J. Sci. technol. (Dinajpur) Vol. 5: 17-27 (2007)
ISSN 1994-0386

LIFE HISTORY AND MANAGEMENT OF CUCURBIT FRUIT FLY BACTROCERA CUCURBITAE ON SWEET GOURD

Sagar Mukherjee, Dil Afrose Tithi, Adnan Al Bachchu, Roushan Ara and Md. Ruhul Amin

ABSTRACT

The life history of *Bactrocera cucurbitae* (Diptera: Tephritidae) on sweet gourd showed that the mean pre-oviposition, oviposition, incubation, larval and pupal period were 11.25, 9.75, 0.81, 12.25 and 7.75 days, respectively. The mean longevity of adult male was 18.25 days and the longevity of adult female was 23.50 days. The mean fecundity of a female was 52.75. The average length of eggs, larvae, pupae, adult male and female were 1.48, 10.13, 6.00, 7.50 and 8.75 mm, respectively. Whereas, the mean breadth of eggs, larvae, pupae, adult male and female were 0.48, 3.38, 2.18, 3.25 and 5.50 mm, respectively. The evaluation of different management practices revealed that the bagging of fruits showed the lowest level of infestation and the highest yield was obtained in the bagging treatment. So, the study indicated that bagging of fruits might be considered as a suitable method in suppressing fruit fly on sweet gourd.

***Key words**: Life history, Bactrocera cucurbitae, management, sweet gourd*

INTRODUCTION

The soils and agro-climates of Bangladesh are highly conducive for growing numerous vegetables. Among them cucurbits are the major groups (Nasiruddin *et al*., 2004). The annual production of vegetables in Bangladesh is 2.5 million tons including potato and sweet potato (Anonymous, 1993). The daily requirement of vegetables for a full-grown person is 285g (Ramphall and Gill, 1990). But per capita consumption of vegetables is only 50g per day in Bangladesh, which is the lowest among the countries of South and South East Asia (Rekhi, 1997). As a result, chronic malnutrition is commonly seen in Bangladesh. The vegetable production in Bangladesh is very low in summer. In this season, the major vegetables grown are cucurbits. Therefore, during the lag period, cucurbitaceous vegetables play an important role to supplement this shortage (Rashid, 1993). In 2004-2005 cropping year, 138 thousand metric tons sweet gourd was produced in Bangladesh (BBS, 2006).

Cucurbits are infested by several insect pests which are considered to be the significant obstacles for its economic production. Among them, cucurbit fruit fly, *Bactrocera cucurbitae* Coquillett is the major pest responsible for considerable damage (Butani and Jotwani, 1984). Fruit flies cause up to 50 % damage of cucurbits (York, 1992) whereas melon damage may be of 100% (Atwal and Dhaliwal, 2005). Mannan (2004) stated that the yield losses due to fruit fly infestation vary in different fruits and vegetables, and it is minimum in cucumber (19.19%) and maximum in sweet gourd (69.96%). The adult females lay eggs usually just below the epidermis of the fruit by inserting their ovipositor. The infested fruits gradually decayed due to the action of saprophytic organisms like fungi and bacteria. If the infested fruits do not rotten

Department of Entomology, Hajee Mohammad Danesh Science and Technology University, Dinajpur 5200, Bangladesh

they deform and become unfit for human consumption (Nasiruddin *et al*., 2004). It is therefore, necessary to device means to reduce damage of this pest without adverse effect on the agro-ecosystem. Management of this pest is difficult because of its internal feeding behaviour.

Several management practices have been reported to control cucurbit fruit fly. Kapoor (1993) suggested to use chemical, biological and legal approaches. Components of these methods are not always feasible and the growers do not use (Akhtaruzzaman, 1999). Direct foliar sprays of insecticides fail to control this pest (Kapoor, 1993) as the larvae develop inside fruit. Nasiruddin and Karim (1991) found that spraying Dipterex 80 SP reduced 61.92 % infestation in snake gourd, but Diptrex 80 SP is not available in market for farmer's use. Mechanical and cultural practices such as field sanitation, infested fruit picking, bagging of fruits, ploughing of soils are very effective control measures of this pest (Akhtaruzzaman, 1999). Collection and destruction of infested fruits helped population reduction of fruit flies (Nasiruddin and Karim, 1992). Covering of fruits by polythene bag is an effective control of fruit fly in teasel gourd. The lowest fruit fly incidence in teasel gourd occurred in bagging of fruit (4.2 %) while the highest (39.38 %) was recorded in the fruits of control plots (Anonymous, 1988). Unfortunately no single method has so far been proved to be an effective and reliable to control this pest (Kapoor, 1993). Therefore, the present study was undertaken to get the detail information of the life history of cucurbit fruit fly, and to find out effective and environmental friendly management technique.

MATERIALS AND METHODS

The study was conducted in the laboratory and experimental field of the Department of Entomology, Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, Bangladesh during April to July, 2007.

Biology and morphometric study: Five infested sweet gourd, *Cucurbita moschata* fruits that were aged more than one week were collected from the field and were kept in the laboratory in rearing jars. When adult emerged, one pair of male and female was placed in a single glass jar and its mouth was covered by mosquito net. The males were identified by their small size and rounded abdomen, and females were identified by their conspicuous sharp ovipositor. Sweet gourd fruit juice and water were supplied into the glass jar. Newly emerged males and females were kept for 10 days to allow their mating and one week old sweet gourds were provided for their oviposition. The duration between the time of mating and beginning of laying egg was considered as the pre-oviposition period. The ovipositon period was considered as the duration between the period of first and last egg laid. The fertilized females laid eggs just below the epidermis of the fruit. The incubation period was considered as the duration of egg laying to hatching. Some of the oviposited fruits were dissected for confirmations of oviposition. The incubation period was recorded from another set of oviposited fruits. The larval period was considered as the duration of egg hatching to jumping stage of larvae. When jumping stage of larvae appeared, the larvae became ready for pupation. The duration between jumping stage of larvae and starting of adult emergence is considered as the pupal period. Larvae were transferred into another jar containing appropriate moist soil in which pupation took place. When adult emerged from the pupa then the pupal period were recorded. The duration between starting of adult emergence and death of adult was considered as the adult longevity. Adult longevity was recorded by rearing them with proper supply of sweet gourd juice as diet. The fecundity of female was observed by providing young fruit daily. Every day a fresh fruit dome was offered to a female for laying eggs. This was continued until the death of the female. Oviposited eggs were collected by cutting flesh fruit with knife. The eggs with flesh were placed in glass jar containing water. Eggs were separated and their number was counted. For scientific information the data of different parameters were observed and replicated four times. Oculomicrometer was used for the measurement of length and breadth of the eggs. The length and breadth of larvae, pupae and adult flies were measured with the help of ordinary millimeter scale.

Experimental design, treatments and layout: The experiment was conducted in Randomized Complete Block Design (RCBD) with 5 treatments and 4 replications. The treatments were: Treatment 1 = Nimbicidine (Azadiractin) @ 5 ml/litre water at 10 days interval, Treatment 2 = Secufon 80 SP (Trichlorfon) @ 1 ml/litre water at 10 days interval, Treatment 3 = Bagging of fruits at 2 days after anthesis (DAA) and left for 7 days in scaffold, Treatment 4 = Decis 2.5 EC (Deltamethrin) 1 ml/litre water at 10 days interval, Treatment 5 = Control. The land was divided into 20 plots (4.0 x 2.0 m^2) with an inter plot distance of 2 m. Each pit (40 x 40 x 40 cm^3) was dug per plot and each pit having two sweet gourd plants representing a replication.

Raising of crop: The experimental field was prepared by deep ploughing and harrowing followed by laddering as recommended by Rashid (1993). The field layout was marked after final land preparation. Seeds of sweet gourd were collected from the BRAC seed farm, Basherhat, Dinajpur. Five seeds were sown directly in each pit of the experimental plots. Before sowing the seeds were treated with vitavax-200 @ 2g/kg seed. After sowing seeds, a light irrigation was applied. Required irrigation was regularly applied after raising of seedling. Two healthy plants were kept in each pit. Sevin 85WP @ 1.5kg /ha followed by a light irrigation was applied in soil around each pit in ring method and then covered with soil to avoid the infestation of cutworm. After germination of seedlings, soil of each plot was drenched with 1% solution of vitavax-200 to save the plants from the attack of anthracnose disease. Weeding was done and drainage facilities were provided as recommended by Rashid (1993). Infestation of red pumpkin beetle was managed mechanically. Dithane-M 45 @ 2.5 g/litre of water was applied at the flower initiation stage for controlling the prevailing anthracnose and downey mildew.

Application of treatments: Nimbicidine was applied @ 5ml/ litre of water as cover spray at 10 days interval, starting from the flower initiation stage in the randomly selected plots of all replication. The application of Nimbicidine was continued till the late fruiting stage. This was uniformly sprayed to ensure complete coverage of the plants. In the same way Secufon 80 SP (Trichlorfon) was applied @ 1 ml/litre of water and Decis 2.5 EC @ 0.5 ml / litre of water. The bagging of fruit was done by using polythene bags provided with holes made by an ordinary pin for proper aeration. In the morning, the pollinated female flowers were bagged by hand at 2 days after anthesis (DAA) and left for seven days. The mouth of the bag was wrapped and closed by thread near the peduncle of the fruit. After 7 days the polythene bags were removed.

Data colloection and analysis: The whole reproductive period of sweet gourd was divided into four stages viz., fruit initiation, early, mid and late fruiting stages. At the end of reproductive period, the final harvest was done. After harvesting, the healthy fruits (HF) and the infested fruits (IF) were separated by visual observation. The number of healthy fruits and infested fruits at fruit initiation, early, mid and late fruiting stages were counted and the percent fruit infestation for each treatment was calculated by using the following formula:

$$\%\ \text{Fruit infestation (number)} = \frac{\text{Number of IF}}{\text{Number of HF} + \text{Number of IF}} \times 100$$

After sorting of the healthy fruits (HF) and the infested fruits (IF), the weight was taken for healthy, infested and total ones separately. The percent infested fruit by weight for each treatment was calculated by using the formula:

$$\%\text{ Fruit infestation (weight)} = \frac{\text{Weight of IF}}{\text{Weight of HF} + \text{Weight of IF}} \times 100$$

Fruit infestation by number and weight for each treatment of reproductive stages was used to find out the average weight of single healthy and infested fruits. The percent weight reduction per fruit for each treatment was then calculated using the following formula:

$$\%\text{ Weight reduction per fruit} = \frac{\text{Weight of single HF} - \text{Weight of single IF}}{\text{Weight of single HF}} \times 100$$

After harvesting the healthy and infested fruits were sorted out. The infested fruits were cut and the edible and non-edible portion of the fruits were separated. Individual portion was weighed for each treatment. Finally the percent edible portions of single infested fruits were calculated by the following formula:

$$\%\text{ Weight of edible portion of single infested fruit} = \frac{\text{Weight of edible portion of IF}}{\text{Total Weight of IF}} \times 100$$

After harvesting, the weights of healthy and infested fruit were separately recorded. The total production of each treatment was calculated and determined the yield (t/ha). The percent yield increase over control was computed by using the following formula:

$$\%\text{ Increase of yield over control} = \frac{\text{Yield of treated plot - Yield of control plot}}{\text{Yield of control plot}} \times 100$$

The results of the different management practices were analyzed by MSTAT-C program. The means were separated by using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Biology of insect: The life history of cucurbit fruit fly has presented in table 1. Results indicated that the pre-oviposition period varied from 8 to 15 days with an average of 11.25 ± 1.29 days. Hollingsworth *et al.* (1997) found that the pre-oviposition period ranged from 11 to 12 days when reared on cucumber. Whereas, Koul and Bhagat (1994) observed 10 to 16.3 days, and Butani and Jotwani (1984) obtained 9 to 16 days. The results of the present study were almost in agreement with their findings and this little variation might be due to environmental conditions and quality of food. In this study, the oviposition period was found to vary from 5 to 14 days with an average of 9.75 ± 1.63 days (table 1). The result of this observation matched with Koul and Bhagat (1994) who obtained this range from 5 to 15 days. The incubation period varied from 18 to 21 hours with an average of 19.5 ± 0.56 hours. Nasiruddin *et al.* (2004) reported that the incubation period of cucurbit fruit fly varied from 18 hours in the summer and 3 to 4 days in winter. Koul and Bhagat (1994) stated that the incubation period of cucurbit fruit fly on bitter gourd varied from 1 to 5.1 days. The larval period ranged from 11 to 13 days and the mean larval period was 12.25 ± 0.41 days. Koul and Bhagat (1994) found that the larval developmental period ranged from 4.2 to 16.3 days on bottle gourd. In this study the duration of pupal period varied from 7 to 9 days with an average of 7.75 ± 0.41 days (table 1). But this was ranged from 5 to 8 days in summer and about 3 weeks in winter as observed by Nasiruddin *et al.* (2004). The longevity of male and female adult varied from 16 to 20 days and 20 to 27 days with an average of 18.25 ± 0.74 and 23.50 ± 1.35 days, respectively (table 1). Koul and Bhagat

(1994) found that the female lived longer (21.7 to 30.7 days) than the male (15.0 to 28.5 days). The findings of the current study were slightly different with their results. It may be the cause of the type of food and amount of feeding and environmental condition. The numbers of egg were laid by the female varied from 36 to 74 with an average of 52.75 ± 6.83. A female melon fly can lay a total of 800-900 eggs during her life span (Vargas *et al.*, 1984). The fecundity of a female may varied widely due to seasonal parameters; like quality of food, feeding, environment etc.

Table 1: Life history of *B. cucurbitae* reared on sweet gourd

Life history parameters	Minimum	Maximum	Mean ± SE
Pre-oviposition period (day)	8	15	11.25 ± 1.29
Oviposition Period (day)	5	14	9.75 ± 1.63
Fecundity (number of eggs / female)	36	74	52.75 ± 6.83
Incubation period (hour)	18	21	19.5 ± 0.56
Larval period (day)	11	13	12.25 ± 0.41
Pupal period (day)	7	9	7.75 ± 0.41
Male longevity (day)	16	20	18.25 ± 0.74
Female longevity (day)	20	27	23.50 ± 1.35

Morphometric measurements: Morphometric measurements of *B. cucurbitae* have been presented in table 2. The white, cylindrical and slightly curved eggs were 1.40 to 1.60 mm long with an average of 1.48 ± 0.04 mm, and breadth ranged from 0.40 to 0.55 mm with an average of 0.48 ± 0.03 mm. These results were in harmony with Nasiruddin *et al.* (2004) who observed the length and breadth of eggs of cucurbit fruit fly 1.30 and 0.40 mm, respectively. The newly hatched larvae were creamy white in colour. Atwal and Dhaliwal (2005) mentioned that the maggot were legless and appeared as headless, dirty-white, thicker at one end and taper at other end. A full grown maggot is 9-10 mm long and 2 mm broad in the middle. The present study illustrated that the length of full grown larvae varied from 9.50 to 11.00 mm with an average of 10.13 ± 0.27 mm and breadth ranged from 3.00 to 4.00 mm with an average of 3.18 ± 0.21 mm. A full grown maggot is 9-10 mm long and 2 mm broad in the middle. The length and breadth of pupae varied from 5.0 to 7.0 and 2.0 to 2.3 mm with an average of 6.00 ± 0.31 and 2.18 ± 0.05 mm, respectively. The pupae were barrel shaped, light brown or pale in colour. These results were almost similar to those obtained by Nasiruddin *et al.* (2004) who reported that the length and breadth of pupae were 5.50 and 2.00 mm, respectively. The length of male and female varied from 7.0 to 8.0 and 8.0 to 9.0 mm with an average of 7.5 ± 0.25 and 8.75 ± 0.22 mm, respectively The breadth of male and female varied from 3.0 to 4.0 and 5.0 to 6.0 mm with an average of 3.25 ± 0.22 and 5.50 ± 0.25 mm, respectively. These results were in accordance with those of Atwal and Dhaliwal (2005) and Nasiruddin *et al.* (2004).

Table 2: Morphometric measures (mean ± se) of *B. cucurbitae* reared on sweet gourd

Developmental stages	*Length (mm)*	*Breadth (mm)*
Egg	01.48 ± 0.04	0.48 ± 0.03
Larva	10.13 ± 0.27	3.38 ± 0.21
Pupa	06.00 ± 0.31	2.18 ± 0.05
Adult male	07.50 ± 0.25	3.25 ± 0.22
Adult female	08.75 ± 0.22	5.50 ± 0.25

Fruit infestation as number: Figure 1 shows the fruit infestation by number (mean ± SE %) at various growth stages of sweet gourd viz. fruit initiation, early, mid and late fruiting stages along with the mean infestation all stages following the application of Nimbicidine, Secufon 80 SP, bagging of fruits, Decis 2.5 EC and control. Average fruit infestation by number was significantly lowest (29.91 ± 2.02 %) in bagging fruits as compared to control (62.31 ± 2.81 %). Statistically similar results were revealed in Nimbicidine (46.81 ± 3.58 %) and Secufon 80 SP (46.79 ± 3.44 %) treated plots. At the fruit initiation stage, infestation rates of all the treatments were found significantly different. The lowest percent (26.73 ± 2.44 %) of fruit infestation was found in bagging fruits and the highest was obtained in control (67.10 ± 1.39 %). The rate of infestation by the application of Nimbicidine (44.05 ± 4.92 %) and Secufon 80 SP (46.11 ± 3.28 %) were statistically comparable. At early fruiting stage, the bagging of fruits showed significantly lowest infestation (34.18 ± 1.86 %) compared to control (71.19 ± 2.72 %). At the mid fruiting stage, significantly the lowest (34.15 ± 1.39 %) infestation was obtained in bagged fruits. The level of infestation in Nimbicidine (54.28 ± 3.68 %) and Secufon 80 SP (52.92 ± 2.49 %) treated plots were statistically similar. But all the treatments showed significantly different results in comparison of control (58.45 ± 2.99 %). At the late fruiting stage, significantly the lowest (25.83 ± 2.39 %) and highest (52.50 ± 4.15 %) results were obtained from bagged fruits and control, respectively. But the performances of Secufon 80 SP (43.33 ± 3.54 %) and Decis 2.5 EC (47.50 ± 4.15 %) were not statistically significant. Uddin (1996) reported that fruit infestation was reduced in fruits of barrier + yellow pan trap + bagged of fruits. Decrease rate of fruit infestation was observed when the fruits were bagged at the initial stage (Amin, 1995 and Kapoor, 1993). They explained that bagging might be successful method of prevention of oviposition. After evaluating of seven treatments against the fruit fly on cucumber, Akhtaruzzaman *et al.* (2003) opined that the treatment Cypermethrin sprayed at 15 days intervals + bagging of fruits at 3 DAA and left for 5 days + bait trap might be considered as a superior method. From the present study it is revealed that the bagging of fruits at 2 DAA and left for 7 days is the best treatment to reduce the fruit infestation.

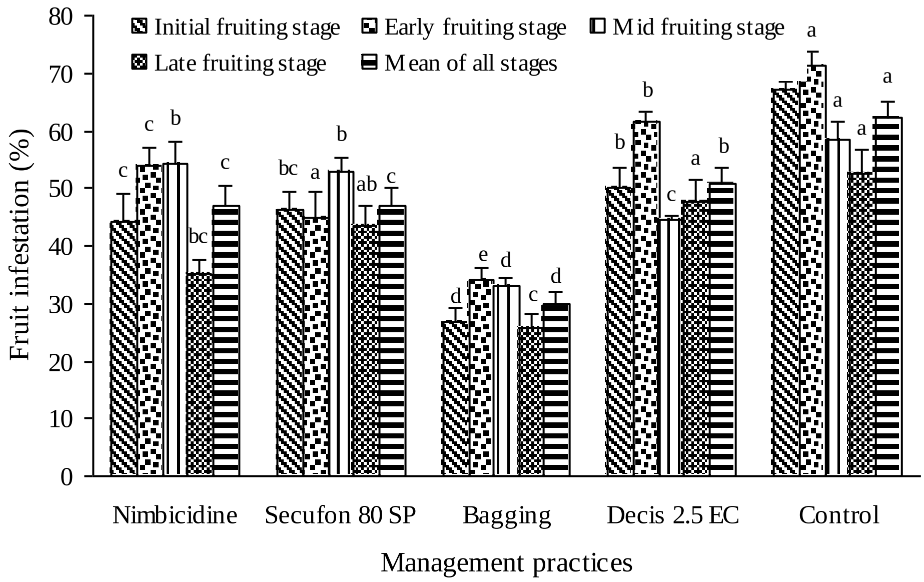

Fig. 1. Effect of different management practices of *B. cucurbitae* on fruit infestation (mean number ± SE%) at various reproductive stages of sweet gourd. Bars with no common letter are significantly different ($p \leq 0.05$, DMRT).

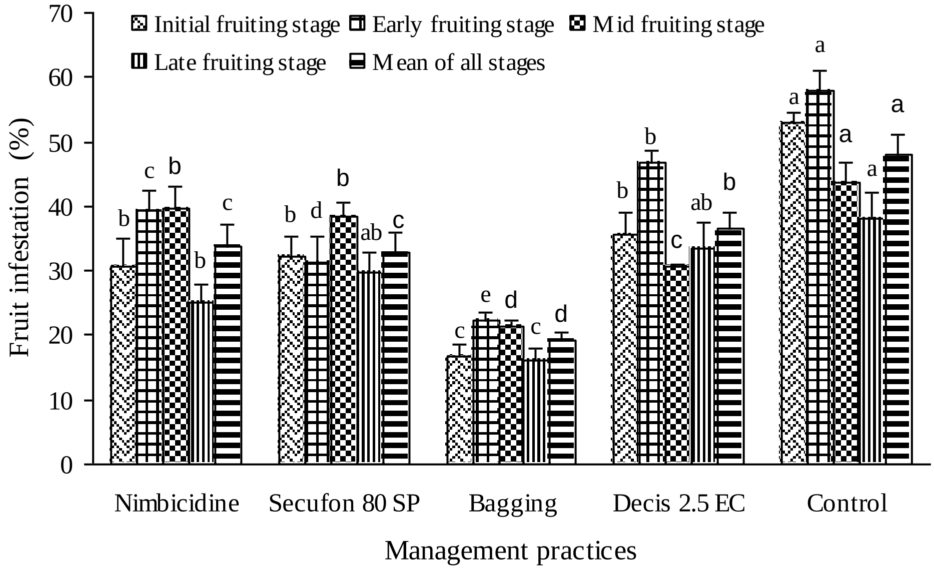

Fig. 2. Effect of different management practices of *B. cucurbitae* on fruit infestation (mean weight ± SE%) at various reproductive stages of sweet gourd. Bars with no common letter are significantly different ($p \leq 0.05$, DMRT).

Fruit infestation as weight: Figure 2 shows the fruit infestation by weight (mean ± se %) at fruit initiation, early, mid and late fruiting stages along with the mean infestation of all stages in Nimbicidine, Secufon 80 SP, bagging of fruits, Decis 2.5 EC and control plots. Mean infestation rate was significantly lower (19.08 ± 1.48 %) in the bagged fruits followed by Secufon 80 SP (32.88 ± 3.08 %), Nimbicidine (33.73 ± 3.40 %), Decis 2.5 EC (36.69 ± 2.34 %) treated plots and control (48.16 ± 2.95 %). Statistically similar results were obtained from Nimbicidine (33.73 ± 3.40 %) and Secufon 80 SP (32.88 ± 1.62 %). At the fruit initiation stage, infestation rate was significantly lowest (18.52 ± 1.73 %) in bagged fruits as compared to control (52.88 ± 1.59 %). The results on infestation rate by weight due to application of Nimbicidine (30.42 ± 4.41 %), Secufon 80 SP (32.19 ± 2.98 %) and Decis 2.5 EC (35.71 ± 3.25 %) were statistically identical. At the early fruiting stage, the infestation rate was lowest (23.99 ± 1.41%) in the bagged fruits and the highest infestation (57.81 ± 3.34 %) was observed in the control plots. The results of other treatments were also statistically different from that of control followed by Secufon 80 SP (31.23 ± 4.07 %), Nimbicidine (39.32 ± 3.04 %) and Decis 2.5 EC (46.88 ± 1.85 %). Fruit infestation at the mid fruiting stage was also significantly the lowest (22.99 ± 1.05%) in bagged fruits. The effect of Nimbicidine (54.28 ± 3.68) and Secufon 80 SP (52.92 ± 2.49 %) were statistically identical. At the late fruiting stage, significantly the lowest and highest values were obtained in bagged fruits (16.14 ± 1.71 %) and control plots (38.14 ± 3.83 %), respectively. But the performances of other treatments such as Nimbicidine (25.17 ± 2.74 %), Secufon 80 SP (29.80 ± 2.97 %) and Decis 2.5 EC (33.54 ± 3.79 %) were statistically similar. Amin (1995) found significantly lowest infestation (4.61 %) in bagged cucumber compared to other chemical and botanical control measures. Bagging of cucumbers with perforated polythene bags at immature stage significantly reduced the fruit fly infestation (Akhtaruzzaman *et al.*, 1999).

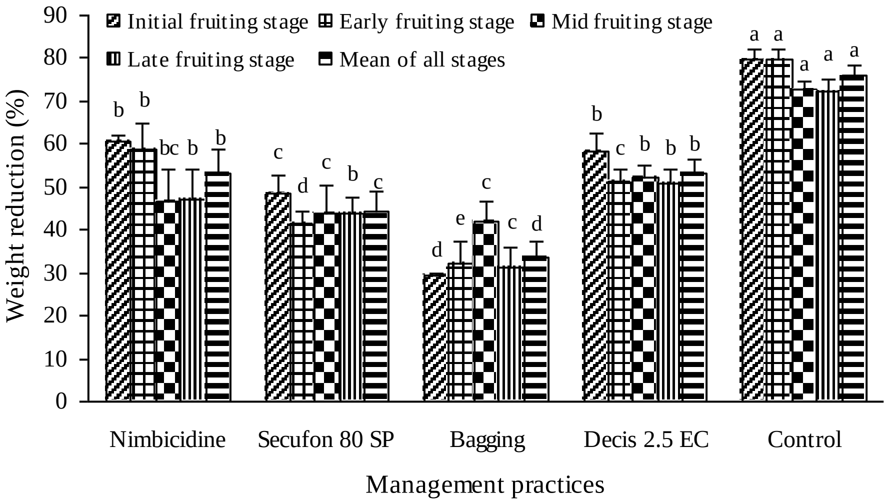

Fig. 3. Effect of different management practices *B. cucurbitae* on weight reduction per fruit (mean weight ± SE%) at various reproductive stages in sweet gourd. Bars with no common letter are significantly different ($p \leq 0.05$, DMRT).

Weight reduction per fruit: Figure 3 shows the weight reduction per fruit at different fruiting stages. Significantly the lowest weight reduction per fruit (33.53 ± 3.81 %) was obtained in bagged fruits and the weight reduction in all other treatments showed statistically different from that of control. At the fruit initiation stage, significantly the lowest weight reduction per fruit (29.15 ± 0.86 %) was also obtained in bagged fruits. Weight reduction per fruit in all the management techniques were significantly lower compared to control but the performances of Nimbicidine (60.43 ± 1.56 %) and Decis 2.5 EC (58.43 ± 4.15 %) were statistically similar. At early fruiting stage, significantly the lowest reduction (32.15 ± 4.98 %) was found in bagged fruits followed by Secufon 80 SP (41.28 ± 3.21 %), Decis 2.5 EC (51.17 ± 2.75 %), Nimbicidine (58.60 ± 6.43 %), and the highest (79.64 ± 2.51 %) was observed in control. The weight reduction per fruit at the mid fruiting stage was the lowest (42.05 ± 4.36 %) and was obtained in bagged fruits. This result due to application of Nimbicidine (46.70 ± 7.35 %), Secufon 80 SP (43.88 ± 6.41) was statistically identical. The lowest weight reduction per fruit was again obtained in bagged fruits (31.03 ± 5.04 %) at late fruiting stage. Application of Nimbicidine (47.17 ± 6.71 %), Secufon 80 SP (44.03 ± 3.44 %) and Decis 2.5 EC (50.68 ± 3.39 %) showed statistically similar results. Bagging of fruits with perforated polythene bags at immature stage significantly reduced the fruit fly infestation (Uddin *et al*., 1998). So, bagging of fruits at this stage decreased the infestation. In addition, retaining fruit within bag for 7 days provided opportunity for a fruit to get enough time for rind hardness.

Effect on quality of infested fruits and fruit yield: Figure 4 shows the percent weight of edible portion of an infested fruit at fruit initiation, early, mid and late fruiting stage along with the mean infestation of all stages. The mean weight of edible portion of an infested fruit was significantly highest (74.39 ± 2.11 %) in bagged fruits followed by Secufon 80 SP (61.37 ± 2.05%), Decis 2.5 EC (57.81 ± 1.46%), Nimbicidine (56.12 ± 1.89 %) and control (47.83 ±

1.70 %). At the fruit initiation stage, significantly the highest edible portion of an infested fruit was obtained in bagged fruits (79.65 ± 3.40 %). There was no significant difference in edible portion of an infested fruit obtained from Nimbicidine (63.55 ± 2.81%) and Secufon 80 SP (64.82 ± 1.35%) treated plots. At the mid fruiting stage, significantly the highest (74.64 ± 1.76 %) edible portion of an infested fruit was obtained again in bagged fruits as compared other treatments including control. At the late fruiting stage, significantly the highest (70.83 ± 1.07 %) edible portion of an infested fruit was obtained in bagged fruits followed by Secufon 80 SP (61.92 ± 1.96 %), Decis 2.5 EC (53.25 ± 2.76 %), Nimbicidine (52.79 ± 2.92 %) treated plots and control (45.39 ± 1.14 %). There was no significant difference in the parameter obtained from Nimbicidine (52.79 ± 2.92 %) and Decis 2.5 EC (53.25 ± 2.76 %) treated plots. The qualities of an infested fruit directly depend on the intensity of infestation. A simple infestation did not affect the quality or quantity of fruits. Kabir *et al*. (1991) stated that the multiple infestations by fruit fly affect the quality and quantity of fruit and reduced the weight tremendously.

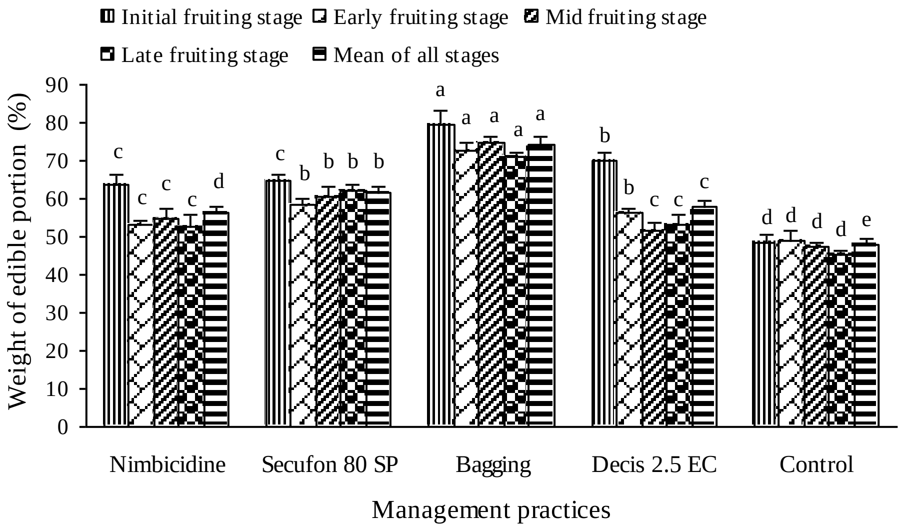

Fig. 4. Effect of different management practices *B. cucurbitae* on weight of edible portion of single infested fruit (mean weight ± SE%) at various reproductive stages of sweet gourd. Bars with no common letter are significantly different ($p \leq 0.05$, DMRT).

The highest amount of healthy yield (16.53 ± 1.25 t/ha) was harvested in bagged fruits followed by Secufon 80 SP (11.21 ± 1.12 t/ha), Decis 2.5 EC (09.30 ± 0.96t/ha) Nimbicidine (09.29 ± 0.92 t/ha) treated plots and control (08.05 ± 0.36 t/ha) plots (table 3). The effect of Nimbicidine (09.29 ± 0.92 t/ha) and Decis 2.5 EC (09.30 ± 0.96t/ha) on healthy yield were statistically comparable. The highest quantity of infested yield (4.25 ± 0.42 t/ha) was obtained in control followed by Secufon 80 SP (3.24 ± 0.15 t/ha), Decis 2.5 EC (3.47 ± 0.19 t/ha), Nimbicidine (3.89 ± 0.21 t/ha) and bagging (2.98 ± 0.11 t/ha) treated plots. The highest yield (19.51 ± 1.77 t/ha) was attained in bagging treated fruits followed by Secufon 80 SP (14.45 ± 1.43 t/ha), Decis 2.5 EC (12.77 ± 1.23 t/ha) Nimbicidine (13.18 ± 1.27 t/ha) treated plots and control (08.05 ± 0.36 t/ha) plots. It is difficult to appraise the extent of damage caused by fruit fly (Narayanan and Batra 1960). The effect of infestation of fruit fly on sweet gourd invariably causes deformation and retardation of the growth of fruits and causes damages in terms of quality, quantity and market value. Infested fruits reduced in size and weight as compared to the healthy fruits. Severe infestation involving a number of punctures, and the larvae inside the fruit cause decomposition of fruits with foul odour (Kabir *et al*., 1991; Mckinlay *et al*., 1992). Amin

(1995) obtained significantly the lowest weight reduction (24.45 %) when the fruits were bagged at fruit initiation stage. Evaluating all the treatments this study indicated that bagging of fruits at 2 days after anthesis (DAA) and left for 7 days might be considered as a suitable method in reducing fruit infestation, weight reduction and also increase the edible portion of single infested fruit and total yield.

Table 3: Effect of different management practices on increase of yield over control

Treatments	Healthy yield		Infested yield		Total yield	
	Ton/ha	Increased (%)	Ton/ha	Decreased (%)	Ton/ha	Increased (%)
Nimbicidine	09.29 ± 0.92 c	46.99	3.89 ± 0.21 b	08.47	13.18 ± 1.27 c	22.56
Secufon	11.21 ± 1.12 b	77.37	3.24 ± 0.15 c	23.76	14.45 ± 1.43 b	33.54
Bagging	16.53 ± 1.25 a	161.55	2.98 ± 0.11 d	29.88	19.51 ± 1.77 a	77.27
Decis	09.30 ± 0.96 c	47.15	3.47 ± 0.19 c	18.35	12.77 ± 1.23 c	19.01
Control	06.32 ± 1.02 d	-	4.25 ± 0.42 a	-	10.57 ± 1.18 d	-

Means followed by different letters within a column are significantly different ($p \leq 0.05$, DMRT).

REFERENCES

Akhtaruzzaman M, Alam MZ and Sardar MA. 1999. Suppressing fruit fly infestation by bagging of cucumber at different days after anthesis. Bangladesh J. Entomol. 9 (1&2): 103-112.

Akhtaruzzaman M, Alam MZ and Sardar MA. 2003. Effectiveness of some IPM packages for economic management of fruit fly on cucumber. J. Asiat. Soc. Bangladesh Sci. 29 (1): 1-10.

Akhtaruzzaman M. 1999. Integrated management of fruit fly on cucumber. Ph.D. Thesis. Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh. 79-162 p.

Amin MR. 1995. Effect of some indigenous materials and pesticides in controlling fruit fly Bactrocera cucurbitae Coquillet on cucumber. M.S. Thesis. Department of Entomology, Institute of Postgraduate Studies in Agriculture, Gazipur, Bangladesh. 56 p.

Anonymous. 1988. Comparative efficacy of bagging and trapping in controlling fruit fly, Bactrocera cucurbitae Coq. attacking kakrol (Momordica diocia Roxb.). Research Report on fruit fly in cucurbits (1987-1988). Paper presented at the International Review Workshop held on August 28-30, 1988. Division of Entomology, BARI, Gazipur, Bangladesh. 17 p.

Anonymous. 1993. Research and development of vegetable crops. Paper presented in the workshop on research and development of vegetable crops; held on March 9-10, 1993 at IPSA, Gazipur, Bangladesh. 1-7 p.

Atwal AS and Dhaliwal GS. 2005. Agricultural Pests of South Asia and Their Management. Kalyani Pub. New Delhi-110002. 277-278 p.

BBS. 2006. Statistical Year Book of Bangladesh. Bangladesh Bureau of Statistics. Planning Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. 154 p.

Butani DK and Jotwani MG. 1984. Insects in Vegetables. Periodical Expert Book Agency, D-42, Vivek Vihar, Delhi-110032, India. 69-74 p.

Hollingsworth R, Vagalo M and Tsatsia F. 1997. Biology of melon fly, with special reference to the Solomon Islands. Management of fruit flies in the Pacific Proceedings of Australian Country Indus. Agric. Res. 76: 140–144.

Kabir SM, Rahman HR and Molla MAS. 1991. Host plants of Dacinae fruit flies (Diptera: Tephritidae) of Bangladesh. Bangladesh J. Entomol. 1: 60-75.

Kapoor VC. 1993. Indian Fruit Flies. Oxford & IBH Publishing Co. Ltd., New Delhi, India. 228 p.

Koul VK and Bhagat KC. 1994. Biology of melon fruit fly, Bactrocera (Dacus) cucurbitae Coquillett (Diptera: Tephritidae) on bottle gourd. Pest Manage. Econ. Zool. 2: 123–125.

Mannan, MA. (2004) Study on the relative preference of fruit fly, Bactrocera cucurbitae on different cucurbit. Annual Research Report (2004-05), Division of Entomology, BARI, Gazipur. 54 p.

McKinlay RG, Spavll AM and Straub RW. 1992. Pests of solanaceous crops: Vegetable Crop Pests. McKinlay Press. Houndmills, Basingstok. Hampshire and London. 263-326 p.

Narayanan ES and Batra HN. 1960. Fruit flies and their control. Indian Coun. Agril. Res. New Delhi. 1-68 p.

Nasiruddin M and Karim MA. 1991. Role of poison bait technology in IPM of fruit flies. Annual Research Report (1990-91), Division of Entomology, BARI, Gazipur. 14 p.

Nasiruddin M and Karim MA. 1992. Evaluation of potential control measures for fruit fly, Bactrocera (Dacus) cucurbitae in snake gourd. Bangladesh J. Entomol. 2 (1&2): 31-34.

Nasiruddin M, Alam SN, Khorsheduzzaman AKM, Rahman AKMZ, Karim ANMR, Jasmine HS and Rajotte EG. September, 2004. Integrated management of cucurbit fruit fly, Bactrocera cucurbitae Coquillett in Bangladesh. IPM CRSP Bangladesh Site Technical Bulletin No. 1. 16 p.

Ramphall and Gill HS. 1990. Demand and supply of vegetables and pulses in South Asia: Vegetable Research and Development in South Asia. Proc. Workshop held at Islamabad, Pakistan on 24-29 September, 1990. AVRDC Publication No. 90. 331, AVRDC, Tainan, Taiwan.

Rashid M. 1993. Vegetables Science (Sabji Biggyan in Bengali), Bangla Academy, Dhaka. 33-254 p.

Rekhi SS. 1997. Vegetable improvement and seed production. Key note paper presented in the National Seminar on March 3-4, at BARI, Joydebpur, Gazipur, Bangladesh.

Uddin MJ, Alam MZ, Haq M and Rahman MM. 1998. Evaluation of some management practices against fruit fly on cucumber. Bangladesh J. Agril. Res. 23 (3): 531-538

Uddin MJ. 1996. Development of suitable package(s) of IPM components for the management of selected insect pests of cucumber. M.S. Thesis Institute of Postgraduate Studies in Agriculture, Gazipur, Bangladesh. 72 p.

Vargas RI, Miyashita D and Nishida T. 1984. Life history and demographic parameters of three laboratory reared Tephritids. Annals Entomol. Soc. America. 77: 651-656.

York A. 1992. Pest of cucurbit crops: Marrow, pumpkin, squash, melon and cucumber: Vegetable Crop Pests. McMillan Press. Houndmills, Basingstoke, Hampshire and London. 139-161 p.