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Arif Shah
Department of Entomology
Balochistan Agriculture College,
Quetta- Pakistan

Ahmed Zia
National Insect Museum, NARC
Islamabad-Pakistan

Muhammad Ather Rafi
National Insect Museum, NARC
Islamabad-Pakistan

Sardar Azhar Mehmood
National Insect Museum, NARC
Islamabad-Pakistan

Sumera Aslam
Department of Zoology - Hazara
University K.P.K-Pakistan

Muhammad Tariq Chaudhry
Agricultural Training Institute -
Karor, District Layyah, Punjab
Pakistan

Correspondence
Ahmed Zia
National Insect Museum, NARC
Islamabad-Pakistan

Quantification of Honeydew Production Caused By Dubas Bug on Three Date Palm Cultivars

Arif Shah, Ahmed Zia, Muhammad Ather Rafi, Sardar Azhar Mehmood, Sumera Aslam and Muhammad Tariq Chaudhry

Abstract
Dubas bug, *Ommatissus lybicus* is a key sucking pest of date palm in Balochistan. Three main commercial date palm cultivars, viz, Kehraba, Jan Sore and Mozavati were selected for present study. Suceptability of cultivars were scaled by considering number and size of honeydew droplets. Count of honeydew droplets excreted by dubas bug (population) was highly significant among tested cultivars over the seasons and various life stages. Irrespective of cultivars, among all life stages maximum (7.1) and minimum (2.8) number of honeydew droplets were excreted by 5th nymphal instar and adult stages of dubas bug respectivelly. Mean diameter of honeydew droplet (spot) size of 1st instar, 5th instar, and adult stages was 0.15, 0.60, 0.65 mm, with a relative % age of 6.0, 23.5 and 25.4, respectively. Mean diameter of honeydew droplet was 0.426 mm and 0.428 mm in spring and summer 2009-10, respectively.The size of honeydew droplets was larger in Jan Sore compared to Mozavati and Kehraba cultivars.

Keywords: Honeydew, Dubas bug, Date palm.

Introduction
The Dubas bug, *Ommatissus lybicus* (Deberg) Aschae and Wilson (Homoptera: Tropiduchidae) or the Old world date [1] is a key sucking pest of date palm in the Arabian subcontinent [2]. The bug exudes honeydew; hence the Arabic name for this pest is "dibis" meaning honey-dew [3].

Both the nymphs and adults of this sap–sucking homopterous (dubas bug) cause direct and indirect damage to date palm. Direct damage is caused by puncturing the cells during sap sucking from leaves, midrib of fronds and fruit stalk, and insertion of female genetalia during egg deposition, and it leaves scars /spots on infested leaves. While the indirect damage of dubas bug caused by the accumulation of dust on honeydew droplets present on leaves encouraging growth of saprophytic fungus (*Meliola camellia*) under favorable environmental conditions that throttles the stomata opening and decreases photosynthetic rate [4, 5].

Fruits of infected date palms are smaller and they ripe more slowly, with a high percentage of reducing sugar and low percentage of sucrose [6]. Dubas bug may cause economic losses up to 50 % [7]. According to Gassouma (2004) [8] in case of heavy infestation, the dubas bug might reduce the date yield approaching to 50 %. In Oman, dubas bug has been considered the most serious pest of date palm and it can even cause the death of tree [9].

Apparently, this monoohagous and bivoltine prefers particular date palm cultivars for feeding [10]. In Panjgur dubas bug attacks all the date palm cultivars. However, some varieties such as Kehraba and Sabzoo are more damage by this pest compared to Mozavati, Jan Sore and Rabbahi [11].

Honeydew droplets ejected (excreted) by sucking pest is a direct by-product from plants phloem intake [12]. Honeydew droplets excreted by sucking pest is greatly influenced by leaf nutrient composition [13], plant conditions [14] water stress and temperature [15]. The size of honeydew droplets (visual observation), of whitefly have positive correlation with nymphal development stage [16].

Information on quantification of honeydew production (droplets) and chlorophyll losses caused by dubas bug in date palm cultivars is not yet reported. At present, infestation level of dubas bug is measured on the basis of eggs count per leaflet, categorized as low (5), medium (5-10) and heavy (>10) [3] without considering the injury level which is dual-sided phenomenon, governed by both insect and host population [17]. The severity of injury/ infestation caused by dubas bug varies among varieties, seasons, areas, management practices

and most importantly intensity of dubas bug population. Therefore, this study was aimed, to quantify honeydew production by dubas bug feeding on three date palm cultivars (Kehraba, Jan Sore and Mozavati). Hypothesis of this study was "number and size of honeydew droplets vary with development stages of dubas bug, and date palms cultivars differ for honeydew production chlorophyll loss exposed to various density levels of dubas bug. These informations can be used in research leading to establishment of threshold level for dubas bug, based on yield losses in different date palm cultivars by considering honeydew production and chlorophyll loss at different density level and different life stages of dubas bug.

Materials and Methods

Plant Materials

Three main commercial date palm cultivars, viz, Kehraba, Jan Sore and Mozavati, of about the same age (ranged 10-12 years) were selected for this study. Date palm trees were interplanted with *Medicago sativa* (for fodder purpose) and irrigated at weekly interval. All other agricultural practices were kept almost the same during the course of study. Prior to starting of the experiment, the old fronds and suckers of selected cultivars were removed in order to homogenize the date palm trees (experimental unit). Honeydew excretions by dubas bug were quantified for four consecutive generations (spring and summer) during 2009 and 2010.

Collection and counting of honeydew droplets

Number of honeydew droplets (spots) secreted by dubas bug was counted on water-sensitive papers (WSP) of the size 26 × 76 mm (Syngenta, Switzerland) as shown in Figure 1.

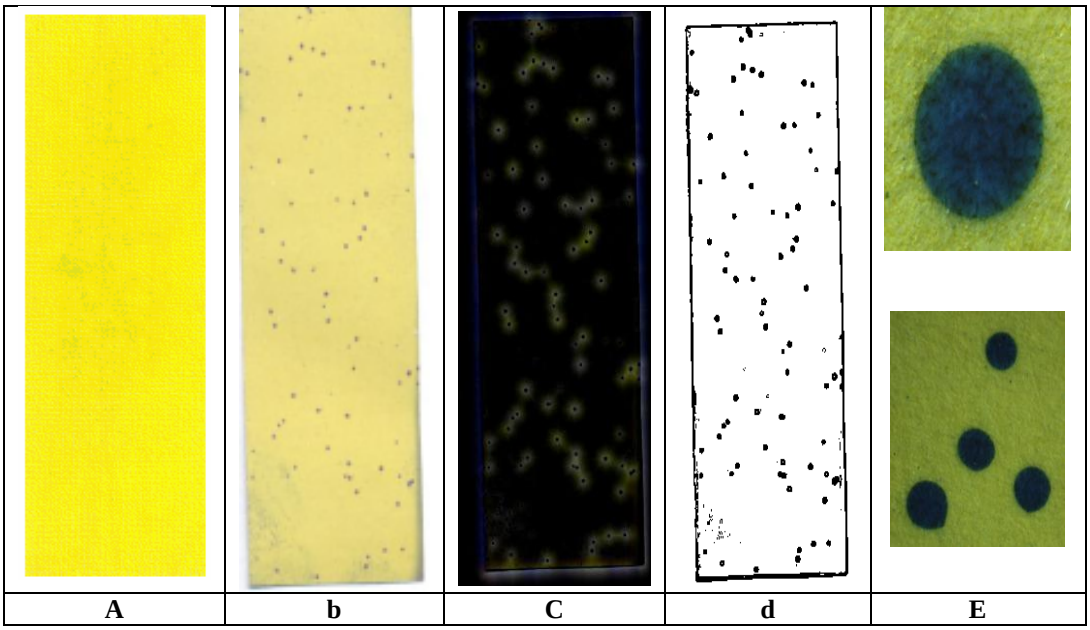

Fig 1: A view of water-sensitive paper: (a) before exposure, (b) after exposure, (c-d) formatted for honeydew counting purpose, (d) magnified honeydew droplets on WSP.

Water -sensitive papers were placed in a disposable petri dish measuring (100 mm Ø and 20 mm heigh). Each petri dish was placed on ground at a distance of 1.5-2.0 meter from palm trunk perpendicular to the middle of frond. In this way four petri dishes containing single WSP were placed under each tree in four directions (north, south, east and west). After placing, all petri dishes were opened by replacing the cover. The WSP remained open for 2 hours (9:00-11:00 a.m.) to collect the secreted honeydew droplets. After two hours, before collection all the placed petri dished containing WSP were re-covered on the spot to avoid any addition of honeydew droplets while collecting the remaining petri dishes. The sensitive surface (yellow) of WSP containing droplets were protected by covering with self-adhesive transparent tape. Additional information (date, time, site and name of variety) was maintained with the strip [18]. Plastic gloves were used to avoid any mark on WSP while placing and collecting the WSP in petri dishes.

Number of honeydew droplets on WSP was counted under the microscope by placing one (1), half (½) and one-fourth (¼) inch^2 window 4-5 times randomly on each WSP strip. Cluster or lines of drops produced by a single individual were counted as single drop [19, 16].

Number of honeydew droplets excreted by each development stage (on individual basis) was collected by caging them in a petri disch for an hour containing water-sensitive paper.

Measurement of honeydew droplet spot size

Honeydew droplets spots size (diameter) on WSPs was measured by using ocular micrometer in microscope (XSZ 107 BN) with 10X magnification. Owing to the presence of different size (visual observation) of honeydew droplet spots, a window of a size of ½ cm^2 was placed on each WSP and measured 5-6 honeydew droplets (spots) randomly. Finally the area (mm^2) of honeydew droplet (spots) on each WSP was calculated with the following formula:

Area (mm^2) = 11/4 ×d^2,

Where:

d^2 is diameter of honeydew droplet spots on WSP and 11/4 is multiplication factor.

Measurement of honeydew production for cultivars rating

Rating of selected cultivars, based on honeydew production (mm^2) excreted by each life stage and population (nymphs and adults) of dubas bug was carried out by considering number and size of honeydew droplets (spots) under control and field conditions, respectively. On individual basis honeydew production was calculated by multiplying mean number (per hour WSP^{-1}) with respective honeydew droplets size of that stage [14]. Each life stage was caged in a petri dish for an hour containing single WSP. While, honeydew production of dubas bug population(nymphs and adults) feeding on the same cultivars under field condition was calculated by multiplying

mean number (per 2 hrs WSP^{-1}) of honeydew with respective honeydew droplets size of that week over the season. Then the mean honeydew production from each cultivar was calculated and compared.

Statistical Analysis

Data recorded were subject to two-way ANOVA to examine the effect of both main factors and difference between treatments means were separated by Tucky's multiple range tests for significance (5 %). Regression analysis using mean diameter of honeydew droplets size secreted by different life stages of dubas bug feeding on three cultivars of date palm were performed through linear regression. Graphic work was done using Microsoft Excel software.

Results and Discussion

Honeydew droplet spot size

Data in Table **1** revealed that honeydew droplet (spot) size (HDS) significantly affected by dubas bug life stages. It is clear from Figure 2 that honeydew droplet size increased with development of dubas bug; however, mean diameter (mm) of honeydew droplet excreted by dubas bug differed none significantly among tested cultivars. Irrespective of cultivars, mean diameter of honeydew droplet (spot) size of 1st instar, 5th instar, and adult stages was 0.15, 0.60, 0.65 mm, with a relative % age of 6.0, 23.5 and 25.4, respectively (Table 2).

Season had no affect on the size of honeydew droplet size excreted by dubas bug in spring and summer generations. Mean diameter of honeydew droplet was 0.426 mm and 0.428 mm in spring and summer 2009-10, respectively (Table 3). Honeydew droplet (spot) size had significant and positive correlation with dubas bug life stages. The strength of relationship is shown in Figure 2.

Results of present study showed that honeydew droplets (spot) size was highly dependent on dubas bug development stages. Thus it was assumed that this could be due to larger size of anal opening in later stages of dubas bug. To my Knowlwdge no information is available in literature to compare the result of present work. However, generally these findings are in line with Hussain, (1963) [3] who found that honeydew droplets of dubas bug are smaller at first and they become larger after three weeks, with a variable size and spherical in shape. Similarly, Henneberry *et al*. (2001) [16] found that the size (visual observation) of honeydew droplets in sweet potato whitefly (SPWF) increased with increasing nymphal instars. In another study, Ajayi *et al.*, (1982) [20] found that the size of honeydew droplets increased with the age of aphids.

The ANOVA indicated that numerically the size of honeydew droplets was larger in Jan Sore compared to Mozavati and Kehraba cultivars. This could be due to variation in the sugar and water ratio (viscosity) of honeydew droplets of tested cultivars; as more spreading of diluted honeydew droplets on WSP compared to thicker droplets.

Honeydew droplets number

The mean number of honeydew droplets (spots) excreted by various life stages of dubas bug had found highly significant differences (P<0.05). However, the mean count of honeydew droplets excreted by each life stage were non-significant among tested cultivars on an individual basis. Irrespective of cultivars, among all life stages maximum (7.1) and minimum (2.8) number of honeydew droplets (per WSP/h) were excreted by 5th nymphal instar and adult stages of dubas bug (Table 4). Relative % age of honeydew droplets of 1st, 2nd, 3rd, 4th, 5th nymphal instar and adult dubas bug were 15.7, 17.7, 18.5, 18.8, 21 and 8.2, respectively (Table 5).

Similarly, irrespective of dubas bug life stages and sampling weeks, the count of honeydew droplets (per WSP/2hr) excreted by dubas bug (population) were highly significant among tested cultivars over the seasons (Table 6). Mean number of honeydew droplets of Kehraba (32.2) were higher than that of Jan Sore (28.7) and Mozavati (20.0) (Table **6**). Among all the sampling weeks, maximum (66.6) numbers of honeydew droplets were recorded in the 6th followed by 7th (63.6) sampling week. The lowest count (0.4) of honeydew droplets (spots) were scored in the 14th sampling week with no statistical differences from 1st (1.0) and 13th (1.8) sampling week (Table 6).

Comparatively, the mean number of honeydew droplets excreted by different life stages from tested cultivars on individual basis were non-significant in both spring and summer seasons (2009 and 2010). However, numerically honeydew output was more (5.8/WSP/h) in summer season compared to that in spring (5.5/WSP/h) (Table 7).

Honeydew production/cultivars rating

Data with respect to cultivars rating based on honeydew production (mm^2) excreted by different life stages and population of dubas bug is described in Table 8 and 9. It revealed that irrespective of each life stages, mean honeydew production excreted by dubas bug on different life stages basis had non-significant difference among tested cultivars; however, honeydew production of dubas bug (population) feeding on tested cultivars were highly significant over the season (14 weeks).

Based on dubas bug life stages, the mean estimated honeydew production (mm^2) per WSP/hour of Kehraba, Jan Sore and Mozavati was 2.4, 2.3 and 2.3, respectively (Table 8). While, the mean estimated honeydew production of dubas bug population feeding on respective cultivars was 25.6, 22.5 and 15.9 mm over the entire season (14 weeks), respectively. Peaked honeydew production in Kehraba (63.6 mm^2) and Jan Sore (57.2 mm^2) was recorded in 7th sampling week; while in Mozavati (39.5 mm^2) it was in 6th sampling week (Table **9**).

Irrespective of tested date palm cultivars and dubas bug developmental stages, the mean honeydew output was non-significant between spring and summer season (2009-10). However, an average, honeydew output was more (5.8/WSP/h) in summer season compared to that in spring (5.5/WSP/h) (Table 10).

The mean honeydew droplet output of *Acyrthosiphon pisum* (Harr.) increased from the first-instar nymph to the adult phase and decreased slightly during asexual reproduction [21]. It indicates that insect developmental stage /body size has significant effect on honeydew production and frequency. However, in present study the low production of honeydew by adult stage may be due to accumulation of sufficient energy/food carried over from earlier stages of development. Other reason for low production of honeydew droplets by adult may be due to different dietary requirement, however the type and concentration of secondary plants compounds which have stage specific stimuli cannot be ruled out.

Though mean number of honeydew droplets excreted by different life stages of dubas bug had non-significant differnce among tested cultivars; however, mean number of honeydew droplets/production of dubas bug (population) were more in Kehraba than Jan Sore and Mozavati. Generally, these results with respect to honeydew production by dubas bug population over the season are in line with that reported [10]. They found that dubas bug feeding on Madjhool cultivar of date palm, produces more honeydew than on Deglet Noor variety. Higher number of honeydew droplets of Kehraba in present work

could be due to higher dubas bug density per leaflet. Positive relationship between dubas bug number and honeydew production has also been documented by [18]. Similarly, Ghaffar *et al.* (2011) [22] reported that the rate of honeydew production of brown planthopper (BPH) *Nilaparvata lugens* (Stal) was significantly affected by rice varieties. In another study, Beggs *et al*. (2005) [23] reported that tree type has strong effect on number of honeydew production.

Effect of temperature and host plant growth stages on the quantity of honeydew production has been well documented [24, 16]. In present study, honeydew production was less numerically in spring as compared to that in summer. The reason behind this could be due to optimum nutrient availability in host plant and temperature in summer than in spring season [23] also found that honeydew production in scale insects (*Ultracoelostoma assimile* and *U. brittini*) was highly variable within and between the years.

Table 1: Mean diameter (mm) of honeydew droplet (spot) size on WSP excreted by different life stages of dubs bug feeding on three date palm cultivars spring and summer 2009-10 (average of four seasons).

Dubas bug life stages	Date palm cultivars							
	Kehraba		Jan Sore		Mozavati		Mean**	
1st instar	0.15	e	0.15	e	0.15	e	0.15	F
2nd instar	0.24	d	0.24	d	0.23	d	0.24	E
3rd instar	0.40	c	0.41	c	0.38	c	0.40	D
4th instar	0.50	b	0.51	b	0.51	b	0.51	C
5th instar	0.59	a	0.59	a	0.61	a	0.60	B
Adult	0.66	a	0.65	a	0.63	a	0.65	A
Mean^{ns}	0.42	A	0.43	A	0.42	A	0.42	
Coeffificent of variation (CV) % =6.8, Least Significant Difference (LSD) for: Cultivars(cv)=0.01, Dubas Life stages (DLs)=0.03, Interaction=0.06								

Main effects (capital letters) and interactions (small letters) Means in column with different letters are significantly different from each other at $P < 0.05$ (Tukey's test).

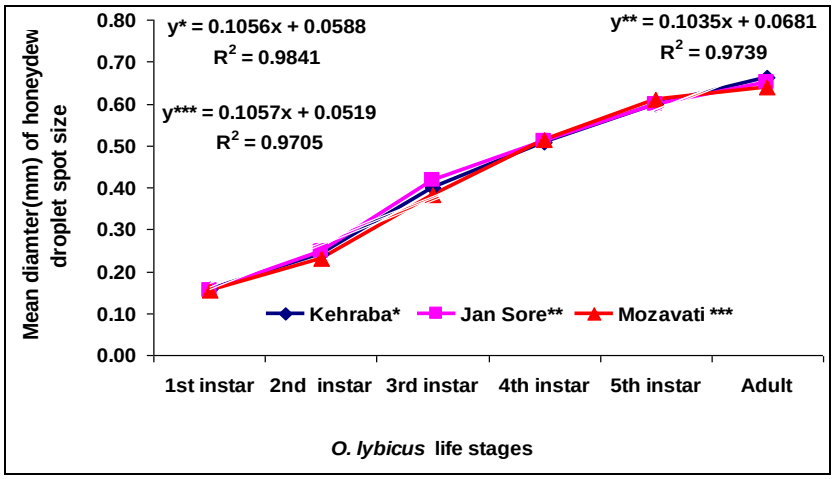

Fig 2: Relationship between *O. lybicus* life stages and honeydew droplet spot size collected from Kehraba, Jan Sore and Mozavati date palm cultivars in spring and summer 2009-10 (average of four seasons).

Table 2: Relative percentage of honeydew droplets (spot) size on WSP excreted by different life stages of dubas bug feeding on three date palm cultivars in spring and summer 2009-10 (average of four seasons).

Dubas bug life stages	Cultivars			Mean**
	Kehraba	Jan Sore	Mozavati	
1st instar	6.1	5.9	6.0	6.0
2nd instar	9.4	9.6	9.1	9.4
3rd instar	15.6	16.2	15.1	15.6
4th instar	19.7	19.8	20.3	19.9
5th instar	23.2	23.1	24.1	23.5
Adult	25.7	25.2	25.2	25.4

Table 3: Comparative mean diameter (mm) of honeydew droplet (spot) size on WSP excreted by different life stages of dubas bug feeding on three date palm cultivars in spring and summer 2009-10 (average of four seasons).

Dubas Life stages	Seasons		
	Spring 2009-10	Summer 2009-10	Mean**
1st instar	0.15 e	0.15 e	0.15 F
2nd instar	0.22 d	0.25 d	0.24 E
3rd instar	0.39 c	0.40 c	0.40 D
4th instar	0.51 b	0.50 b	0.51 C
5th instar	0.60 a	0.59 a	0.60 B
Adult	0.65 a	0.65 a	0.65 A
Mean^{ns}	0.42 A	0.42 A	0.42
Coefficient of variance 6.0, LSD for: Season(S)= 0.01, Dubas Life stages(DLs)=0.03, S*DLs=0.05			

Main effects (capital letters) and interactions (small letters) Means in column with different letters are significantly different from each other at $P < 0.05$ (Tukey's test).

Table 4: Mean number of honeydew droplets (spots) per WSP/hour excreted by different life stages of Dubas bug feeding on three date palm cultivars in spring and summer 2009-10 (average of four seasons).

Dubas Life stages	Cultivars							
	Kehraba		Jan Sore		Mozavati		Mean**	
1st instar	5.2	a-c	5.4	a-c	5.5	a-c	5.3	B
2nd instar	5.8	a-c	6.1	a-c	6.3	ab	6.0	AB
3rd instar	6.4	ab	6.5	a	6.2	ab	6.3	AB
4th instar	6.6	a	6.5	a	6.1	a-c	6.4	AB
5th instar	7.2	a	7.0	a	7.2	a	7.1	A
Adult	2.9	bc	2.6	c	2.9	bc	2.8	C
Mean[ns]	5.7	A	5.7	A	5.7	A	5.7	
Coefficient of variance =26.9, LSD for : Cultivars(Cv)=0.9, Dubas Life stages(DLs)=1.6, Cv*DLs=3.5								

Main effects (capital letters) and interactions (small letters) Means in column with different letters are significantly different from each other at $P < 0.05$ (Tukey's test).

Table 5: Relative percentage of honeydew droplets (spots) per WSP/ hours excreted by different life stages of Dubas bug feeding on three date palm cultivars in spring and summer 2009-10 (average of four seasons).

Dubas Life stages	Cultivars			
	Kehraba	Jan Sore	Mozavati	Mean**
1st instar	15.2	15.7	16.0	15.6
2nd instar	17.0	17.8	18.3	17.7
3rd instar	18.6	18.9	18.0	18.5
4th instar	19.3	19.1	17.9	18.8
5th instar	21.1	20.5	21.1	20.9
Adult	8.5	7.7	8.4	8.2

Table 6: Mean number of honeydew droplets (spots) per WSP per 2 hours excreted by dubas bug population feeding on three date palm cultivars in different sampling weeks in spring and summer 2009-10 (average of four seasons).

Treatment	Cultivars							
Sampling Week	Kehraba		Jan Sore		Mozavati		Mean**	
1st	1.9	no	0.5	o	0.5	o	1.0	I
2nd	9.6	k-n	5.9	k-o	7.1	k-o	7.5	H
3rd	26.6	gh	26.1	gh	19.5	h-j	24.1	F
4th	48.0	d	46.6	d	31.3	fg	42.0	D
5th	70.4	b	60.0	c	45.3	de	58.6	B
6th	80.0	a	70.1	b	50.0	d	66.7	A
7th	75.9	ab	69.8	b	45.1	de	63.6	A
8th	59.2	c	50.2	d	34.0	fg	47.8	C
9th	37.2	ef	32.0	fg	21.0	hi	30.1	E
10th	21.9	hi	20.3	hi	13.6	i-k	18.6	G
11th	11.1	j-l	10.6	k-m	7.6	k-o	9.8	H
12th	6.6	k-o	7.6	k-o	3.9	l-o	6.0	H
13th	2.0	m-o	2.0	m-o	1.3	no	1.8	I
14th	0.7	o	0.2	o	0.3	o	0.4	I
Mean**	32.2	A	28.7	B	20.0	C	27.0	
Coefficient of variance = 9.6, LSD for : Cultivars (Cv)=1.3**, Weeks (W)=4.2**,C*W=8.6								

Main effects (capital letters) and interactions (small letters) Means in column with different letters are significantly different from each other at $P < 0.05$ (Tukey's test).

Table 7: Comparative number of honeydew droplets (spots) per WSP/hour excreted by different life stages of Dubas bug feeding on three date palm cultivars in spring and summer 2009-10 (average of four seasons).

Dubas bug life stages	Season					
	Spring 2009-10		Summer 2009-10		Mean**	
1st instar	5.1	b	5.6	ab	5.3	B
2nd instar	6.1	ab	6.0	ab	6.0	AB
3rd instar	6.2	ab	6.5	ab	6.3	AB
4th instar	6.2	ab	6.7	ab	6.4	AB
5th instar	7.1	a	7.2	a	7.1	A
Adult	2.7	c	2.9	c	2.8	C
Mean[NS]	**5.5**	**A**	**5.8**	**A**	**5.7**	
Coefficient of variance =15.0, LSD for: Season(S)=0.4, Dubas life stages (DLs)=1.1, S*DS=1.8						

Main effects (capital letters) and interactions (small letters) Means in column with different letters are significantly different from each other at $P < 0.05$ (Tukey's test).

Table 8: Mean honeydew production (mm^2) per WSP/hour excreted by different life stages of Dubas bug feeding on three date palm cultivars in spring and summer 2009-10 (average of four seasons).

Dubas bug life stages	Cultivars						Mean**	
	Kehraba		Jan Sore		Mozavati			
1st instar	0.8	f	0.8	f	0.8	f	0.8	E
2nd instar	1.4	ef	1.5	ef	1.4	ef	1.4	DE
3rd instar	2.5	c-e	2.73	b-e	2.4	c-f	2.5	BC
4th instar	3.3	a-c	3.29	a-d	3.1	a-d	3.2	B
5th instar	4.3	ab	4.1	ab	4.3	a	4.3	A
Adult	1.9	c-f	1.7	d-f	1.8	c-f	1.8	CD
Mean^{ns}	**2.4**	**A**	**2.3**	**A**	**2.3**	**A**	**2.3**	
Coefficient of variance =29.9, LSD for: Cultivars (Cv)=0.4, Dubas Life stages (DLs)=0.7, Cv*DS=1.6								

Main effects (capital letters) and interactions (small letters) Means in column with different letters are significantly different from each other at $P < 0.05$ (Tukey's test).

Table 9: Average honeydew quantity (mm^2) per WSP/2 hrs excreted by dubas bug (population) feeding on three date palm cultivars in spring and summer 2009-10 (average of four seasons).

Treatment	Cultivars						Mean**	
Sampling weeks	Kehraba		Jan Sore		Mozavati			
1st	0.72	no	0.2	o	0.1	o	0.3	H
2nd	3.7	l-o	2.5	m-o	2.6	m-o	2.9	GH
3rd	11.4	i-n	10.8	j-o	7.3	j-o	9.9	F
4th	26.3	fg	24.2	f-h	16.4	g-j	22.3	E
5th	47.1	b-d	38.1	de	31.2	ef	38.8	C
6th	57.4	ab	51.6	b-d	39.4	de	49.5	AB
7th	63.6	a	57.2	ab	39.0	de	53.2	A
8th	55.7	ab	48.7	b-d	31.4	ef	45.2	B
9th	41.7	c-e	32.9	ef	22.1	f-i	32.2	D
10th	25.8	fg	23.4	f-h	15.8	g-k	21.6	E
11th	13.7	h-l	13.3	h-m	9.7	j-o	12.2	F
12th	8.5	j-o	9.7	j-o	5.0	k-o	7.7	FG
13th	2.6	m-o	2.53	m-o	1.7	no	2.3	H
14th	0.9	no	0.2	o	0.4	o	0.5	H
Mean**	25.6	A	22.5	B	15.9	C	21.3	
Coefficient of variance =15.4, LSD for: cultivars(Cv.)=1.7, Week(W)=5.4**, Cv*W=10.9								

Main effects (capital letters) and interactions (small letters) Means in column with different letters are significantly different from each other at $P < 0.05$ (Tukey's test).

Table 10: Comparative mean honeydew production (mm^2) per WSP/hour excreted by different life stages of Dubas bug feeding on three date palm cultivars in spring and summer 2009-10 (average of four seasons).

Dubas life stages	Seasons				Mean**	
	spring 2009-10		summer 2009-10			
1st instar	0.7	f	0.8	f	0.8	E
2nd instar	1.3	ef	1.5	ef	1.4	D
3rd instar	2.4	cd	2.6	bd	2.5	C
4th instar	3.1	bc	3.4	b	3.2	B
5th instar	4.3	a	4.3	a	4.3	A
Adult	1.8	de	1.8	de	1.8	D
Mean^{NS}	2.3	A	2.4	A	2.3	
Coefficient of variance =16.6, LSD for: Season(S)=0.2, Dubas life stages (DLs)=0.5, S*DLs=0.8						

Main effects (capital letters) and interactions (small letters) Means in column with different letters are significantly different from each other at $P < 0.05$ (Tukey's test).

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