Evaluation of Some Growth Regulators Foliar Application on Yield and Quality of Okra Plants

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ABSTRACT: Okra (*Abelmoschus esculentus* L. *Moench*) is a commercial vegetable crop and multipurposed plant belongs to family Malvacea. Nevertheless, the field productivity of this important plant still limited despite a numerous or vast literature published about the effect of some other chemical growth regulators. Nevertheless, foliar application of the cytokinins and auxins either singly or in combinations have not investigated extensively. Therefore, two filed experiments were conducted in a private farm at Hosh Essa region, El-Baharia Governorate, Egypt, during two successive seasons, 2016 and 2017, to evaluate the mode of actions of both cytokinin; (benzyladenine BA) and the auxin (Naphatalene acetic acid; NAA) alone or in combination on growth performance (morphological and physiological traits), yield and quality (nutritional status) of okra, "Lady's fingers" cv. The experiments were carried out, in a randomized complete blocks design with 16 treatments, replicated each turn. The auxin (NAA) tested levels were: 0, 10, 20 and 40 mg/l, and the cytokinin (BA) tested levels were 0, 25, 50 and100 mg/l, and their combination. The data collected were analyzed using analysis of variance (ANOVA) with the aid of GENSTAT 5 package and significant means were separated using Least Significant Difference (LSD) at 5% probability level. The obtained results indicated that the yield and its components, gradually, increased due to foliar application with 40 NAA+100 BA mg/l compared to the other treatments and control one during both seasons of 2016 and 2017, such as (pod length, diameter and weight, days to first flowering, number of pods per plant, weight of pod/plant, yield (kg/fed.), during both seasons. Also, foliar application of the same mixed combination, significantly, increased chemical composition of okra plants, such as N, P, K percentages, and mucilage percentage during both 201٦ and 201٧ seasons. It is possible to include that the aforementioned combination of both auxin and cytokinin could be advisable to okra growers to increase and enhance growth performance of okra "Ladys fingers" cv.

Key words: Okra, plant growth regulators, NAA, BA, yield, chemical composition.

INTRODUCTION

Okra, popularly, known as Ladys fingers is an important annual vegetable crop belongs to family Malvaceae. It plays an important role in the human diet and is a good source of protein, carbohydrates, vitamins, calcium, potassium, enzymes, and total minerals which are often lacking in the diet of developing country. Its medicinal value has, also, been reported in curing ulcers and relief from hemorrhoids. Okra has been found to be medicinal plants too. Furthermore, the pods of okra have reawakened beneficial interest in bringing this crop into commercial production (Singha *et al.,* 2014).

Growth and yield of okra depends upon many factors including seed quality, nutrition, climatic conditions and cultural practices (Kusvuran, 2012). Chemical substances like plant growth regulators can bring changes in the phenotypes of plants and affect growth either by enhancing or by stimulating the natural growth regulatory systems (plant hormonas) from seed germination to senescence (Das and Das, 1995). These substances can improve physiological efficiency of plants including photosynthetic capacity and effective partitioning of

assimilates. The productivity in field crops can be increased by stimulating the translocation of photo-assimilates (Solaimalai *et al.,* 2001). Naphthalene acetic acid (NAA), is a synthetic auxin that enhances ethylene biosynthesis in treated flowers and young pods, which in turn induces abscission of those organs when applied to more mature tissues. However, auxins at low doses reduce abscission possibly by promoting tissue attachment through enhanced differentiation and development of vascular bundles (El-Otmani *et al.,* 2000). Also, NAA is an ingredient of many commercial horticultural products used for rooting of cuttings, inhibition of flower drop, bud and button shedding besides inhibiting sprouting and development of suckers (El-Otmani *et al.,* 2000; Williams and Taji, 1989). On the other side, benzyladenine (BA), is a synthetic cytokinin that promotes outgrowth of axillary and adventitious shoots, enhances cell division, breakdown the dormancy of axillary buds, inhibit elongation of vegetative growth, application of shoot senescence enhance chlorophyll formation within tissues, protein synthesis, break apical dominance and release axillary branches and involve in carbohydrate metabolism (George and Shemington, 2008).

But the question remaining whether the plant growth regulators as cytokinins or auxins, or their combination have significant functions on growth, yield and quality of okra or not.

Therefore, the main objective of the present study is to assess the mode of actions of both the cytokinins (benzyl adenine; BA) and Naphatalene acetic acid (NAA) alone or in combination on growth performance (morphological and physiological traits), yield and quality (nutritional status) of okra “Lady’s fingers” cv.

MATERIALS AND METHODS

The conducted experiments were done in Hosh Essa region, El-Baharia Governorate, Egypt, during two successive seasons of both 2016 and 2017 to assess the mode of actions of both cytokinins (BA) and auxins NAA alone or in combination; on growth performance (morphological and physiological traits), yield and quality (nutritional status) of okra “Lady’s fingers” cv.

Experimental materials

The materials under investigation consisted of “lady’s fingers” variety of okra and two plant growth regulators as BA (0, 25, 50 and 100 mg/l) and NAA (0, 10, 20 and 40 mg/l). Seeds of okra were planted in a single row 10 m long, 0.6 m wide and hills 30 cm apart at the rate of 5 seeds per hill. Each plot contained 5 rows. The plot area was 30 m^2 for each. Sowing date was on 20 May for the first and second seasons, respectively. Three weeks later, seedlings were thinned and the strongest one being remained in each hill. Other cultural practices were carried out as recommended for the conventional okra planting.

Experimental methods

The experiment was conducted as a Factorial experiments laid out in Randomized Complete Blocks Design with two growth regulators BA, NAA and their combinations, thus forming 16 treatment combinations. Treatment was replicated three times. Foliar application of both tested independent variables and their combinations was carried out after 30 and 60 days from sowing.

Soil texture was clay soil. A surface sample (0-30cm depth) was collected in both seasons before planting to identify some physical and chemical properties as shown in Table (1).

Table (1). Some physical and chemical properties of the experimental soil in 2016 and 2017 seasons

Parameter	2016	2017	Unit
Mechanical Analysis			
Sand	59.72	60.59	%
Silt	10.00	9.01	%
Clay	30.28	30.40	%
Textural class	Sandy clay Loam		
pH (1:2 water suspension)	8.10	8.16	-
Ca CO_3	10.20	10.26	%
EC(1:2, water extract)	2.10	1.97	dS/m
O.M.	1.20	1.28	%
Soluble cations			
Ca^{2+}	9.6	9.8	meq/l
Mg^{2+}	2.2	2.2	meq/l
Na^{+}	8.0	8.1	meq/l
K^{+}	1.2	1.2	meq/l
Soluble anions			
HCO_3^{-}	9.8	10.0	meq/l
Cl^{-}	9.0	9.1	meq/l
SO_4^{2-}	2.2	2.3	meq/l
Available nutrients			
Nitrogen (N)	420.0	423.0	mg/kg
Phosphorus (P)	12.8	12.9	mg/kg
Potassium (K)	220.0	222.0	mg/kg

Physical and chemical analyses of the field tested soil were done at the laboratory of soil and Agric. chemistry department, Fac. Agric. Saba Basha, Alex. Univ.

Data recorded

(A) Vegetative growth characters:

- Plant height (cm).

The height of plant was measured at 90 days average. The total height of main shoot of five observational plants was recorded in centimeter from ground level to tip of main shoot and averaged to per plant.

- Number of branches per plant.

Number of branches per plant was recorded by counting branches arising from the main shoot of the observational plants in each treatment and averaged to per plant.

- Number of leaves per plant.
- Leaf area (cm^2) per plant was determined in mid-season for each sample by the disk method (Bermner and Taha, 1960).
- Total chlorophyll using soil plant analysis development (SPAD): as SPAD units using "Minolta (chlorophyll meter) SPAD-502 (Yadava, 1986).

(B) Yield and yield Components

- **Days spanned to the first flowering**

Number of days taken from sowing to the first flower opening on each observational plant was recorded and average number of days to first flower was worked out.

- **Pod weight (g)**

In each plot, ten pods were used for recording diameter and length. The pods weight were recorded, then divided by ten and resultant value was expressed as mean weight of pod (g).

- **Pod diameter (cm)**

The diameter of ten randomly selected pods at edible maturity stage at mid pod length from five observational plants were recorded with Vernier calliper and mean value was recorded as diameter of pod (cm).

- **Pod length (cm)**

The pods used for computing diameter were used to record length as well. The length was recorded with help of scale and then average pod length was determined.

- **Number of pods per plant**

Total number of edible green pods on each of the five selected plants was counted at edible pod maturity stage and average was worked out.

- **Weight of pods per plant (g/plant)**

Weight of edible green pods per plant on each of the five selected plants were counted and average weight of green pods per plant was worked out per treatment.

- **Yield (kg/fed)**

Total yield weight (kg/ fed) was estimated as the weight of all harvested pods/ plant for each treatment).

Chemical composition:

The NPK percentages were determined in the dry leaves and pods. Their dry weights were determined following drying in a drying oven to a constant weight at 75^{o}C for 72 hour according to Tandon (1995). After dryness, the plant samples were milled and stored for analysis as reported. However, 0.5g of the powder was wet-digested with H_2SO_4–H_2O_2 mixture (Lowther, 1980) and the following determinations were carried out in the digested solution to determine the following:

- Nitrogen percentage (N %)

Nitrogen % was determined in digested plant material colorimetrically by Nessler`s method (Chapman and Pratt, 1978). Nessler solution was as follows: (35 IK/100 ml d.w. + 20g $HgCl_2$ / 500 ml d.w.) +120 g NaOH / 250 ml d.w.). Reading was achieved using wave length of 420 nm and N was determined as percentage as follows:

% N = NH_4 % x 0.776485

- Phosphorus percentage (P %):

Phosphorus (%) was determined by the Vanadomolyate yellow methods given by Jackson (1973) and the intensity of color developed was read in spectrophotometer at wave length of 460nm.

- Potassium percentage (K %):

Potassium (%) was determined according to the method described by Jackson (1973) using Beckman Flame photometer.

- Protein (%)

Protein was determined by estimating the total nitrogen in the leaves and pods multiplied by 6.25 to obtain the percentage according to A.O.A.C. (1990).

Leave protein (%) = N (%) x 6.25

- **Mucilage content**:

One hundred milliliter of distilled water were added to 25g of sample and kept for 24h. The suspension was filtered through muslin close and 50 ml of ethanol added to the filtrate. It was stirred on the magnetic stirrer for 15 min and filtered through pre-weighed filter paper, and kept in the oven until drying. After drying the material, it was again weighed along with filter paper. Mucilage content was calculated using the formula of Rao and Sulladurath (1977)

Mucilage content (%) = $\frac{W2 - W1}{W}$

W2 is the weight of filter paper along with material after drying, W1 weight of pre-weighed filter paper, W weight of sample

Statistical Analysis

The statistical analysis of the collected data obtained from field experiment for all the characters was done by analysis of variance method for factorial experiment laid out in randomized complete block design as described by Panse and Sukhatme (1985). The data obtained from laboratory studies was analysed by using method for FCRD as described by Snedecor and Cocharan (1967).

RESULTS AND DISCUSSIONS

Vegetative growth characters:

Results presented in Table (2) showed that vegetative growth characters of okra plants were gradually, increased, significantly ($p \leq 0.05$) with foliar application a mixture of NAA+BA at 40 and 100 mg/l, respectively, during 2016 and 2017 seasons. In this respect, the foliar application of the given combination, resulted in the highest values of all studied vegetative growth characters as plant height (160.06 and 174.47 cm), number of branches/ plant

(6.01and 6.18), number of leaves per plant (46.03 and 48.04), leaf area (2671.05 and 3071.50 cm^2), total chlorophyll (50.89 and 58.77 SPAD unit), respectively, during both seasons compared with other treatments. On the other hand, the control treatment, gave the lowest mean values of vegetative growth characters as plant height (91.28 and 98.93 cm), number of branches/ plant (4.00 and 4.08), number of leaves per plant (28.06 and 30.04), leaf area (950.41 and 1111.91 cm^2), total chlorophyll (26.30 and 31.14 SPAD unit), during 2016 and 2017 seasons, respectively.

These findings probably taken place due to the mode of actions of either auxin or cytokinin on their combinations (especially at 40 mg/l NAA + 100 mg/l BA) on vegetative growth whereas both enhance a numerous of biosynthesis and metabolism activates. These results are similar to those obtained by Kumar and Sen (2005); Ismaeil (2006); Kokare *et al.* (2006); Patil *et al.* (2007); Prasad and Srihari (2008); Patil and Patil (2010); Jasmine and John (2012); Ravat and Makani (2015); Gadade *et al.* (2017), on okra.

Table (2). Averages of vegetative growth characters of okra "Lady's Fingers" cv. as affected by foliar application of BA, NAA and their combinations during both seasons of 2016 and 2017

Treatments		Plant height (cm)		Number of leaves		Number of branches		Leaf area (cm^2/plant)		Total chlorophyll (unit SPAD)	
		2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Plant growth regulators											
A) NA (mg/l)											
0		98.65c	116.68d	31.80d	33.33d	4.39c	4.55d	1297.67c	1518.12d	31.02d	37.67d
10		114.77b	122.90c	39.29c	41.34c	4.41c	4.64c	1523.55b	1780.49c	35.25c	40.89c
20		131.64a	140.48b	39.64b	42.46b	5.06b	5.20b	1629.60b	2001.54b	40.05b	46.22a
40		139.04a	150.00a	42.24a	43.57a	5.26a	5.26a	1978.58a	2301.61a	48.05a	44.56b
B) BA (mg/l)											
0		104.61c	113.26d	35.05d	37.29d	4.31d	4.57d	1159.52d	1356.33b	32.72d	37.85c
25		116.50bc	125.80c	36.15c	37.35c	4.64c	4.72c	1431.06c	1674.67c	36.36c	42.56b
50		120.83b	139.78b	41.21a	42.92b	4.83b	4.83b	1748.59b	2045.35d	40.39b	43.79a
100		142.16a	151.20a	40.55b	43.14a	5.35a	5.53a	2089.84a	2525.21a	44.89a	45.14ab
Interaction effect (AXB)											
0	0	91.28f	98.93f	28.06 c	30.04b	4.00c	4.08c	950.41l	1111.91p	26.30l	31.14f
	25	101.42e	109.93e	31.07 b	32.05b	4.28c	4.54c	1173.35j	1372.73n	29.22k	38.43de
	50	78.72g	122.14e	36.04 b	37.99b	4.16c	4.25c	1372.36g	1605.51k	32.47i	38.43de
	100	123.19e	135.71d	32.03 b	33.23b	5.12b	5.34b	1694.56d	1982.29g	36.08g	42.70bcd
10	0	98.28f	104.95e	36.00 b	39.04b	4.10c	4.70c	1079.18l	1262.67o	29.89k	35.38ef
	25	108.67e	116.46e	35.06 b	37.04b	4.17c	4.24c	1332.41i	1558.82l	33.21i	39.31de
	50	120.25e	129.40e	42.02 a	43.10a	4.21c	4.33c	1646.59f	1924.41h	36.90g	40.35cde
	100	131.90d	140.78c	44.08a	46.19a	5.17b	5.30b	2036.01c	2376.04d	41.00d	48.33ab
20	0	110.59e	121.97e	38.06b	40.00a	4.85c	5.02b	1213.28k	1419.35m	33.97j	40.21cde
	25	124.33e	135.52d	38.43b	40.51a	5.27b	5.24b	1497.78h	1752.54i	37.74h	42.87bcd
	50	138.15d	150.58b	42.00a	44.21a	5.04b	5.23b	1849.61e	2163.54e	41.92e	46.64bc
	100	153.50b	153.86b	40.07a	45.10a	5.08b	5.32b	1957.73b	2670.97b	46.59b	55.16a
40	0	118.30e	127.19e	38.10b	40.07a	4.27c	4.47c	1395.20j	1632.19j	40.74h	44.68bcd
	25	131.59d	141.32c	40.03a	39.82b	4.84c	4.88c	1722.29g	2014.84f	45.27f	49.64ab
	50	146.21c	157.02b	44.80a	46.37a	4.92b	5.50b	2125.77d	2487.90c	50.30c	55.16a
	100	160.06a	174.47a	46.03a	48.04a	6.01a	6.18a	2671.05a	3071.50a	50.89a	28.77f
Interaction AXB		**ns**	**ns**	**	**	**	**	**ns**	**	**	**

Average values having the same letter (s) are significant at 0.05 level of probability.
* *: Significantly different at 0.01 level of probability.
ns: not significant

B. Yield and yield components

Results in Table (3) exhibited that the yield and its components of okra plants gradually increased significantly ($p \leq 0.05$) with foliar application a mixture of NAA +BA at 40 and 100 mg/l, respectively, during 2016 and 2017 seasons. In this respect, the foliar application of the given combination; resulted in the highest mean values of all studied characters as number of days to flowering (30.06 and 36.07 days), pod length (9.85 and 10.74 cm), pod diameter (2.28 and 2.48 cm), pod weight (8.91 and 9.15 g), number of pods per plant (32.67 and 34.71), weight of pod/plant (291.04 and 317.76 g), yield (7567.32 and 8261.77 kg/fed.), respectively, during both seasons compared to other treatments. On the other side, the control treatment, gave the lowest mean values of the yield and its components of okra plants i.e. number of days to flowering (38.41 and 35.78 days), pod length (3.66 and 3.99 cm), pod diameter (1.20 and 1.31 cm), pod weight (5.42 and 5.16 g), number of pods per plant (28.69 and 29.77) weight of pod/plant (155.68 and 153.69 kg), yield (4047.84 and 3996.07 kg/fed.), during 2016 and 2017 seasons, respectively.

These results could be attributed to the favorite combination of both auxin and cytokinin on signal transduction via cell membrane and affecting biosynthetic pathways which reflect on assimilates partitioning of okras yield and its components (George and Shemington, 2008).

These results are similar, more or less, to those obtained by Kumar and Sen (2005); Ismaeil (2006); Kokare *et al.* (2006); Patil *et al.* (2007); Prasad and Srihari (2008); Patil and Patil (2010); Jasmine and John (2012); Ravat and Makani (2015); Gadade *et al.* (2017) on okra.

Rawat *et al.* (2002) indicated that usage of plant growth regulator has contributed significant increase of the yield and quality of vegetables. Napthalene acetic acid (NAA) is an important plant growth regulator, which tends to encourage the vegetative growth and increase yield of chilies. Singh *et al.* (1999) found that foliar application of the plant growth regulators as GA and NAA encouraged vegetative growth, pod characters and ultimate seed yield per okra plant.

Table (3). Number of days to flowering, yield and yield components of okra "Ladys Fingers" cv. as affected by foliar application of BA, NAA and their combinations during both seasons of 2016 and 2017.

Treatments		Number of days to flowering		Pod length (cm)		Pod diameter (cm)		Pod weight (g)		Number of pods/plant	
		2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
A) NAA (mg/l)											
0		39.44a	42.20a	4.32d	4.71d	1.42d	1.55d	6.36d	6.06d	27.36b	28.72c
10		33.51b	35.64b	5.38c	5.87c	1.60c	1.70c	6.99c	7.21c	26.75b	27.72d
20		29.77bc	31.81c	6.75b	7.36b	1.73b	1.88b	7.94b	7.66b	29.83a	30.14b
40		28.97c	31.01d	8.47a	9.23a	1.96a	2.13a	7.40a	8.34a	30.68a	31.96a
B) BA (mg/l)											
0		32.20a	29.81d	5.28d	5.76d	1.42d	1.55d	6.41d	6.80d	28.06b	28.37c
25		32.36a	33.31c	5.87c	6.40c	1.58c	1.72c	6.91c	6.91c	27.37b	28.27c
50		33.04a	36.81b	6.52b	7.11b	1.75b	1.91b	7.52b	7.45b	29.85a	30.76b
100		34.08a	40.90a	7.25a	7.90a	1.95a	2.12a	7.85a	8.11a	29.35a	31.13a
Interaction effect (AXB)											
0	0	38.41a	35.78g	3.66k	3.99l	1.20h	1.31h	5.42c	5.16e	28.69b	29.77b
	25	38.80a	39.75d	4.07j	4.43k	1.34g	1.46g	6.17c	6.00d	25.89b	26.03b
	50	39.63a	44.18b	4.52i	4.93j	1.49f	1.62f	7.66b	6.15d	23.13b	28.98b
	100	40.90a	49.08a	5.02h	5.48i	1.65e	1.80e	6.20c	6.96d	31.71a	30.08a
10	0	33.16a	30.22j	4.56i	4.98j	1.35g	1.47g	6.75c	7.96c	22.30b	21.78c
	25	32.83a	33.58h	5.07h	5.53i	1.50f	1.64f	6.28c	6.03d	27.51b	27.96b
	50	33.50a	37.31e	5.63g	6.14h	1.67e	1.82e	7.02b	6.92d	31.04a	32.09a
	100	34.54a	41.45c	6.26f	6.82g	1.86c	2.03c	7.93b	7.92c	26.17b	29.06b
20	0	29.04a	26.98l	5.72g	6.24h	1.46f	1.60f	6.54c	7.06c	35.33a	33.89a
	25	29.31a	29.97jk	6.36f	6.93g	1.63e	1.77e	7.14b	7.29c	26.94b	27.00b
	50	29.91a	33.31hi	7.08e	7.70f	1.81d	1.97d	7.55b	7.88c	30.19a	28.98b
	100	30.84a	37.01ef	7.85d	8.56d	2.01b	2.19b	8.37a	8.43b	26.87b	30.68a
40	0	28.21a	26.29l	7.18e	7.83e	1.66e	1.81e	6.93c	7.02c	25.91b	28.05b
	25	28.50a	29.22k	7.93c	8.70c	1.84cd	2.01cd	8.05a	8.33b	29.12b	32.09a
	50	29.12a	32.46i	8.87b	9.66b	2.05b	2.23b	7.87b	8.87b	35.12a	33.00a
	100	30.06a	36.07fg	9.85a	10.74a	2.28a	2.48a	8.91a	9.15a	32.67a	34.71a
Interaction AXB		**ns**	**	**	**	**	**	**	**	**	**

Average values having the same letter (s) are significant at 0.05 level of probability.
* *: Significantly different at 0.01 level of probability.
ns: not significant

To be Cont…

Treatments		Weight of pods/plant (g/plant)		Yield (kg/fed)	
		2016	2017	2016	2017
A) NAA (mg/l)					
0		172.34d	174.40d	3584.90d	3627.20d
10		187.20c	198.69c	3893.96c	4932.04c
20		219.14b	231.15b	4558.24b	4808.01b
40		245.34a	268.85a	5103.22a	5592.20a
B) BA (mg/l)					
0		179.21c	190.93d	3727.74c	3971.53d
25		188.92b	197.36c	3950.41b	4105.26c
50		224.84a	230.50b	4676.89a	4794.55b
100		230.05a	254.29a	4785.28a	5289.39a
Interaction effect (AXB)					
0	0	155.68g	153.69j	3238.27d	3196.85f
	25	159.78g	156.19j	3326.70d	3248.79e
	50	177.31f	178.36h	3688.28d	3709.96e
	100	196.61f	209.37f	4089.53c	4355.12d
10	0	150.56g	173.46h	3131.82e	3607.99e
	25	172.72f	168.82i	3592.67d	3511.51e
	50	217.90e	222.21f	4532.46c	4622.10d
	100	207.63e	230.27e	4318.88c	4789.73d
20	0	230.97c	239.50e	4804.32b	4981.74c
	25	192.52f	196.87g	4004.54c	4095.06d
	50	228.13d	228.45f	4744.42c	4751.96d
	100	224.94d	259.77d	4678.85c	5403.28c
40	0	179.63f	197.09g	3736.53d	4099.53d
	25	234.65c	267.57c	4880.92b	5565.66c
	50	276.03b	292.98b	5741.58a	6094.17b
	100	291.04a	317.76a	6053.85a	6609.41a
Interaction AXB		**	**	**	**

Average values having the same letter (s) are significant at 0.05 level of probability.
* *: Significantly different at 0.01 level of probability.

B) Chemical composition

Results presented in Table (4) showed similar performance as reported earlier, whereas, foliar application with similar combination NAA at 40 mg/l +BA at 100 mg/l significantly ($p \leq 0.05$) increased all chemical composition of okra plants during both seasons of the study.

Foliar application of the above-mentioned mixture, brought about the maximum mean values of the concentrations of N (2.92 and 3.18 %), P (0.77 and 0.79 %), K (2.91 and 3.17 %), protein percentage (18.28 and 19.91 %), and mucilage percentage (5.30 and 5.42 %) of the pods during both seasons of the study, As for the contents of leaves N, P and K during 2016 and 2017 seasons, were (3.99 and 4.71 %), (0.36 and 0.40 %) and (3.58 and 3.90 %), consecutively.

On the other hand, control treatment gave the minimum mean values of the concentrations of N (1.62 and 1.77 %), P (0.35 and 0.38 %), K (1.83 and 1.99 %), protein percentage (10.12 and 11.08 %), and mucilage percentage (2.79 and 2.84 %) for pods, respectively, during both seasons, while in leaves, the concentrations of N (2.33 and 2.54 %), P (0.19 and 0.20 %), K (1.34 and 1.46 %), during 2016 and 2017 seasons, each in turn.

Such findings could be attributed to the stimulatory effects of both tested growth regulator and their best combination on cell division and enlargement which lead to promote leaf area, then photosynthetic activities and assimilation formation, which distribute for reproductive and productive activities to take place (George and Shirrengton, 2008). Also, the increase in pod yield and its components could be taken place due to the vigorous of the plants owing to the made of actions of both applied growth regulators on modulating of endogenous plant hormones and activate of enzymes involved in different biosynthetic pathways, which control and enhance plant growth and development (Ghoname *et al.,* 2007).

Similar results were reported by Ramesh and Thirumurugan (2001), Patil *et al.* (2002), El-Abagy *et al*. (2003) and Gad (2005).

On conclusion, combination NAA at 40 mg/l +BA at 100 mg/l significantly gave the best results on the all chemical composition of okra plants compared the other treatments and control such as (NPK % in fruit and leaves, protein % and mucilage percentage.

Table (4). Percentages of chemical composition of pods of okra "Lady's Fingers" cv. as affected by foliar application of BA, NAA and their combinations during both seasons of 2016 and 2017

Treatments		Concentrations on edible pods								Mucilage (%)	
		N (%)		P (%)		K (%)		Protein (%)			
		2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Plant growth regulators											
A) NAA (mg/l)											
0		1.91d	2.09d	0.42d	0.45d	2.16c	2.35d	11.97d	13.07d	3.29d	3.36c
10		2.14c	2.33c	0.52c	056c	2.26 b	2.46c	13.94c	14.43c	3.61c	3.15d
20		2.29b	2.50b	0.59b	0.63b	2.27b	2.55b	14.29b	15.65b	4.10b	4.25b
40		2.51a	2.73a	0.66a	0.68a	2.50a	2.72a	15.70a	17.12a	4.55a	4.66a
B) BA (mg/l)											
0		1.87d	2.04d	0.47d	0.49d	1.94d	2.14d	11.73d	12.81d	3.30d	3.26d
25		2.08c	2.27c	0.51c	0.55c	2.16c	2.38c	12.99c	14.23c	3.66c	3.63c
50		2.32b	2.53b	0.57b	0.61b	2.40b	2.64b	14.50b	15.65b	4.07b	4.03b
100		2.58a	2.81a	0.64a	0.68a	2.70a	2.94a	16.13a	17.57a	4.53a	4.49a
Interaction effect (AXB)											
0	0	1.62l	1.77 i	0.35g	0.38i	1.83g	1.99m	10.12k	11.08i	2.79k	2.84jk
	25	1.80k	1.97k	0.39g	0.42hi	2.03ef	2.21j	11.28j	12.31h	3.10i	3.16hij
	50	2.00i	2.19i	0. 44f	0.47gh	2.26d	2.46g	12.55h	13.68g	3.45g	3.52fgh
	100	2.23g	2.43g	0.49e	0.53fg	2.51c	2.74d	13.95f	15.20e	3.84e	3.91ef
10	0	1.81k	1.98k	0.44f	0.48gh	1.92fg	2.09l	11.34j	12.37h	3.06j	2.67k
	25	2.02i	2.20i	0.49e	0.53fg	2.13e	2.32i	12.61h	13.75g	3.40h	2.97ijk
	50	2.24g	2.44g	0.55d	0.59def	2.37d	2.58f	14.01f	14.61f	3.78f	3.30ghi
	100	2.49d	2.71d	0.61c	0.66cd	2.63bc	2.87c	15.60d	16.97c	4.21d	3.67efg
20	0	1.94j	2.12j	0.52de	0.53fg	1.90g	2.16k	12.14i	13.27g	3.47g	3.59efg
	25	2.16h	2.36h	0.54d	0.59def	2.11e	2.41h	13.30g	14.74ef	3.86e	3.99de
	50	2.40e	2.62e	0.61c	0.66cd	2.35d	2.67e	15.01e	16.38d	4.29c	4.44c
	100	2.67b	2.91b	0.68b	0.74ab	2.73b	2.97b	16.70b	18.20b	4.77b	4.97b
40	0	2.13h	2.32h	0.56d	0.57ef	2.12e	2.31i	13.31g	14.51f	3.86e	3.95e
	25	2.36f	2.58f	0.63c	0.64de	2.35d	2.56f	14.78e	16.13d	4.29c	4.39cd
	50	2.63c	2.86c	0.69b	0.71bc	2.62bc	2.85c	16.43c	17.92b	4.77b	4.88b
	100	2.92a	3.18a	0.77a	0.79a	2.91a	3.17a	18.28a	19.91a	5.30a	5.42a
Interaction AXB		**	**	**	ns	**ns**	ns	**	**	**	ns

Average values having the same letter (s) are significant at 0.05 level of probability.
* *: Significantly different at 0.01 level of probability.
ns: not significant

Table (5). Percentages of chemical composition of leaves of okra "Lady's Fingers" cv. as affected by foliar application of BA, NAA and their combinations during both seasons of 2016 and 2017

Treatments		Concentrations in leaves					
		N (%)		P (%)		K (%)	
		2016	2017	2016	2017	2016	2017
Plant growth regulators							
A) NAA (mg/l)							
0		2.75c	3.00d	0.22d	0.25d	1.58d	1.72d
10		3.00b	3.27c	0.25c	0.27c	1.97c	2.15c
20		3.31a	3.61b	0.26b	0.30b	2.46b	2.68b
40		3.43a	4.05a	0.31a	0.34a	3.07a	3.35a
B) BA (mg/l)							
0		2.64d	2.98d	0.22d	0.24d	1.92d	2.10d
25		2.94c	3.28c	0.25c	0.28c	2.14c	2.33c
50		3.27b	3.64b	0.28b	0.30b	2.38b	2.59b
100		3.63a	4.05a	0.31a	0.34a	2.65a	2.88a
Interaction effect (AXB)							
0	0	2.33h	2.54j	0.19l	0.20j	1.34j	1.46j
	25	2.94gh	2.82h	0.21k	0.25i	1.49i	1.62i
	50	2.88efg	3.14f	0.23i	0.25h	1.66h	1.80h
	100	3.20cdef	3.49d	0.26g	0.28g	1.84g	2.01g
10	0	3.54gh	2.77i	0.21j	0.23f	1.67h	1.83h
	25	2.82efg	3.08g	0.24h	0.26e	1.86g	2.03g
	50	3.14def	3.42e	0.26f	0.29d	2.07f	2.25f
	100	3.49bcd	3.80c	0.29d	0.32c	2.30e	2.51e
20	0	2.81fg	3.70g	0.23i	0.25e	2.09f	2.28f
	25	3.12def	3.40e	0.26g	0.28d	2.32e	2.58e
	50	3.47bcd	3.78c	0.29e	0.32c	2.58d	2.81d
	100	3.86ab	4.20b	0.32c	0.35b	2.87c	3.13c
40	0	2.90efg	3.43e	0.26f	0.29d	2.60d	2.84d
	25	2.23cde	3.82c	0.29d	0.32c	2.89c	3.15c
	50	3.59abc	4.24b	0.33b	0.36b	3.22b	3.51b
	100	3.99a	4.71a	0.36a	0.40a	3.58a	3.90a
Interaction AXB		**ns**	**	**	**	**	**

Average values having the same letter (s) are significant at 0.05 level of probability.
* *: Significantly different at 0.01 level of probability.
ns: not significant

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الملخص العربي

تقييم الرش الورقي ببعض منظمات النمو علي المحصول وجودة الثمار لنباتات الباميا

[١]مرفت ربيع هاشم عسكر [٢]على ابراهيم على حسن عبيدو [٣]سامح عبد المنعم عبد الله [٢]علي عدنان عوض جبل

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الباميه هي محصول تجاري ومتعدد الأستخدامات وتنتمي للعائلة الخبازية إلا أن إنتاجية هذا المحصول الهام مازالت محدودة علي الرغم من الأدبيات المرجعية المنشورة عن تأثير بعض منظمات النمو النباتية إلا أن الرش بالسيتوكنينات مع الأوكسينات سواء منفردة أو في توليفات لم يتم دراستها بتوسع ولذلك أجريت تجربتان حقليتان في مزرعة خاصة بحوش عيسي– البحيرة– مصر، أثناء الموسمين المتتاليين ٢٠١٦ وكذلك ٢٠١٧ لتقييم الفعل التأثيري لكل من السيتوكنين (البنزيل أدينين) والأوكسين (نفتالين حمض الخليك) سواء منفردة أو في توليفات علي النمو (الصفات المورفولوجية والفسيولوجية) والإنتاج وجودة (الحالة التغذوية) للباميا، صنف ليديز فينجر. كانت التجارب قد نفذت كتجارب عاملية في قطاعات عشوائية كاملة بوجود ١٦ معاملة كرر كل منها ثلاث مرات. وكانت مستويات الأوكسين نفتالين حمض الخليك المستخدمة (صفر (كنترول)، ١٠، ٢٠، ٤٠ ملجم/لتر)، السيتوكنين (البنزيل أدينين) المستخدمة (صفر (كنترول)، ٢٥، ٥٠، ١٠٠ ملجم/لتر) مع توليفاتها. تم تحليل البيانات التي تم جمعها بإستخدام تحليل التباين بمساعدة حزمة الجينستات ٥) وكانت الفروق بين المتوسطات قد حددت بإستخدام طريقة أقل فرق معنوي (عند مستوي إحتمال 0.05). وأشارت النتائج المتحصل عليها أن الإنتاج ومكوناته، بصفة عامة، تزداد نتيجة الرش بتوليفة بين ٤٠ ملجم/لتر من الأوكسين نفتالين حمض الخليك + ١٠٠ ملجم/لتر من

السيتوكنين (البنزيل أدينين) مقارنة مع المعاملات الآخري ومعاملة الكنترول أثناء موسمي الزراعة ٢٠١٦ وكذلك ٢٠١٧ مثل (طول القرن، القطر والوزن، عدد الأيام حتي أول تزهير، عدد القرون /نبات، ووزن القرون /نبات، الإنتاج (كجم/فدان)، أثناء موسمي الزراعة. كما أدت نفس المعاملة رشا إلي زيادة معنوية في المكونات الكيماوية لنباتات البامية، مثل (النيتروجين ، الفوسفور البوتاسيوم، (كنسبة مئوية) والنسبة المئوية للمادة المخاطية أثناء موسمي الزراعة. وأنه لمن الممكن أن نخلص إلي أن التوليفة سابق الإشارة إليها من كلا من الأوكسين و السيتوكنين يمكن أن ينصح بها لمزارعي البامية لزيادة وتعزيز سلوك النمو للبامية صنف ليديز فينجر.