Effect of Bunch Covering and Biological Control on Insects and Microbial Load of Date Palm Fruits

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Abstract

This study aimed to evaluate the effect of bunch covering and biological control on safety from insects and microbes of two date palm cultivars grown in Egypt, Siwi date (semi dry cv.) in two zones (El-Dakhla and Bahariya Oasis) and Bartamoda (dry cv.) in Aswan governorate during two successive seasons 2020 and 2021. The results found that insect pests such as *Parlatoria blanchardii*, *Carpophilus sp*., *Oryzaephilus surinamensis* and *Ephestia calidella* in semi-dry and dry dates without bunch cover and biological control comparing other treatments. Results indicated that bunch covering of date fruits at the suitable time and biological control with *Trichogramma sp.* cards were reduced number of insects, symptoms, and microbial loads of date fruits higher than that other ones. Insect infestation percentages were ranged from (9.85) to (18.82 %) of Sewi semi dry dates. while, (7.8 and 9.5 %) of Bartamoda dry dates with control. while, the treated bunch covering and biological control were reduced less than (3.11 %) of semi dry dates and less than 2.88% of dry dates, respectively. Also, results indicated that using *Trichogramma sp.* cards in sawmill reduced infestation percentages and microbial loads compared with control.

Keywords: Date fruits, bunch covering, pest control, biological control, microbial load
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Introduction

Date palm(phoenix dactylifera L.), is a tropical and subtropical tree, belonging to the family Palmae (Arecaceae) is one among man- kind's oldest cultivated plants, and in the Arabian Peninsula it has played an important role in the day-to-day life of the people for last 7000 years (Ahmed *et al*., 1995). World production of dates has increased significantly and steadily over the last 30 years. Arab countries produce about 74.5% of the world's total production. Egypt is the largest world's top ten producers of dates (FAO, 2018). Egypt produces 1.710.601tons of date fruits. Only 16.5% of total date fruit production was directed for food processing (Ministry of Agriculture and Land Reclamation, 2020). *Ephestia* moth was found in very low numbers in the field and in the product gathered after harvesting. This was considered main stored date pests in the surrounding countries (Al Antary *et al*., 2015). Plastic nets were first used to protect the ripening date fruits from casual large pests, such as birds, lizards and Later, the raisin moth, the carob moth, the greater date moth, and sap beetles (Blumberg, 2008). The most depreciatory damage on date palm fruit quality in Morocco is the date's infestation by moths (*Ectomyelois ceratoniae*) and the percentage of infested dates is estimated between 1 to 4% in the field and can reach more than 70% during fruit storage. Bunch covering with nets was decreased infestation rates lees than 1% (Zirari and Laaziza,

2010). Aldawood (2013) indicated that dates fruit bunches provided with covers showed less *E. cautella* infestation as compared to uncovered dates fruit bunches. The bagging bunches increased the bunch weight, accelerated ripening and improved fruit quality compared with the ungagged ones (Mostafa *et al*., 2014). Also, Rubel *et al*. (2019) reported that disease infection, insect infection and physiological disorder at harvesting time of banana bunch covering materials namely white polythene bag, black polythene bag, blue polythene bag and old cloth along with control (no bunch covering) were decreased from 12.67 as a control to 4.33, 5.33 and 2.33 of disease infection, 5.0, 10.67 and 2.33 of compared the control 50.0 insect infection and physiological disorder 8.0 8.33 and 1.0 compared the control 13.4, respectively. Perring and Nay (2015) reported that Carob moth, *Ectomyelois ceratoniae* and infestations of marketable fruit were significantly lower for mesh bags (0.6–3.1%) compared with paper wraps (8.5–15.5%). Other fruit pests such as raisin moth, *Cadra figulilella* and beetles were less common than the carob moth. Aleid *et al*. (2014) recommended that the comparative analysis of microbiological quality and physicochemical properties at the farm level, as well as a comprehensive investigation of current guidelines on date quality, are required to review the important quality criteria of date's standards. Therefore, the present study aimed to evaluate the effect of covering treatment and biological control in the field and sawmills on insects and microbial of dates fruits in three different regions.

Materials and methods

Raw materials

White polyethylene bags nets of 1.7 and 0.15 mm^2 meshes and the size (1×0.80 m) were purchased from El Tahrir Company for Shade and Safety Net, Egypt.

Trichogramma cards

The egg parasitoid was obtained from the mass rearing laboratory of *Trichogramma sp.*, Plant Protection Research Institute, Agricultural Research Center, Giza, Egypt. The parasitized eggs of the host were glued onto paper cards (1.5×3.5 cm) each containing 1000 eggs approximately. The paper cards were hanged on date palm trees using strings and released just before sunset. The rate of release was 10.000 eggs/feddan.

Experimental design

The experiment was performed during the 2020 and 2021 seasons on the selected extension fields for project ID:4664 (Improving the quality and safety of Egyptian dates and dates products) and funded by the Academy of Scientific Research, Ministry of Higher Education and Scientific Research, Egypt. The three extension fields were grown date palm trees (65-70 date palm tree/ field) in a private orchard located at Bahariya Oasis, El-Dakhla Oasis and Aswan, Egypt. Covering bunches were performed at the first color stage immediately and bunches remained covered until the harvest date. *Tricograma sp.* parasite cards were released three times, the first during pollination, the second starting, the coloring stage of date fruit

and the third during drying date in open filed (sawmills) in Aswan and Bahariya Oasis. The date fruits were harvested at tamr stage. The date fruits were not reached at tamr stage during harvesting complete drying in sawmills till reached tamr stage.

Infestation test

Ten- kilogram date fruits were collected randomly and checked visually and examined by using binocular to identify insects, symptoms and insect infestation percentages. The insect infestation percentages of the insects were calculated as follows:

Insect infestation %= Insect infestation date fruits x 100/ Total date fruits (Kg)

Microbiological analysis

Date flesh fruit (10 g) were weighed and (90 ml) sterile peptone water was added, and then homogenized for 2 minutes, and serial dilution was prepared. 1ml of the stock solution was transferred into a test tube containing nine milliliter (9.0 ml) of sterile distilled water and the tube was shaken and labeled 101. From the tube containing one milliliter (1.0 ml) was then transferred into another tube containing 9.0 ml of sterile distilled water and labeled as 102 using sterile syringes. This was also agitated and the procedure was repeated up to 10^5 using sterile syringes. Then results were reported as colony forming units (CFU) per gram (APHA, 1992). One Milliliter (1.0 ml) from the dilution factors of each labeled sample was transferred into appropriately labeled triplicate sterile petri dishes. This was followed by pouring a cooled nutrient agar (for the total count), Potato Dextrose Agar (for the yeast and mold), Salmonella agar for the (*salmonella sp.*), Macconkey agar for the (*E. coli*) and Listeria agar for the (*Listeria sp.*) each into appropriately labeled separate triplicate petri dishes. The plates were incubated at 30˚C±2 ˚C for 12-48 hours for microorganism while, yeasts and mold were incubated at 25˚C for 4-5 days (Atlas, 2004).

Results and discussion

Effect of bunch covering and biological control on the number of insects, symptoms and percentage of infestation after the harvest of date fruits

The data presented in Table (1) shows the effect of bunch covering with sachet and biological control on the number of insects, symptoms and percentage of infestation of date fruits pests in the three tested regions (Bahariya Oasis, Dakhla Oasis and Aswan) during two consecutive seasons . For the Bahariya region and El-Dakhla Oasis, the obtained results indicated that the species of insects of control were founded in the Siwi semi dry date palm were (*Parlatoria blanchardi , Carpophilus spp., Oryzaephilus surinamensis* and *Ephestia calidella*), respectively while the treated bunch covering was founded (*Parlatoria blanchardi*) only. On the other hand, Aswan region, the species of insects of Bartamoda dry dates of control founded *Parlatoria blanchardi* and *Oryzaephilus surinamensis* compared with treated date palm by covering punch that *Parlatoria blanchardi* founded only. Results illustrated that

number of insects in the control Siwi fruit in Baharia Oasis was higher than that of the same date (Siwi date fruits), this due to increasing moisture content in the date fruit. Aldawood (2013) investigate the effect of covering dates bunch on *Ephestia cautella* infestation, in the field and found that *E. cautella* infestation of dates fruit bunches provided with covers was less as compared with uncovered dates fruit bunches. Latifian (2012) revealed that bunch covering had suitable effects in decreasing the lesser date moth infestation. Hajjar and Al-Masoud (2018) reported that *Trichogramma cacoeciae* decreased the moth and egg of *Ephestia calidella* on date palm in Saudi Arabia. The symptoms of infestation with *Virachola Livia and Ephestia sp*. decreased to be recorded 0 compared with the control (which did not cover its bunch), where, it was recorded 22.17 of *Ephestia sp.* in 2020 and 2021 seasons of Siwi date fruits in Bahariya Oasis while ,the same insects of El-Dakhla Oasis was 8 and 9 in two seasons, respectively. On the other hand, symptoms of *Ephestia sp.* were not founded in Bartamoda dry dates regardless treatment or control. Latifian (2017) mentioned that the use of integrated management for control, including biological control and agricultural methods, such as covering the bunch, led to improving the quality and quantity of dates, reducing the number of insects and reducing the pesticides used. Results in table (1) showed that infestation percentage in two seasons was high at three times for control compared with bunch covering regardless region or date types. Covering of dates prevent of penetration all insect pests including beetles, ants, flies, rats, and birds of date fruits.

Effect of biological control on the number of insects, symptoms and percentage of date fruits infestation after sawmill of date fruits

Data presented in Table (2) showed the effect of biological control on the number of insects, symptoms and infestation percentage of free date fruits from insects before complete drying in a sawmill at Bahariya Oasis and Aswan. The results indicated that the treatment with biological control recorded a high number of *Parlatoria blanchardi* compare with control and treated biological control. It may be due to high relative humidity on these production dates. *Ephestia calidella* was founded in Sewi date at semi dry while, it is not founded in Bartamoda dry dates. It may be this insect lives in moisture content about 20%. Infestation number of *Virachola livia* was decreased of dry date treated with biological control during drying in sawmill compared with the control. Symptoms of *Virachola livia* and *Ephestia sp.* were reduced with biological control than control. On the other hand, in the Aswan region results showed that treatment by biological control reduced to (1.5 and 2) for two seasons of the number Oryzaephilus *surinamensis.* From Table (2) the percentage of insect infestation was observed a sharp decrease in the treated with biological control of dates compared with control. Latifian, *et al*. (2014) and Latifian and Rad (2017) showed that cultural management factors were included tillage, fertilization, irrigation, pruning, bunch covering and bunch arrangement have a great effects in decreasing the date palm borer pest infestations and date spider mite infestation.

Effect of bunch covering and biological control on microbial loads after harvest of date fruits in 2020 and 2021 seasons

Results in Table (3) showed that, the microbial load in control and covering samples. In control samples results were as follows: Sewi cultivar in Bahariya Oasis, the average of the total viable count were 95 and 100 CFU/g, when yeast and mold were 20 and 25 CFU/g and *Listeria sp.* were 34 and 25 CFU/g in season 2020 and 2021, respectively. In the Sewi cultivar in El-Dakhla Oasis, the average of total counts were 75 and 77 CFU/g, 20 and 15CFU/g in yeast and mold while, the *Listeria sp.* were 12 and 7.5 CFU/g during season 2020 and 2021 respectively. In the Bartamoda cultivar, in 2020 and 2021 the total count were 260 and 200 CFU/g, 4 and 5 CFU/g in yeast and mold, and in *Listeria sp.* were 50 and 30 CFU/g respectively. In covering samples, the average of total count in the Sewi cultivar in Bahariya Oasis were 23 and 20 CFU/g, yeast and mold were 2 and 3 CFU/g. 7 and 2.5 in *Listeria sp*. In the Siwi cultivar in El-Dakhla Oasis, 60 and 65 CFU/g in the average of total count, 15 and 17 CFU/g in yeast and mold and 4 and 2 CFU/g in *listeria sp*. In Bartamoda cultivar, the total counts were 198 and 150 CFU/g, 2 and 3 CFU/g in yeast and mold, and in *Listeria sp*. were 35 and 15 CFU/g, respectively in 2020 and 2021.

Results in Table (3) cleared that, the total viable count ranged from 23 to 260 CFU/g regardless treatments with bunch covering or biological control or date cultivars. These results are agreement with Public Health Laboratory Services (1996) in the United Kingdom and Gilbert *et al.* (2000) who showed the guideline of aerobic colony counts not exceed more than 10^7 CFU/g in fresh fruits. Abdul Aly *et al.* (2018) indicated that the source of microbial development result mostly from bad post-harvest operation in the field. Bellaouchi *et al.* (2017) reported that total viable counts in fifteen under-valued date varieties ranged from $1.7x10^3$ to 5x108 CFU/g. Yeasts ranged from 6 CFU/g to $2.1x10^8$ CFU/g, while mold varied between 2 CFU/g and $1.3x10^5$ CFU/g. They said that these values are due to high contents water activity ranging between 0.7 and 0.8 in date fruits. Using covering bunch referred that microbial load was decreased comparing the control samples. These results agreement with Amani and Avagyan (2014) reported that cover of polyethylene over a banana bunch in Iran is recommended because of the fungi that cause symptoms of tip end rot, pitting, cigar end rot, diamond spot, brown spot, and Sunburn were not observed. Jia *et al.* (2005) presented that banana was prevented from the multiplication of fungi by using bunch covering.

Table (1): Effect of bunch covering and biological control on the number of insects, symptoms and percentage of infestation after harvest of date fruits during 2020 and 2021 seasons

Date cultivars	Sample origin	Treatments	Date fruit pests						Infestation symptoms		Infestation (%)	
			Parlatoria blanchardi		*Oryzaephilus surinamensis*		*Ephestia calidella*		*Ephestia spp.*			
		Year	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Sewi	Bahariya Oasis	Control	24	18	6	4	14	10	22	17	18.82	10.14
		With covering	12	7	--	---	--	--	--	--	3.11	2.5
Sewi	El Dakhla Oasis	Control	6	4	4	4	6	5	8	9	14	9.
		With covering	2	2	---	--	---	--	--	--	2.8	2.1
Bartamoda	Aswan	Control	48	55	26	20	--	--	--	--	7.8	9.5
		With covering	15	10	--	---	--	---	--	--	2.88	0.8

Table (2): Effect biological control on the number of insects, symptoms and percentage of infestation after sawmill of date fruits during 2020 and 2021 seasons

Date cultivars	Sample origin	Treatments	Date fruit pests						Infestation symptoms		Infestation (%)	
			Parlatoria blanchardi		*Oryzaephilus surinamensis*		*Ephestia calidella*		*Ephestia spp.*			
		Year	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Sewi	Bahariya Oasis	Control	9.0	8	--	--	2.75	8	7.32	5.11	22.5	17.50
		With covering	7.8	6	--	--	1.92	2.0	1.55	2.21	6.68	4.61
Bartamoda	Aswan	Control	5.1	4.5	4	6	--	--	1	2	1.6	1.0
		With covering	3.11	2.5	2	1.5	--	--	--	--	1.0	0.8

Table (3): Effect of bunch covering and biological control on microbial loads after the harvest of date fruits in 2020 and 2021 seasons (10xCFU/g)

Date cultivars	Samples origin	Treatments	Total count (T.C)		Yeast and mold (Y&M)		*Listeria*	
		Year	2020	2021	2020	2021	2020	2021
Sewi	Bahariya Oasis	Control	95	100	20	25	34	25
		With covering	23	20	2	3	7	2.5
Sewi	El-Dakhla Oasis	Control	75	77	20	15	12	7.5
		With covering	60	65	15	17	4	2
Bartamoda	Aswan	Control	260	200	4	5	50	30
		With covering	198	150	2	3	35	15

Effect of biological control after sawmills on microbial loads of date fruits in 2020 and 2021 seasons (10xCFU/g)

Data in Table (4) showed that, the effect of biological control on microbial load on treated dates in seasons 2020 and 2021. The averages of total microbes count in the Siwi in 2020 and 2021 respectively were 130 and 150 CFU/g in control samples and that were 43 and 25 in treated samples. While, in the Bartamoda were 74 and 70 CFU/g in control and 63 and 45 CFU/g. In yeast and mold detection, in the Siwi cultivar was 37 and 45 CFU/g in control while there were 16 and 17 CFU/g in treated samples. In the Bartamoda cultivar there were no data reported in yeast and mold in control and treated samples. Results in detection of *Salmonella spp*. referred that there were nell all samples. Detection of *E.coli* presented that was 7 and 5 CFU/g in control and 5 and 4 CFU/g in treated in Siwi cultivar while there were not observed in all Bartamoda cultivar samples. Listeria spp were 90 and 105 CFU/g in control and were 14 and 15 CFU/g in treated samples in Siwi cultivar and that were 66 and 70 CFU/g in control and 43 and 35 CFU/g in treated samples in Bartamoda cultivar in season 2020 and 2021 respectively. *Trichogramma* card used as natural bio-control agent and agricultural ecosystem for *Lepidopteran* pests. So, the pests were decreased and also expected microbial contamination.

Results in Table (4) showed that total counts of Sewi dates was higher than that of Bartamoda dates regardless treatments These results are agreement with Abekhti *et al.* (2013) who found that fungus attack fruits at the early stages of maturation, but at tamr stage their number decreased and only *xerophilic* fungi as *Catenularia fuliginia* are able to grow on dried dates. Kader (2007) reported that microbial spoilage of dates at tamr stage can be caused by yeasts, mold and bacteria. It can be controlled by drying to equal or less than 20% moisture and

maintaining the recommended temperature and relative humidity ranges throughout the handling system.

Table (4): Effect of biological control in sawmills on microbial loads of semi and dry dates (10xCFU/g)

Date cultivars	Samples origin	Treatments	Total count (T.C)		Yeast and mold (Y&M)		*Listeria*	
		Year	2020	2021	2020	2021	2020	2021
Sewi	Bahariya Oasis	Control	130	150	37	45	90	105
		With biological control	143	125	31	37	78	115
Bartamoda	Aswan	Control	74	70	-	--	66	70
		With biological control	63	65	--	--	54	74

Conclusion

From the results of this research, it is recommended to bunch covering and biological control in the field to control insect infections and microbial loads in date fruits. Moreover, biological control in sawmills should be used to avoid increasing insect infestations.

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تأثير تغطية السوباطات والمكافحة البيولوجية على الحشرات والحمل الميكروبى لثمار نخيل البلح

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الملخص العربي

تهدف الدراسة إلى تأثير تغطية سوباطات نخيل البلح والمكافحة البيولوجية على التحكم فى الحشرات والميكروبات لنوعين من التمور الأول صنف نصف جاف (السيوي) في منطقتين (واحة الداخلة والواحات البحرية) والثانى صنف جاف (البرتمودا) في محافظة أسوان خلال موسمي 2020 و 2021. أظهرت النتائج أن بعض الحشرات مثل *Parlatoria blanchardi, Carpophilus sp., Oryzaephilus surinamensis* and *Ephestia calidella* موجودة فى الثمار نصف جافة والجافة بدون تغطية والمكافحة البيولوجية مقارنة بالمعاملة الأخرى. أشارت النتائج إلى أن تغطية سوباطات ثمار البلح في الوقت المناسب والمكافحة البيولوجية باستخدام كروت *Trichogramma* قللت من عدد الحشرات واعراض الاصابة بالحشرات والحمل الميكروبي من ثمار نخيل البلح أعلى من العينة المقارنة. تراوحت نسب الإصابة بالحشرات من (9.85 إلى 18.82 %) فى تمور سيوي (نصف جاف)، بينما تراوحت نسبة الاصابة (7.8 و 9.5%) فى تمور برتمودا (جاف) بينما تم تقليل الاعراض إلى أقل من (3.11%) فى ثمار التمر (نصف جافة) الذى سبق له تغطية السباطات و المكافحة البيولوجية وأقل من (2.88%) من التمور الجافة. كما أشارت النتائج إلى أن استخدام بطاقات *Trichogramma* في المنشرة قلل من نسب الإصابة والأحمال الميكروبية مقارنة بالعينة المقارنة.

الكلمات الدالة: ثمار التمور، تغطية السوباطات، مكافحة الآفات، المكافحة البيولوجية، الحمل الميكروبي