

INTERACTION EFFECTS OF BA AND/OR PIX ON SOYBEAN PLANTS:

2. CHANGES IN YIELD CHARACTERISTICS AND QUALITY.

Abd El-Dayem, H.M.M.**; Amany A. Ramadan*; H.A.M. Mostafa*; A.L. Wanas** and Mervat S.H. Gad*

* Botany Department, National Research Center, Dokki, Giza, Egypt.

** Agric. Bot. Dept., Fac. of Agric. Moshtohor, Banha branch, Zagazig Univ.

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, chemical analysis 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 successive 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 element content (nitrogen, potassium, phosphorus, calcium and magnesium) of soybean yielded seeds as compared with 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 ($P < 0.05$). The most effective treatment including the highest carbohydrate and oil contents 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 and invalide and the oil for human 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 these yield parameters on cotton plant (Sawan *et al.*, 2001) and on soybean (Gu and Gu, 1998). The number of pods per plant, pod weight, seed weight per plant increased due to Pix application of chick pea plants (Wasnik and Bagga, 1996). 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, Wyszowska (1999) on *Vicia faba* illustrated that BA treatments increased seed's phosphorus content. Regarding the mineral contents, 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; on soybean (Mostafa *et al.*, 1993) and on Roselle (Sadak, 2005). Protein content of different plants increased markedly due to BA application (Patil *et al.*, 2002 and El-Abagy *et al.*, 2003). Meanwhile, using Pix (El-Shahaby *et al.*, 1994 on soybean and Sawan *et al.*, 2001 on cotton) increased protein its 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 (2000-2001) 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 15th 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).

Yield and yield components:

At harvest (120 days after sowing in the two seasons) ten randomly plants from each treatment were taken 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).

Chemical analysis of 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 (PMO₃ 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 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 injected 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).

Statistical analysis:

Data were statistically analyzed according to Snedecor and Cochran (1980). Means compared by L.S.D. test at significant probability level of 0.05 and 0.01.

RESULTS AND DISCUSSION

Flowers, shedding and yield parameters:

The presented data (Table 1) show that BA and/or Pix applications at all their concentrations induced significant increases in flowers and pods number/plant in both seasons and decreased the shedding %as compared with the control. The maximum values of flower were 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 value compared with the use of each one alone.

The reduction of shedding percentage, in comparison to the control, interestingly, was decreased (in general) with the increase of the applied concentration 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 as a result of Pix treatment of soybean plants 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 GA₃ 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 GA₃+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 led to insignificant increase in seed number but a higher significant increase in response to 50 and 100 ppm BA regarding, seed yield, pods weight/plant and weight of 100 seeds of soybean plant. 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 reproduction 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 these processes enhanced the seed yield due to the increases in number of pods, number of seeds/pod and 100 seed 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 observed due to 50 ppm Pix. In this connection, in studies on cotton plant; numerous authors 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 (Prasad *et al.*, 2000).

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

Treatments (ppm)		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
BA 25 50 100	Pix 0	49.5	28.6	42.2	99.9	10.9	16.7	10.7
		51.9	30.1	42.0	102.3	13.0	18.6	12.3
		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
	50	57.9	35.0	39.5	111.9	15.8	19.9	13.9
	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	18.7	12.6
	50	61.5	36.8	40.2	122.1	17.4	20.7	14.1
	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	60.1	38.2	36.1	135.0	20.9	22.4	15.4
	100	56.7	35.4	37.6	118.8	15.9	21.1	13.2
100	25	56.1	31.3	44.2	106.5	13.6	19.8	12.5
	50	56.8	35.5	37.1	118.8	15.4	21.2	12.7
	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 conformed by several authors (Wasnik and Bagga, 1996 and Zaky *et al.* 1999) who indicated that the higher levels of chlorophyll content in Pix treated plant provided the higher production of photosynthetic 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 and the translocation of photo-assimilates from leaves to fruit 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 GA₃ or BA alone.

Chemical composition of seeds:

1. Minerals content:

Concerning benzyladenine foliar spray, available results (Table 2) indicated that nitrogen, phosphorus, potassium, calcium and magnesium contents of soybean seeds 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 contents of 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 within 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 *Vicia faba* 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 regarding all mineral contents, except for magnesium content in response to 50 and 100 ppm which showed a significant reduction. In this respect, Albuquerque et al. (2000) on grape and Abdel-Aziz (2002) on *Origanum majorana* found generally that Pix treatments resulted in greater concentration of calcium, potassium, nitrogen and phosphorus.

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

Treatments (ppm)		Mineral content %									
		N	P	K	Ca	Mg					
Control		5.14	0.22	2.14	0.13	0.37					
BA	Pix										
25		5.95	0.25	2.24	0.38	0.42					
50	0	5.10	0.23	2.65	0.40	0.43					
100		4.92	0.23	2.27	0.22	0.27					
	25	5.82	0.24	2.18	0.39	0.47					
0	50	5.82	0.23	2.39	0.31	0.27					
	100	5.70	0.23	2.18	0.31	0.26					
	25	5.95	0.25	2.26	0.41	0.40					
25	50	5.90	0.25	1.93	0.40	0.37					
	100	5.78	0.23	1.70	0.30	0.30					
	25	6.42	0.25	2.60	0.47	0.47					
50	50	5.82	0.28	2.50	0.45	0.35					
	100	5.46	0.25	2.00	0.30	0.27					
	25	5.60	0.24	2.51	0.44	0.32					
100	50	5.58	0.29	2.35	0.38	0.17					
	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				
for BA or Pix		0.4	0.6	0.036	0.008	0.13	0.17	0.35	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 contents of the yielded seeds. Meanwhile, the contents 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 may be related to their effect of membrane permeability and the rate of ion entry through the membrane of enhance their translocation to the shoot and consequently to fruit (Van Steveninck, 1976). Furthermore, Kinetin 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 content of nitrogen, phosphorus and potassium in 1st, 2nd and 3rd cut than the use of each growth regulator alone.

2. Carbohydrates content:

The reported results of BA and/or Pix (Table 3) on carbohydrates contents (total soluble sugar, polysaccharide and total carbohydrates) of soybean yielded seeds showed clearly that BA foliar applications 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 cytokinins (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, polysaccharide as well as total carbohydrates contents.

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 fruit 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 the soybean plants during 2001 season.

Treatments (ppm)		Carbohydrates (mg/100g dry weight)						Protein mg/100g dry weight	Oil Contents %
		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		31.9	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
	50	20.8		287.7		308.5		36.3	23.7
	100	17.7		268.0		285.7		35.6	24.3
25	25	22.0		275.6		297.6		37.5	22.1
	50	23.7		290.2		314.0		36.9	24.4
	100	22.6		283.1		305.7		36.3	24.1
50	25	22.0		291.9		314.0		40.0	23.1
	50	26.2		305.0		331.2		36.9	26.3
	100	24.0		283.3		307.3		34.1	24.0
100	25	20.8		282.2		303.0		35.0	23.7
	50	24.7		303.8		328.5		35.0	25.2
	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
for BA or Pix		1.6	2.2	18.3	25.2	12.9	18.3	2.2	3.0
for BA x Pix		3.2	4.4	36.5	50.3	25.2	39.3	4.3	6.0

3. Protein content:

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 content was increased markedly in soybean seed. 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 content.

Regarding the use of Pix alone on protein content 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 protein content in seeds 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 hormonal 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) who stated that BA and/or Pix application act as activators of RNA and protein synthesis.

4. Oil Content:

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 content. The highest oil content was recorded in response to 50 ppm of both BA + Pix as compared with control. The observed increments in oil content 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. They attributed the obtained increments, as a result of foliar application of BA. 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 content 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 may be due to its capability of preventing the hydrolytic break down 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 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 oil during 2001 season.

Treatments (ppm)	Heptanoic		Caprylic		Capric		Lauric		Myristolic		Pentadecami:		Palmitic		Stearic		Arachidic acid		Tricosanoic		Lignoceric		Oleic		Linoleic		Linolenic		Eicosenoic		Eeritic		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	C24:1	C24:1	C24:1	C24:1	C24:1	C24:1	C24:1	C24:1	C24:1	C24:1	C24:1	C24:1	C24:1	C24:1	C24:1	C24:1	C24:1	C24:1	C24:1	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																																								
25	0.05	0.40	0.51	0.05	0.03	0.27	8.82	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	0.06	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	0.02	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	-	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																					
50	0.06	0.38	0.08	0.18	0.88	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																					
100	0.03	0.09	0.02	0.12	0.06	0.03	11.42	0.94	0.91	0.63	5.49	21.82	39.82	6.74	0.29	1.02	1.14	19.74	70.83																					
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																					
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																					
100	0.05	0.43	0.06	0.13	0.61	0.02	9.81	0.57	1.42	0.46	2.82	16.67	28.39	4.06	0.47	1.97	1.43	16.38	52.99																					
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	-	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																					
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	50.62	7.35	0.09	0.94	0.64	18.12	80.21																					
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																					
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	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, Petadconic and Stearic, which 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 it was 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, desaturator and chain elongation reactions. In this respect, Ibrahim *et al.* (2001) found that kinetin treatment increased unsaturated fatty acids at the response 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 (Chloroflurcnol, 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, Lauric, Myristic, 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 البنزويل أدنين و/أو البكس على نبات فول الصويا:

٢- التغيير في خصائص المحصول وجودته

- حسني محمد عبد الدايم** ، أماني عبد المحسن رمضان* ، هشام عفيفي محمد مصطفى* ، أحمد لطفي ونس** ، ميرفت سيد حسنين جاد*
* قسم النبات ، المركز القومي للبحوث ، الدقي ، الجيزة ، مصر.
* قسم النبات الزراعي ، كلية الزراعة بمشتهر ، جامعة الزقازيق ، فرع بنها.

يهدف هذا البحث إلى دراسة تأثير الرش بالبنزويل أدنين والبكس بتركيزات مختلفة (٢٥ ، ٥٠ ، ١٠٠ جزء في المليون) لكل منهما منفرداً وأيضاً تفاعل كل منهما مع الآخر على نبات فول الصويا من حيث عدد الأزهار وكذلك على المحصول ومكوناته وأيضاً تحليل البذرة الناتجة لمحتواها من كربوهيدرات وبروتين وزيت وكذلك الأحماض الدهنية المشبعة وغير المشبعة في زيت البذور. أوضحت النتائج أن استخدام كلا من البنزويل أدنين والبكس منفرداً أو معاً قد أدى إلى زيادة معنوية في عدد الأزهار وعدد القرون وأيضاً عدد ووزن البذور الناتجة ووزن ١٠٠ بذرة وكذلك نقص ملحوظ في نسبة تساقط الأزهار ، وكانت أفضل النتائج عندما عوملت النباتات بكلا منهما معاً بصفة عامة وبالمعاملة بـ ٥٠ جزء في المليون من كل من البنزويل أدنين والبكس بصفة خاصة في معظم القياسات مقارنة باستخدام أي من المركبين منفرداً.

كما أوضحت نتائج هذه الدراسة أيضاً أن المعاملات التجريبية المختلفة رفعت محتوى البذور الناتجة من النتروجين والبيوتاسيوم والفوسفور والكالسيوم والماغنيسيوم مقارنة بمثيلاتها في النباتات غير المعاملة. كما إندادت بالمثل معنوية محتوى البذور من السكريات الذائبة الكلية والسكريات المعقدة والبروتين ونسبة الزيت، وكانت المعاملة الأكثر تأثيراً في إعطاء نسبة أعلى من الكربوهيدرات والزيت هي الرش بـ ٥٠ جزء في المليون من كلا المركبين معاً ، بينما كان أعلى تركيز للبروتين في المعاملة بـ ٥٠ + ٢٥ جزء في المليون من البنزويل أدنين + البكس على الترتيب. تحسن محتوى زيت البذور من الأحماض الدهنية حيث أوضحت نتائج GLC زيادة ملحوظة في مستوى الأحماض الدهنية غير المشبعة (الأوليك ، اللينولييك ، الإيكوزينويك ، الإيريوسيك ، والنرفونيك) ، بينما انخفض مستوى اللينولييك. وفي نفس الوقت كانت هناك زيادة محسوسة في مستوى الأحماض الدهنية المشبعة نتيجة لجميع التركيزات المستخدمة من البنزويل أدنين و/أو البكس.