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Investigation on Level of Infestation and Management of Cucurbit Fruit Fly, *Bactrocera cucurbitae* (Coquillett) in Different Cucurbit Crops

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ABSTRACT

Among four selected cucurbitaceous bitter gourd crop was found most infested host for cucurbit fruit flies whereas, bottle gourd was found least infested host for cucurbit fruit flies. Based on the observations on the numbers of fruit infestation, bitter gourd and ridge gourd was found most likely host among four cucurbitaceous vegetables for cucurbit fruit flies. For management of cucurbit fruit flies among four cucurbits crops Cue lure traps was found most effective in bitter gourd, ridge gourd, and pumpkin and bottle gourd crops them Methyl eugenol. Among four installed Methyl eugenol traps (treated) cucurbits field trials higher yield 10.00, 17.75, 7.7 and 19.6 t/ha were obtained in bitter gourd, bottle gourd, ridge gourd and pumpkin respectively but uninstalled Methyl eugenol traps (untreated) cucurbits field trials 8.00, 14.00, 5.50 and 16.00 tonnes/hectare yield were obtained in bitter gourd, bottle gourd, ridge gourd and pumpkin respectively at Meerut. While among four cucurbits fields installed methyl eugenol traps (treated) cucurbits fields higher yield 11.50, 15.50, 8.00 and 17.50 were obtained (tonnes/hectare) in bitter gourd, bottle gourd, ridge gourd and pumpkin but uninstalled Methyl eugenol traps (untreated) cucurbits fields 8.50, 12.20, 6.65 and 13.50 tonnes/hectare yield were obtained in bitter gourd, bottle gourd ridge gourd and pumpkin respectively.

Key words: *Methyl eugenol traps; Cue lure traps; Cucurbit; Bactrocera cucurbitae*

INTRODUCTION

Cucurbits are infested by several insect pests which are considered to be the significant obstacles for economic production. Among them, cucurbit fruit fly is the serious pest responsible for considerable damage of cucurbits[6]. The cucurbit fruit fly, *Bactrocera cucurbitae* can attack about 16 different types of cucurbit crops. Although the rate of attack varies among the crop, infestation reduced both the yield and quality of the cucurbit fruits. Yield losses due to fruit fly infestation vary from 19.19 to 69.96 percent in different fruits and vegetables[8]. Depending on the environmental conditions and susceptibility of the crop species, the extent of losses varies between 30 to 100%[13,10,8,9,33]. The major constraint to sustainable increased productivity of cucurbits is the high incidence of insect pests.

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Cucurbits are infested by a number of pests such as cucurbit fruit fly, red pumpkin beetle, epilachna beetle etc. Among them cucurbit fruit fly, *Bactrocera cucurbitae* (Coquillett) is a devastating pest of different cucurbit vegetables in many parts of the world which may cause more than 60% yield loss[19]. The pest has been reported to damage about 81 host plants and as a major pest of cucurbitaceous vegetables, especially the bitter gourd, musk melon, snap melon, snake gourd, ridge gourd etc.

Methyl eugenol (4-allyl-1, 2-dimethoxybenzene) is a kairomone[22] that is attractive to many species of the Subfamily Dacinae (Tephritidae) in the South Pacific Region[14]. Methyl eugenol was used for male annihilation or killing of sexually immature males before they were able to mate with females[36] to eradicate established populations of Oriental fruit fly (*Bactrocera dorsalis* (Hendel)) in the Mariana Islands[37]. Cue-lure is a derivative of anisylacetone (4-[p-methoxyphenyl]-2-butanone), [4], an unstable synthetic compound that is sensitive to hydrolysis[22]. It is the most effective attractant available for survey and detection of this insect. Cue-lure also attracts other tephritids[11] and Drew and Hooper[12] reported over 80 species of Dacini responded to it. Cue-lure is not known to occur naturally, but its hydrolyzed form, raspberry ketone (4-[p-hydroxyphenyl]-2-butanone)[4,22], is known to occur in at least one plant species[24]. At least 90 per cent of the Dacinae species were strongly attracted to either methyl eugenol or to cue-lure raspberry ketone[15]. Pawar *et al.*[27] reported that sex attractant cue-lure was more effective than the food attractant tephrilure in traps for monitoring *D. cucurbitae* on bitter gourd.

Methyl eugenol, when used together with an insecticide impregnated into a suitable substrate, forms the basis of male annihilation technique (MAT). Methyl eugenol attracts the males of *B. dorsalis*, *B. correcta* and *B.zonata*[39]. Male annihilation is the primary control technique for the Oriental fruit fly as it uses a mixture of methyl eugenol and an insecticide to attract and kill males resulting in a decreased mating and subsequent decline in the population over time[38,35].

Considering the hazardous impact of chemicals on non-target organisms and the environment, present studies were undertaken to assess the losses caused by *B. cucurbitae* and efficacy of different traps aiming to develop an eco-friendly and sustainable pest management system in cucurbits. Therefore an experiment was conducted at two places viz., Block Daurala, District Meerut and Block Punwarka, District Saharanpur, India for management of cucurbit fruit flies in different cucurbits viz., bitter gourd, bottle gourd, ridge gourd and pumpkin crops was observed by using methyl eugenol and cue lure traps.

MATERIAL AND METHODS

Management of cucurbit fruit flies in different cucurbits viz., bitter gourd, bottle gourd, ridge gourd and pumpkin crops was observed by using methyl eugenol and cue lure traps. Data of (install and uninstall methyl eugenol and Cue lure traps) cucurbits field were taken regularly till complete three observations**.** Data of cucurbits fields were taken after setting fruits and 15 day interval in cucurbits crops. Total fruit's yield of cucurbits was observed in install (using) and uninstall methyl eugenol and cue lure traps fields at both places during experiment season. The management of cucurbit fruit fly in the cucurbit crops was observed and calculated carefully by taking weight of cucurbit fruits yield in different cucurbits at both places viz., Block Daurala, District Meerut and Block Punwarka, District Saharanpur.

Location and Time of the Experiments

The experiment was carried out at the two locations on bitter gourd, bottle gourd, ridge gourd and pumpkin of cucurbitaceous vegetable field in *zaid* and *kharif* season. An experiment was conducted at two places viz., Block Daurala, District Meerut and Block Punwarka, District Saharanpur, India for management of cucurbit fruit flies.

Preparation of mixture of parapheromones:

Fruit fly (Diptera: Tephritidae) lures and baits have long been employed for monitoring and eradicating insect pests. Cue-lure, a synthetic lure for male melon fruit flies, *Dacus cucurbitae* Coquillett, has been used since 1960[4]. Six ml Methyl eugenol or cue lure, three ml ethyl alcohol and one ml malathion 50 EC [10 ml= (6:3:1)] was measured separately with the help of measuring cylinder and poured methyl eugenol and malathion 50 EC into wide mouthed one liter glass container. The mixture was shaken thoroughly and kept in tight closed container for further use. About 10 ml mixture, thus prepared, was sufficient for soaking one Block of cotton wick. Required amount of fresh mixture was prepared every time when cotton wicks/ plywood Blocks were to be soaked. Mixture of cue-lure was also prepared as described above and kept separately for use. Sufficient care was taken during preparation of ME/CL mixtures so that none of these get mixed with each other.

Preparation of Bottle Fruit Fly Trap:

Bottle Fruit Fly Traps were prepared in the Laboratory of Department of Entomology. Sufficient numbers of transparent cold drink bottles (1.25 liter capacity) were purchased from market. A total of four entry holes of 22.5 mm' size were made at equal distance just little above bottom with the help of a blade. A cotton bundle impregnated with 6 ml methyl eugenol, 3.0 ml cue-lure and 1 ml melathion was placed inside the trap in a loop made of iron wire. Impregnation of this chemical was carried out at weekly intervals in summer session. In order to hang soaked cotton wick into the bottle fruit fly traps and for taking out trapped flies. A hole was also made in the bottom of each bottle for the hanging the dispenser into the trap and also to hang the trap from the branch of trees or bamboo poles fixed for the experiments purpose. Rameash *et al*.[30] evaluated the efficacy of seven dispenser blocks of melolure (4-formyloxyphenylbutenone-2) against the melon fly, *B. cucurbitae* (Coquillet) in bitter gourd, *Momordica charantia* L. The average ranking of dispensers based on the mean fly catch per week was in the order of plywood block (10.93) > acacia wood block (6.57) > strawboard block (8.20) > cotton wad block (6.63)> rubber block (2.40) > sponge block (2.50) > soft board block (1.73).

Preparation of cotton wick:

Absorbent cotton wool I.P. packed was used for wick preparation. After taking-out required quantity of cotton from the pack, the same was put in between two palms and rolled with a light pressure to make a wick. From one pack weighing 250 g about 833-834 wicks could be prepared *i.e.* about 0.3 g cotton was required to prepare one wick.

RESULTS AND DISCUSSION

Level of fruit infestation (damage %) of fruit fly in cucurbitaceous vegetables at Block Daurala, District Meerut

The level of infestation of cucurbit fruit fly was differed significantly among bitter gourd, bottle gourd, ridge gourd and pumpkin crops. The highest and lowest level of fruit infestation of fruit fly at different times were

found (40% and 17%) on bitter gourd crop at (27 and 23th S.W.) respectively. In bottle gourd the highest and lowest level of infestation of fruit fly was found (21% and 9% at 27 and 25th S.W.), respectively. In ridge gourd the highest and lowest level of infestation of fruit flies were observed (29% and 14% at 28 and 31th S.W.), respectively. In pumpkin the highest and lowest level of fruit infestation of fruit flies were found (24%, and 9% at 29 and 25th S.W.) respectively (Table-1). Average fruit infestations of cucurbit fruit flies were found 25.55%, 12.8%, 20.01%, and 14.8% respectively in bitter gourd, bottle gourd, ridge gourd and pumpkin crops at Block Daurala. Fruit infestation of fruit flies was positively correlated with minimum temperature, relative humidity and rainfall but negatively correlated with maximum temperature during *zaid* and *kharif* at Block Daurala.

Therefore, among four selected cucurbitaceous bitter gourd crop was found most infested host for cucurbit fruit flies whereas, bottle gourd was found least infested host for cucurbit fruit flies. Based on the observations on the numbers of fruit infestation, bitter gourd and ridge gourd was found most likely host among four cucurbitaceous vegetables for cucurbit fruit flies at Block Daurala. It is obvious that an egg-laying female fruit fly was oviposited on that host where appropriate environment is present for off-spring growth. Therefore, it could be stated that all the four vegetables was not required the same environment requirement for fruit fly egg laying and infestation.

Level of fruit infestation (damage %) of fruit fly in cucurbitaceous vegetables at Block Punwarka, District Saharanpur

The level of infestation (damage %) of cucurbit fruit fly was also significantly differed among bitter gourd, bottle gourd, ridge gourd and pumpkin crops at Block Punwarka. The highest and lowest level of fruit infestation of fruit fly at different times were observed (36% and 21%) on bitter gourd crop (at 29 and 24th S.W.) respectively. In bottle gourd the highest and lowest level of infestation of fruit fly were found (20% and 8% at 29 and 25th S.W.) respectively. In ridge gourd the highest and lowest level of infestation of fruit flies were observed (27% and 12% at 28 and 25th S.W.) respectively. In pumpkin the highest and lowest level of fruit infestation of fruit flies were found (21%, and 7% at 28 and 23th S.W.) respectively. Average fruit infestations of cucurbit fruit flies were found 28.88%, 14.33%, 19.88%, and 12.33% respectively in bitter gourd, bottle gourd, ridge gourd and pumpkin crops at Block Punwarka. Fruit infestation of fruit fly was positively correlated with minimum temperature, relative humidity and rainfall but negatively correlated with maximum temperature during *zaid* and *kharif* at Block Punwarka. Consequently, among four selected cucurbitaceous crops bitter gourd was observed most infested crop to cucurbit fruit fly, whereas, bottle gourd was found slightest infested host to cucurbit fruit fly (Table-2).

Based on the observations on the numbers of fruit damage, bitter gourd and ridge gourd were found most likely hosts and bottle gourd and pumpkin were found slightest hosts for cucurbit fruit flies among four cucurbitaceous vegetables at both places Saharanpur and Meerut. 2nd most infestested cucurbit was ridge gourd at both places. It is obvious that an egg-laying female fruit fly was oviposited on that host where appropriate environment is present for off-spring growth. Therefore, it could be stated that all the four vegetables was not required the same environment requirement for fruit fly egg laying and infestation. Some researcher has been reported important facts about level of infestation of cucurbit fruit flies which are correlated objective of level of infestation (present study topic objective) following are: Shah *et al.*[32] reported the ovipositor of fruit fly causes wounds on the fruit or vegetables by piercing in the form of punctures, which appear like dark spots on the surface. In freshly punctured specimens, the fluid that exudes accumulates in the form of a droplet which later dries up and appears like brown resinous deposit.

Management of fruit flies using Cue lure trap in four cucurbit crops at Block- Daurala, District- Meerut in *zaid* and *kharif* season

The bottle fruit fly traps were installed on four cucurbits crops fields for management of cucurbit fruit flies. The higher yields was obtained from four cucurbits install cue lure traps fields then uninstall cue lure traps cucurbit fields at Block- Daurala by using cue lure traps. The yield of bitter gourd was obtained (12.5 t/ha) in install cue lure traps field where, uninstall cue lure traps field the yield of bitter gourd was obtained (6.8 t/ha). Akram *et al*.[1], has been reported the highest yield (12.88 t/ha) in treated field plot and lowest (10.02 t/ha) in untreated field plot of bitter gourd. The yield of bottle gourd was obtained (19 t/ha) by install cue lure traps field where, uninstall cue lure traps field the yield of bottle gourd was obtained (16.75 t/ha). The yield of ridge gourd crop was obtained (8.7 t/ha) by install cue lure traps field where, uninstall cue lure traps field the yield of ridge gourd was obtained (5.25 t/ha). The yield of pumpkin crop was obtained (22.3 t/ha) by install cue lure traps field where, uninstall cue lure traps field was obtained (15.2 t/ha) from improved varieties of four cucurbits in *zaid* and *kharif* season 2015 by using cue lure in traps (tabel-3). Data were taken fifteen days intervals. Bottrell[5] reported that sex pheromones have been utilized in the insect pest control program through population monitoring, survey, mass-trapping, mating disruption and killing the target pest in the trap. Dhillon *et al*[8]. reported that the melon fruit fly can successfully be managed by protein baits, cue-lure traps. Ali[3] reported that pheromone trap with funnel + Bait trap showed the best performance in controlling cucurbit fruit fly. He reported that highest yield (38.44 t/ha), highest healthy fruit (35.23 t/ha) and lowest infested fruit (3.21 t/ha) were achieved from the treatment.

Management of fruit flies using methyl eugenol trap in four cucurbit crops at Block Punwarka, (Saharanpur) in *zaid* and *kharif* season

The bottle fruit fly traps were installed on four cucurbits crops fields for management of cucurbit fruit flies. The higher yields was obtained from four cucurbits install methyl eugenol traps fields then uninstall methyl eugenol traps cucurbits fields at Block Punwarka (Saharanpur) by using methyl eugenol in traps. The yield of bitter gourd crop was obtained (11.5 t/ha) in install methyl eugenol traps field where, uninstall methyl eugenol traps field the yield of bitter gourd was obtained (8.5 t/ha). Akram *et al*.[1], has been reported the highest yield (12.88 t/ha) in treated field plot and (10.02 t/ha) in untreated field of bitter gourd. The yield of bottle gourd crop was obtained (15.50 t/ha) in install methyl eugenol traps field where, in uninstall methyl eugenol traps raps field the yield of bottle gourd was obtained (12.2 t/ha). The yield of ridge gourd was obtained (8.0 t/ha) in install methyl eugenol traps field where, in uninstall methyl eugenol traps field the yield was obtained (6.65 t/ha). The yield of pumpkin crop was obtained (17.5 t/ha) in install methyl eugenol traps field where, in uninstall methyl eugenol traps field the yield was obtained (5.25 t/ha) from improved varieties of four cucurbits in *zaid* and *kharif* season 2015 by using methyl eugenol in traps (tabel-4). Data were taken fifteen days intervals.

Bottrell[5] reported that sex pheromones have been utilized in the insect pest control program through population monitoring, survey, mass-trapping, mating disruption and killing the target pest in the trap. Dhillon *et al.*[9] reported that the melon fruit fly can successfully be managed by protein baits, cue-lure traps. Ali[3] reported that pheromone trap with funnel + Bait trap showed the best performance in controlling cucurbit fruit fly. He reported that highest yield (38.44 t/ha), highest healthy fruit (35.23 t/ha) and lowest infested fruit (3.21 t/ha) were achieved from the treatment.

Management of fruit flies using Cue lure trap in four cucurbit crops at Block Punwarka, (Saharanpur) in *zaid* and *kharif*

The bottle fruit fly traps were installed on four cucurbits crops fields for management of cucurbit fruit flies. The higher yields was obtained from four cucurbits fields by install

cue lure traps field then uninstall cue lure traps cucurbits fields at Block-Punwarka by using cue lure in traps. The yield of bitter gourd crop was obtained (13.5 t/ha) by install cue lure traps field where, in uninstall cue lure traps field the yield of bitter gourd was obtained (6.5 t/ha). Akram *et al*.[1] has been reported the highest yield (12.88 t/ha) in treat field plot and lowest (10.02 t/ha) in untreated field plot of bitter gourd. The yield of bottle gourd crop was obtained (18.0 t/ha) in install cue lure traps field where, uninstall cue lure traps field was obtained (15.4 t/ha). The yield of ridge gourd was obtained (9.75 t/ha) in install cue lure traps field where, uninstall cue lure traps field the yield was obtained (6.65 t/ha). The yield of pumpkin crop was obtained (19.5 t/ha) in install cue lure traps field where, uninstall traps field the yield of pumpkin was obtained (14.85 t/ha) from improved varieties of four cucurbits in *zaid* and *kharif* season 2015 by using cue lure in traps (tabel-5). Data were taken fifteen days intervals. Bottrell[5] reported that sex pheromones have been utilized in the insect pest control program through population monitoring, survey, mass-trapping, mating disruption and killing the target pest in the trap. Dhillon *et al.*[10], reported that the melon fruit fly can successfully be managed by protein baits, cue-lure traps. Ali[3] reported that pheromone trap with funnel + Bait trap showed the best performance in controlling cucurbit fruit fly. He reported that highest yield (38.44 t/ha), highest healthy fruit (35.23 t/ha) and lowest infested fruit (3.21 t/ha) were achieved from the treatments.

Maximum percentage of fruit infestation was found on bitter gourd While, minimum fruit infestation was found on bottle gourd. Ridge gourd was found 2nd infected cucurbit crop by cucurbit fruit fly. In level of infestation test, among four hosts bitter gourd was most infested host by cucurbit fruit fly thereafter, ridge gourd, pumpkin and bottle gourd respectively at both place (Block Daurala and Block Punwarka) in *zaid* and *kharif* season 2015. The average infestation of cucurbit fruit flies 25.55%, 12.88%, 20.01% and 14.8% were observed in bitter gourd, bottle gourd, ridge gourd and pumpkin respectively at Block Daurala. Therefore, among four selected cucurbitaceous crops bitter gourd was found most infested host to cucurbit fruit fly, whereas, bottle gourd was found least infested host to cucurbit fruit fly. Based on the observations on the numbers of fruit infestation, bitter gourd was most likely and bottle gourd slightest that all four vegetables of cucurbitaceous attracted cucurbit fruit fly to oviposit at both place Saharanpur and Meerut. 2nd most infested fruit cucurbit was ridge gourd at both places.

For management of cucurbit fruit flies among four cucurbits crops Cue lure traps was found most effective in bitter gourd, ridge gourd, and pumpkin and bottle gourd crops them Methyl eugenol. Among four installed Methyl eugenol traps (treated) cucurbits field trials higher yield 10.00, 17.75, 7.7 and 19.6 t/ha were obtained in bitter gourd, bottle gourd, ridge gourd and pumpkin respectively but uninstalled Methyl eugenol traps (untreated) cucurbits field trials 8.00, 14.00, 5.50 and 16.00 tonnes/hectare yield were obtained in bitter gourd, bottle gourd, ridge gourd and pumpkin respectively at Meerut. While among four cucurbits fields installed methyl eugenol traps (treated) cucurbits fields higher yield 11.50, 15.50, 8.00 and 17.50 were obtained (tonnes/hectare) in bitter gourd, bottle gourd, ridge gourd and pumpkin but uninstalled Methyl eugenol traps (untreated) cucurbits fields 8.50, 12.20, 6.65 and 13.50 tonnes/hectare yield were obtained in bitter gourd, bottle gourd ridge gourd and pumpkin respectively at Saharanpur. Among four installed cue lure traps (treated) cucurbits field trials higher yield 12.5, 19.00, 8.7 and 22.30 tones/hectare were obtained in bitter gourd, bottle gourd, ridge gourd and pumpkin respectively but uninstall cue lure traps (untreated) cucurbits field trials 6.8, 16.75, 5.25 and 15.2 tonnes/hectare were obtained in bitter gourd, bottle gourd, ridge gourd and pumpkin respectively at Meerut. While among four installed cue lure traps cucurbits field trials higher yield 13.5, 18.00, 9.75 and 19.5 were obtained tonnes/hectare in bitter

gourd, bottle gourd, ridge gourd and pumpkin respectively but uninstall (untreated) cue lure cucurbits field trials 6.5, 15.40, 6.65 and 14.85 tonnes/hectare yield were obtained in bitter gourd, bottle gourd ridge gourd and pumpkin respectively at Block Punwarka among all the treatments most effective results of bottle fruit fly traps were found in bitter gourd, ridge gourd then bottle gourd and pumpkin at both palaces.

Pradhan[28] has been reported losses of the fruit flies have been reported as 28.7-59.2, 24.7-40.0, 27.3-49.3, 19.4-22.1 and 0-26.2% in pumpkin, bitter gourd, bottle gourd, cucumber and sponge gourd respectively, in Nepal. Hollingsworth *et al*.[16] reported infestation in bitter gourd fruit in Papua New Guinea, and 90% in snake gourd and 60 to 87% in pumpkin fruit in Solomon Island by melon fruit fly. Kabir *et al*.[18] reported yield losses due to fruit infestation varies in different fruits and vegetables and it is minimum in cucumber (19.19%) and maximum in sweet gourd (69.96%). Singh *et al.*[34] has been reported 31.27% damage on bitter gourd and 28.55% on water melon in India. Weems and Heppner[40] has been reported if brown color flies with yellow red strips are seen around the crop it indicates the presence of fruit fly damage. The adult female lays eggs just below the epidermis or sometimes a little deeper in the pulp, and/or on young leaves or stems of the host plants. The eggs are laid into unopened flowers, and the larvae successfully developed in the tap roots, stems and leaf stalks. Kate *et al.*[20] has been revealed infestation of fruit fly commenced during 5th week after germination and increased during next four weeks (6th, 7th, 8th and 9th week after germination) and formed the peak with an infestation of 22.4%. Then, the infestation declined gradually up to 12.00% during last week of April *i.e.* 12th week after germination. Mwatawala *et al.*[23] has been reported *Bactrocera cucurbitae* appeared to dominate most indigenous cucurbit infester. Sapkota *et al*., has been reported that cucurbit fruit fly preferred young and immature fruits and resulted in a loss of 9.7% female flowers. Out of total fruits set, more than one-fourth (26%) fruits were dropped or damaged just after set and 14.04% fruits were damaged during harvesting stage, giving only 38.8% fruits of marketable quality. Ryckewaert *et al.*[31] has been reported that fruit flies are main pest of cucurbits crops. Losses of as much as 100% of cucurbit crop harvests have been frequently observed in Reunion (Indian Ocean). Raghuvanshi *et al*.[29] has been reported that in *kharif*, maximum bitter gourd fruit damage (62.70%) occurred in the 45 SW. A second peak, with 49.70% fruit damage was observed during the 15 SW periods. Pal *et al.*[25] has been reported that *B. cucurbitae* reared from all growing cucurbits and trapped in cue-lure baited traps. *B. cucurbite* with 37.5% and 38.7% were predominant in respective lure during 2011 and 2012, respectively. Aldawood[2] has been reported that infestation of fruit flies was peak in the last week of May in Huraimila.

Gupta and Verma[13] found lowest rate of *B. cucurbitae* infestation in plots sprayed with fenitrothion (0.025%), protein hydrolysate (0.25%) or molasses (0.5%), which was significantly more effective than the recommended bait spray of malathion (0.25%) and gur (0.5%). Wong *et al*.[41] compared both laboratory-reared and wild adults of the melon fly, *Dacus cucurbitae* Coquillett, for their response to cue-lure at various ages. Virgin laboratory (4, 6, 8, 10, 12, 14 days old) and wild (10, 12, 14, 16, 18, 20, 22 days old) flies were released into outdoor field cages and trapped from 0800 until 1600 hr. Response of males to cue-lure increased with age and corresponded with sexual maturity for each strain, whereas females of both strains were relatively non responsive to cue-lure. They concluded that failure to eradicate male annihilation programs against *D. cucurbitae* in past may be explained in part by the fact that only older males, which may have already mated with gravid females, respond to cue-lure. The mean persistence period of melolure was highest in acacia wood block (9.0 weeks), followed by plywood block (8.0 weeks). The straw board block absorbed the maximum

quantity of melolure mixture (26.07 ml), while the lowest quantity (6.17 ml) was absorbed by sponge block. The plywood block recorded a maximum catch efficiency of 0.65 flies per ml of melolure mixture absorbed, whereas the lowest catch efficiency (0.09 flies/ml) was observed in soft board block. Zaman[42] reported that the cue-lure baited traps attracted the melon fruit fly, *B. cucurbitae* males from mid-July to mid-November (peaked in August) and from 2nd week of August to the 2nd week of November (peaked in September) for the two years. However, Jaiswal *et al.*[17] opined that 90 per cent farmers used attractant traps of cue-lure along with field sanitation for *B. cucurbitae* management to be very effective. Patel *et al.*[26] while studying the efficacy of different dispenser blocks with methyl eugenol and malathion mixtures against *B.dorsalis* in mango orchards revealed that acacia, plywood, mango wood, neem wood, straw board, teak wood, salwood and rose wood blocks recorded a half-life of 95, 101, 108, 99, 90, 91, 108 and 91 days, respectively, with a mean daily catch of 7.36, 7.69, 7.00, 7.35, 8.01, 6.92, 5.51 and 5.61 flies/trap, respectively. Khan *et al.*[21], concluded that cue-lure was more effective in higher male catches of fruit flies (171.82/trap/week) as compared to methyl eugenol (81.69/trap/week). However Chaudhary and Patel[7] while conducting experiments with different doses (0.05, 0.10, 0.15, 0.20 and 0.25 ml) of cue-lure to standardize the optimum dose to suppress population of melon fly, *B.cucurbitae* in cucurbit crops observed that 0.25 ml dose of cue-lure remained active for 32 weeks while, the remaining doses attracted male flies only upto 30 weeks.

Table-1: Level of fruit infestation of fruit fly by Fruit damage (%) at Block Daurala, District Meerut

S. N.	Period	S.W.	Fruit infestation% of cucurbit fruit flies/week in four different cucurbit crops				Temperature ^{0}C		Avg. RH%	Avg. Rainfall mm
			Bitter gourd	Bottle gourd	Ridge gourd	Pumpkin	Max.	Mini.		
1.	3-9 June	23	17	10	20	11	35.50	25.20	48.9	05.10
2.	10-16 June	24	20	9	18	10	36.94	25.64	51.42	07.20
3.	17-23 June	25	18	8	16	9	36.34	25.77	58.64	11.80
4.	24-30 June	26	25	12	23	14	33.69	23.83	75.78	54.30
5.	1-7 July	27	40	21	25	17	33.80	25.10	67.71	84.60
6.	8-14 July	28	38	18	29	20	31.06	25.27	85.36	86.60
7.	15-21 July	29	25	15	`17	20	34.16	26.60	72.28	77.00
8.	22-28 July	30	27	12	15	15	34.04	25.89	66.21	00.00
9.	29 July-4 August	31	20	11	14	17	33.77	25.87	70.78	00.00
Average			25.55	12.80	20.01	14.8				

Table-2: Level of infestation of fruit fly by Fruit damage (%) at Block Punwarka, District Saharanpur

S. N.	Period	S. W.	Fruit infestation of cucurbit fruit flies/ week in four different cucurbit crops				Temperature ^{0}C		Avg. RH%	Avg. Rainfall mm
			Bitter gourd	Bottle gourd	Ridge gourd	Pumpkin	Max.	Min.		
1.	3-9 June	23	23	10	17	7	38.8	24.2	38.50	2.1
2.	10-16 June	24	21	12	15	9	38.9	24.2	51.00	0.8
3.	17-23 June	25	25	8	12	8	36.1	24.4	68.50	36.3
4.	24-30 June	26	29	17	22	12	33.3	23.8	74.00	67.6
5.	1-7 July	27	34	18	25	17	32.2	28.8	73.50	123.7
6.	8-14 July	28	35	19	27	21	31.5	25	87.50	137.2
7.	15-21 July	29	36	20	19	12	33.0	26.2	83.00	32.2
8.	22-28 July	30	30	14	23	14	33.6	26.2	72.00	0.0
9.	29 July- 4 August	31	27	11	19	11	32.8	25.8	83.00	19.5
Average			28.88	14.33	19.88	12.33				

Table-3: Management of fruit flies using Cue lure trap in four cucurbit crops at Block- Daurala, District-Meerut in *zaid* and *kharif* season

Treat -ments No.	Gain yield (t/ ha) from-4cucurbits field by install and uninstall bottle fruit fly traps							
	Bitter gourd		Bottle gourd		Ridge gourd		Pumpkin	
	Install	Uninstall	Install	Uninstall	Install	Uninstall	Install	Uninstall
T_1	3.2	1.5	5	4.50	2.25	1.50	7.1	4.7
T_2	4.1	2.3	6	5.25	3.40	2.00	8.0	6.5
T_3	5.2	3.0	8	7.00	3.15	1.75	7.2	5.0
Total	12.5	6.8	19	16.75	8.70	5.25	22.3	15.2
SE(m) ±	0.082		0.10		0.28		0.33	
CD at 5%	0.53		0.68		N/A		N/A	

Table-4: Management of fruit flies using methyl eugenol trap in four cucurbit crops at Block Punwarka (Saharanpur) in *zaid* and *kharif*

Treat -ments No.	Gain yield (t/ha) from-4cucurbits field by install and uninstall bottle fruit fly traps							
	Bitter gourd		Bottle gourd		Ridge gourd		Pumpkin	
	Install	Uninstall	Install	Uninstall	Install	Uninstall	Install	Uninstall
T_1	3.7	2.85	5.25	3.5	2.4	2.4	5.75	4.35
T_2	4.2	2.90	5.75	4.7	2.8	2.25	6.50	5.20
T_3	3.6	2.75	4.50	4.0	3.0	2.00	5.25	4.00
Total	11.5	8.5	15.50	12.20	8.0	6.65	17.5	13.55
SE(m) ±	0.18		0.44		0.46		0.06	
CD at 5%	N/A		N/A		N/A		0.40	

Table-5: Management of fruit flies using Cue lure trap in four cucurbit crops at Block Punwarka (Saharanpur) in *zaid* and *kharif*

Treat -ments No.	Gain yield (t/ha) from-4cucurbits field by install and uninstall bottle fruit fly traps							
	Bitter gourd		Bottle gourd		Ridge gourd		Pumpkin	
	Install	Uninstall	Install	Uninstall	Install	Uninstall	Install	Uninstall
T_1	3.7	1.9	5.0	4.5	3.5	2.4	6.3	4.75
T_2	5.2	2.6	7.0	5.9	3.25	2.25	7.0	5.50
T_3	4.6	2.0	6.0	5.0	3.0	2.0	6.2	4.60
Total	13.5	6.5	18.0	15.4	9.75	6.65	19.5	14.85
SE(m) ±	0.27		0.17		0.02		0.06	
CD at 5%	N/A		1.13		0.19		0.42	

Figure: 1. Level of infestation of cucurbit fruit flies in four different cucurbits crops at Block Daurala, District Meerut

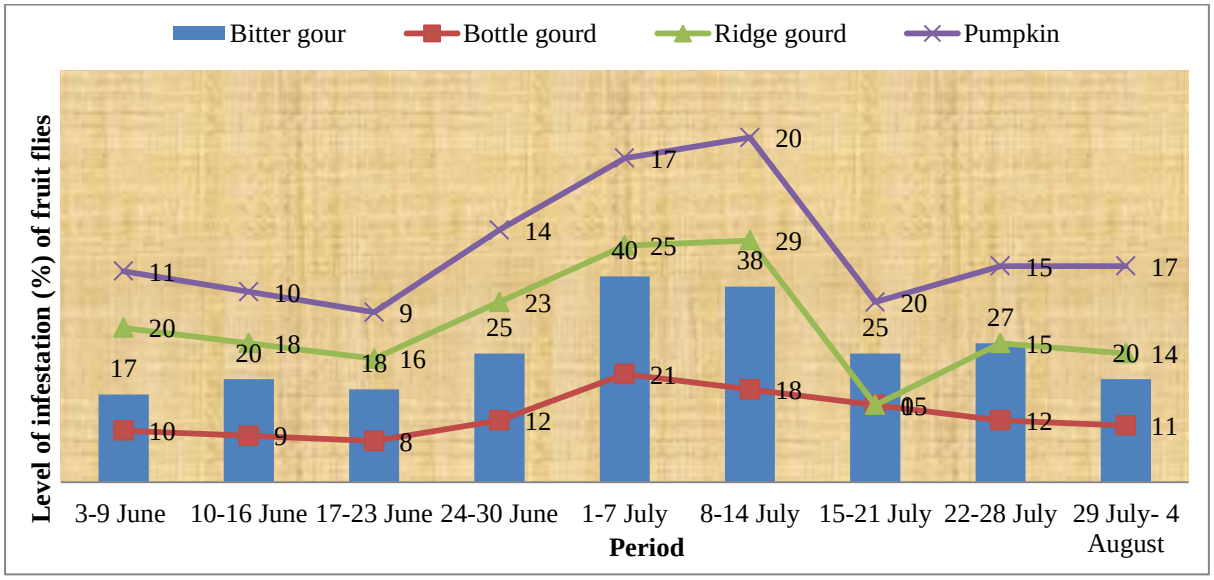
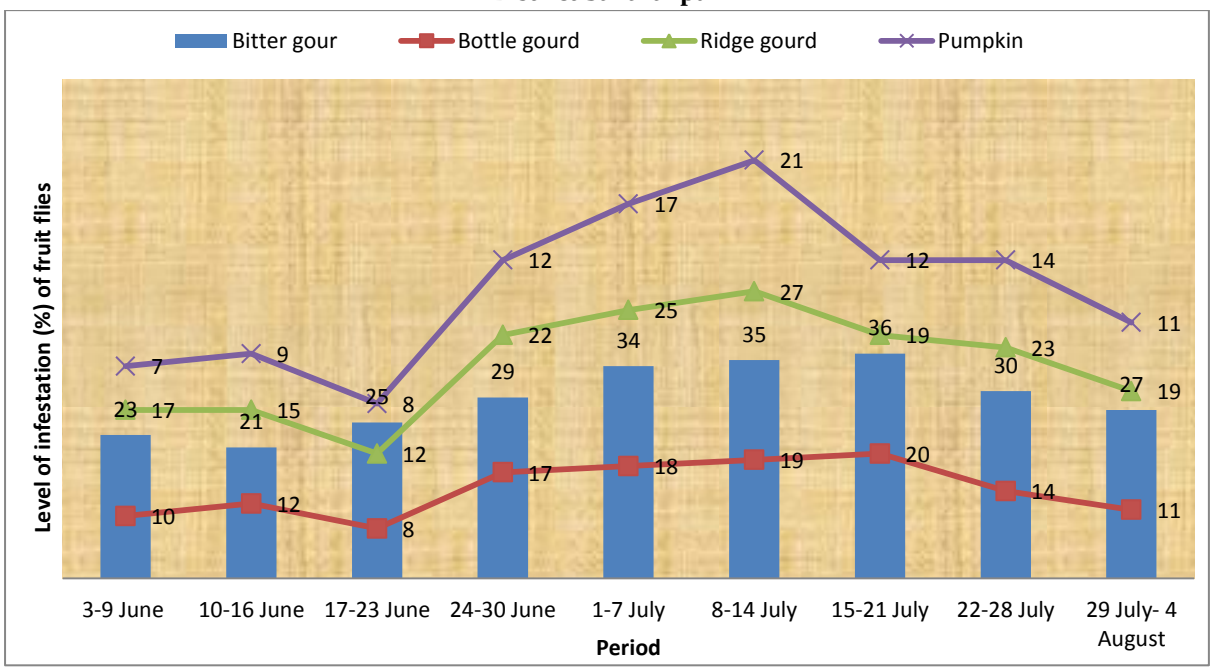


Figure: 2. Level of infestation of cucurbit fruit flies in four different cucurbits crops at Block Punwarka, District Saharanpur



CONCLUSION

Methyl eugenol and cue lure traps were found the most effective methods for monitoring the population of fruit fly and one of the best tools for taking decision for its management. Cue lure traps were found the most effective result against cucurbit fruit fly then methyl eugenol traps. Large numbers of cucurbit fruit flies were caught by using cue lure traps among four cucurbits crops fields then methyl eugenol traps. For management of cucurbit fruit fly among four cucurbits crops cue lure traps were found most effective tool in bitter gourd, ridge gourd, pumpkin and bottle gourd crops then methyl eugenol traps. In bitter gourd and ridge gourd were found most effective management of cucurbit fruit fly by using of methyl eugenol and cue lure traps then bottle gourd and pumpkin crops at both places. Higher yield of cucurbits was obtained from cue lure traps then methyl eugenol traps in cucurbit field crops at both places.

REFERENCES

1. Akram, M.W., Rahman, M.M. and Ali, R., Evaluation of some management practices for the suppression of cucurbit fruit fly in bitter gourd. *J. Bangladesh Agril. Univ*., **8(1):** 23–28 (2010).
2. Aldawood, S.A.R., Comparative study of Cucurbit fruit fly: *Dacusciliatus Loew* (Diptera: Tephritidae) infestation on Zucchini squash (*Cucurbita pepo* L.) at Huraimila and Diraab, Riyadh Region, Saudi Arabia. Egypt. Acad. *J. Biolog. Sci.,* **6(2):** 91 – 96 (2013).
3. Ali, M., Project on Effectiveness of different pheromone-trap designs for ecofriendly management of cucurbit fruit fly, a major quarantine pest of cucurbit vegetables. *Dept. of Entomology Sher-e-Bangla Agricultural University, Dhaka*. 25p. (2012).
4. Beroza, M., Alexander, B.H., Steiner, L.F., Mitchell, W.C. and Miyashita, D.H., New synthetic lure for the male melon fly. *Science* **131:** 1044-1045 (1960).
5. Bottrell, D. G., Council on environmental quality: integrated pest management. US *Government Printing Office*, Washington D.C. 120p. (1979).
6. Butanni, D. K. and Jotwani, M. G., Insects in vegetables. Periodical Expert Book Agency. Vivek-Vihar, Delhi, India, 69-79 (1984).
7. Chaudhary, F.K. and Patel, G.M., Dose of cue-lure for suppression of melon fly population in pumpkin. *AGRES*. **2:** 181-185 (2012).
8. Dhillon, M. K., Naresh, J. S., Ram S. and Sharma, N. K., Influence of physico chemical traits of bitter gourd, *Momordica charantia L.* on larval density and resistance to melon fruit fly, *Bactrocera cucurbitae* (Coquillett*). J. Appl. Entomol.* **129:** 393-399 (2005 b).
9. Dhillon, M. K., Naresh, J. S., Singh, R. and Sharma, N. K., Evaluation of bitter gourd (*Momordica charantia L.)* genotypes for resistance to melon fruit fly, *Bactrocera cucurbitae*. Indian J. Pl. Prot. **33(1):** 55-59 (2005c).
10. Dhillon, M. K., Sing, R., Naresh, J. S. and. Sharma, H. S., The melon fruit fly,*Bactrocera cucurbitae*: A review of its biology and management. *Journal of Insect Science*, **5:** 40 (2005a).
11. Drew, R.A.I., The response of fruit fly species (Diptera: Tephritidae) in the south pacific area to male attractants. *J. Aust. Entomol. Soc.* **13:** 267-270 (1974).
12. Drew, R.A.I. and Hooper, G.H.S., The responses of fruit fly species (Diptera: Tephritidae) in Australia to various attractants. *J. Aust. Entomol. Soc*. **20:** 201-205 (1981).
13. Gupta, D. and Verma, A.K., Population fluctuations of the maggots of fruit flies Dacus cucurbitae Coquillett and D. tau (Walker) infesting cucurbitaceous crops. Adv. Pl. Sci. **5:** 518-523 (1992).
14. Hardy, D.E., Review of economic fruit flies of the South Pacific region. *Pac. Insects* **20:** 429-432 (1979).
15. Hardy, D.E., Contribution of taxanomic studies to integrated pest management. Fruit flies with emphasis on the Asia pacific region. In: *Proc. First Intern. Symp. Fruit Flies in Tropics*. [Eds. S. Vijaysegaran and A.G. Ibrahim], MARDI, Serdang, Malaysia, pp. 430 (1991).
16. Hollingsworth, R., Vagalo, M. and Tsatsia, F., Biology of melon fly, with special reference to Solomon Island. *In:* Allwood, A. J. and Drew, R. A. I. editors. Management of fruit flies in the Pacific. Proc. *Australian Country Indust, Agril. Res*., **76:** 140-144 (1997).
17. Jaiswal, J.P., Gurung, T.B. and Pandey, R.R., Findings of melon fruit fly control survey and its integrated management 1996/97, Kashi, Nepal. Lumle Agriculture Research Centre Working paper 97/53, pp. 1-12 (1997).
18. Kabir, S. M. H., Rahman, R. and Molla, M.A.S., Host plants of Dacinae fruit flies (Diptera: Tephritidae) of Bangladesh. Bangladesh. *J. Entomol*., **1:** 60-75 (1991).
19. Kapoor, V.C. and Agarwal, M.L., Fruit flies and their natural enemies in India, 104-105. *In : Proceedings of the*

CEC/IOBC International Symposium on Fruit Flies of Economic Importance. [Ed. R. Drew], Athens, Greece, 1982. Balkema Publications, Rotterdam (1983).

20. Kate, A. O., Bharodia, R. K., Joshi, M. D., Pardeshi, A. M. and Makadia, R. R., Seasonal incidence of fruit fly, *Bactrocera cucurbitae* (Coquillet) on cucumber. *Asian Sciences*, **4:** 83-84 (2009).
21. Khan, M.A., Gogi, D. A., Khaliq, A., Subhani M.N. and Ali, A., Efficacy of methyl eugenol and cue-lure traps for monitoring melon fruit fly in relation to environmental conditions in bitter gourd. *J. Agric. Res*. **48:** 525-530 (2010).
22. Metcalf, R.L. and Metcalf, E.R., Fruit flies of the family Tephritidae, pp. 139-152. In: *Plant Kairomones in Insect Ecology and Control*. [Eds. R.L. Metcalf and E.R. Metcalf], Routledge, Chapman & Hall Inc., *New York*. (1992).
23. Mwatawalaa, M. A. P., Makundib, M. R. and Meyerc, M. D., Incidence and host range of the melon fruit fly *Bactrocera cucurbitae (Coquillett)* (Diptera: Tephritidae) in Central Tanzania. International Journal of Pest Management, **56(3):** 265–273 (2010).
24. Nishida, R., Iwahashi, O. and Tan, K.H., Accumulation of *Dendrobium* super-bum (*Orchidaceae*) fragrance in the rectal glands by males of the melon fly, *Dacus cucurbitae*. *J. Chem. Ecol*. **19:** 713-722 (1993).
25. Pal, S., Singh, D. K. and Singh, R., Population fluctuation and Species diversity of fruit fly, *Bactrocera spp*. *Oil Seeds Section*, C.S. Azad Univ. of Agri. and Tech. Kanpur-208002 (2013).
26. Patel, R.K., Verghese, A., Patel, V.M., Joshi, B.K., Stonehouse, J.M. and Mumford, J.D., Bait, lure and cultural IPM of fruit flies in mangoes in Gujarat. Pest Manag. *Hort. Ecosys*. **11:** 155-158 (2005).
27. Pawar, D.B., More, U.N. and Lawande, K.E., Monitoring of fruit fly population in bitter gourd crop with the help of cue lure trap. *J. Maharashtra Agri. Univ.* **16(2):** 281 (1991).
28. Pradhan, R. B., Relative susceptibilities of some vegetables grown in Kathmandu valley to *D. cucurbitae Coquillett. Nep. J. Agric.* **12:** 67-75 (1976).
29. Raghuvanshi, A.K., Satpathy, S. and Mishra, D.S., Role of abiotic factors on seasonal abundance and infestation of fruit fly, *Bactrocera cucurbitae* (coq.) on bitter gourd. *Journal of Plant Protection Research*, (2012).
30. Rameash, K., Thomas, J., Chellapan, M. and Mathew, M.P., Studies on dispensers of melolure in the attraction of melon fly, *Bactrocera cucurbitae*. *Indian J. Pl. Protec.* **37:** 55-58 (2009).
31. Ryckewaert, P., Deguine, J. P., Brvault, T. and Vayssires, J. F., Fruit flies (diptera: tephritidae) on vegetable crops in Reunion Island (Indian Ocean): state of knowledge, control+ methods and prospects for management. *Fruits*, **65(2):** 113-130 (2010).
32. Shah, M. I., Batra, H. N. and Renjhen, P. G., Notes on biology of *Dacus ferrugeneus* (*Streumeta*) and other fruit flies in the North West Frontier province. *India J. Entomol.* **10:** 240-266 (1948).
33. Shooker, P., Khayrattee, F. and Permalloo, S., Use of maize as a trap crops for the control of melon fly, *B. cucurbitae* (Diptera:Tephritidae) with GF-120. Bio-control and other control methods (online). Available on:http\\www.fcla. edu/flaEnt/fe87p354. Pdf. (2006).
34. Singh, S. V., Mishra, A., Bisan, R. S., Malik, Y. P. and Mishra, A., Host preference of red pumpkin beetle, *Aulacophora foveicollis* and melon fruit fly, *Dacus cucurbitae*. *Indian J. Entomol.* **62:** 242-246 (2000).
35. Stark, J. D. and Vargas, R.I., Differential response of male Oriental fruit fly (Diptera: Tephritidae) to coloured traps baited with methyl eugenol. J.Econ. Entomol. **85:** 808-812 (1992).
36. Steiner, L.F., Fruit fly control in Hawaii with poison-bait sprays containing protein hydrolysates. *J. Econ. Entomol.* **45:** 838-843 (1952).

37. Steiner, L.F., Hart, W.G., Harris, E.J., Cunningham, R.T., Ohinata, K. and Kamakahi, D.C., Eradication of the Oriental fruit fly from the Mariana Islands by the methods of male annihilation and sterile insect release. *J. Econ. Entomol*. **63:** 131-135 (1970).
38. USDA-APHIS, Eradication of the tri-fly complex from the state of Hawaii. Final Environmental Impact Statement. *USDA-APHIS FEIS 85-1Hyattsville*, Maryland, pp. 547 (1985).
39. Verghese, A., Sreedevi, K., Nagaraju, D.K. and Jayanthi Mala, B.R., A farmer-friendly trap for the management of the fruit fly, *Bactrocera spp*. (Tephritidae: Diptera). Pest Manag. *Hort. Ecosys*. **12:** 164-67 (2006).
40. Weems, H. V. J. and Heppner, J. B., Melon fly, *Bactrocera cucurbitae* Coquillett. Florida Department of Agriculture and Consumer Services, Division of Plant Industry, and T.R. Fasulo, University of Floridae. *University of Florida Publication*. pp. 51-105 (2001).
41. Wong, T.T.Y., Mcinnis, D.O., Mohsen, M., Ramadan, M. and Nishimoto, J.I., Age related response of male melon flies *Dacus cucurbitae* (Diptera: Tephritidae) to cue-lure. *J. Chem. Ecol*. **17:** 2481-2487 (1991).
42. Zaman, M., Assessment of the male population of the fruit flies through kairomone baited traps and the association of the abundance levels with the environmental factors. *Sarhad J. Agri*. **11:** 657-670 (1995).