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Evaluation of different cultivars against shoot and fruit borer *Earias vittella* (Fab.) in okra

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Abstract

The present field experiment was conducted during *Kharif* season- 2014 at Research Farm, Department of Entomology, JNKVV, College of Agriculture, Rewa (M.P.) to evaluate the cultivars of okra against shoot and fruit borer, *Earias vittella* (Fab.) under the agro climatic condition of Rewa district. Ten cultivars were evaluated for assessing the infestation of okra shoot and fruit borer on percentage of damaged fruits on number and weight basis. The mean percentage of damaged fruits on number and weight basis in different cultivars were varied from 9.01 to 22.16% and 8.34 to 21.59% as compared to check variety; Julie (15.89% and 15.44%). The lowest percentage of damaged fruits (9.01%) as well as the minimum percentage of weight loss (8.34%) was observed in cultivar; Purvi which gave the maximum healthy fruits yield of 2196g./ ten plants (i.e. 81.33 q./ha). The highest percentage of damaged fruits i.e. 22.16% and maximum percentage of weight loss of 21.59% was recorded in cultivar Bhindi selection-51 which gave the minimum healthy fruit yield of 1242g./ ten plants i.e. 46 q./ha. The minimum percentage of damaged fruits and weight loss (i.e. 9.01% and 8.34%) was recorded from cultivar Purvi which was at par with Super Rekha (9.31% and 8.40%) and were found significantly superior over other cultivars including variety; Julie (15.89% and 15.44%). The highest percentage of damaged fruits and weight loss (i.e. 22.16% and 21.59%) was recorded from cultivar Bhindi selection-51 followed by Abhimanyu (20.19% and 19.60%) and Bhindi No.-319 (19.06% and 18.62%) which were significantly inferior to check variety.

Keywords: *Earias vittella* (Fab.), percentage of damaged fruits and weight loss, okra, yield

Introduction

Vegetables play an important role in our diet as a source of vitamins, carbohydrates and minerals etc. It is an essential commodity in our balance diet to overcome the problem of malnutrition especially in developing countries like India, where malnutrition is major health problem in children as well as in adults (Randhawa, 1974 and Khan Masood *et al.*, 2001)^[11,5]. Okra (Lady's finger or bhindi), *Abelmoschus esculentus* (L.) Moench is cultivated in India mainly for its immature fruits. Okra fruits have nutritious as well as dietary value. Though, it is mainly used as a fresh vegetable, it is also consumed as canned, dehydrated or frozen forms. It is an important source of vitamins like vitamin A, B and C (30mg/100 g) and also contains fat, carbohydrates and minerals like calcium (90 mg/100g), iron (1.5 mg/100 g), magnesium and potassium (Aykrout, 1963)^[3]. The roots and stems of okra are also used as a cleansing agent during gur or brown sugar preparation (Chauhan, 1972)^[4]. Okra ripe seeds are roasted, grind and used as a substitute for coffee in some countries. Mature fruits and stems containing crude fibre are used in the paper industry. Its seed contains about 40% oil. Okra is said to be very useful against genito-urinary disorders, spermatorrhoea and chronic dysentery (Nandkarni, 1927)^[9]. Its medicinal value has also been reported in curing ulcers and relief from haemorrhoids (Adams, 1975)^[1]. India is the largest producer of this crop in the world and contributes approximately 72% of the total production with an area, production and productivity of 0.53 million hectares, 6.34 million tonnes of okra fruits and 11.98 tonnes /ha, respectively. In Madhya Pradesh, it occupies an area of 0.26 lakh ha with a production and productivity of 3.05 lakh metric tonnes of fruits and 11.53 tonnes/ha, respectively (Anonymous, 2015)^[2].

One of the major constraints for the low productivity of okra is its high vulnerability to attack by insect pests. Intensity of damage caused by pests also varies from season to season.

During summer, okra fruits fetch a higher price in the market, but the pest attack is comparatively more which results in a lower yield of marketable fruits than other seasons. Okra is attacked by 72 species of insect pests but among them shoot and fruit borer, *Earias vittella* (Fab.) is the one of the most destructive pests of okra and damage is done in two ways. First, the terminal portion of growing shoots is bored by caterpillars, which move down by making tunnels inside. As a result, the shoot drops downward or dry up. Secondly, the larvae enter the fruits by making holes, rendering them unfit for human consumption. According to an estimate this pest can cause 36-90% loss in fruit yield of okra. The affected fruits are rendered unfit for human consumption, as well as for procurement of seed.

The pest infestation is also very high in Rewa district and indiscriminate use of pesticides is a common practice in the region which has created several undesirable effects on environment, insecticide residues, resistance to secondary pest resurgence, adverse effect on beneficial organisms and human health keeping this fact in view, the present investigation was undertaken to evaluate the cultivars of okra against shoot and fruit borer.

Materials and Methods

A field trial was conducted in the field of Department of Entomology, JNKVV, College of Agriculture, Rewa (M.P.) during *kharif* season-2014 in randomized block design with ten cultivars in three replications including check variety, Julie. All Okra varieties were sown on 10th July, 2014 in plots of 3 × 2.6 m with spacing of 60 × 45 cm. The recommended fertilizer dose (N: P: K-100: 50: 50 kg/ha) was applied by broadcasting method. All the cultural practices except plant protection were carried out as per recommendations. The first and last picking of fruits were done on 26th August and 09th October, 2014. Observation on shoot and fruit borer incidence was recorded on ten randomly selected tagged plants from each plot. The observations recorded on ten different cultivars including check variety; Julie.

No insecticide spray was done throughout the experimental period in the crop for the control of insect pests. Observation on percent fruit infestation was recorded on number and weight basis at the interval of 4 days. The number and weight of damaged and healthy fruits were recorded from the initiation of fruiting to last picking i.e. twelfth picking of the fruits at the interval of 4 days. The total yield of marketable fruits obtained from different cultivars was calculated and converted to per hectare yield. The data collected were subjected to Randomized Design for their significance. The details of screened cultivars were presented in table 1. The percentage of fruit loss and loss in weight of fruits was calculated by the following formula:

$$\text{a. Percentage of damaged fruits} = \frac{\text{No. of Damaged fruit} \times 100}{\text{Total no. of fruits}}$$

$$\text{b. Percentage of weight loss} = \frac{\text{Weight of damaged fruits} \times 100}{\text{Total Weight of fruits}}$$

Table 1: Details of screened cultivars

S. No.	Variety	Name of cultivar	Type of cultivar
1.	V ₁	Bhindi no.-319	Hybrid
2.	V ₂	Purna	Hybrid
3.	V ₃	Super Rekha	Hybrid
4.	V ₄	JKOH-7315	Hybrid
5.	V ₅	Zhilmil	Hybrid
6.	V ₆	Abhimanyu	Hybrid
7.	V ₇	Nilima	Hybrid
8.	V ₈	Purvi	Hybrid
9.	V ₉	Bhindi selection-51	Research
10.	V ₁₀	Julie (Check variety)	Composite

Results

Response of different cultivars on per cent fruit infestation

The infestation of shoot and fruit borer, *Earias vittella* (Fab.) was started on fruits at the time of second picking of fruits and the percentage of damaged fruits on number and weight basis were found between 0 to 10% and 0 to 8.64%, respectively in different cultivars. The highest percentage of damaged fruits (10%) was recorded in Bhindi selection-51 followed by Abhimanyu (9.09%) and Bhindi No.-319 (8.33%). As regard to the damage on weight basis, highest percentage of damaged was recorded in Bhindi selection-51 (8.64%) followed by Bhindi No.-319 (8%) and Abhimanyu (7.86%). Rest of the cultivars including check variety were found free from the infestation, both on number and weight basis. At the time of last picking of fruits i.e. twelfth picking, the number and weight of percentage of damaged fruits varied from 25 to 42.85% and 23.52 to 44.45%, respectively. The lowest fruit infestation (25%) was recorded in two different cultivars i.e. Purvi and Super Rekha and the highest (42.85%) damage fruits were received from cultivars Bhindi selection-51 and Zhilmil. Cultivars Purna and Bhindi No.-319 were recorded similar percentage of damaged fruits i.e. 40% besides check (40%) at this picking. However, the minimum loss (23.52%) in fruit weight was observed in Purvi which was at par with Super Rekha (23.68%). These two cultivars were found significantly superior over other cultivars including check (39.02%). The maximum percentage of weight loss was recorded in cultivar Bhindi selection-51 (44.45%) followed by Abhimanyu (43.63%). On the basis of overall fruit infestation, the mean percentage of damaged fruits on both number and weight basis in different cultivars were found between 9.01 to 22.16% and 8.34 to 21.59%. The lowest infestation was recorded from Purvi (9.01%) which was at par with Super Rekha (9.31%) and were found significantly superior over other cultivars including check (15.89%). The highest infestation (22.16%) was recorded from Bhindi selection-51 followed by Abhimanyu (20.19%) and Bhindi No.-319 (19.06%) which were found significantly inferior to check (15.89%). Whereas, the minimum percentage of weight loss (8.34%) showed by Purvi which was at par with Super Rekha (8.40%) and were found significantly superior over other cultivars including check (15.44%). Bhindi Selection-51 showed the maximum percentage of weight loss (21.59%) followed by Abhimanyu (19.60%) and Bhindi No.-319 (18.62%) which were observed significantly inferior to check variety (15.44%). The detailed data for per cent fruit infestation in different cultivars at each picking has been given in table 2 a and table 2 b.

Table 2a: Fruit infestation on number and weight basis in different cultivars of okra during *Kharif*, 2014

Name of cultivar	Number of fruit pickings - 12													
	1 st		2 nd		3 rd		4 th		5 th		6 th		7 th	
	N.B.	W.B.	N.B.	W.B.	N.B.	W.B.	N.B.	W.B.	N.B.	W.B.	N.B.	W.B.	N.B.	W.B.
Bhindi no.-319	0	0	8.33 (13.26)	8 (13.02)	11.11 (18.91)	10.06 (17.99)	15.38 (22.93)	13.57 (21.34)	17.24 (24.40)	16.67 (23.98)	16.12 (23.56)	17.40 (24.54)	18.51 (24.49)	17.50 (24.62)
Purna	0	0	0	0	5.88 (11.13)	6.47 (11.64)	8 (15.98)	8.17 (16.17)	10.71 (18.87)	11.91 (20.03)	13.33 (21.26)	12.30 (20.42)	15.38 (21.98)	16.51 (23.77)
Super Rekha	0	0	0	0	5 (10.29)	4.54 (9.73)	7.14 (15.09)	5.88 (13.63)	6.06 (13.86)	5.16 (12.71)	8.33 (16.58)	7.16 (15.31)	9.67 (16.90)	7.41 (15.55)
JKOH-7315	0	0	0	0	5.26 (10.54)	4.93 (10.18)	7.14 (15.09)	6.14 (13.96)	6.89 (14.82)	6.20 (14.00)	9.67 (17.88)	8.60 (16.80)	11.11 (18.18)	9.67 (17.86)
Zhilmil	0	0	0	0	5.56 (10.82)	4.57 (9.73)	8 (15.98)	7.33 (15.94)	10.34 (18.52)	8.52 (16.74)	12.90 (20.92)	11.59 (19.70)	14.81 (21.53)	14.22 (21.98)
Abhimanyu	0	0	9.09 (13.83)	7.86 (12.84)	11.76 (19.49)	10.29 (18.14)	15.38 (22.93)	14.21 (21.89)	17.85 (24.86)	17.39 (24.43)	16.67 (23.94)	16.67 (23.94)	20 (25.53)	18.75 (25.38)
Nilima	0	0	0	0	5.26 (10.54)	4.90 (10.12)	7.40 (15.37)	6.67 (14.49)	9.67 (17.88)	8.51 (16.73)	12.12 (20.12)	11.12 (19.31)	13.79 (20.70)	12.31 (20.38)
Purvi	0	0	0	0	4.76 (9.99)	4.37 (9.54)	6.89 (14.78)	6.13 (13.92)	6.06 (13.86)	4.93 (12.49)	8.10 (16.34)	7.18 (15.31)	9.37 (16.62)	7.41 (15.59)
Bhindi selection-51	0	0	10.00 (14.54)	8.64 (13.46)	13.33 (20.82)	12.50 (20.01)	17.39 (24.45)	16.12 (23.38)	20 (26.42)	18.71 (25.48)	18.51 (25.36)	19.45 (26.04)	20.84 (26.09)	19.59 (26.06)
Julie (Check)	0	0	0	0	6.67 (11.86)	5.69 (10.87)	9.09 (17.04)	8.19 (16.19)	15.38 (22.93)	14.47 (22.18)	14.28 (22.03)	15.12 (22.69)	16 (22.44)	14.88 (22.48)
SEm±	-	-	0.243	0.211	1.390	1.390	0.387	0.140	0.34	0.293	0.149	0.130	0.126	0.192
CD at 5%	-	-	0.753	0.654	4.309	4.309	1.198	0.434	1.076	0.907	0.463	1.103	0.390	0.596

Note: -XX values in parenthesis are angular transformed value.

Where, N.B. - Number basis, W.B.-Weight basis Continued..... To Table 2 b

Table 2b: Fruit infestation on number and weight basis in different cultivars of okra during *Kharif*, 2014

Name of cultivar	Number of fruit pickings - 12											
	8 th		9 th		10 th		11 th		12 th		Mean	
	N.B.	W.B.	N.B.	W.B.	N.B.	W.B.	N.B.	W.B.	N.B.	W.B.	N.B.	W.B.
Bhindi no.-319	22.72 (28.32)	21.71 (27.59)	27.78 (31.63)	27.16 (31.22)	33.34 (34.99)	32.72 (34.65)	37.50 (37.27)	36.76 (36.87)	40 (39.82)	39.02 (39.37)	19.06 (25.66)	18.62 (25.32)
Purna	18.18 (25.03)	18.84 (25.72)	22.23 (27.92)	23.56 (28.76)	27.27 (31.08)	28.82 (32.25)	33.34 (34.82)	33.78 (35.09)	40 (39.82)	40 (39.82)	14.42 (22.04)	15.04 (22.54)
Super Rekha	11.53 (19.63)	10.44 (18.81)	14.28 (21.92)	12.66 (20.65)	18.75 (25.34)	17.04 (24.04)	22.23 (27.34)	21.11 (26.67)	25 (30.60)	23.68 (29.73)	9.31 (17.40)	8.40 (16.56)
JKOH-7315	13.63 (21.39)	13.04 (21.13)	16.67 (23.77)	15.78 (23.08)	21.42 (27.21)	20.58 (26.77)	25 (29.13)	24.08 (28.47)	28.57 (32.50)	27.11 (31.61)	10.81 (18.82)	10.14 (18.27)
Zhilmil	17.39 (24.45)	18.22 (25.25)	22.23 (27.92)	23.07 (28.20)	28.57 (32.06)	29.41 (31.97)	30 (32.79)	30.00 (32.80)	33.34 (35.58)	33.34 (35.62)	14.09 (21.74)	13.74 (21.53)
Abhimanyu	23.80 (29.07)	22.98 (28.61)	29.41 (32.69)	29.78 (32.84)	33.34 (34.99)	32.67 (34.60)	37.50 (37.27)	36.92 (36.75)	42.85 (41.21)	43.63 (41.76)	20.19 (26.46)	19.60 (26.07)
Nilima	16.67 (23.91)	16.30 (23.81)	21.05 (27.11)	20.43 (26.65)	26.67 (30.86)	25.67 (30.18)	30 (32.79)	29.03 (32.16)	33.34 (35.58)	31.37 (34.38)	13.24 (21.06)	12.69 (20.62)
Purvi	11.12 (19.20)	10.11 (18.50)	13.63 (21.39)	12.72 (20.70)	17.64 (24.54)	17.41 (24.41)	20 (25.82)	19.86 (25.73)	25 (30.60)	23.52 (29.81)	9.01 (17.10)	8.34 (16.50)
Bhindi selection-51	25 (29.85)	24.09 (29.37)	29.41 (32.69)	29.78 (32.84)	36.36 (37.81)	35.48 (36.30)	40 (38.94)	38.75 (38.18)	42.85 (41.21)	44.45 (42.15)	22.16 (27.85)	21.59 (27.45)
Julie (Check)	19.04 (25.69)	17.93 (25.05)	23.52 (28.79)	22.97 (28.42)	27.27 (31.08)	27.27 (31.07)	33.34 (34.82)	32.00 (33.99)	40 (39.82)	39.02 (39.18)	15.89 (23.22)	15.44 (22.89)
SEm±	0.175	0.566	0.205	0.256	0.241	0.290	0.554	0.602	0.449	0.465	0.171	0.088
CD at 5%	0.543	1.754	0.635	0.795	0.747	1.640	1.717	1.864	1.390	1.440	0.531	0.272

Note: -XX values in parenthesis are angular transformed value

Where, N.B. - Number basis, W.B.-Weight basis

Response of different cultivars on number of healthy and damaged fruits

It was observed that number of healthy fruits ranged between 5 to 9 fruits in different cultivars at the time of first picking. The maximum number of healthy fruits (09 fruits per ten plants) was recorded in two cultivars i.e. Super Rekha and Purvi followed by JKOH-7315 (08 fruits per ten plants) which were significantly superior over other cultivars including check variety, Julie (06 fruits per ten plants). Whereas, the minimum number of healthy fruits i.e. 5 fruits per ten plants was recorded in Bhindi Selection-51 which was significantly

inferior to check. As regard to the damaged fruits at this stage, no infestation of the pest was recorded in any cultivar. At the time of second picking the number of healthy and damaged fruits in different cultivars varied from 9 to 14 fruits and 0 to 1 fruit, respectively. Super Rekha and Purvi produced the maximum healthy fruits (14 fruits/ten plants) and were found significantly superior over other cultivars including check (10 fruits/ten plants). Bhindi Selection-51 was lowest in order of healthy fruits production (09 fruits/ten plants). The highest number of damaged fruits (1 fruit/ten plants) was noted in cultivars i.e. Bhindi No.-319, Abhimanyu and Bhindi

Selection-51. Rest of the tested cultivars also including check variety were free from infestation at this stage. On the basis of overall fruit production, total number of healthy and damaged fruits in different cultivars recorded from 151 to 232 fruits and 23 to 43 fruits, respectively. The highest yield of healthy fruits/ ten plants i.e. 232 fruits/ ten plants was given by Purvi followed by Super Rekha (224 fruits/ ten plants) were recorded as less infested cultivars than other cultivars also including check (164 fruits/ ten plants). While, Bhindi Selection-51 gave the lowest healthy fruits yield (151fruits/ ten plants) which was significantly inferior to check. As

regard to the damaged fruits, minimum number (23 fruits/ ten plants) noted in cultivars i.e. Purvi and Super Rekha closely followed by JKOH-7315 (24 fruits/ ten plants) which were significantly superior over other cultivars including check (31 fruits/ ten plants). The maximum yield of damaged fruits (43 fruits/ ten plants) observed in Bhindi Selection-51 followed by Abhimanyu (42 fruits/ ten plants) and Bhindi No.-319 (41 fruits/ ten plants) were found significantly inferior to check. The detailed data for number of healthy and damaged fruits in different cultivars at each picking has been given in table 3 a and table 3 b.

Table 3a: Number of healthy and damaged fruits in different cultivars at the time of fruit pickings during, *Kharif* 2014

Number of healthy and damaged fruits per ten plants at the time of fruit pickings																
Number of fruits pickings -12																
Name of cultivar	1 st picking		2 nd picking		3 rd picking		4 th picking		5 th picking		6 th picking		7 th picking		8 th picking	
	HF.N	DF.N	HF.N	DF.N	HF.N	DF.N	H.F. N	D.F.N.	H.F. N	D.F.N.	HF.N	DF.N	HF.N	DF.N	HF.N	DF.N
Bhindi no.-319	7 (2.73)	0	11 (3.39)	1 (0.93)	16 (4.06)	2 (1.56)	22 (4.74)	5 (2.33)	17 (4.18)	5 (2.33)	26 (5.14)	5 (2.33)	22 (4.74)	5 (2.33)	17 (4.18)	5 (2.33)
Purna	6 (2.54)	0	11 (3.39)	0	16 (4.06)	1 (0.93)	22 (4.74)	4 (2.11)	18 (4.30)	4 (2.11)	26 (5.14)	3 (1.86)	22 (4.74)	4 (2.11)	18 (4.30)	4 (2.11)
Super Rekha	9 (3.08)	0	14 (3.80)	0	19 (4.41)	1 (0.93)	28 (5.33)	3 (1.86)	23 (4.84)	3 (1.86)	33 (5.78)	2 (1.56)	28 (5.33)	3 (1.86)	23 (4.84)	3 (1.86)
JKOH-7315	7 (2.73)	0	12 (3.53)	0	18 (4.30)	1 (0.93)	24 (4.94)	3 (1.86)	19 (4.41)	3 (1.86)	28 (5.33)	2 (1.56)	24 (4.94)	3 (1.86)	19 (4.41)	3 (1.86)
Zhilmil	7 (2.73)	0	12 (3.53)	0	17 (4.18)	1 (0.93)	23 (4.84)	4 (2.11)	19 (4.41)	4 (2.11)	27 (5.24)	3 (1.86)	23 (4.84)	4 (2.11)	19 (4.41)	4 (2.11)
Abhimanyu	6 (2.54)	0	10 (3.24)	1 (0.93)	15 (3.93)	2 (1.56)	20 (4.52)	5 (2.33)	16 (4.06)	5 (2.33)	25 (5.04)	5 (2.33)	20 (4.52)	5 (2.33)	16 (4.06)	5 (2.33)
Nilima	8 (2.91)	0	13 (3.67)	0	18 (4.30)	1 (0.93)	25 (5.04)	4 (2.11)	20 (4.52)	4 (2.11)	29 (5.43)	3 (1.86)	25 (5.04)	4 (2.11)	20 (4.52)	4 (2.11)
Purvi	9 (3.08)	0	14 (3.80)	0	20 (4.52)	1 (0.93)	29 (5.43)	3 (1.86)	24 (4.94)	3 (1.86)	34 (5.87)	2 (1.56)	29 (5.43)	3 (1.86)	24 (4.94)	3 (1.86)
Bhindi selection-51	5 (2.34)	0	9 (3.08)	1 (0.93)	13 (3.67)	2 (1.56)	19 (4.41)	5 (2.33)	15 (3.93)	5 (2.33)	22 (4.74)	5 (2.33)	19 (4.41)	5 (2.33)	15 (3.93)	5 (2.33)
Julie (Check)	6 (2.54)	0	10 (3.24)	0	14 (3.80)	1 (0.93)	21 (4.63)	4 (2.11)	17 (4.18)	4 (2.11)	24 (4.94)	4 (2.11)	21 (4.63)	4 (2.11)	17 (4.18)	4 (2.11)
SEm±	0.052	-	0.007	0.231	0.03	0.144	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01
CD at 5%	0.162	-	0.02	0.716	0.09	0.448	0.07	0.04	0.05	0.04	0.07	0.08	0.07	0.04	0.05	0.04

Note: * Figures in parenthesis are square root transformed values ($\sqrt{X + 0.5}$)

Where, ^{xx} H.F. = Number of healthy fruits and ^{xxx} D.F. = Number of damaged fruits continued..... to Table 3 b

Table 3b: Number of healthy and damaged fruits in different cultivars at the time of fruit pickings during, *Kharif* 2014

Number of healthy and damaged fruits per ten plants at the time of fruit pickings												
Name of cultivar	9 th picking		10 th picking		11 th picking		12 th picking		Total fruits per ten plants		Mean fruit infestation	
	H.F. N	D.F.N.	H.F. N	D.F.N.	H.F. N	D.F.N.	H.F. N	D.F.N.	H.F. N	D.F.N.		
Bhindi no.-319	13 (3.67)	5 (2.33)	8 (2.91)	4 (2.11)	5 (2.33)	3 (1.86)	3 (1.86)	2 (1.56)	174 (13.20)	41 (6.44)	19.06 (25.66)	
Purna	14 (3.80)	4 (2.11)	8 (2.91)	3 (1.86)	6 (2.54)	3 (1.86)	3 (1.86)	2 (1.56)	178 (13.36)	30 (5.52)	14.42 (22.04)	
Super Rekha	18 (4.80)	3 (1.86)	13 (3.67)	3 (1.86)	7 (2.73)	2 (1.56)	3 (1.86)	1 (1.22)	224 (14.98)	23 (4.84)	9.31 (17.40)	
JKOH-7315	15 (3.93)	3 (1.86)	11 (3.39)	3 (1.86)	6 (2.54)	2 (1.56)	5 (2.33)	2 (1.56)	198 (14.08)	24 (4.94)	10.81 (18.82)	
Zhilmil	14 (3.80)	4 (2.11)	10 (3.24)	4 (2.11)	7 (2.73)	3 (1.86)	4 (2.11)	2 (1.58)	189 (13.76)	31 (5.61)	14.09 (21.74)	
Abhimanyu	12 (3.53)	5 (2.33)	8 (2.91)	4 (2.11)	5 (2.33)	3 (1.86)	4 (2.11)	3 (1.86)	166 (12.90)	42 (6.51)	20.19 (26.46)	
Nilima	15 (3.93)	4 (2.11)	11 (3.39)	4 (2.11)	7 (2.73)	3 (1.86)	4 (2.11)	2 (1.56)	203 (14.26)	31 (5.61)	13.24 (21.06)	
Purvi	19 (4.41)	3 (1.86)	14 (3.80)	3 (1.86)	8 (2.91)	2 (1.56)	3 (1.86)	1 (0.93)	232 (15.24)	23 (4.84)	9.01 (17.10)	
Bhindi selection-51	12 (3.53)	5 (2.33)	7 (2.73)	4 (2.11)	6 (2.54)	4 (2.11)	4 (2.11)	3 (1.87)	151 (12.30)	43 (6.59)	22.16 (27.85)	
Julie (Check)	13 (3.67)	4 (2.11)	8 (2.91)	3 (1.86)	6 (2.54)	3 (1.86)	3 (1.86)	2 (1.56)	164 (12.82)	31 (5.61)	15.89 (23.22)	
SEm±	0.03	0.01	0.01	0.01	0.04	0.01	0.01	0.143	0.002	0.014	0.171	
CD at 5%	0.10	0.04	0.03	0.03	0.14	0.05	0.04	0.444	0.007	0.045	0.531	

Note: * Figures in parenthesis are square root transformed values ($\sqrt{X + 0.5}$)

Where, ^{xx} H.F. = Number of healthy fruits and ^{xxx} D.F. = Number of Damaged fruits N.B. - Number basis

Response of different cultivars on weight of healthy and damaged fruits

At the time first picking of fruits, a variation in the weight of healthy fruits in different cultivars was observed between 40 to 77g. Maximum healthy fruits yield (77g per ten plants) was recorded in Super Rekha followed by Purvi (76g per ten plants) which were significantly superior over other cultivars. Whereas, the minimum healthy fruits yield (40g. per ten plants) was harvested from Bhindi Selection-51. As regard to the damage fruits at this stage no infestation of pest in any cultivar was recorded. The weight of healthy and damaged fruits in different cultivars varied from 74 to 122g and 0 to 8g. at second picking. Super Rekha produced the maximum healthy fruits (122g. per ten plants) which was at par with Purvi (120g. per ten plants) but significantly superior over other cultivars including Julie (82g. per ten plants). Bhindi Selection-51 recorded the minimum healthy fruits yield (74g./ ten plants) and was found significantly inferior to check (82g./ ten plants). As regard to the, the maximum damaged fruits yield (8g./ ten plants) was recorded in cultivar Bhindi No.-319 followed by Abhimanyu (7g./ ten plants) and Bhindi Selection-51(7g./ ten plants). While in other cultivars no

infestation was recorded. On the basis of overall yield, total yield of healthy and damaged fruits ranged between 1242 to 2196g/ten plants (i.e. 46 to 81.33q/ha) and 200 to 348g/ten plants (i.e.7.41 to 12.89q/ha). The highest yield of healthy fruits (2196g. i.e. 81.33q/ha) obtained by Purvi which was at par with Super Rekha (2191g i.e. 81.15q/ha) which were significantly superior over other cultivars including check variety (1402g i.e. 51.93q/ha). The lowest yield of healthy fruits (1242g i.e.46q/ha) recorded from Bhindi Selection-51 followed by Abhimanyu (1370g i.e. 50.74q/ ha) which were found significantly inferior to check. However, the minimum yield of damaged fruits (200g per ten plants.i.e.7.41q/ha) in cultivar Purvi followed by Super Rekha (201g i.e. 7.44q/ha) and JKOH-7315 (203g. i.e.7.52q/ha) which were recorded significantly superior over other cultivars including check (256g i.e. 9.48q/ha). However, Bhindi No.-319 gave the maximum yield of damaged fruits (348g i.e.12.89q/ha) which was at par with Bhindi Selection-51 (342g i.e.12.67q/ ha) and were found significantly inferior to check. The detailed data for weight of healthy and damaged fruits in different cultivars at each picking has been given in table 4 a and table 4 b.

Table 4a: Weight of healthy and damaged fruits in different cultivars at the time of fruit picking during *Kharif*, 2014

Weight of healthy and damaged fruits in gram per ten plants at each picking																		
Number of fruit pickings - 12																		
Name of cultivar	1 st		2 nd		3 rd		4 th		5 th		6 th		7 th		8 th		9 th	
	HFW	DFW	HFW	DFW	HFW	DFW	HFW	DFW	HFW	DFW	HFW	DFW	HFW	DFW	HFW	DFW	HFW	DFW
Bhindi no.-319	57	0	92	8	134	15	191	30	210	42	223	47	198	42	155	43	118	44
Purna	48	0	90	0	130	9	191	17	207	28	221	31	187	37	155	36	120	37
Super Rekha	77	0	122	0	168	8	249	15	294	16	324	25	287	23	240	28	193	28
JKOH-7315	59	0	103	0	154	8	229	15	242	16	255	24	224	24	180	27	144	27
Zhilmil	58	0	102	0	146	7	202	16	236	22	244	32	211	35	175	39	131	39
Abhimanyu	48	0	82	7	122	14	181	30	190	40	205	41	169	39	134	40	99	42
Nilima	67	0	110	0	155	8	224	16	258	24	272	34	242	34	195	38	148	38
Purvi	76	0	120	0	175	8	245	16	289	15	323	25	287	23	240	27	192	28
Bhindi selection-51	40	0	74	7	105	15	156	30	165	38	178	43	160	39	126	40	99	42
Julie (Check)	49	0	82	0	116	7	168	15	189	32	202	36	183	32	151	33	114	34
SEm±	0.18	-	1.54	1.46	0.36	0.39	1.01	0.72	0.77	0.50	0.82	0.39	0.97	0.54	1.83	1.64	1.16	0.74
CD at 5%	0.56	-	4.79	4.52	1.13	1.20	3.15	2.23	2.39	1.56	2.55	1.20	3.01	1.69	5.67	5.09	3.62	2.30

Where, HFW= Healthy fruits weight and DFW= Damaged fruits weight Continued..... to Table 4 b

Table 4b: Weight of healthy and damaged fruits in different cultivars at the time of fruit picking during *Kharif*, 2014

Weight of healthy and damaged fruits in gram per ten plants at each picking										Total yield of okra fruits			
Number of fruit pickings - 12										After final picking of fruits			
Name of cultivar	10 th		11 th		12 th		Total fruit wt. per ten plants		Total yield (q./ha.)			Mean percentage of weight loss	
	HFW	DFW	HFW	DFW	HFW	DFW	HFW	DFW	Total yield	HFY	DFY		
Bhindi no.-319	74	36	43	25	25	16	1520	348	69.19	56.30	12.89	18.62 (25.32)	
Purna	69	28	49	25	24	16	1491	264	65.00	55.22	9.78	15.04 (22.54)	
Super Rekha	146	30	71	19	29	9	2191	201	88.59	81.15	7.44	8.40 (16.56)	
JKOH-7315	108	28	57	18	43	16	1798	203	74.11	66.59	7.52	10.14 (18.27)	
Zhilmil	98	40	63	27	34	17	1700	271	73.00	62.96	10.04	13.74 (21.53)	
Abhimanyu	68	33	41	24	31	24	1370	334	63.11	50.74	12.37	19.60 (26.07)	
Nilima	113	39	66	27	35	16	1885	274	79.96	69.81	10.15	12.69 (20.62)	
Purvi	147	31	76	19	26	8	2196	200	88.74	81.33	7.41	8.34 (16.50)	
Bhindi selection-51	60	33	49	31	30	24	1242	342	58.67	46.00	12.67	21.59 (27.45)	
Julie (Check)	72	27	51	24	25	16	1402	256	61.41	51.93	9.48	15.44 (22.89)	
SEm±	0.65	0.66	0.36	0.40	1.50	1.46	7.51	4.44	0.16	0.278	0.164	0.088	
CD at 5%	2.03	2.07	1.13	1.25	4.65	4.52	23.28	13.76	0.49	0.863	0.510	0.272	

Where, HFW= Healthy fruits weight and DFW= Damaged fruits weight HFY= Healthy fruits yield and DFY= Damaged fruits yield

Discussion

Screening of different cultivars was evaluated by many researchers against shoot and fruit borer *Earias vittella* (Fab.)

in okra. Meena *et al.* (2010)^[8] studied the seasonal incidence of Shoot and fruit borer (*Earias insulana* and *Earias vittella*) on okra (cv. Parbhani Kranti) and reported its infestation

beginning from the first week of August until the final harvesting of the crop. They also reported an increase of infestation from 1.0 and 0.66% during the initial stage to 23.0 and 25.0% on the third week of October during 2002 and 2003, respectively, which is in conformity with the present findings. Findings of Shukla *et al.* (1997)^[13], Sharma *et al.* (2010)^[12] and Yadav *et al.* (2007)^[14] also support the present findings. The present finding gets support from the study of Sharma *et al.* (2010)^[12] who reported the maximum quantum of damaged fruits was 54.3% and 54.7% on number and weight basis, respectively, were recorded in the 42nd standard week i.e. 3rd week of October. In the present study, the maximum amount of damaged fruits both on number and weight basis in ten different cultivars varied from 25 to 42.85%.and 23.52 to 44.45%, respectively, were recorded in also last picking of fruits which was done on 09th October, 2014 i.e. 41th standard week (2nd week of October). In present findings, cultivars JKOH-7315 and Purna were recorded 10.81% and 14.42% fruit damage as well as 10.14% and 15.04% weight loss. The present findings are in agreement with that of Konsam *et al.* (2015)^[6] who have reported 7.90% and 11.95% fruit damage and 5.71% and 13.09% weight loss in the varieties JKOH-7315 and Purna among 15 tested cultivars. At present experiment, the lowest percentage of damaged fruits (9.01%) as well as the minimum percentage of weight loss (8.34%) was observed in cultivar; Purvi which gave the maximum healthy fruits yield of 2196g/ten plants (i.e. 81.33 q/ha). The highest percentage of damaged fruits i.e. 22.16% and maximum percentage of weight loss of 21.59% was recorded in cultivar Bhindi selection-51 which gave the minimum healthy fruit yield of 1242g/ ten plants i.e. 46 q/ha. Mandal *et al.* (2006)^[7] and Netam *et al.* (2007)^[10] evaluated 7 and 24 okra cultivars against shoot and fruit borer (*Earias vittella*) and found that less susceptible varieties both on number and weight basis gave maximum healthy fruits yield. The present study of course gets support from the study of Konsam *et al.* (2015)^[6].

Conclusion

Earias vittella is a devastating pest of okra with high damage potential which makes its control indispensable. Use of various chemical insecticides belonging to different classes is in vogue for suppression of this pest but only partial control of this pest could be achieved and indiscriminate use of pesticides is a common practice which is responsible for several undesirable effects on ecosystem, insecticide residues, resistance to secondary pest resurgence, adverse effect on beneficial organisms and health of cattle and human being. Hence, need of eco-friendly approaches and the use of tolerant/ resistant genotype/ cultivars of “okra” are necessary for the benefit of farmer and consumer communities. However, among different tested cultivars has indicated that Super Rekha and Purvi were appear to be promising cultivars. Hence, it may be concluded that Super Rekha and Purvi could be a better option for sustainable management of shoot and fruit borer in okra. Farmers may be advised to use these cultivars for the effective control of *Earias vittella* and higher yield.

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