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Article

Host preference and eco-friendly management of cucurbit fruit fly under field condition of Bangladesh

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Abstract: Experiments were carried out to investigate the host preference of cucurbit fruit fly, *Bactrocera cucurbitae* and its management to cucurbitaceous vegetables namely, bitter gourd, ridge gourd and snake gourd. Among the vegetables, bitter gourd was found as mostly preferable (upto 40.69% fruit infestation) and snake gourd was found as the least preferable (18.64% fruit infestation). Among management tactics (fruit bagging, neem oil, mahogany oil, alamonda leaf extract, pheromone trap and cider vinegar traps), bagging reduced maximum fruit infestation (upto 75.51%) compared to controlled plots. Among the botanicals, neem oil was mostly effective (21.64% reduction of fruit infestations) followed by alamonda leaf extract and mahogany oil. Both traps were found effective and more insect were trapped in the pheromone trap.

Keywords: bagging; botanical extracts; cucurbits; cider vinegar trap; pheromone trap

1. Introduction

The cucurbitaceous vegetables are form one of the largest groups in the vegetable kingdom with their wide adaptation from arid to the humid tropic environments. The cucurbits such as cucumber, bitter gourd, sponge gourd, ridge gourd, bottle gourd, sweet gourd, snake gourd, ash gourd, pointed gourd, and pumpkins are some of the major vegetables are principally grown year round across the Bangladesh. But it becomes principal vegetables during the summer season due to the scarcity of other vegetables in the market. Irrespective to other causes, enormous yield losses of cucurbitaceous vegetables are causing from the attack of insect pests in every year. Cucurbit fruit fly, *Bactrocera cucurbitae* (Coquillett) is one of the most devastating pests of cucurbitsin many parts of the world which may cause more than 60% yield loss (Kapoor, 1993). The female fruit flies insert their eggs into the developing fruits while visiting as a result, fruit juice oozes come out form the injury which ultimately transformed into resinous brown deposit. The eggs hatch inside the fruit into maggots which feed on the flesh (pulp) and make tunnels. The infested fruits may be rotten, dry up, shed up prematurely and sometimes, become deformed which ultimately reduce the market value. Infestations vary with the environmental conditions and the crop species. Depending on the variation of environmental parameters and host crops, the extent of losses varies between 30 to 100% (Gupta and Verma, 1992; Dhillon *et al*., 2005a,b,c; Shooker *et al*., 2006). Conventionally farmers apply synthetic chemical insecticides to control cucurbit fruit fly. However, inappropriate use of broad spectrum synthetic insecticides are responsible for the development of insecticide resistance, pest resurgence, outbreak of secondary pests, destruction of non-target organisms (Hagen and Franz,1973), environment hazards (Devi *et al.*, 1986; Fishwick,1988) and human health risks. On the other hand, knowledge on host preference and non-chemical management approaches can be effective tools in the eco-friendly and sustainable management of cucurbit fruit fly. Considering the aforesaid issues the present study was conducted to perform comparative study on the host preference of cucurbit fruit fly and its management with non-chemical management practices.

2. Materials and Methods

The experiments on host preference and management of cucurbit fruit fly (*Bactrocera cucurbitae*) were carried out in the field laboratory of department of Entomology, Bangladesh Agricultural University during the period of April to July 2013. The land was ploughed and cross-ploughed for several times with a power tiller to obtain good tilth. All ploughing operations were followed by laddering for breaking up the clods. All weeds and stubbles were removed from the field and then it was divided into 24 equal plots of 4 feet by 4 feet. Finally, the unit plots were prepared as 10cm raised beds along with basal doses of recommended fertilizers maintaining single pit in each for experiments. Among the plots, 9 were used for the host preference tests in which three selected cucurbitaceous vegetables such as bitter gourd (BARI Karola-1), ridge gourd (*BARI* Jhinga-1) and snake gourd (Local Chichinga) collected from Bangladesh Agricultural Research Institute (BARI) and local market of Mymensingh town were sown maintaining three replications of each. Management experiments were performed in rest 15 plots where seeds of bitter gourd were sown. Before sowing, seeds were soaked overnight for proper germination. Three seeds were sown in each pit and one healthy seedling per pit was maintained through thinning at 7 days after germination. Each plant was supported by bamboo platform (bamboo macha) for easy creeping and preventing from lodging. Proper growth and development of each plant was maintained with all recommended horticultural practices. Total number of fruits and infested fruits were recorded at 5 days intervals which were started at 10 days after first flowering. Relative preference of cucurbit fruit fly to the vegetables was then compared using the percentage of infested fruits generated from the following formula.

$$\%\ Fruit\ infestaion = \frac{Number\ of\ infested\ fruit(IF)}{Number\ of\ total\ fruit\ (TF)} \times 100$$

Comparative efficacy of management tactics (bagging with paper bags, three botanical insecticides viz. neem oil, mahogany oil and allamanda leaf extract and two traps viz. pheromone trap and cider vinegar traps) were evaluated based on the percent infested fruits using the aforesaid formula and compared with untreated control plots. Each management practice and control plot was replicated for three times. For bagging, tender fruit was covered by a paper bag to avoid fruit fly contact. Fruits were observed after 5 days of bagging and the total number of fruits and infested fruits were counted. The infested fruits were removed after each data counting. Botanical insecticides were sprayed at five days interval @ 5mlL^{-1} of water. After 5 days of each spraying, total number of fruits and total number of infested fruits per plot were recorded. After completion of management experiments with bagging and botanicals, pheromone traps (designed by BARI with culure and soapy water) and cider vinegar traps were hung up under bamboo platform (randomly selected plots). Numbers of fruit flies trapped were recorded at alternative days. Total fruits and infested fruits were also recorded for the selected plots. The old cider vinegar and soapy water were replaced at 7 days intervals. Data were analyzed by MSTAT-C and SPSS programs and DMRT was performed when it was necessary.

3. Results and Discussion

a. Host preference of fruit fly

Percent fruit infestation by cucurbit fruit fly were significantly ($P<0.01$) different among bitter gourd, ridge gourd and snake gourd (Table 1). The highest percentages of fruit infestation at different times were found on bitter gourd (40.13%, 40.95%, and 36.98% respectively at 3 consecutive counting). On the other hand, the lowest fruit infestations were found on snake gourd (18.64%, 21.55%, and 19.91% at 1st, 2nd and 3rd counting respectively) which was almost half comparing to the bitter gourd infestations. Ridge gourd was found moderately preferable to cucurbit fruit fly because fruit infestation level were found in between bitter gourd and snake gourd at different counting.

Therefore, among three selected cucurbitaceous vegetables, bitter gourd was the mostly preferable and snake gourd was the least preferable host to cucurbit fruit fly. Based on the observations, it was most likely that fruit fly lay eggs in all three vegetables but they did not choice equally for egg laying and infestation. The present study was in full agreement with observation of Hollingsworth *et al*. (1997) and Singh *et al*. (2000), they stated bitter gourd as the most susceptible vegetable to cucurbit fruit fly among three host namely bitter gourd, snake gourd, and pumpkin fruits. Likewise, Krishna *et al.* (2006) reported that, maximum fruit fly infestation occurred in bitter gourd and lowest infestation occurred in cucumber followed by ridge gourd. Moreover, Doharey (1983) described bitter gourd (*Momordica charantia*), musk melon (*Cucumis melo*), snap melon (*Cucumis melo var. momordica*) and snake gourd (*Trichosanthes anguina* and *T. cucumeria*) as more preferred hosts among 70 vegetables he evaluated. However, the present result is contradictory with Humayra *et al*. (2010) where they stated snake gourd as more preferable host than bitter gourd and cucumber. Again, Gaine *et al.* (2013) found more or less similar infestations of fruit fly in bitter gourd and ridge gourd.

Table 1. Fruit infestation (%) by cucurbit fruit fly at different counting.

Crop	Fruit infestation (%)		
	1st counting	2nd counting	3rd counting
Bitter gourd	40.13a	40.95a	36.98a
Ridge gourd	25.00b	29.93b	30.61b
Snake gourd	18.64c	21.55c	19.91c
Level of probability	**	**	**
$LSD_{0.05}$	3.30	3.26	3.42

Different letters at same counting are significantly different

Table 2. Fruit infestation (%) at different counting under various treatments.

Treatment	Fruit infestation (%) at different counting			
	Pretreatment data	1st counting	2nd counting	3rd counting
Control	39.32a	40.13a (2.06)	40.95a (4.15)	36.98a (-5.95)
Bagging	30.63d	13.43c (-56.15)	7.50c (-75.51)	9.26b (-69.77)
Neem oil	38.49a	30.16b (-21.64)	32.70ab (-15.04)	33.13a (-13.93)
Mahogany oil	37.12b	36.18ab (-2.53)	37.95ab (2.24)	33.48a (-9.81)
Allamanda leaf extract	35.16c	28.62b (-18.60)	30.16b (-14.22)	30.64a (-1.85)
Level of probability	**	**	**	**
$LSD_{0.05}$	1.46	4.55	6.34	5.58

Different letters at same counting are significantly different.
Figures in parenthesis with -/+ represent percent reduction/increase of fruit infestation.

Table 3. Efficacy of pheromone and cider vinegar traps in reducing fruit infestation caused by fruit flies.

Traps	Mean number of infested fruits		
	1st counting	2nd counting	3rd counting
Control	39.17a	34.21a	36.80a
Pheromone trap	30.30b	26.76b	28.66b
Cider vinegar trap	32.73b	27.83b	30.45b
Level of probability	*	**	**
$LSD_{0.05}$	6.013	3.409	3.614

Different letters at same counting are significantly different.

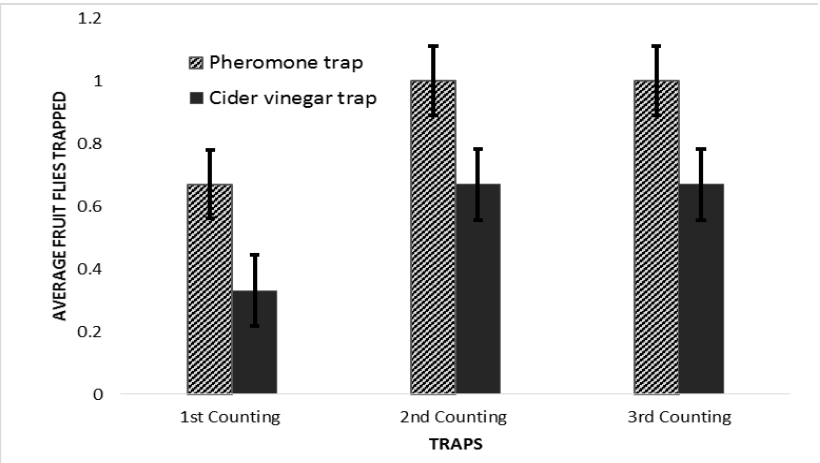

Figure 1. Efficacy of pheromone trap and cider vinegar trap.

b. Management of cucurbit fruit fly

***i.* Comparative efficacy of bagging and botanicals**

Efficacies of bagging and botanical insecticides were evaluated on the basis of percent fruit infestations on bitter gourd. Percent fruit infestation varied significantly ($p<0.01\%$) for different treatments. The highest fruit infestations occurred in control plots which were significantly different than all treated plots (39.32%, 40.13%, 40.95% and 36.98% at 10 days after first flowering as pretreatment data, 5 days after treatment application, 5 days after 1st counting and 5 days after 2nd counting respectively) (Table 2). Among treatments, the least fruit infestations were recorded for bagging, 13.43%, 7.50% and 9.26% at three consecutive counting respectively which almost 1/3rd compared to botanicals. Upto 76% reduction of fruit infestation over control were found in case of bagging which was the most reduction of infestation among all treatments used in the experiments. The result was alike with Akhtaruzzaman *et al*. (2000), they stated bagging of cucumber fruits at 3 days after anthesis for 5 days can reduce fruit fly infestations effectively and safely. Among three botanicals, the least fruit infestations were recorded in alamanda leaf extract treated plots (28.62%, 30.16% and 30.64%, at three successive counting respectively) but the percent reduction of fruit infestation was highest in neem oil treated plots (21.64%, 15.04% and 13.93%, at three successive counting respectively) over pretreatment data. On the other hand, mahogany oil was the least effective against fruit fly because highest percentage of fruit infestation was observed on (36.18%, 37.95%, 33.48%, at three consecutive counting) mahogany oil treated plants with least reduction of percent fruit infestations. Therefore, neem oil was the most efficient in reduction of fruit fly infestation followed by alamonda leaf extract and mahogany oil. These observations are supported by Singh (2003), he stated that neem extract can be used effectively as an excellent alternative to synthetic insecticides. Similarly, Khalid (2009) reported neem oil and neem seed extract can reduce the fruit fly infestation significantly.

***ii.* Comparative efficacy of fruit fly traps**

The mean number of fruit fly trapped in pheromone trap and cider vinegar trap were compared to ascertain their efficacy (Figure 1). According to the graph, more fruit flies were trapped in pheromone traps compared to cider vinegar trap in every of three successive counting. Initially, almost half number of fruit flies was trapped in cider vinegar trap which gradually increased up to two third of trapped in the pheromone trap. Therefore, pheromone trap was the more effective than cider vinegar trap for cucurbit fruit fly trapping. The present study was in agreement with observation of Nasiruddin *et al.* (2002), where they stated that, pheromone trap performed more effectively than other traps he used. A few little numbers of fruit flies were trapped during this experimental period. This circumstance might be due to variation in agro-ecological system as well as cropping pattern of the experimental location, species diversity and richness. It might also be due to the large cultivation of rice surrounding the experimental field.

***iii.* Fruit infestations after setting pheromone and cider vinegar traps**

Data on fruit fly infested fruits and total number of fruits were counted at 5 days intervals from the plots where pheromone and cider vinegar traps were set. The data were then calculated as percentage and presented in the Table 3. Both pheromone and cider vinegar traps were found statistically alike but significantly efficient in reducing fruit infestations comparing to untreated plots (up to 39.17%). Pheromone traps was the most effective where less fruit infestations was recorded at every successive counting. Comparatively more fruit infestations (upto 32.73%) were found in plots with cider vinegar traps.

4. Conclusions

Bitter gourd was mostly preferable and snake gourd was found lest preferable variety followed by ridge gourd to cucurbit fruit fly. Bagging was the most effective measure among the management tactics used in the experiment and neem oil was mostly effective followed by alamonda leaf extracts and mahogany oil among botanical insecticides evaluated in the experiment. Both traps were observed effective but pheromone trap was comparatively better than cider vinegar trap to control fruit fly. Therefore, host preference ranking among the selected vegetables were bitter gourd> ridge gourd> snake gourd to the cucurbit fruit fly and the ranking of fruit fly control measures based on the efficacy was bagging of fruits>neem oil>alamonda leaf extract>mahogany oil> pheromone trap> cider vinegar trap for the management of cucurbit fruit fly.

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Conflict of interest
None to declare.

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