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INFLUENCE OF PACLOBUTRAZOL FOLIAR SPRAYING ON GROWTH, FLOWERING AND SOME CHEMICAL CONSTITUTENTS OF SWEET PEA (*Lathyrus odoratus* L.) PLANTS

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ABSTRACT

The present investigation was conducted in the experimental area in Faculty of Agriculture, Fayoum, Cairo University in two successive seasons of 2003/2004 and 2004/2005. The objective of this study is to investigate the effect of paclobutrazol (PP_{333}) spraying at the rates of 10, 20 and 30 mg L^{-1} on growth, flowering and some chemical constituents of sweet pea (*Lathyrus odoratus* L.) plants. Appreciable effects of various treatments were observed on all the studied parameters during the two growing seasons. Spraying plants with PP_{333} at all rates decreased plant height, leaf area $leaf^{-1}$, leaf area $plant^{-1}$, fresh and dry weight of leaves and branches $plant^{-1}$, floral stalk length, fresh and dry weight $inflorescence^{-1}$ and $flower^{-1}$. On the other hand, No. of branches, leaves and inflorescences $plant^{-1}$ were increased in response to the treatment of PP_{333}.The flowering date as affected by PP_{333} spraying was delayed with respect to chemical constituents; leaf pigments (chlorophyll a, b and total as well as carotenoids), total soluble carbohydrates in leaves and flowers as well as anthocyanin concentration in flowers were increased. However, total free amino acids and total indoles in leaves were decreased by PP_{333} application. Additionally, the pronounced effect in the vegetative growth and flowering characters as well chemical constituents were obtained when the plants were sprayed with 30 mg L^{-1}. *Finally*, in the light of these results, it could be concluded that to produce showy flowering pot plants from sweet pea, the plants must be sprayed with paclobutrazol at the rate of 30 mg L^{-1}.

INTRODUCTION

Annual flowering plants are considered one of the main lines in landscape gardening. Sweet pea (*Lathyrus odoratus* L.) is one of these plants which has many daisy like flowers available in a wide range of colours and flower patterns, this makes it very showy flowering plant.

The production of potted plants may depends on controlling plant height and improving the other characteristics of plant such as flowering, flower number, plant colour and branching. Growth retardants may have an important role in controlling these characters and improve ornamental value of plants in order to be used as flowering pot plants (Ecke *et al.*, 1990; Martin *et al.*, 1994 and Matter, 2003).

Paclobutrazol (PP_{333}) is one of such substances which affects plant habit and development of many ornamental plant species and produced it as flowering pot plants. In this respect, Menesy *et al.* (1989) on *Senecio hybridus*, Salem *et al.* (1991) on *Gomphrena globosa* L., El-Sallami (2001) on poinsettia and Matter (2003) on *Althaea rosea* L., confirmed that PP_{333} as a

growth retardant had a great effect on growth, flowering and chemical constituents of plants and producing compact plants.

Thus, the present work aimed to study the effect of paclobutrazol (PP_{333}) spraying at different rates on growth, flowering and some chemical constituents of sweet pea (*Lathyrus odoratus* L.) plants.

Keywords:Sweet pea, paclobutrazol, growth, flowering, chemicalconstituents

MATERIAL AND METHODS

A pot trial was conducted during two successive seasons; 2003/2004 and 2004/2005 in the experimental area in the Faculty of Agriculture, Fayoum, Cairo University, Egypt. It aimed to study the influence of PP_{333} foliar application on growth, flowering and some chemical constituents of sweet pea plants. Seeds of sweet pea were sown on 18th September for both seasons in 30 cm diameter clay pots filled with loamy clay soil (3 seeds for each pot). The physical and chemical properties of used soil as analyzed by the standard procedures of Klute (1986) and Page *et al.* (1982) are shown in Table (1).

Table (1): Physical and chemical properties of the tested soil before sowing for both seasons.

Property	2003/2004	2004/2005
Physical:		
Clay%	21.6	22.1
Silt%	42.9	40.2
Sand%	35.5	37.7
Soil texture	Loamy clay	Loamy clay
Chemical:		
pH (1: 2.5)	7.4	7.6
ECe ($dS.m^{-1}$)	1.55	1.72
Total N (mg $100^{-1}g$)	54.26	57.11
Organic matter%	1.02	1.16
Soluble cations (mg L^{-1}):		
K^+	0.25	0.31
Na^+	7.20	7.57
Ca^{++}	14.30	15.03
Soluble anions (mg L^{-1}):		
SO_4^{--}	8.85	7.82
Cl^-	15.00	13.06
HCO_3^-	2.50	2.62

When the seedlings were in the fourth true leaf-stage (39 days after sowing), the plants were thinned for one plant each pot and were treated as follows:-

1- Control; untreated with PP_{333}, but sprayed with distilled water only.
2- Spraying with PP_{333} at the rate of 10 mg L^{-1}
3- Spraying with PP_{333} at the rate of 20 mg L^{-1}
4- Spraying with PP_{333} at the rate of 30 mg L^{-1}

In PP_{333} application, suspended paclobutrazol ±-(R*, R*)-β-[(4-chlorophyneyl)methyl]-α-(1,1-dimethyl)-1H-(1,2,4-triazol)-1-ethanol (Kamoutsis *et al.*, 1999) was diluted with distilled water to the rates of 10, 20 and 30 mg L^{-1} and sprayed on the plants to the run-off stage, three times. The first application was conducted when the plants had 4 true leaves (39 days from sowing) and second and third sprays were applied after 10 and 20 days from the first one, respectively. However, few drops of tween-20 (as a witting agent) were added to the spraying solution.

Recommended cultural practices for sweet pea were followed. A complete randomized block design with 3 replicates (10 pots replicate^{-1}) for each treatment was used. At the flowering stage, the following data were recorded.

I- Vegetative growth traits.

Plant height (cm), was recorded from pot-soil surface to the terminal growing- tip of the plant. Also, number of branches and leaves plant^{-1}, leaf area leaf^{-1}(cm^2), leaf area plant^{-1}(dm^2) were estimated. Fresh and dry weight of leaves and branches plant^{-1}(g) were also recorded

II- Flowering traits.

Flowering date (days); the number of days from sowing to the beginning of flowering of plants in each treatment, number of flowers plant^{-1}; each 15 days from the starting of flowering till the end of experiment for each treatment (226 days from sowing in the first season and 230 days from sowing in the second one), length of floral stalk (cm), fresh and dry weight inflorescence^{-1} and flower^{-1}(g) were recorded.

III- Chemical constituents.

Leaf pigments; chlorophyll a, b and total as well as carotenoids concentration (mg g^{-1} fresh weight of leaf) were determined using colorimetric method as described by Arnon (1949). Anthocyanin content (mg $100g^{-1}$ fresh weight of flowers) was colorimetrically determined according to Fuleki and Francis (1968). Total soluble carbohydrates content (%) were colorimetrically determined in dry matter of leaves and flowers using phenol-sulphoric acid reagent method as outlined by Dubois *et al.* (1956). Total free amino acids were colorimetrically determined as described by the method of Rosein (1957). Total indoles were colorimetrically determined by the method of Larson *et al.* (1962). The obtained data were statistically analyzed and comparisons among means of different treatments were performed using the Least Significant Differences procedure (LSD) at p=0.05 level as illustrated by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

I- The effect on vegetative growth.

1- Plant height

Data presented in Table (2) clearly show that, PP_{333} treatments at all concentrations (10, 20 and 30 mg L^{-1}) caused a significant reduction in plant height as compared to untreated plants (control). Such reduction was

gradually increased by increasing PP_{333} concentration in both seasons. The reduction (%) in the plant height (as shown in Table 2) in the first season was: 22.5%, 45.71% and 56.07% for 10, 20 and 30 mg L^{-1}, respectively. While, in the second season was: 28.4%, 40.84% and 59.77% for 10, 20 and 30 mg L^{-1}, respectively as compared with the control. The data revealed also that, the higher the rate of PP_{333} applied (30 mg L^{-1}), the greater the reduction was obtained. In this respect, the reduction in plant height induced by PP_{333} application might be explained on ground of the histological study conducted by Zhaoliang *et al.* (1995). They retrieved that the dwarfing effect of PP_{333} on the stature of the plant, arises as a result of decreasing cells length rather than number of cells. Changes in GA_S/ABA balance in PP_{333}- treated plants were probably responsible for the reduction in plant height (Wan *et al.*, 1989). Such result may be a direct reflection of its inhibitory effect on biosynthesis of GA_3 at the same enzymatic sites (Hedden and Greabe, 1984). Many investigators reported similar findings on different crops; Hammer and Kirk (1981), El-Masry and Barakat (1991) on potato, Ludolph (1992) on some ornamental plants. Lozoyasaldan (1994) on chrysanthemum, Mojecka and Kerin (1995) on pepper, Kamoutsis *et al.* (1999) on *Gardenia jasmoides* L., Osman (2000) and Nassar *et al.* (2001) on sweet pepper and Matter (2003) on hollyhock.

Table (2): Effect of PP_{333} on vegetative growth traits of sweet pea during 2003/2004 and 2004/2005 seasons.

Treatment	Plant height (cm)	No. of branches plant^{-1}	No. of leaves plant^{-1}	Leaf area leaf^{-1} (cm^2)	Leaves area plant^{-1} (dm^2)	Fresh wt. of leaves plant^{-1} (g)	Dry wt. of leaves plant^{-1} (g)	Fresh wt. of branches plant^{-1} (g)	Dry wt. of branches plant^{-1} (g)
				2003/2004					
Control	70.00	9.33	79.75	25.40	20.26	48.48	17.24	48.57	13.28
PP_{333}(ppm)									
10	45.25	11.00	101.50	16.11	16.35	40.51	13.55	42.27	10.06
20	38.00	13.00	135.50	10.02	13.57	35.24	11.82	37.10	7.89
30	30.75	16.67	178.01	5.11	9.09	26.14	7.76	32.88	5.13
$LSD_{0.05}$	**6.45**	**1.15**	**9.31**	**3.82**	**2.56**	**3.81**	**2.98**	**4.03**	**2.19**
				2004/2005					
Control	73.00	8.20	83.11	23.11	19.21	46.53	18.83	50.49	13.60
PP_{333}(ppm)									
10	50.12	11.14	117.15	13.18	15.44	41.98	14.91	47.25	11.16
20	43.19	15.11	146.21	8.07	11.79	32.32	10.77	41.08	8.18
30	29.37	18.03	181.15	5.33	9.65	27.14	8.32	36.93	6.34
$LSD_{0.05}$	**5.36**	**2.19**	**13.19**	**2.42**	**1.72**	**3.13**	**1.83**	**2.08**	**1.71**

2- Number of branches plant^{-1}

Paclobutrazol concentrations expressed a significant influence on number of branches plant^{-1} in both seasons (Table 2). Increasing PP_{333} concentration significantly increased number of branches plant^{-1} as compared with the control. The increase (%) in branches plant^{-1} in the first season was: 17.89(%), 39.39(%) and 78.67(%) for 10, 20 and 30 mg L^{-1}, respectively.

While, in the second one, the increase was: 35.85(%), 84.26(%) and 119.87(%), respectively as compared with the control. Generally, it could be concluded that increasing PP_{333} concentration associated with the gradual increase in number of branches plant^{-1}. These results may be due to that PP_{333} caused a stopping apical dominance phenomenon (Maus, 1987 on *Hibiscus* and Adham, 2001 on hollyhock).

3- Number of leaves plant^{-1}

As clearly shown in Table (2), spraying plants with PP_{333} at any concentration increased the number of leaves plant^{-1} over the control. The increases were significant in the two seasons as compared with the control. The increases (%) in the number of leaves plant^{-1} over the control were: 79.93%, 98.74% and 135.87% in the first season for 10, 20 and 30 mg L^{-1}, respectively and 77.05%, 127.66% and 143.17% in the second season for 10, 20 and 30 mg L^{-1}, respectively. Such increase in the number of leaves plant^{-1} might be attributed to the increase in the number of branches plant^{-1} which resulted from overcoming the apical dominance by PP_{333}. Similar results were obtained by Osman(2000) and Nassar *et al.* (2001) on sweet pepper and Adham (2001) and Matter (2003) on hollyhock.

4- Leaf area leaf^{-1}

Data presented in Table (2) elucidate the influence of PP_{333} concentration on leaf area leaf^{-1}. The application of PP_{333} treatments significantly decreased leaf area leaf^{-1} in both seasons as compared with the control. The leaf area leaf^{-1} was decreased by 8.35%, 51.65% and 83.46% in the first season by spraying with PP_{333} at the rates of 10, 20 and 30 mg L^{-1}, respectively. While in the second season, the decrease was: 17.48%, 42.97% and 73.47% for 10, 20 and 30 mg L^{-1}, respectively. In general, the leaf area leaf^{-1} was decreased with increasing the rate of PP_{333}. This reduction in leaf area leaf^{-1} in PP_{333}-treated plants may be due to the reduction in cell division (Helal, 1993 on *Euphorbia pulcherrima* L., Ruter, 1996 on *Lantana camara* L. and Nassar *et al.*, 2001 on sweet pepper).

5- Leaf area plant^{-1}

The results in Table (2) show that, the PP_{333} treatments affected leaf area plant^{-1} by the trend as in the leaf area leaf^{-1}in both seasons. However, the depressive effect of PP_{333} on leaf area plant^{-1}, clearly demonstrated that the enhancing effect of PP_{333} on number of leaves plant^{-1} was not able to overcome its depressive effect on leaf area. Latimer (1992) proved similar results on tomato and Helal (1993) on *Euphorbia pulcherrima*.

6- Fresh and dry weight leaf^{-1}

In both seasons, the treatments of PP_{333} significantly decreased the fresh and dry weight of the leaf as compared with the control (Table 2). The differences between PP_{333} concentrations were significant. The results show also that, the fresh and dry weight leaf^{-1} of PP_{333}-treated plants decreased with increasing the concentration of PP_{333}. However, the higher values of low PP_{333} concentrations (10 mg L^{-1}) as compared to the other ones (20 and 30 mgL^{-1}) could be discussed on the base that PP_{333}-treated plants at low

have higher content of dry matter than the higher concentrations (Steffens and Wang, 1984).On the other hand, the depressive effect at high concentrations of PP_{333} could be due to the drastic internal shading within the compacted canopy (Pombo *et al.*, 1985).

7- Fresh and dry weight of branches plant^{-1}

The obtained results in Table (2) show that all treatments of PP_{333} affected the fresh and dry weight of branches plant^{-1} by the trend as in the fresh and dry weight of leaves plant^{-1} in both seasons.

II- The effect on flowering.

1- Flowering date

Paclobutrazol concentrations imposed a significant influence on the number of days to flower in the two seasons with a similar trend in both (Table 3). Increasing PP_{333} concentration significantly delayed the flowering date as compared to the control. The higher rate of PP_{333} (30 mg L^{-1}) proved to be the most effective in this concern. The retarding effect of PP_{333} on flowering date could be related to the role of PP_{333} on delaying senescence of the vegetative organs preceding flowering (McArthur and Eaton, 1987) which probably attained due to the increase in nutrients acquisition. Such results are in accordance with those obtained by Nassar *et al.* (2001) on sweet pepper and Adham (2001) and Matter (2003) on hollyhock.

Table (3): Effect of PP_{333} on floral traits of sweet pea during 2003/2004 and 2004/2005 seasons.

Treatment	Date of flowering (days)	Length of floral stalk (cm)	Fresh wt.of inflorescence (g)	Dry wt.of inflorescence (g)	Fresh wt.of flower (g)	Dry wt.of flower (g)
			2003/2004			
Control	92	17.25	1.358	0.267	0.403	0.077
PP_{333}(ppm):						
10	97	13.50	1.275	0.220	0.315	0.058
20	102	11.63	1.122	0.196	0.302	0.044
30	121	9.13	0.800	0.143	0.288	0.030
$LSD_{0.05}$	**4**	**1.31**	**0.062**	**0.019**	**0.011**	**0.012**
			2004/2005			
Control	98	15.63	1.240	0.230	0.360	0.066
PP_{333}(ppm):						
10	106	12.25	1.160	0.190	0.310	0.051
20	119	10.13	0.940	0.157	0.214	0.040
30	125	9.01	0.687	0.119	0.182	0.026
$LSD_{0.05}$	**6**	**1.07**	**0.062**	**0.027**	**0.021**	**0.010**

2- Floral stalk length

Floral stalk length was significantly decreased by PP_{333} treatments in both seasons as compared with the control (Table 3). The shortest floral stalk was obtained from PP_{333} at the rate of 30 mg L^{-1}. The floral stalk length was decreased by 21.74%, 32.58% and 41.13% (in the first season) and decreased by 21.63%, 35.19% and 42.35% (in the second season) for 10, 20 and 30 mg L^{-1}, respectively, as compared with the control. The differences between PP_{333} concentrations were significant. Similar results were obtained by Selim and El-Khateeb (1988) on *Sencio cruentus* and Wang and Dunlap (1994) on *Hibiscus rosa-sinensis* L.

3-Fresh and dry weight inflorescence^{-1} and flower^{-1}

Data in Table (3) show that, PP_{333} treatments led to a significant decrease in fresh and dry weight inflorescence^{-1} as compared with the control in both seasons. Fresh and dry weight inflorescence^{-1} was decreased as the PP_{333} concentration increased in both seasons. The same trend was observed with fresh and dry weight flower^{-1}. The aforementioned data indicate that, the obvious effect of PP_{333} is to restrict the plant height as well as the increase in the number of inflorescences and consequently, the fresh and dry weight was decreased. These results are in harmony with that of Menesy *et al.* (1989) on cineraria and Matter (2003) on hollyhock.

4- Number of inflorescences plant^{-1}

Paclobutrazol concentrations exerted a significant effect on number of inflorescences plant^{-1} (Table 4). The trend was similar in both seasons. All concentrations of PP_{333} significantly increased the number of inflorescences plant^{-1} over control. Also, data show that the number of inflorescences plant^{-1} as affected by PP_{333} treatments progressively increased with advancing in plant age after the starting of flowering (15 days interval from flowering till the end of experiment in both seasons; 226 in the first season and 230 in the second one). In each season, the increase in the inflorescences plant^{-1} was parallel to the increment in PP_{333} rate with a significant only between the high studied rate (30 mg L^{-1}) and the other ones (10 and 20 mg L^{-1}). While, the differences between 10 and 20 mg L^{-1} was not significant. However, as compared with the control, No. of inflorescences plant^{-1} at the end of experiment was increased by 98.99%, 123.74% and 168.65% in the first season for 10, 20 and 30 mg L^{-1}, respectively, while, in the second season the increase was: 80.97%, 103.24% and 148.88% for 10, 20 and 30 mg L^{-1}, respectively. The positive effect of PP_{333} on the number of inflorescences plant^{-1} might be resulted from diversion of the assimilates into flower development, possibly due to the reduced demand by the roots (Wilknson and Richards, 1987). Also, these findings are in agreement with the results obtained by Nishizawa (1993) on strawberry, Osman (2000) and Nassar *et al.* (2001) on sweet pepper and Matter (2003) on hollyhock.

Table (4): Number of inflorescences 15 days^{-1} from the starting of flowering and total inflorescences plant^{-1} during 2003/2004and 2004/2005 seasons.

Treatment	Total No. of inflorescences plant^{-1} (days from the starting of flowering)						
	15	30	45	60	75	90	105
			2003/2004				
Control	2.25	4.75	6.50	11.20	19.15	26.20	43.80
PP_{333}(ppm):							
10	6.00	11.00	15.75	19.83	27.46	49.06	87.16
20	6.25	12.00	17.40	22.37	30.47	55.10	98.00
30	12.00	21.50	27.83	34.83	45.87	74.87	117.67
$LSD_{0.05}$	**3.11**	**6.07**	**5.19**	**8.01**	**7.13**	**11.09**	**17.18**
			2004/2005				
Control	2.11	5.09	7.01	14.00	21.18	30.43	57.13
PP_{333}(ppm):							
10	5.30	9.02	13.70	21.22	30.15	53.00	103.06
20	6.11	10.30	15.17	24.25	34.60	61.75	116.11
30	9.75	18.80	29.00	37.60	41.13	82.11	142.19
$LSD_{0.05}$	**2.31**	**4.05**	**6.19**	**7.15**	**8.01**	**13.17**	**20.51**

III- The effect on chemical constituents.

1- Leaf pigments concentration (Chlorophyll and carotenoids)

Data presented in Table (5) clearly show that, PP_{333} treatments increased leaf pigments concentration as compared with the control in both seasons. The differences between all concentrations of PP_{333} treatment and control were significant. The increase in leaf pigments was gradually increased as the concentration of PP_{333} increased. The increases in the leaf pigments linked with increasing concentration in PP_{333} might be attributed to the character of PP_{333} on depressing leaf area which lead to intensification of pigments in leaf. On the other hand, for the explanation of the incremental effect of PP_{333} on chloroplast pigments, it could be illustrated on the basis that PP_{333} treatment stimulated the endogenous cytokinins synthesis and there is an intimate relationship between cytokinin and chlorophyll metabolism in the leaf *i.e.* cytokinins retard chlorophyll degradation, preserve it and increase its synthesis. Besides, cytokinins activate a number of enzymes participating in a wide range of metabolic reactions in the leaves. These reactions included the maturation of proplastid into chloroplasts (Kulaeva, 1979). Similar findings were reported by Robert and Culver (1983) on sunflower, Park and Lee (1989) on pepper, Helal (1993) on poinsettia, Lee and Kwack (1995) on *Hibiscus syriacus*, Osman (2000), Nassar *et al.* (2001) on sweet pepper and Matter (2003) on hollyhock.

Table (5): Effect of PP_{333} on leaf pigments at the starting of flowering of sweet pea during 2003/2004 and 2004/2005seasons.

Treatment	Chlorophyll (mg g^{-1} fresh wt.)			Carotenoids (mg g^{-1} fresh wt.)
	A	B	T	
		2003/2004		
Control	1.090	0.629	1.719	0.290
PP_{333}(ppm):				
10	1.185	0.750	1.935	0.318
20	1.256	0.861	2.117	0.358
30	1.753	1.067	2.820	0.405
$LSD_{0.05}$	0.071	0.093	0.137	0.019
		2004/2005		
Control	0.969	0.517	1.486	0.279
PP_{333}(ppm):				
10	1.058	0.601	1.659	0.337
20	1.143	0.811	1.954	0.381
30	1.507	1.113	2.620	0.442
$LSD_{0.05}$	0.072	0.067	0.149	0.032

2- Anthocyanin concentration.

All concentrations of PP_{333} significantly increased anthocyanin concentration as compared with the control in both seasons (Table 6). The differences between all concentrations of PP_{333} were significant in both seasons. This increase in anthocyanin concentration was due to that these treatments significantly increased total carbohydrates content and consequently increased the production of this pigment. These results are confirmed by those of Helal (1993) on *Euphorbia pulcherrima* and Matter (2003) on hollyhock.

3- Total soluble carbohydrates

As shown in Table (6), total soluble carbohydrates in leaves and flowers increased with increasing PP_{333} rates in both seasons. This increase was significant between the three studied rates of PP_{333} and control in both seasons. Moreover, the data indicate that total soluble carbohydrates content of flowers was higher than that of leaves for all treatments (control and all rates of PP_{333}). In general, it is noticed that, the high rate of PP_{333} (30 mg L^{-1}) is more effective in increasing total soluble carbohydrates content. These results are confirmed by those of Wielander and Wample (1981) on apple, who stated that PP_{333} increased the rate of total carbohydrates content as a result of increasing photosynthetic rate, which in turn may be due to the increase in chlorophyll concentration (Table 5).

4- Total free amino acids

It is clear from the results in Table (6) that total free amino acids concentration was gradually decreased as PP_{333} concentration increased in both seasons. The treatments of PP_{333} led to a significant decrease of total free amino acids concentration in leaves as compared with control in both seasons. Also, the differences between the rates of PP_{333} were significant in the two studied seasons.

Table (6): Effect of PP_{333} on some chemical constituents of sweet pea during 2003/2004 and 2004/2005 seasons.

Treatment	Total soluble carbohydrates (%)		Total free amino acids (mg g^{-1} dry wt. of leaves)	Total indoles (mg g^{-1} fresh wt. of leaves)	Anthocyanin (mg100^{-1}g fresh wt. of flowers)
	Leaves	Flowers			
			2003/2004		
Control	3.96	6.04	1.797	1.286	58.55
PP_{333}(ppm):					
10	4.79	8.33	1.471	0.858	104.38
20	6.04	10.62	1.225	0.705	132.38
30	7.08	12.29	1.144	0.572	178.21
$LSD_{0.05}$	**0.70**	**1.47**	**0.069**	**0.102**	**18.13**
			2004/2005		
Control	4.99	6.17	2.450	1.500	55.17
PP_{333}(ppm):					
10	5.82	7.60	1.703	1.143	98.09
20	7.29	9.17	1.309	1.030	125.22
30	8.12	10.10	1.212	0.657	163.89
$LSD_{0.05}$	**0.59**	**0.87**	**0.082**	**0.071**	**21.11**

5- Total indoles

Data presented in Table (6) show that the PP_{333} treatments significantly decreased the total indoles concentration in leaves of pea plants in both seasons as compared with control. Such inhibitory effect of PP_{333} on total indoles concentration was directly proportional to the used concentration of PP_{333}. In this respect, the differences between all concentrations of PP_{333} are significant. However, the decrease in the concentration of total indoles in response to the different rates of PP_{333} may be attributed to the depressive effects of PP_{333} on auxins synthesis system and/or the stimulative effects of PP_{333} on the activity of IAA oxidase and growth inhibitors (Hathout, 1995).

Finally, in the light of these results, it could be concluded that to produce showy flowering pot plants from sweet pea, the plants must be sprayed with paclobutrazol at the rate of 30 mg L^{-1} (at the fourth leaf stage).

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تأثير الرش الورقى بالباكلوبوترازول على النمو والإزهاروبعض المكونات الكيميائية لنباتات بسلة الزهور

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أجرى هذا البحث بكلية الزراعة بالفيوم-جامعة القاهرة خلال موسمى ٢٠٠٣/٢٠٠٤، ٢٠٠٤/٢٠٠٥ وذلك لدراسة تأثير الرش الورقى بالباكلوبوترازول (١٠، ٢٠، ٣٠ ملليجرام /لتر) على النمو والإزهار وبعض المكونات الكيميائية لنبات بسلة الزهور. أثرت المعاملات المختلفة تأثيرا واضحا على جميع المواصفات المدروسة وذلك خلال موسمى النمو.

وقد أوضحت النتائج ما يلى:

- أدى رش النباتات بالباكتوبوترازول لجميع المعدلات المستخدمة إلى حدوث نقص فى كل من: إرتفاع النبات-مساحة الورقة-المساحة الورقية الكلية للنبات-الوزن الطازج والجاف للأوراق والفروع-طول الحامل الزهرى-الوزن الطازج والجاف للنورات والأزهار.
- أدت التركيزات المختلفة من الباكلوبوترازول إلى زيادة كل من عدد الفروع-عدد الأوراق-عدد النورات للنبات، ولكنها أدت إلى حدوث تأخير فى ميعاد الإزهار.
- أدت معاملات الرش بالباكلوبوترازول إلى زيادة محتوى الأوراق من كلوروفيل أ، ب والكلوروفيل الكلى- الكاروتينويدات-الكربوهيدرات الكلية فى الأوراق والأزهار-صفة الأنثوسيانين فى الأزهار. بينما حدث نقص فى تركيز كل من الأحماض الأمينية الكلية الحرة والإندولات الكلية.
- كان لمعاملة الرش بالباكلوبوترازول بتركيز ٣٠ملليجرام/لتر التأثير الواضح على النمو والإزهار والمكونات الكيميائية التى تم دراستها مقارنة بالمعاملات الأخرى. والذى يوصى باستخدامه فى ظل نتائج هذه الدراسة-للحصول على بسلة الزهور كنباتات أصص.