Full Length Research Article

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Research Journal of Agricultural Sciences
Volume 15; Issue 03 (May–Jun 2024); pp 605–609

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

Effect of Moisture Content in Okra on Infestation by Shoot and Fruit Borer, *Earias vitella*

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Received: 11 Feb 2024; Revised accepted: 02 Apr 2024

Abstract

Fifty genotypes of okra were evaluated for resistance to shoot and fruit borer, *Earias vitella* at College of Agriculture, Kerala Agricultural University, Vellanikkra, Thrissur from October 2020 to March 2021. The mean fruit damage varied greatly throughout the fifty genotypes studied, ranging from 3.42 to 85.31 per cent. The highest mean fruit damage of 85.31 per cent was shown by IC 117123 and lowest in Susthira, 3.42 per cent. Variation in moisture content among fifty genotypes was also significantly evident and it varied from 75.25 to 94.86 per cent. Correlation analysis showed a significant positive (0.659) relation between moisture content and fruit damage.

***Key words*:** Okra, Shoot and fruit borer, *Earias vitella*, Moisture, Correlation

Okra, also known as ladies finger (*Abelmoschus esculentus* L.), is one of the most extensively grown vegetable crops globally for its edible green fruits. India ranks first in the world with a production of 6466 thousand MT and an area of 531 thousand hectares with a productivity of 12.0 MT/ha. In Kerala, okra is grown in an area of 2.48 thousand ha with a production of 34.65 MT and productivity [1]. Several biotic and abiotic factor that contribute to the yield reduction in okra. Insect herbivory is the foremost among the different constraints that contribute to yield loss in okra. The crop, right from germination to harvest is attacked by several insect pests, of which shoot and fruit borer, *Earias vitella* is the most important one. Okra is susceptible to various diseases such as damping-off, powdery mildew, Fusarium wilt, root-knot nematodes, and bacterial wilt. These diseases can significantly reduce plant vigor, yield, and quality. The shoot and fruit borer alone reported to cause 35 to 90% fruit damage in different parts of the country [2].

Earias vitella is an important lepidopteran pest of okra and cotton and it is distributed all over the tropics. When the crop is young, larvae bore into tender shoots and tunnel downwards which wither, drop down, and growing points are killed. In fruits, the larvae bore inside these and feed on inner tissues which become deformed in shape with no market value. The moisture content in plants will attract the insects; for instance, the moringa moth, *Noorda blitialis* attacked more succulent and younger leaves [3]. Similarly, the early varieties with more succulent and thicker stems are more susceptible to damage by the pea stem borer *Melanagromyza phaseoli* [4]. In this context, the study was undertaken to identify the effect of the moisture content of fruits from selected genotypes of okra on the shoot and fruit borer, *Earias vitella*. In this regard, the study was conducted to determine the impact of moisture content in selected genotypes of okra on infestation by shoot and fruit borer, *Earias vitella*. Controlling Earias vitella infestations in okra requires integrated pest management strategies, which may include cultural, biological, and chemical control methods. These strategies aim to minimize pest populations while minimizing environmental impact and preserving natural enemies of the pest. Early detection, regular monitoring, and timely intervention are crucial for effectively managing Earias vitella and mitigating its impact on okra production.

MATERIALS AND METHODS

The study was conducted by screening fifty okra genotypes in an open field condition at College of Agriculture, Kerala Agricultural University, Vellanikkra, Thrissur (10° 32’52.0” N latitude and 76° 16’45.5” E longitude at an elevation of 40 m above MSL) from October 2020 to March 2021. The details of genotypes used is given in (Table 1). The details of materials used and methods followed for each experiment is described below:

Design and layout for screening

The experiment was laid out in a completely randomized design (CRD) with 50 okra genotypes as treatments in 2 replications. Nine plants were maintained in each replication, thus constituting a total experimental population of 900 plants. All the agronomic practices like weeding, fertilizer application and watering were done according to Package of Practice Recommendations of Kerala Agricultural University [5]. Salkeerthi, an okra variety released by KAU and used as a susceptible check in the present study was planted in border rows in the experimental plot about 20 days before the actual

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Citation: Anju VK, Subramanian M. 2024. Effect of moisture content in okra on infestation by shoot and fruit borer, *Earias vitella*. *Res. Jr. Agril. Sci.* 15(3): 605-609.

planting of genotypes to be screened. No synthetic pesticides were used at any stage of the screening.

Table 1 Details of okra genotypes used for the study

S. No.	Genotypes	Source
1	Susthira	KAU, Thrissur
2	Anjitha	KAU, Thrissur
3	Manjima	KAU, Thrissur
4	Aruna	KAU, Thrissur
5	IC 140906	ICAR-NBPGR
6	Arka Anamika	IIHR, Bangalore
7	P6	TNAU, Coimbatore
8	Pusa Bhindi 5	IARI, Delhi
9	Aanakomban	Farmers field
10	IC 282275	ICAR-NBPGR
11	IC 282272	ICAR-NBPGR
12	IC 282265	ICAR-NBPGR
13	IC 140902	ICAR-NBPGR
14	IC 128893	ICAR-NBPGR
15	IC 128080	ICAR-NBPGR
16	IC 282283	ICAR-NBPGR
17	IC 282284	ICAR-NBPGR
18	IC 117229	ICAR-NBPGR
19	IC 128057	ICAR-NBPGR
20	IC 24137	ICAR-NBPGR
21	EC 329424	ICAR-NBPGR
22	IC 218900	ICAR-NBPGR
23	IC 140910	ICAR-NBPGR
24	IC 128078	ICAR-NBPGR
25	Salkeerthi	KAU, Thrissur
26	IC 128888	ICAR-NBPGR
27	IC 282295	ICAR-NBPGR
28	IC 128890	ICAR-NBPGR
29	IC 117226	ICAR-NBPGR
30	IC 140907	ICAR-NBPGR
31	IC 282294	ICAR-NBPGR
32	IC 128885	ICAR-NBPGR
33	IC 128892	ICAR-NBPGR
34	IC 282283	ICAR-NBPGR
35	IC 128894	ICAR-NBPGR
36	IC 128883	ICAR-NBPGR
37	IC 128075	ICAR-NBPGR
38	IC 128055	ICAR-NBPGR
39	IC 128035	ICAR-NBPGR
40	IC 128076	ICAR-NBPGR
41	IC 117123	ICAR-NBPGR
42	IC 128068	ICAR-NBPGR
43	IC 128079	ICAR-NBPGR
44	IC 128887	ICAR-NBPGR
45	IC 117202	ICAR-NBPGR
46	IC 117235	ICAR-NBPGR
47	IC 43748	ICAR-NBPGR
48	IC 282278	ICAR-NBPGR
49	IC 140909	ICAR-NBPGR
50	IC 282266	ICAR-NBPGR

KAU: Kerala Agricultural University
ICAR - NBPGR: Indian Council of Agricultural Research - National Bureau of plant Genetic Resources
TNAU: Tamil Nadu Agricultural University
IARI: Indian Agricultural Research Institute
IIHR: Indian Institute of Horticultural Research

Screening of okra genotypes for resistance to okra shoot and fruit borer (SFB), Earias vitella

The genotypes in the polybags were regularly observed for infestation. Healthy and damaged fruits were counted during each harvest. Fruit damage was calculated and recorded as per cent damage.

$$Fruit\ damage\ (\%) = \frac{Number\ of\ damaged\ fruits}{Total\ number\ of\ fruits} \times 100$$

Estimation of moisture content in fruits

Moisture content of all fifty genotypes were analyzed at the harvesting stage. Hot air oven method was used for estimating the moisture content of okra fruits. Ten grams of fruit was taken and dried at 80° C until constant weights were observed. After drying, dry weight was measured and moisture content was estimated by using the following formula [6]. Moisture content of each genotype was expressed in per cent.

$$\text{Moisture content } (\%) = \frac{\text{Fresh weight} - \text{dry weight}}{\text{Fresh weight}} \times 100$$

Interpretation of data by statistical methods

A software, GRAPES 1.0.0 by Gopinath *et al.* [7] was used for the analysis of data. One way ANOVA was used for the analysis of damage percentage of okra SFB. The effect of moisture and incidence of SFB in okra damage was done by a correlation analysis technique.

RESULTS AND DISCUSSION

The mean fruit damage of fifty genotypes of okra and its fruit moisture content is represented in (Table 2). The mean fruit damage varied greatly throughout the fifty genotypes studied, ranging from 3.42 to 85.31 per cent. Susthira had the least mean fruit damage of 3.42 per cent and it is significantly superior among all the other genotypes. The NBPGR accession IC 282294 had comparatively a lower fruit damage of 11.53 per cent, but it was different from Susthira. The genotypes, Aruna, IC 140906, IC 218900 and IC 128885 had a mean fruit damage of 20.14 per cent, 27.14 per cent, 27.37 per cent and 29.04 per cent respectively, and were statistically on par with each other. The highest mean fruit damage of 85.31 per cent was shown by IC 117123, and it was followed by IC 282266 (76.6%) and both were significantly different from each other. These were followed by IC 282284 (75.85%) and IC 128076 (75.32%), both of which were statistically on par with each other. Infestation by *E. vitella* on okra has been studied extensively by several workers [8-10]. Kumar *et al.* [11], who evaluated thirty genotypes of okra, observed shoot damage of 9.00 to 33.07 per cent and fruit damage of 12.52 to 36.55 per cent. Similarly, Jayanth *et al.* [12], had reported shoot damage of 3.33 to 23.33 per cent among forty okra genotypes. In another study, mean fruit damage varying from 4.57 to 21.43 per cent among 21 okra genotypes [13]. Observations on infestation by *E. vitella* on twenty-four genotypes of okra by Reddy *et al.* [14] showed shoot and fruit damage to vary from 5.86 to 20.36 and 11.03 to 35.09 per cent respectively. Similarly, Patel *et al.* [15] screened twelve varieties of okra and found that shoot infestation varied from 4.33 per cent in Rudra to 24.66 per cent in Rajrani. Fruit damage was also varied among varieties, ranging from 4.94 per cent to 31.62 per cent. The high degree of resistance in Susthira has been reported previously by Karuppaiyan [16], who observed two accessions, namely, Susthira and EC 305760, both belonging to *A. caillei* alone were resistant to *E. vitella* among the 144 genotypes of okra evaluated. Balakrishnan *et al.* [17] at KAU also reported that the use of Susthira, as a parent in breeding programme resulted in lower shoot and fruit damage in the resultant hybrid.

Table 2 Mean fruit damage and moisture content of different okra genotypes

S. No.	Genotypes	Mean fruit damage (%)	Mean moisture content (%)
1	Susthira	3.42 (0.12)	72.25
2	Anjitha	45.92 (0.74)	91.53
3	Manjima	60.71 (0.91)	93.34
4	Aruna	20.14 (0.52)	89.05
5	IC 140906	27.21 (0.53)	80.22
6	Arka Anamika	36.31 (0.64)	88.86
7	P6	41.45 (0.69)	85.35
8	Pusa Bhindi 5	35.21 (0.30)	89.76
9	Aanakomban	34.72 (0.62)	91.65^{de}
10	IC 282275	43.75 (0.72)	86.29
11	IC 282272	52.22 (0.80)	85.30
12	IC 282265	56.66 (0.85)	90.18
13	IC 140902	65.75 (0.97)	93.30
14	IC 128893	48.77 (0.77)	83.73
15	IC 128080	61.87 (0.91)	88.23
16	IC 282283	50.36 (0.78)	88.18
17	IC 282284	75.85 (1.10)	94.72
18	IC 117229	39.81 (0.68)	85.23
19	IC 128057	49.37 (0.77)	89.21
20	IC 24137	47.62 (0.76)	92.31
21	EC 329424	51.91 (0.80)	93.31
22	IC 218900	27.37 (0.54)	81.21
23	IC 140910	46.95 (0.75)	88.32
24	IC 128078	45.95 (0.47)	89.84
25	Salkeerthi	65.17 (0.94)	90.71
26	IC 128888	46.66 (0.75)	87.26
27	IC 282295	32.00 (0.59)	84.34
28	IC 128890	44.82 (0.73)	92.40
29	IC 117226	45.09 (0.73)	86.37
30	IC 140907	45.81 (0.74)	87.26
31	IC 282294	11.53 (14.35)	78.32
32	IC 128885	29.04 (0.56)	80.71
33	IC 128892	46.73 (0.75)	85.47
34	IC 282283	53.21 (0.81)	89.79
35	IC 128894	53.73 (0.82)	90.495
36	IC 128883	35.33 (0.63)	85.28
37	IC 128075	69.41 (0.99)	92.32
38	IC 128055	61.73 (0.90)	90.18
39	IC 128035	49.97 (0.78)	87.36
40	IC 128076	75.32 (1.06)	94.26
41	IC 117123	85.31 (1.98)	94.86
42	IC 128068	45.61 (0.73)	87.56
43	IC 128079	43.57 (0.71)	82.41
44	IC 128887	48.80 (0.77)	84.77
45	IC 117202	44.70 (0.72)	88.98
46	IC 117235	69.16 (0.99)	90.23
47	IC 43748	74.18 (1.06)	91.89
48	IC 282278	41.86 (0.96)	84.39
49	IC 140909	47.81 (0.76)	87.66
50	IC 282266	76.60 (1.06)	94.5
	CD (0.05)	(0.365)	(1.054)

Figures in the parenthesis are arc sign transformed value
CD: Critical difference

Variation in moisture content among fifty genotypes was significantly evident and it varied from 75.25 to 94.86 per cent. The lowest moisture content of 75.25 per cent was noticed in Susthira and it was statistically lower among all the genotypes. The accession IC 282294 was recorded with a comparatively lower moisture content of 78.32 per cent, and it was statistically lower than IC 140906 (80.22%), IC 128885 (80.71%) and IC 218900 (81.21%), being on par with each other. The highest moisture content was measured in IC 117123 followed by IC 282284 (94.75%), IC 282266 (94.5%). All the three accessions were on par with each other and significantly superior from rest of the populations analyzed. Eighteen genotypes out of fifty were observed with more than 90 per cent moisture content, whereas a half of the population, exactly speaking, 30 genotypes had a moisture content between 80 to 90 per cent. Only two genotypes, namely, Susthira and IC 282294 were recorded with less than 80 per cent moisture content. Moisture content had a positive correlation (0.659) with the fruit damage in okra. The correlation was significant at the 0.001 level (two tailed) (Table 3, Fig 1).

Table 3 Correlation between fruit damage and moisture content

	Damage
Moisture	0.659***

The present study is consonance with Banger *et al.* [18] who found that okra variety AOL-05-1 had least fruit damage and least moisture content of 15.89 per cent and 85.33 per cent respectively, and on the other hand, highly susceptible variety (AOL-08-10) had high moisture content of 90.11 per cent. Having said that, the reports linking to the moisture content and fruit damage in okra are meager. Rao and Panwar [19] reported low moisture contents in the resistant genotypes of maize against *Chilo partellus.* Further, Melon fly, *Bactocera cucurbitae*, infestation increased with increasing moisture level [20]. The results of this study are complemented by Hazra *et al.* [21] and Elanchezhyan *et al.* [22], who noticed a significant and positive relationship with moisture content and shoot and fruit borer *Leucinodes orbanalis* damage in brinjal, as moisture content increases succulence as well, enhances attractiveness, and promotes odour and fragrance, luring insects from a distance for landing and therefore oviposition. Furthermore, moisture has a direct impact on the nutritional availability of nitrogen for herbivores. In addition, the concentrations of phenols and tannins, anti-nutritional metabolites, increase in the presence of decreasing moisture content. As it turns out, a combination of all of these factors influences insect growth and development on host plants. The resistant variety of brinjal had the lowest moisture content of 78.72 per cent, whereas it was 94.00 per cent in the susceptible variety, and it gave a clear-cut positive correlation between moisture content and susceptibility [23]. Roshni [24] and Beegum [25] reported similar findings in bitter gourd and cowpea, respectively, and these findings are consistent with the current study.

CONCLUSION

Along with many biochemical and morphological parameters, moisture content of plants have a prominent role in making a host plant resistant or susceptible to insect attack. The study on effect of moisture content of okra on infestation by shoot and fruit borer, *E. vitella* revealed a positive correlation between fruit moisture and fruit damage. The relationship between moisture content and susceptibility to insect infestation can be valuable for developing strategies to manage pest populations. This might involve adjusting irrigation practices, selecting plant varieties with traits that confer resistance to pests, or implementing cultural practices to promote optimal plant health and reduce susceptibility to infestation.

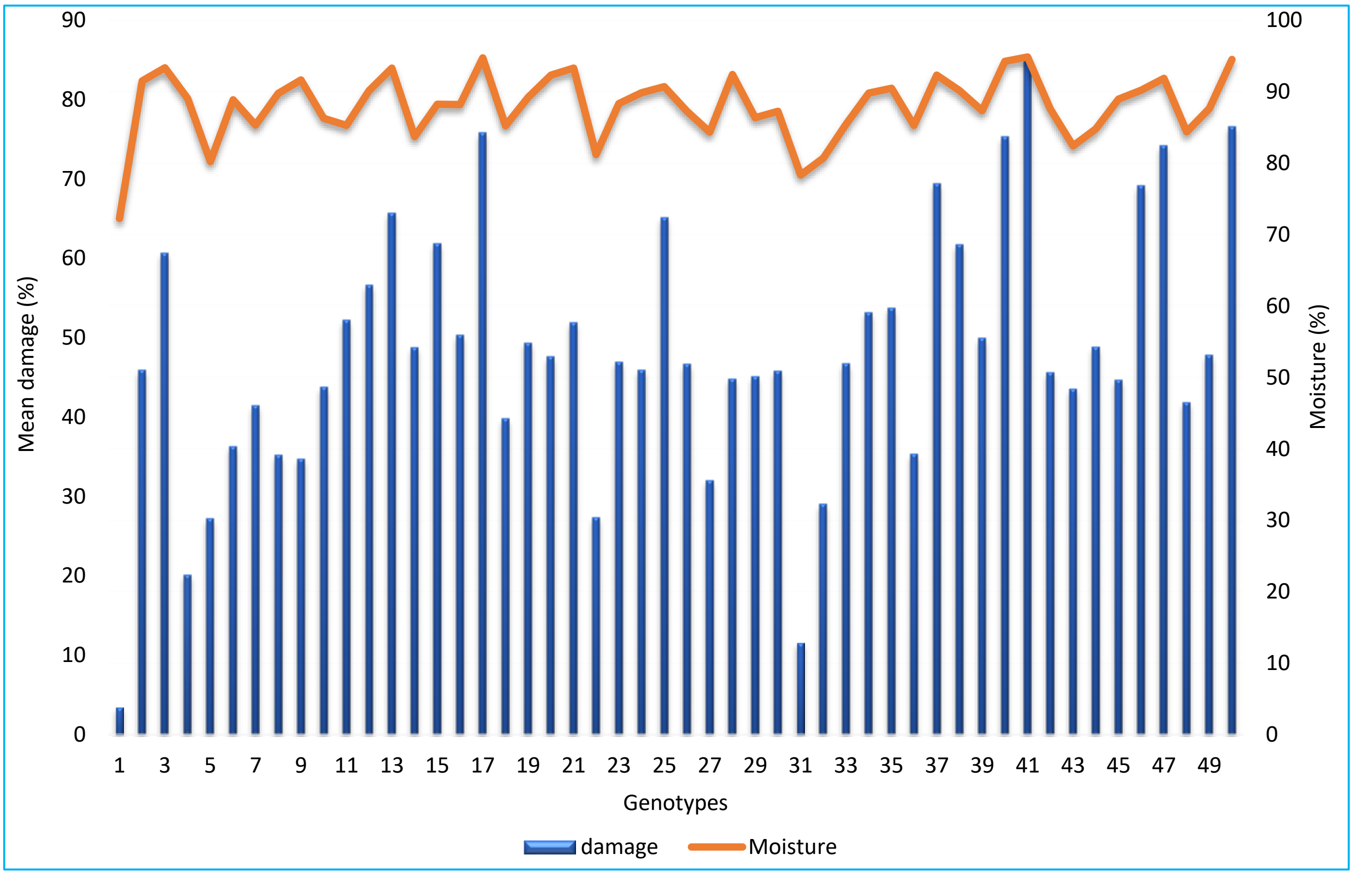

Fig 1 Influence of fruit moisture on fruit damage by shoot and fruit borer, *Earias vitella*

LITERATURE CITED

1. NHB [National Horticultural Board]. 2021. Horticulture In formation Service, National Horticultural Board, Gurgaon, (India). pp 55-56.
2. Chincholkar AS, Yadav U, Magar PN. 2023. Comparative field efficacy of biorationals and chemical insecticides against shoot and fruit borer, *Earias vittella* in okra. *Pharma Innov. Journal* 12(5): 129-132.
3. Bedana TM, Singh SK, Selvaraj T, Negeri M. 2013. Distribution and damage status of moringa moth (*Noorda blitealis* Walker) on *Moringa stenopetala* Baker (Cufod.) in southern Rift Valley of Ethiopia. *Int. Jr. Agric. Tech*. 9(4): 963-985.
4. Singh G, Mishra PN. 1997. Note on susceptibility of certain vegetable pea varieties to *Melanagromyza phaseoli* (Tryon) and *Thrips tabaci* Lindeman. *Indian Jr. Agriculture* 7(11): 587-588.
5. KAU (Kerala Agricultural University) 2016. Package of practices recommendations: crops. Kerala Agricultural University, Thrissur, Kerala. pp 360.
6. Ranganna S. 1997. *Manual of Analysis of Fruit and Vegetable Products*. Tata McGraw Hill Publishing Company Limited, New Delhi. pp 634.
7. Gopinath PP, Parsad R, Joseph B, Adarsh VS. 2021. GRAPES: General Rshiny Based Analysis Platform Empowered by Statistics. https://www.kaugrapes.com/home. version 1.0.0. DOI: 10.5281/zenodo.4923220.
8. Afzal M, Mukhtar MK, Tahir HM, Babar MH, Sherawat HM. 2015. Screening of different okra genotypes against fruit borer (*Earias* spp.) (Lepidoptera: Noctuidae) on okra crop. *Pakistan Jr. Zoology* 47(6): 1631-1635.
9. Halder J, Sanwal SK, Rai AK, Rai AB, Singh B, Singh BK. 2015. Role of physico-morphic and biochemical characters of different okra genotypes in relation to population of okra shoot and fruit borer, *Earias vittella* (Noctuidae: Lepidoptera). *Indian Jr. Agric. Sciences* 85(2): 278-282.
10. Jalgaonkar VN, Mahla M, Naik K, Vyas A, Golvankar G. 2018. Varietal preference of okra shoot and fruit borer, *Earias vittella* (Fab.) in summer season under field condition in Konkan region of Maharashtra. *Int. Jr. Curr. Microbiology Applied Science* 7(11): 2397-2402.
11. Kumar S, Kumar P, Nishad RN, Yadav SK, Patel PK. 2020. Evaluate the performance of promising germplasm/varieties of okra against shoot and fruit borer. *Jr. Ento. Zool. Studies* 8(5): 759-761.
12. Jayanth S, Bhanderi DR, Chawla SL, Patel AI, Saravaiya SN, Sakriya SG. 2021. Screening of okra genotypes across environments for resistance against shoot and fruit borer, yellow vein mosaic virus and enation leaf curl virus. *Pharma Innov. Journal* 10(11): 407-413.
13. Kadam PS, Chikte PB, Rathod PK. 2022. Evaluation of okra genotypes for resistance to shoot and fruit borer, *Earias vittela* (Fabricius). *Pharma Innov. Journal* 11(6): 3064-3068.

14. Reddy AJ, Kumar DVSR, Rao S, Prasannakumari V, Roja V. 2023. Comprehensive screening and categorization of selected okra germplasm lines against shoot and fruit borer (*Earias vittella*) tolerance during plant ontogeny. *Journal of Ent. Research* 47(3): 482-488.
15. Patel A, Singh H, Kumar S, Shanker R, Kumar P. 2023. Screening of different varieties against *Earias vittella* (Fab.) and categorization on the basis of shoot and fruit damage in okra. *Journal of Ent. Research* 47(1): 42-47.
16. Karuppaiyan R. 2006. Breeding for resistance to shoot and fruit borer (*Earias vittella* Fab.) in okra (*Abelmoschus esculentus* (L.) Moench). *Ph. D. Thesis*, Kerala Agricultural University, Thrissur, (India). pp 178.
17. Balakrishnan D, Sreenivasan E, Radhakrishnan VV. 2011. Fruit and shoot borer resistance (*Earias vittella* Fab.) in okra (*Abelmoschus esculentus* (L.) Moench). *Asian Jr. Bio. Sci*. 6(2): 194-197.
18. Banger K, Tian H, Lu C. 2012. Do nitrogen fertilizers stimulate or inhibit methane emissions from rice fields? *Glob. Chang. Biology* 18(10): 3259-3267.
19. Rao CN, Panwar UPS. 2002. Morphological plant characters affecting resistance to *Chilo partellus* in maize. *Ann. Pl. Protec. Science* 8: 145-149.
20. Dhillon MK, Singh R, Naresh JS, Sharma NK. 2005. Influence of physico-chemical traits of bitter gourd, *Momordica charantia* L. on larval density and resistance to melon fruit fly, *Bactrocera cucurbitae* (Coquillett). *Journal of Applied Entomology* 129(7): 393-399.
21. Hazra P, Dutta R, Maity TK. 2004. Morphological and biochemical characters associated with field tolerance of brinjal (*Solanum melongena* L.) to shoot and fruit borer (*Leucinodes orbonalis*) and their implication in breeding for tolerance. *Indian Jr. Genet. Plant Breeding* 64(3): 255-256.
22. Elanchezhyan K, Murali RK, Rajavel DS. 2009. Biochemical basis of resistance in brinjal genotypes to shoot and fruit borer, (*Leucinodes orbonalis,* Guen.). *Jr. Ento. Research* 32(2): 101-104.
23. Dar SA, Wani AR, Nehru RK, Mir SH, Jeelani MI. 2014. Biochemical basis of resistance in brinjal genotypes against shoot and fruit borer (*Leucinodes orbonalis*, Guenee). *Chem. Sci. Rev. Letters* 6(23): 1931-1940.
24. Roshni M. 2014. Morphological and biochemical bases of resistance to melon fruit fly *Bactrocera cucurbitae* (Coquillett) (Diptera: Tephritidae) in bitter gourd (*Momordica charantia* L.). *M. Sc. Thesis*, Kerala Agricultural University, Kerala (India). pp 54.
25. Beegum N. 2015. Morphological and biochemical bases of resistance to spotted pod borer, *Maruca vitrata* (Fab.) (Lepidoptera: Crambidae) in cowpea. M.Sc. Thesis, Kerala Agricultural University, Thrissur, (India). pp 105.