

Antibiosis effects of okra and their hybrid derivatives on shoot and fruit borer

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ABSTRACT

Investigation was carried out to study the antibiosis mechanisms of resistance in okra accessions and their hybrid derivatives against Shoot and Fruit borer *Earia vittella* and the role of various biophysical factors of resistance. On estimating the antibiosis effects of the test accessions on the various life stages of *E. vittella*, the lowest total larval duration (14.62 days) was recorded on Hy2. The accessions Hy1 and Hy2 recorded the shortest larvae of the final instar (1.0 cm) and the longest was (1.8 cm) in the accession Arka Anamika. Regarding mean larval weight, the larvae reared on Arka Anamika gained maximum of 0.680 mg where as accession Hy1 gained the lowest weight of 0.315 mg. Highest larval mortality was recorded on the accession Hy2 followed by Hy1. Regarding the pupal characters, highest pupal weight (0.916mg) and maximum length of pupa recorded on the accession Arka Anamika whereas the accession Hy2 recorded the least pupal weight of 0.326 mg. The accession Hy2 recorded maximum total pupal duration (13.2 days). Cent percent adult emergence was recorded in the accession Arka Anamika. There was no adult emergence recorded in the accession Hy2. The highest adult longevity period of both male and female recorded on the accession Arka Anamika. Mean egg period and mean hatchability also high on the accession Arka Anamika followed by Hy6. Among the biophysical factors, maximum number of trichomes and high length and breadth of trichomes were recorded on the accession Hy2. Fruit length of Arka Anamika was greater than other accessions. Fruit width of Salem Local was greater than other accessions. Fruit angle to stem / branch of accession Hy4 was higher than other accessions. A significant negative correlation was observed among trichome density, trichome length, fruit width and fruit angle to stem with larval mortality, pupation percentage and adult longevity.

Keywords: Okra accessions, Hybrid derivatives, Antibiosis and Biophysical factors

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INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench), also known as lady's finger or bhindi, belongs to family Malvaceae and is an important crop grown throughout the year. Okra is a vegetable which is found in a fresh state in almost all markets in India, during all seasons due to its strong commercial value for poor farmers and its vital importance as food diet among the inhabitants of cities and villages. The fruit borers are alone reported to cause damage to the extent of 3.5 to 90 per cent to okra in different parts of the country (Mandal *et al.*, 2006). Among the borers, *Earias* spp. is distinguished from other pests by their marked tendency for stem boring. The larvae enter the

terminal bud of vegetable shoot and channel down from the growing point (Krishnikumar and Srinivasan, 1987). Control measures commonly used against insect pests in horticultural crops mainly consist of pesticides, but these products are often toxic to the environment and to non-target species. Consequently, the ideal way to solve the pest problem is by Integrated Pest Management (IPM), Host plant resistance is the main basic component of IPM, and the utilization of resistant plants has long been considered as one of the most effective components of insect control.

MATERIALS AND METHODS

Based on preliminary and confirmatory field screening of 38 okra accessions for resistance against the shoot and fruit borer, *Earias vittella*, three promising accessions namely Salem Local, Madurai Local and Anu were selected (Karthik, 2015) and by further crossing them, six viable hybrids (F1) were obtained and used for further studies.

Crossing techniques

The selected immature buds which were likely to open during the next morning were emasculated in the previous day evening between 3.00 and 6.00 p.m. The tip of the corolla of the flower bud was cut-off and a vertical cut was given to the united calyx. The calyx and corolla were gently removed including staminal column without injuring the gynoecium. The emasculated flower buds (female) and the flower buds selected as male were also covered with butter paper. Enough care was taken not to disturb the style and stigma of the emasculated flower buds. The anthers that dehisced between 7.00 and 9.00 a.m were collected and used for dusting over the stigma of emasculated flower. The pollinated flowers were covered with a butter paper cover and labelled. Thus, plant-to-plant direct and reciprocal crosses were affected. Hybridization process was carried out for about 25 days until sufficient quantity of hybrid seeds were produced. The crossed seeds were collected separately by maintaining identity and individuality. The details of F1 hybrids given below:

Hybrids	Parentage
Hybrid 1	Salem Local × Madurai Local
Hybrid 2	Madurai Local × Salem Local
Hybrid 3	Salem Local × Anu
Hybrid 4	Anu × Salem Local
Hybrid 5	Madurai Local × Anu
Hybrid 6	Anu × Madurai Local

Antibiosis of bhendi accessions against *E. vittella*

Antibiosis studies were conducted in the laboratory on the parents and their hybrid derivatives. The experiments were conducted under controlled conditions of temperature viz., 27 ± 2°C and relative humidity 75-85

percent. The susceptible accession Arka Anamika was used as a susceptible check. Each treatment was replicated five times with five larvae each. The observations on different parameters were recorded as indicated below.

Larvae characters

Observations on the length of the larvae were made on ten days after hatching when larvae almost reached full grown stage. Three larvae randomly selected from each replication and length of the each larva was measured on a cm scale from which the average length was worked out. Regarding the weight of the larva, the larvae taken for measurement of length on tenth day after hatching were weighed using an electronic balance and the average was worked out. For length of the pupae, newly formed pupae were used for observation. Three pupae were selected at random from each replication and their length was recorded by using a cm scale from which the average pupae length was worked out. The time taken by larvae from hatching till pupation was recorded in each replication and the average period was calculated.

Pupae characters

For length and weight of the pupae, the pupae selected for measurement of the length were weighed using an electronic balance and the average worked out. The time in between pupation of the larvae and emergence of moths was recorded and the average pupal period was calculated

Larval mortality and adult characters

Ten neonate larvae were released individually in the cage. The larvae were observed once in two days and supplied with fresh fruits whenever needed and the larval mortality, Percentage of moth emergence, adult longevity, fecundity, egg period and hatchability were recorded.

Biophysical factors of resistance trichome density

Fruit bits of known area were boiled in hot water for 20 min. Then the fruit bits were transferred to 20 mL of ethanol and again boiled for 20 min. This was done to remove the chlorophyll content. Then the fruit bits were boiled in 20mL of lactic acid for 20

minutes. The number of trichome hairs were counted by using a compound microscope and expressed in number per cm². The samples were collected at three different parts of the fruit of the same accession and replicated three times (Halder *et al.*, 2015).

Length and breadth of the trichome hairs

Thin fruit sections of accession were taken and length and breadth of the trichome hairs were measured after processing the fruit bits as indicated above. The samples were collected at three different parts of fruits of the same accession and replicated three times. Measurements were taken by using a compound microscope (10x and 40x) with the micrometer standardized.

Fruit length, Fruit width and fruit angle

Twenty randomly selected fruits were harvested from each accession and the length of the fruit and its width were measured by tracing with the help of a graph paper. The angle between the fruit and the mean stem was measure by using a protractor.

Statistical Analysis

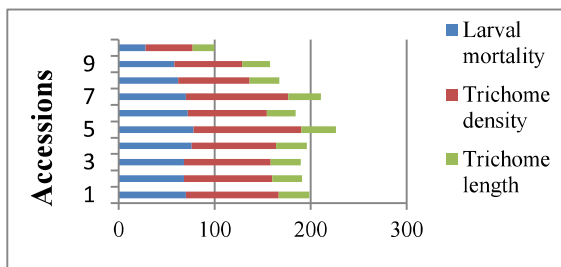
The data thus obtained from the different experiments were analysed statistically using Randomized Block Design (RBD). The data thus gathered were statistically analysed using IRRISTAT software and the critical difference values were arrived at. Necessary correlation analysis was also carried out.

RESULTS AND DISCUSSION

On estimating the antibiosis effects of the test accessions on the various life stages of *E. vittella*, it was observed that, the lowest total larval duration recorded on Hy2. The accessions Hy1 and Hy2 recorded the shortest larvae of the final instar of *E. vittella* and longest was in the accession Arka Anamika. Regarding mean larval weight, the larvae reared on Arka Anamika gained maximum of 0.680 mg whereas accession Hy1 gained lowest weight of 0.315 mg. Highest larval mortality recorded on the accession Hy2 (Fig 1). The accession Hy2 recorded the least pupal weight whereas highest pupal weight recorded on the accession Arka Anamika and the length of pupa was also high in the Arka Anamika. The accession, Hy2 recorded maximum total pupal duration (Table 1).

Fig 1. Influence of trichomes on larval mortality of *E.vittella*

adult emergence was recorded in the accession



Arka Anamika. There was no adult emergence recorded in the accession Hy2. The highest adult longevity period of both male and female recorded on the accession Arka Anamika 118 eggs /female was recorded. Mean egg period and mean hatchability also high on the accession Arka Anamika followed by Hy3 (Table 2). Among the accessions, Hy2 had maximum number of trichomes and this accession least preferred by *E. vittella*. Regarding fruit characters, fruit length of Arka Anamika was greater and fruit width of Hy2 was greater than other accessions. Fruit angle to stem of accessions Hy2 was higher than other accessions (Table 3). Antibiotic effect of the accession Hy2 was more pronounced on survival and development of *E. vittella*. This is may due to parentage of these hybrids are Madurai Local and Salem Local. The accessions Salem Local and Madurai Local were collected from a hilly terrain in Madurai and Salem districts respectively. Wild relatives or their derivatives have been reported to possess resistance against shoot and fruit borer, *E. vittella* (Sankhyan and Verma, 1997). The accessions Arka Anamika recorded the longest larvae of the final instar of *E. vittella*. The larvae reared on Arka Anamika recorded the least larval mortality and gained maximum weight. Regarding the pupal and adult characters, the highest pupal weight, less pupal duration and 100% adult emergence and the highest adult longevity period of both male and female recorded on the accession Arka Anamika. Sharma and Jat (2009) reported that Arka Anamika was a

Table 1. Antibiosis effect of the okra accessions and their hybrids on *E. vittella* larvae and pupae.

Name of the accession	Mean larval duration	Mean larval weight	Pupal Duration (day)	Pupa Weight (mg)
Salem Local	16.12 ± 0.14	0.360 ± 0.0027	12.0 ± 1.5	0.422 ± 0.0035
Madurai Local	17.0 ± 0.18	0.372 ± 0.0027	12.2 ± 1.7	0.426 ± 0.0046
Anu	16.8 ± 0.27	0.366 ± 0.0028	12.0 ± 1.5	0.523 ± 0.0041
Hy1	15.12 ± 0.16	0.315 ± 0.0020	12.4 ± 1.4	0.386 ± 0.0025
Hy2	14.62 ± 0.13	0.320 ± 0.0018	13.2 ± 1.0	0.326 ± 0.0036
Hy3	17.16 ± 0.19	0.482 ± 0.0022	9.8 ± 1.3	0.565 ± 0.0021
Hy4	15.50 ± 0.15	0.330 ± 0.0019	12.6 ± 1.2	0.332 ± 0.0023
Hy5	18.00 ± 0.23	0.562 ± 0.0023	11.2 ± 1.8	0.612 ± 0.0038
Hy6	18.08 ± 0.21	0.620 ± 0.0021	10.5 ± 1.8	0.686 ± 0.0040
Arka Anamika (S check)	19.00 ± 0.15	0.680 ± 0.0029	6.4 ± 2.0	0.916 ± 0.0053

Table 2. Antibiosis effect of the okra accession and their hybrids on *E. vittella* adults

Name of the accession	Mean adult longevity days		Fecundity Female	Mean egg period (day)	Mean percent hatchability*
	Female	Male			
Salem Local	6.0 ± 1.6	5.7 ± 1.3	89.45 ± 6.33	4.5 ± 1.2	85.0
Madurai Local	6.1 ± 1.5	5.3 ± 1.3	92.60 ± 7.25	4.2 ± 1.0	90.0
Anu	6.3 ± 1.4	5.5 ± 1.2	98.30 ± 6.55	4.0 ± 1.3	95.0
Hy1	5.5 ± 1.5	5.0 ± 1.4	78.50 ± 5.16	3.3 ± 1.1	50.0
Hy2	4.7 ± 1.0	4.6 ± 1.1	72.40 ± 4.32	3.2 ± 1.0	48.0
Hy3	6.7 ± 1.1	6.1 ± 1.1	103.60 ± 6.46	4.9 ± 1.2	94.30
Hy4	4.8 ± 1.2	4.5 ± 1.2	75.00 ± 4.83	3.5 ± 1.1	75.0
Hy5	6.5 ± 1.4	5.5 ± 1.3	112.5 ± 6.75	4.8 ± 1.4	95.50
Hy6	6.4 ± 1.2	6.0 ± 1.1	108.80 ± 7.48	4.6 ± 1.6	98.0
Arka Anamika (S check)	7.8 ± 2.1	6.7 ± 1.5	118.22 ± 9.35	5.4 ± 1.9	99.66

Each value is a mean of five replications. Mean value is followed by standard deviation.

highly preferable variety for study of *E. vittella* biology. However, the findings did not agree with those of Muazzma Akhter *et al.* (2014) Arka Anamika was found to be less preferred by *E. vittella*. Biophysical characters of okra such as trichome density, trichome length and breadth, fruit length, fruit width and fruit angle to stem to influence the resistance of the accessions against *E. vittella*. Hence in the present study, density of trichomes, length and breadth of trichomes were analysed. Among the accessions, Hy2 had maximum number of trichomes and this accession was least preferred by *E. vittella* (Plates 1 and 2). Prabu *et al.* (2009) reported that plant species has a distinctive set of defense traits from morphological factors that have behavioral and physiological effect for a potential herbivore consumer.

Plate 1. Glandular trichomes on the fruit of Hy2 accession



Plate 2. Non-Glandular trichomes on the fruit of Hy2 accession



Kumbher *et al.* (1991) found negative correlation of increased fruit hair density of bhendi towards resistance to *E. vittella*. Halder *et al.* (2015) also reported that a significant negative correlation was observed between trichome density and borer incidence. Further, high trichome

density might be imparting the physical barrier for the borer rendering their non-preference over the low trichome genotypes. Similar observations were also documented by Halder *et al.* (2006), who observed significant negative correlation between trichome density in pods and pod borer infestation and damage severity in mungbean. Regarding fruit characters, fruit length of Arka Anamika was greater and fruit width of Hy2 was greater than other accessions. Lengthy fruits were found more suitable for damage by *Earias* as they harboured more larvae/fruit. Present study was in accordance with that Halder *et al.* (2006), who reported similar findings on *Maruca* infesting cowpea. They also found that pod infestation was higher in genotypes that had highest pod length than other genotypes. Kamashi and Srinivasan (2008) also reported host physical property on the degree of infestation. Fruit angle to stem of accessions Hy2 was higher than other accessions. From the present investigation, it can be concluded that, antibiotic effect of the accession Hy2 was more pronounced on survival and development of *E. vittella*.

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