INFESTATION LEVELS AND POPULATION DENSITY OF INSECT PESTS ATTACKING STORED DATES UNDER THE CONDITIONS OF EL-BAHRIA OASES, EGYPT

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INTRODUCTION

Dates is an important crop which provides a primary article of food and commerce in the great desert areas extending from western north Africa to India .Dates on the other hand occupy the fourth position among tropical and subtropical fruit production after citrus, banana and pineapple (Anonymous, 1978). Bahria oases produce about 43945 M. T. of semi-dry and dry tamr. This annual production is subjected to attack by many insect pests in stores which cause great ravages. Shafic and Wajih (1982) reported that the Indian meal moth, *Plodia interpunctella* Hbn. infests date bunches and that infestation of dates may extend to stored dates.Larvae and adults of the saw-toothed grain beetle, *Oryzaephilus surinamensis* feed on almost all kinds of stored food products including stored dates and capable of causing significant economic damage in Saudi Arabia (El-Sayed and Baeshin, 1982) .In El-Bahria oases, Hussain (1981) studied the population dynamics of *Ephestia cautella* as a pest infesting dates in main stores.

This paper shed light on key pests of stored semi-dry and dry dates, their population densities and assessment of infestation levels in stores under the circumstances of El- Bahria oases.

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MATERIAL AND METHODS

These experiments were carried out under store conditions of El- Bahria oases (El -Bawietti locality). About 100 kg of each semi-dry (Saidi variety) and dry dates (Kakea and Firihi varieties) were stored in frond bags and jute bags respectively .Bags were stored for 8 months in normal stores. Weekly samples of stored dates, 250 g each, with five replicates were taken randomly and thoroughly examined. Symptoms of insect infestation were denoted and infested fruits were dissected to clarify the causal insect species. Number of infested fruits in a sample was counted.and percent of infested dates by each insect species was calculated and recorded. Meanwhile, number of insects present in each sample was assessed and recorded. These experiments lasted for about 259 days in 1998 and 171 days in 1999 This work is derived and results of the project No. 17/1/S/W/M financed by the Regional Council for Research & Agricultural Extension (French Side Fund), Cairo, A. R Egypt.

RESULTS AND DISCUSSION

Insect infestation assessment of stored dates:

Harvested dates were exposed to sunlight for 1 -2 weeks before storage. Assessment of insect infestation was carried out for the three date varieties: Saidi (semi-dry date), Kakea and Firihi (dry dates), the most common date varieties in El-Bahria oases, throughout storage period of 203 days.

1998 results:

Results in Table (1) indicate that infestation percentages of stored dates infested by insect pests increased as storage period increased for the three tested date varieties. At the first sampling time infestation levels averaged 14.5%, 1, 9% and 3.2% for saidi, kakea and firihi dates, respectively. One month latter, these values became 15.63 %, 3.42 % and 7.81%, respectively. During winter period (January-March), rate of infestation increment was low, however, by the end of March, 31.8 % of saidi stored dates became heavily infested and infestation rate reached the double value of infection at the beginning of this experiment. For kakea and firihi varieties, percent of date infestation became 9 and 4 folds by the end of March. After elapsing of 140 days of date storage more than 50 % of stored saidi and kakea dates were infested by insects while such value did not exceed 17.65 % for firihi dates. By the beginning of summer season, (June-September) there was noticeable sharp

increase of date infestation and infestation rate ranged 82.8%-98.6%, 65.5% 93.2% and 51.5%-97.9% for saidi, kakea and flrihi dates, respectively.

TABLE (I)

Monthly average of stored dates o different varieties under Normal conditions of Bahria Oases stores, 1997/1998

Month	Storage Period (Days)	% Infestd dates		
		Date Variety		
		Saidi	Kakea	Firihi
December,1997	7	14.5	1.9	3.2
January, 1998	35	15.63	3.42	7.81
February	63	17.70	7.52	11.83
March	91	31.84	17.10	13.53
April	119	44.95	37.93	17.65
May	140	52.40	57.80	17.97
June	168	82.83	65.50	51.50
July	203	96.29	85.94	94.36
August	231	97.53	93.17	97.85
September	259	98.57	82.61	88.93
Average		55.22a	45.29ab	40.46bc

Means followed by the same letter are not significantly [p=0.05; Duncan,s multiple range test (1955)].

1999 results:

During this season, insect infestation assessment of stored dates (saidi, kakea and firihi) was conducted throughout a storage period of only 6 months since date growers in El-Bahria oases do not store dates for a longer period. Data presented in Table (2) show that infestation rates of stored dates were in general lower than the preceding season. For all date varieties, there was a steady increase of infestation by the increase of storage period. After 15 days of storing saidi, kakea and firihi dates respectively, they suffered 2.9%, 11.5% and 4.2 % infestation by insect pests. Infestation increase ratio was low during winter months (January-March), it ranged 2.9%- 17.5%, 4.3% -17.6% and 4.2% -40.3 % for saidi, kakea and firilii dates respectively. By raising of store temperature during spring and summer months (April -June) , there was considerable increase of date infestation and it reached the maximum after 180 days (80.8 %), 165 days (78.5 %) and 180 days (62.9 %) for saidi, kakea and firihi dates, respectively. Monthly averages of date' infestation revealed that maximum infestation occurred throughout June and seasonal averages of date infestation amounted 34.2 %, 27.1 % and 34.7 % for saidi, kakea and firihi dates.

TABLE (II)

Monthly average of infesed stored dates of differen varieties under normal conditions of El-Bahria Oases 1999.

Month	Storage Period (Days)	% Infestd dates		
		Date Variety		
		Saidi	Kakea	Firihi
January, 1999	45	3.6	7.9	9.8
February	73	11.4	16.8	25.9
March	104	16.5	14.3	37.4
April	134	46.0	20.2	32.2
May	165	50.2	41.6	48.1
June	195	77.7	61.3	54.7
Seasonal average		Ab 34.1	c 27.1	a 34.7

Means followed the same letter are not significantly [p=0.05; Duncan's multiple range test (1995)].

Results of the two consecutive seasons indicate the liability of semi-dry and dry dates to insect infestation in stores. Infestation level increased as the storage period increased and the maximum infestation rates always occur during warm months (May -September). Semi-dry dates (saidi) was the most susceptible (52.1%) followed by dry dates: kakea (44.2%) and firihi (44.8%).

The previous results indicate that date infestation by insects in stores depends mainly upon environmental conditions of the store, particularly store temperature, storage period, and variety of stored dates. Prevailing low temperature inside stores during winter season may oppose insect development and reproduction, consequently infestation rates become low J. However, infestation levels sharply increased when store temperature increased to 26.6°C-28.5°C and 52.6-63.6% relative humidity throughout summer months. These results confirm with the findings of Abdel-Salam and El-Saeady (1982) who reported the increase of E .cautella population infesting kakea dates in store by the increase of store temperature and maximum population of this pest occurred during April- May at a temperature range of 21–24°C and 36-39% relative humidity. On the other hand, fruit kind affected date infestation during storage. Semi -dry dates (saidi) was rapidly infested and the rate of its infestation was significantly ($P > 0.05$) higher than dry dates (fitihi and kakea). Conclusion that could be derived ftom the present results is that storage of semi-dry and dry dates under low temperature than 15°C could safely inhibit date infestation by different insect pests for about three months and in this respect semi-dry dates are more susceptible to insect infestation than dry

dates. Infestation averages of saidi, kakea and firihi dates stored for approximately 10 months were 52.1%, 44.2% and 44.8%, respectively.

Table (3) presents infestation averages of semi-dry and dry dates kept in normal store conditions at El-Bahria oases throughout two consequtive seasons of 1998 and 1999 .Results reveal obvious variation in rates of insect infestation between the two seasons and these noticable differences could be regarded mainly to the difference of storage period. In 1998 -season, dates were stored for 10 months while in the next season this period was only 6 months. However, percentages of semi-dry (saidi) and dry (kakea, firihi) dates were in 1999 less than in 1998 but without significant differences.

TABLE (III)

Monthly average of semi-dry (Saidi) and dry dates (Kakea & Firihi) insect infestation in stores during 1998 & 1999 seasons in El-Bahria Oases stores.

Month	Date infestation %								
	Saidi			Kakea			Firihi		
	1998	1999	Av.	1998	1999	Av.	1998	1999	Av.
December	14.5	-	14.5	1.9	-	1.9	3.2	-	3.2
January	15.6	3.6	9.6	4.3	7.9	5.7	7.8	9.8	8.8
February	17.7	11.4	14.6	7.5	16.8	12.2	11.8	25.9	18.9
March	31.8	16.5	24.2	17.1	14.3	15.7	13.5	36.4	24.9
April	44.9	23.0	33.9	37.9	26.2	32.1	17.6	32.2	24.9
May	52.4	50.2	51.3	57.8	41.6	49.7	17.9	48.1	33.1
June	82.8	77.7	80.3	65.5	61.3	63.4	51.5	54.7	53.1
July	96.3	-	96.3	85.9	-	85.9	94.4	-	94.4
August	97.5	-	97.5	93.2	-	93.2	97.9	-	97.9
September	98.6	-	98.6	82.6	-	82.6	88.9	-	88.9
Average	55.2	34.1	a 52.1	45.3	27.1	b 44.2	40.5	34.7	bc 44.8

Means followed by the letter are not significantly [p=0.05; Duncan's multiple range test (1995)].

Records of monthly averages of date, infestation throughout the two consecutive years showed considerable and proptional increase of date infestation and 50% of stored dates became heavily infested on May after 6 months of storing dates. Fast increase of date infestation was shown from the beginning of June and continued till the end of September when 98.6%, 82.6% and 88.9% of Saidi, kakea and firhi dates become populated with harmful insects. Seasonal averages of dates infestation revealed that semi-dry (saidi) dates was more liable to insect infestation than dry dates (kakea, firihi) Infestation levels of saidi, kakea and firihi dates as

estimated for 1998 and 1999 seasons averaged 52.1%, 45.3% and 44.8%, respectively. Gough (1918) stated that fallen and harvested dates in Dakhlah and Khargah oases (Egypt) are attacked by E. cautella and insect infestation may continue in stores.

Population density and dynamics of insect pests infesting stored dates:

Data present in Tables (4 & 5) demonstrate that insect species responsible for dates infestation in stores were *Ephestia calidella, Ephestia cautella, Oryzaephilus surinamensis* and *Coccotrypus dactyliperda.* Population density of these species as well as occurrence time in stored dates varied according to insect species and prevailing conditions favorable for insect development and multiplication.

1998 results for semi -dry dates

Concerning the dynamics of insect populations attacking semi-dry dates (saidy), it was found that population density of insects amounted 4 individuals / kg dates at the beginning of population estimation under store conditions of 14.9 C and 64.6 % relative humidity. One month latter, insect number significantly increased 3-folds during January and became 10 -folds by March when store temperature raised to 16.5°C. As shown in Table (4), the saw -toothed beetle *O. surinamensis* was the most abundant species in semi-dry dates, it constituted 50.48 % of the total insect '1"11 e populations infesting semi-dry dates. It had two peaks throughout storage period, the first peak appeared in February (41.68 %) and the second one occurred in August (99.33 %). The oases date moth, *E. calidella* ranked the second species, it constituted 29.52 % of the total insect population and had only one peak (88.75 %) in March. The fig moth *E. cautella* showed two peaks in January (32.08 %) and in June (15.15 %). Infestation with date -stone beetle, *C. dactyliperda* seems to be lees important since its population density did not exceed 2.08 % of the total insect populations throughout the whole storage period (10 months) .These results indicate that this insect species is unable to reproduce and, develop under store conditions.

1999 results for semi-dry dates:

Results in Table (5) reveal that the greatest increase of insect populations lies between mid-April and mid-June when insect density increased from 10 individuals/kg stored dates to reach 292 insects by June 1st. Contrary to the previous season, the oases date moth *E. calidella* was the most abundant species which constituted 33 % of the total insect populations. This species showed two peaks of activity on April (69.5 % and on mid-May (16.67 %). The fig moth, *E. cautella*

ranked the second pest; it had two conspicuous peaks on mid-April and mid-June representing 65 % and 36.4 % of the total insects populations. This species constituted 28.2 % of the total insect numbers present. On the other hand, the saw–toothed beetle *O. surinamensis* was dominant especially throughout May and June; its population density averaged 27.6 % showing only one peak by mid-May (77.4 %). The least abundant species was represented by *C. dactyliperda* which accounted 11.2 % of the total insect populations. This species was mostly active during January-March and had only one peak on mid-January (28.5 %). These results reveal that the main insect pests threaten semi-dry dates in stores are *O. surinamensis*, *E. calidella*, and *E. cautella*; their population densities amounted 60.5 %, 29.5 % and 17.1 % of the total insect populations.

TABLE (IV)

Monthly population ensity of insect species inested stored dates (Saidi vriety) in Baharia Oases stores, 1997/1998

Month	Infested Dates (%)	No. of insect per/Kg	% insect species present			
			Ephestia calidella	*Ephestia cautella*	*Oryzaphilus surnamensis*	*Cocotrypes dactyliperda*
December, 1997	14.50	4.5	18.75	0.0	6.25	6.25
January, 1998	15.63	13.0	47.13	32.08	12.0	8.3
February	17.70	7.0	58.33	0.0	41.68	0.0
March	31.48	40.0	88.75	11.25	0.0	0.0
April	59.48	26.5	53.75	10.0	30.0	6.25
May	94.90	85.33	26.2	10.06	63.73	0.0
June	82.83	307.0	0.9	15.15	83.9	0.0
July	96.26	2352.0	1.22	0	98.78	0.0
August	97.53	1210.0	0	0.7	99.33	0.0
September	98.57	932	0.1	0	97.33	0.0
Average	55.29	497.68	29.52b	7.92c	50.8a	2.08c

Means followed by the same letter are not significantly different [p=0.05; Duncan's multiple range test (1955)].

Dry dates:

1998 results for dry dates

Population dynamics and population composition of insect pests infesting dry dates (kakea and firihi) were different than semi-dry dates (saidi) .In case of kakea dates, the total number of insects present in one kilogram dates average 962 individuals during the period extending from December 1997 to September 1998 where store temperature and relative humidity were 14.9 -16.5 C and 61.3 -64.6 % RH. The number of insects isolated from one kilogram infested dates ranged

between 8 and 33 insects during December-March. As store temperature reached 28.5 C, insect population substantially increased and reached the maximum (1131 individuals/kg dates) by July (Table 5).

TABLE (V)

Monthly population density of insect species infusing stored dates (Kakea variety) in Baharia Oases stores, 1997/1998.

Month	Infested dates (%)	No. of insect per/Kg	% insect species present			
			Ephestia calidella	*Ephestia cautella*	*Oryzaphilus surnamensis*	*Cocotrypes dactyliperda*
December, 1997	1.9	8	100	0	0	0
January , 1998	3.42	15	61.33	0	38.67	0
February	7.52	10	62.50	6.25	0	6.25
March	17.10	3.3	4.87	3.25	93.35	0
April	37.93	194	7.65	3.22	89.13	0
May	57.80	319	0	76.76	83.56	0
June	65.5	825	0.5	18.12	81.37	0
July	85.94	1131	0	1.30	98.7	0
August	93.17	962	0	0.1	99.93	0
September	82.61	467	0	0	100	0
Average	45.24	396.4	23.68b	3.92c	71.77a	0.63c

Means followed by the same letter are not significantly different [p=0.05; Duncan's multiple range test (1955)].

Insect species responsible for kakea dates infestation were nearly the same of 0semi-dry dates (saidi). The key pest was *O. surinamensis* which constituted 71.8%; of the total insect populations, followed by E. calidella (23.7 %), *E. cautella* (3.%) and finally by *C. dactyliperda* (0.6 %). *E. calidella* occupied the period extended from December to April and its population density was higher than the former three species. Maximum density of this species occurred in December and gradually declined throughout January and February but drastically dropped to 7 .65 through March and April. Although the population density of the fig moth *E. cautella* constituted only 3.9 % of the total insect populations but it was present fa longer storage period in infested dates than *E. calidella*. Similarly to semi-dry date. *O. surinamensis* was recorded in high numbers throughout March -September and its population density ranged between 81.3 % and 100 % of the total insect populations (Table 5).

Data presented in Table (6) demonstrate that firihi dates were infested by the same former insect species. Insect population density was frequently low through December -February; the number of insects ranged between 9 and 29

insects/kg dates at store temperature of 14.9-15.3°C and 57.3-64.6% relative humidity During summer months (June, July, August) , insect density attained the maximum
(1123 insects /kg dates) at store conditions of 28.5°C and 55 % RH. Firihi date could be stored for about 6 months but with lower infestation than kakea dates.

TABLE (VI)

Monthly population density of insect species infusing stored dates (Feriehi variety) in Baharia Oases stores, 1997/1998.

Month	Infested Dates (%)	No. of insect per/Kg	% insect species present			
			Ephestia calidella	*Ephestia cautella*	*Oryzaphilus surnamensis*	Cocotrypes dactyliperda
December, 1997	3.20	29	46.2	30.8	0	23
January , 1998	7.81	16	75.0	6.5	0	16.5
February	11.83	9	91.67	0	0	8.32
March	13.53	30	28.75	14.82	56.42	0
April	7.65	12	6.0	9.25	84.75	0
May	17.96	52	33.1	0	66.9	0
June	51.50	444	0.6	25.55	73.75	0
July	4.36	1123	0.68	0	99.23	0
August	97.85	864	0	0.3	99.7	0
September	88.93	543	0	0	100	0
Average	39.46	312.28	28.21b	8.72c	58.29a	4.98cd

Means followed by the same letter are not significantly different [p=0.05; Duncan's multiple range test (1955)].

Regarding population composition of insect pests infesting firihi dates, it was found that *O. surinamensis* is the key pest and composed 58.3 % of the total insect populations and appeared from March to September. The oases date moth *E. calidella* ranked the second order, it amounted 28.2 % and was present through December-May. *E. cautella* composed 8.72 % and followed by *C. dactyliperda* (4.78 %) and appeared only through December -February.

1999 results for dry dates:

In 1999 -season, insect species responsible for dry date (kakea and firihi) infestation were the same of the previous season, however the mean number of insects per kilogram infested dates was significantly ($P > 0.05$) lower (Tables 8 & 9) .Insect species successfully multiplied on dry dates but its population size was significantly ($P > 0.05$) on firihi dates than kakea.

The fig moth *E. cautella* appeared one month earlier on firihi than on kakea dates, however three peaks were recorded on kakea while only two peaks could be

detected on firihi dates. Insect population density ranged between 4 and 36.9 insects with an average of 11.9 individuals/kg dates on kakea while this value was 55.2 insects/kg on firihi dates. This species constituted 11.9% and 20.6 % of the total insect populations infesting dates, respectively.

TABLE (VII)

Monthly population density of insect species infusing stored dates (Saidi variety) in Baharia Oases stores, 1999.

Month	Infested Dates (%)	No. of insect per/Kg	% insect species present			
			Ephestia calidella	*Ephestia cautella*	*Oryzaphilus surnamensis*	*Cocotrypes dactyliperda*
January , 1999	3.6	10	69.0	2.0	0	28.5
February	11.4	12.0	39.0	17.0	0	19.0
March	16.5	23.0	36.5	43.0	8.5	15.5
April	23.0	47.0	65.0	7.5	23.5	4.0
May	50.2	144.0	16.6	6.0	77.4	0
June	77.7	292.0	7.3	36.4	56.4	0
Average	34.1	88.0	33.0a	28.2ab	27.6b	11.2c

Means followed by the same letter are not significantly different [p=0.05; Duncan's multiple range test (1955)].

TABLE (VIII)

Monthly population density of insect species infusing stored dates (Kakea variety) in Baharia Oases stores, 1999.

Month	Infested dates (%)	No. of insect per/Kg	% insect species present			
			Ephestia calidella	*Ephestia cautella*	*Oryzaphilus surnamensis*	*Cocotrypes dactyliperda*
January , 1999	7.9	14.0	0.0	91.7	0	8.4
February	16.8	18.0	17.5	55.0	0	27.5
March	14.3	38.5	20.5	17.5	56.7	2.4
April	26.2	58.5	13.3	7.4	79.4	0
May	41.6	140.0	5.4	5.2	89.5	0
June	61.3	273.5	12.0	2.8	85.2	0
Average	27.1	90.4	11.9c	29.9b	51.8a	6.4d

Means followed by the same letter are not significantly different [p=0.05; Duncan's multiple range test (1955)].

The oases date moth, *E. calidella* behaved similarly on kakea and flfihi dates, however its population activity showed two distinct peaks (mid-January and May 1st) on kakea and only one peak (mid-January) on firihi dates. Seasonal average of insect density was consequently lower on frihi (25.5 %) than on kakea dates

(29.9%). Similarly to the preceding season, the saw-toothed beetle *O. surinamensis* was the most dominant insect species on dry dates, its population composed 51.8% and 47..3% of the total insect populations infesting kakea and flfihi dates, respectively. The insect activity showed two peaks on both kakea (mid-March, mid-May) and flfihi (May 1st and mid-June). Date stone beetle, *C. dactyliperda* had the lowest population density in dry dates and occurred in harvested dates stored for 2–3 months. Insect population size composed 6.4 -6.6% of the total insect populations.

TABLE (IX)

Monthly population density of insect species infusing stored dates (Firihivariety) in Baharia Oases stores, 1999.

Month	Infested dates (%)	No. of insect per/Kg	% insect species present			
			Ephestia calidella	*Ephestia cautella*	*Oryzaphilus surnamensis*	*Cocotrypes dactyliperda*
January , 1999	9.8	22.0	36.1	52.9	0.0	20.5
February	25.9	27.0	15.9	67.8	8.8	14.0
March	36.4	37.5	43.1	20.4	32.1	5.0
April	32.2	138.0	33.8	9.8	61.5	0.0
May	48.1	192.0	12.5	2.1	85.5	0.0
June	54.7	348.0	3.9	0.0	96.1	0.0
Average	34.7	127.4	0.6bc	25.5b	47.3a	6.6b

Means followed by the same letter are not significantly different [p=0.05; Duncan's multiple range test (1955)].

TABLE (X)

Monthly average of insect population density infestation stored semi-dry and dry dates during 1998 & 1999 seasons in El-Bahria Oases stores.

Month	Date infestation %								
	Saidi			Kakea			Firihi		
	1998	1999	Av.	1998	1999	Av.	1998	1999	Av.
December	5	-	5	8	-	8	29	-	29
January	13	10	11.5	15	14	14.5	16	22	19
February	7	12	9.5	10	18	14	9	27	18
March	40	24	31.5	3	39	21	30	38	34
April	27	47	37	194	59	126.5	12	138	75
May	85	144	114.5	319	140	229.5	52	192	122
June	307	292	299.5	825	274	549.5	444	348	396
July	2352	-	2352	1131	-	1131	1123	-	1123
August	1210	-	1210	962	-	962	864	-	864
September	932	-	932	467	-	467	543	-	543
Average	498	88	501	396	91	355	312	128	322

Monthly averages of insect population density for infested stored semi-dry and dry dates in normal stores at EI-Bahria oases during 1998 and 1999 seasons are given, in Table (10). As previously stated, because storage period of dates in 1999 was shorter than in 1998, insect population density detected from infested dates in 1999 was lower. Seasonal averages of insect populations amounted 498, 396 and 312 insects per one kilogram of saidi, kakea and fiihiseason while these values were significantly ($P > 0.01$) lower in 1999; they averaged 88, 91 and 128 individuals/kg of saidi, kakea and firihi dates, respectively. These great differences could be attributed to the short period of storage in 1999 (6 months) than in 1998 (10 months) Computed data of 1998 and 1999 seasons showed that insect population densities in semi-dry dates was significantly ($P > 0.05$) higher than in dry dates.

SUMMARY

Assessment of semi-dry and dry date infestation by different insect pests in stores at EI-Bahria oases during 1998 and 1999 seasons as well as the population density of these insect pests were carried out. Monthly averages of date infestation during storage were markedly different according to kind of stored dates, storage period and stores circumstances. In 1998-season, rates of infested dates increased as storage period increased. Dates infestation of semi-dry variety (saidi) and dry dates (kakea & firihi) averaged 14.5, 1.9 and 3.2% during December and progressively increased to 52.4%, 57.8 % and 51.5 % in April and June. Maximum infestation of these three date types were recorded after elapsing of 259 days of storing dates. In the following season (1999), infestation rates were loaveraged 34.2%, 27.1% and 34.7% for saidi, kakea and firihi dates throughout storage period of 6 months. Computed results of the two successive seasons revealed the ability of semi-dry and dry dates to insect infestation in stores and the maximum infestation levels always occur during warm months (May -September) .Percentages of dates infestation averaged 52.1%, 44.2% and 44.8% for saidi, kakea and flfihi dates, respectively indicating that semi-dry dates was the most injurious by insect pests through storage.

Insect species responsible for stored date infestation were *E. calidella, E. cautella, 0. surinamensis* and *C. dactyliperda.* Population density of these species as well as their occurrence time varied according to insect species and store conditions. In case of semi-dry dates (saidi), the density of insects amounted only 4 individuals / kg dates after elapsing of 20 days in 1998. This number raised to 3-folds during January and to 10-folds by March when store temperature and relative humidity reached 16.5°C and 61.3% RH. A second insect increment appeared during July

which reached 2352 insects/kg dates. Insect population drastically dropped by the end of September. *E. calidella* occurred from December to May and composed 29.5 % of the total insect populations. The second species *E. cautella* was found from April to July and constituted 7.9% of the total insect populations. *O. surinamensis* was the most abundant species and composed 60.5% of the total insect populations. This species was presented allover the storage period but with low numbers during December-April. The date-stone beetle, *C. dactyliperda* was the least abundant species (2.1%) occurring during December-February. In case of dry dates (kakea & firihi), *O. surinamensis* was the key pest and composed 71.8% of the total insect populations, followed by *E. calidella* (23.7%), *E. cautella* (3.9 %) and finally by *C. dactyliperda* (0.6 %). The number of insects averaged 33 individuals/kg dates during cool months. As store temperature raised to 28.5°C, insect density increased to 1131 insects / kg dates.

In 1999 season, insect population densities and fluctuations were nearly the same of the preceding season. Dynamics of insect species infesting semi-dry dates showed the superiority of *E. calidella* while in the case of dates *O. surinamensis* was the most abundant and the key pest.

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