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Effect of Foliar Spray with Pollen Grains Extract of Date Palm and Some Materials on Growth, Yield and Fruits Quality of Eggplant Plants Grown at Late Seasons

Usrya A.I. Byan

Vegetables Research Department, Horticulture Research Institute,
Agriculture Research Center, Giza, Egypt

Abstract: A field experiment was carried out at the Experimental Farm, Kaha vegetable research Station, Qalubia Governorate, Egypt, during two successive summer seasons of 2018 and 2019 to study the effect of using bio- stimulant aqueous extract of date palm pollen grains which applied as foliar spraying at 2, 4 and 6 g/L as well as two stimulant commercial products (green over and big lord at 1cm/L of each) and tap water (control), on the vegetative growth, yield and its components as well as chemical composition of the eggplant plants grown at late seasons. The results indicated that application of all materials in this study especially date palm pollen grains extract as foliar spray at 4 and 6 g\L increased all tested growth parameters, yield and components and its chemical composition as compared to the other treatments and control in both seasons. In the present study generally, it can recommend by spray eggplant plants with any one of the compounds used in this experiment especially date palm pollen grains extract at 4 or 6 g/liter, which registered statistical increment on fruit yield with best quality. It can said that, foliar spray by all rates of date palm pollen grains extract produced fruit yield more than the control by 50% especially the rate of 6 g/liter.

Key words: Eggplant · Date palm pollen grains extract · Foliar spray Growth · Yield

INTRODUCTION

Eggplant (*Solanum melongena* L.) is a member of the Solanaceae family, it is one of the most important public vegetable crops for the poor strata which grown during summer season in Egypt. Eggplant fruits contain different considerable amount of carbohydrates, proteins and some minerals i.e. nitrogen, phosphorus, potassium as well as iron and hence, it is important for human nutrition [1, 2].

New approaches to agriculture tend to use environmentally friendly and safety products with a broad spectrum of activity. Nowadays many preparations offered for crop production are designed to not only fertilize the plants and stimulate its growth, but also minimize the problems related to reduce the environmental pollution which caused by a huge application of mineral fertilizers. Pollen grains, the fine, powder-like materials produced by flowering plants and gathered by bees, are the male reproductive cells of flower which, it can play an important role in substituting the plants with the vitamins and minerals because of land infertility problems and many other reasons, which affect the plants growth, yield and quality of the plants. Also, it is able to promote vegetative growth, mineral nutrient uptake and improve the productivity of many plants. The application of bio-stimulants such as pollen grains s could be considered as a good production strategy for obtaining high yields of nutritionally valuable vegetables with lower impact on the environment [3, 4]. Date palm (*Phoenix dactylifera* L. family Palmaceae) pollen grains consider one of the most effective pollen grains and commonly used in the Middle East, especially in Egypt. It has beneficial effect in the field of agriculture as a good nutritional, growth promoting and enhancing flowering because the fact that it contains growth substances as auxin, tryptophan, higher concentration of indoles, enzymes electrophoresis, sterols, triterpenes, saponins, proteins, vitamins (A, C and E), minerals such as B, Zn, Se, Fe, Mo, Cu, Mn, Carbohydrates, glycosides and amino acids as reported by many investigators which help in

Corresponding Author: Usrya A.I. Byan, Vegetables Research Department,
Horticulture Research Institute, Agriculture Research Center, Giza, Egypt.

improving the plants growth and its production [5-7]. Moreover, Abo AL-Mikh [8] and Abdulkadhim [9], found that the spray of the palm pollen grains extract improved vegetative qualities of plant height, leaf area, number of leaves and dry weight of vegetative and root group, as well as the proportion of NPK for pomegranate seedlings.

According to big lord compound which it is consider commercial auxins which it is contain naphthalene acetic acid (NAA). Auxins have been implicated in many processes of plant growth and development such as root initiation, growth, flowering and fruit set. Exogenously applied plant growth regulators may affect the growth and development of plant, in this regard Karapanos *et al*. [10] on solanaceous vegetable crops , Salasa, *et al.* [11] on sweet pepper and Makrogianni *et al*. [12] on eggplant) indicated that, the fruit quality parameters were improved when used the commercial auxins– naphthalene acetic acid (NAA) and NAA-amide were applied by foliar sprays.

Concerning to green over compound, which it is contain a commercial product containing higher concentration of amino acidc , macro and micro nutrients, using macro and micro nutrients through foliar fertilization is preferable to avoid not only nutrients obsession in the soil, but also leaching during irrigation. Improving the micronutrient status of plants would increase yield and increase micronutrient content in seeds, leading to better nutrition of the crop and to improved human nutrition [13]. Many workers reported that, spraying the plants by foliar fertilizers significantly improved growth, yield and pods quality of legumes crops [14, 15]. Moreover, Abd El-Aal and Eid [16] reported that foliar application by growth stimulators as amino acids at 4 ml/l induced favorable results on soybean cultivation which improved its growth, productivity and quality.

Thus, this study aimed to improve growth, yield and fruit quality of eggplant grown in clay soil under high temperature conditions by using some safety materials (aqueous extract of date palm pollen grains) and some compounds (green over and big lord).

MATERIALS AND METHODS

Two successive experiments were carried out in the Experimental Farm, Kaha vegetable research Station, Qalubia Governorate, Egypt, to study the effect of pollen grains extracts of date palm, green over and big lord on growth and fruit quality of eggplant plants grown at late seasons. The soil of the experiment was clay in texture with 8 pH, 2.61 EC dS/m, 115 ppm N, 39 ppm P and 182 ppm K, 116 ppm Ca and 55 ppm Mg (average two seasons). The present investigation was conducted during two successive late summer seasons of 2018 and 2019 under high temperature condition. Seeds of eggplant (*Solanum melongena* L.) cv. Laala-2 were sown in nursery at the second week of April during both seasons in plates filled with a mixture from sand and peat moss (l: l). After 60 days from seed sowing, eggplant seedlings were transplanted in plots (40 spacing between the plants). The plot area was 8.4 m^2 and includes 3 ridges each of 0.7 m width and 4.0 m length. Randomized complete block design with three replicates was adopted. This experiment included six treatments (tap water as control, date palm pollen grains extract at 2, 4 and 6 g/L, green over at 1cm/liter and big lord at 1cm/liter) the plants were sprayed four times by the used materials at 30, 45, 60 and 75 days after transplanting.

The other cultural practices for growing eggplant plants (irrigation, fertilization, weed control and pest control) were carried out according to the recommendation of Egyptian Ministry of Agriculture, Egypt.

Preparation of Date Palm Pollen Grains Extracts: Pollen grains of Egyptian date palm (*Phoenix dactylifera* L. variety El-Hayani) were collected at the end of March from Shabramant, Giza, Egypt during the agricultural season at the beginning of opening the covers of the male species. The extract was prepared from pollen grains of date palm using the procedure reported by Nagai *et al*. [17] with some modifications as follows: To prepare three concentrations of water pollen grains extract (2, 4and 6 g) of pollen grains whereas every one soaked in 1 litter of distilled water for 24 hours and turning it with electric mixer and filter the extract with filter paper.

The Data Recorded

Measurement of Plant Vegetative Growth: Three plants were randomly chosen from every treatment in the three replicates at fruit sitting stage (after 85 days after transplanting), in order to determine the following:

Plant length (the length of main stem cm), stem diameter (cm), number of leaves/plant, number of branches/plant and dry weights of shoots (Leaves and stems) /plant. The samples of the vegetative parts were dried in the oven for 48 h at 75°C to constant weight and then the dry weight per plant was calculated using the standard methods as illustrated by A.O.A.C [18].

Table 1: Components of date palm pollen grains which taken from Hassan [5]

Subject	Ingredients
Moisture	28.80(%)
Vitamins	Vitamin A, H, E, D, K and group vitamins B (B1, B2, B6, B12, Niyasine, Butine, Anysitole, Rothine
Hormones	Astron hormone
Food Ingredients	Carbohydrates 13%, Protein 35%, Fat 5%
Mineral salts	Ti, Mo, B, Si, Zn, I, Cu, Mn, Mg, Fe, Cl, Na, S , P, K, Ca
Amino acids	Alanine (Ala) 2.61 Arginine (Arg) 1.61 Aspartic acid (Asp) 3.55 Glutamic acid (Glu) 1.74 Glycine (Gly) 2.24 Serine (Ser) 1.89 Cysteine (Cys) 0.42 Tyrosine (Tyr) 1.55 Proline (Pro) 0.28 Ammonia 0.45
Other compounds	Phenolic acids, , clycerides, mono acids, bilateral acids and triple acids auxin (IBA) and tryptophan (auxin precursor)

Table 2: Names and contains of the materials used in this study

Compounds name	Composition	Concentration
1-Control (Tap water)	Tap water	-
2-Green over	N (5%), P (5%), K (5%), Zn (3%), Fe (1.7%), Cu (1.3%), amino acid (10.5%) and fulvic acid (10 %).	1 cm/liter
3-Big lord	NAA (1.1%), V.C (0.001%) , V.B (0.001%) and adjuvant up to100%	1 cm/liter
4-Date palm pollen grains at three rates	As shown in Table (1)	2, 4 and 6 g/ liter

Leaf area was calculated from the fourth upper leaves according to the following formula of Wallace and Munger [19]:

Leaf area (cm^2) = Leaves dry weight (gm) x disk area / Disk dry weight (gm).

Measurement of Fruits Yield and its Components: Five eggplant fruits randomly taken from every treatment at the third picking in the three replicates to determine the fruit length, fruit diameter, average of fruit weight, early fruit yield(ton/fed) as the first, second, third, fourth and five pickings , total fruit yield (ton/fed), the all pickings of fruits as well as relative yield (%).

Measurement of Chemical Constituents: Phosphours and potassium were determined in dry fruit on the basis of dry weight according to the methods described by Olsen and Sommers [20] and Jackson [21], respectively.

Total leaf chlorophyll was measured at fruit sitting stage (85days after sowing) from the fourth upper leaves using Minolta chlorophyll Meter SPAD- 501 as SPAD units.

Statistical Analysis: Data obtained were subjected to the proper analysis of variance (randomized complete block design) as described by Snedecor and Cochran [22] using M. stat program. Averages between treatments were differentiated by using LSD at 5% level.

RESULTS AND DISCUSSION

Vegetative Growth Characters: Data in Table (3) reveal that all treatments under investigation significantly encouraged the vegetative growth of eggplant plants expresses as plant length, stem diameter, number of leaves/ plant, number of branches/ plant, leaf area and dry weight g / plant as compared to the control treatment (tap water). The augment significant results recorded with those plants which sprayed by date palm pollen grains extract at rates of 4 and 6 g\L, which motivated and raised the previous parameters until reached to almost the multiplied results than the control treatment in both seasons. The obtained results agreed with those of Abed Al-Hussain and Ibriham [3]; Sazetak [4]; El Fouly *et al*. [14]; El-Habbasha *et al.* [15] and Abd El-Aal and Eid [16]. These increment in eggplant growth attributed to date palm pollen grains extract which has many stimulant compounds such as auxin, tryptophan, higher concentration of indoles, vitamins (A, C and E), minerals such as B, Zn, Se, Fe, Mo, Cu, Mn, carbohydrates, glycosides and amino acids as mentioned before in Table (1) which may play an important role in improving growth characters as mentioned by Hassan [5]; Basuny *et al.* [6] and Abou-Sreea *et al.* [7]. Moreover, Abo AL-Mikh [8] and Abdulkadhim [9] found that the spray of the palm pollen grains extract improved vegetative qualities of plant height, leaf area, number of leaves and dry weight of vegetative for pomegranate seedlings.

Fruit Yield and its Components: It is quite clear from the data presented in Table (4) that all treatments used especially 6, 4, 2 g/L foliar spraying with date palm pollen grains extract respectively, tended to produce significantly increases in fruits yield and its components under investigation (except fruit diameter) as compared to the control treatment in both growing seasons. It can said that, foliar spray at 6 g/L of date palm pollen grains extract produced fruit yield more than the control by 51.28% and

Table 3: Effect of foliar spray with date palm pollen grains extract, green over and big lord on vegetative growth of eggplant plants during 2018 and2019 seasons

	Plant length (cm)		Stem diameter (cm)		No. of. leaves / plant		No. of. branches / plant		Leaf area (cm^2)		Dry weight (g / plant)	
Treatments	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Tap water (control)	55.00	52.10	1.00	1.06	68.00	63.00	10.33	11.00	454.78	405.61	51.30	47.00
Green over at 1cm/L	66.30	65.10	1.10	1.20	131.00	134.00	19.50	20.00	724.09	703.80	79.35	75.90
Big lord at 1cm/L	64.30	63.10	1.30	1.26	78.00	80.00	10.33	13.00	725.34	716.66	66.63	69.20
Date palm pollen grains extract at 2 g/L	77.00	75.66	1.23	1.40	113.00	114.00	15.00	19.00	700.45	744.44	82.95	73.70
Date palm pollen grains extract at 4 g/L	80.66	80.00	1.43	1.44	134.00	139.00	19.33	20.10	962.35	811.44	116.90	113.60
Date palm pollen grains extract at 6 g/L	75.60	77.50	1.30	1.30	136.00	148.00	20.00	21.00	719.54	759.18	93.15	95.70
L.S.D at 5%	10.33	16.92	0.14	0.13	13.84	16.29	1.72	1.87	7.61	9.16	11.60	10.33

Table 4: Effect of foliar spray with date palm pollen grains extract, green over and big lord on yield and its components of eggplant plants during 2018 and2019 seasons

	Fruit length (cm)		Fruit diameter (cm)		Average fresh fruit weight (g)		Early yield ton/fed		Total yield ton/fed		Relative yield (%)	
Treatments	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Tap water (control)	10.90	9.00	2.60	2.70	36.70	37.10	2.10	2.55	16.36	16.93	100	100
Green over at 1cm/L	11.03	11.30	2.50	2.60	37.80	39.80	2.19	3.23	18.20	18.56	111.25	109.62
Big lord at 1cm/L	11.50	11.80	2.70	2.70	42.60	41.70	2.74	2.81	18.85	18.72	115.22	110.57
Date palm pollen grains extract at 2 g/L	12.50	12.20	2.40	2.42	42.60	43.30	4.94	5.00	22.12	23.09	135.21	136.39
Date palm pollen grains extract at 4 g/L	12.60	13.00	2.50	2.40	45.30	45.10	4.87	4.93	22.47	23.94	137.34	141.41
Date palm pollen grains extract at 6 g/L	13.20	14.00	2.45	2.30	47.20	50.34	4.55	4.61	24.75	25.12	151.28	148.37
L.S.D at 5%	1.48	0.99	N.S	N.S	1.50	1.48	1.87	1.52	0.93	1.39	-	-

48.37 % in the 1st and 2nd seasons, respectively as shown in Table (4). Foliar spray with pollen grains extract of date palm at 6 g/L increased fruit length, average fruit weight and total yield in both growing seasons with no significant differences with pollen grains extract at 2 or 4 g/L with respect to fruit length and early yield in both growing seasons. These superiority results obtained from eggplant plants that sprayed with date palm pollen grains extract may be attributed to their strong vegetative plant growth, which possessed much shoot, leave number and widest leaf area as shown in Table (3) that could induce more photosynthetic rates. This in turn may be inducing reflect of the high contain of carbohydrates, more cell division, more vegetative vigorous which producing higher total yield than those of the control. Moreover, that marvelous influence of pollen grains extract on fruit setting which reflect most of fruits yield and its components in addition it contains growth substances as auxin, tryptophan, higher concentration of indoles, enzymes electrophoresis, sterols, triterpenes, saponins, proteins, vitamins (A, C and E) minerals such as B, Zn, Se, Fe, Mo, Cu, Mn, carbohydrates, glycosides and amino acids and the role of this compounds of enhancing the values of number of fruits, fruit weight and high fruit setting and all that reflect on the fruit yield as shown in Table (4) as stated by many authors like Hassan [5]; Basuny *et al.* [6] and Abou-Sreea, *et al.* [7]. Many workers reported that, spraying plants with foliar fertilizers significantly improved yield and pods quality of legumes crops [14, 15]. Moreover, Abd El-Aal and Eid [16] reported that foliar application with growth stimulators as amino acids at 4 ml/l induced favorable results on soybean cultivation which improved its growth, productivity and quality.

Chemical Properties of Eggplant Fruits as Well as Total Chlorophyll Leaf Concentration: Data in Table (5) illustrated that application of all materials in this study on the eggplant plants increased all tested chemical properties of eggplant fruits P%, K% as well as chlorophyll leaf concentration especially the treatment of foliar spray by date palm pollen grains extract at 4 and 6 g\L as compared to the other treatments and tap water (control) in both seasons. Generally this results may be explained on the assumption that many growth substances as auxin, tryptophan, higher concentration of indoles, enzymes electrophoresis, sterols, triterpenes, saponins, proteins, vitamins (A, C and E), minerals such as B, Zn, Se, Fe, Mo, Cu, Mn, Carbohydrates , glycosides and amino acids which may play an important role in improving fruit quality as well as the proportion of NPK [5-8].

Table 5: Effect of foliar spray with date palm pollen grains extract, green over and big lord on chemical properties of eggplant fruits as well as total chlorophyll leaf reading of eggplant plants during 2018 and 2019 seasons

	P (%)		K (%)		Total chlorophyll leaf concentration SPAD	
Treatments	2018	2019	2018	2019	2018	2019
Tap water (control)	0.42	0.49	2.50	2.95	41.70	43.80
Green over at 1cm/L	0.58	0.59	2.86	3.09	44.93	45.45
Big lord at 1cm/L	0.66	0.65	3.26	3.16	49.30	46.60
Date palm pollen grains extract at 2 g/L	0.66	0.66	3.08	3.15	49.36	48.50
Date palm pollen grains extract at 4 g/L	0.67	0.69	3.31	3.49	50.30	48.90
Date palm pollen grains extract at 6 g/L	0.68	0.70	3.30	3.41	50.96	51.55
L.S.D at 5%	0.10	0.09	0.07	0.08	0.97	1.03

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