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INTERACTION EFFECTS OF BA AND/OR PIX ON SOYBEAN PLANTS:
2. CHANGES IN YIELD CHARACTERISTICS AND QUALITY.

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ABSTRACT

This study aimed to investigate the effect of foliar application of benzyladenine "BA", Pix (both at 25, 50 and 100 ppm) and the interaction between them on flower abscission, yield and yield components as well as chemical constituents of yielded seeds (carbohydrate, protein, oil contents and its fatty acids composition).

The obtained results revealed that there is a marked improvement in flower number and yield characteristics via the increase in pod number and decrease in shedding percentage and consequently seed number, seed yield, seeds weight per plant and 100-seeds weight as a result of foliar BA and/or Pix application of soybean plant in the two growing seasons. The interaction treatments were more potent than the use of each growth regulator alone, especially 50 ppm BA + 50 ppm Pix in most parameters.

The results of the present investigation revealed also that, the different treatments increased the concentration of nitrogen, potassium, phosphorus, calcium and magnesium in soybean yielded seeds as compared with the control. In addition, total soluble sugars, polysaccharides as well as total carbohydrate, protein and oil percentage of the harvested seeds of different treated soybean plants increased significantly. The most effective treatment including the highest carbohydrate and oil concentrations is the mixture of 50 ppm of both BA and Pix, while the highest protein content was observed in response to 50 ppm BA + 25 ppm Pix.

The BA and/or Pix treatments improved the fatty acids composition of soybean seed's oil, A marked increase in the levels of unsaturated fatty acids (oleic, linolenic, eicosenoic, erucic and nervonic), while linoleic was decreased. In the meantime, there was an increase in the detectable saturated fatty acids with all treatments.

Keywords: Soybean, BA, Pix, interaction, yield, minerals, protein, carbohydrate, oil and fatty acid.

INTRODUCTION

Soybean plant is considered as one of the most important summer legume in the world because it is a source of oil and protein (Jones and Luchsinger, 1987). It has manifold uses, i.e. it is an important aid to agriculture, available commercial crop, a good feed for livestock and the source of numerous raw materials for use in industry. Soybean flour with a low carbohydrate and high protein content is an excellent food for diabetics, the milk for infants as well as the oil for cooking (Caldwell *et al.*, 1973).

Mostly the main purpose of using the bio-regulators on plants is directed to yield increase or improvement. On soybean, numerous investigators recommended the use of cytokinins to improve the yield and yield components (El-Etr, 2000; Ramesh *et al.*, 2001 and El-Abagy *et al.*, 2003). Essa (1999) found that kinetin increased flower characters (number of flowers, flower diameter and pedicel of flower) and fresh and dry weights of Baccara and Eiffel Tower rose cvs. Shehata et al. (2001) on maize plant sprayed with kinetin found a significant increase in the reproductive characters (number of ears, ear weight and weight of 100-grains).

In accord with the effect of Pix on yield parameters, Gu and Gu(1998) and Wasnik and Bagga, (1996) found that the number of pods per plant, pod weight, seed weight per plant were increased due to Pix application on soybean and of chickpea plants. It is interesting to mention that there is an additive effect using a mixture of two growth regulators such as promalin (Kumar et al., 2003 and Sadak, 2005) they found that promalin (GA+BA) achieved a significant increase of tomato and Roselle yield, respectively. Pan et al. (1989) indicated that the foliar BA application stimulated the transaction of mineral nutrients (K, Ca, Mg and P) to shoot lateral branches and consequently the seeds of soybean plants. Also, Wyszkowska (1999) on faba bean illustrated that BA treatments increased seed's phosphorus content. Regarding the mineral elements, treating plants with Pix increased their levels in cotton plants (Zhang et al., 1990).

Several investigators confirmed the potent role of BA and/or Pix on carbohydrates content. The BA foliar application induced an increase of total carbohydrates in different plants such as soybean (Mostafa et al., 1993) and on roselle (Sadak, 2005). Protein concentration of different plants increased markedly due to BA application (Patil et al., 2002 and El-Abagy et al., 2003). Meanwhile, using Pix on soybean (El-Shahaby et al., 1994) and on cotton (Sawan et al., 2001) increased their protein content.

Regarding oil and fatty acids composition of the yielded oil seeds, Mostafa et al. (1993) on soybean and Sadak (2005) on Roselle plants found that cytokinins increased oil percentage. Meanwhile, Pix treatments increased the seed oil content of different plants (Sawan et al., 2001 on cotton and Abdel-Aziz, 2002 on *Origanum majorana*).

This work was designed to investigate the possible effects of BA and/or Pix on yield, yield components and chemical composition of soybean seeds.

MATERIALS AND METHODS

Two pot experiments were carried out in the green house of Botany Department, National Research Center, Dokki, Giza, Egypt, during two growing successive seasons (2000 and 2001) to study the effect of foliar application of benzyladenine (BA) and/or mepiquat chloride (Pix) on the yield and chemical composition of soybean yielded seeds.

A homogenous lot of soybean seeds (*Glycine max* L. Merr.) were selected and thoroughly washed with continuous tap water for a limited period (30 minutes) then dried and sown after inoculation with Okadin (*Rhizobium japonicum*) on the 15[th] of May 2000 and 2001 in pots 30 cm. diameter. The pots contained equal amounts of soil (7 kg from mixture of clay and sand 2:1 w/w, respectively). A phosphorous fertilizer in the form of triple superphosphate (5 g) was added to each pot. Ten seeds were sown in each pot and the irrigation was carried out according to the usual practice by adding equal amounts of water. After twelve days from sowing, thinning was performed, where five uniformed seedlings were left for experimentation in each pot. The plants were exposed to normal day length and natural illumination. The pots were divided to Sixteen sets each of 8 pots. The experiment was performed as a complete randomized design with 8 replicates. BA and Pix were used as foliar application each in four concentrations (0, 25, 50 and 100 ppm) alone or in combination. The plants of each treatment were sprayed three times. The foliar spray was carried out after thirty days, forty five days and sixty days from sowing throughout the two successive seasons (2000 and 2001).

Sampling date and collecting data:

I- Yield and yield components:

At harvesting time (120 days from sowing in the two seasons) ten plants from each treatment were randomly chosen for estimating the following characters: number of pods/plant, seed number/plant, pod weight (g) plant, seed yield (g)/ plant and weight of 100-seeds (g).

II- Chemical constituents in the seeds:

Total nitrogen was determined by using the modified micro-kjeldahl method of Peach and Tracey (1966). Phosphorus was determined according to the method described by Chapman and Pratt (1978). Potassium was determined using Eppendorp flame photometer B700 E. according to the method described by Cottenie *et al.* (1982). Calcium, magnesium and iron were determined by using the atomic absorption spectrophotometer (PMO$_3$ Zeiss) by Cottenie *et al.* (1982).

Extraction procedure of carbohydrate fractions was carried out according to Younis (1963). Total soluble sugars were determined according to Bell (1955). Meanwhile, the polysaccharides were determined according to Younis (1963).

Determination of amino nitrogen was done according to the method described by Muting and Kaiser (1963) and total soluble nitrogen fractions and total nitrogen according to Pirie (1955). The subtraction of the total soluble-N from total-N gave the value for protein-N, in which it multiplied by 6.25 (factor) to give the crude protein percentage.

The method adopted for extraction and determination of the oil content as described by Meara (1957). The fatty acids were converted to methyl esters according to Sink *et al.* (1964). The fatty acid methyl esters were infected into a Gas liquid chromatography. (6 feet x 1/8 inch internal diameter column packed with 20% diethylene glycol succinate on chromosorb 60-80 mech).

III- Statistical analysis:

Data were statistically analyzed according to Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

I-Flower shedding and yield parameters:

The presented data (Table, 1) show that BA and/or Pix application at all their assigned concentrations induced significant increases in flowers and pods number/plant in both seasons and decreased the flower shedding percentage as compared with the control. The highest number of flowers was obtained in response to BA or Pix each at 50 ppm. Concerning the interaction effect between BA and Pix, the data also showed that flowers and pods number/plant gave the highest values compared with the use of each one alone.

The reduction of shedding percentage, in comparison to the control, interestingly, was in parallel with the applied concentrations of BA or Pix in both seasons. It is well observed that the interaction treatments were more effective than the single treatment of either BA or Pix where the most potent treatment in reducing shedding % was 50 ppm BA + 50 ppm Pix. In this respect, Essa (1999) and Cho *et al.* (2002) found that kinetin significantly increased flower characters (number and flower diameter, pedicel of flower, fresh and dry weights) of rose and soybean plants, respectively.

The increments in flowers and pod numbers of soybean plants as a result of Pix treatments could be explained by Gaber *et al.* (1993) soybean plants and Chandrabu *et al.* (1995) on groundnut who found that Pix increased the flowers number, number of mature pods and pods yield and decreased the number of immature pods/plant. Meanwhile, the interaction effect can be confirmed by Dawh (1989) who found that GA_3 combined with CCC increased flowers number, flowers fresh and dry weights, flower stalk length and flowers / leaf ratio of *Cineraria hybrida*. Also, Kassem and Namich (2003) stated that GA_3+Pix increased the total number of flowers and number of open bolls in addition to the reduction of shedding percentage leading to a significant increase in cotton yield and its seeds.

Generally, the available results (Table, 1) indicated that the foliar sprayed plants with BA exhibited an insignificant increase in the seed number/plant, meanwhile a higher significant increase in response to 50 and 100 ppm BA regarding, seed yield, pods weight/plant and weight of 100 seeds of was obtained. These results are in accordance with those obtained by Nagel *et al.* (2001) on soybean and El-Abagy *et al.* (2003) on faba bean who indicated that the sprayed plants with BA showed a marked increase in the number of pods/plant, weight of pods/plant, seed index, seed and straw yield/plant and the biological yield. The later authors added also that the highest value was recorded at 50 ppm BA over the control plants. The increase in yield attributes could be due to an increase in the rate of assimilates transport from the source to the developing seeds and a decrease in the abortion of reproductive organs. This possibility is supported by the findings of Vijay and Laxmi (2001) who explained that 40 ppm BA enhanced the mobilization of reserves from leaf and stem towards pod and this process enhanced the seed yield due to the increases in number of pods, number of seeds/pod and 100 seeds weight of mungbean plants.

Concerning the effect of Pix on yield components, it is clear from Table (1) that Pix at all concentrations improved the quantity of soybean yield compared with untreated plants. The most pronounced increases in the yield parameters (Seed yield, pods weight/plant and weight of 100 seeds) were obtained with 50 ppm Pix. In this connection, in study on cotton plant; Prasad *et al.* (2000) found that Pix increased number of sympodia, % of flowers and bolls retention, earliness percentage, number of open bolls, boll weight, lint percentage, seed index and seed cotton yield .

Table (1): Yield and its components of soybean plants as affected by BA and/or Pix treatments. Mean of the two growing seasons(2000 and 2001).

Treatments (ppm) BA	Pix	Flowers number/ Plant	Pods number /Plant	Shedding %	Seeds number/ plant	Seeds yield /plant (g)	Pods weight /plant (g)	weight of 100-seeds (g)
Control		48.9	27.1	44.5	96.6	9.4	13.4	9.6
25	0	49.5	28.6	42.2	99.9	10.9	16.7	10.7
50	0	51.9	30.1	42.0	102.3	13.0	18.6	12.3
100	0	51.0	31.7	38.1	102.0	12.9	18.0	12.3
0	25	51.6	30.2	41.5	103.2	12.7	17.1	12.0
0	50	57.9	35.0	39.5	111.9	15.8	19.9	13.9
0	100	54.1	32.7	39.6	112.5	14.0	19.2	12.3
25	25	53.3	30.5	42.7	106.8	13.9	16.7	12.6
25	50	61.5	36.8	40.2	122.1	17.4	20.7	14.1
25	100	56.9	34.7	39.0	116.1	15.2	19.8	12.9
50	25	55.3	31.9	42.2	110.4	15.7	19.9	13.8
50	50	60.1	38.2	36.1	135.0	20.9	22.4	15.4
50	100	56.7	35.4	37.6	118.8	15.9	21.1	13.2
100	25	56.1	31.3	44.2	100.5	13.6	19.8	12.5
100	50	56.8	35.5	37.1	118.8	15.4	21.2	12.7
100	100	54.9	33.5	38.7	114.0	13.3	19.9	11.4
L.S.D at		0.05 0.01	0.05 0.01	0.05 0.01	0.05 0.01	0.05 0.01	0.05 0.01	0.05 0.01
for BA or Pix		1.2 1.9	1.1 1.6	1.0 1.6	8.0 10.7	0.9 1.2	1.7 2.3	0.8 1.0
for BA x Pix		2.4 3.8	2.3 3.3	2.1 3.2	16.1 21.4	1.8 2.4	3.4 4.6	1.6 2.1

The increase in the yield due to interaction effects was confirmed by several authors (Wasnik and Bagga, 1996 and Zaky *et al.* 1999) who indicated that the higher levels of chlorophylls in Pix treated plant provided the higher production of photosynthates and consequently increased the yield of chickpea plant. Also, the work of Oosterhuis *et al.* (1998) reported that Pix and Pix plus *Bacillus cereus* improved, especially in presence of *Bacillus cereus*, leaf photosynthesis and dry matter as well as the translocation of photo-assimilates from leaves to fruits and led to increase the yield. It is worthy to mention that the combined effects of BA + Pix were additive on yield components. Bondok *et al.* (1991) found that the number of flowers, number of bolls and seed cotton yield increased in response to promalin treatment than the use of GA_3 or BA alone.

II- Chemical composition of seeds:

II-1. Mineral elements:

Concerning benzyladenine foliar spray, available results (Table, 2) indicated that nitrogen, phosphorus, potassium, calcium and magnesium concentration in the seeds of plants treated with BA showed; in general; a significant increases as compared with control. The highest values in potassium, calcium and magnesium were recorded in response to 50 ppm BA foliar application. These stimulatory effects of BA treatments on the mineral concentrations in soybean seeds were confirmed by several investigators, (Shahin, 1999 and Ibrahim *et al.*, 2001). These induced increments in nitrogen, phosphorus and potassium could be due to BA effect on the movement of nutrients in the plant tissues. In this respect, Pan *et al.* (1989)

indicated that foliar application at BA stimulated the translocation of mineral nutrients (potassium, calcium, magnesium and phosphorus) to shoot lateral branches and consequently to the seeds of soybean plants. Also, WyszKowska (1999) on faba bean plants showed that BA increased the uptake of nitrogen, phosphorus, potassium, sodium, calcium and magnesium.

The effect of Pix treatments (25, 50 and 100 ppm) induced a significant increase in the concentrations of all determined mineral elements, except for magnesium in response to 50 and 100 ppm which showed a significant reduction. In this respect, Albuquergue *et al.* (2000) on grape and Abdel-Aziz (2002) on *Origanum majorana* found generally that Pix treatments resulted in greater concentrations of calcium, potassium, nitrogen and phosphorus.

Table (2): Effect of BA and/or Pix treatments on minerals concentration in the yielded seeds of the soybean plants during 2001 season.

Treatments (ppm)		Mineral (g/100g d. wt.)				
		N	P	K	Ca	Mg
Control		5.14	0.22	2.14	0.13	0.37
BA	Pix					
25	0	5.95	0.25	2.24	0.38	0.42
50	0	5.10	0.23	2.65	0.40	0.43
100	0	4.92	0.23	2.27	0.22	0.27
0	25	5.82	0.24	2.18	0.39	0.47
0	50	5.82	0.23	2.39	0.31	0.27
0	100	5.70	0.23	2.18	0.31	0.25
25	25	5.95	0.25	2.28	0.41	0.40
25	50	5.90	0.25	1.93	0.40	0.37
25	100	5.78	0.23	1.70	0.30	0.30
50	25	6.42	0.25	2.60	0.47	0.47
50	50	5.82	0.28	2.50	0.45	0.35
50	100	5.46	0.25	2.00	0.30	0.27
100	25	5.60	0.24	2.51	0.44	0.32
100	50	5.58	0.20	2.35	0.38	0.17
100	100	5.40	0.27	2.28	0.38	0.16
L.S.D at		0.05 0.01	0.05 0.01	0.05 0.01	0.05 0.01	0.05 0.01
for BA or Pix		0.4 0.6	0.006 0.008	0.13 0.17	0.05 0.06	0.04 0.05
for BA x Pix		0.8 1.1	0.012 0.016	0.25 0.34	0.09 0.12	0.07 0.10

Concerning the interaction effect, spraying soybean plant with all treatments of BA + Pix caused, in general, a significant increase in nitrogen, phosphorus and calcium concentrations of the yielded seeds. Meanwhile, the concentrations of potassium and magnesium due to all concentrations of BA + 50 or 100 ppm Pix showed a significant decrease. The influence of BA and Pix on the mechanism of ions uptake might be related to their effect of membrane permeability and the rate of ion entry through the membrane and enhancement of their translocation to the shoot and consequently to fruits (Steveninck, 1976). Furthermore, Kinelin altered the membrane composition (Merillon *et al.*, 1993) and increased membrane fluidity (Vodnik *et al.*, 1999). Similar results were obtained by Abdel-Aziz (2002) who found that the interaction between Pix and BA (100 or 200 ppm Pix + 20 or 40 ppm BA) on *Origanum majorana* caused marked increases in the concentrations of nitrogen, phosphorus and potassium in 1st, 2nd and 3rd cut than the use of each growth regulator alone.

II 2. Carbohydrates concentration:

The reported results of BA and/or Pix (Table, 3) on carbohydrates concentrations (total soluble sugars, polysaccharides and total carbohydrates) of soybean yielded seeds showed clearly that different applied treatments induced significant increases in all carbohydrate fractions. The most pronounced increase was elicited in response to 50 ppm BA + 50 ppm Pix compared with the control plants and the usage of individual growth regulator. A similar pattern of BA (cytokinins) effect was reported by Sitohy and Sharaf (1986) and Mansour *et al.* (1988) on safflower and wheat plants, respectively. In this regard the early study of Mothes (1964) suggested that cytokinin (kinetin) could be considered one of the major growth regulators which play an important role in the filling of storage organs (seeds and tubers). Also, Asthir *et al.* (1998) stated that kinetin stimulated the activity of enzymes participating in the synthesis of polysaccharides at the expense of simple carbohydrates (mono and disaccharides). Meanwhile, El-Shahaby *et al.* (1994) on soybean seeds observed that Pix increased the reducing sugar, polysacharide as well as total carbohydrates concentrations.

As regard to the effect of BA + Pix interaction, it is clear from (Table, 3) that there is a much more increases in carbohydrate fractions of yielded seeds. This synergetic effect may be attributed to the effect of BA in combination with Pix in increasing the photosynthetic activity and consequently more synthesis of sugars and increases the mobilization of sugars to fruits of soybean plants. Similar conclusion was reported by Bondok *et al.* (1991) on cotton and Sadak (2005) on roselle plants.

Table (3): Effect of BA and/or Pix treatments on chemical composition of the yielded seeds of soybean plants during 2001 season.

Treatments (ppm)		Carbohydrates (mg/g d. wt.)			Protein g/100g d. wt.	Oil %
		Total Soluble Sugar	Poly-saccharides	Total carbohydrates		
Control		15.1	249.7	264.8	32.0	20.80
BA	Pix					
25	0	19.9	262.2	282.1	37.5	21.3
50	0	20.9	287.5	308.5	31.0	22.9
100	0	18.7	272.9	291.7	30.6	21.63
0	25	18.3	265.6	283.9	36.3	21.33
0	50	20.8	287.7	308.5	36.3	23.7
0	100	17.7	268.0	285.7	35.6	24.3
25	25	22.0	275.6	297.6	37.5	22.1
25	50	23.7	290.2	314.0	36.9	24.4
25	100	22.6	283.1	305.7	38.3	24.1
50	25	22.0	291.9	314.0	40.0	23.1
50	50	26.2	305.0	331.2	36.9	26.3
50	100	24.0	283.3	307.3	34.1	24.0
100	25	20.8	282.2	303.0	35.0	23.7
100	50	24.7	303.8	328.5	35.0	25.2
100	100	23.9	274.6	298.5	33.8	23.2
L.S.D. at		0.05 0.01	0.05 0.01	0.05 0.01	0.05 0.01	0.05 0.01
for BA or Pix		1.6 2.2	18.3 25.2	12.9 18.3	2.2 3.0	1.2 1.8
for BA x Pix		3.2 4.4	36.5 50.3	25.2 39.3	4.3 6.0	2.3 3.6

II-3. Protein percentage:

Concerning the foliar application of BA on the protein percentage of soybean yielded seeds (Table, 3), the available results indicated that under the effect of low concentration of BA (25 ppm) the protein percentage was increased markedly in soybean seeds. On the other hand, 50 and 100 ppm BA induced a significant decrease. This pattern of effect may be attributed to the effect of BA on the proteolytic activity. Similar results were obtained by Patil *et al.* (2002) on soybean since they found that BA increased the concentration of protein percentage.

Regarding the use of Pix alone on protein percentage there was a highly significant increase. The maximum value was recorded in response to 25 or 50 ppm Pix (36.3%) compared with control (32.0%). Similar results were obtained by El-Shahaby *et al.* (1994) on soybean and Sawan *et al.* (2001) on cotton who found that there is a gradual increase in the seed of protein content as a result of different doses of Pix application.

Concerning the effect of BA combined with Pix on seed protein, there is a positive effect observed on protein content of seeds (Table 3) and the most pronounced effect was observed in response to 50 ppm BA + 25 ppm Pix. These increases may be attributed to the effect of these growth regulators treatments on the incorporation of amino acids into protein and/or translocation of the soluble nitrogen to developing fruits. In this respect, Abdel-Hamid (1997) and Sawan *et al.* (2001) using different plants recorded pronounced increases in protein content due to BA or Pix applications, respectively. This could be also explained by the suggestion of Hopkins and Hüner (2004) that BA and/or Pix application act as activators of RNA and protein synthesis.

II-4. Oil percentage:

Regarding the effect of BA and/or Pix on soybean seed oil, the obtained results (Table, 3) showed that these treatments increased significantly the oil percentage. The highest oil percentage was recorded in response to 50 ppm of both BA + Pix as compared with control. The observed increments in oil percentage in response to BA doses were in agreement with the results obtained by Youssef and Talaat (1998) on lavender and Patil *et al.* (2002) on soybean. Also, the recent study of Sudria *et al.* (2001) showed that BA increased the content of essential oils by 150% with respect to the control of *Lavandula dentata* plantlets.

The remarkable increase in the oil percentage of soybean seeds in response to Pix treatments was in harmony with the result obtained by El-Shahaby *et al.* (1994), Sawan *et al.* (2001) on cotton. The study of Abdel-Aziz (2002) found that the different concentrations of Pix increased significantly the seed oil content of *Origanum majorana*. The increase in essential oil content as a result of the use of Pix might be due to its capability of preventing the hydrolytic breakdown of oil naturally occurring in the plants (Shive and Sisler 1976).

5. Fatty acids composition of soybean oil:

The results of the gas chromatographic analysis of the methyl esters of fatty acids in yielded soybean seeds presented in (Table, 4).

Table (4): Effect of BA and/or Pix treatments on the percentage of fatty acids composition of the soybean seeds oil during 2001 season.

Treatments (ppm)		Heptanoic	Caprylic	Capric	Lauric	Myristoic	Pentadecamic	Palmitic	Stearic	Arachidic acid	Tricosanoic	Lignoceric	Oleic	Linoleic	Linolenic	Eicosenoic	Eerutic	Nervonic	Saturated	Unsaturated
		C7:0	C8:0	C10:0	C12:0	C14:0	C15:0	C16:0	C18:0	C20:0	C23:0	C24:0	C18:1	C18:2	C18:3	C20:1	C22:1	C24:1		
Control		0.04	0.16	0.02	0.11	0.12	0.04	11.43	0.41	0.93	0.45	0.95	17.09	47.54	3.96	0.08	0.47	1.05	14.66	70.19
BA	Pix																			
25	0	0.05	0.40	0.51	0.05	0.03	0.27	8.62	1.05	1.33	0.44	4.26	18.35	31.64	3.97	0.48	2.12	2.05	17.21	58.61
50	0	0.06	0.49	0.06	0.06	0.69	0.05	12.98	1.79	0.53	0.48	3.16	22.95	39.21	5.37	1.79	2.49	1.05	20.35	72.86
100	0	0.02	0.10	0.02	0.02	0.11	0.04	9.65	1.23	0.58	0.32	3.16	11.67	39.21	6.16	0.19	1.03	1.04	15.20	59.30
0	25	-	0.29	0.03	0.12	0.44	0.02	11.69	1.11	1.18	0.47	4.23	15.76	31.48	4.89	0.45	1.70	1.77	19.58	56.05
0	50	0.06	0.38	0.08	0.18	0.89	0.04	11.74	1.39	1.75	0.55	4.99	23.92	40.14	5.38	0.14	1.38	1.65	22.04	72.61
0	100	0.03	0.09	0.02	0.12	0.06	0.03	11.42	0.94	0.91	0.63	5.40	21.62	39.82	6.74	0.29	1.02	1.14	19.74	70.83
25	25	0.05	0.35	0.06	0.13	0.13	0.03	9.77	0.99	1.33	0.49	3.92	17.96	42.67	4.66	0.40	1.29	2.04	17.25	69.02
25	50	0.06	0.48	0.08	0.16	0.91	0.02	9.88	0.60	1.29	0.52	3.57	20.91	32.33	6.19	0.59	1.82	2.19	17.57	64.03
25	100	0.05	0.43	0.06	0.13	0.61	0.02	9.81	0.57	1.42	0.45	2.82	16.67	28.39	4.06	0.47	1.97	1.43	16.38	52.99
50	25	-	0.04	0.03	0.07	0.04	0.02	19.13	1.18	0.81	0.51	4.67	13.03	28.36	4.52	0.26	0.86	1.36	26.50	48.39
50	50	-	0.04	0.08	0.09	0.08	0.02	9.92	1.79	1.18	0.66	7.86	16.13	39.29	6.15	0.38	1.09	1.96	21.72	65.00
50	100	0.03	0.29	0.03	0.11	0.11	0.05	12.04	1.69	0.21	0.55	3.01	20.57	50.02	7.35	0.09	0.94	0.64	18.12	80.21
100	25	0.03	0.19	0.11	-	0.15	-	12.79	1.78	0.35	0.11	3.21	22.14	45.68	4.55	0.07	1.27	0.81	18.72	75.13
100	50	0.42	0.44	0.09	0.19	0.35	0.06	11.47	1.07	0.35	0.17	4.68	23.04	38.45	5.58	0.11	1.59	1.58	19.29	70.35
100	100	0.03	0.35	0.04	0.19	0.12	0.06	10.33	1.13	1.01	0.51	4.65	15.42	34.12	5.06	0.13	1.48	1.83	18.42	58.04

The present data showed that the predominant unsaturated fatty acids of seed's oil was Linoleic (47.54%) followed by Oleic (17.09%). While the predominant saturated fatty acids was Palmitic acid (11.43%).

The foliar spray of soybean plants with different concentrations of BA and/or Pix, in general, induced a marked increases in the levels of unsaturated fatty acids; Oleic ($c_{18:1}$), Linolenic ($c_{18:3}$), Eicosenoic ($c_{20:1}$), Erucic ($c_{22:1}$), Nervonic ($c_{24:1}$), except for Linoleic ($c_{18:2}$) which showed a remarkable reduction. . In the meantime, the saturated fatty acids (Arachidic ($c_{20:0}$), Tricosanoic ($c_{23:0}$), Lignoceric ($c_{24:0}$) also induced a marked increase in response to BA and/or Pix. The other detectable saturated fatty acids of soybean seed's oil were Heptanoic, Caprylic, Capric, Lauric, Myristic, Peladconic and Stearic, which are constitute the minor fatty acids in the methyl esters, showed a variable changes as compared with the control under the effect of BA and/or Pix applications. The total saturated fatty acids showed a marked increase in response to BA and/or Pix of soybean methyl ester. Also, due to 50 ppm BA, 50 or 100 ppm Pix and 50 ppm BA + 100 ppm Pix and 100 ppm BA + 25 ppm Pix treatments the total unsaturated fatty acids were markedly increased, while with other treatments they were decreased.

Regarding BA effect, the results are quite similar to those obtained by Ahmed *et al.* (1988) on soybean and safflower and Sadak (2005) on Roselle plants since they found that kinetin play a role in fatty acids synthesis, de-saturation and chain elongation reactions. In this respect, Ibrahim *et al.* (2001) found that kinetin treatment increased unsaturated fatty acids on the account of saturated fatty acids in *Helianthus annuus* yielded seeds.

In addition, Abdel Rehim *et al.* (2000) reported that kinetin gave the high percentage of unsaturated fatty acids and proved the efficiency of de-saturation in Datura seeds. Moreover, it may play a role in fatty acid's synthesis, de-saturation and chain elongation reactions. The effects on individual fatty acids varied between cultivars and treatments (Baricevic, 1996). El-Kobasy (1999) confirmed that kinetin treatments increased the true protein which included enzymes at biosynthetic and de-saturation pathways of fatty acids metabolism.

With regard to the effect of Pix, the results are in harmony with those obtained by Bruce (1990) who indicated that the growth retardants (Chloroflurenol, Pix, ancymidol and ethephon) decreased the content of Linoleic and Linolenic acids in soybean oil. Also, Abdel Rehim *et al.* (2000) found that alar caused an increase in the percentage of Capric, Laurfic, Myristolic, Stearic, Palmitic Linolic and Oleic acids while the percentage of Linolic was significantly decreased in datura seed oil. Similar results were recorded by Abd El-Dayem and El-Deeb (2000) and Sawan *et al.* (2001).

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تأثيرات تداخل البنزيل أدنين و/أو البكس على نبات فول الصويا:
٢- التغير في خصائص المحصول وجودته

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يهدف هذا البحث إلى دراسة تأثير الرش بالبنزيل أدنين والبكس بتركيزات مختلفة (٢٥ ، ٥٠ ، ١٠٠ جزء فى المليون) لكل منهما منفردا وأيضا تداخل كل منهما مع الآخر على نبات فول الصويا من حيث عدد الأزهار وكذلك المحصول ومكوناته وأيضا المكونات الكيميائية للبذور الناتجة من كربوهيدرات وبروتين وزيت وكذلك الأحماض الدهنية المشبعة وغير المشبعة في زيت البذور.

أوضحت النتائج أن استخدام كلا من البنزيل أدنين والبكس منفردا أو معا قد أدى إلى زيادة معنوية في عدد الأزهار وعدد القرون وأيضا عدد ووزن البذور الناتجة ووزن ١٠٠ بذرة وكذلك نقص ملحوظ في نسبة تساقط الأزهار ، وكانت أفضل النتائج المتحصل عليها في هذا الشأن عندما عوملت النباتات بكل منهما معا (معاملات التداخل) بصفة عامة وبالمعاملة بـ ٥٠ جزء في المليون من كل من البنزيل أدنين + البكس بصفة خاصة وذلك في معظم القياسات مقارنة باستخدام أى من المركبين منفرداً.

كما أوضحت نتائج هذه الدراسة أيضا أن المعاملات التجريبية المختلفة أدت إلى زيادة تركيز عناصر النتروجين والبوتاسيوم والفوسفور والكالسيوم والماغنيسيوم فى بذور النباتات المعاملة مقارنة بمثيلاتها في النباتات غير المعاملة. كما زاد أيضا و بدرجة معنوية تركيز كل من السكريات الذائبة الكلية والسكريات العديدة وكذلك النسبة المئوية للبروتين و الزيت فى بذور النباتات المعاملة، وكانت المعاملة الأكثر تأثيرا في إعطاء نسبة أعلى من الكربوهيدرات والزيت هي الرش بـ ٥٠ جزء في المليون من كلا المركبين معا ، بينما كان أعلى تركيز للبروتين فيبذور النباتات المعاملة بـ ٥٠ + ٢٥ جزء في المليون من البنزيل أدنين + البكس على الترتيب.علاوة على ذلك فقد تحسن محتوى زيت البذور من الأحماض الدهنية حيث أوضحت نتائج GLC زيادة ملحوظة في مستوى الأحماض الدهنية غير المشبعة (الأوليك ، اللينولينيك، الإيكوزينويك، الإيروسيك ، والترتونيك) ، بينما انخفض مستوى اللينوليك. وفي نفس الوقت كانت هنالك زيادة محسوسة في مستوى الأحماض الدهنية المشبعة نتيجة لجميع التركيزات المستخدمة من البنزيل أدنين و/أو البكس.