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Improving Pollination Process of Samani Date Palm Cultivar Using the Bio-Activator Milagro Stimcrop

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Authors' contributions

This work was carried out in collaboration between all authors. Authors MAS and MMN designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author MSES managed the literature searches, analyses of the study performed the spectroscopy analysis and author OMH managed the experimental process and author EAM identified the species of plant. All authors read and approved the final manuscript.

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ABSTRACT

This study was carried out during two successive seasons 2011 & 2012 for improving pollination process of Samani date palm cultivar grown in sandy soil of private orchard located at Abo-Rawash region, El-Giza Governorate, Egypt. Uniform date palms 20 years old were treated for three times i.e. (i) pollen grains, (ii) Millagro Stimcrop and (iii) Pollen grains with Milagro Stimcrop. The first was applied in dust form as soon as female inflorescence opened. The second and third were applied after month and two months from initial treatment using the same rates. Effect of the bio- activator Milagro Stimcrop on improving pollination process, yield and fruit quality was assessed.

Results showed the different treatments markedly improved pollination process, yield and fruit quality of Samani date palm. The best results were achieved as 1g pollen grain was combined with 1g Milagro Stimcrop which recorded the highest significant values for fruit set and retained fruits. Also, the physical and chemical characteristics of fruits expressed by fruit shape, weight, volume, flesh value, bunch weight and yield/tree as well as SSC %, reducing sugars and total sugars were markedly enhanced. This means that the bio-

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activator Milagro Stimcrop has a good stimulant action for improving pollination process, yield and fruit quality of Samani date palm cultivar as combined with pollen grains in dust form at rate (1g+1g), besides its environmentally safe effect as non-chemical tool.

Keywords: Date palm; samani cv; pollination; fruit quality; milagro Stimcrop; yield.

1. INTRODUCTION

Date palm (*Phoenix dactylifera* L.) is one of the oldest fruit crops grown in the arid Arab regions of North Africa and Middle East. Dates are a major food source where its tree parts used for various purposes as well as resembling income source for local populations. Also, date palm plays a significant role in economy, society and environment of these areas [1,2].

Samani cv. is considered one of the most important soft date fruits in Egypt. The successful in horticultural management practices is directed toward obtaining a high yield with good fruit quality. Pollination is a principal cultural practice for date palm orchards where it classified as dioecious species with male and female flowers produced on separate trees [3]. Dates are naturally wind pollinated, but humans have assisted in this pollen transfer since great antiquity by using limited quantity of pollen grains as basis to justify the use of mechanical pollination using dusters and sprayers.

Therefore, artificial hand pollination becomes a necessary operation as a mean to ensure good yield [4,5]. Using natural biological activators i.e., the seaweed Milagro Stimcrop has made plant nutrition a central element of farming practice. It improves plant growth in all parts as a tonic for physiological processes in particular to enhance hormonal photosynthesis that increases yield and improves fruit quality characteristics [6,7]. Its bio-stimulant effect comes from organic molecular content of the brown algae *Ascophyllum nodosum* which becomes the key to enhance plant's complex biological engine that provide plants with they needs to realize their full genetic potential [8,9,10].

Thus, the objective of the present work was to assess the effects of a commercially available extract of the brown algae *Ascophyllum nodosum* namely Milagro Stimcrop with or without pollen grains as a safe way for enhancing pollination process, increase yield and improve fruit quality of Samani date palm cultivar.

2. MATERIALS AND METHODS

2.1 Plant Material and Experimental Design

This study was carried out during two seasons (2011 & 2012) on 20 years old Samani date palm *Cv.* (*Phoenix dactylifera* L.) grown in sandy soil at 8 x 8meters a part under drip irrigation system. Tested palms were grown in a private orchard located at Abo-Rawash region, El-Giza Governorate, Egypt under conventionally cultural practices. The experiment was designed as randomized complete block design with 3 replicates (2 palms per replicate) and grouped under 3 treatments. The physical and Chemical properties of the experimental soil are presented in Table 1 (Analyzed according to Wild et al. [11].

Table 1. Soil physical and chemical properties

Physical properties		Chemical properties					
Sand %	63.4	Organic matter %	3.6	P %	0.60	Zn ppm	3.4
Clay %	14.2	pH	8.4	K %	0.86	Mn ppm	3.2
Silt %	22.4	EC ds/m -1	1.5	Ca %	4.20	Fe, ppm	7.8
Texture	Sandy	CaCO%	5.2	Mg%	1.10		

The biological activator Milagro Stimcrop in organic micro scale form was mixed with filler material and dust applied to female inflorescence. Its micro-granules product characterized by: 50.0% algae's organic molecular content, 19.0% K_2O, 1.0% Organic N, 0.1% Betaine and 4.0% Mannitol.

The selected palm dates were equally shared between the following treatments: Nine selected female uniform date palm trees were pollinated during the first week of April as soon as it opened by dusting female inflorescence using 5 g of (2g. pollen grains+3g filler material) or (2g Milagro+3g filler material) or (1g pollen grains+1g Milagro+3g filler material) as soon as it opened. These treatments were re-conducted after month and two months from initial treatment.

2.2 Studied Parameters

Fruits were picked during the second week of September at mature stage (Bisir or Khalaal). Twenty fruits were randomly selected from each bunch, for determination of physical and chemical fruit properties.

2.3 Physical Characteristics

Fruit length and diameter (cm), shape (L/D), volume (cm^3), weight (g), flesh/fruit % and seed/fruit% were assessed**.**

2.3.1 Fruit set percentage

The number of set fruits was recorded, and fruit set % calculated according to El-Mkhtoun [12]:

$$\text{Fruit set \%} = \frac{\textit{Number of fruits setting on the strand}}{\textit{Total number of flower per strand}} \textit{ x 100}$$

2.3.2 Fruit retention percentage

Was determined according to Soliman & El-Kosary [13] using the following equation:

$$\text{Fruit set \%} = \frac{\textit{Total number of retained fruits per bunch}}{\textit{Total nodes number per bunch}} \times 100$$

2.3.3 Specific weight

Was calculated as weight/volume.

2.3.4 Total yield/palm

Bunches were harvested and weighted during the 2nd week of September at the peak of color development. Number of bunches/palm was recorded and the average of yield weight/palm was calculated (Kg).

2.4 Chemical Characteristics

2.4.1 Total sugars (g/100g fresh weight)

Was determined as described by Smith et al. [14].

2.4.2 Reducing sugars

Was determined using Methanolic extract according to AOAC [15].

2.4.3 Non-reducing sugars

Was determined by differentiate between total and reducing sugars**.**

2.4.4 Total soluble tannins (g/100g fresh weight)

Was determined in fruit tissue (including skin and flesh) using Folin-Ciocalteu and sodium carbonate reagent and measured for absorbance using a UV-V Spectrophotometer at 750 *nm* according to Taira [16].

2.4.5 Soluble solid contents (SSC %)

Was determined in fruit juice using hand refractometer (Model 10430 Bausch & Lomb Co. Calif., USA).

2.4.6 Total acidity percentage (TA %)

Estimated as Malic acid /100ml juice according to AOAC, 1995 [15].

2.4.7 Statistical analysis

Data subjected to analysis of variance to determine the significant differences and Duncan's multiple range test was used for means comparison when F test significant at P 0.05 [17].

3. RESULTS AND DISCUSSION

3.1 Effect of the Bio-Activator on Physical Fruit Characteristics

3.1.1 Fruit length

It is noticed from Table, 2 that the best values were obtained when the dates treated with Milagro S.+ pollen grains (5.93 & 6.00cm) followed by pollen grain treatment (5.70 & 5.84

cm) for the first and second seasons, respectively. As for sole treatment of Milagro application, data showed less response in fruit length**.**

3.1.2 Fruit diameter

Regarding fruit diameter, results showed that the tested cv. registered the highest values (3.40 & 3.44cm) as dusted with Milagro S. + pollen grains. Followed by pollen grains treatment (3.32 & 3.26cm).

Table 2. Physical characteristics of samani date fruits as affected by the bio-activator Milagro Stimcrop (during 2011 and 2012 seasons)

Treatments	Fruit length (L/cm)	Fruit diameter (D/cm)	Fruit shape L/D	Fruit weight (g)	Fruit volume (cm^3)	Flesh/fruit w/w %	Seed/fruit w/w %
First season							
Pollen grains P	5.70b	3.32b	1.72	28.70b	29.89b	90.50b	9.50b
Milagro. MS	5.54c	3.20c	1.73	27.04c	26.04c	89.17c	10.83a
P+MS	5.93a	3.40a	1.74	30.87a	30.96a	91.43a	8.57c
LSD at 5%	0.124	0.023	NS	0.479	0.615	0.483	0.367
Second season							
Pollen grains P	5.84b	3.26b	1.79	31.77b	31.33b	90.27b	9.73b
Milagro. MS	5.68c	3.17c	1.79	31.03c	30.87c	89.73c	10.27a
P+MS	6.00a	3.44a	1.74	32.05a	32.00a	90.98a	9.02c
LSD at 5%	0.127	0.046	NS	0.253	0.478	0.436	0.312

Means followed by same letters do not differ significantly at 0.05.

3.1.3 Fruit shape

Data in Table, 2 revealed that Samani cv. treated with Pollen grains or Milagro or combination of them, were similar in shape with non significant differences between its L/D ratios, this hold true for both seasons**.**

3.1.4 Fruit weight

Data indicated that date palms treated with (Milagro S. + pollen grains) showed highest values (30.87 & 32.05g) than other treatments. Regarding sole treatments, data cleared that dusting with pollen grain induced high significant increment in fruit weight (28.70 & 31.77 g) as compared with Milagro one.

3.1.5 Fruit volume

Data in Table, 2 cleared that the trend of fruit volume was similar to those of fruit weight.

3.1.6 Flesh / fruit %

The best results were significantly obtained when dates were pollinated with pollen grains + Milagro S. (91.43& 90.98%) followed in descending order by sole application of pollen grains (90.50 & 90. 27%), in the 1^{st} and 2^{nd} season, respectively "Table 2". Regarding pollination with sole Milagro treatment, results recorded the third in this respect.

3.1.7 Seed/fruit %

Data indicated that fruits from palms treated with sole application of Milagro contained the highest seed/fruit % (10.83 & 10.27 %) as compared with pollen grains treatment (9.50 & 9.73%). Meanwhile, the least values were recorded as palms treated with Pollen grains+ Milagro.

3.2 Effect of the Bio-Activator on Productivity.

3.2.1 Fruit set %

Table, 3 cleared that dusting with Pollen grains + Milagro Stimcrop had dominated in fruit set values which recorded (63.33 & 64.97 %). High values were also obtained as pollen grains used alone (59.57& 60.19 %) followed in descending order by the sole treatment of Milagro S. (57.37& 57.03%).

Table 3. Fruit set, fruit retention, yield and Specific weight of Samani date fruit (during 2011 and 2012 seasons)

Treatments	Fruit set%	Fruit retention%	Specific weight	Bunch Wt (kg)	Yield/palm (kg)
First season					
Pollen grains P	59.57b	39.00b	0.96	19.50b	126.3b
Milagro.S MS	57.37c	37.08c	1.04	18.64c	119.5c
P + MS	63.33a	45.77a	0.99	22.50a	136.7a
LSD at 5%	1.229	1.087	NS	0.484	2.55
Second season					
Pollen grains P	60.19b	43.09b	1.01	21.38b	125.3b
Milagro MS	57.03c	40.35c	1.01	19.22c	120.0c
P + MS	64.97a	46.68a	1.00	24.70a	133.8a
LSD at 5%	0.993	0.891	NS	0.625	2.76

Means followed by same letters do not differ significantly at 0.05

3.2.2 Fruit retention %

Significant increment in fruit retention were showed with different treatments. The best one that gave highest significant values were obtained in dates pollinated by combined treatment of Milagro + pollen grains (45.77 & 46.68%) followed by sole pollen grains treatment (39.0 & 43.09 %) for the first and second season, respectively "Table 3".

3.2.3 Specific weight

Table 3 showed that trend of specific weight was significantly similar with different tested treatments.

3.2.4 Bunch weight (*Kg*)

The highest bunch weight values were significantly obtained by combined treatments of Milagro S.+ pollen grains (22.5 & 24.7Kg) as compared with either sole treatment. Moreover,

bunch weight recorded high values with pollen grains treatment (19.5 & 21.38kg) followed in descending order by Milagro S. treatment (18.64 & 19.22Kg) with highly significant differences between them.

3.2.5 Total yield / palm (Kg)

Obtained data revealed that combined treatments of Milagro S.+ pollen grains recorded best results in total yield/palm (136.7&133.8 Kg) as compared with other treatments. Pollen grains Followed by Milagro treatment reflected high values of total yield / palm (126.3 & 125.3) and (119.5 & 120.0 kg), consecutively during 1st and 2nd season "Table 3".

The improvement in all aspects of physical characteristics for pollinated date cv. by the growth activator Milagro S. as dusting female inflorescence with pollen grains at rate (1g pollen grains+1g Milagro+3g filler material). may be attributed to its effects in stimulating biosynthesis of organic materials especially carbohydrates and proteins, and enhancement the formation and movement of natural hormones which are vital to improvement of cell division and cell enlargement, especially in meristematic tissues [18]. These results are also in harmony with those obtained by Al-Hammadi [19], Morales [20] and El-Khawaga [21].

Moreover, the enhancement in fruit set, fruit retention and yield / date palm of Samany cv. by pollination with either Milagro alone or combined with pollen grains may be attributed to its effects in the processes of photosynthesis, Auxin, Cytokinin, Gibberellins, Ethylene, Hydrogen Sinamed and Humic that progress the formation and movement of natural hormones which are vital to improvement of cell division, especially in the meristematic tissues. These findings are in accordance with reports by Soliman and El-Kosary [13], Kassem and Marzouk [22], Abo-El-Ez et al. [18], El-Kosary [23] and Al-Qurashi et al. [24].

3.3 Effect of the Bio-Activator on Fruit Chemical Characteristics

3.3.1 Non reducing sugars (%)

Fruits from palms treated with Pollen grains or Milagro S. contained less non reducing sugar values than those treated with its combination (8.6 & 8.44%). The lowest values were obtained as dates pollinated with Milagro (7.73 & 7.37 %), with high significant different among them (Table 3). Meanwhile, Samani *cv*. pollinated with pollen grains only reflected high significant increase values (8.01 & 7.73 %) in this respect**.**

3.3.2 Reducing sugars%

The best results for this parameter were registered with treatment of Milagro S + pollen grains (66.62 & 68.20 %), followed by pollen grains (66.27 & 66.93%) and Milagro S (65.44 & 65.61) treatments for the 1st and 2nd season, respectively.

3.3.3 Total sugars%

From obtained data, it is noticed that trend of total sugars was similar to those of reducing and none reducing one.

Table 4. Effect of the growth activator Milagro Stimcrop on the chemical characteristics of Samani date fruits (2011&2012 seasons)

Treatments	Non reducing sugar %	Reducing sugar %	Total sugar %	Tannins %	SSC %	Total Acidity %
First season						
Pollen grains P	8.01b	66.27ab	74.28b	0.510	25.23b	0.214
Milagro.S MS	7.73c	65.44b	73.17c	0.524	24.72c	0.223
P + MS	8.60a	66.62a	75.22a	0.498	25.78a	0.209
LSD at 5%	0.023	0.396	0.278	NS	0.322	NS
Second season						
Pollen grains P	7.73b	66.93b	74.66b	0.514	25.14b	0.232
MilagroS MS	7.37c	65.61c	72.98c	0.507	24.71c	0.239
P + MS	8.44a	68.20a	76.64a	0.503	26.00a	0.225
LSD at 5%	0.270	0.518	0.434	NS	0.295	NS

Means followed by same letters do not differ significantly at 0.05

3.3.4 Total soluble tannins%

It could be noticed from Table 4 that total soluble tannin values were statistically similar for different tested treatments.

3.3.5 Soluble solid contents SSC%

It is clear from Table 4 that best results of soluble solid contents were obtained as pollen grains combined with Milagro (25.78 & 26.0%) followed by single treatment of pollen grains (25.23 & 25.14%). While the least significant values, were obtained with the sole treatment of Milagro S.

3.3.6 Total acidity (TA %)

Results showed that Samani cv. treated with tested pollinators and its combination reflected similar effect with none significant differences among them.

The progress in contents of reducing, total sugars and total soluble solids as well as reduction in total acidity, tannins and non reducing sugars in juice of Samani date palm cultivar as pollinated with the growth activator Milagro S. alone or combined with pollen grain, may be attributed to the effect of natural hormones, Hydrogen Sinamed and Humic. It improved growth in all parts of the plant as a tonic for physiological processes in particular to enhance the process of photosynthesis and increases the yield moreover improves the quality characteristics. Similar results were reported by many authors such Al-Qurashi et al. [25], Eris et al. [26], Abo-El-Ez et al. [18] and Iqbal et al. [27].

4. CONCLUSION

Results of the present investigation demonstrated that the natural bio-activator Milagro Stimcrop has potential strategy for improving pollination process, yield and fruit quality of Samani date palm cv. as dusting female inflorescence with pollen grains at rate (1g. pollen grains+1g Milagro+3g filler material). Besides its environmentally safe effect as natural product.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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