



## Pollen extracts application as a natural growth substance on *Strelitzia reginae* Ait. plants

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**Abstract:** A field experiment was carried out at the Experimental Farm of the Faculty of Agriculture at Fayoum University. Two successive seasons to study the effect of bio-stimulant with water date Palm Pollen Extracts (WPE) applied as foliar spraying at rates (0, 5, 10, 15, 20 and 25 g/L) on the vegetative growth, flowering and chemical composition of the bird of paradise *Strelitzia reginae* plants. Results showed that, spraying *Strelitzia* plants at 10, 15 and 20 gm/L a significantly increased all growth parameters (plant height, petiole diameter, leaf petiole length, offsets number plant<sup>-1</sup>, blade length, blade width, blade area, fresh and dry matters of leaves and roots, highest stalk length and diameter, spadix length and diameter, inflorescences numbers, fresh and dry matters of inflorescences, vase life (Days) and the least number of days from spadix appearance to flowering) and N, P and K concentration and uptake in leaves and inflorescences compared to the control treatment in both seasons. Data also showed highest values of growth characters and flowering and were recorded with 20 g/L extracts of date palm pollens as compared with the control and other treatments in first and second seasons. Applying 10 g/L foliar spraying of extracts date palm pollens gave increased in pigment content and total carbohydrates percentage in leaves and inflorescences as compared with control and other treatments in both seasons. The magnitude variation of N, P and K uptake in leaves with respect to the rate 10 g/L in leaves whereas variation of N, P and K uptake in inflorescences with respect to the rate 15 g/L as compared with other treatments.

**Key words:** Bird of paradise *Strelitzia reginae* plants - Date Palm Pollen Extracts fertilizers - growth parameter - chemical composition.

### Introduction

The name of Bird-of-Paradise or crane flower (*Strelitzia reginae* Ait.) comes from the remarkably shaped and colored flower cluster, like the crested head of a bird. The genus *Strelitzia* includes about five species. They are *S. nugusta*, *S. reginae*, *S. kewensis*, *S. nicoli* and *S. candida*. It belongs to family Strelitziaceae<sup>1</sup> Bird-of-Paradise is an evergreen perennial herbaceous plant, grown in the regions having moderate subtropical climate. The brilliant colors and unusual appearance of the flowers have made it exceptionally popular as cut flower. Therefore, the crop is cultivated in many parts of the world such as South Africa, Canary Islands, Italy, Egypt, Australia, New Zealand, California, Florida, Hawaii, India, Venezuela and other areas<sup>2</sup> in order to produce cut flowers for both domestic and international mark.

New approaches to agriculture tend to use environmentally friendly and safe products with a broad spectrum of activity. Nowadays many preparations offered for crop production are designed to not only fertilize the plants and stimulate their growth, but also minimize the problems related to reduce the environmental pollution caused by a huge application of mineral fertilizers. The application of bio-stimulants such as pollens

could be considered as a good production strategy for obtaining high yields of nutritionally valuable vegetables with lower impact on the environment<sup>3</sup>.

Pollens, the fine, powder-like materials produced by flowering plants and gathered by bees, are the male reproductive cells of flowers<sup>4</sup>. Pollen has gained increased attention for its therapeutic properties, as antibacterial antimutagenicity and anticancer<sup>5</sup>. It can play an important role in substituting the plants with the vitamins and minerals they lack because of land infertility problems and many others, which affect the plants growth, yield and quality of the plants in general. Also, it able to promote vegetative growth, mineral nutrient uptake and improve the productivity of many plants. In addition, bio-stimulants improved antioxidant activity, and higher pigment levels in leaves compared to non-treated plants<sup>6,7,8,9</sup>. In addition, the extract proved to be an excellent economic resource for plant growth substances used in Banana tissue culture<sup>10</sup>. Date palm (*Phoenix dactylifera* L. family *Palmaceae*) pollens are one of the most effective pollens and commonly used in the Middle East, especially in Egypt, where there are four famous local dates in Egypt; Amhat, Hiani, Sewy and Zaghlol. Date palm pollen extract has many compounds which are important in biological processes such as enzymes which are analyzed by electrophoresis<sup>11</sup>, sterols, triterpenes, saponins, proteins, vitamins A, C & E, minerals such as B, Zn, Se, Fe, Mo, Cu, Mn, and amino acids, Carbohydrates and glycosides<sup>12,13,14</sup> which help in improving the plants growth. In addition, palm pollen grains are a good economic nutritional source, which can be used as a human food supplements<sup>15</sup>. The objective of study is to determine the extent foliar spraying of date palm pollens aqueous extract as a natural bio-stimulant can improve the vegetative growth, the flowering and chemical composition of the bird of paradise plants.

## Materials and Methods

A field experiment was carried out at the Experimental Farm of the Faculty of Agriculture at Fayoum University, for two growing seasons (2014-2015). This investigation aimed to study the effect of bio-stimulant with water date Palm Pollen Extracts (WPE) applied as foliar spraying on the vegetative growth, flowering and chemical composition of the bird of paradise *Strelitzia reginae* plants. Prior to any practices, a composite soil sample was taken from the soil surface (0-30 cm) of the experimental site, air-dried, sieved by 2 mm sieve and analyzed (Table 1). The physical and chemical properties of the soil were determined according to<sup>16</sup>

**Table 1. Some mechanical and chemical analysis of used soil samples obtained from the experimental in two seasons**

Years	Mechanical analysis									
	Sand %	Silt %	Clay %	Texture class						
2014	32.29	32.23	35.81	Sandy clay						
2015	32.97	31.95	36.68	Sandy clay						
Years	Available nutrients (mg/kg)									
	pH	EC dSm <sup>-1</sup>	N	P	K	Fe	Zn	Mg	Mn	CaCO <sub>3</sub> %
2014	7.51	2.91	17.53	23.77	96.67	3.77	0.83	0.33	8.77	4.71
2015	7.33	2.73	18.67	22.81	97.60	3.65	0.87	0.35	8.71	4.91

### Pollen grains:

Pollen grains of Egyptian date palm (*Phoenix dactylifera* L., variety El-Sewy) were collected in March from Giza, Egypt.

### Preparation of Palm Pollen Extracts:

The extract was prepared from pollen grains of date palm using the procedure reported by<sup>17</sup> with some modifications as follows: To prepare water pollen extract, 0.1 g of pollen grains was mixed with 10.0 ml of distilled water. After one hour, the mixture was sonicated by ultrasonic probe (frequency at 6 kHz) for cut 30s then centrifuged at 5,000 rpm for 10 min with the temperature set at 20°C. The resulting supernatant was used as water pollen extract in all experiments. Then the volume was completed with water according to the concentration used (0, 5, 10, 15, 20 and 25 g/L). The control treatment was sprayed with tap water. The tested bio-stimulant was applied as a foliar spray thrice by 21-day intervals, beginning from 50 days after

transplanting at the first of February to the end of December in both seasons. The experimental design was a complete randomized blocks with three replications for each treatment. The plot area was 2.4 m<sup>2</sup> (two rows of 2 m length and 1.2m width). The plants were planted at the spacing of 1m x 1m. Identical one-year-old transplanted seedlings of *Strelitzia reginae* with same size (produced from seeds), 30 centimeters height at the 5-leaf stage and grown in sandy clay soil in texture and fairly uniform without distinct changes in texture were cultivated and used for the experiment. All the plants received recommended agriculture practices.

## Data recorded:

### Vegetative growth characters:-

Vegetative data were taken at the end of the experiment by the end of December. The growth characteristics measured were plant height (cm), petiole diameter (cm), leaf petiole length (cm), offsets number plant<sup>-1</sup>, leaves number plant<sup>-1</sup>, blade length (cm), blade width (cm), blade area (cm<sup>2</sup>), fresh and dry matters (D.M.) of leaves and roots (g). The leaf characters were taken on the 4<sup>th</sup> leaf of the plant. Leaves area was digitally measured according to the method of <sup>18</sup>.

### Flowering characters:-

Flowering data was taken through the entire year. The inflorescence parameters were stalk length (cm), stalk diameter (cm), spadix length and spadix diameter (cm), inflorescences number plant<sup>-1</sup>, fresh and dry matters (D.M.) of inflorescences (g), number of days from spadix appearance to flowering and Vase life (Days).

### Chemical analysis:-

Chlorophyll a, b and Carotenoids (mg/g) were determined in leaf fresh samples as described by <sup>19</sup>. N, P and K percentages as well as total carbohydrates in both leaves and inflorescence were determined. Total carbohydrates were determined according to <sup>20</sup>. Total nitrogen percentage was determined by using microkeldahl method as described by <sup>21</sup>. Phosphorus and potassium were determined according to the method described by <sup>22</sup>.

### Statistical analysis:-

All data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the Completely Randomized Design (CRD) using MSTATC computer software package according to <sup>23</sup>. Least Significant Difference (LSD) method was used to test the differences between treatment means at 5% level of significance.

## Results and Discussion

### Effect of extracts date palm pollens on bird of paradise plants:

#### 1-Vegetative growth characters:

Data in table (2) indicated that application of extracts date palm pollens foliar spraying at rates of (0, 5, 10, 15, 20 and 25 g/L) on the bird of paradise plants increased all tested growth as compared to the control treatment in both seasons. Obtained results agreed with those of <sup>10,24,25,26,27,28</sup>. Generally increasing growth parameters may be explained on the assumption that proteins, amino acids, different nutrients and higher percentage of vitamin which may play an important role in improving growth characters. Comparing the effect of different rates of foliar spraying of date palm pollens on the bird of paradise obtained data showed that the highest values of vegetative the measurement of growth characters were recorded with 20 g/L extracts date palm pollens as compared with the control and other treatments in first and second seasons. These results are in agreement with those obtained by <sup>29, 13,14</sup>.

#### 2- Flowering characters:

It is quite clear from the data presented in table (3) showed the response of flowering characters to foliar spraying of date palm pollens at a different rates, overcame the control treatment. Also, results show that the highest stalk length and diameter, spadix length and diameter, inflorescences number, inflorescences fresh

matter ,inflorescences Dry matter ,vase life (Days) and the least number of days from spadix appearance to flowering were obtained as a result of using 20 g/L foliar spraying of extract date palm pollens in both seasons. Apparently, the differences between values of all flowering characters in both seasons, are, to some extent, highly significant especially with regard to vase life (Days) and the number of days from spadix appearance to flowering whereas the differences of stalk length and inflorescences records were not significant. That marvelous influence of pollen extract on most of flowering characters may goes back to what it contains from amino acids, vitamins, minerals, proteins as stated by many authors like,<sup>30</sup>also, due to carbohydrates and glycosides it has as assured by<sup>12</sup> as well, as a result of carotenoids, flavonoids and phytosterols as found by<sup>31</sup>.

**Table 2.Effect of foliar application of extracts date palm pollens on vegetative growth characters of bird of paradise plantsat two successive seasons.**

Characters Seasons Conc.	Plant height (cm)		petiole diameter (cm)		leaf Petiole length (cm)	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
0 g/L	57.65	56.08	0.91	0.91	26.71	21.97
5 g/L	64.16	64.26	0.94	0.96	29.60	27.86
10 g/L	68.95	69.05	1.12	1.11	34.15	32.08
15 g/L	71.59	71.69	1.19	1.20	36.90	34.83
20 g/L	87.24	87.34	1.35	1.34	51.52	50.24
25 g/L	80.78	77.54	1.28	1.30	43.47	40.73
L.S.D 5%	18.39	9.11	0.26	0.21	10.87	13.40
	offsets number plant <sup>-1</sup>		Leaves number plant <sup>-1</sup>		Blade length (cm)	
0 g/L	1.96	1.95	10.38	11.29	17.74	16.95
5 g/L	2.03	2.29	11.65	11.53	19.34	18.56
10 g/L	3.06	2.89	12.44	12.39	21.64	20.93
15 g/L	3.23	3.12	13.13	13.35	23.55	22.72
20 g/L	3.87	3.60	14.48	14.36	25.80	25.01
25 g/L	3.69	3.55	13.54	13.12	24.36	23.57
L.S.D 5%	0.35	0.46	n.s.	n.s.	1.29	1.58
	Blade width (cm)		Blade area (cm <sup>2</sup> )		leaf fresh matter (g)	
0 g/L	6.89	7.67	131.52	127.40	28.30	27.45
5 g/L	7.40	8.17	137.03	132.91	29.96	29.11
10 g/L	8.19	8.97	151.82	147.70	32.86	32.01
15 g/L	8.63	9.40	154.66	150.54	34.25	33.39
20 g/L	10.10	10.87	180.64	173.17	37.71	37.20
25 g/L	9.23	9.99	170.69	166.53	35.16	34.31
L.S.D 5%	1.37	0.85	n.s.	n.s.	n.s.	n.s.
	leaf dry matter (g)		Fresh matter of Root (g)		Dry matter of Root (g)	
0 g/L	6.48	6.40	134.37	125.71	10.85	9.45
5 g/L	7.52	7.46	159.77	151.11	12.30	10.88
10 g/L	8.08	8.00	183.85	175.19	13.72	12.30
15 g/L	7.86	7.77	196.89	188.23	14.43	13.01
20 g/L	8.99	8.92	282.95	274.29	16.72	15.07
25 g/L	8.75	8.67	263.39	254.73	15.69	14.27
L.S.D 5%	1.36	0.93	32.88	11.02	1.29	0.90

**Table 3. Effect of foliar application of extracts date palm pollens on flowering characters of bird of paradise plants at two successive seasons.**

Characters Seasons Conc.	Stalk length (cm)		Stalk diameter (cm)		Spadix length (cm)	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
0 g/L	45.69	46.57	1.00	1.02	12.98	14.30
5 g/L	51.20	52.08	1.14	1.17	13.49	14.81
10 g/L	55.99	56.87	1.34	1.38	16.29	17.61
15 g/L	74.28	73.83	1.68	1.74	17.09	18.41
20 g/L	64.48	65.36	1.60	1.63	16.81	18.13
25 g/L	58.58	59.46	1.48	1.45	16.52	17.84
L.S.D 5%	n.s.	n.s.	0.34	0.26	1.49	0.94
	Spadix diameter (cm)		Inflorescences number plant <sup>-1</sup>		Inflorescences F. M. (g)	
0 g/L	1.74	1.71	1.37	1.39	38.61	37.62
5 g/L	1.93	1.86	1.48	1.50	40.12	39.13
10 g/L	2.16	2.09	2.91	2.92	42.91	41.92
15 g/L	2.62	2.51	4.27	4.38	50.32	49.33
20 g/L	2.45	2.36	2.94	2.74	48.74	47.75
25 g/L	2.35	2.28	2.50	2.51	45.75	44.76
L.S.D 5%	0.11	0.12	0.26	0.44	n.s.	n.s.
	Inflorescences D. M.(g)		No. of days from spadix appearance to flowering		Vase life (Days)	
0 g/L	4.84	5.42	91.05	89.79	8.18	7.84
5 g/L	5.35	5.93	85.09	86.25	9.63	9.55
10 g/L	6.14	6.72	69.13	79.88	12.05	11.30
15 g/L	8.05	8.30	65.03	57.50	15.25	14.50
20 g/L	6.96	7.55	79.09	76.56	14.02	13.61
25 g/L	6.87	7.46	85.30	81.35	13.26	11.51
L.S.D 5%	0.75	0.79	16.02	17.72	2.42	3.86

### 3- Chemical constituents:

Registered data showed clearly from Table(4) it can be concluded that increasing chlorophyll a and b, Carotenoids, total carbohydrates percentage leaves (D.M), total carbohydrates percentage inflorescences (D.M), as compared with the control treatment in first and second season. Data also, observed that applying 10 g/L foliar spraying of extracts date palm pollens gave an increase in pigment content and total carbohydrates percentage leaves, total carbohydrates percentage inflorescences as compared with other treatments (5,15 ,20 and 25g/L) in both seasons. The available data in Tables (5&6) illustrate that all treatments tended to increase N, P and K concentration and uptake in leaves and inflorescences of bird of paradise plants as compared with the control treatment in both seasons<sup>32</sup>. The positive response of plant characters might be attributed to the increase in dry matter formation. The maximum N, content was noticed when applying 10 g/L foliar spraying of date palm pollens(1.99% and 1.97% in leaves) and (2.88 and 2.81% in inflorescences in both seasons respectively. The same trend was observed for P and K content in leaves and inflorescences both seasons. The increment of leaves nitrogen concentration ranged between 70.0 % and inflorescences nitrogen concentration ranged between 72.4 % and leaves phosphorus concentrations ranged between 36 % and inflorescences phosphorus concentrations ranged between 42 % whereas leaves potassium concentration ranged between 79.3% and inflorescences potassium concentration ranged between 97.4% in first and second season respectively. In comparison to the different rates of foliar spraying of extracts date palm pollens on N, P and K increased uptake in leaves and inflorescences of bird of paradise plants. Data also, showed that the magnitude variation of N, P and K uptake in leaves with respect to the rate 10 g/L in leaves whereas variation of N, P and K uptake in inflorescences with respect to the rate 15g/L as compared with other treatments in both seasons was very clear. The increase in the chemical composition may be attributed to the constituents of the date pollen extract which help in enhancing these characters like other bio-stimulants such as licorice extracts on onion plant as stated by<sup>25</sup>

**Table 4.**Effect of foliar application of extracts date palm pollens on chlorophyll a and b, Carteniodes, total carbohydrates percentage leaves (D.M), total carbohydrates percentage inflorescences (D.M), of bird of paradise plants at two successive seasons.

Characters Seasons Conc.	Chl. a ( mg/g)		Chl. b ( mg/g)		Chl. A +b ( mg/g)	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
0 g/L	1.00	0.98	0.58	0.60	1.58	1.58
5 g/L	1.13	1.12	0.69	0.70	1.82	1.82
10 g/L	1.79	1.77	1.17	1.18	2.96	2.95
15 g/L	1.68	1.66	1.03	1.05	2.71	2.71
20 g/L	1.57	1.59	0.91	0.92	2.48	2.51
25 g/L	1.36	1.35	0.80	0.81	2.16	2.16
L.S.D 5%	0.15	0.17	0.17	0.16	0.32	0.33
	Carteniodes ( mg/g)		Total carbohydrates % leaves ( D.M)		Total carbohydrates % inflorescences ( D.M)	
0 g/L	0.63	0.58	20.61	19.62	16.61	15.62
5 g/L	0.70	0.66	22.12	21.13	18.12	17.13
10 g/L	1.64	1.61	32.32	31.33	26.32	27.33
15 g/L	1.39	1.45	30.74	29.41	26.07	25.41
20 g/L	1.26	1.28	27.41	26.76	23.75	22.76
25 g/L	1.02	1.01	24.57	23.92	20.91	19.92
L.S.D 5%	0.26	0.26	1.40	2.73	2.65	1.13

**Table 5.**Effect of foliar application of extracts date palm pollens on nitrogen, phosphorus and potassium content (%) and uptake (mg/plant) of leaves of bird of paradise plants at two successive seasons

Treatments	%						Uptake (mg/plant)					
	Nitrogen		Phosphorus		Potassium		Nitrogen		Phosphorus		Potassium	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
0 g/L	1.17	1.14	0.41	0.32	1.80	1.81	75.81	73.87	26.56	20.73	116.64	117.28
5 g/L	1.38	1.35	0.51	0.41	1.88	1.79	103.77	101.52	38.35	30.83	141.37	134.60
10 g/L	1.99	1.97	0.64	0.52	2.94	2.91	160.79	159.17	51.71	42.01	237.55	235.12
15 g/L	1.90	1.87	0.62	0.54	2.70	2.65	149.34	146.98	48.73	42.44	212.22	208.29
20 g/L	1.81	1.78	0.57	0.48	2.23	2.14	162.71	160.02	51.24	43.15	200.47	192.38
25 g/L	1.47	1.44	0.56	0.45	1.95	1.94	128.62	126.00	49.00	39.37	170.62	169.75

**Table 6.**Effect of foliar application of extracts date palm pollens on nitrogen, phosphorus and potassium content (%) and uptake (mg/plant)of inflorescences of bird of paradise plants at two successive seasons

Treatment s	%						Uptake (mg/plant)					
	Nitrogen		Phosphorus		Potassium		Nitrogen		Phosphorus		Potassium	
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season
0 g/L	1.67	1.62	0.42	0.39	1.45	1.45	80.82	87.80	20.32	21.13	70.18	78.59
5 g/L	1.84	1.77	0.43	0.43	1.53	1.59	98.44	104.96	23.00	25.49	81.85	94.28
10 g/L	2.88	2.81	0.58	0.56	2.55	2.58	176.83	188.83	35.61	37.63	156.57	173.37
15 g/L	2.81	2.74	0.52	0.52	2.55	2.42	226.20	227.42	41.86	43.16	205.27	200.86
20 g/L	2.00	1.94	0.48	0.48	1.80	2.30	139.20	146.47	33.40	36.24	125.28	173.65
25 g/L	1.97	1.90	0.48	0.46	1.72	1.79	135.33	141.74	32.97	34.31	118.16	133.53

## Conclusion

Generally, date palm pollen extract can be used as an effective bio-stimulant, and applied on different plants. It has beneficial effect in the field of agriculture as a good nutritional, growth promoting and flowering enhancing because the fact that it contains growth substances as minerals, amino acids, auxin, tryptophan and higher concentration of indoles. As a result, extract date palm pollen are considered an organic farm input and can be used as a substitute to synthetic growth regulators with less harm neither upon environment nor upon the human beings.

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