a b	3.78 a	3.76 a	1.04 a	1.10 a
		Control	14.81 a	13.19 a	1.10 d	1.13 d	1.05 a	1.04 a
	Valantino	B	12.44 a b	12.44 a	4.24 a	4.39 a	1.00 a	1.00 a
		Si	13.31 a	13.38 a	4.22 a	4.77 a	1.04 a	1.05 a
Second dates		E	15.13 a	15.31 a	5.34 a	5.25 a	1.04 a	1.02 a
		Control	9.44 b	8.88 b	5.16 a	4.39 a	1.03 a	1.02 a
		B	13.25 a	13.25 a	2.14 c	2.16 c	1.11 a	1.08 a
	Rivergaro	Si	12.25 a b	13.06 a	3.17 b	3.17 b	1.10 a	1.09 a
		E	13.88 a	13.81 a	1.62 c	1.72 c	1.02 a	1.27 a
		Control	9.88 b	10.19 a b	1.78 c	1.54 c	1.08 a	1.08 a
		B	18.69 a	18.94 a	1.52 c	1.53 c	1.78 a	1.06 a
	Bronco	Si	17.63 a	17.63 a	1.68 c	1.68 c	1.78 a	1.76 a
		E	16.44 a	16.31 a	1.56 c	1.42 c	1.61 a	1.79 a
		Control	15.44 a	13.06 a	1.04 d	1.07 d	1.65 a	1.50 a
		B	11.94 a b	12.75 a	4.28 a	4.30 a	1.72 a	1.43 a
Third dates	Valantino	Si	12.38 a b	12.56 a b	4.75 a	4.59 a	1.74 a	1.76 a
		E	14.44 a	14.75 a	3.25 b	3.43 a b	1.62 a	1.62 a
		Control	11.69 a b	12.00 ab	4.50 a	4.47 a	1.87 a	1.79 a
		B	13.31 a	13.31 a	1.23 d	1.18 c	1.39 a	1.37 a
		Si	15.06 a	15.00 a	3.97 a	3.24 b	1.25 a	1.33 a
	Rivergaro	E	13.44 a	13.69 a	1.66 d	1.37 c	1.29 a	1.28 a
		Control	10.63 a b	11.50 a b	1.42 c	1.36 c	1.57 a	1.73 a

B = Berelex$_{40\ SG}$ Si = potassium silicate E = Ethylene di amine tetra acetic acid (EDTA).

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significant according to Duncan's multiple range tests

CONCLUSION

It is known that the temperatures change from season to season and fluctuate daily. The high temperature stress has become a major concern for crop production worldwide because it greatly affects the growth, development and productivity of plants. The results presented in this investigation show that it is possible to mitigation the negative impact of High temperature stress on the growth parameters and productivity of snap bean by application of foliar spray antioxidant (potassium silicate), growth regulators like Berelex as a Gibberellic acid and EDTA. The interactions between treatments showed that the combination which gave the best values for most parameters Therefore, it is recommended for snap bean grown under the same condition of the study in order to get the biggest green pods yield (ton/fed) and its physical and chemical quality that cultivation theBronco cv. and the Valantino cv. in the first sowing date (1st April) and the third sowing date (1st May) with foliar spray by Berelex, potassium silicate and EDTA.

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