Reaction of Different Bitter Gourd (*Momordica charantia* L.) Genotypes to Melon Fruit Fly, *Bactrocera cucurbitae* (Coquillett)

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Abstract

Seventeen bitter gourd genotypes were evaluated under field conditions for resistance to Melon fruit fly, Bactrocera cucurbitae *(Coquillett), during 2001 rainy and 2002 summer seasons. Melon fruit fly infestation was significantly lower (9.4%) in IC 256185 and IC 248256 (10.2%) compared to 82.1% infestation in the susceptible check, Pusa Do Mausmi. Genotypes IC 213311, IC 248282, IC 256110, IC 248254, IC 248281, IC 248292 and IC 68314-B also showed resistance to the melon fruit fly in both rainy and summer seasons. Genotypes with low furit fly infestation had low larval numbers in the fruits, and there was a positive correlation (r=0.96) between percentage fruit infestation and number of larvae/fruit. Wild relative resistant bitter gourd (*M. charantia *var.* muricata*) can be used in the resistance breeding programs to increase the levels, and diversify the basis of resistance to* B. cucurbitae.

Keywords: Bitter gourd, melon fruit fly, host plant resistance

Introduction

The melon fruit fly, *Bactrocera cucurbitae* (Coquillett) (Diptera: Tephritidae) is widely distributed throughout the temperate, tropical and sub-tropical regions of the world (Fletcher, 1987). It damages a wide range of host plants, and is a major threat to cucurbitaceous vegetables in India. Bitter gourd, (*Momordica charantia* Linn.) is one of the most preferred hosts of melon fruit fly and fruit infestation has been reported to vary from 41 to 89% (Gupta and Verma, 1978; Rabindranath and Pillai, 1986). This pest has been reported to infest 95% of bitter gourd fruits in Papua (New Guinea), and 90% of snake gourd and 60 to 87% of pumpkin fruits in Solomon Islands (Hollignsworth *et al.*, 1997). Singh *et al.*, (2000) reported 31.3% damage on bitter gourd and 28.6% on watermelon in India. The development of fruit fly-resistant varieties is the most desirable method of controlling this pest. Some resistant sources of resistance were identified earlier, but their level of resistance was low to moderate (Thakur *et al.*, 1992; Thakur *et al.*, 1994; Thakur *et al.*, 1996; Tewatia *et al.*, 1997). Therefore, study was conducted to identify bitter gourd genotypes with moderate to high level of resistance to the melon fruit fly from cultivated bitter gourd genotypes and its wild relatives.

Materials and methods

Seventeen genotypes, comprising of two highly-resistant, five resistant, six moderately- resistant, two susceptible, and two highly-susceptible were selected from the preliminary screening of 48 bitter gourd genotypes (32 bitter gourd accessions, eight commercial cultivars, and eight accessions from the wild relative, *Momordica charantia* var. *muricata*) procured from the National Bureau of Plant Genetic Resources (NBPGR), New Delhi; and Department of Vegetable Crops, Chaudhary Charan Singh Haryana Agricultural University (CCSHAU), Hisar. The test material was planted in rainy season 2001 and summer season 2002 at the Vegetable Research Farm, CCSHAU, Hisar in a randomized complete block design (RCBD), and there were three replications. The entries were planted on raised beds (2.5 x 1.5 m) with a plant to plant spacing of 45 cm and there were five plants per plot. Recommended agronomic practices (except chemical control) were followed for raising the crop. Marketable fruits were picked at six-day intervals for observations on fruit fly infestation, and number of larvae per fruit. The infested and uninfested fruits were counted to estimate fruit infestation. The infested fruits were cut open to count the number of larvae per fruit. In all, there were seven pickings. The 48 genotypes were grouped into different categories (Table 1) on the basis of per cent fruit infestation and number of larvae per fruit (Nath, 1966).

Statistical analysis

The data on number of larvae were transformed into square

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Table 1. Grouping of bitter gourd genotypes into different categories on the basis of percentage fruit infestation and number of larvae per fruit

Fruit infestation (%)	Reaction	Mean fruit infested (%)	No of larvae per fruit	Genotypes
1-10	Highly resistant	9.8	4.3	IC 256185, IC 248256
11-20	Resistant	14.2	4.9	IC 213311, IC 248282, IC 256110, IC 248254, IC 248281, IC 248292, IC 68314-B
21-50	Moderately resistant	35.3	5.0	Midhi Pagal, Green Long, Konkan Tara, IC 85606, IC 68306, IC 4413, IC 45350, IC 44425-A, IC 85604, IC 85605-B, IC 68272, BL 237, IC 44415-B, IC 44410, Jaunpuri, IC 85637, IC 44420, IC 45352, IC 44428, IC 68309, IC 68292, Coimbatore White Long, IC 85619-A, BG 14, IC 44423, IC 68238-1, Jhalri Baramasi, IC 45338, Hirkani, IC 68251, IC 68250, IC 32817, IC 85622, IC 68272-1
51-75	Susceptible	57.3	6.1	IC 33227, Pusa Vishesh, IC 68255
76-100	Highly susceptible	79.9	8.1	Arka Harit, Pusa Do Mausmi

root values, and per cent fruit infestation into angular values and then subjected to analysis of variance. The significance of differences between the genotypes was judged by F-test, and the treatment means were compared by least significant difference at $p<0.05$.

Results and discussion

There were significant differences among the genotypes tested for percentage fruit infestation and number of larvae per fruit (Table 2). Out of 48 bitter gourd genotypes, two genotypes (IC 256185, IC 248256) from *M. charantia* var *muricata* (wild types) were categorized as highly resistant, while seven genotypes *viz.*, IC 213311, IC 248282, IC 256110, IC 248254, IC 248281, IC 248292 (wild types) and IC 68314-B showed a resistant reaction (Table 1). Thirty-four genotypes were moderately susceptible, three genotypes (IC 33227, IC 68255 and Pusa Vishesh) showed a susceptible reaction, while two genotypes (Arka Harit and Pusa Do Mausmi) were highly susceptible. Percentage fruit infestation in different pickings in 48 genotypes ranged from 8.2% (IC 256185) to 10.9% (IC 248256) in highly resistant group, 11.1% (IC 213311) to 17.2% (IC 248292) in the resistant group, 21.8% (Midhi Pagal) to 47.6% (Jhalri Baramasi) in moderately resistant group, 53.9% (IC 33227) to 61.5% (IC 68255) in susceptible group, and 75.0% (Arka Harit) to 83.3% (Pusa Do Mausmi) in the highly susceptible group. The range for numbers of larvae per fruit varied from 3.3 (IC 256185) to 6.8 (IC 248256) in highly resistant group, 3.0 (IC 213311) to 6.2 (IC 248292) in resistant group, 2.6 (IC 44413) to 9.6 (Coimbatore White Long) in moderately resistant group, 4.6 (IC 68255) to 7.0 (IC 33227) in susceptible group, and 5.1 to 9.2 (Pusa Do Mausmi) in the highly susceptible group.

The percentage fruit infestation and number of larvae per fruit in 17 bitter gourd genotypes ranged from 9.4 to 82.1% and 3.8 to 8.3 larvae per fruit during rainy season 2001, while during summer season 2002 it ranged from 7.3 to 57.0% and 3.4 to 7.8 larvae per fruit across the genotypes (Table 2). It may be concluded that at high insect pressure (during rainy season 2001) only IC 256185 and IC 248256, wild bitter gourd types were recognized as highly resistant while, at moderate insect pressure (during summer season 2002) wild bitter gourd types IC 256185, IC 248256, IC 248281, IC 213311, and IC 248282 were also recognized as highly resistant to fruit fly. But based on the mean values of both the seasons there was no change in their relative ranking. The decrease in melon fly infestation during 2002 summer season may be because of lower fruit fly population due to high temperatures (35 to 40^{o}C), and low humidity (30 to 40%). High temperatures, long sunshine hours, low humidity, and plantation activity have been reported to influence the population density of *B. cucurbitae* in northeastern Taiwan (Lee *et al.*, 1992). However, the level of infestation was lower during the summer season as compared to the 2001 rainy season. Low level of infestation during the summer season 2002 also influnced the grouping of cultivated bitter gourd genotypes but, there was no change in their relative ranking, except Pusa Vishesh and IC 68255 (which was susceptible during the 2001 rainy season and moderately resistant during summer season 2002), Arka Harit

Table 2. Fruit fly infestation on different genotypes of bitter gourd during rainy season 2001 and summer 2002

Genotypes	Fruit infestation (%)			Number of Larvae/fruit			Remarks
	Rainy 2001	Summer 2002	Mean	Rainy 2001	Summer 2002	Mean	
IC 256185	9.4*** (17.8)*	7.3*** (15.5)8	8.3 (16.7)	3.8*** (2.0)**	3.8*** (1.9)**	3.8 (2.0)	HR
IC 248256	10.2 (18.6)	8.4 (16.8)	9.3 (17.7)	4.7 (2.2)	3.6 (2.0)	4.2 (2.1)	HR
IC 213311	11.7(20.1)	9.0(17.4)	10.4(18.8)	5.9(2.4)	4.2(2.1)	5.1(2.3)	R
IC 248282	13.1(21.3)	9.1(17.5)	11.1(19.4)	4.7(2.2)	4.9(2.2)	4.8(2.2)	R
IC 256110	13.5(21.5)	10.7(19.1)	12.1(20.3)	5.7(2.4)	3.4(1.8)	4.6(2.1)	R
IC 248281	15.2(22.9)	8.9(17.3)	12.6(20.1)	4.5(2.1)	4.7(2.2)	4.6(2.2)	R
IC 68314-B	16.5(24.0)	21.3(27.5)	18.9(25.8)	4.9(2.2)	4.8(2.2)	4.9(2.2)	R
Green Long	25.7(30.4)	21.2(27.3)	23.4(28.9)	5.7(2.4)	5.5(2.3)	5.6(2.4)	MR
Konkan Tara	25.8(30.5)	23.6(29.0)	24.8(29.8)	5.1(2.3)	5.0(2.2)	5.1(2.3)	MR
BL 237	33.3(35.2)	22.0(28.0)	27.6(31.6)	4.0(2.0)	4.2(2.1)	4.1(2.1)	MR
Jaunpuri	36.1(36.9)	21.1(32.1)	28.6(32.1)	7.2(2.7)	6.0(2.4)	6.6(2.6)	MR
Jhalri Baramasi	41.4(40.0)	23.7(29.1)	32.5(34.6)	6.8(2.6)	6.4(2.5)	6.6(2.6)	MR
Hirkani	44.5(41.8)	24.6(29.7)	34.5(35.8)	6.3(2.5)	6.1(2.5)	6.2(2.5)	MR
Pusa Vishesh	56.6(48.8)	29.9(33.1)	43.3(41.0)	5.9(2.4)	6.7(2.6)	6.3(2.5)	MR
IC 68255	59.2(50.3)	45.1(42.1)	52.1(46.2)	5.5(2.3)	6.2(2.5)	5.8(2.4)	S
Arka Harit	77.7(61.9)	53.4(46.9)	65.5(54.4)	8.3(2.9)	7.8(2.8)	8.0(2.9)	S
Pusa Do Mausmi	82.1(64.9)	57.0(49.0)	69.5(57.0)	7.8(2.8)	7.8(2.8)	7.8(2.8)	S
SE	1.62(1.03)	2.59(1.78)	-	1.13(0.23)	0.33(0.07)	-	-
LSD (p<0.05)	2.63(1.68)	4.31(2.95)	-	1.83(0.37)	0.54(0.12)	-	-
CV(%)	4.6(2.9)	11.1(6.4)	-	19.6(9.6)	6.0(3.0)	-	-

* Figures in the parentheses are angular transformed values
** Figures in the parentheses are square root trasformed values
*** Based on 7 fruit pickings
HR = Highly resistant , R = Resistant , MR = Moderately resistant , S = Susceptible

and Pusa Do Mausmi, which were highly susceptible during the 2001 rainy season, were categorized as susceptible during summer season 2002 and based on the mean values for both the seasons. Fruit infestation and the number of larvae per fruit did not differ significantly across season, except in Pusa Vishesh, BL 237, IC 68255, Arka Harit, and Pusa Do Mausmi. There was a positive correlation (r= 0.96) between percentage furit infestation and number of larvae per fruit (Figure 1). But no trend was observed in increase/ decrease in number of larvae per fruit across the seasons. Inayatuallah *et al*. (1991) reported a positive correlation between fruit fly infestation and number of fruit fly males trapped/trap/day (r=0.86), and number of puparia per square feet of soil (r=0.92). Short Green Karlei (Lall and Sinha, 1974) IHR 89, and IHR 213 (Pal *et al.*, 1984), Hisar II, Acc. 3, and Ghoti (Srinivasan, 1991), Acc. 23, and Acc. 33 (Thakur *et al.*, 1992), C 96 and NBTI 1 (Thakur *et al.*, 1994 and 1996), and Kerala collection 1 and Faizabad collection 17 (Tewatia *et al.*, 1997) have earlier been reported to be resistant to melon fruit fly, but they showed low to moderate level of resistance in the present studies. The plant-herbivore interactions are influenced by several morphological and biochemical plant traits, environmental conditions, and physiological conditions of the test insects (De-Ponti, 1977). Morphological factors interfere with feeding and oviposition by the insects. Shape of the fruit also influences the orientation of fruit flies to a potential ovipositional site (Boller and Prokopy, 1976). Chelliah and Sambandam (1971) observed that egg ying by the melon fruit fly was 17.8% in fruits having tough rind in *Cucumis callosus* as compared to 87.33% in fruits of the susceptible variety, Delta Gold. Percentage fruit infestation increases with an increase

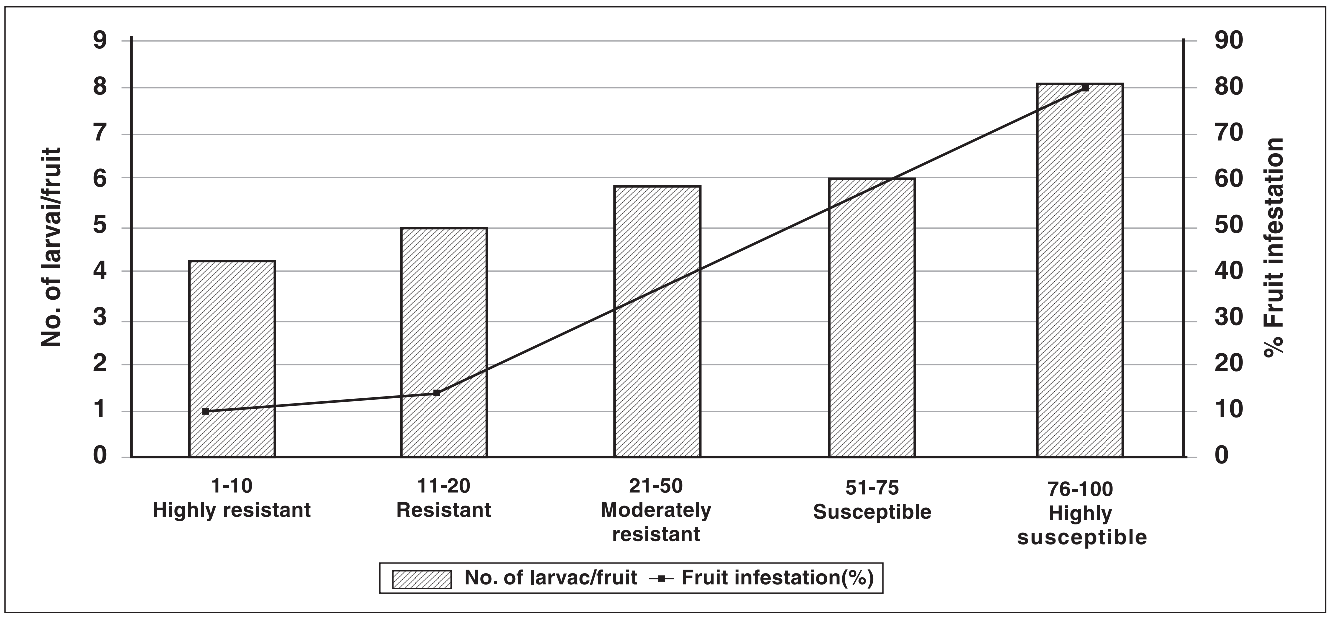

Figure 1. Fruit infestation (%) and number of larvae per fruit in bitter gourd genotypes with different levels of susceptibility/resistance to melon fruit fly

in fruit length and diameter (Jaiswal *et al.*, 1990; Tewatia *et al.*, 1998). These are some of the earlier studies, which support our present findings. The melon fly-resistant genotypes of bitter gourd can be grown by the farmers *per se* or used in resistance breeding programs. Genotypes with different mechanisms can be used in a resistance-breeding program to broaden the bases of resistance to melon fly. Wild relative resistant bitter gourd (*M. charantia* var. *muricata*) can also be used in the resistance breeding programs to increase the levels, and diversify the basis of resistance to *B. cucurbitae.*

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