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Effect of Some Growth Regulators in The Presence of Boron on Growth, Yield and Chemical Composition of Common Bean Under Different Sowing Dates

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ABSTRACT

Two field experiments were carried out during the two successive summer seasons of 2014 and 2015 in a private sector farm at Kafr Elsohbi Village, Shibin Alqanter, Qalubia Governorate, Egypt to improve the growth, productivity and quality of common bean (*Phaseolus vulgaris L.*) cv. Nebrasica using some growth regulators i.e., naphthalene acetic acid (NAA) at 40 ppm, gibberellic acid (GA_3) at 100 ppm, benzyladenine (BA) at 40 ppm supplemented with boron spray at 100 ppm grown at different sowing dates (mid February, mid March and mid April). In general the tallest plants were scored by the combinations of mid March planting date, with those received NAA+B. In addition, the highest number of branches and leaves as well as the heaviest fresh and dry weights of plant were registered by the combination of mid March sowing date, with those received BA+B treatment in the two seasons. Moreover, the highest dry seed yield/plant, seed yield/fed and weight of 100 seeds were scored by the combination of BA+B-sprayed plants with sowning on mid March in the two seasons. Furthermore, leaf and seed chemical composition i.e., total nitrogen, phosphorus, potassium and total carbohydrates as well as total protein were greatly responded for the studied sowing dates. However, mid March sowing date gave rise to the highest values of N, P, total carbohydrates and total protein contents, followed by mid February sowing date, especially those sprayed with BA+B treatment in the two seasons.Conclusively, in order to produce higher dry seed yield with good quality of common bean, it is preferable to sow the seeds on mid March and spray the plants with benzyladenine at 40 ppm enriched with boron at 100 ppm three time during the growing season. Additionally, the plants that sown on mid February and April could give the previously mentioned prospective traits when sprayed with benzyladenine and boron treatments.

Keywords: common bean, cv. Nebrasica, sowing dates, growth regulators, boron, growth, chemical composition, seed yield and quality.

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INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is very important legume vegetable crop grown in Egypt for direct human consumption or exportation. It is an important source of energy. It is rich in protein, dietary fibers, minerals (Ca, P, Fe, K, Mg & Mn) and vitamins (A, B1, B2 & C) with 22-27 % protein and high amino acids (Şehirali, 1988). The total area devoted to common beans during growth season of 2013/2014 was ١٠٩٢٩٤ fed, this area produced 109294 ton with an average yield of 1 -1.2 ton dry seed/fed. according to the Statistics of Ministry of Agriculture 2014, Egypt.

Sowing date is one of the most important factors that affects the timing and duration of the vegetative and reproductive stages, hence it affect productivity during growing. Environmental factors such as temperature and light duration differ with varying sowing date. Individual elements such as light and temperature have direct effect on physiological processes such as photosynthesis and respiration (Mahmoud, 2008). Since, it is so important to determine the optimum sowing date for common bean which achieve the best limits for these factors in order to get the optimum yield.

Using plant growth regulators is a common horticultural practice to increase growth and productivity of vegetable crops. Plant growth regulators can improve rooting, vegetative growth, flowering, fruiting and fruit growth, senescence, regulation of some metabolic processes and plant resistance to temperature or water stresses (Latimer, 1992). Cytokinins are a class of plant growth substances (phytohormones) that promote cells division of plant roots and shoots. They are involved primarily in cell growth and differentiation, but also affects apical dominance, axillary bud growth, and leaf senescence. Benzyladenine (BA) is a first-generation synthetic cytokinin that elicits plant growth and development. Benzyladenine is recognized by its ability to induce cell division in certain plant tissues. It can also overcome the apical dominance of many plants and stimulate the lateral buds to develop into an entire new plant. BA can delay senescence and cause transport of many solutes from older parts of the leaves or even from older leaves into the treated zone (Salisbury and Ross, 1974). In this respect, Eid (1991) reported that most studied treatments of NAA (25,50and 75 ppm) significantly promoted the vegetative growth, increased the photosynthetic pigments, mineral content of NPK in plant foliage, delayed flowering, increased number of flowers /plant and total seed yield/fed as well as the dry seed mineral content of NPK. The treatment of 50 ppm NAA was the most effective treatment in this regard. In addition, Zewail *et al.*(2011) reported that spraying faba bean plant with NAA at 20ppm gave the highest values of vegetative growth, chemical constituents of plant foliage, flowering behaviour (number of flower and setting%), total yield and its components and fruit quality. Abbasi *et al.* (2013) indicated that NAA at o.o2 % increased plant growth and yield of tomato plants by improving mineral uptake.

Gibberellins (GAs) are a class of phytohormones that control many aspects of plant growth and development, including seed germination, leaf expansion, stem elongation, flower initiation and development, sex determination, and fruit development (Li *et al*. 2010). In this regard, Ngatia *et al.*(2004) reported that application of GA_3 at 2.5,5,7.5 mg/l led to an increase in plant height, leaf area, fresh and dry weight of common bean plants. It also increased number of pods and seed yield per plant as well as 100-seed mass and harvest index.

Boron (B) is one of the important micronutrients that has basic role in stabilizing certain constituents of cell walls structure and function and activity of plasma membrane, improvement of cell division, tissue differentiation. So, boron could be directly joined with cell growth (Goldbach *et al*., 1990). In addition, Ganie *et al.* (2013) revealed that application of boron increased net photosynthetic rate that could be attributed to the increase in chlorophylls content of leaves.

Therefore, the aim of this study was to improve the growth and productivity of common bean using some growth regulator substances under different sowing dates.

MATERIALS AND METHODS

Two field experiments were carried out during the two successive summer seasons of 2014 and 2015 in a private sector farm at Kafr Elsohbi Village, Shibin Alqanter, Qalubia Governorate, Egypt to improve the growth, productivity and seed quality of common bean (*Phaseolus vulgaris* L.) cv. Nebrasca using some growth substances (naphthalene acetic acid (NAA), gibberellic acid (GA_3), benzyladenine (BA) and boron) grown under different sowing dates. The physical and chemical analysis of the used soil are determined according to Chapman and Pratt(1982) and are shown in Table 1.

Table 1: physical and chemical analyses of the used soil.

Physical analysis		**Chemical analysis**			
		Cations (meq/l)		**Anions (meq/l)**	
Coarse sand	17.6%	Ca^{++}	7.41	CO_3^{--}	Zero
Fine sand	37.5%	Mg^{++}	3.39	HCO_3^-	4.36
Silt	26.8%	Na^+	2.23	Cl^-	3.48
Clay	18.1 %	K^+	1.31	SO_4^{--}	6.42
Texture class: Sandy loam					
Soil pH	7.8	Available N		28.6 mg/kg	
E.C (dS/m)	1.44	Available P		14.1 mg/kg	
Organic matter	1.89%	Available K		143 mg/kg	

The local meteorological data during 2014 and 2015 at Shibin Alqantar, Qalubia Governorate are shown in Table 2.

Table 2: Monthly air temperature and relative humidity in Qalubia region during two seasons of the experimental.

	First season 2014			**Second season 2015**		
	Air temperature °C		**R.H %**	**Air temperature °C**		**R.H %**
Months	**Max**	**Min**	**Average**	**Max**	**Min**	**Average**
February	29 .9	5.5	55	29.2	1.5	76
March	35.7	10.2	57	31.5	2.4	80
April	38	10.8	49	29.5	6.2	61
May	44.1	16.5	49	40.8	11.5	59
June	39.9	18.7	52	39	18.6	66
July	40.8	21.8	55	38.1	17.8	74
August	43.9	23.9	55	37.7	17.4	73

This experiment included 12 treatments, which were the combinations between three sowing dates and four growth substances foliar spray as follows:

A-**Sowing date treatments**

1. 15th February
2. 15th March
3. 15th April

B-**Growth substances treatments:**

The plants were subjected to foliar spray with the following mixture solutions three times during the growing seasons at two weeks by interval starting after three weeks from seed sowing.

1. Control (spray with tap water)
2. Naphthalene acetic acid (NAA) at 40 ppm + Boron (B) at 100 ppm.
3. Gibberellic acid (GA_3) at 100 ppm + Boron (B) at 100 ppm.
4. Benzyladenine (BA) at 40 ppm+ Boron (B) at 100 ppm.

These treatments were arranged in a split plot design with three replicates. Sowing dates were employed in the main plot, while, the growth stimulants foliar spray treatments were devoted randomly in the sub plots.

The experimental plot area was 14 m^2 consisted of one row; each row was 20 m length and 0.7 m width. The planting distance was 10 cm apart between hills on one side of irrigation line. After complete germination plants were thinned leaving two plants per hill. All replicates received similar agricultural practice such as fertilization, irrigation management also disease and pest control programs according to the recommendations of the Egyptian Ministry of Agriculture. A drip irrigation system with nozzles of 20 cm apart was adopted for fertigation.

Data recorded

1- Vegetative growth characters:

After 60 days from seed sowing five plants from each experimental plot were randomly taken for measuring; plant height, number of branches/plant, number of leaves /plant, fresh and dry weights/plant.

2- **Chemical constituents determination**;

total nitrogen, phosphorus, potassium and total carbohydrates were determined in the dry matter of leaves according to Pregl (1945), John (1970), Brown and Lilleland (1946) and Herbert et al. (1971), respectively.

3- Seed yield and its components:

At harvest time i.e., 100 days after sowing dry pods of each plot were harvested at maturity stage, then weighted in each harvest and seeds were extracted and the following parameters were calculated: seeds yield/plant, total seeds yield/fed. and weight of 100 seeds.

4- Seed chemical composition :

The dry seeds at harvest were oven dried at 70 C° till a constant weight. In addition, the digested dry matter of each sample was taken for chemical determination of total N, total protein, P, K and carbohydrates were determined according to the methods mentioned in case of chemical analysis of leaves **.**

Statistical analysis:

All obtained data in both seasons of study were subjected to analysis of variance as factorial experiments in split plot design. Duncan's analysis was

used to differentiate means according to Snedecor and Cochran (1991).

RESULTS AND DISCUSSION

1- Vegetative growth parameters

Data presented in Table 3 clearly show that all studied sowing dates had a significant effect on all measured vegetative growth parameter in the two seasons. In this concern, sown common bean seeds on mid of March showed to be the most effective sowing date for inducing the highest values of plant height, branches number/plant, leaves number/plant, fresh and dry weights of plant, followed by those sown on mid-February, while sowing on mid-April ranked the third in this regard in the two seasons. In this respect, Anany (2010) and Khairy (2013) reported that planting common bean on 1st of March gave the highest vegetative growth parameter.

As for the effect of growth substances, it was observed that all utilized growth substance enriched with boron at 100 ppm treatments increased the studied vegetative growth parameters when compared with the untreated control plants in the two seasons. Meanwhile, NAA+B-sprayed plants gave the tallest plants, followed by those received GA_3+B treatment. The differences between the abovementioned two treatments were not significant in the first season only. Whereas, the greatest number of branches and leaves/plant as well as the heaviest fresh and dry weights of plants were scored by BA +B-sprayed plants, followed by those sprayed by GA_3+B treatment in the two seasons. Obtained results are in agreement with those reported by Ngatia *et al*.(2004), Abd-Alla (2006), Emongor (2007), Zewail *et al*.(2011), Alexander *et al*.(2012), Sakineh *et al*.(2013). Concerning the interaction effect between sowing dates and growth substances, data in the same Table indicate that the tallest plants (64.3 and 67.6 cm) was scored by the combinations of mid March sowing date, combined with those received NAA+B, followed by those sprayed with GA_3 +B treatment as it recorded 63.1 and 64.9 cm in the first and second seasons, respectively. In addition, the highest number of branches (6.84 and 6.73)and leaves (34.30 and 31.9) as well as the heaviest fresh weight of plant (69.30 and 65.40 g) and dry weight (10.81 and 9.48 g) were registered by the combinations of sowing on mid March with those received BA+B treatment, in the first and second seasons, respectively. Moreover, the combination of the same treatment of growth substances with sowing on mid February gave high increments in vegetative growth parameters as compared with the combination of mid April which scored the least values in this concern in the two seasons.

Table 3: Effect of sowing date and foliar spray with growth regulator and their interaction on vegetative growth characteristics of common bean during the two seasons of study 2014 and 2015

Treatment		First season 2014					Second season2015				
Planting Time	Foliar spray	Plant Height (cm)	No. of branches /plant	No.of leaves /plant	Fresh weight g/plant	Dry weight g/plant	Plant Height (cm)	No. of branches /plant	No.of leaves /plant	Fresh weight g/plant	Dry weight g/plant
15Febaraury		55.08b	4.49b	26.14b	56.47b	8.55b	58.1b	4.47b	23.4b	52.78b	7.47b
15March		60.44a	5.51a	29.42a	62.53a	9.61a	63.3a	5.44a	26.3a	59.35a	8.51a
15April		38.60c	4.02c	22.42c	45.40c	6.82c	37.8c	3.73c	20.4c	45.50c	6.29c
	Control	46.23c	3.71d	22.00d	48.50d	7.29d	47.8d	3.70d	18.7d	45.23d	6.21d
	NAA+ B	55.37a	4.33c	24.67c	52.93c	8.03c	57.2a	4.31c	22.1c	51.37c	7.27c
	GA3 + B	53.50a	4.98b	26.77b	56.87b	8.66b	54.6b	4.82b	24,9b	54.67b	7.79b
	BA+ B	50.39b	5.66a	30.55a	60.90a	9.34a	52.5c	5.36a	27.9a	58.90a	8.42a
15Febaraury	Control	51.20c	3.82g	21.30f	51.30f	7.69g	52.9f	3.79f	18,8f	45.30fg	6.34g
	NAA+ B	58.20b	4.02ef	25.20de	54.20e	8.18f	62.3c	4.12e	21.9d	51.60e	7.27e
	GA3 + B	56.1b	4.84b	26.90c	58.10d	8.83e	59.7d	4.76d	25.4c	55.30d	7.85d
	BA+ B	54.8bc	5.29c	31.14b	62.30c	9.53c	57.3a	5.21c	27.6b	58.90c	8.42c
15March	Control	56.3b	4.13e	26.40cd	54.60e	8.29f	58.3de	4.20e	21.2de	51.90e	7.36e
	NAA+ B	64.3a	5.3c	27.40c	61.00c	9.33d	67.6a	5.02c	24.9c	58.30c	8.33c
	GA3 + B	63.1a	5.93b	29.60b	65.20b	10.04b	64.9b	5.84b	27.4b	61.80b	8.89b
	BA+ B	58.b	6.84a	34.30a	69.30a	10.81a	62.4c	6.73a	31.9a	65.40a	9.48a
15April	Control	31.2f	3.19h	18.30g	39.60i	5.91j	32.4i	3.12g	16.1g	38.50h	4.94h
	NAA+ B	43.6d	3.86fg	21.40f	43.60h	6.59i	41.9g	3.81f	19.6ef	44.20g	6.21g
	GA3 + B	41.3de	4.17e	23.80e	47.30g	7.12h	39.2h	3.86f	21.9d	46.90f	6.65f
	BA+ B	38.3e	4.86d	26.20cd	51.10f	7.69g	37.8h	4.14e	24.3c	52.40e	7.36e

Means of the same column followed by the same letter were not significantly different according to Duncan MRT at5%

2-Leaves chemical composition determinations:

Data tabulated in Table 4 indicate that the highest values of leaf total nitrogen, phosphorus, potassium and total carbohydrates contents were gained by sowing on mid March sowing date, followed in descending order by those sown on mid February and mid April in the two seasons.

With regard to the effect of growth substances, data in Table 4 point out that all sprayed growth substances significantly increased leaf total nitrogen, phosphorus, potassium and total carbohydrates content compared with the control treatment, with superior for BA+B-sprayed plants in the two seasons. Also, GA_3+B and NAA+B – sprayed plants gave the highest increases

in these parameters in the two seasons. In this regard, Eid (1991), Ngatia *et al.*(2004), Abd-Alla (2006), Emongor (2007), Zewail *et al.*(2011), Alexander *et al.*(2012), Sakineh *et al.*(2013) mentioned that growth regulator substances improved chemical constituent of plant foliage.

Referring to the interaction effect between sowing date and growth substances, data in the same Table show clearly that the combination of sowing on mid March combined with foliar spray with BA+B exhibited to be the most effective one for inducing the richest leaf total nitrogen, phosphorus, potassium and total carbohydrates content , in the two seasons. On the reverse, the lowest values of leaf nitrogen, phosphorus, potassium and total carbohydrates contents were detected with the combination of mid April sowing date, combined with those received no growth substances (control) in the two seasons.

Table 4: Effect of sowing date and foliar spray with growth regulator and their interaction on plant foliage chemical constituents of common bean during the two seasons of study 2014 and 2015

Treatment		First season 2014				Second season2015			
Planting Time	Foliar spray	N %	P %	K %	Total carbohydrates %	N %	P %	K %	Total carbohydrates %
15Febaraury		1.90b	0.246b	1.69ab	10.40b	1.84b	0.260b	1.74a	10.76b
15March		2.05a	0.276a	1.75a	10.81a	2.00a	0.291a	1.82a	12.49a
15April		1.80c	0.221b	1.63b	9.28c	1.76c	0.231c	1.92a	9.86c
	Control	1.75d	0.221b	1.56c	8.78d	1.72d	0.228b	1.94a	9.20d
	NAA+ B	1.84c	0.256a	1.66b	9.79c	1.82c	0.270a	1.71a	10.83c
	GA3 + B	1.99d	0.247ab	1.73b	10.60b	1.93b	0.263a	1.80a	11.58b
	BA+ B	2.08a	0.266a	1.81a	11.47a	2.00a	0.282a	1.87a	12.54a
15Febaraury	Control	1.75ef	0.216de	1.56de	8.94g	1.71f	0.224fg	1.59b	9.71i
	NAA+ B	1.82de	0.257a-d	1.68b-d	10.16e	1.83cd	0.273a-f	1.72ab	10.37f
	GA3 + B	1.97bc	0.245b-e	1.74a-c	10.82d	1.89b-d	0.264b-f	1.81ab	11.24e
	BA+ B	2.06b	0.266a-d	1.81ab	11.67b	1.94b	0.281a-d	1.87ab	12.26d
15March	Control	1.83de	0.247b-e	1.62c-e	9.14g	1.82cd	0.249c-g	1.69ab	10.10g
	NAA+ B	1.94c	0.285ab	1.73a-c	10.21e	1.91bc	0.305ab	1.81ab	12.43c
	GA3 + B	2.19a	0.276a-c	1.79ab	11.39c	2.11a	0.296a-c	1.87ab	13.24b
	BA+ B	2.26a	0.298a	1.86a	12.48a	2.18a	0.316a	1.94ab	14.19a
15April	Control	1.69f	0.202e	1.50e	8.27h	1.64f	0.211g	2.54a	8.34j
	NAA+ B	1.76ef	0.228c-e	1.59de	9.00g	1.72ef	0.234d-g	1.62b	9.68h
	GA3 + B	1.83de	0.221de	1.68b-d	9.60f	1.81de	0.230e-g	1.74ab	10.26f
	BA+ B	1.92cd	0.234b-e	1.78ab	10.25e	1.89b-d	0.249c-g	1.81ab	11.17e

Means of the same column followed by the same letter were not significantly different according to Duncan MRT at5%

3- Yield parameters:

Data outlined in Table 5 declare that sowing on mid March was superior for producing the highest seed yield/plant, seed yield/fed and weight of 100 seeds, followed in descending order by those sown on mid February and mid April in the two seasons. The differences between the aforementioned three sowing dates were significant in the two seasons. These results are in agreement with those reported by Anany (2010) and Khairy (2013) on common bean.

Regarding the effect of growth substances, data in Table 5 show also that seed yield/plant, seed yield/fed and weight of 100 seeds were responded positively to the applied growth substances as compared with un-treated control plants in the two seasons. In general, BA+B -sprayed plants recorded the highest values of seed yield per plant, seed yield/fed and weight of 100 seeds, followed by NAA +B -sprayed plants, with significant differences between them in the two seasons. In this respect, Eid (1991),Ngatia *et al.*(2004), Abd-Alla (2006), Emongor (2007), Zewail *et al.*(2011), Alexander *et al.*(2012), Sakineh *et al.*(2013) used different growth substances reported similar results. As for the interaction effect between sowing dates and growth substances, data in Table 5 reveal that the highest seed yield/plant (19.68 and 20.26 g), seed yield/fed (1181.0 and 1216 kg) and weight of 100 seeds (39.12 and 41.84g) were scored by the combinations of sowing on mid March, combined with those plants received BA+B treatment, in the first and second seasons respectively. Moreover, the combination of sowing on mid February with the same treatment of growth substances had positive effective on the aforementioned yield parameters as compared with the combination of sowing on mid April with the same treatment of growth substance which recorded the lowest values of seed yield/plant, seed yield/fed and weight of 100 seeds in the two seasons.

4- Seed chemical composition.

Data outlined in Table 6 show that total nitrogen, phosphorus, potassium and total carbohydrates as well as total protein content of seeds were greatly responded to the studied sowing dates in the two seasons. In this sphere, sowing on mid March is being the best date for giving the highest values of seed total N,P,K total carbohydrates and total protein contents , followed by mid February sowing date which ranked the second and mid April sowing date which ranked the last in this respect in the two seasons .

Table 5: Effect of sowing date and foliar spray with growth regulator and their interaction on seed yield and its components of common bean during the two seasons of study 2014 and 2015

Treatment		First season 2014			Second season2015		
Planting time	Foliar spray	Seed yield /plant(g)	Seed yield /fed.(Kg)	Weightof100 seeds (g)	Seed yield /plant(g)	Seed yield /fed.(Kg)	Weightof100 seeds (g)
15Febaraury		14.16b	850.2b	35.80b	14.38b	863.7b	36.28b
15March		17.62a	1057.0a	36.97a	18.28a	1097.0a	39.44a
15April		11.38c	683.4c	30.47c	11.66c	699.6c	30.68c
	Control	12.54d	752.4d	32.56c	12.74d	764.7d	32.13d
	NAA+ B	14.68b	891.6b	35.02b	15.34b	920.4b	36.51b
	GA3 + B	14.28c	857.6c	33.88b	14.76c	886.4c	35.30c
	BA+ B	15.88a	952.8a	36.20a	16.26a	976.0a	37.93a
15Febaraury	Control	12.42f	745.2f	34.16de	12.38gh	742.8gh	33.16f
	NAA+ B	14.56e	873.6e	36.50bc	14.92e	895.2e	37.42c-e
	GA3 + B	14.32e	859.2e	35.21cd	14.24f	865.2f	36.19e
	BA+ B	15.38d	922.8d	37.34ab	15.86d	951.6d	38.34b-d
15March	Control	15.24d	916.8d	35.21cd	15.80d	948.8d	36.37de
	NAA+ B	18.24b	1094.0b	37.31ab	18.86b	1132.0b	40.16ab
	GA3 + B	17.28c	1037.0c	36.24bc	18.22c	1093.0c	39.41bc
	BA+ B	19.68a	1181.0a	39.12a	20.26a	1216a	41.84a
15April	Control	9.92i	595.2i	28.31g	10.04j	602.4j	26.87h
	NAA+ B	11.78g	706.8g	31.24f	12.24h	734.4h	31.94fg
	GA3 + B	11.28h	676.8h	30.19fg	11.68i	700.8i	30.30g
	BA+ B	12.58f	754.8f	32.14ef	12.68g	760.8g	33.61f

Means of the same column followed by the same letter were not significantly different according to Duncan MRT at5%

Concerning the effect of growth substances, data in Table 6 also indicate that all sprayed growth regulator substances progressively increased seed content of N, P, K, total carbohydrates and total protein over un-treated control plants , with superior for BA+B- sprayed plants in the two seasons. In addition, GA_3+B and NAA+B treatments registered high increases in these parameters in the two seasons compared to the control treatment.

Regarding to the interaction effect between sowing date and growth substances, results in Table 6 indicate that the highest values of seed N,P, K, total carbohydrates and total protein contents were detected with the combination of mid March sowing date, with BA+B-sprayed plants, followed by the combination of mid February sowing date in the two seasons. On the contrary, the lowest values of seed N, P, K, total carbohydrates and total protein contents were observed by the combination of mid April sowing date, with those received no growth substances in the two seasons.

Table 6: Effect of sowing date and foliar spray with growth regulator and their interaction on seed chemical constituents of common bean during the two seasons of study 2014 and 2015

Treatment		First season 2014					Second season2015				
Planting Time	Foliar spray	N %	P %	K %	Total carbohydrates %	Total protein %	N %	P %	K %	Total Carbohydrates %	Total protein %
15February		3.12b	0.431ab	2.01b	54.95a	19.53b	3.45b	0.493ab	2.15b	56.60a	21.59b
15March		3.20a	0.439a	2.24a	55.40a	20.03a	3.58a	0.505a	2.28a	56.95a	22.42a
15April		3.02c	0.411b	1.86c	54.17a	18.89c	3.27c	0.474b	1.94c	52.70b	20.45c
	Control	2.70d	0.406b	1.99b	52.50c	16.91d	3.15c	0.445b	1.95d	53.00d	19.69c
	NAA+ B	3.02c	0.432ab	1.97b	54.13b	18.90c	3.43b	0.504a	2.05c	54.43c	21.46b
	GA3 + B	3.21b	0.423ab	2.04ab	55.80a	20.06b	3.49b	0.497a	2.18b	56.27b	21.83b
	BA+ B	3.53a	0.446a	2.15a	56.93a	22.06a	3.67a	0.516a	2.31a	57.97a	22.98a
	Control	2.69f	0.402bc	1.91e-h	52.20ef	16.81f	3.17gh	0.463e-g	1.96g	54.80cd	19.81gh
15	NAA+ B	3.06d	0.439a-c	1.96d-g	54.10c-e	19.13d	3.42de	0.501a-e	2.09f	55.00cd	21.38de
February	GA3 + B	3.21c	0.432a-c	2.06c-f	56.30a-c	20.06c	3.54cd	0.492b-f	2.24cd	57.20b	22.13cd
	BA+ B	3.54ab	0.452ab	2.12b-e	57.20ab	22.13ab	3.69b	0.516a-d	2.31bc	59.40a	23.06b
	Control	2.84e	0.417a-c	2.37a	53.70d-f	17.75e	3.24fg	0.421g	2.11ef	52.90de	20.25fg
15March	NAA+ B	3.10cd	0.442a-c	2.13b-d	54.20c-e	19.38cd	3.62bc	0.531ab	2.21c-e	56.70bc	22.63bc
	GA3 + B	3.24c	0.436a-c	2.19a-c	56.30a-c	20.25c	3.62bc	0.526a-c	2.36b	58.40ab	22.63bc
	BA+ B	3.64a	0.461a	2.28ab	57.40a	22.75a	3.87a	0.542a	2.47a	59.80a	24.19a
	Control	2.58f	0.400c	1.71h	51.60f	16.17f	3.04h	0.452fg	1.79h	51.30e	19.00h
15April	NAA+ B	2.91e	0.417a-c	1.82gh	54.10c-e	18.19e	3.26fg	0.481c-f	1.86gh	51.60e	20.38fg
	GA3 + B	3.18cd	0.402bc	1.89f-h	54.80b-d	19.88cd	3.32ef	0.473d-f	1.94g	53.20de	20.75ef
	BA+ B	3.41b	0.426a-c	2.05c-f	56.20a-c	21.31b	3.47d	0.492b-f	2.17d-f	54.70cd	21.69d

Means of the same column followed by the same letter were not significantly different according to Duncan MRT at5%

Generally, such increments in all studied growth and yield components as well as seed quality parameters of common bean during mid March sowing date may be due to the suitable and prevalent metrological factors, specially temperature (Table 2) which affect positively and increased the vegetative and flowering growth phases of plants. Also, such suitable metrological factors increased the macronutrients absorption

(Table,5) and in turn reflected on the assimilation rate of plants which positively affect on growth, flowering and fruit set as well as productivity of plant. On the other side, late sowing (mid of April) resulted in the reduction of all tested parameters that it may be due to the highest prevailing temperature during the vegetative and flowering growth period which was non suitable for flower set and increased the use of assimilated materials in respiration and consequently reduced the anabolic rate of new plant parts and in turn reduced plant growth and productivity. In this respect, Abd-Alla (2006) indicates that under Qalubia Governorate conditions sowing common bean plants on the first of March reflected the highest growth and productivity. Whereas, the enhancing effect of tested growth regulators, especially benzyladenine may be attributed to the effect of such compounds on cell division, cell elongation, bud formation and branching which reflect positively on plant growth. Furthermore, the obtained results might be due to the role of benzyladenine on promoting protein synthesis, increasing cell division and enlargement (Cheema and Sharma, 1982). Moreover, these results might be explained according to the role of benzyladenine on promoting proteins, soluble and non-soluble sugars synthesis, or may be due to the ability of kinetin for making the treated area to act as a sink in which nutrients from other parts of the plant are drawn (Salisbury and Ross, 1974). In addition, it may be due to the role of boron in improving enzyme activation, photosynthetic assimilation, metabolism of nucleic acid, carbohydrate, protein bio-syntheses of some plant hormones and phenol compounds. Furthermore, boron has been benefits in sugar translocation, nucleic acids synthesis and pollen tube growth. In addition, boron plays a key role in higher plants by facilitating the short and long-distance transport of sugar via the formation of borate-sugar complexes (Marschner, 1997 and Goldbach and Wimmer, 2007)

Conclusively, in order to produce higher dry seed yield with good quality of common bean, it is preferable to sow the seeds on mid March and spray the plants with benzyladenine at 40 ppm enriched with boron at 100 ppm. Additionally, the plants that sown on mid February and April could give the previously mentioned prospective traits when enriched with benzyladenine and boron treatments.

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تاثيرمواعيد الزراعه و بعض منظمات النمو فى وجود البورن على نمو ومحصول والتركيب الكيمياوى للفاصوليا الجافة

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اجريت تجربتان حقليتان خلال الموسم الصيفى لعامى ٢٠١٤و٢٠١٥ فى مزرعة خاصة بقرية كفرالصهبى- شبين القناطر محافظة القليوبية لتحسين نمو وانتاجية وجودة الفاصوليا الجافة صنف نبراسكا برش بعض منظمات النمو (نفثالين حمض الخليك بتركيز ٤٠ جزء فى المليون وحمض الجبريليك بتركيز ١٠٠ جزء فى المليون والبنزيل ادينين بتركيز ٤٠ جزء فى المليون مصاحبا للرش بالبورن بتركيز١٠٠ جزء فى المليون) وذلك عند الزراعة فى مواعيد زراعة مختلفة (منتصف فبراير – منتصف مارس- منتصف ابريل). وقد اوضحت النتائج المتحصل عليها ان زراعة الفاصوليا فى منتصف مارس ورش النباتات بالبنزيل ادينين + البورن ادى الى الحصول على اعلى قيم قياسات النمو الخضرى (طول النبات – عدد الافرع/النبات –عدد الاوراق/النبات - الوزن الطازج والجاف للنبات). وعلاوة على ذلك فقد ادت هذه المعاملة الى الحصول على اعلى محصول بذرى للنبات وللفدان وكذلك وزن وكذلك بالنسبة الى التركيب الكيمياوى للاوراق والبذور (النتروجين – الفوسفور- البوتاسيوم- الكربوهيدرات الكلية - البروتين) كانت اعلى القيم التى تم الحصول عليها فى هذا الشان عند الزراعة فى منتصف مارس يليه منتصف فبراير وكذلك رش النباتات بالبنزيل ادينين + البورن. ويمكن التوصية بانه للحصول على اعلى محصول بذرى بمواصفات جودة عالية يفضل زراعة الفاصوليا الجافة صنف نبراسكا فى منتصف شهر مارس ورش النباتات بالبنزيل ادينين بتركيز ٤٠ جزء فى المليون مصاحبا للرش بالبورن بتركيز١٠٠ جزء فى المليون. بالاضافة الى ذلك فان النباتات المنزرعة فى منتصف شهر فبراير او ابريل يمكن ان تعطى انتاجية جيدة خصوصا اذا تم رشها بالبنزيل ادينين + البورن ثلاث مرات خلال موسم النمو.