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Field evaluation of bitter gourd (*Momordica charantia* L.) genotypes for resistance against melon fly, *Zeugodacus cucurbitae* (Coquillett)

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ABSTRACT: Fifteen bitter gourd genotypes have been evaluated for bio-physical basis of plant resistance against melon fly, *Zeugodacus cucurbitae* (Coquillett) under field conditions during 2019. Among 15 bitter gourd genotypes, six genotypes *viz.,* IC622912, IC599423, IC622913, IC622906, IC599434 and IC622908 showed moderately resistant reaction with significantly lower fruit infestation ranging from 37.78 to 48.44 per cent with larval density vary from 3.37 to 8.69 larvae per fruit. Remaining nine genotypes *viz*., IC616045, IC599421, IC611325, IC599420, IC622909, IC599424, IC599401, IC616046 and Pusa Do Mausami were found susceptible with significantly higher fruit infestation (51.44-74.44%) and larval population (4.83-10.13/fruit). Significant and positive correlation was observed between per cent fruit infestation and larval population per fruit. Fruit infestation was positively correlated with biophysical traits of bitter gourd fruits *viz.,* fruit length, fruit diameter and flesh thickness and negatively with number of ridges/cm2 (middle part) of fruit.

Keywords: Melon fly, bitter gourd, fruit infestation, larval population, plant resistance

INTRODUCTION

Bitter gourd (*Momordica charantia* L.) is one of the most significantly growing vegetables in India with an annual production of 1.21 MT from 1.01 lakh ha during 2019-20 (Indiastat, 2019-20). Among all the insect pests infesting bitter guard, melon fly, *Zeugodacus cucurbitae* (Coquillett) is the most serious one. It attacks 61 plant species and 28 of them are cucurbits. Economic impacts are due to its quarantine status (Dey Mayer., 2015). In India, melon fly infests the crop from flowering stage up to harvesting of the fruits and extent of crop losses by the pest varies from 30 to 100 per cent (Shooker *et al.,* 2006). It damages the crop by ovipositional injury by female adults, internal feeding on ovaries and fruit pulp by maggots, and rottening of fly-damaged fruits (Viraktamath *et* al., 2003).

Host plant resistance is one of the important IPM strategies where the morphological and biochemical traits of plant significantly influence the degree of damage by pest. Host plant resistance is an interaction between plant and insect pest which results in undesirable host plant for feeding or oviposition of insect pest. Jaiswal *et al.* (1990) reported that the insects feeding and oviposition was interfered by morphological traits of host plant. Lack of knowledge on the availability of resistance sources limits the development and cultivation of fruit fly resistant bitter gourd varieties in IPM program (Dhillon *et al.*, 2005). Though, chemical management is one of the effective tools for managing this pest, the use of broad-spectrum insecticides may leave residues on fruits which results in health hazards. Thus it is necessary to identify the genotypes and biophysical traits of fruits importing resistance against oviposition and larval feeding activities of the melon fly.

MATERIALS AND METHODS

Field trail was conducted in a pendal system at Horticulture garden, S.V. Agricultural College, Tirupati, Andhra Pradesh during *Kharif*, 2019-2020. Fifteen bitter gourd genotypes including check (Pusa Do Mausami) were collected from the Division of Germplasm Conservation, ICAR-National Bureau of Plant Genetic Resources (NBPGR), New Delhi.

Raising of seedlings

Seeds were subjected to hot water treatment at 50°C for 30-40 min followed by soaking of seeds in 0.2 per cent KNO_3 solution for 4 hrs to improve the germination. Seeds were sowed in protrays provided with coco-peat, a growing media under greenhouse condition at Insectary, Department of Entomology. Bitter gourd seedlings of 3-4 leaf stage were transplanted to main field. Each genotype was planted in a single row of 7 m length with spacing of 35 cm within the row and 1m between the rows. The crop was raised by following package of agronomic practices recommended by Dr. YSR Horticultural University, Andhra Pradesh except crop protection practices.

Table 1. Incidence of fruit infestation and larval population of melon fly, *Z. cucurbitae* on bitter gourd genotypes under field conditions

1st Picking		2nd Picking		3rd Picking		Pooled Mean	
Fruit infestation (%)*	Maggot population/ fruit**	Fruit infestation (%)*	Maggot population/ fruit**	Fruit infestation (%)*	Maggot population/ fruit**	Fruit infestation (%)*	Maggot population/ fruit**
43.56^{ab}	3.22^{a}	33.09^{a}	3.56^{a}	36.71^{ab}	4.40^{a}	37.78^{a}	3.73^{a}
(41.30)	(2.05)	(35.12)	(2.13)	(37.29)	(2.32)	(37.90)	(2.17)
47.77^{bc}	5.67^{bcd}	38.89^{ab}	6.08^{bcd}	34.31^{a}	7.15^{abcd}	40.32^{ab}	6.30^{cd}
(43.72)	(2.58)	(38.58)	(2.66)	(35.74)	(2.85)	(39.39)	(2.69)
48.55^{bc}	4.88^{abc}	47.11^{cd}	5.33^{abc}	35.19^{ab}	4.67^{ab}	43.61^{abc}	4.96^{c}
(44.17)	(2.42)	(43.34)	(2.51)	(36.30)	(2.38)	(41.30)	(2.53)
38.33^{a}	8.01^{def}	43.06^{bc}	10.67^{f}	51.08^{bcd}	7.41^{abcd}	44.16^{abc}	8.69^{ef}
(38.25)	(2.99)	(41.01)	(3.41)	(45.62)	(2.87)	(41.63)	(3.10)
50.13^{bcd}	5.58^{bcd}	43.20^{bc}	5.08^{abc}	44.76^{abc}	5.37^{ab}	46.03^{abc}	5.35^{bc}
(45.07)	(2.57)	(41.09)	(2.46)	(41.99)	(2.51)	(42.72)	(2.52)
50.95^{bcd}	6.08^{bcd}	51.69^{d}	6.60^{cde}	42.67^{abc}	6.85^{abcd}	48.44^{abc}	6.51^{cd}
(45.55)	(2.64)	(45.97)	(2.76)	(40.78)	(2.80)	(44.01)	(2.74)
45.15^{abc}	5.13^{abc}	52.35^{d}	4.12^{ab}	56.81^{cd}	4.75^{a}	51.44^{bcd}	4.67^{ab}
(42.22)	(2.46)	(46.35)	(2.26)	(49.01)	(2.36)	(45.83)	(2.38)
56.77^{de}	6.70^{bcde}	48.33^{cd}	7.15^{cde}	53.37^{cd}	6.30^{abc}	52.82^{bcd}	6.71^{cd}
(48.89)	(2.77)	(44.04)	(2.85)	(46.93)	(2.70)	(46.62)	(2.77)
50.39^{bcd}	8.67^{ef}	52.29^{d}	7.21^{cde}	61.33^{de}	6.01^{abc}	54.67^{cd}	7.29^{de}
(45.22)	(3.09)	(46.31)	(2.85)	(51.55)	(2.63)	(47.69)	(2.87)
44.30^{abc}	6.67^{bcde}	63.61^{e}	6.63^{cde}	58.53^{cd}	7.11^{abcd}	55.48^{cd}	6.80^{d}
(41.73)	(2.76)	(52.90)	(2.75)	(50.01)	(2.83)	(48.18)	(2.79)
48.49^{bc}	4.62^{ab}	54.62^{d}	5.33^{abc}	64.44^{de}	4.55^{a}	55.85^{cd}	4.83^{ab}
(44.14)	(2.36)	(47.65)	(2.51)	(53.41)	(2.31)	(48.39)	(2.41)
62.12^{e}	8.76^{ef}	63.35^{e}	8.67^{def}	63.23^{de}	10.33^{d}	62.90^{de}	9.25^{f}
(52.02)	(3.12)	(52.74)	(3.10)	(52.84)	(3.36)	(52.48)	(3.20)
51.67^{cd}	7.25^{cde}	62.29^{e}	7.40^{cde}	75.43^{e}	8.08^{bcd}	63.13^{de}	7.58^{de}
(45.96)	(2.87)	(52.11)	(2.89)	(60.58)	(3.01)	(52.79)	(2.92)
62.39^{e}	8.17^{def}	76.06^{f}	11.18^{f}	74.93^{e}	9.02^{cd}	71.13^{e}	9.45^{f}
(52.17)	(3.02)	(60.71)	(3.49)	(59.97)	(3.16)	(57.61)	(3.22)
69.19^{f}	10.61^{f}	78.73^{f}	9.33^{ef}	75.40^{e}	10.46^{d}	74.44^{e}	10.13^{f}
(56.28)	(3.40)	(62.54)	(3.21)	(60.27)	(3.38)	(59.69)	(3.33)
6.45	0.40	4.30	0.42	8.47	0.56	6.62	0.24
2.21	0.14	1.48	0.14	2.91	0.19	2.27	0.08
7.48	8.62	5.41	8.96	10.46	11.98	8.37	5.23

Within a column, means followed by the same letter are not significantly different by DMRT (P = 0.05; LSD).
Figures in the parentheses are retransformed values (*Arc sign transformation; **Square root transformation).
Fruit infestation is expressed in %; larval population as number of larvae/fruits.

Observations recorded

Observations on per cent fruit infestation and larval population per fruit were recorded by picking marketable size fruits (at 60 days after sowing) from randomly selected five plants from each genotype. Total of three pickings were done at 6-days intervals (Dhillon *et al.*, 2005).

Fruit infestation

Marketable size fruits irrespective of healthy and infested fruits are harvested at 6-days intervals from randomly selected five plants from each genotype and the per cent fruit infestation was worked out.

Larval population

The infested fruits from each genotype were brought to the laboratory for recording observation on larval population per fruit. Five randomly selected fruits from each genotype were cut opened to count the number of larvae per fruit (Gogi *et al.,* 2009).

Biophysical traits of bitter gourd fruits

Biophysical characteristics of fruit *viz.,* fruit length, fruit diameter, flesh thickness and number of ridges per cm^2 of fruit were recorded and correlated with per cent fruit infestation and larval population. Five marketable size fruits were randomly selected from each genotype for recording the biophysical traits (Chillar, 2007).

Fruit length (cm): Length of the fruits was measured with the help of digital vernier calliper.

Fruit diameter (cm): Diameter was measured from the centre of the fruit at two different points with the help of vernier callipers.

Flesh thickness (mm): Flesh thickness was measured at two opposite points with Vernier callipers.

Number of ridges per cm^2: Number of ridges per cm^2 area of each fruit (centre part of the fruit) was recorded.

Categorization of bitter gourd genotypes

The genotypes were grouped into different levels of resistance based on per cent fruit infestation by following rating system given by Nath (1966) (Table 1).

Statistical analysis

Data was subjected to angular and square root transformation in order to achieve normality in the data before analysis. The data on per cent fruit infestation, larval population per fruit and biophysical fruit traits were analysed through one-way ANOVA using SPSS 16 software. The mean values of all the parameters were compared using Tukey's HSD tests at probability level of 5 per cent. Correlations between per cent fruit infestation, larval population per fruit and biophysical fruit traits were determined using correlation analysis at the 95% significance level.

RESULTS

Reactions of bitter gourd genotypes to melon fly infestation

During first picking of fruits (60 DAS; preferably marble sized fruits), highest fruit infestation of 62.39 per cent was recorded in IC616045 followed by IC599421 (62.12%) and IC622909 (56.77%) which were statistically on par with larval population of 8.17, 8.76 and 6.70 per fruit, respectively. Whereas, significantly lowest fruit infestation of 38.33 per cent was recorded in genotype IC622906 with larval population of 8.01 per fruit compared to Pusa Do Mausami (69.19% and 10.61 larvae/fruit of marble size) (Table 1). In second picking (67 DAS), the genotypes IC622912 and IC599423 were recorded with lowest fruit infestation of 33.09 and 38.89 per cent and larval population of 3.56 and 6.08 per fruit, respectively which were statistically on par. Highest fruit infestation of 78.73 per cent was recorded in Pusa Do Mausami (Check) with larval population of 9.33/fruit, followed by IC616045 (76.06%). Genotypes; IC599401, IC599421 and IC611325 were recorded with fruit infestation of 62.29-63.61% with larval density of 6.63-8.74 per fruit, which are statistically at par. In remaining genotypes, fruit infestation was ranging from 43.06 to 54.62 per cent with larval density ranging from 4.12 to 7.21 per fruit (Table 2). During the final third picking of fruit (73 DAS), the genotypes IC599423, IC622913, IC622912, IC622908 and IC599434 were recorded with significantly lowest fruit infestation ranging from 34.31 to 44.76 per cent with larval density ranging from 4.40 to 7.15 per fruit compared to Pusa Do Mausami (75.40% and 10.46 larvae/fruit). Highest fruit infestation of 75.43 per cent and larval density of 8.08 larvae per fruit was recorded in IC611325 followed by IC616045, IC599424 and IC599421 which were statistically on par with fruit infestation of 74.93, 64.44 and 63.23 per cent and 9.02, 4.55 and 10.33 larval population per fruit, respectively.

Overall, mean fruit infestation (average of three pickings) is ranged from 37.78 to 74.44 per cent with mean larval population of 3.73 to 10.13 per fruit. Significantly higher fruit infestation was recorded in IC616045 (71.13%) with larval population of 9.45 per fruit followed by IC599421 (63.13% and 7.58/fruit) and IC611325 (62.90% and 9.25/fruit) which were

Table 2. Grouping of bitter gourd genotypes by following the rating system of Nath (1966)

Category	Type of infestation	Level of infestation (%)	List of Genotypes
Immune (0)	No damage	0	Nil
Highly resistant (HR)	Slight damage	1-10	Nil
Resistant (R)	Slight medium damage	11-20	Nil
Moderately resistant (MR)	Medium damage	21-50	IC622912, IC599423, IC622913, IC622906, IC599434, IC622908
Susceptible (S)	Damage	51-75	IC599424, IC611325, IC616045, IC616046, IC599420, IC622909, IC599421, IC599401, Pusa Do Mausami
Highly susceptible (HS)	Severe damage	76-100	Nil

Table 3. Bio-physical traits of bitter gourd genotypes screened against *Z. cucurbitae* under field conditions

Genotype	Fruit length (cm)	Fruit diameter (cm)	Number of ridges per cm²	Rind thickness (mm)
IC622912	10.20^{b}	3.30^{bc}	30.33^{g}	4.41^{ab}
IC599423	12.30^{cd}	3.15^{bc}	24.73^{cde}	5.20^{cd}
IC622913	9.22^{b}	3.12^{bc}	29.47^{fg}	5.64^{de}
IC622906	9.02^{b}	3.08^{b}	27.60^{efg}	5.99^{ef}
IC599434	12.10^{cd}	3.40^{bc}	24.40^{cd}	4.42^{ab}
IC622908	12.39^{cd}	3.26^{bc}	22.13^{c}	4.88^{bc}
IC616046	4.35^{a}	2.52^{a}	42.53^{h}	6.46^{f}
IC599401	9.96^{b}	3.34^{bc}	27.47^{defg}	4.17^{a}
IC599424	13.55^{de}	4.53^{e}	25.60^{de}	6.41^{f}
IC622909	12.36^{cd}	3.39^{bc}	27.61^{efg}	5.09^{cd}
IC599420	11.73^{c}	3.60^{cd}	27.20^{def}	5.50^{cde}
IC611325	5.07^{a}	3.48^{bcd}	26.13^{de}	5.59^{de}
IC599421	14.51^{e}	3.92^{d}	24.80^{cde}	5.86^{ef}
IC616045	9.57^{b}	3.89^{d}	8.01^{a}	5.85^{ef}
Pusa Do Mausami	13.50^{de}	3.28^{bc}	19.07^{b}	4.91^{bc}
C.D.	1.42	0.43	2.78	0.56
SE(m)	0.48	0.15	0.95	0.19
C.V.	7.94	7.65	6.40	6.26

Within a column, means followed by the same letter are not significantly different by DMRT (P = 0.05; LSD).

statistically on par. Significantly lower fruit infestation was observed in genotype IC622912 with larval density of 3.73 per fruit followed by IC599423 (6.30/fruit), IC622913 (4.96/fruit), IC622906 (8.69/fruit), IC599434 (5.35/fruit) and IC622908 (6.51/fruit) were statistically on par. Fruit infestations of melon fly on remaining genotypes were varied from 51.44 to 55.85 per cent with larval population 4.67 to 7.29 per fruit. The susceptible check Pusa Do Mausami was recorded with highest fruit infestation of 73.54 per cent with larval population of 18.78 per fruit.

Grouping of bitter gourd genotypes based on fruit infestation

Fifteen genotypes of bitter gourd were grouped based on per cent fruit infestation by following the Nath's system of classification (Table 2). Out of fifteen genotypes, none of the genotype was found resistant to melon fly. However, six genotypes *viz.,* IC622912, IC599423, IC622913, IC622906, IC599434 and IC622908 were categorized as moderately resistant as the percentage of fruit infestation ranged between 37.78 to 48.44% with larval density varied from 3.37 to 8.69 per fruit. Whereas, the remaining nine genotypes *viz.,* Pusa Do Mausami, IC616045, IC599421, IC611325, IC599420, IC622909, IC599424, IC599401 and IC616046 were found susceptible with fruit infestation of 74.44, 71.13, 63.13, 62.90, 55.85, 55.48, 54.67, 52.82 and 51.44 per cent, respectively with larval population ranged from 4.83 to 10.13 per fruit (Table 1).

Average larval population per fruit was significantly lower (3.73-8.69/fruit) in moderately resistant genotypes compared to susceptible genotypes (4.67-10.13/fruit) (Table 1). This indicated that larval population was significantly and positively correlated (r=0.737) with fruit infestation. Observation on melon fly infestation on bitter gourd genotypes at different intervals reveals that fruit infestation was decreased with increase of crop maturity in moderately resistant genotypes. While in susceptible genotypes the per cent fruit infestation was increased as the crop reaches maturity phase.

Influence of biophysical traits of bitter gourd fruits on fruit infestation and larval population of melon fly in bitter gourd genotypes

Observations on biophysical traits of fruit *viz.,* fruit length, fruit diameter, number of ridges per cm^2 and flesh thickness of all the fifteen genotypes were recorded and presented in Table 4. Influence of biophysical traits of bitter gourd fruits are correlated with fruit infestation and larval population/fruit (Table 4).

Fruit length (cm)

Significant differences were found among the genotypes with respect to fruit length where, fruit length of moderately resistance genotypes is varied from 9.02 (IC622906) to 12.39 cm (IC622908). Whereas in case of susceptible genotypes, fruit length is ranged from 4.35 (IC616046) to 14.51 cm (IC599421). Per cent fruit infestation (r=0.097) and larval population per fruit (r=0.079) are positively correlated with fruit length (Table 4).

Fruit diameter (cm)

Moderately resistant genotypes showed varied fruit diameter varying from 3.08 (IC622906) to 3.40 cm (IC599434) and in susceptible genotypes it is varied from 2.52 (IC616046) to 4.53 cm (IC599424). Per cent fruit infestation (r=0.391) and larval population per fruit (r=0.319) was positively correlated with fruit diameter (Table 4).

Number of ridges per cm^2

Ridge density of fruit showed negative correlation with fruit infestation (r=-0.533) and larval population (r=-0.635). In which significantly higher fruit infestation (71.13%) and larval population (9.45/fruit) was recorded in IC616045 with ridge density of 8.01 per cm^2 whereas the genotype IC622912 with 30.33 ridges per cm^2 is recorded with significantly lower fruit infestation (37.78%) and larval population (3.73/fruit) (Table 5).

Rind thickness (mm)

Rind thickness was found comparatively higher in susceptible genotypes ranging from 4.17 (IC599401) to 6.41mm (IC599424) than moderately resistance genotypes which varied from 4.41 (IC622912) to 5.99 mm (IC622906). Per cent fruit infestation (r=0.220) and larval population per fruit (r=0.204) was positively correlation with rind thickness (Table 4).

DISCUSSION

Field screening of 15 bitter gourd genotypes for sources of resistance against melon fly was conducted under field condition, all the genotypes showed varied reactions to melon fly infestation. Among 15 genotypes, none of the genotypes shown resistance to melon fly. While, six genotypes *viz*., IC622912, IC599423, IC622913, IC622906, IC599434, and IC622908 were categorized as moderately resistant with significantly lower per cent fruit infestation and larval population. The nine genotypes *viz*., IC616045, IC599421, IC611325, IC599420, IC622909, IC599424, IC599401, IC616046 and Pusa Do Mausami (check) showed susceptible reaction with highest per cent fruit infestation. Larval

Table 4. Correlation coefficient (r) between percent fruit infestation and larval population per fruit with different bio-physical traits of fruits of different bitter gourd genotypes

Fruit Parameter	r value with Fruit infestation	r value with Larval population
Fruit length	0.097^{NS}	0.079^{NS}
Fruit diameter	0.391^{NS}	0.319^{NS}
Ridges cm^{-2}	-0.533^{*}	-0.635^{*}
Rind thickness	0.220^{NS}	0.204^{NS}

population showed significant and positive correlation with fruit infestation whereas larval population was significantly higher in susceptible genotypes compared to moderately resistant genotypes. Highest larval population in susceptible genotypes could be due to increased length of the fruits vary from 12.66 to 13.55 cm.

These results were similar to the findings of Dhillon *et al.* (2005) who found that the bitter gourd genotypes *viz.,* IC-256185, IC-248256, IC-213311, IC-248282, IC-256110 and IC-248281 as resistant sources to melon fly with less percentage of fruit damage (8.3-12.6%) and less larval population (3.8-5.10 larvae/fruit). Similarly, Chillar (2007) found six resistant bitter gourd genotypes *viz.,* IC-213311, IC-256185, IC-248256, IC-248282, HK-127 and MC-58 with fruit infestation 11.05 to 21.40 per cent. Singh *et al.* (1977) also reported the lowest per cent of fruit infestation by melon fly in bitter gourd cultivar BG-12 (29.4%) and highest incidence (48.7%) in BG-9 and BG-11.

The results of present investigation are corroborated with the findings of following Authors; Gogi *et al.* (2009), grouped the genotypes; Col-II and FSD-long as resistant with fruit infestation of < 20 per cent and 1-3 maggots per fruit. Moderately resistance genotypes; Col-Nakana sahib, Col-I and GS-21 with 20-50 per cent of fruit infestation and 3 to 6 maggots per fruit. Eight genotypes *viz.,* Col-III, Col-Multan, Col-Vehari, Chaman, Sunder-F1, Janpuri, F1-484 and F1-485 were found susceptible with 50-80 per cent of fruit damage and 6-10 maggots/ fruit. Virendra *et al.* (2010) reported that bitter gourd genotypes *viz.,* IC-213311, IC-256185, IC-248256, IC-248282, MC-58 and HK-127 as resistant (1-10% fruit infestation) and the genotype IC-85619-A as highly susceptible (76-100%). Also, Panday *et al.* (2012) found that bitter gourd genotype IC 248282 as resistant with 13.64 per cent of fruit infestation followed by Kerala collection - 1 (15.68%) and IC 68314 (18.1%). Katiyar *et al.* (2014) reported the highly resistant genotypes (IC 68314 and IC 248256) with lowest fruit infestation (8.09% and 9.01%, respectively) and Arka Harit was grouped as highly susceptible with 78.20 per cent of fruit infestation. Recently, Koushik *et al.* (2019) reported that the genotype US-6214 and Meghnad-2 showed resistant reaction melon fruit fly with fruit damage of 14.50 and 16.50 per cent and larval density of 3.63 and 4.08/fruit, respectively.

Biophysical traits of bitter gourd fruits *viz.,* fruit length, fruit diameter and flesh thickness has non-significant and positive correlation with fruit infestation and larval population per fruit. Whereas, number of ridges per cm^2 of fruit was found to be negatively correlated with fruit infestation and larval population per fruit. Dhillon *et al.* (2005) reported six resistant wild accessions *viz*., IC 256185, IC 248256, IC 213311, IC 248282, IC 256110 and IC 248281 with fruit infestation of 7.26 to 15.20 per cent and 3.8 to 5.7 of larvae per fruit. Two susceptible cultivar Arka Harit and Pusa Do Mausami were recorded with fruit infestation and larval population of 65.5 per cent and 8.0/fruit, 69.5 per cent and 7.8/fruit, respectively. They also found that larval density per fruit was found positively and significantly correlated (P=0.001) with per cent fruit infestation. Both per cent fruit infestation and larval density per fruit were found positively and significantly correlated (P=0.001) with fruit length (r=0.62 and r=0.72, respectively), fruit diameter (r=0.65 and r=0.63, respectively) and flesh thickness (r=0.92 and r=0.77, respectively); negatively and significantly correlated (P=0.00) with number of ribs per cm square. Present findings are on par with findings of Tewatia (1994) that, out of fifty-five genotypes of bitter gourd screened against melon fly, two genotypes, Faizabad Collection-17 and Kerala Collection-1 were found resistant with 12.19 and 15.90 per cent fruit

infestation, respectively and two genotypes, Arka Harit (84.46%) and Pusa Do Mausami (87.00%) were found highly susceptible. Maximum fruit length and diameter was recorded in susceptible genotype Pusa Do Mausami (12.76 cm) and Arka Harit (3.75 cm), respectively. Whereas, in resistant genotype Faizabad Collection-17; fruit length and diameter are 8.60 cm and 2.78 cm, respectively. The maximum flesh thickness of 6.60 mm was recorded in highly susceptible genotype Pusa Do Mausami and lower flesh thickness in resistant genotype Faizabad Collection-17 (5.73 mm) and Kerala Collection-1 (5.13 mm). Similarly, Devaraj *et al.* (2018) classified genotypes; UHSBRG-5, UHSBRG-15, UHSBRG-12, UHSBRG-18, UHSBRG-19, UHSBRG-17, UHSBRG-9, UHSBRG-1, UHSBRG-6, UHSBRG-16 and UHSBRG-13 under resistant category with 11 to 20 per cent of fruit infestation. Boller and Prokopy (1976) reported the potential regulatory action of morphological factors of host plant *viz.,* hairiness, color, smell, fruit structure *etc*., on host preference of fruit fly in cucurbit. Thakur *et al.* (1996) reported similar findings that, the per cent fruit infestation and larval population per fruit were significantly and positively correlated with each other and further significant and positive correlation of these two were observed with fruit length, fruit diameter and flesh thickness. Combined effects of flesh thickness and fruit diameter results in 93 per cent of variation in fruit fly infestation and larval population per fruit followed by flesh thickness and fruit length (76.3%). Similarly, Chillar (2007) found IC-213311, IC-256185, IC-248256, IC-248282, HK-127 and MC-58 as resistant sources with 11.05 to 21.40 per cent of fruit infestation and 2.55 to 4.27 larvae per fruit, where the fruit infestation was positively correlated (P=0.01) with number of larvae per fruit (r=0.96). The fruit infestation was positively correlated (P=0.05) with fruit length (r=0.53), fruit diameter (r=0.64), flesh thickness (r=0.44) and negatively correlated with number of ridges per cm^2 (r=-0.46). Lasker and Chatterjee (2013) reported the effect of morphological traits on fruit infestation and larval density of melon fly on ten bitter gourd cultivars and recorded the significant positive correlation (r=0.48) of maggot density per fruit with per cent fruit infestation. The fruit weight (r=0.76 and 0.75), fruit length (r=0.0.71 and 0.72) and fruit diameter (r=0.68 and 0.60) was positively correlated fruit infestation and larval density per fruit, where ribs density (r=-0.78 and -0.73), ribs depth (r=0.-24 and -0.18) and skin toughness (r=-0.80 and -0.84) are negatively correlated. Fruit fly ovipositor penetration was inhibited due to hard rind of the fruits (Gichimu *et al.,* 2008)

CONCLUSION

Genotypes such as IC622912, IC599423, IC622913, IC622906, IC599434 and IC622908 can be exploited as the sources of host plant resistance against melon fly. Biophysical traits of bitter gourd fruits (fruit length, fruit diameter and flesh thickness) are positively correlated with fruit infestation by melon fly. Whereas number of ridges/cm^2 of fruit is negatively correlated with melon fly infestation, which can be exploited in resistance breeding programmes.

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