INDIAN JOURNAL OF ARID HORTICULTURE
2013 Vol. 8 (1-2): 21-24

Screening of ridge gourd varieties/ genotypes [*Luffa acutangula* (Roxb.) L.] for resistance against fruit fly (*Bactrocera cucurbitae* (Coquillett)) in hot arid region of Rajasthan

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Abstract

Host plant resistance is an important component for management of the melon fruit fly, *Bactrocera cucurbitae* (Coquillett) owing to difficulties associated with its chemical and biological control. Ridge gourd varieties/ genotypes viz., AHRG-49, Arka Sujata, AHRG-29, AHRG-36, AHRG-47, AHRG-41, S. Manjari, AHRG-31, AHRG-33, AHRG-42, AHRG-30, AHRG-57, S. Uphal, Pusa Nasdar, AHRG-35, Jaipuri Long, AHRG- 23, AHRG-56, AHRG-53, AHRG-58, AHRG-50, AHRG-28, AHRG-43, AHRG-44, AHRG-46, AHRG-48, AHRG-52, AHRG-59 and AHRG-61 were evaluated to screen out the suitable resistant/susceptible varieties/ genotypes against the fruit fly in hot arid region of Rajasthan. The results imparted that the percentage of fruit infestation and larval population per fruit on tested varieties/ genotypes of ridge gourd varied significantly. Pooled data showed that the AHRG-49, AHRG-33, AHRG-42, AHRG-30, AHRG- 23, AHRG-58, AHRG-50, AHRG-28, AHRG-43, AHRG-52 and AHRG-59 were categorized as susceptible varieties/ genotypes with fruit infestation (70.85%, 68.13%, 57.97%, 55.93%, 70.17%, 55.00%, 53.25%, 65.75%, 57.82%, 69.68% and 65.83%, respectively) and larval population per fruit (22.27, 28.92, 25.93, 22.73, 22.63, 24.28, 22.27, 23.42, 24.12, 21.97, 24.93 and 24.13, respectively). Whereas, the varieties/ genotypes AHRG-29, AHRG-57 and Pusa Nasdar had fruit infestation (17.92%, 16.22% and 18.50%, respectively) and larval population per plant (16.60, 13.45 and 14.55, respectively) and declared as resistant varieties/ genotypes to fruit fly. The AHRG-47, AHRG-31, AHRG-48 and AHRG-61 with fruit infestation (78.02%, 80.13%, 80.10% and 79.42%, respectively) were highly susceptible varieties/ genotypes to fruit fly in pooled data of both the seasons *viz.*, 2011 and 2012. Lower values of host plant susceptibility indices based on fruit infestation (HPSI) were recorded on resistant varieties/ genotypes , AHRG-29, AHRG-57 and Pusa Nasdar (36.12%, 32.69% and 37.29%, respectively) could be used as a source of resistance for developing ridge gourd varieties/ genotypes resistant to fruit fly.

Key Words: *Screening, resistant, Bactrocera cucurbitae, Luffa acutangula*

Introduction

Luffa acutangula has essentially old world origin in subtropical Asia region particularly India (Kalloo, 1993). Plants are monoecious, andromonoecious, hermaphrodite and having gynoecious sex form (Richharia, 1948; Choudhury and Thakur, 1965). Fruits of ridge gourd are very nutritious and good source of vitamin A, calcium, phosphorus, ascorbic acid and iron (Aykroyd, 1963). Medicinally used as toothache, disinfectant, antihelmintic, anti-diarrhea, anti-syphilitic, purgative, cordio tonic, laxative and also potentially cure to diabetes and hypertension. Melon fruit fly, *Bactrocera cucurbitae* (Diptera: Tephritidae: Dacinae) are economically important pests of the cucurbits and are geographically distributed throughout the tropics and subtropics of the world (Chinajariyawong *et al.*, 2003), especially in most of the countries of South East Asia (Allwood *et al.*, 1999). It has more than 81 plant species as its host (Dhillon *et al.*, 2005a), but plants of family Cucurbitacae are considered to be its preferred hosts (Allwood *et al.*, 1999). The infested fruits and flowers do not develop properly and fall down or rot on the plant and result in a dramatic reduction of yield (Dhillon *et al.*, 2005a, Haldhar *et al.*, 2013). Depending on the cucurbit species, season and prevailing climatic conditions, a loss of 30 to 100% can be caused by the melon fruit fly (Dhillon *et al.*, 2005b). As the maggots damage the fruits internally, it is difficult to control this pest with insecticides. Hence, development of varieties resistant to melon fruit fly is an impotent component of integrated pest management (Panda and Khush 1995). Cultivation of varieties/ genotypes resistant to fruit fly is a crucial component of integrated pest management programmes for ridge gourd because of difficulties associated with chemical and

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biological control. Development of ridge gourd varieties/ genotypes resistant to fruit fly has been limited in India owing to inadequate information on the sources of plant traits associated with resistance to pest infestations. The present study was designed to screening of ridge gourd varieties/ genotypes associated with resistance against melon fruit fly in terms of fruit infestation and larval density under field conditions.

Materials and Methods

Twenty nine varieties/ genotypes of ridge gourd *viz.*, AHRG-49, Arka Sujata, AHRG-29, AHRG-36, AHRG-47, AHRG-41, S. Manjari, AHRG-31, AHRG-33, AHRG-42, AHRG-30, AHRG-57, S. Uphal, Pusa Nasdar, AHRG-35, Jaipuri Long, AHRG- 23, AHRG-56, AHRG-53, AHRG-58, AHRG-50, AHRG-28, AHRG-43, AHRG-44, AHRG-46, AHRG-48, AHRG-52, AHRG-59 and AHRG-61 were sown at experimental farm of Central Institute for Arid Horticulture (CIAH), Bikaner (28°06'N, 73°21'E). The crop was sown in rainy, 2011 and summer, 2012 with three replicates (blocks) for each varieties/ genotypes following a randomized block design. The area of each bed was 5 m × 2 m and the plant to plant distance was maintained at 50 cm with drip irrigation system. All the recommended agronomic practices (e.g. weeding, fertilization, hoeing, etc.) were performed equally in each experimental bed. Six pickings were done for the entire growing season of ridge gourd fruits. Ten fruits were randomly selected from each picking from each experimental bed; a total of 30 fruits were taken from each picking of each genotype and were brought to the laboratory for microscopic examination for fruit infestation. The infested fruits were sorted and the percent fruit infestation was calculated. Ten fruits from all infested fruits from each picking of each genotype were then randomly selected for further examination, and the numbers of larvae were counted in each infested fruit. The varieties/ genotypes were categorized by following the rating system given by Nath (1966) for fruit infestation as: immune (no damage), highly resistant (110%), resistant (1120%), moderately resistant (2150%), susceptible (5175%) and highly susceptible (76100%).

Calculation of host plant susceptibility indices (HPSI)

The objective of the present study was to determine the role of varieties/ genotypes towards susceptibility in percentage within the test materials. The HPSI was calculated by the following formula (Aziz and Hasan, 2010).

$$\text{Percent HPSI} = 100\ (B\text{-}A)/B \times 100$$

Where, A is larval population per fruit/ percent fruit infestation in individual genotype of ridge gourd and B is larval population per fruit/ percent fruit infestation on all varieties/ genotypes of ridge gourd on average basis.

Table 1. Larval density and percent fruit infestation of fruit fly on different variety/ genotypes of ridge gourd in arid region

S. No.	Varieties/ genotypes	2011 year (Rainy season)		2012 year (Summer season)		Pooled data		Resistance category
		Larval density/ fruit	Fruit infestation (%)	Larval density/ fruit	Fruit infestation (%)	Larval density/ fruit	Fruit infestation (%)	
1	AHRG-49	22.50	71.33 (57.61)	22.03	70.37 (57.00)	22.27	70.85 (57.30)	S
2	Arka Sujata	17.77	30.63 (33.59)	17.27	29.93 (33.15)	17.52	30.28 (33.37)	MR
3	AHRG-29	16.90	18.13 (25.19)	16.30	17.70 (24.85)	16.60	17.92 (25.02)	R
4	AHRG-36	17.07	35.23 (36.39)	16.53	34.70 (36.07)	16.80	34.97 (36.23)	MR
5	AHRG-47	27.80	78.20 (62.46)	27.27	77.83 (62.21)	27.53	78.02 (62.33)	HS
6	AHRG-41	16.57	22.27 (28.14)	16.20	21.93 (27.91)	16.38	22.10 (28.03)	MR
7	S. Manjari	20.37	40.43 (39.47)	19.70	39.90 (39.15)	20.03	40.17 (39.31)	MR
8	AHRG-31	29.27	80.47 (64.10)	28.57	79.80 (63.55)	28.92	80.13 (63.82)	HS
9	AHRG-33	26.20	68.53 (55.86)	25.67	67.73 (55.37)	25.93	68.13 (55.62)	S
10	AHRG-42	23.00	58.30 (49.46)	22.47	57.63 (49.37)	22.73	57.97 (49.57)	S
11	AHRG-30	22.93	56.17 (48.52)	22.33	55.70 (48.26)	22.63	55.93 (48.39)	S
12	AHRG-57	13.60	16.47 (23.92)	13.30	15.97 (23.53)	13.45	16.22 (23.72)	R
13	S. Uphal	18.70	42.97 (40.94)	18.20	42.43 (40.63)	18.45	42.70 (40.78)	MR
14	Pusa Nasdar	14.77	18.70 (25.61)	14.33	18.30 (25.31)	14.55	18.50 (25.46)	R
15	AHRG-35	17.70	25.90 (30.58)	17.30	25.33 (30.20)	17.50	25.62 (30.39)	MR
16	Jaipuri Long	18.60	36.40 (37.09)	18.07	35.87 (36.77)	18.33	36.13 (36.93)	MR
17	AHRG- 23	24.50	70.47 (57.07)	24.07	69.87 (56.69)	24.28	70.17 (56.88)	S
18	AHRG-56	17.57	25.20 (30.12)	16.93	24.87 (29.90)	17.25	25.03 (30.01)	MR
19	AHRG-53	18.17	27.50 (31.62)	17.63	27.13 (31.38)	17.90	27.32 (31.50)	MR
20	AHRG-58	22.60	55.23 (47.99)	21.93	54.77 (47.72)	22.27	55.00 (47.85)	S
21	AHRG-50	23.70	53.63 (47.07)	23.13	52.87 (46.63)	23.42	53.25 (46.85)	S
22	AHRG-28	24.33	66.17 (54.42)	23.90	65.33 (53.91)	24.12	65.75 (54.16)	S
23	AHRG-43	22.20	58.27 (49.74)	21.73	57.37 (49.22)	21.97	57.82 (49.48)	S
24	AHRG-44	21.10	46.97 (43.24)	20.60	46.43 (42.94)	20.85	46.70 (43.09)	MR
25	AHRG-46	21.30	47.30 (43.43)	20.67	46.77 (43.13)	20.98	47.03 (43.28)	MR
26	AHRG-48	27.43	80.43 (64.09)	26.90	79.77 (63.60)	27.17	80.10 (63.84)	HS
27	AHRG-52	25.23	70.13 (56.85)	24.63	69.23 (56.29)	24.93	69.68 (56.57)	S
28	AHRG-59	24.73	66.13 (54.30)	23.53	65.53 (54.03)	24.13	65.83 (54.21)	S
29	AHRG-61	28.60	79.77 (63.56)	27.87	79.07 (63.10)	28.23	79.42 (63.33)	HS
SEm±		0.85	1.43	0.83	1.43	0.84	1.43	
CD (P = 0.05)		2.42	4.07	2.36	4.05	2.38	4.06	

Data presented are mean of three replications; Figures in parentheses are angular value

Statistical analysis

Transformations (angular transformed value) were used to achieve normality in the data before analysis (Steel *et al.*, 1997), but untransformed means are presented in tables. The data on percentage fruit infestation and larval density per fruit and biochemical fruit traits were analyzed through one-way ANOVA using SPSS 16 software (O'Connor 2000). The means of significant parameters, among tested varieties/ genotypes, were compared using critical difference (CD) tests for paired comparisons at probability level of 5%.

Results and discussion

The twenty nine ridge gourd varieties/ genotypes were taken for screening against melon fruit fly. The significant differences were found in percentage fruit infestation and larval density per fruit among the tested varieties/ genotypes during screening. The larval density per fruit had a significant positive correlation with percentage fruit infestation. Pooled data showed that the AHRG-29, AHRG-57 and Pusa Nasdar were the most resistant; Arka Sujata, AHRG-36, AHRG-41, S. Manjari, S. Uphal, AHRG-35, Jaipuri Long, AHRG-56, AHRG-53, AHRG-46 and AHRG-48 were moderately resistant; AHRG-49, AHRG-33, AHRG-42, AHRG-30, AHRG- 23, AHRG-58, AHRG-50, AHRG-28, AHRG-43, AHRG-52 and AHRG-59 were susceptible whereas AHRG-47, AHRG-31, AHRG-48 and AHRG-61 were the highly susceptible varieties/ genotypes

Table 2. Host plant susceptibility indices (HPSI %) for fruit fly on different variety/ genotypes of ridge gourd in arid region

S. No.	Varieties/ genotypes	HPSI based on larval population (%)			HPSI based on fruit infestation (%)		
		2011	2012	Pooled 2011-12	2011	2012	Pooled 2011-12
1	AHRG-49	104.36	104.92	104.64	142.92	142.70	142.81
2	Arka Sujata	82.41	82.22	82.32	61.38	60.70	61.04
3	AHRG-29	78.39	77.62	78.01	36.33	35.90	36.12
4	AHRG-36	79.16	78.73	78.95	70.59	70.37	70.48
5	AHRG-47	128.94	129.84	129.38	156.68	157.84	157.26
6	AHRG-41	76.84	77.14	76.99	44.61	44.48	44.55
7	S. Manjari	94.47	93.81	94.14	81.01	80.92	80.96
8	AHRG-31	135.75	136.03	135.89	161.22	161.83	161.53
9	AHRG-33	121.52	122.22	121.87	137.31	137.36	137.34
10	AHRG-42	106.68	106.99	106.83	116.81	116.88	116.84
11	AHRG-30	106.37	106.35	106.36	112.54	112.96	112.75
12	AHRG-57	63.08	63.33	63.20	32.99	32.38	32.69
13	S. Uphal	86.73	86.67	86.70	86.09	86.05	86.07
14	Pusa Nasdar	68.49	68.25	68.37	37.47	37.11	37.29
15	AHRG-35	82.10	82.38	82.24	51.89	51.38	51.64
16	Jaipuri Long	86.27	86.03	86.15	72.93	72.74	72.83
17	AHRG- 23	113.64	114.60	114.11	141.19	141.69	141.44
18	AHRG-56	81.48	80.63	81.06	50.49	50.43	50.46
19	AHRG-53	84.26	83.97	84.12	55.10	55.03	55.06
20	AHRG-58	104.82	104.44	104.64	110.67	111.07	110.86
21	AHRG-50	109.93	110.16	110.04	107.46	107.21	107.34
22	AHRG-28	112.86	113.81	113.33	132.57	132.50	132.53
23	AHRG-43	102.97	103.49	103.23	116.74	116.34	116.54
24	AHRG-44	97.87	98.10	97.98	94.10	94.17	94.13
25	AHRG-46	98.79	98.41	98.60	94.77	94.84	94.81
26	AHRG-48	127.24	128.10	127.66	161.16	161.77	161.46
27	AHRG-52	117.04	117.30	117.17	140.52	140.40	140.46
28	AHRG-59	114.72	112.06	113.41	132.51	132.90	132.70
29	AHRG-61	132.65	132.70	132.67	159.82	160.35	160.08

References

Allwood, A.J.,Chinajariyawong, A., Drew, R.A.I., Hamacek, E.L., Hancock, D.L., Hengsawad, C., Jinapin, J.C., Jirasurat, M., Kong Krong, C., Kritsaneepaiboon, S., Leong, C.T.S. and Vijaysegaran, S. 1999. Host plant records for fruit flies (Diptera: Tephritidae) in South-East Asia. *Raff. Bull. Zool.*, 7: 199.

Aykroyd, W. R. 1963. The nutritive value of Indian foods and the planning of satisfactory diets. ICMR Special Report Series No 42.

Aziz, M.A. and Hasan, M. 2010. Sustainable management of Earias spp. on okra in Punjab, Pakistan. VDM Publishers Germany.

Chinajariyawong, A., Kritsaneepaiboon, S. and Drew, R.A.I. 2003. Efficacy of protein bait sprays in controlling fruit flies (Diptera: Tephritidae) infesting angled luffa and bitter-gourd in Thailand. *Raff. Bull. Zool.*, 51: 715.

Choudhury, B., Thakur, M. R. 1965. Inheritance of sex forms in Luffa. *Indian Journal of Genetics*, 25:188-197.

Dhillon, M. K., Singh, R., Naresh, J. S. and Sharma, N. K. 2005a. The influence of physico-chemical traits of bitter gourd, *Momordica charantia* L. on larval density and resistance to melon fruit fly, *Bactrocera cucurbitae* (Coquillett). *Journal Applied Entomology*, 129, 393399.

Dhillon, M. K., Singh, R., Naresh, J. S. and Sharma, H. C. 2005b. The melon fruit fly, *Bactrocera cucurbitae*: a

review of its biology and management. *Journal of Insect Science*, 5, 116.

Gogi, M. D., Ashfaq, M., Arif, M. J. and Khan, M. A. 2010. Screening of bitter gourd (*Momordica charantia*) germplasm for resistance against melon fruit fly (*Bactrocera cucurbitae*) in Pakistan. *International Journal of Agricultural Biology*, 11, 746750.

Gogi, M. D., Ashfaq, M., Arif, M. J. and Khan, M.A. 2009. Screening of bitter gourd (*Momordica charantia*) germplasm for sources of resistance against melon fruit fly (*Bactrocera cucurbitae*) in Pakistan. *International Journal of Agriculture Biology*, 11: 746750.

Gogi, M. D., Ashfaq, M., Arif, M. J., Sarfraz, R. M. and Nawab, N. N. 2010. Investigating phenotypic structures and allelochemical compounds of the fruits of *Momordica charantia* L. genotypes as sources of resistance against *Bactrocera cucurbitae* (Coquillett) (Diptera: Tephritidae). *Crop Protection*, 29, 884890.

Haldhar, S. M., Bhargava, R., Choudhary, B. R., Pal, G. and Kumar, S. 2013. Allelochemical resistance traits of muskmelon (*Cucumis melo*) against the fruit fly (*Bactrocera cucurbitae*) in a hot arid region of India. *Phytoparasitica* , 41:473-481.

Kalloo, G. 1993. Loofah-Luffa spp. In G Kalloo and BO Bergh (eds.). Genetic Improvement of Vegetable Crops 265-266, Pergamon Press.

Nath, P. 1966. Varietal resistance of gourds to the fruit fly. *Indian Journal of Horticulture*, 23, 6978.

O'Connor, B. P. 2000. SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. *Behavior Research Methods, Instrumentation and Computer*, 32, 396402.

Panda, N. and Khush, G. S. 1995. *Host plant resistance to insects*. Wallingford, UK: C.A.B. International, pp 431.

Richharia, R. H. 1948. Sex inheritance in *Luffa acutangula*. *Current Science*, 17:358.

Sarfraz, M., Dosdall, L. M. and Keddie, B. A. 2006. Diamondback mothhost plant interactions: implications for pest management. *Crop Protection*, 25, 625639.

Shahid, I., Muhammad, A., Muhammad, A. K. and Nazir, J. 2014. Cultivar variation of cauliflower against cabbage butterfly *Pieris brassicae* (L.) Pieridae: Lepidoptera. *Pakishtan Journal of Agriculture Science*, 51(2), 325-329.

Steel, R. G. D., Torrie, J. H. and Dickey, D. A. 1997. *Analysis of variance II*: multiway classifications. In: Steel RGD, Torrie JH, Dickey DA, Editors, Principles and Procedures of Statistics: A Biometrical Approach (third ed.), WCB/McGraw-Hill, USA, 204252.

Weems, H. V, and Heppner, J. B. 2001. *Melon fly, Bactrocera cucurbitae (Coquillett) (Insecta: Diptera: Tephritidae)*. Florida Department of Agriculture and Consumer Services, Division of Plant Industry, University of Florida, Publication no. EENY- 199.