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Antixenois Studies in Helicoverpa armigera(Hubner) Oviposition towards certain Sunflower Genotypes

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***Abstract:** A study on the ovipositional preference of Helicoverpa armigera females on certain sunflower genotypes was conducted at the Faculty of Agriculture, Annamalai University, Tamilnadu during 2014-2017. The head borer, Helicoverpa armigera, is one of the most important pests of sunflower, and host plant resistance is an important component for minimizing the extent of losses caused by this pest. To develop insect- resistant cultivars, it is important to understand the contributions of different components of resistance, and therefore, we studied the antixenosis mechanism of resistance to H. armigera in a diverse array of sunflower genotypes under no choice, and multi- choice conditions. Antixenosis for oviposition was observed in case of AHT 02, AHT 14, KBSH 1, GMU 631, and GHU 615 under no- choice; and GMU 631, AHT 02, GHU 615, IHT 751, and KBSH 1 under multi- choice conditions. The susceptible check, Morden was highly preferred for oviposition in both the antixenosis tests. The genotypes AHT 02, KBSH 1, GMU 631, and GHU 615 can be used as sources of non- preference mechanism of resistance in sunflower improvement programs to breed for resistance to H. armigera.*
***Keywords:** Head borer, Sunflower genotypes, antixenosis, no-choice test, multi-choice test.*

Introduction

Sunflower (*Helianthus annus* L.) is one of the important oil seed crop in India, contributing to the edible oil industry of the country. Sunflower originated from Mexico and southwestern America from where it had spread worldwide (Gibbon and Pant,1985). In India it is cultivated in an area of 14 lakh ha with a production of 8.23 lakh tonnes (Anonymous, 2011). Several biotic and abiotic factors are involved in reducing the yield of sunflower. Among the biotic factors, insect pests play a major role in devastating this crop. In the recent past, insect pest outbreaks are posing serious threat to profitable production of sunflower. Sunflower is an introduced crop in India and the pest complex is different from that of temperate region. Lepidopteran and coleopterous pests, such as, head moth, stem weevil and sunflower beetle attack the crop the temperate regions. Out of many insect species recorded as pests of sunflower in India, the key pests are the head borer (*Helicoverpa armigera*) , and the tobacco caterpillar (*Spodoptera litura* Fabr.), the green semilooper (*Trichoplusia orichalcea*) (Basappa and Santhalakshmi Prasad, 2005). Among the insect pests infesting sunflower, the head borer, *Helicoverpa armigera* is a serious threat causing economic loss to farmers. Currently the pest is controlled using a variety of pesticides. As with all pesticides, there is always danger of the target species developing resistance as well as causing problems in the environment. Plant resistance is an environmentally safe and cost-effective pest management technique. Developing pest resistant varieties would greatly enhance the options available for controlling this pest. There are three mechanisms of host plant resistance: antixenosis- plants act as poor hosts to the insect, antibiosis- plants have adverse effect on the biology of feeding insect, and tolerance- plants have inherent ability to withstand the attack of the insect .The present study was conducted to study the ovipositional preference of head borer, *Helicoverpa armigera* female on certain sunflower accessions under no choice and free choice conditions.

Materials and Methods

Mass culturing of *Helicoverpa armigera*

For the purpose of screening studies, a continuous, homogenous, disease free and virulent culture of the test insect, *Helicoverpa armigera* was maintained throughout the study period under controlled conditions. A temperature of 25 – 30 ^{o}C and relative humidity of 70 to 85 per cent was maintained.

The methodology recommended by Armes *et al.* (1994) was adopted in this study for the mass culturing of *H. armigera* with few modifications. Larvae collected from sunflower fields were reared on artificial medium in small glass vials. The larvae were allowed to feed continuously without any disturbance and periodic observations were made till pupation. The pupae were then transferred to a oviposition cage which was made of a cylindrical iron frame (40 cm high and 25 cm dia.) fitted with a circular card board at 25 cm height from the base of the frame. The frame was covered with muslin cloth using plastic clips and kept in a plastic bucket (35 cm dia and 30 cm high) filled 3/4th capacity with water. Pupae collected were transferred to a petri dish and kept over the cardboard at the centre of the frame and strips of cloth (15cm x 5cm.) were hung from the top of the frame for enabling the emerging moths to alight upon for stretching their wings and cuticle hardening.

Newly emerged adults were collected in glass tubes (10cm x3cm.), sexed and allowed in glass jars (14.5 cm high and 10.5cm dia.) instead of large metal frames with cloth covers as used by Armes *et al.* (1994) @five pairs per jar for mating and oviposition sucrose solution enriched with commercial vitamin mixture was provided as adult feed in small rubber septa inside the mating cage.

The top of the mating jar was covered with moist muslin cloth and a strip of cloth was also hung vertically inside which served as oviposition substrate. The cloth was moistened periodically using wet sponge. Egg laying commenced from the second day after mating and the egg cloths were replaced daily. The dead moths were removed. The mating and oviposition cage was filled 1/4th from the bottom with moist sand in order to maintain relatively higher humidity (80 to 85 %) and lower temperature (25±2^{o}C).

The egg cloths were collected and preserved in small plastic containers(7 cm dia. and 8 cm high). The plastic containers containing egg cloths were kept buried 3/4th under moist sand on plastic trays to increase the humidity and to lower the temperature. After the emergence of neonate larvae from the eggs, the egg cloths were spread over the canopy of young chick pea plants (10 days old) grown already in plastic trays. The young larvae were allowed to feed on chick pea up to IInd instar (Patel *et al.* 1968) and then transferred to artificial diet in small glass vials (5 ml.) under seclusion, as the larvae were cannibalistic. The artificial diet was prepared as per Shorey and Hale (1965).

The final instar larvae, stop feeding and burrow into the diet for pupation. Healthy pupae were collected, surface sterilized with 1.8 per cent solution of sodium hypochlorite followed by two rinses of sterile water. The pupae were air dried in shade, spread over a layer of sterilized saw dust taken in 150 mm dia petri dish @ 50 pupae per petri dish and kept in adult emergence cage.

Antixenosis for oviposition by head borer

Nonpreference for oviposition was studied under no-choice, and multi-choice conditions. The twigs /inflorescences used for studying antixenosis were procured from the sunflower field. The plant material was thoroughly examined for the presence of eggs or larvae, if any, before use in laboratory.

No choice:

Young sunflower heads along with three leaves of selected genotypes were caged separately using the mylar film. A pair of premated *H.armigera* adults was released inside the cage. Five such cages were maintained for each accession individually. Ten per cent sucrose solution enriched with vitamin mixture was provided as diet for the moths. After 48h and 72 h, the number of eggs laid in each accession was counted and per cent hatching was also recorded.

Free choice:

Ovipositional preference of *H. armigera*, as a free-choice experiment, among the selected accessions was assessed as described above. Fresh heads of the selected accessions was excised along with three leaves and kept in conical flasks inside a plastic container.(45cm high and 45 cm dia). Five replications were maintained. Five pairs of pre mated adults per replication were released. Number of eggs laid and per cent hatching in each accession were recorded after 48 and 72 h.

Results and Discussion

Nonpreference or Antixenosis for oviposition

A. No-choice Test

Among the genotypes tested, AHT 02 was least preferred (97 eggs) by *H. armigera* adults for oviposition. The genotypes GK 2002 and IHT 751 recorded 240 eggs and 171 eggs respectively as compared to the susceptible check, Morden with 381 eggs. The relative oviposition preference ranged from 22.65 to 59.38 suggesting non-preference for oviposition by *H. armigera* females. The data exhibits a considerable variation in number of eggs and relative oviposition preference among the headborer-resistant genotypes tested. In choice tests under caged conditions, Van den Berg (1997) observed significant differences in number of eggs laid. Pant (1980) observed wide variations in ovipositional behaviour of *H. armigera* on resistant and susceptible genotypes and inferred that the oviposition preference might be due to some volatile chemical factors in the foliage, which either attract or repel the adults.

Table 1: No-choice Test for ovipositional non-preference of *H. armigera* to sunflower genotypes (cage study)

Sl. No.	Genotype	No. of eggs laid female $^{-1}$	ROP (%)
1.	KBSH 1	153.00 (12.30 ± 0.39)	-42.65
2.	IHT 751	171.00 (13.07 ± 0.39)	-38.00
3.	GHU 615	162.00 (12.7 ± 0.39)	-40.29
4.	GMU 631	153.00 (12.36 ± 0.29)	-42.65
5.	AHT 14	137.60 (12.36 ± 0.11)	-46.89
6.	GK 2002	240.00 (15.49 ± 0.32)	-22.65
7.	AHT 02	97.00 (09.84 ± 0.13)	-59.38
8.	K 578 (R)	176.00 (13.26 ± 0.19)	-36.76
9.	MORDEN (S)	381.00 (19.50 ± 0.20)	

(R) - Resistant Check; (S) - Susceptible Check

Relative Oviposition Preference in relation to (S)

B. Multi-choice Test

It was observed that egg laying was very low in GMU 631 (113.33 eggs) when compared with the genotypes AHT 14 and GK 2002 which recorded 240.33 eggs and 208.33 eggs respectively as compared to the susceptible check, Morden with 272.33 eggs. The relative oviposition preference ranged from 06.24 to 41.22 suggesting non-preference for oviposition by *H. armigera* females. The data exhibits a considerable variation in number of eggs and relative oviposition preference among the headborer-resistant genotypes tested. This is in accordance with the findings of Taneja (1989) who reported that the number of eggs were significantly less on the head borer resistant genotypes as compared to susceptible ones in sorghum.

Table 2: Multi-choice Test for ovipositional non-preference of *H. armigera* to sunflower genotypes (cage study)

Sl. No.	Genotype	No. of eggs laid female $^{-1}$	ROP (%)
1.	KBSH 1	172.67 (13.09 ± 0.85)	-22.40
2.	IHT 751	163.33 (12.77 ± 0.85)	-25.02
3.	GHU 615	160.00 (12.60 ± 0.85)	-25.98
4.	GMU 631	113.33 (10.47 ± 0.85)	-41.22
5.	AHT 14	240.33 (15.49 ± 0.85)	-06.24
6.	GK 2002	208.33 (14.32 ± 0.85)	-13.32
7.	AHT 02	131.67 (11.44 ± 0.85)	-34.93
8.	K 578(R)	91.67 (09.56 ± 0.85)	-49.63
9.	MORDEN (S)	272.33 (16.49 ± 0.85)	

(R) - Resistant Check; (S) - Susceptible Check

Relative Oviposition Preference in relation to (S)

In the present study, the number of eggs laid were significantly lower in genotypes GMU 631 and AHT 03 as compared with the susceptible check which recorded higher number of eggs. Thus, the genotypes AHT 02, KBSH 1, GMU 631, and GHU 615 can be used as sources of antixenosis/non- preference mechanism of resistance in sunflower improvement programs to breed for resistance to *H. armigera*.

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