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REMOVING THE TERMINAL BUD IN COMPARISON WITH SPRAYING OF BENZYL ADININE AND THEIR EFFECTS ON GROWTH AND RODUCTIVITY OF EGGPLANT UNDER DIFFERENT RATES OF NITROGEN FERTILIZATION

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ABSTRACT: Two field experiments were carried out during consecutive summer seasons of 2007 and 2008 at the Experimental Farm, Faculty of Environmental Agricultural Sciences, El-Arish, Suez Canal University, Egypt to study the effect of four nitrogen rates (0, 60, 90 and 120 kg/*fed.*), foliar spray with benzyl adenine (BA) at 25 ppm and removing the terminal bud (RTB) on growth, yield and nitrogen use efficiency of eggplant under North Sinai conditions, and the results indicated that:

It has been found that fertilization of eggplant with 90 kg N / *fed.* recorded the tallest plants and increased dry weight of roots, branches, and total dry weight / plant. It also, increased average fruit weight, yield /plant, fruit length without significant differences with application of 60 or 120 kg N/ *fed.* as well as increased the nitrogen use efficiency, whereas N at 120 kg / *fed.* recorded the maximum values of N content in leaves and stems, yield/plant, total yield/ *fed.* and the relative total yield (%).

Number of branches/plant and the relative branching (%) were significantly decreased with increasing nitrogen rates in the first season, whereas control treatment recorded the highest value of number of branches/ plant.

Spraying eggplants with benzyl adenine (BA) at 25 ppm or removing the terminal bud significantly increased number of branches /plant and the relative branching(%), dry weight of branches, total dry weight /plant and the relative total dry weight(%) compared to control treatment.

Fertilization of eggplant with N at 90 or 120 kg */fed.* plus spraying with BA at 25 ppm increased the most parameters of yield and its components without significant differences with applicaton of 90 or 120 kg */fed.* with removing the terminal bud.

Key words: Eggplant, nitrogen, removing the terminal bud, benzyl adenine, branching, yield, nitrogen use efficiency.

INTRODUCTION

Eggplant (*Solanum melongena* L.) is a common and popular vegetable crop grown in the subtropics and tropics. It is called brinjal in India, and in Europe aubergine. Eggplant is a perennial, but grown commercially as an annual crop. The name eggplant derived from the shape of the fruit of some varieties, which are white and shaped very similarly to chicken eggs. Production of eggplant is highly concentrated with 85% of output coming from five countries. China is the top producer (56%) of world output and India is second (26%), Egypt (3.11%) Turkey (2.5%) and Indonesia (1.21%) (FAO, 2008).

Nitrogen is considered as one of the major nutrients required by the plants for their growth, development and yield (Singh *et al.,* 2003). Also, nitrogen fertilization of eggplant has a considerable effect on increasing number of fruits /plant (Bobadi and Damme, 2003), yield /plant (Rosati *et al.,* 2002) , fruit weight (Devi *et al.,* 2002) , total fruit yield (Devi *et al.,* 2002; Bobadi and Damme, 2003; Satpal and Saimbhi, 2003), marketable yield (Satpal and Sainbhi, 2003), plant height and number of leaves /plant (Wange and Kale, 2004) and fruit diameter and fruit length (Jilani *et al.,* 2008).

Shoot branching is the process by which axillary buds located on the axil of a leaf develop and form new flowers and branches. The process by which a dormant bud activates and becames an actively growing branch is complex and very finely tuned. But outgrowth is regulated by cytokinins. Cytokinins travel acropetally and promote outgrowth (Ongaro and Leyser, 2008).

Cytokinins such as benzyl adinine (BA) reduces the apical dominance and promote the growth of lateral bud. Thus the effect of cytokinins is antagonistic to the effect of auxins in apical dominance, also cytokinins delay of senescence : Senescence is the phenomenon, in which the leaves loss their chlorophyll, turn yellow and ultimately shed from the plant. During senescence the proteins, nucleic acids and chlorophyll broken down into simpler elements such as sugar, amino acids etc. These substances are transported to other parts of the plant. Application of cytokines delays the process of senescence by preventing the degradation of chlorophyll, proteins and nucleic acid. Therefore, it is noticed that cytkinins levels in the leaf lamina is of important regulation of the process senescence (Reddy *et al.*, 2004).

Hormone that is involved in shoot branching is cytokinins (Cline, 1991). Exogenous cytokinins applied to buds promote their outgrowth Miguel *et al.*, 1998) and cytokinin levels increase in buds as they activate (Emery *et al.*, 1998). Cytokinins promoted translocation of nutrients (Mok and Mok, 1994). Spraying pea plants with kinetin at 10 ppm increased stem length, number of branches /plant, number of leaves /plant, dry weight of roots, ariel plant parts and total dry weight /plant, yield /plant and yield / *fed.* (Bardisi, 2004).

Growth of the shoot apex (terminal shoot) usually inhibits the development of the lateral buds on the stem beneath. This phenomenon is called apical dominance. If the terminal bud of the plant is removed, the inhibition is lifted and lateral buds began growth. The release of apical dominance enable lateral branches to develop and the plant became bushier. The terminal bud a plant hormone called auxin which is transported down the plant and inhibits the growth of the lateral buds. Removing the terminal buds (RTB) removes the source of auxin and the lateral buds can now develop to become more bushy plant.

After decapitation, cytokinins from the root accumulate in buds (Mader *et al.*, 2003) also, the levels of cytokinins exported from the root increase (Bangerth *et al.*, 2000). Removing the apical bud prior to the start of flowering increased branching of soybean compared to the control. When the terminal bud was removed after the start of flowering plant height and leaf area index were reduced (Bauer *et al.*, 1976).

Therefore, the aim of this work was to study the effect of nitrogen fertilization, spraying with benzyl adinine and removing the terminal bud on shoot branching, yield and nitrogen use efficiency of eggplant under condition of North Sinai Governorate.

MATERIALS AND METHODS

Two field experiments were carried out during consecutive summer seasons of 2007 and 2008 at the Experimental Farm, Faculty of Environmental Agricultural Sciences, El-Arish, Suez Canal University, North Sinai Governorate, Egypt to study the effect of nitrogen fertilization, foliar spray with benzyl adenine (BA) at 25 ppm and removing the terminal bud (RTB) on branching, yield and nitrogen use efficiency of eggplant. The soil properties are sandy loam in texture, pH: 7.8 and 8.1 and EC: 0.70 and 0.695 (dSm^{-1}) in the 1st and 2nd season, respectively. EC and pH of irrigation water are 7.54 dSm^{-1} and 7.5, respectively. The total N, P and K contents of FYM are 0.45(%), 0.25 (%) and 0.52 (%).

This experiment included 12 treatments which were the combinations between three nitrogen rates; i.e., 60, 90, and 120 kg/*fed.* as well as the control treatment and both spraying with BA at 25 ppm and removing the terminal bud (RTB) as well as the control treatment. The treatments were randomly arranged in a split - plot design with three replications, whereas the nitrogen rates were randomly arranged in the main plots, while BA and RTB treatments as well as control treatments were randomly arranged in the sub-plots. Plot area was 18 m^2, contained one dripper line (18m in length and 1m in width). Of this line, 10 m^2 was devoted for yield determination and 8 m^2 for samples to measure vegetative parameters. Plants were transplanted on 25th and 29th April in the 1st and 2nd season, respectively. The distance between plants was 50cm. Snow ovana eggplant *cv.* was used in this experiment.

Benzyl adinine was added as foliar spray for four times, one time / two weeks beginning 30 days from transplanting. Each experimental unit received two liter solution of BA at 25 ppm using spreading agent (super film). Removing the terminal bud of plant (RTB) was done at 30 days after transplanting, whereas both control and RTB were sprayed with distilled water and spreading agent. All plants received FYM at a rate of 40 m^3 / *fed.* and 70 kg P_2O_5 as well as 120 kg K_2O /feddan. Nitrogen fertilization treatments were applied at 10 days after transplanting through the irrigation water (fertigation) two times weekly. All other conventional agricultural treatments were applied.

Data Recorded

Plant growth

A random samples of five plants were randomly taken from every experimental unit at 120 days after transplanting and the following data were recorded: plant height (cm), No. of branches / plant, relative branching(%) and No. of leaves / plant. Different plant parts were oven dried at 70°C till constant weight and the following data were recorded: dry weight of roots, dry weight of leaves, dry weight of branches, total dry weight (roots + leaves + branches) / plant and relative total dry weight (%) which was calculated as dividing the total dry weight of plant on total dry weight of control multiplying in 100. The relative branching was estimated according to the same method.

Nitrogen composition in leaves and stems

Nitrogen content in leaves and stems was determined on the basis of dry weight in the 2nd season only at 120 days after transplanting according to the methods described by Bremner and Mulvaney (1982).

Yield and its components

Fruits of each experimental unit were packed at proper maturity stage, counted and weighed in each harvest and the following data were recorded: Average number of fruits/plant, average fruit weight (g), yield/plant (g), total yield (ton/*fed.*) and relative total yield%.

Fruit characters

Random samples of five fruits from every experimental unit were randomly taken and the following data were recorded: fruit length (cm) and fruit diameter (cm).

Nitrogen use efficiency (NUE)

The NUE calculated by using the following formulas:

$$\text{a. NUE} = \frac{\text{Total yield (kg)}}{\text{N added (kg)}} =$$

kg yield /kg N (Clark, 1982)

b.NUE=

$$\frac{\text{Yield of fertilized yield of control}}{\text{Fertilized N applied}}$$

= kg yield /kg N (Craswell and Godwin, 1984).

Statistical Analysis

Statistical analysis of the obtained data was carried out according to statistical analysis of variance according to Snedecor and Cochran (1980). Duncan's multiple range tests was used for comparison among means (Duncan, 1958).

RESULTS AND DISCUSSION

Plant Growth

Effect of nitrogen fertilization

The obtained results in Table 1 show that fertilization of eggplant with nitrogen at different rates reflected a significant effect on plant height, number of both branches and leaves / plant, dry weight of roots, branches, leaves and total dry weight /plant , except number of branches /plant in the 2^{nd} season and dry weight of leaves in the 1^{st} season. Application of N at 60, and 120kg */fed.* significantly increased plant height, number of leaves /plant dry weight of roots, branches and total dry weight /plant compared to the control without significant differences among them in both seasons. Nitrogen application at 90 kg/*fed.* gave the tallest plants (44.88 and 45.31cm in the 1^{st} and 2^{nd} season, respectively) and the highest dry weight of branches (21.14 g/plant in the 1^{st} season). Whereas N at 120 kg / *fed.* gave the highest number of leaves /plant (46.33 and 43.77 /plant in the 1^{st} and 2^{nd} season, respectively) and total dry weight /plant (73.81 g/plant in the 2^{nd} season).

The increases in total dry weight were about 20.79 and 29.766% for N at 90 kg */fed.* and 18.90 and 33.37% for N at 120 kg / *fed.* over the control in the 1^{st} and 2^{nd} season, respectively.

The enhancing effect due to the increase in nitrogen dose on plant growth may be attributed to that N plays major roles in the synthesis of structural proteins and other several macromolecules, in addition to vital contribution in several biochemical process in the plant related to growth (Marschner, 1995). Besides, nitrogen is an important constituent of protoplasm. Also, enzyme the biological catalytic agents, which speed up life processes, have N as their major Values having the same alphabetical letter (s) did not

Table 1. Effect of nitrogen fertilization, spraying with benzyl adinine (BA) and removing the terminal bud (RTB) on plant growth of eggplant grown in sandy soil during 2007 and 2008 seasons

Treatments	Morphological characters				Dry weight/plant (g)				
	Plant height (cm)	No. of branches /plant	Relative branching (%)	No. of leaves /plant	Roots	Branches	Leaves	Total	Relative total dry weight %
N (kg/fed.)				First season (2007)					
0	37.50b	9.44a	100	36.22b	14.86b	17.15b	27.55a	59.57b	100
60	43.11a	8.88a	94.06	42.77ab	18.26ab	20.33a	30.44a	69.05a	115.91
90	44.88a	8.55a	90.57	40.77ab	19.37a	21.14a	31.44a	71.96a	120.79
120	44.11a	6.11b	64.72	46.33a	19.28a	20.22a	31.33a	70.83a	118.90
				Second season (2008)					
0	36.01b	8.78a	100	35.55b	14.29b	15.14b	25.90b	55.34b	100
60	40.63ab	9.78a	111.38	43.55a	18.16a	19.32a	31.37a	68.86a	124.43
90	45.31a	9.34a	106.37	39.77ab	19.49a	20.57a	31.74a	71.81a	129.76
120	42.67ab	8.67a	98.74	43.77a	19.98a	20.73a	33.10a	73.81a	133.37
BA and RTB				First season (2007)					
Control	44.75a	6.41b	100	35.08b	17.38a	18.18b	28.91a	64.48b	100
BA at 25 ppm	43.33ab	8.58a	133.95	44.08a	19.04a	19.93ab	30.91a	69.89a	108.39
RTB	39.12b	9.75a	152.10	45.41a	17.41a	21.01a	30.75a	69.18a	107.28
				Second season (2008)					
Control	41.93ab	7.65b	100	36.25b	16.34a	16.49b	29.21a	62.04b	100
BA at 25 ppm	42.32a	9.15ab	119.60	41.75ab	18.48a	20.34a	31.31a	70.14a	113.05
RTB	39.21b	10.64a	139.08	44.00a	19.13a	20.00a	31.05a	70.19a	113.13

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to Duncan's multiple range test.

significantly differ at 0.05 level of significance, according to Duncan's multiple range test. Constituents (Mengel and Kirkby, 1978). These results agree with those reported by Singh *et al.*, (2003) and Wange and Kale (2004) on eggplant.

Effect of BA and RTB

As for, the effect of removing the terminal bud (RTB) and spraying with (BA), it is obvious from data in Table 1 that RTB and BA reflected a significant effect on plant height, number both of branches and leaves, dry weight of branches and total dry weight /plant, but they did not reflect any significant effect on dry weight of roots and leaves in both seasons.

Spraying with BA adinine (BA) at 25 ppm and RTB significantly increased number of both branches and leaves /plant, dry weight of branches and total dry weight /plant compared to the control. Removing the terminal bud (RTB) gave the shortest plants (39.12 and 39.21 cm in the 1st and 2nd season, respectively) and also recorded the maximum number of both branches (9.75 and 10.64 /plant in the 1st and 2nd season, respectively) and leaves/plant (45.11 and 44.00/ plant in the 1st and 2nd season, respectively) as well as dry weight of branches (21.01 and 20.00 g/plant in the 1st and 2nd season, respectively), whereas BA at 25 ppm gave the highest values of total dry weight /plant (69.89 and 70.14 g /plant in the 1st and 2nd season, respectively).

The increases in branching were about 52.10 and 39.08% for RTB and 33.95 and 19.10% for BA over the control in the 1st and 2nd season, respectively. Also, the increases in total dry weight were about 8.39 and 13.05% for BA at 25 ppm and 7.08 and 13.13% for RTB over the control in the 1st and 2nd season, respectively.

The stimulative effect of BA and RTB on branching may be due to that cytokinins promote the growth of lateral bud and reduces apical dominance (Cline, 1991; Emery *et al.*, 1998; Miguel *et al.*, 1998; Reddy *et al.*, 2004; Ongaro and Leyser, 2008). Also, removing the terminal bud removes the source of auxin and the lateral buds can now develop causing the plant to become more bushy plant. These results agree with those reported by Bauer *et al.* (1976) on soybean with respect to removing the terminal bud and Bardisi (2004) on pea with respect to kinetin.

Effect of the interaction

Presented data in Tables 2 and 3 show that the interaction between N at different rates and both BA and RTB showed a significant effect on plant height, number of both branches and leaves, dry weight of roots, branches, leaves and total dry weight /plant, except dry weight of roots, branches and leaves in the 1st season. The interaction between N at 90 kg/*fed.* and BA at 25 ppm and also the interaction between N at 120 kg /*fed.* and control gave the tallest plants (48.33 and 46.10 cm for the interaction between N at 90 kg/*fed.* and BA at 25 ppm and 49 and 45.10 cm for the interaction between N at 120 kg /*fed.* and control in the 1st and 2nd season, respectively). The interaction between N at 60 or 90 or 120 kg /*fed.* and RTB gave the highest values of number of both branches and leaves / plant, whereas the interaction between N at 90 or 120 kg and spraying with BA at 25 ppm gave the highest values of total dry weight /plant (75.93 and 75.70 g/plant for the interaction between N at 90 kg /*fed.* and BA at 25 ppm and 72.82 and 79.56 g/plant for the interaction between N at 120 kg and BA at 25 ppm in the 1st and 2nd season, respectively).

The increments in branching were about 43.60 and 54.17% for RTB without N, 34.85 and 67.16% for the interaction between N at 60 kg and RTB and 39.16 and 64.62% for the interaction between N at 90 kg and RTB over the control in the 1st and 2nd season, respectively. Also, the increases in total dry weight were about 36.27 and 52.86 % for the interaction between N at 90 kg/*fed.* and BA at 25 ppm and 30.06 and 60.66% for the interaction between N at 120 kg /*fed.* and BA at 25 ppm over the control in the 1st and 2nd season, respectively.

Nitrogen Contents

Effect of nitrogen fertilization

Data given in Figs. 1and 2 show that N fertilization of eggplant at different rates increased N content in leaves and stems compared to control. Nitrogen application at a rate of 120 kg N/ *fed.* gave the highest value of N contents in leaves and stems followed by N at 90 kg / feddan.

Effect of BA and RTB

Presented data in Figs. 1 and 2

Table 2. Effect of the interaction between nitrogen fertilization and both spraying with benzyl adinine (BA) and removing the terminal bud (RTB) on plant growth of eggplant grown in sandy soil during 2007 season

Treatments		Morphological characters				Dry weight/plant (g)				
		Plant height (cm)	No. of branches /plant	Relative branching (%)	No. of leaves /plant	Roots	Branches	Leaves	Total	Relative total dry weight %
N (kg /fed.) X BA and RTB										
0	Control	37.66de	7.66de	100	31.00e	13.82a	15.56a	26.33b	55.72c	100
	BA at 25 ppm	39.33de	9.66a-c	126.10	39.00cd	14.68a	17.21a	27.00ab	58.89bc	105.68
	RTB	35.50e	11.00a	143.60	38.66cd	16.08a	18.68a	29.33ab	64.10a-c	115.03
60	Control	44.66a-d	7.66de	100	35.66de	17.94a	18.94a	29.33ab	66.21a-c	118.82
	BA at 25 ppm	44.33a-d	8.66cd	113.05	45.33b	19.97a	20.28a	31.66a	71.92ab	129.07
	RTB	40.33c-e	10.33ab	134.85	47.33ab	16.89a	21.78a	30.33a	69.01ab	123.85
90	Control	47.66a-c	6.00f	78.32	35.66de	19.37a	18.77a	28.66a	66.81a-c	119.90
	BA at 25 ppm	48.33ab	9.00bcd	117.49	43.33bc	20.67a	22.59a	32.66a	75.93a	136.27
	RTB	38.66de	10.66a	139.16	43.33bc	18.07a	22.06a	33.00a	73.13a	131.24
120	Control	49.00a	4.33g	56.52	38.00d	18.39a	19.47a	31.33a	69.20ab	124.19
	BA at 25 ppm	41.33b-e	7.00ef	91.38	48.66a	20.83a	19.65a	32.33a	72.82a	130.06
	RTB	42.00a-e	7.00ef	91.38	52.33a	18.61a	21.54a	30.33a	70.49ab	126.5

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to Duncan's multiple range test.

Table 3. Effect of the interaction between nitrogen fertilization and both spraying with benzyl adinine (BA) and removing the terminal bud (RTB) on plant growth of eggplant grown in sandy soil during 2008 season

Treatments		Morphological characters				Dry weight/plant(g)				
		Plant height (cm)	No. of branches /plant	Relative branching (%)	No. of leaves /plant	Roots	Branches	Leaves	Total	Relative total dry weight %
N (kg /fed.) X BA and RTB										
0	Control	35.50de	6.70e	100	35.00e	13.79d	12.16d	23.56e	49.52e	100
	BA at 25 ppm	38.10d	9.33a-e	139.25	36.66de	13.16d	15.87cd	25.36de	54.40e	110.12
	RTB	34.43e	10.33a-c	154.17	35.00e	15.92b-d	17.41bc	28.76cd	62.10d	125.40
60	Control	41.06bc	8.83a-e	131.79	35.00e	18.10a-d	17.76bc	30.40bc	66.26cd	133.80
	BA at 25 ppm	43.43a-c	9.33a-e	139.25	45.00bc	17.55a-d	19.97a-c	33.36ab	70.89bc	143.15
	RTB	37.40d	11.20a	167.16	50.66a	18.83a-d	20.23a-c	30.36bc	69.43bc	140.20
90	Control	45.80a	7.33de	109.40	34.66bc	18.44a-d	17.27bc	30.13bc	65.85cd	132.97
	BA at 25 ppm	46.10a	9.66a-d	144.17	41.00cd	19.96a-c	23.71a	32.03a-c	75.70ab	152.84
	RTB	44.03ab	11.03ab	164.62	43.66bc	20.09a-c	20.73a-c	33.06ab	73.89ab	149.03
120	Control	45.36a	7.76c-e	115.82	40.33cd	15.02cd	18.77a-c	32.76a-c	66.55cd	134.39
	BA at 25 ppm	41.66bc	8.26b-e	123.28	44.33c	23.24a	21.82ab	34.50a	79.56a	160.66
	RTB	41.00c	10.00a-d	149.25	46.66ab	21.68ab	21.62ab	32.03a-c	75.33ab	152.12

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to Duncan's multiple range test.

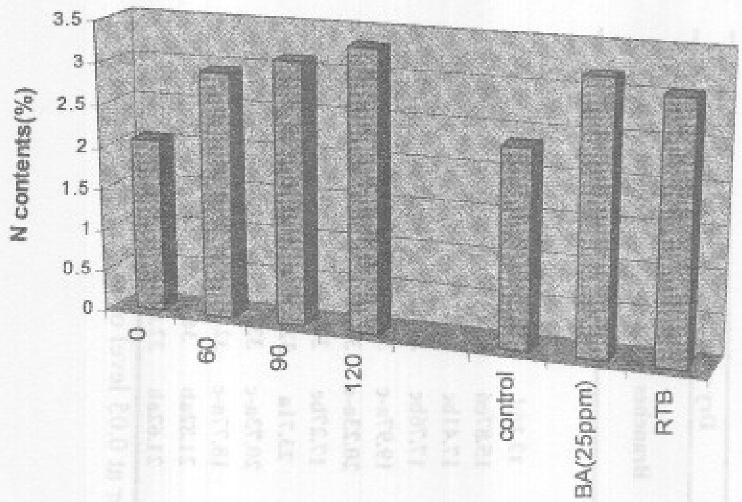

Fig.1. Effect of nitrogen fertilization and both BA and RTB on nitrogen conten in eggplant leaves

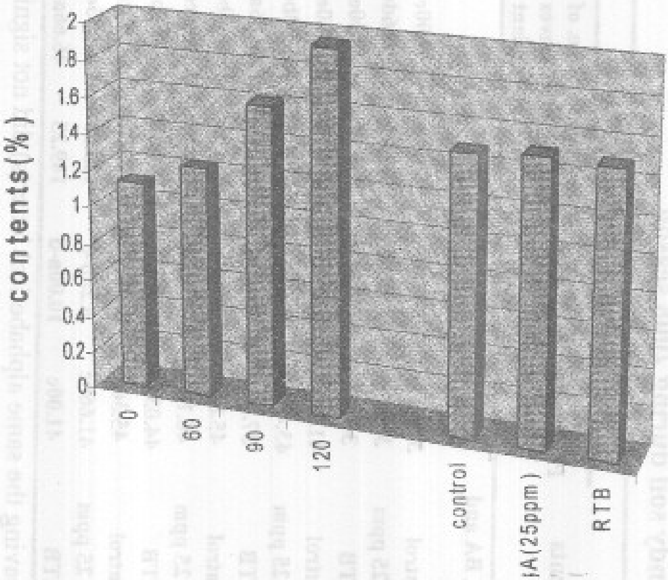

Fig.2. Effect of nitrogen fertilization and both BA and RTB on nitrogen content in eggplant stems

show that spraying eggplant with BA at 25 ppm or bud RTB of eggplant increased N content in leaves compared to control treatment, whereas there were no significant differences among the treatments in terms of N content in stems. These results are in accordance with those reported by Michaloje and Buczkowska (2008).These results may be due to that cytokinins promoted translocated of nutrients (Mok and Mok, 1994).

Effect of interaction

Presented data in Fig. 3 show that the interaction between fertilization with 60 or 90 and 120 kg / *fed.* with spraying of BA at 25 ppm gave the highest values of N content in leaves without significant differences with application of 120 kg N/*fed.* with spraying of BA at 25 ppm. It is clear from Fig.4 that the interaction between 120 kg N / *fed.* and spraying with BA at 25 ppm gave the highest values of N content in stem.

Yield and Its Components

Effect of nitrogen fertilization

It is obvious from data in Table 4 that number of fruits/ plant, average fruit weight, yield /plant, yield/ *fed.*, fruit length and fruit diameter were significantly increased with increasing N rates with no significant differences among 60, 90 and 120 kg / *fed.* Nitrogen at a rate of 90 or 120 kg/*fed.* gave the highest values of number of fruits / plant (37.31 and 40.30 for N at 90 kg and 40.75 and 41 for N at 120 kg/*fed.* in the 1st and 2nd season, respectively, average fruit weight (43.20 and 38.98 g/fruit for N at 90 kg and 42.52 and 39.03 g/fruit for N at 120 kg / *fed.* in the 1st and 2nd season, respectively, yield /plant (1612 and 1572.76 g/plant for N at 90 kg / *fed.* and 1727 and 1571.90 for N at 120 kg / *fed.* in the 1st and 2nd season, respectively), yield / *fed.* (13.54 and 13.21 ton/ *fed.* for N at 90 kg / *fed.* and 15.51 and 13.20 ton/ *fed.* for N at 120 /kg /*fed.* in the 1st and 2nd season, respectively.

The increases in total yield /*fed.* were about 41.78 and 72.22 % for N at 90 kg / *fed.* and 51.93 and 72.09% for N at 120 kg/ *fed.* over the control in the 1st and 2nd season, respectively. The stimulative effect of N on total yield might be due to the favorable effect of N on dry weight, Table 1, number of fruits /plant, average fruit weight and yield /plant Table, 4. These results coincided with

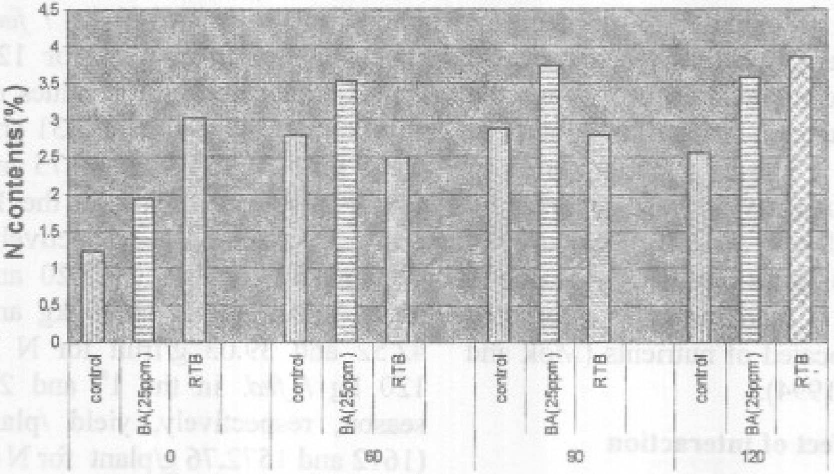

Fig. 3. Effect of interaction between nitrogen fertilization and both BA and RTB on nitrogen content in eggplant leaves

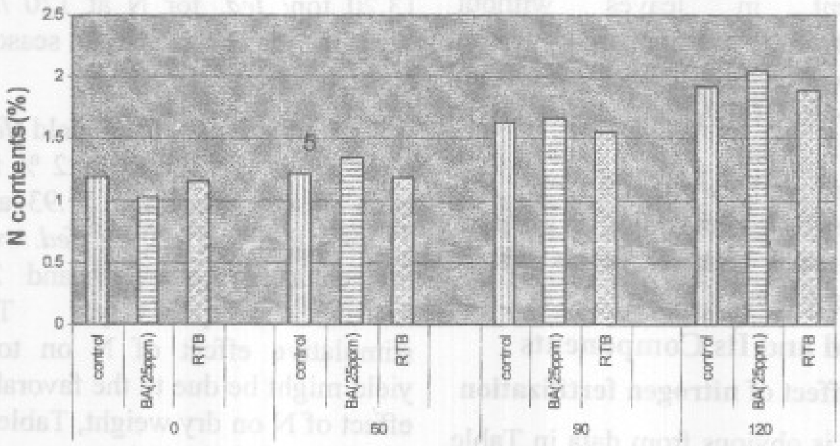

Fig. 4. Effect of interaction between nitrogen fertilization and both BA and RTB on nitrogen content in eggplant stem

Table 4. **Effect of nitrogen fertilization, spraying with benzyl adinine (BA) and removing the terminal bud (RTB) on yield and fruit characters of eggplant grown in sandy soil during 2007 and 2008 seasons**

Treatments	Yield and its components					Fruit characters	
	No. of fruits/plant	Average fruit weight (g)	Yield/plant (g)	Total yield /fed.(ton)	Relative total yield %	Fruit length(cm)	Fruit diameter(cm)
N (kg/fed.)				First season(2007)			
0	30.88b	37.15b	1137b	9.55b	100	11.80b	2.90bc
60	38.26a	37.29b	1414ab	11.88ab	124.39	13.47ab	2.82c
90	37.31a	43.20a	1612a	13.54a	141.78	14.07a	3.31ab
120	40.75a	42.52a	1727a	14.51a	151.93	13.78a	3.58a
				Second season(2008)			
0	31.66b	28.81b	913.21b	7.67b	100	11.58b	2.76c
60	36.76ab	37.70a	1294.35ab	10.87ab	141.72	12.98a	2.83bc
90	40.30a	38.98a	1572.76a	13.21a	172.22	14.01a	3.26ab
120	41.00a	39.03a	1571.90a	13.20a	172.09	13.95a	3.54a
BA and RTB				First season(2007)			
Control	32.13b	40.43a	1304.00b	10.95b	100	12.30b	2.98a
BA at 25 ppm	38.26a	41.78a	1601.00a	13.45a	122.83	14.26a	3.35a
RTB	40.01a	37.92a	1512.00ab	12.70ab	115.98	13.28ab	3.13a
				Second season(2008)			
Control	32.12b	35.87a	1123.64c	9.44b	100	11.80b	2.90b
BA at 25 ppm	39.55a	37.43a	1500.90a	12.60a	133.47	14.28a	3.31a
RTB	40.62a	35.08a	1389.63b	11.67a	123.62	13.31a	3.08ab

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to Duncan's multiple range test.

those reported by Bobadi and Damme (2003), Rosati *et al.* (2002), Devi *et al.* (2002), Satpal and Saimbhi (2003), Singh *et al.* (2003), Aujla *et al.* (2007) and Jilani *et al.* (2008) on eggplant.

Effect of BA and RTB

Regarding the effect of BA at 25 ppm and RTB, The obtained results in Table 4 show that both BA and RTB reflected significant differences on number of fruits /plant, yield /plant, yield / *fed.*, fruit length and fruit diameter in both seasons and did not reflect any significant effect on average fruit weight in both seasons and fruit diameter in the 1st season. RTB gave the highest average number of fruits/ plant (40.0 and 40.62/ plant in the 1st and 2nd season, respectively), followed by BA at 25 ppm (38.26 and 39.55/ plant in the 1st and 2nd season, respectively), whereas BA at 25 ppm gave the highest values of yield /plant (1601.00 and 1500.90 g/plant in the 1st and 2nd season, respectively) and total yield /*fed.* (13.21 and 12.60 ton/*fed.* in the 1st and 2nd season, respectively).

The increments in the total yield/ *fed.* were about 22.83 and 33.47 % for BA at 25 ppm and 15.98 and 23.62% for RTB over the control in the 1st and 2nd season, respectively. The increases in the total yield by applying BA or RTB might be due to the favorable effect of BA or RTB on No. of fruits / plant and yield / plant Table 4. These results agree with those reported by Bardisi (2004) on pea with respect to kinetin.

Effect of the interaction

It can be seen from data given in Tables 5 and 6 that the interaction between N at different rates and both BA and RTB had significant effect on number of fruits /plant, average fruit weight, yield /plant, total yield / *fed.* fruit length and fruit diameter. The interaction between N at 120 kg and BA at 25 ppm significantly increased number of fruits /plant (46.26 and 45.20 fruits /plant in the 1st and 2nd season, respectively), whereas the interaction between N at 90 or 120 kg N / *fed.* and BA at 25 ppm significantly increased yield /plant (1821 and 1750 g/plant for the interaction between N at 90 kg /*fed.* and BA at 25 ppm and 1869 and 1857 g/*fed.* for the interaction between N at 120 kg and BA at 25 ppm in the 1st and 2nd season , respectively), total yield/ *fed.* (15.29 and 14.70 ton / *fed.* for the interaction between N at 120 kg / *fed.* and BA at 25 ppm and

Table 5. Effect of the interaction between nitrogen fertilization and both spraying with benzyl adinine (BA) and removing the terminal bud (RTB) on yield and fruit characters of eggplant grown in sandy soil during 2007 season

Treatments		Yield and its components					Fruit characters	
		No. of fruits/plant	Average fruit weight(g)	Yield/plant (g)	Total yield (ton/fed.)	Relative total yield %	Fruit Length (cm)	Fruit Diameter (cm)
		N (kg /fed.) X BA and RTB						
0	Control	26.93e	36.65a	991c	8.32c	100	10.33e	2.80d
	BA at 25 ppm	30.53de	40.36a	1212bc	10.18bc	122.25	13.06bcd	2.95cd
	RTB	35.20b-e	34.43a	1208bc	10.15bc	121.99	12.00d	2.95cd
60	Control	34.33b-e	35.72a	1210bc	10.17bc	122.23	12.16cd	2.66d
	BA at 25 ppm	37.60a-d	39.42a	1504abc	12.63abc	151.80	13.86abc	2.85d
	RTB	42.86ab	36.75a	1528abc	12.83abc	154.20	14.40ab	2.95cd
90	Control	31.80cde	42.84a	1367abc	11.48abc	137.89	13.40bcd	2.95cd
	BA at 25 ppm	38.66a-d	46.95a	1821a	15.29a	183.77	15.36a	3.66ab
	RTB	41.46a-c	39.82a	1650ab	13.86ab	166.46	13.46bcd	3.33b
120	Control	35.46b-e	46.50a	1649ab	13.85ab	166.46	13.33bcd	3.51b
	BA at 25 ppm	46.26a	40.37a	1869a	15.70a	188.70	14.76ab	3.93a
	RTB	40.53abc	40.70a	1664ab	13.97ab	167.90	13.26bcd	3.29bc

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to Duncan's multiple range test.

Table 6. Effect of the interaction between nitrogen fertilization and both spraying with benzyl adinine (BA) and removing the terminal bud (RTB) on yield and fruit characters of eggplant grown in sandy soil during 2008 season

Treatments		Yield and its components					Fruit Characters	
		No. of fruits/plant	Average fruit weight(g)	Yield/plant (g)	Total yield /fed.(ton)	Relative total yield %	Fruit length(cm)	Fruit diameter(cm)
N (kg/fed.) X BA and RTB								
0	Control	26.00f	27.55c	680.32l	5.71f	100	9.25e	2.68d
	BA at 25 ppm	33.00def	29.95c	1039.33j	8.73e	152.88	13.25bc	2.85d
	RTB	36.00cde	28.95c	1020.00k	8.57e	150.08	12.25cd	2.75d
60	Control	29.00ef	39.50ab	1084.33i	9.11de	159.54	11.42d	2.71d
	BA at 25 ppm	37.20bcd	38.00ab	1355.84g	11.39b-d	199.47	13.89ab	2.90d
	RTB	44.10ab	35.60b	1442.89e	12.12bc	212.25	13.62b	2.88d
90	Control	36.50b-e	37.05ab	1333.66h	11.20cd	196.14	13.30bc	2.82d
	BA at 25 ppm	42.80abc	41.50a	1750.74b	14.70a	257.44	14.99a	3.70ab
	RTB	41.60abc	38.40ab	1633.89c	13.72ab	240.28	13.75b	3.27c
120	Control	37.00bcd	39.40ab	1396.26f	11.73bc	205.42	13.25bc	3.40bc
	BA at 25 ppm	45.20a	40.30ab	1857.69a	15.60a	273.20	15.00a	3.82a
	RTB	40.80a-d	37.40ab	1461.76d	12.27bc	214.88	13.62b	3.41bc

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to Duncan's multiple range test.

15.70 and 15.60 ton/*fed.* for the interaction between N at 120 kg /*fed.* and BA at 25 ppm in the 1st and 2nd season, respectively.

The increases in the total yield /*fed.* were about 83.77 and 157.44% for the interaction between N at 90 kg and BA at 25 ppm and 88.70 and 73.20% for the interaction between N at 120 kg /*fed.* and BA at 25 ppm over the control in the 1st and 2nd season, respectively. The stimulative effect of the interaction between N at 90 or 120 kg /*fed.* and both BA or RTB on total yield / *fed.* might be due to their favorable effect on number of fruits /plant and yield / plant (Tables 5 and 6).

Nitrogen Use Efficiency

The term "mineral use efficiency" have defined in many ways. Usually, it defined as output divided by input (Clark, 1982). He also added that, a plant which, produces the highest yield per given amount of added element can be considered to be an efficient plant. But, this may not be a plant produces the highest total output at higher or lower levels of nutrients. A "mineral efficient" plant may also be one that produces the greatest dry matter or produces the most harvestable produce per unit of added element or taken up.

Since, according to the previous definition and the objection on it, the plant produces highest yield may not show the highest value that indicating the efficiency. In the present work, presented data in Tables 7 and 8 show that the highest utilization of N-efficiency by fertilization of eggplant with N at 60 kg / *fed.* and the interaction between 60kg/N and both BA and RTB in both season, however these treatments produced low total yield/feddan.

In this work, to have more understood about the efficiency, the control treatment taken as base for comparison and calculate the efficiency by the formula proposed by Craswell and Godwin, (1984).

Data in Tables 7 and 8 illustrate that application of 90 kg N / *fed.* or N at 90 kg/*fed.* with spraying BA at 25 ppm increased the value of nitrogen use efficiency in both seasons. These treatments produced high total yield/feddan.

It could be concluded that obtained results in this research could be explained in the light of that cytokinins are involved in delaying senescence's of plant. During senescence the proteins, nucleic acid and chlorophyll broken down into simpler elements

Table 7. Show nitrogen use efficiency by eggplant grown in sandy soil during 2007 and 2008 seasons

Treatments	Nitrogen use efficiency	
	According to the formula of Clark (1982)	According to the formula of Craswell and Godwin (1984)
N (kg /*fed.*)	First season (2007)	
60	198.00	38.83
90	150.44	44.33
120	120.91	41.33
	Second season (2008)	
60	181.16	53.33
90	146.77	61.55
120	110.00	46.08

Table 8. Show nitrogen use efficiency by eggplant grown in sandy soil during 2007 and 2008 seasons

Treatments		Nitrogen use efficiency	
		According to the formula of Clark (1982)	According to the formula of Craswell and Godwin (1984)
N (kg/fed.) X BA and RTB		First season (2006)	
60	Control	169.50	30.83
	BA at 25 ppm	210.50	40.83
	RTB	213.83	44.66
90	Control	127.55	35.11
	BA at 25 ppm	169.88	56.77
	RTB	154.00	41.22
120	Control	115.41	46.08
	BA at 25 ppm	130.83	46.25
	RTB	116.41	31.83
		Second season (2007)	
60	Control	151.83	56.83
	BA at 25 ppm	189.83	44.33
	RTB	202.00	59.16
90	Control	124.44	61.11
	BA at 25 ppm	163.33	66.33
	RTB	152.44	57.22
120	Control	97.75	50.25
	BA at 25 ppm	130.00	57.25
	RTB	102.25	30.83

BA: benzyal adinine, RTB: removing the terminal bud.

such as sugar, amino acid. These substances are transported to other parts of the plant. Application of cytokinins delays the process of senescence by preventing the degradation of chlorophyll, proteins and nucleic acid. Therefore, it is noticed that cytokinins levels in the leaf lamina is important regulation of the process senescence (Reddy *et al.*, 2004). They also reported that cytokinins reduce the apical dominance and promote the growth of lateral buds. Removing the terminal bud removes the source of auxin and cytokinins from the root accumulates in buds (Bangerth *et al.*, 2000 and Mader *et al.*, 2003), this cytokinins promote outgrowth (Ongaro and Leyser, 2008) and shoot branching (Cline, 1991).

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مقارنة إزالــة البرعــم الطرفى والرش بالبنزيل أدينين وتأثيــرهما على نمو وإنتاجية الباذنجان تحت مستويات مختلفة من التسميد النيروجينى

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أجريت تجربتان حقليتان خلال صيف موسمي ٢٠٠٦و٢٠٠٧ فى مزرعة كلية العلوم الزراعية البيئية بالعريش جامعة قناة السويس – مصر وذلك لدراسة تأثير أربع معــدلات من التسميد النيتروجينى (صفر و٦٠ و٩٠ و١٢٠كجم / فدان) ورش النباتــات بالبنزيــل أدينين بتركيز ٢٥ جزء فى المليون وكذلك إزالة البرعم الطرفــى للنبــات علــى النمــو، والمحصول، وكفاءة استخدام النيتروجين للباذنجان المنزرع تحت ظروف محافظة شــمال سيناء وقد أوضحت النتائج أن :

تسميد نباتات الباذنجان بمعدل ٩٠ كجم نيتروجين للفدان قد سجل أعلــى ارتفــاع للنبات وأدى إلى زيادة كل من الوزن الجاف للجذور، والأفرع، والوزن الجاف الكلى للنبات، ومتوسط وزن الثمرة، ومحصول النبات، وطول الثمرة مع عدم وجود اختلافات معنوية مع استخدام ٦٠ أو ١٢٠ كجم نيتروجين للفدان ،كــذلك أدت إلــى زيــادة كفــاءة اســتخدام النيتروجين بينما سجل التسميد بمعدل ١٢٠ كجم للفدان أعلــى القــيم بالنــسبة لمحتــوى الأوراق والسوق من النيتروجين، ومحصول النبات، ومحصول الفدان ، والمحصول النسبى للفدان، كما انخفض عدد الأفرع، والتفريع النسبى مع زيادة التسميد الازوتى خلال الموســم الأول حيث حققت معاملة الكنترول أعلى قيمة لعدد الأفرع للنبات.

أدى رش نباتات الباذنجان بالبنزيل أدينين بمعدل ٢٥ جزء فى المليــون أو إزالــة البرعم الطرفى للنبات إلى زيادة عدد الأفرع للنبات، والتفريع النــسبى، والــوزن الجــاف للأفرع، والوزن الجاف الكلى للنبات، والوزن الجــاف النــسبى للنبــات مقارنــة بمعاملــة الكنترول. وقد أبدت نفس المعاملات زيادة فى عدد الثمــار، والمحــصول الكلــى للفــدان، والمحصول النسبى الكلى، وطول الثمرة.

أدى تسميد الباذنجان بـــ ٩٠ أو ١٢٠ كجم نيتروجين للفــدان ورشــها بالبنزيــل أدينين بمعدل ٢٥ جزء فى المليون الى زيادة معظم صفات المحصول ومكوناته مــع عــدم وجود اختلافات معنوية مع استخدام نفس المعدلين من التسميد الازوتى مع ازلــة البــرعم الطرفى للنبات.