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The Biology and Food Consumption of the African Bollworm *Helicoverpa armigera* (Hub) on Sunflower at Gedarif, Sudan

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Abstract
An experiment was conducted under laboratory conditions at Gedarif, Sudan to study the biology of the African bollworm *Helicoverpa armigera* (Hub) (Lepidoptera: Noctuidae), and to determine the amount of food consumed by 3rd to 6th larval instars on the three sunflower varieties, i.e.(Damazin-1) open pollinated and two hybrids (Hysun 33 and Pannar 7355). The results showed that females of *H. armigera* laid their eggs singly. The maximum number of eggs laid per a single female was on followed by Pannar 7355 (78-467)Damazin-1 (79-893) and the minimum eggs laid was recorded on Hysun33 (70-531). Six larval instars were developed on the three sunflower varieties during 11-15, 11-14 and 10-12 days on Damazin-1, Hysun 33 and Pannar 7355, respectively. The life cycle was longer with Damazin-1(24-45 days) than that with two hybrids Pannar 7355 (22-40 days) and Hysun 33 (28-34 days). The total amount of food consumed was greater on Damazin-1 (210.7 mg) compared to Pannar 7355 (149.8mg) and Hysun 33 (118.3mg).

Keywords: African bollworm, Sunflower, Hysun 33, Panar 7355, Damazin-1, food.

Introduction
The African bollworm *Helicoverpa armigera* (Hub) (Lepidoptera: Noctuidae) had been reported as the most important insect pest on sunflower in Africa, Europe, India, Asia, and Australia, (Zalucki *et al*, 1994). Yield loss due to *H. armigera* on sunflower in South Africa was more than 20% (Du plessis, 1997). In the Sudan, the pest reported to attack cotton, sunflower, sorghum, maize, groundnuts, cowpea, tomato, and green pepper (Schmutterer, 1969). The cotton bollworm can feed on most plant structures
Including stems, leaves, flower heads and fruits at different development stages (Moral Garcia, 2006).The damage of this pest appears when the young larvae feed on budding stages, mainly on bracts and bore into the developed seeds causing empty seeds (Du plessis and Van den Berg, 1999). The insect as a group, feed on a remarkable diverse of organic substance. At the same time, most species show a high degree of specificity in their choice of food (Waldbauer, 1964). Population parameters are important in measurement of population growth capacity of species under specified conditions. In addition, parameters as indices of population growth rates responding to selected conditions and as bioclimatic indices in assessing the potential of a pest population growth in a new area (Southwood and Henderson, 2000). The

cohort life table gives the most comprehensive description of the survivorship, development and reproduction of a population that are fundamental factors in both theoretical and applied population ecology (Taghizadeh *et al.*, 2008). There was little information on the biology of *H. armigera* on sunflower cultivars. Therefore, the present study provides novel information on the biology and food consumption of *H. armigera* on different sunflower cultivars. The objective of this work was to study the biology of the African bollworm and to determine the food consumption by 3rd to 6th larval instars on the three sunflower varieties.

Materials and Methods

The experiment was conducted at Gedarif Research Station under laboratory conditions (temp. 29-33Cº and R.H 53%) during season 2008/09. Three sunflower varieties i.e. Damazin-1(open pollinated) and two hybrids (Hysun 33 and Pannar 7355) were used for study. Samples of the African bollworm larvae were collected from the three sunflower varieties infested in the Gedarif Research Station farm and brought to the laboratory. Larvae of the same size kept singly in the Petri-dishes (9×1.5cm) and fed on fresh leaves of the specific variety from which each larva was taken until adult stage. Emerging adults from each variety were put in pairs (male and female) in a cage (9×11cm) with a strip of a black cloth hanged inside the cage. For the adult moth feeding, a test tube with 10% sugar solution (sucrose) plugged with cotton wick, was erected and suspended inside the cage. The study was replicated 20 times. The eggs laid on the strip of a black cloth were carefully put in Petri-dishes under room condition (29-33°C and R. H 53%**)**. After hatching, 40 young larvae were transferred to Petri-dishes singly and fed on fresh leaf and developed seeds from the relevant sunflower variety, and continue until adult stage. The time and number of egg laying, hatching, molting of each larval instar, pupation, adult emergence, pre-oviposition, oviposition, post-oviposition periods and survival time of adults were recorded. The previous varieties of sunflower were introduced separately to the larvae. Three groups, each of 20 larvae of the 3rd larval instar were kept singly in Petri-dish (9×1.5cm). A constant weight (3 grams) of developed seeds of each variety was offered daily to the larvae of the respective instar until pupation. Seeds eaten by each 3rd to 6th larval instars were determined by using the following formula:-

Food eaten = initial weight of food – (weight of food remained + moisture loss). (The moisture loss was determined in the control treatment).

Results and Discussion

The pre-oviposition period was longer (2-5 days) on Hysun 33 compared to Damazin-1(2-4 days) and Pannar 7355 (2-3 days) (Table 1). Patel and Talati (1968) reported that the pre-oviposition period takes (1- 4 days). The longest oviposition period was recorded on Dmazin-1 (5-8 days) and slightly shorter (4-8 days) on Pannar7355 followed by Hysun33 (3-8 days) (Table 1). Khalil (1992) stated that the oviposition period takes 7 days after adult emergence. No remarkable difference in the post-oviposition period was observed between the three varieties (Table 1). The maximum number of eggs laid per single female was recorded on Damazin-1(893 egg/female) and the minimum number laid on Hysun 33 (531 egg/female), followed by Pannar7355 (467 egg/female) (Table 1). Balla (1978) reported 555eggs/female on cotton in Gezira, and Khalil (1992) recorded 1139 eggs/female on sunflower in Damazin. The eggs hatched after 2-3 days on three sunflower varieties (Table 2). Similar results revealed by Khalil (1992). The larvae have six larval instars (Table 2), which is similar to the findings reported by Schmutterer (1969). Larval development completed in 11-15, 11-14 and 10-12 days on Damazin-1, Hysun33 and Pannar7355, respectively (Table 2). These findings agreed with Khalil (1992) who reported 12-16 days for the

larval period. Pupation period lasted for 8-9 days on the three varieties (Table 2). Schmutterer (1969) who reported 8-13 days revealed similar results. The longest life cycle was recorded on Damazin-1 (26-46 days) and slightly shorter on Pannar 7355 (22-40 days) and Hysun 33 (24-45 days) (Table 2), while Khalil (1992) stated 27-37 days for total life cycle. The weight of food consumed by the 3rd to 6th larval instars on the three sunflower varieties increased with the 4th and 5th instars and decreased with 6th larval instar. The average weight of food consumed from Damazin-1 by 4th and 5th larval instars
was found to be 56.4 and 89.8 mg and from Pannar 7355 (61.1and 48.3mg) and from Hysun 33 (34.8 and 45.6mg) (Table 3).

The greatest amount of food consumption was recorded with the Damazin-1 (210.7 mg), slightly lower with the Pannar7355 (149.8mg) and the lowest amount of food consumption was recorded with the Hysun33 (118.3mg) (Table3).

Conclusion

It is obvious from the study that the eggs laid by a single female are much more on the local variety of sunflower Damazin-1 compared to that on the two hybrids of sunflower Hysun 33 and Pannar 7355. The time needed for the insect development and oviposition is much longer on the Damazin-1 than that on the two hybrids. This indicated that Damazin-1 variety has determinable effect on the African bollworm (ABW) biology. The high amont of food consumed by the fourth and fifth larval instars of the *H. armigera* may indicate that those two instars are the most destructive on sunflower. The total amount of food consumption was greater on Damazin-1compared to two hybrids. Therefore, whenever Damazin-1 planted in rain-fed areas more attention for ABW control measures should be considered.

Table 1: Pre-Oviposition, Oviposition, Post-oviposition (days) and number of eggs/female of *Helicoverpa armigera* on thre sunflower varietiers at Gedarif, Sudan, season 2008/09

Variety / Adult No.	Damazin-1				Hysun 33				Pannar 7355			
	Pre-ovi	ovi	Post-ovi	Egg/female	Pre-ovi	Ovi	Post-ovi	Egg/femal	Pre-ovi	ovi	Post-ovi	Egg/female
1	4	6	1	296	3	4	1	70	3	8	3	264
2	2	5	1	893	4	3	1	313	3	4	1	225
3	3	8	1	79	5	8	1	314	3	4	1	197
4	2	5	1	241	3	4	1	531	3	8	2	228
5	2	6	1	353	2	6	3	199	3	4	1	353
6	2	6	2	415	2	6	2	181	2	5	2	467
7	4	6	1	514	4	3	1	315	3	4	1	410
8	2	5	2	427	3	6	2	313	3	5	1	230
9	3	7	1	698	4	5	1	190	3	7	1	154
10	4	6	3	405	2	6	1	423	3	6	1	78
Mean	2.8	6.0	1.4	432.1	3.1	5.1	1.4	284.9	2.9	5.5	1.4	259.8
Rang	2-4	5-8	1-3	79-893	2-5	3-8	1-3	70-531	2-3	4-8	1-3	78-467

Table 2: The duration (days) of different developmental stages of the *Helicoverpa armigera* on the three sunflower varieties at Gedarif, Sudan, season 2008/09

Variety	Eggs(incubation period) (days)	Larval duration (days)						Pupal duration	Adult duration(days)			Total life cycle
		1st in	2nd in	3rd in	4th in	5thin	6th in	(days)	Pre-ovi	ovi	post-ovi	
Hysun 33	2-3	1-4	2-3	2-4	1-2	1-2	1-2	8-9	2-5	3-8	1-3	24-45
Pannar 7355	2-3	1-3	1-2	1-2	1-2	1-2	1-2	8-10	1-3	4-8	1-3	22-40
Damazin-1	2-3	1-7	2-3	2-4	1-2	1-2	1-2	8-9	2-4	5-8	1-2	26-46

in= instar
Ovi= oviposition

Table 3: Average weight of food consumed (mg) daily by 3rd to 6th larval instars *Helicoverpa armigera* on the three sunflower varieties at Gedarif, Sudan, season 2008/09

Variety	larval instars				
	III	**IV**	**V**	**VI**	**Total weight(mg)**
Hysun 33	12.1±7.3	34.8±11.8	45.6±14.9	29.4±14.8	118.3±24.4
Pannar 7355	40.4±12.8	61.1±11.1	48.3±17.2	14.3±12.6	149.8±35.6
Damazin-1	17.3±8.2	56.4±18.5	89.8±23.8	52.4±31.9	210.8±45.8

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الإحيائية والغذاء المستهلك لديدان اللوز الأفريقية على زهرة الشمس فى القضارف- السودان

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المستخلص

أجريت تجربة بولاية القضارف، السودان. للقيام بدراسة إحيائية على ديدان اللوز الأفريقية، والغذاء المستهلك بواسطة الأطوار اليرقية من الثالث وحتى السادس على ثلاثة أصناف من زهرة الشمس صنف (دمازين-1) مفتوح التلقيح واثنين من الهجن (هاى صن 33 و بانار 7355). أوضحت النتائج أن إناث ديدان اللوز الإفريقية تضع البيض فرادى، حيث سجل أعلى عدد للبيض على الصنف دمازين-1(79- 893 بيضة لأنثى) بانار 7355(78-467 بيضة لأنثى). وأدناه على الصنف هاى صن 33 (70-531 بيضة لأنثى) و أيضا لوحظ من الدراسة أن الحشرة تمر بسته أطوار يرقيه تتراوح مابين 11-15، 11-14و10-12 يوم على الصنف دمازين-1، هاى صن33 و و بانار7355 على التوالي. أطول دورة حياة للحشرة الكاملة سجلت (30- 36يوما) على الصنف دمازين-1 مقارنة مع بانار7355(28-37 يوما)و هاى صن 33 (28- 34 يوما). أكبر كمية من الغذاء المستهلك سجلت على الصنف دمازين-1(210.7ملجم) وأدناها على بانار7355(149.8 ملجم) و هاى صن 33 (118.3 ملجم).