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Effect of Perianth (Cap) Persistence on Date (*Phoenix dactylifera* L.) Fruits Infestation with Store Insects

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Abstract. This study was conducted to investigate the effect of perianth (cap) persistence on date fruits infestation with store insects as well as the effect of two fruit detaching methods at four fruit ripening stages on cap persistance, using four cultivars viz. Rothana, Rushodia, Sukari and Shagra. The criterion of infestation is the presence of frass inside the fruit.

Less than half the fruits with caps were infested, whereas most of the fruits without caps were infested in all cultivars. cv Rothana was the least affected, followed by cv Rushodia, whereas cv Shagra was the most affected.

Most fruits lost their caps when they were detached from strands at the 100% Rutab stage. On the other hand, more fruits retained their caps when detached by twisting rather than by pulling for most cultivars and fruit ripening stages.

Date growers, who store their date fruits openly, are advised to avoid detaching the fruits from strands at the 100% Rutab stage. Fruits at this stage should be detached only when they become fairly dry. This would result in more fruits with caps and, consequently, less infestation.

Introduction

Date palm (*Phoenix dactylifera* L.) is the major fruit crop in north Africa and Arabian peninsula [1]. More than four hundered thousand tons of fruits are produced annually in Saudi Arabia [2]. Some of this amount is consumed fresh at the Khalal and Rutab stages, whereas the major part is stored openly and used during the rest of the year, thus becomes vulnerable to the attack of store insects [3,4]. The masses of frass and the presence of live and/or dead larvae inside infested fruits renders them unpalatable and consequently reduces their economic value [5].

Extensive research has been reported on the control of store insects of date fruits [1,3,6-8]. However, most of this research was concerned with the chemical

treatment of fruits to eliminate the insects which could have already inflicted significant damage. Moreover these chemicals may leave some hazardous residues [9,10,pp. 293-310]. therefore some protective measures are needed to repel or prevent the insects from penetrating the fruits in store houses.

It has been observed that the fruits with perianth (caps) are less likely to be infested [6]; however, no data were presented to substantiate this point. The present study was carried out to investigate the effect of cap persistence on the extent of date fruit infestation, and to point out some practices which may enhance fruit cap persistence.

Materials and Methods

four date cultivars viz. Rothana, Rushodia, Sukari and Shagra were used in this study which was conducted at the College of Agriculture, King Saud University, Qassim, Saudi Arabia. These cultivars are popular in Qassim region and their fruits differ in hardness at the Tamer stage (Tamer refers to the stage when the fully ripe fruits become fairly dry). The fruits of cv Rothana are the hardest, whereas those of cv Shagra are the softest.

Experiment 1

In 1985 five fruit samples per cultivar were collected from different date growers at Qassim, Saudi Arabia, three months after harvest. The fruits of each sample were divided into two groups; those with caps and those without caps. Each group consisted of two hundred fruits. Every fruit was split into two halves and examined for infestation. The criterion of infestation is the presence of frass inside the fruit. The data were used to calculate the percentage of infested fruits of each group.

Experiment 2

Four samples of fully ripe fruits of each cv were collected at harvest. The fruits without caps were discarded. For each sample six hundred fruits with caps were divided randomly into two equal groups. The fruits of one group were left with caps attached while the caps were removed from the fruit of the other group. Then the fruits of each sample were put in a mesh bag and stored among infested fruits of the same cultivar at room temperature. Three months later each fruit was split into two halves and examined for infestation to calculate the percentages of infested fruits with caps and without caps for each cultivar.

In experiments 1 and 2 the data were subjected to arc-sine transformation [11,pp. 306-308] and analysed as split plot using cvs as main treatments and fruit groups i.e. with or without caps, as subtreatments.

Experiment 3

Three semi-ripe bunches of each cultivar were collected from different trees. Half the fruits at the 50% Rutab stage were detached from the strands by twisting while the rest were detached by pulling each fruit. The fruits at 75% and some of the fruits at 100% Rutab stages were treated similarly. (The percentage designating the Rutab stage = the length of the soft apical end × 100/the whole length of the fruit). The rest of the fruits at the 100% Rutab stage were left attached to the strands and stored at room temperature for two months. Then the fruits were detached as described earlier. One hundred fruits per ripening stage and detaching method were chosen randomly and, then examined for the presence of the cap to calculate the percentage of fruits with caps for each fruit ripening stage and method of detaching.

The data were subjected to arc-sine transformation and then analysed as split-split plot using cvs as main treatments, fruit ripening stages as sub-treatments and detaching methods as sub-sub-treatments.

Results and Discussion

Experiments 1 and 2 indicated that about 20% or less of cvs Rotahana, Rushodia and Sukari, and about 50% of cv Shagra fruits with caps were infested with store insects, whereas most of the fruits without caps were infested in all cultivars (Table 1). Cv Rothana fruits were the least affected, followed by cv Rushodia, whereas cv Shagra fruits were the most affected, irrespective of the fruit type, indicating that the cvs with harder fruits were less infested. The significant difference between the cvs with respect to the infestation of the fruits with caps (Table 1) could be attributed to the loose adherence of the caps to the fruits of cvs Shagra and Sukari in comparison with cvs Rothana and Rushodia, which enables the date store insects

Table 1. Effect of fruit group on the percentage of infested fruits in Experiments 1 and 2

Fruit group	Cultivar				
	Rothana	Rushodia	Sukari	Shagra	Ave.
Experiment 1:					
Fruits with caps	7.9*bC	10.3 bC	20.1 bB	49.3 bA	22.1 b
Fruits without caps	82.4 aB	88.6 aB	97.0 aA	98.4 aA	91.8 a
Ave.	45.2 C	49.7 C	58.6 B	73.9 A	–
Experiment 2:					
Fruits with caps	9.5 bB	12.7 bB	16.1 bB	53.8 bA	23.0 b
Fruits without caps	79.8 aB	91.5 aB	93.8 aAB	98.8 aA	88.5 a
Ave.	44.7 C	52.2 BC	55.0 B	76.4 A	–

* Mean separation by Duncan's multiple range test at 0.05 level of probability using transformed values (arc-sine). Means in the same column bearing the same lower case letter are not significantly different. Means in the same row bearing the same upper case letter are not significantly different

to find their way inside these fruits. On the other hand some fruits of cvs Rothana and Rushodia were found to be sealed at their basal ends, even after caps removel, which might have prevented their infestation, a situation which did not occur with the other two cvs. The substantial differences between the fruits with caps and those without caps, regarding the extent of infestation (Table 1), is probably the reason behind the positive association between the prices of fruit lots and the percentages of fruits with caps in each lot within the same cv (Personal communication).

These findings suggest that any measure which could enhance fruit caps persistence may probably lead to the reduction of fruit infestation. Therefore the effect of two methods of fruit detaching from strands at four fruit ripening stages on cap persistence was investigated.

Analysis of variance for the percentage of fruits with caps, after subjected to arcsine transformation, were presented in Table 2. There are significant differences between cultivars, fruit ripening stages and the fruit detaching methods, as well as their first order interactions.

Table 2. Analysis of variance of the transformed (arc-since) percentages of fruits with caps.

Source of variation	df	MS
Cultivars (C)	3	1650.27**
Error (a)	8	26.31
Fruit ripening stage (S)	3	10095.53**
C × S	9	395.58**
Error (b)	24	26.98
Fruit detaching method (M)	1	791.78*
C × M	3	145.44*
S × M	3	350.50**
C × S × M	9	54.33
Error (C)	32	40.25

*, ** indicates significance at 0.05 and 0.01 levels of probability, respectively.

Detaching the fruits from strands at the 100% Rutab stage resulted in significantly lower percentages of fruits with caps compared to all other fruit ripening stages for all cvs and both fruit detaching methods (Table 3). At the 100% Rutab stage the fruits were soft at the basal ends and, therefore, slipped easily when detached, leaving the caps behind. For the rest of fruit ripening stages the differences were not significant between 50% and 75% Rutab and whether these were superior to the Tamer stage or not depended on the cv and fruit detaching method. Significantly higher percentage of fruits with caps were obtained when the fruits were detached by twisting rather than by pulling for 50% and 75% Rutab stages and all cvs except cv Rushodia (Table 3). Similarly less danger of fruit plugging was observed with mandarines (*Cit-*

rus reticulata Blanco) when the fruits were detached by twisting in comparison with pulling [12, pp. 119-115].

Table 3. Effect of two fruit detaching methods and four fruit ripening stages on the percentages of the fruits with caps in four date cultivars.

Fruit ripening stage	Cultivar				
	Rothana	**Rushodia**	**Sukari**	**Shagra**	**Ave.**
50% Rutab	44.8 aB	28.5 bC	83.3 aA	71.3 aA	57.5 a
75% Rutab	43.7 aB	25.3 bC	80.8 aA	69.0 aA	55.4 a
100% Rutab	2.1 bA	0.9 cA	4.8 cA	1.5 cA	2.1 b
Tamer	57.8 aB	61.6 aA	65.1 bA	53.5 AB	57.8 a
Ave.	35.5 C	24.9 D	57.1 A	45.6 B	-
Fruit detaching method					
Pulling	24.7 bC	25.3 aC	51.6 bA	39.6 bB	34.9 b
Twisting	43.2 aB	24.4 aC	62.6 aA	49.8 aB	46.4 a

	Fruit ripening stage			
	50% Rutab	75% Rutab	100% Rutab	Tamer
Pulling	49.3 bB	44.2 bB	1.1 aC	63.6 aA
Twisting	66.0 aA	66.3 aA	3.6 aC	55.6 aB

* As in table 1

In conclusion, the date growers who use to store date fruits openly are advised to avoid detaching the fruits from strands at the 100% Rutab stage and it would be better to leave the fruits attached until they become fairly dry. In case the fruits are to be detached at earlier stages, this may be done by twisting the individual fruits so as to keep the caps on them and thereby reduce the incidence of infestation with date store insects.

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تأثير الغلاف الزهري على إصابة ثمار النخيل بالتسوس

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ملخص البحث. أجـري هذا البحث على أربعة أصناف من النخيل لتوضيح علاقة الغلاف الزهري بالتسوس الذي يصيب الثمار التي تخزن عاديا، ثم دراسة تأثير جني الثمار بطريقتي اللف والشد عند أربعة مراحل للنضج على نسبة الثمار التي يوجد عليها الغلاف الزهري. وجود بقايا الحشرات داخل الثمرة هو المعيار الذي استخدم للحكم على إصابتها بالتسوس.

لقد وجد أن نسبة قليلة من الثمار ذات الغلاف الزهري قد أصيبت بالتسوس في حين أن معظم الثمار عديمة الغلاف الزهري قد تعرضت للاصابة في كل الأصناف. أقل الأصناف إصابة هو الصنف «روثانا» يليه الصنف «رشودية» وأكثرها إصابة هو الصنف «شقراء» ثم الصنف «سكري».

أدى جني الثمار عند مرحلة النضج ١٠٠٪ رطب إلى أقل نسبة من الثمار ذات الغلاف الزهري بينما أدى جني الثمار بطريقة اللف إلى نسبة أعلى من الثمار ذات الغلاف الزهري بالمقارنة مع طريقة الشد، وعليه فإنه ينصح بعدم جني الثمار التي تخزن عاديا عند مرحلة النضج ١٠٠٪ رطب ويجب أن تترك مثل هذه الثمار على السباطات حتى تجف، كي تظل الأغلفة الزهرية لاصقة بها مما يقلل من نسبة الثمار المصابة بالتسوس.