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Screening of brinjal (*Solanum melongena* L.) genotypes for resistance to spotted beetle, *Henosepilachna vigintioctopunctata* (Coccinellidae, Coleoptera)

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Abstract
Epilachna beetle (*Henosepilachna vigintioctopunctata* Fab.) is a poly-phagous pest, severely affecting brinjal. A field experiment was conducted to study the response of fifty nine genotypes which include germplasm accessions, commercial high yielding varieties as well as F_1 hybrids and a wild spp. *i.e. Solanum sysibrifolium* against epilachna beetle which was carried out during *Kharif* season in the year of 2018-19. No field infestation was observed in *S. sisymbrifolium* being highly resistant to epilachna beetle with lowest infestation percentage and lowest number of grubs/ adults per plant. *S. sisymbrifolium* was the best source of resistance against epilachna beetle which was confirmed by choice test as well as no-choice test.

Keywords: Brinjal, epilachna beetle, spotted beetle, screening, *Henosepilachna vigintioctopunctata, Solanum melongena*

Introduction
Solanum melongena L. (Brinjal/eggplant/Guinea squash) is a widely grown crop of Asia, Africa and some parts of Europe popularly known as Poor man's vegetable [1]. Eggplant is native to India where the vast diversity of the crop is available [2]. Globally 48.4 million tons of brinjal are produced from an area of 1.85 million hectare with a productivity of 26.1 kg per hectare (FAO stat. (2012)]. The leading brinjal producers are China (56% of world output), India (26% of world output), Egypt and Turkey. Now, India is the second largest producer of brinjal producing 12.5 million tons of brinjal with an area coverage of 0.67 million hectare (Horticulture Statistical Division, Department of Agriculture, Govt. of India, 2017). But, still the productivity is very low *i.e.* 18.88 t/ha as compared to other countries like china (35.9 t/ha) and Egypt (26.3 t/ha) (FAO stat, 2012). The cause of low yield and productivity of brinjal all over India is due to various biotic and abiotic stresses, out of which epilachna beetle is one the major destructive pests.

The beetles belonging to the family Epilachninae, constitute 15% of the known species of coccinellidae [3]. The severity of this insect is manifested in India, China, Sri Lanka, East and Central Asia, Australia and North America. The 28-spotted hadda beetle, *Henosepilachna vigintioctopunctata* (Fab.) is a polyphagous pest and is considered as voracious foliage feeder of many cultivated and wild plants belonging mainly to the families Solanaceae and Cucurbitaceae

Henosepilachna beetle results in significant economic losses to brinjal depending on place and season due to variations in prevailing environmental conditions [4]. It causes damage at both, adult and larval stages which feed on the epidermal tissues of leaves, flowers, and fruits by scrapping the chlorophyll content and cause a big yield loss by skeletonization of leaves which gradually dry and drop down. The larvae enclose their attack to the lower surface whereas adult beetles usually feed on the upper surface of the leaves. Again, Brinjal crop is considered as one of the best oviposition choice for the female hadda beetles [5]. The management of Henosepilachna beetle was based on synthetic pesticides due to their quick and knock down. The frequent and indiscriminate application of these pesticides in the vegetable fields has resulted into widespread development of resistance, undesirable effects on non-target organisms, presence of toxic residues in food, environmental and health hazards [6]. These problems have highlighted the need for identification of new resistance sources for the creation of genetically resistant cultivars for commercial cultivation. Hence, an attempt was made to screen 59 genotypes of brinjal against coccinellid beetle carried out during *Kharif* season, 2018-19 at ICAR-IIHR-CHES, Bhubaneswar

Fig 1: Epilachna adult, grub and field view

Materials and Methods

Present experiment was carried out in RBD with 2 replications (15 plants each). Total 59 genotypes which include germplasm accessions, commercial OP varieties, commercial F_1 hybrids and wild spp. *i.e. Solanum sysibrifolium* was screened for resistance against epilachna beetle. Randomly 5 plants from each replication from each treatment were selected and grubs per plant, number of adults per plant, number of infested plants, infestation were recorded at peak infestation stage.

For scoring, 3 leaves were selected from top, middle and end portion of plant randomly and mean was taken. Scoring was done on basis of extent of damage to leaf area [7], where

0 - Healthy leaf
1. Approximately up to 1/4th of leaf area infested
2. Approximately up to 1/2 of leaf area infested
3. Approximately up to 3/4th of leaf area infested
4. Approximately more than 3/4th of leaf area infested

In which genotype having score '0' being highly resistant and genotype with score '4' being highly susceptible (Fig 2).

Choice test was done to study the host preference of epilachna in lab condition. 5 leaves of one of the highly susceptible genotypes and 5 leaves of the most resistant genotype were placed in a tray into which 50 grubs of epilachna beetle was released and the tray was covered with a transparent polythene film with holes for aeration purpose. Grubs were collected 24 hours prior to release and fed only water to induce gregarious feeding. Then damage percent was observed after 24 hours and 72 hours (Fig 3). Digital images were taken by the help of mobile camera using proper calibration by the use of Bio-Leaf mobile app [8] which is used to measure the infected leaf area by insects as compared to the normal leaf area to record extent of damage after decided interval (Table 3). No-choice was done for confirmation of degree of resistance exhibited by the resistant genotype. 10 leaves of the most resistant genotype were placed in a tray and 50 grubs were released into it and covered with a transparent polythene film. The damage percent was recorded after 72 hours (Fig 4).

Fig 2: scoring of leaves as per infestation

Fig 3: Choice test

Fig 4: No-choice test

Results and Discussion

Out of the screened 59 genotypes, *Solanum sisymbrifolium* (Score '0') found to be highly resistant to epilachna beetle. Among the other genotypes BRINJAL No. 23, CHB-11 and CHB-35 were found moderately resistant with scores ranging from 1-2. Genotypes viz. IHR-7, Brinjal 37, Brinjal 7, Arka Kusumkar, Brinjal-34, CHB-16, Ark Neelachal Shyama, CHB 25, CHB 45, CHB 25, BRS 18, Brinjal 1698, Brinjal 972 and Brinjal Green were included in the susceptible group with score ranging from 2-3. All the remaining genotypes were highly susceptible with a score above 3.

Table 1: Scoring of genotypes on basis of leaf infested by epilachna beetle

Score	Genotype	Remark
0-1	*Solanum sisymbrifolium*	Highly resistant
1-2	Brinjal No. 23, CHB-35, CHB-11	Resistant
2-3	IHR-7, Brinjal 37, Brinjal 7, Arka Kusumkar, Brinjal-34, CHB-16, Arka Neelachal shyama, CHB 25, CHB 45, CHB 25, BRS 18, Brinjal 1698, Brinjal 972, Brinjal Green	susceptible
3-4	CHB-51, IIHR-5, IIHR-322, CHB-34, CHB-40, CHB-30, CHB-3, CHB-56, CHB-2, CHB-52, CHB-30B, CHB 23, CHB 41, IC395333, CHB-14, CHB-2, Subhra, Brinjal 132, Indam gb-4, Brinjal-38, Green Queen, Akshita 30, Soham, N-1167, CHB-1, CHB 16, CHB-1, CHB 4, CHB 45, 37-36346, 37-36-34-6, CHB-27, CHB 15, Arka Nidhi, CHB-13, Arka Neelachal Kranti, IIHR-500A, Arka Anand, IIHR-322, IIHR-555, VNR Utkal	Highly susceptible

Highest number of grubs were recorded in Arka Anand (40 grubs/plant) while lowest number of grubs were observed in *Solanum sisymbrifolium* (0 grubs/plant). Maximum number of adult epilachna were found in CHB-52 (13.5 adults/plant) whereas while minimum number of adults were observed in *Solanum sisymbrifolium* (0 adults/plant). Considerably low number of infested plant and infestation percentage was observed in CHB-35 (6.5 and 43.33% respectively) and CHB-11 (4 and 26.67 % respectively) and remaining genotypes were highly infested by epilachna ranging from 66.66 % to 100% (Table 2). In choice test experiment, mean damage of 10.12 % was done by epilachna beetle in susceptible genotype CHB-35, however the resistant genotype *Solanum sisymbrifoilum* only suffered a mean damage of 2.98 % by the grubs (Table 3). No significant damage was exhibited by the insect; thus confirming the resistance in No choice test (Fig 4).

The heavy infestation of epilachna was observed during the end of June to start of July (Fig 5) due to prevalence of high temperature and humidity, as shown in the table for meteorological data taken from Meteorological Department of Odisha University Of Agriculture and Technology. Similar findings were recorded by Omprakash and Raju [9], who found that the infestation of this insect was highest during June-July due to combination of high temperature and high humidity. Food preferences in epilachna are influenced by odour, taste and age of the food plant [10]. The basis for discrimination is chemical with scent being detected by olfactory and gustatory sensilla on maxillary palps and antenna [11]. Restriction to a particular plant family and species selection within the family is dependent on both odour and taste. The degree of resistance also depends upon trichome density [12] as well as presence of spines on leaf surface which may hamper the capability of egg laying. In the present study, wild relative i.e. *Solanum sisymbrifolium* was found to be the best source for resistant to epilachna beetle due to score of '0', minimum adult and grub population as well as infestation percentage, which may be due to presence of spines on leaf surface which is similar to the result obtained by Wagh *et al.*, [13]. The use of wild species as source of resistance to epilachna was also performed by Rajendra and Gopalan [14] in eggplant. Thus, *Solanum sisymbrifolium* can be used in pest management strategy of egg plants against epilachna beetle Further biochemical study needs to be done on this wild species for the development of bio-pesticide, otherwise can be successful incorporated into the background of the commercial cultivars via various breeding approaches.

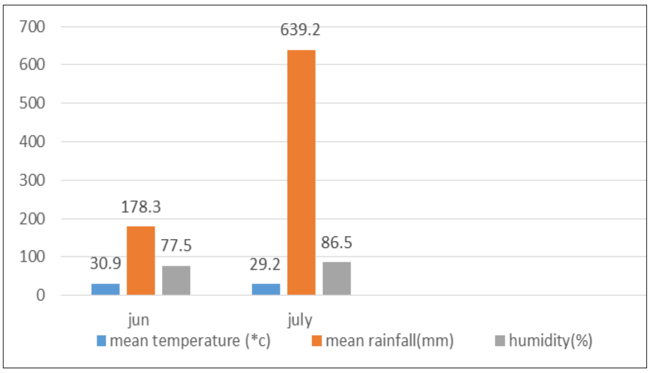

Fig 5: Meteorological data during June and July

Table 2: Score, Number of grubs per plant, Number of adults per plant, number of plants infested and infestation percentage in various genotypes caused by epilachana beetle

Accessions	No. of grubs	No of adults	Plants infested*	Infestation (%)
IHR-7	7	6.4	12	80.00
Brinjal 37	13.6	6	11	73.33
Brinjal 7	22	4.3	12	80.00
IIHR-322	11.7	2.5	14	93.33
Arka Kusumkar	14.8	4.7	11	73.33
IIHR-500A	12.5	2.4	10	66.67
Arka Anand	40	3.9	12	80.00
Brinjal-34	15.7	3.1	11	73.33
IIHR-555	10.2	2.3	15	100.00
Brinjal-3	6.1	3.2	14.5	96.67
CHB-16	5.6	4.2	11.5	76.67
Arka Neelachal Kranti	12.7	4.2	13.5	90.00
Arka Neelachal shyama	13.2	6.3	14	93.33
Arka Nidhi	15.7	2.8	14.5	96.67
CHB-13	35.8	6	14	93.33
CHB-35	16.4	7.1	6.5	43.33
CHB 25	10.6	5.9	14	93.33
CHB 45	25.8	8.6	15	100.00
37-36-34-6	13.5	5.9	15	100.00
CHB-27	15.7	3	14.5	96.67
CHB 15	35.7	6.3	14	93.33
CHB 25	10.3	5.8	12	80.00
CHB 45	25.4	8.6	15	100.00
37-36346	13.9	6	14	93.33
BRS 18	12.4	8.2	15	100.00
Brinjal 1698	11.7	7	15	100.00
CHB 4	14.1	5.4	15	100.00
CHB 11	10.8	11.1	4	26.67
CHB-1	9.2	8.3	15	100.00
Brinjal 972	7.6	8.9	11	73.33
Accessions	No. of grubs	No of adults	Plants infested*	Infestation (%)
CHB 16	7.5	10.7	15	100.00
Solanum sisymbrifolium	0	0	0	0.00
CHB-51	9.2	12.1	15	100.00
IIHR-5	10.2	11.3	15	100.00
IIHR-322	13.9	11.6	15	100.00
CHB-34	10.9	9.3	15	100.00
CHB-40	10.3	11.0	15	100.00
CHB-30	11.1	9.9	15	100.00
CHB-3	6.8	10.1	15	100.00
CHB-56	10.4	10.9	15	100.00
CHB-2	10.6	10.2	15	100.00
CHB-52	11.0	13.5	15	100.00
CHB-30B	12.6	13.0	15	100.00
CHB 23	8.7	8.4	15	100.00
CHB 41	9.0	3.6	15	100.00
IC395333	8.9	3.6	15	100.00
CHB-14	6.7	3.7	15	100.00
CHB-2	8.2	5.6	15	100.00
Subhra	8.3	5.3	15	100.00
Brinjal 132	7.7	2.4	15	100.00
Indam GB-4	10.1	10.1	15	100.00
Brinjal-38	10.3	8.2	15	100.00
Green Queen	11.6	11.1	15	100.00
Akshita 30	9.1	8.8	15	100.00
JK 8031	16.0	8.7	15	100.00
VNR Utkal	17.1	10	15	100.00
Brinjal Green	27.1	9.8	15	100.00
Soham	12.1	7.0	15	100.00
N-1167	17.8	9.7	15	100.00
Mean	13.26	7.08	13.64	90.96
CD.05	9.22	7.41	11.41	76.07

*total number of plants being 15 per treatment in each replication

Table 3: Choice Test

	Susceptible genotype (CHB-45)		Resistant genotype (*Solanum Sisymbrifolium*)	
Leaf number	**Leaf area index**	**Damage percentage**	**Leaf area index**	**Damage percentage**
1	1.22	19.68	6.81	1.04
2	3.84	5.26	5.13	2.68
3	3.47	6.36	4.68	3.41
4	2.80	8.84	3.98	4.89
5	2.46	10.48	3.22	2.86

Conclusion

This study confirms that *Solanum sisymbrifolium* is the only viable source of resistance against epilachna bettle infestation. However, further exploration and exploitation of wild *Solanum* germplasm is needed to combat this sever pest problem as shown in the current experiment.

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