Research Article

MONITORING OF FRUIT FLIES (DIPTERA: TEPHRITIDAE) ON CUCURBIT VEGETABLES IN SINDHULI, NEPAL

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ABSTRACT

Fruit flies (Diptera: Tephritidae) are the common cucurbit crop pests in Nepal. Various lures as well as food-based chemicals have been used by farmers to monitor as well as management. Efficiency and effectiveness of certain lure, their concentrations and their mixture effects to the specific fruit fly or group of fruit flies are not studied yet. Thus, this study was established from April to July, 2019 in Kamalamai Municipality of Sindhuli district in cucurbit crops. Research was in RCBD in a 3×3 factorial design with 9 treatments and 3 replications. Three different types of lures were Cue lure (CL), Methyl Eugenol (ME) and mixture of CL and ME with different concentrations such as 0.25, 0.50 and 1.00 ml. Seven species of fruit fly such as *Zeugodacus cucurbitae*, *Z. tau*, *Z. scutellaris*, *Bactrocera dorsalis*, *B. zonata*, *B. tuberculata* and *Dacus longicornis* were identified and monitored. Significant numbers of *Z. cucurbitae*, *Z. tau* and *Z. scutellaris* were collected in CL alone and in mixture of CL and ME. Similarly, significant numbers of *B. dorsalis*, *B. zonata* and *B. tuberculata* were collected in ME. *Z. scutellaris* and *D. longicornis* were not trapped in ME. Only three species of fruit fly such as *B. dorsalis*, *B. zonata* and *B. tuberculata* were trapped significantly due to different in lure concentrations, highest number in 1.00 ml and lowest in 0.25 ml. Highest mean numbers of fruit flies were trapped in April 2019 and lowest in July 2019 in different types of lures. Hence, 0.25 ml CL could be economically effective for CL attracting fruit fly species (*Z. cucurbitae*, *Z. tau* and *Z. scutellaris*), 1.00 ml ME could be statistically effective for ME attracting fruit fly species (*B. dorsalis*, *B. zonata* and *B. tuberculata*) and mixture of CL and ME showed inhibitory effect in ME attracting fruit fly species. Further research is recommended to assess the effects of mixture of CL and ME on fruit fly species.

Key words: *Bactocera, cucurbits, fruit flies, monitoring, Zeugodacus*

INTRODUCTION

Cucurbit crops such as cucumber (*Cucumis sativus* L.), pumpkins (*Cucurbita moschata* Duchesne ex Poir.), bitter gourd (*Momordica charantia* L.), sponge gourd (*Luffa cylindrica*

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L. Roem), bottle gourd (*Lagennaria siceraria* (Molina) Standl.), ridge gourd (*Luffa acutangula* (L.) Roxb.) and snake gourd (*Trichosanthes anguina* L.) are the major vegetable groups included the national list of Nepal (Joshi *et al*., 2017). These crops are basically grown in summer and pre-monsoon period in Nepal. Insect pest problem and disease are major crop limiting factor in cucurbit crops (Dhakal *et al*., 2014). Fruit fly complex (Diptera: Tephritidae) such as *Zeugodacus cucurbitae*, *Z. tau*, *Z. scutellaris*, *Bactrocera dorsalis*, *B. zonata*, *B. tuberculata* and *Dacus longicornis* are major fruit fly species potentially damage the cucurbit crops in Nepal (Kapoor *et al*., 1980). Currently, the species *Zeugodacus cucurbitae*, *Z. tau* and *Z. scutellaris* are transferred from *Bactrocera* to *Zeugodacus* because these species were more closely related to genus *Dacus* under molecular study and therefore genus *Bactrocera* was splited into *Bactrocera* and *Zeugodacus* (Doorenweerd *et al.*, 2018). Female fruit fly inserts their eggs inside the tender fruits through sharp ovipositors, the eggs after hatching turn into the maggots and they complete their maggots or pupal stage inside the growing fruit. The infected rotten fruits drop into the soil. The damage by this pest ranges from 30-100% depending on the crop species and season (Dhillon *et al*., 2005).

Para-pheromones such as Cue lure and Methyl Eugenol are common pheromones to monitor cucurbit fruit fly population worldwide. Monitoring of fruit fly is an essential starting point to assess fruit fly population in which pest management decisions can be made based on the pest population and crop damage (Dara, 2019). Other management options such as cultural, mechanical, physical, botanicals, quarantine and chemical insecticides are equally important for fruit fly management. Hence a study was conducted to increase the level of pest management decisions by evaluating the efficiency and effectiveness of pest management monitoring tools. Common tools tested were Cue lure, Methyl Eugenol and mixture of both in their different level of concentrations.

MATERIALS AND METHODS

Study area

Sindhuli district is situated north of Mahabharat range (1,05,603.5 ha) and south of Chure range (1,43,496.5 ha) with the total area of 2,49,100 ha. It lies between latitude 26055' N to 27022' N and longitude 85015' E to 86025' E. It consists of 2 Municipalities and 7 Rural Municipalities. Kamalamai Municipality is one of the Municipalities and consists of 14 wards. Rice and maize are the major crops in lowland and vegetables and fruits in upland of Kamalamai Municipality. The study was conducted in three farms of Kamalamai-4 located at Dundada ($85^0$53.704' E and $27^0$14.957' N with 612 meter from the sea level), at Darlami ($85^0$53.679' E and $27^0$14.069' N with 617 meter from the sea level) and at Jayamire ($85^0$53.127' E and $27^0$14.283' N with 515 meter from sea level). Location longitude, latitude and elevations were measured by using the GARMIN GPS map 62s.

Weather data of study area

Weather parameters such as temperature (maximum and minimum), relative humidity (morning at 3:00 am UTC and evening at 12 pm UTC) and rainfall of April, May, June and July 2019 were obtained on daily basis from the Department of Hydrology and Meteorology (DHM), Babarmahal, Kathmandu recorded by its Sindhulimadhi station located at Kamalamai-5, Milan Chowk, Sindhuli. Daily data of temperature, RH and rainfall were converted into weekly mean to relate their effect on trapping of fruit fly.

Materials

Methyl Eugenol, >60% w/w 4-allyl-1, 2-dimethoxybenzene (Sentomol®) and Cue lure, 70% w/w 4-(p-hydroxyphenyl)-2-butanone acetate (Sentomol®) produced in the United Kingdom were managed from the Prime-minister Agriculture Modernization Project (PM-AMP), Junar Superzone, Sindhuli. Steiner trap was used for monitoring the fruit flies. Malathion 50% EC was used to kill the fruit fly trapped inside the Steiner trap. Hand lens (2X) and compound microscope (10X) was used to magnify the morphological traits of collected fruit fly.

Study method

Field experiment was carried out during 15th April to 14th July 2019. It was conducted in three commercially cucurbits growing farmers' fields where planting and other management operations such as variety selection, fertilization, irrigation, weeding, hoeing etc. were managed by the farmers themselves. All three study fields were pesticide free fields. Cucumber (*Cucumis sativus* L.), bitter gourd (*Momordica charantia* L.), bottle gourd (*Lagennaria siceraria* (Molina) Standley), sponge gourd (*Luffa cylindrica* L.) and pumpkins (*Cucurbita moschata* Duchesne) were common cucurbit crops grown in study field. There were two factors each with three levels i.e. 3×3 factorial experiment in Randomized Complete Block Design (RCBD). The treatments consisted of combinations of factor A i.e. lure types and factor B i.e. lure concentrations. There were three types of lure i.e. Cue lure (CL), Methyl Eugenol (ME) and mixture of CL and ME. Each lure was provided with three concentrations (0.25 ml, 0.50 ml and 1.0 ml). In case of mixture, both ME and CL was applied on a single cotton roll at 50:50 ratio in a Steiner trap (Hooper, 1978; Shelly *et al*., 2004).

Table 1. Treatment details in 3×3 factorial in RCBD design

Factor A (Lure type)	Factor B (Lure concentrations)	Treatment combinations
CL	0.25 ml	T_1 = CL with 0.25 ml concentration
	0.50 ml	T_2 = CL with 0.50 ml concentration
	1.0 ml	T_3 = CL with 1.0 ml concentration

Factor A (Lure type)	Factor B (Lure concentrations)	Treatment combinations
ME	0.25 ml	T_4 = ME with 0.25 ml concentration
	0.50 ml	T_5 = ME with 0.50 ml concentration
	1.0 ml	T_6 = ME with 1.0 ml concentration
Mixture of CL and ME	0.125 ml CL+0.125 ml ME	T_7 = Mixing of 0.125 ml CL and 0.125 ml ME
	0.25 ml CL+0.25 ml ME	T_8 = Mixing of 0.25 ml CL and 0.25 ml ME
	0.50 ml CL+0.50 ml ME	T_9 = Mixing of 0.50 ml CL and 0.50 ml ME

Lure preparation

A small cotton roll was soaked with treatments given in Table 1 and placed inside a plastic bucket suspended from the trap ceiling. Another roll of cotton soaked with 1.0 ml Malathion was placed on the bottom of the trap. Treatments were randomly distributed in each location (replication) at a 5.0 m apart as suggested by Shelly *et al*. (2004). Treatments were adjusted at a height of 1.0 m from the ground level (Ali *et al*., 1999; Asquith and Kido, 1994) in each location and before the initiation of flowers. The lures along with Malathion soaked cotton roll was replaced in two weeks interval.

Identification and analysis of trapped species

Trapped fruit flies were collected, identified, counted and recorded on weekly basis. Identification was done by careful observation of their morphological traits such as body colour and size, colour pattern, wing morphology, presence of thoracic vittae, their shapes and colours as suggested by PHA (2018) and Adhikari and Joshi (2018). The monitoring data were subjected to two-way analysis of variance (ANOVA) using Genstat® 18th edition (Version number: 18.1.0.18310). Before performing the ANOVA, data were transformed to $\sqrt{x+0.5}$ to reduce heterogeneity of variance. Treatment means were separated by Duncan's Multiple Range Test (DMRT) at 5% level of significance. Fruit fly species abundances, distribution and compositions were analyzed in column chart by using Microsoft Excel. Mean number of fruit fly species collected from three different research fields (Replication) with standard deviation were represented in column chart.

RESULT AND DISCUSSION

Lure types

Fruit fly species trapped in three types of lure (CL, ME and mixture of CL and ME) were significant ($P<0.05$, 0.01 and 0.001) except for *Dacus longicornis* which is given in Table 2. Three species of fruit fly such as *Zeugodacus cucurbitae*, *Z. tau* and *Z. scutellaris* were

significantly attracted to CL which was statistically similar with mixture of CL and ME. Whereas the ME attracted *Bactrocera dorsalis*, *B. zonata* and *B. tuberculata* that was significantly higher than mixture of CL and ME. Z. scutellaris and *D. longicornis* were not trapped in ME. These results are supported by the findings of various previous authors. Khursheed and Raj (2019) reported that population of *B. dorsalis* and *B. zonata* are influenced by ME and *Z. cucurbitae*, *Z. tau* and *Z. scutellaris* are influenced by CL. Adhikari *et al.* (2018) reported that *B. dorsalis* and *Z. tau* predominantly trapped in ME and CL respectively. They also observed *D. longicornis* in CL. The study further showed that the mixture of CL and ME attracted the equal number of CL attracting fruit fly species, however at the same time, it attracted the significantly fewer number of ME attracting fruit fly species. This result agrees with the study of Hooper (1978) and Shelly *et al.* (2004) in which they observed the inhibitory effect of mixing ME and CL on single cotton roll in a trap to ME attracting fruit fly species. They also suggested to use the ME separately avoiding the mixture of ME and CL where the ME attracting fruit fly species are the economic insect pest.

Table 2. The effect of different lures to fruit fly species in cucurbit crops from April to July 2019 in Kamalamai-4, Sindhuli

Lures (A)	Fruit fly species (Number)						
	Z. cucurbitae	*Z. tau*	*Z. scutellaris*	*B. dorsalis*	*B. zonata*	*B. tuberculata*	*D. longicornis*
CL	250 (125.03)^{a}	109 (54.53)^{a}	3.89 (2.19)^{a}	19 (9.8)^{c}	11 (5.81)^{c}	0.11 (0.31)^{b}	0.44 (0.47)
ME	21 (10.53)^{b}	5 (2.92)^{b}	0.00 (0.25)^{b}	687 (343.9)^{a}	408 (204.42)^{a}	3.56 (2.03)^{a}	0.00 (0.25)
Mixture of CL and ME	216 (108.53)^{a}	107 (53.81)^{a}	3.44 (1.97)^{a}	235 (117.9)^{b}	101 (50.64)^{b}	1.33 (0.92)^{b}	0.33 (0.42)
CV (%)	52	92.4	44.7	51.9	45.9	66.4	230.3
P value	<0.001 (***)	0.008 (**)	<0.001 (***)	<0.001 (***)	<0.001 (***)	<0.001 (***)	0.287 (ns)

CV= Coefficient of variation, Means followed by the same letter in a column are not significantly different by DMRT at 5%. **Significant at 1% level of significance, ***Significant at 0.1% level of significance, ^{ns} Non-significant. Figure in the parenthesis indicates data transformed to √(x+0.5).

Lure concentrations

Effect of various lure concentrations to the number of trapped fruit fly species is shown on Table 3. There was a significant effect of lure concentrations for *B. dorsalis*, *B. zonata* and *B. tuberculate* (P<0.05 and 0.01).

Table 3. The effect of different lure concentrations to the number of fruit fly species in cucurbits April to July 2019 in Kamalamai-4, Sindhuli

Lure concentrations (B)	Fruit fly species (Number)						
	Z. cucurbitae	*B. tau*	*Z. scutellaris*	*B. dorsalis*	*B. zonata*	*B. tuberculata*	*D. longicornis*
0.25 ml	142 (71.47)	60 (30.42)	2 (1.25)	217 (108.5)^{b}	96 (48.14)^{b}	0.78 (0.64)^{b}	0.44 (0.47)
0.5 ml	153 (76.69)	67 (33.58)	2.44 (1.47)	287 (143.8)^{ab}	169 (84.75)^{b}	1.11 (0.81)^{b}	0.22 (0.36)
1.0 ml	191 (95.64)	94 (47.25)	2.89 (1.69)	438 (219.2)^{a}	255 (127.97)^{a}	3.11 (1.81)^{a}	0.11 (0.31)
CV (%)	52	92.4	44.7	51.9	45.9	66.4	230.3
P value	0.46 (ns)	0.55 (ns)	0.38 (ns)	0.032 (*)	0.002 (**)	0.007 (**)	0.499 (ns)

CV= Coefficient of variation, Means followed by the same letter in a column are not significantly different by DMRT at 5%. *Significant at 5% level of significance, **Significant at 1% level of significance, ^{ns} Non-significant. Figure in the parenthesis indicates data transformed to $\sqrt{(x+0.5)}$.

The highest numbers of *B. dorsalis*, *B. zonata* and *B. tuberculata* were trapped in 1.0 ml of lure. There was a non-significant effect of 0.25 ml and 0.5 ml lure concentrations. Likewise, there was no effect of lure concentrations in trapping the *Z. cucurbitae*, *Z. tau*, *Z. scutellaris* and *D. longicornis*. Earlier study of Bhanu *et al*. (2019) also showed statistically non-significant result with different concentrations of CL, however, the result was significant in case of ME where number of fruit fly was increased as ME concentration was increased.

Interaction of lure type and their concentrations

The interaction effect of three lures and their different concentrations to the number of fruit fly species is presented on Table 4. There was a significant effect of lure types and their concentrations on *Bactrocera zonata*. The data in Table 3 indicated that the maximum number of *B. zonata* was trapped from 1 ml of ME followed by 0.5 ml ME and 0.25 ml ME having significant difference among them. The minimum number of *B. zonata* was trapped from 1 ml of CL, 0.5 ml CL, 0.25 ml CL and 0.25 ml combine lure having no significant difference among them. The number of *B. zonata* trapped form combine lure with 0.5 ml and 1 ml was not statistically different with 0.25 ml of ME.

Table 4. The interaction effect of lure types and their concentrations to number of trapped fruit fly species in cucurbit crops from April to July 2019 in Kamalamai-4, Sindhuli

A × B	Number of trapped species of fruit fly						
	Z. cucurbitae	*Z. tau*	*Z. scutellaris*	*B. dorsalis*	*B. zonata*	*B. tuberculata*	*D. longicornis*
CL×0.25 ml	230 (115.4)	100 (50.08)	3.33 (1.917)	19 (9.6)	15 (7.92)^{d}	0 (0.25)	0.67 (0.583)
CL×0.5 ml	222 (111.08)	77 (38.58)	3 (1.75)	23 (11.8)	9 (4.92)^{d}	0 (0.25)	0.67 (0.583)
CL×1.0 ml	297 (148.58)	149 (74.92)	5.33 (2.917)	16 (8.1)	9 (4.58)^{d}	0.33 (0.417)	0 (0.25)
ME×0.25 ml	29 (14.75)	4 (2.42)	0 (0.25)	483 (241.9)	214 (107.08)^{c}	1.33 (0.917)	0 (0.25)
ME×0.5 ml	16 (8.42)	7 (3.75)	0 (0.25)	596 (298.1)	411 (205.92)^{b}	3 (1.75)	0 (0.25)
ME×1.0 ml	16 (8.42)	5 (2.58)	0 (0.25)	983 (491.6)	600 (300.25)^{a}	6.33 (3.417)	0 (0.25)
Mix lure ×0.25 ml	168 (84.25)	77 (38.5)	2.67 (1.583)	148 (74.1)	58 (29.42)^{d}	1 (0.75)	0.67 (0.5833)
Mix lure ×0.5 ml	221 (110.58)	116 (58.4)	4.33 (2.417)	243 (121.6)	86 (43.42)^{cd}	0.33 (0.417)	0 (0.25)
Mix lure ×1.0 ml	259 (129.92)	128 (64.2)	3.33 (1.917)	316 (158.1)	158 (79.08)^{cd}	2.67 (1.583)	0.33 (0.4167)
CV (%)	52	92.4	44.7	51.9	45.9	66.4	230
P value	0.806 (ns)	0.832 (ns)	0.257 (ns)	0.128 (ns)	0.009 (**)	0.103 (ns)	0.586 (ns)

CV= Coefficient of variation, Means followed by the same letter in a column are not significantly different by DMRT at 5%. **Significant at 1% level of significance, ^{ns} Non-significant. Figure in the parenthesis indicates data transformed to √(x+0.5).

Abundance of fruit flies in different lure

The mean number of fruit flies over time in Methyl Eugenol (ME) was higher compared with Cue lure (CL) and mixture of CL and ME (Fig. 1). The highest mean numbers of fruit flies were recorded in CL on 21st April 2019 (512) with gradual reduction on subsequent weeks of April, May, June and first week of July 2019 (8.67). In case of ME, it was recorded on 28th April 2019 (695.33) which was gradually decreased to 19th May 2019 (80.67). Afterward, it showed an increasing trend upto the end of June, 2019 (326.67) and decreased sharply to 14th July 2019 (24). Mixture of CL and ME attracted the highest mean number of fruit flies on 21st April 2019 (458.7) which was gradually decreased to 19th May 2019 (61). It was then increased to 23rd June 2019 (153) with subsequent decline to 14th July 2019 (29.33). Collection of highest mean of fruit flies in ME might be due to the trapping of ME attracting species in ME alone, but CL attracting species were trapped equally in both CL and mixture of CL and ME. As a whole, all the lures attracted the fruit flies with highest mean number in the third and fourth week of April, 2019. It might be due to the availability of host plants and favourable weather conditions such as increasing temperature and relative humidity. Reduction of fruit fly mean number in the weeks of May 2019 was probably due to low relative humidity. Likewise, very low mean numbers of fruit flies collected in the first and second week of July might be due to the harvesting of cucurbit crops and unavailability of host fruits. This result is partly supported by the findings of Abdullah (2008) in which he obtained two major peaks of fruit fly population, one in March/April and other in August/September with dropped either in summer (June) or in fall (December and January).

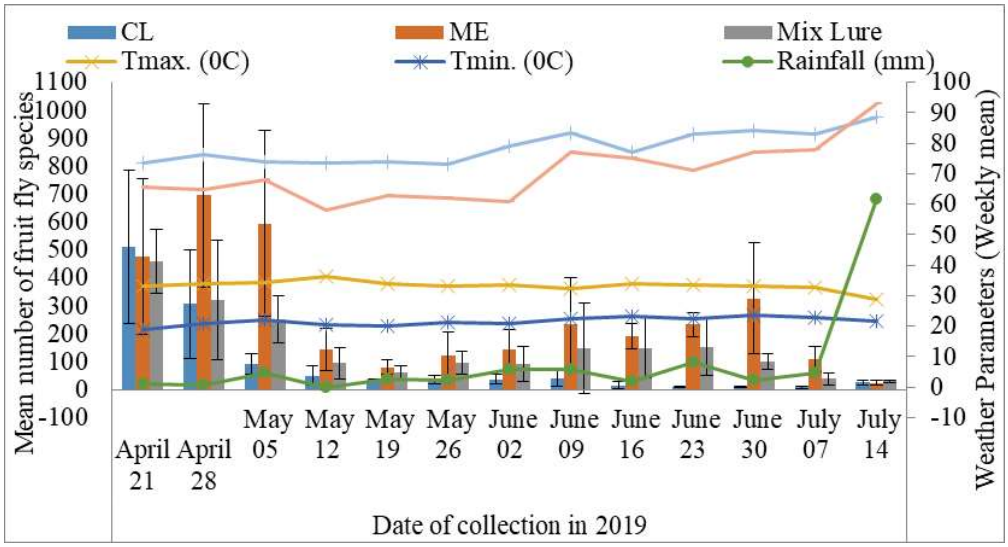


Fig. 1: Mean number of fruit flies (with standard deviation) trapped in different lures in cucurbit crops from April to July 2019 in Kamalamai-4, Sindhuli

Distribution of fruit fly species in different lure

Zeugodacus cucurbitae, Z. tau, Bactrocera dorsalis, B. zonata, Z. scutellaris, B. tuberculata and *Dacus longicornis* were the species of fruit fly trapped in Cue lure (CL) (Fig. 2). *Z. cucurbitae* and *Z. tau* were the most abundant species which were recorded with highest mean number on 21st April 2019 (366.67 and 107.00) respectively. Afterward, *Z. cucurbitae* was declined gradually upto the first week of July 2019 (1.67) and *Z. tau* upto the end of June 2019 (6.00). Mean number of *Z. scutellaris* varied from 0.00 to 5.00, the maximum being observed on 21st April 2019. *B. dorsalis* and *B. zonata* were also observed in CL from 21st April to 26th May 2019 with mean number varied from 2.00 to 36.00 and 0.00 to 30.67 respectively. They were not recorded in the subsequent weeks of June and July. *B. tuberculata* and *D. longicornis* were trapped only on 26th May (0.33) and 9th and 16th June 2019 (1.00 and 0.33) respectively.

Five species of fruit fly such as *B. dorsalis, B. zonata, B. tuberculata, Z. cucurbitae and Z. tau* were monitored in Methyl Eugenol (ME) (Fig. 3). *B. dorsalis* and *B. zonata* were the most abundant species. Mean number of *B. dorsalis* observed on 21st April 2019 was 229.33. It was then increased to its second highest mean number on 28th April 2019 (268.00) and decreased to 19th May 2019 (42.33). Afterward, it was increased gradually upto the end of June 2019 (307.00) where it reached to its highest mean number and again declined in the first and second week of June 2019 (23.33). *B. zonata* was recorded in highest mean number on 28th April 2019 (425.00) and then decreased gradually upto the second week of July 2019 (0.33). *B. tuberculata* was observed from the 5th May 2019 (0.33) and its mean number varied from 0.33 to 2.00 in subsequent weeks of May, June and July 2019. *Z. cucurbitae and Z. tau* were also observed in ME till 26th May 2019 (0.67) and 30th June 2019 (0.33) respectively from 21st April 2019 (39.33 and 6) and afterward, they were not observed.

Seven species of fruit fly such as *Z. cucurbitae, Z. tau, B. dorsalis, B. zonata, Z. scutellaris, B. tuberculata* and *D. longicornis* were monitored in mixture of CL and ME (Fig. 4). *Z. cucurbitae* and *Z. tau* were collected abundantly on 21st April 2019 with mean number 296.33 and 67.67 respectively and then declined gradually upto the weeks of July with a little increase in the weeks of June 2019. *B. dorsalis* was observed on 21st April 2019 (36) and then increased to its second highest mean number on 5th May 2019 (74.67) following decreasing trend to 19th May 2019 (17). Thereafter, it showed increasing trend to its highest mean number on 23rd June 2019 (119) and then decreased gradually to 14th July 2019 (4.33). The mean number of *B. zonata* was recorded highest on 5th May 2019 (75.00) and then decreased gradually to 14th July 2019 (0.33). *Z. scutellaris, B. tuberculata* and *D. longicornis* were also observed occasionally with low mean number that varied from 0.00 to 4.67, 0.00 to 1.67 and 0.00 to 0.33 respectively during the monitoring period.

Highest mean number of *Z. cucurbitae* and *Z. tau* were observed during the third and fourth week of April 2019. It might be due to the availability of host plant and suitable weather

conditions such as increasing temperature and relative humidity. Continuous decline in the mean number of *Z. cucurbitae* and *Z. tau* from third week of April 2019 was due the parapheromone trapping and proper disposal of infested fruit by the farmers. Das *et al*. (2017) reported the highest mean number of *B. dorsalis* and *B. zonata* during the first and second week of April 2013 respectively that coincides with the fruit maturity stage (April-May) of mango. Observation of highest mean number *B. dorsalis* on 30th June 2019 might be due to the ripening stage (May-June) of mango fruit (Win *et al*., 2014). Lowest mean number of *Z. cucurbitae, Z. tau, B. dorsalis* and *B. zonata* observed during the weeks of July 2019 was due to the harvesting of cucurbit crops and unavailability of host fruits. *Z. scutellaris, B. tuberculata* and *D. longicornis* were collected occasionally in a very low number. It might be due to unavailability of suitable host for their survival and spread (Ugwa *et al.*, 2018).

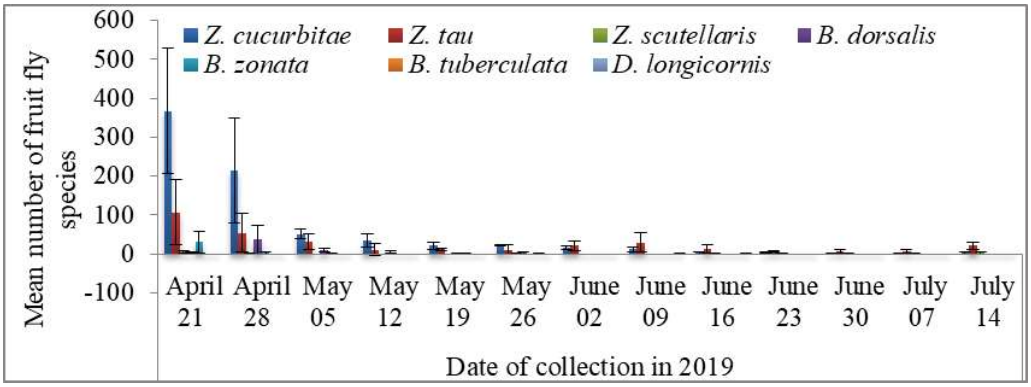


Fig. 2: Mean number of fruit fly species (with standard deviation) trapped in CL in cucurbit crops from April to July 2019 in Kamalamai-4, Sindhuli

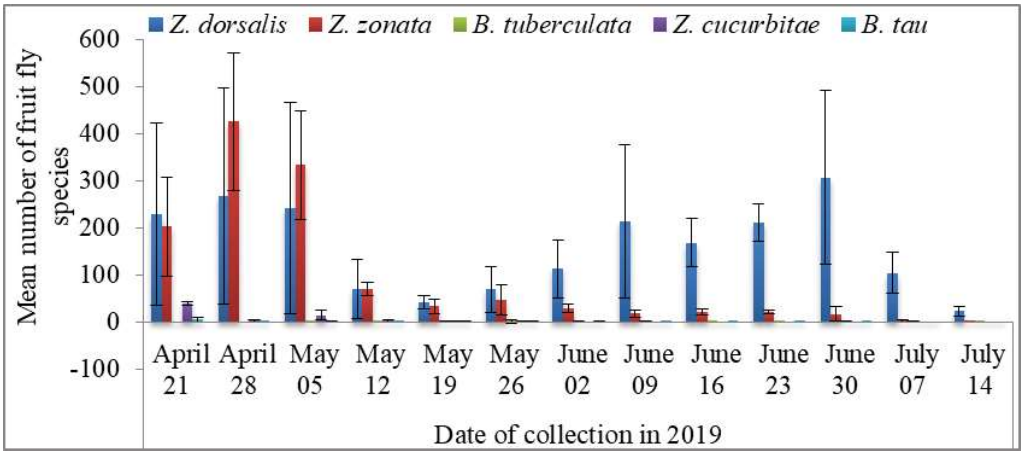


Fig. 3: Mean number of fruit fly species (with standard deviation) trapped in ME in cucurbit crops from April to July 2019 in Kamalamai-4, Sindhuli

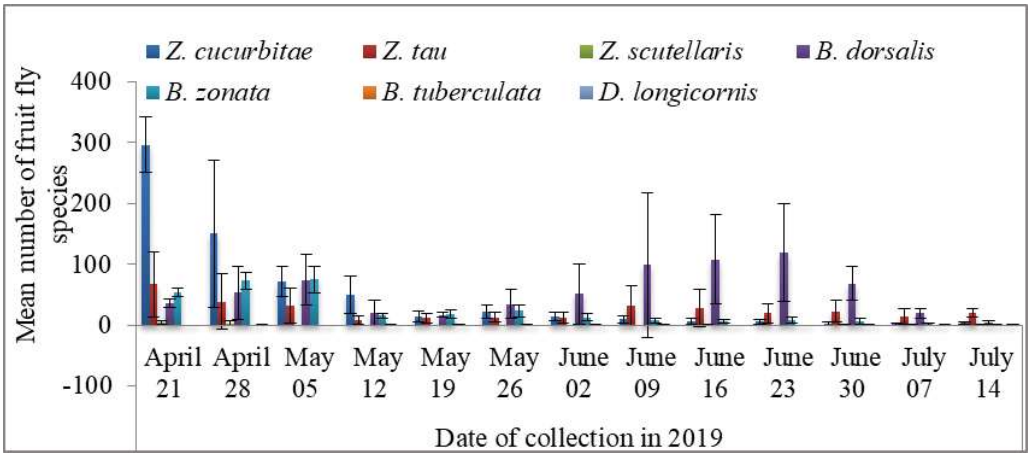
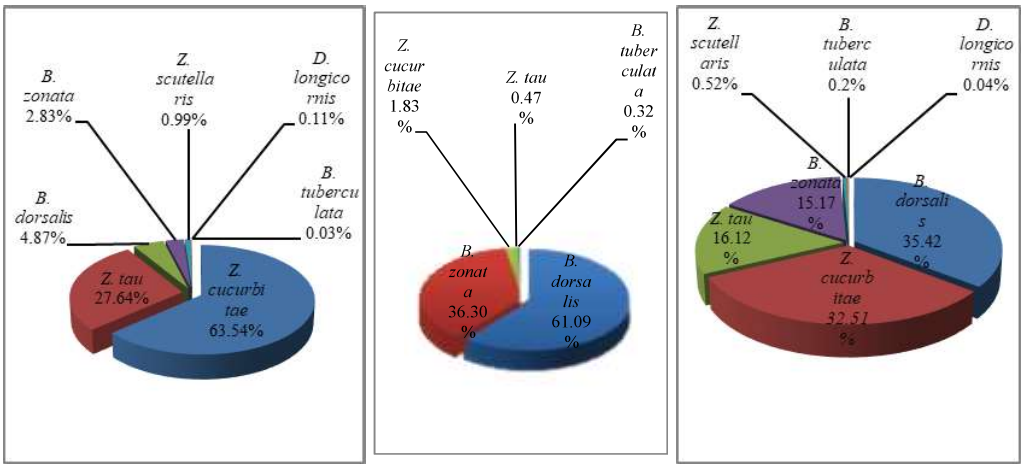


Fig. 4: Mean number of fruit fly species (with standard deviation) trapped in mixture of CL and ME in cucurbit crop from April to July 2019 in Kamalamai-4, Sindhuli

Composition of fruit fly species in different lure

The composition of fruit fly species trapped in Cue lure (CL), Methyl Eugenol (ME) and mixture of CL and ME is presented in Figure 5. The percentage of *Zeugodacus cucurbitae*, *Z. tau*, *Bactrocera dorsalis*, *B. zonata*, *Z. scutellaris*, *Dacus longicornis* and *B. tuberculata* trapped in CL was 63.54, 27.64, 4.87, 2.83, 0.99, 0.11 and 0.03 respectively. Whereas, the percentage of *B. dorsalis*, *B. zonata*, *Z. cucurbitae*, *Z. tau* and *B. tuberculata* trapped in ME was 61.09, 36.3, 1.83, 0.47 and 0.32 respectively. Similarly, the percentage of *B. dorsalis, Z. cucurbitae, Z. tau, B. zonata, Z. scutellaris, B. tuberculata* and *D. longicornis* trapped in mixture of CL and ME was 35.42, 32.51, 16.12, 15.17, 0.52, 0.2 and 0.04 respectively. The percentage of fruit fly species trapped in CL and ME was found different with previous study (Adhikari *et al*., 2018; Nagaraj *et al*., 2014). It may be due to the differences in para-pheromone lure concentration and agro-ecological conditions (Adhikari *et al*., 2018). There is also the mixing of fruit fly species in CL and ME. It may be due to the handling of both lures together (Adhikari *et al*., 2018).



CL ME Mixture of CL and ME

Fig. 5: Percentage of fruit fly species trapped in CL, ME and mixture of CL and ME in cucurbit crops from April to July 2019 in Sindhuli, Nepal

CONCLUSION

Species of fruit fly such as *Zeugodacus cucurbitae, Z. tau, Z. scutellaris, Bactrocera dorsalis, B. zonata, B. tuberculata* and *Dacus longicornis* were reported from this study. *Zeugodacus cucurbitae, Z. tau and Z. scutellaris* could be trapped effectively and economically in Cue lure with 0.25 ml. Methyl Eugenol was effective for *B. dorsalis, B. zonata* and *B. tuberculata* with 1.00 ml concentration. Mixing of Cue lure and Methyl Eugenol in a trap should be avoided where the Methyl Eugenol attracting fruit fly species are the economic insect pest. The highest mean numbers of fruit flies were collected during the April and lowest during the July in different lures.

ACKNOWLEDGEMENT

We would like to express our heartfelt thanks to Institute of Agriculture and Animal Science, Tribhuvan University (IAAS/TU), Prime Minister Agriculture Modernization Project, Junar Superzone, Sindhuli (PMAMP), Shree Barundevi Higher Secondary School, Khattar, Sindhuli, Department of Hydrology and Meteorology, Babarmahal, Kathmandu (DHM) and Kamalamai Municipality, Agriculture Section, Sindhuli for providing financial and technical support to conduct this research.

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