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Effect of Different Ethephon Concentrations on Shiss Removal in 'Khlass' and 'Sukkary' Date Palm Varieties

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Abstract

After pollination, aborted date fruits known as tri-carpel or shiss, remain on the bunch in most of the varieties and exert a competition on fruits in water and nutrients. In Sukkary, they drop down at the end of kimri stage, while remain on 'Khlass' until the harvest. Most of them remain as bisr and little turns into tamr which is not appreciated in the date market. They can only be used as paste that has low price compared to dates. In an attempt to get rid of shiss, we sprayed Ethephon at different concentrations on bunches of 'Sukkary' and 'Khlass' after fruit-set, at hababook stage. Together with the shiss drop, a non-desirable fruit drop also occurs. We are looking for the optimum ethephon concentration where shiss dropped more than fruits. In 'Khlass', the Ethephon concentration 800 ppm showed the highest shiss drop (81%) together with a fruit drop of 20 % that occurs as well, while in 'Sukkary', the concentration of 600 ppm was the best by giving shiss drop equal to 44 % together with a fruit drop equal to 12%. We consider that the concentration of 800 ppm at hababook stage is the ideal concentration to generate optimum drop in shiss with reasonable percentage of fruit drop. We, therefore highly recommend a trial with this concentration on 'Sukkary' as well.

Keywords: Abortion, Shiss, Date palm, Fruit, Ethephon.

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Introduction

The Ethephon or the 2-chloroethylphosphonic acid (CEPA) is a systemic plant growth regulator, which in its liquid state at the proper pH does not yield ethylene; however, when the pH is elevated, it breaks down to form ethylene (Arteca, 1996). However, at pH higher than 4, it breaks down to ethylene, hydrochloric and phosphatic ions. It stimulates the endogenous ethylene production by releasing ethylene in the plant tissue as the cell cytoplasm has a pH higher than 4 (Nicotra, A. 1982).

The main role of ethylene is to make changes in fruit texture, softening, colour, and other processes involved in ripening. It is also known as the aging hormone in plants. It is well known that Ethephon can promote fruit abscission. Ethephon has been performed well as a fruit-thinning agent for many crops (Abeles et al., 1992). Ebert and Bangerth (1982) reported that ethylene inhibited the synthesis and translocation of Indole-3-Acetic Acid (IAA) within the fruits, thus reducing sink strength and ultimately inducing the separation area in the peduncle, which causes fruit drop (Roberts et al. 2002.).

El Hamadi et al. (1983) used Ethephon at different concentration from 200 to 400 ppm after fruit set and deduced that the level of thinning increase by increasing the concentration.

Mohamed et al .(2015) concluded that Ethephon at 1000 ppm, ten days after pollination are suitable for

obtaining economic yield with best fruit quality.

Bakr et al. (2006) tested the effect of ethephon on fruit thinning compared with cytophex at different concentrations and dates of application on 'Samany' date palm variety. They concluded that, 'Samany' fruit set was decreased when ethephon was sprayed at 18 days from pollination especially at 300 ppm.

No study has been done before to use Ethephon in order to remove aborted date fruits known as tri-carpel or shiss that remain on the bunch and compete with fruits on water and nutrients. That was the objective of this investigation.

Materials and Methods

Location of the experiment: This trial was carried out in the Experimental farm "Naam" of Yousef Bin Abdul Latif and Sons Agriculture Co. Ltd. (YALA) in Qassim, Saudi Arabia.

The weather conditions of the farm during the 12 days of the experiment on each of the two date varieties 'Sukkary' and 'Khlass' are summarized in the Figures 1 and 2 as recorded by the weather station of the farm.

For 'Sukkary' during the 12 days of study (6-18

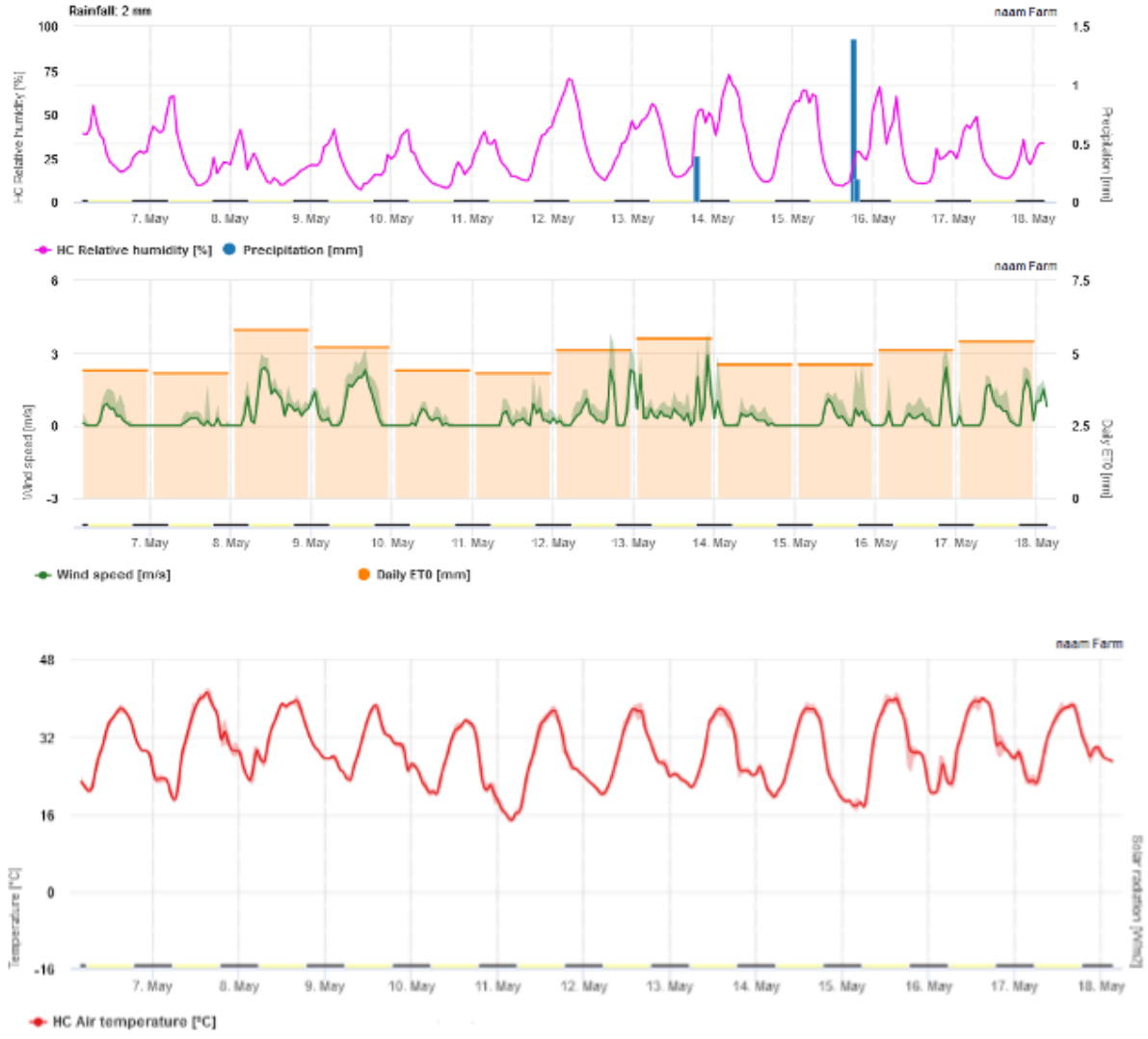

Figure 1. Weather conditions of the experimental farm during the 12 days of study on 'Sukkary' variety (from 6 to 18 May 2019).

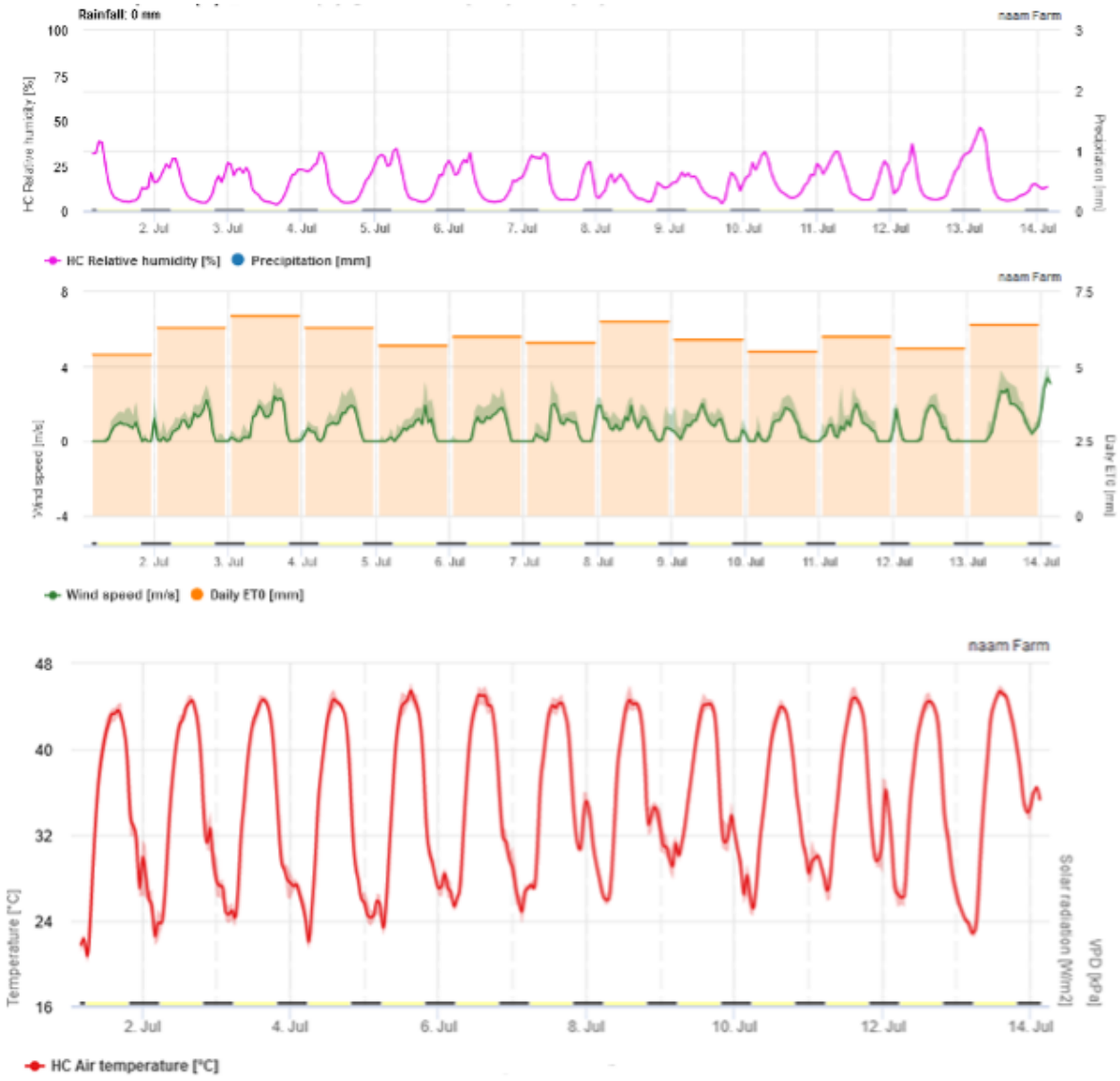

Figure 2. Weather conditions of the experimental farm during the 12 days of study on 'Khlass' variety (from 2 to 14 July 2019).

May 2019), the reference evapotranspiration (ET0) ranged between 4.3 and 5.8 mm day-1, the cumulative precipitation was 2 mm and the maximum wind speed was 5.5 m/s. The maximum temperature recorded during the day ranged between 35.4 and 41.2 °C (Figure 1).

For 'Khlass' during the 12 days of study (2-14 July 2019), the reference evapotranspiration (ET0) ranged between 5.4 to 6.7 mm day-1, there was no precipitations during this period, and the maximum wind speed was 3.3 m/s. The maximum temperature recorded during the day ranged between 43 and 45.5 °C (Figure 2).

The Experiment: The spray started first on 'Sukkary', as it is an early maturing variety, then on 'Khlass'. 'Sukkary' was prayed on 6 May 2019 and the evaluation was done 12 days later on 18 May 2019. 'Khlass' was sprayed on 2 July 2019 and the evaluation was done 12 days later on 14 July 2019.

The concentrations of Ethephon applied on 'Sukkary' were: 1000 ppm, 600 ppm and 400 ppm and the control where only pure water is sprayed. After evaluation of results on 'Sukkary', we changed the concentrations on 'Khlass' to respectively 1000 ppm, 800 ppm, 600 ppm and pure water.

Three trees per variety have been used for this experiment. One bunch per tree per treatment was sprayed. We have in total three bunches per treatment.

Before the spray, the total number of fruits and shiss were counted. After the spray, the bunches are

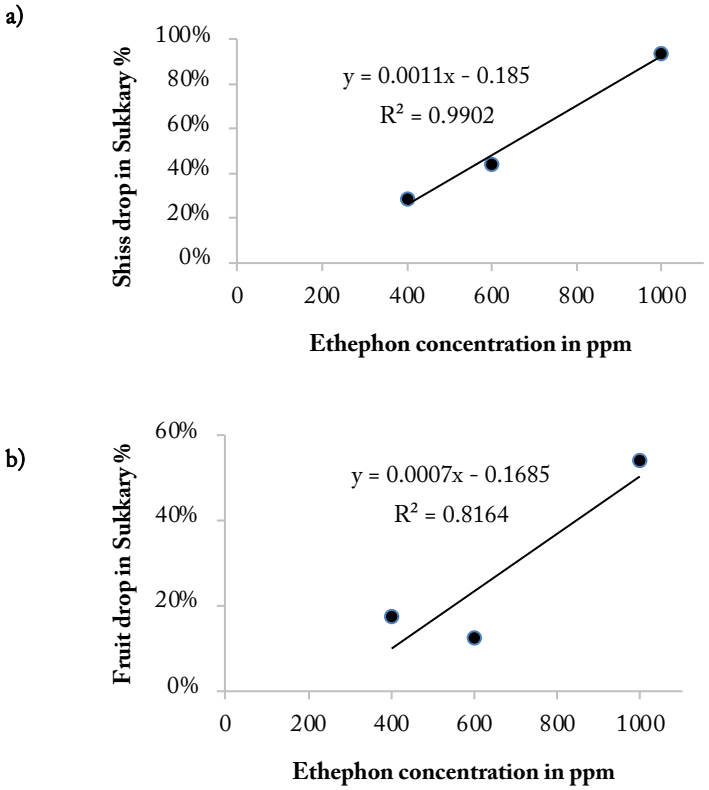

Figure 3. Correlation between sprayed Ethephon concentration and percentage of shiss (a) and fruit drop (b) generated in 'Sukkary' date variety.

covered with a bunch bag (a mesh bag) to collect dropped shiss and fruits.

Fruits and shiss remaining on the bunches are counted 12 days after the spray. Dropped fruits and shiss are calculated as follow:

Number of dropped fruits = IFN –FFN

Number of dropped shiss = ISN –FSN

Where:

IFN : Initial fruit number on the bunch before spray

FFN : Final fruit number on the bunch 12 days after spray

ISN: Initial shiss number on the bunch before spray

FSN : Final shiss number on the bunch 12 days after spray

The percentage of fruits and shiss dropped from the total initial number existing before the spray is calculated as follow:

Percentage of fruit drop (%) = Number of dropped fruits / Number of fruits on the bunch before the spray

Percentage of shiss drop (%) = Number of dropped shiss / Number of shiss on the bunch before the spray

Results and Discussion

When bunches of 'Sukkary' were sprayed with 1,000 ppm of Ethephon, 94% of shiss dropped together with 54% of fruits (Table 1). At 600 ppm Ethephon, 44% of the shiss dropped, against 12% of fruit drop. At the concentration of 400 ppm Ethephon, 28 % of the shiss dropped and 17 % of fruits. For the control where pure water is sprayed on the bunches, 4% of the shiss dropped, together with 8% of fruit drop.

The concentration of 1000 ppm Ethephon, even it generated a desirable high shiss drop, significantly different from the one generated by the concentration of 600 ppm Ethephon, it did the same for the fruit drop (Table 1). This is why we recorded a high correlation between Ethephon concentration from one side and shiss drop (R^2 = 0.9902) and fruit drop percentages (R^2 = 0.8164) from the other side (Figure 3). Therefore, we have to look for an optimum concentration of Ethephon that generated a significant increase of shiss drop with a lower fruit

Table 1. Percentage of drop generated in fruits and shiss of 'Sukkary', 12 days after the spray by Ethephon at different concentrations.

	Ethephon Concentration			Control (Pure Water)
	1000 ppm	600 ppm	400 ppm	
Percentage of shiss drop (%) *	94% a	44% b	28% c	4% d
Percentage of fruit drop (%) **	54% a	12% b	17% b	8% c

(*) Averages of shiss drop (%) that do not share the same letter are significantly different according to T-test analysis.
(**) Averages of fruit drop (%) that do not share the same letter are significantly different according to T-test analysis.

Table 2. Percentage of drop generated in fruits and shiss of 'Khlass', 12 days after the spray by Ethephon at different concentrations.

	Ethephon Concentration			Control (Pure Water)
	1000 ppm	800 ppm	600 ppm	
Percentage of shiss drop (%) *	89% a	81% a	64% b	4% c
Percentage of fruit drop (%) **	37% a	20% b	24% b	0% c

(*) Averages of shiss drop (%) that do not share the same letter are significantly different according to T-test analysis. (**) Averages of fruit drop (%) that do not share the same letter are significantly different according to T-test analysis.

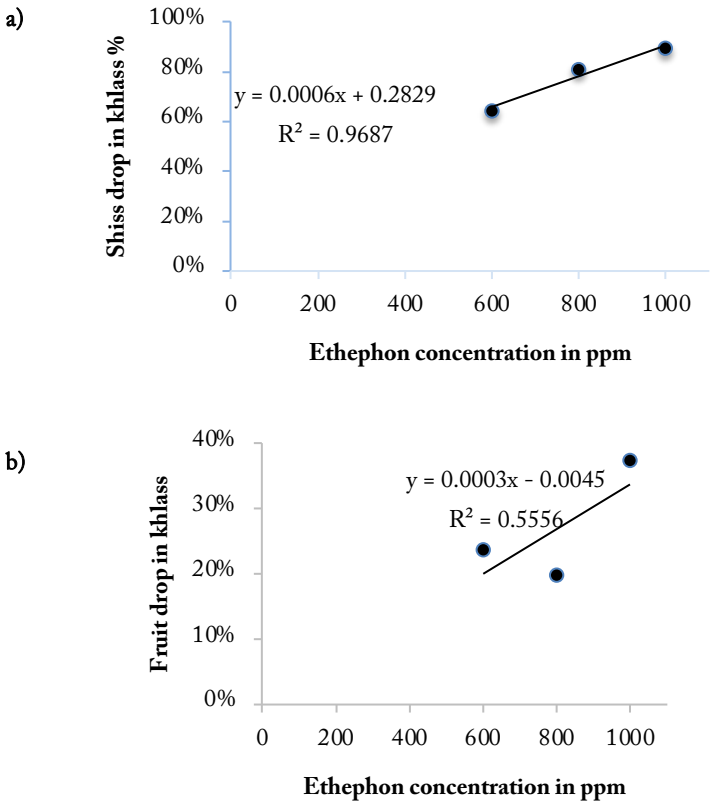

Figure 4. Correlation between sprayed Ethephon concentration and percentage of shiss (a) and fruit drop (b) generated in 'Khlass' date variety.

drop percentage. It seems that an Ethephon concentration between 1000 ppm and 600 ppm (800 ppm for example) might be the optimum concentration to be tried to get at the same time more shiss drop and less fruit drop. For this reason, we replaced the concentration 400 ppm of Ethephon by 800 ppm in the same season on the next experiment on 'Khlass' that flowers after 'Sukkary'.

On the other hand, when bunches of 'Khlass' are sprayed with 1,000 ppm of Ethephon, a total of 89% of shiss dropped together with 37% of fruits (Table 2). At 800 ppm Ethephon, 81% of shiss dropped, which is not significantly different from shiss percentage dropping in the case of 1000 ppm Ethephon. The concentration 800 ppm Ethephon generated also 20% of fruit drop, similar statistically to the fruit dropping in the case of 600 ppm Ethephon (24%). At the concentration of 600 ppm Ethephon, 64 % of the shiss dropped and 24 % of fruits. For the control where pure water is sprayed on the bunches, 4% of the shiss dropped, with no drop recorded in the fruits.

In 'Khlass', the Ethephon concentration 800 ppm showed the optimum drop between shiss (81%) and fruits (20 %), as it generated similar shiss drop percentage generated by the highest Ethephon concentration (1000 ppm) and kept a similar non-desirable fruit drop percentage (20%) as the one generated by the lower 600 ppm ethephon concentration (24%).

This has been translated by a strong correlation between Ethephon concentration and shiss drop (R^2 = 0.9687) (Figure 4a) and a low correlation between Ethephon concentration and fruit drop (R^2 = 0.5556) (Figure 4b).

In a chemical thinning experiment, Mohamed et al., (2015) sprayed after ten days from pollination (10 DAP) the Ethephon at 500 and 1000 ppm on 'Khlass' and 'Ruzeiz' date varieties. When the evaluation is made after two months from pollination, they found out that the fruit drop in both 'Khlass' and 'Ruzeiz' was not concentration-dependant. They reported a fruit drop in 'Khlass' equal to 45.5 % and 38.6 % respectively for 500 ppm and 1000 ppm of Ethephon and in 'Ruzeiz' equal to 16.3 % and 17.9 % respectively for 500 ppm and 1000 pm of Ethephon. The effect of the increase in their Ethephon concentration was only seen at the harvest when they evaluated the fruits retained on the bunch, which was in 'Khlass' 63.9 % and 44.9 % respectively for the treatment 500 ppm and 1000 ppm of Ethephon and was in "Ruzeiz" 77.1 % and 62.5 % respectively for the treatment 500 ppm and 1000 ppm of Ethephon.

Ghazzawy et al., (2019), concluded on 'Khlass' that the Ethephon applied at different concentrations 5 days after pollination (DAP) generated an average of 42.1 % of fruit drop against 43.4 % when applied 10 days after pollination. They also reported in both application times that the greater the concentration of Ethephon is, the lower the fruit drop becomes. When the Ethephon is applied 5 DAP, the fruit drop is 50.1%, 40.2 %, 35.8 % and 36 % respectively for the control, 100 ppm, 200 ppm and 300 ppm of Ethephon.

Conclusion

To remove aborted fruits (known as tri-carpel or shiss) that remains on the bunch and exert a competition on water and nutrients, we sprayed Ethephon in hababook stage at different concentrations on bunches of 'Sukkary' and 'Khlass'.

In 'Khlass', the Ethephon concentration 800 ppm showed the optimum drop (more shiss and less fruits) equal to 81% in shiss and to 20 % in fruits. Whilein 'Sukkary', the concentration of 600 ppm was the optimum by giving shiss drop equal to 44 % and fruit drop equal to 12%.

We consider that the concentration of 800 ppm at hababook stage might be the ideal concentration to generate optimum drop in shiss with reasonable percentage of fruit drop. We, therefore highly recommend a trial with this concentration on 'Sukkary'.

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