OPEN ACCESS

International Journal of Applied Sciences and Biotechnology

A Rapid Publishing Journal

ISSN 2091-2609

Indexing and Abstracting

CrossRef, Google Scholar, Global Impact Factor, Genamics, Index Copernicus, Directory of Open Access Journals, WorldCat, Electronic Journals Library (EZB), Universitätsbibliothek Leipzig, Hamburg University, UTS (University of Technology, Sydney): Library, International Society of Universal Research in Sciences (EyeSource), Journal Seeker, WZB, Socolar, BioRes, Indian Science, Jadoun Science, Jour-Informatics, Journal Directory, JournalTOCs, Academic Journals Database, Journal Quality Evaluation Report, PDOAJ, Science Central, Journal Impact Factor, NewJour, Open Science Directory, Directory of Research Journals Indexing, Open Access Library, International Impact Factor Services, SciSeek, Cabell's Directories, Scientific Indexing Services, CiteFactor, UniSA Library, InfoBase Index, Infomine, Getinfo, Open Academic Journals Index, HINARI, etc.

CODEN (Chemical Abstract Services, USA): IJASKD

Vol-3(4) December, 2015

Available online at:

http://www.ijasbt.org

&

http://www.nepjol.info/index.php/IJASBT/index

SEM-Biotech Publishing

Impact factor*: **1.422**
Scientific Journal Impact factor#: **3.419**
Index Copernicus Value: **6.02**
IBI Factor 2015**: **4.19**

*Impact factor is issued by Universal Impact Factor. Kindly note that this is not the IF of Journal Citation Report (JCR).
#Impact factor is issued by SJIF INNO SPACE; **Impact factor is issued by INFOBASE INDEX.

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R. Maharjan et al. (2015) Int J Appl Sci Biotechnol, Vol 3(4): 714-720
DOI: 10.3126/ijasbt.v3i4.13988

ISSN (Online): 2091-2609
DOI Prefix: 10.3126/ijasbt

International Journal of Applied Sciences and Biotechnology (IJASBT)

Research Article

MONITORING AND VARIETAL SCREENING CUCURBIT OF FRUIT FLY, *BACTROCERA CUCURBITAE* COQUILLETT (DIPTERA: TEPHRITIDAE) ON CUCUMBER IN BHAKTAPUR AND KATHMANDU, NEPAL

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Abstract

Monitoring of cucurbit fruit fly by using four different types of traps was conducted in Sipadole VDC of Bhaktapur district during 2012 to observe the population dynamics. Three different types of fruit flies were recorded, in which the number of *B. cucurbitae* dominated to other species. Only *B. cucurbitae* damaged the cucumber, which was trapped 92.68%, 87.05%, 90.61%, and 69.38% in cue-lure, banana pulp bait, sticky traps and fly catcher, respectively. The highest number of fruit flies (167.5 male fruit flies/3traps) was recorded in cue-lure trap during the first week of September, which coincided with 85.45% RH and 21.67°C and 25.04°C minimum and maximum temperature, respectively. Positive relation of temperature, relative humidity and fruit fly catches was observed. Thus, cue-lure was the most effective traps for monitoring of fruit fly population. In varietal screening, among the six different varieties of cucumber, i.e. Kathmandu local, Kusle, Kamini, Malini, Kasinda and Mahyco Green Long, they were highly significant difference in yield. Kamini gave the highest marketable fruit 26.66 mt/ha yield and the lowest by Kusle (5.05 mt/ha). All the varieties were affected by cucurbit fruit fly. The highest number of unmarketable fruit set was observed in Kamini (22.29 fruits/plant).

Keywords: Monitoring; Varietal Screening; Cucumber; Fruit fly

Introduction

Cucurbits are tropical in origin and grown mostly in Africa, tropical America, and Asia, mainly Southeast Asia. Cucumber (*Cucumis sativus* L.) occupies fourth importance in the world (Tatlioglu, 1993) compared to other vegetable. Cucumber and other cucurbit fruits are generally fat-free and low in sodium. It is basically a summer season crop grown both in the hills and Terai region of Nepal. In fiscal year 2011/12 about 1, 24,262 mt cucumber is produced from 8,500 ha land with productivity of 14.6mt/ha in Nepal (VDD, 2012).

Cucurbit fruit fly (*Bactrocera cucurbitae* Coquillett) is one of the serious problems that limits the production and productivity of cucumber. It is also known as melon fly and melon fruit fly. The extents of damage due to cucurbit fruit fly vary between 30 to 100% depending upon the season and susceptibility of the crops species and varieties (Dhillion *et al.,* 2005). Pradhan (1976) reported that the degree of infestation varied from 19.4-22.1% in cucumber. It prefers to infest young, soft skinned ovaries even before anthesis. When the humidity is high, intensity of cucurbit fruit fly damage becomes severe. Its abundance increases with increase in daily temperatures, however higher than 31°C is not ideal for its growth and reproduction (Dhillion *et al.,* 2005).

Several management techniques are being applied to overcome this pest because three of its life stages are hidden and the only adult stage is the usual target of the pest control activities. Some of the management strategies such as hydrolyzed protein spray, para-pheromone trap, spraying of ailanthus and cashew leaf extract, neem products, bagging of fruits, field sanitation, food baits, and spray of chemical insecticides are being adopted. But these methods are not able to control the pest population completely. Farmers of Nepal are also using different chemical insecticides in routine basis to combat this pest which is very hazardous to growers, consumers and also results environmental pollution (NARC, 1998). Now-a-days, due to the ever increasing global awareness about the undesirable side effects of deadly chemicals on human health, the plant protection strategies have been shifting from the use of chemicals to integrated pest management (IPM) because of increasing failure of chemical pesticides in controlling major pests and diseases. Field sanitation, diversion from the main crops, use of cue-lure traps, food baits and

hydrolyzed protein bait are some of the appropriate IPM tools (Satpathy and Rai, 2002).

Numerous varieties of cucumber have been developed with their specific characteristics in terms of yield, stress tolerance, diseases resistance. Unfortunately success in developing fruit fly-resistant varieties has been limited. There is a distinct possibility of transferring resistance genes in the cultivated genotypes from the wild relatives of cucurbits for developing varieties resistant to melon fruit fly through wide hybridization. Most of the research works related to varieties conducted in different government and NARC farms have shown that commercial varieties, such as Green Long and Poinsett for Terai, and Kusle and Bhaktapur Local for the hills are suitable for fresh fruit production during March-April (Pandey and Adhikari, 1996).This study is carried out to study the pest abundance in relation to climatic parameter and also find out level of resistance in different varieties commonly grown in Nepal against cucurbit fruit fly. So this study help to develop pest management strategies against cucurbit fruit fly.

Materials and Methods

The monitoring was done to study the occurrence of fruit fly in Sipadol VDC of Bhaktapur district during July-September, 2012. A varietal screening experiment was carried out during March-July, 2012 in Manamaiju VDC of Kathmandu district. The cucurbit fruit fly was monitored with the help of three types of traps and one bait, i.e. cue lure traps (5 drops of cue-lure and 10 drops of malathion), banana pulp bait (500 g banana pulp, 10 ml molasses 2.5 ml Malathion, 10g borax and water), sticky traps and fly catchers. Traps were installed on 9th July, 2012 in cucumber field of farmer at Sipadol, Bhaktapur at 1m height from ground. Three traps of each type were set in four ropani land of farmers. Regular monitoring was carried out from the date of flowering to harvesting. The pheromone was replaced in each trap at 15 days interval and banana pulp bait at four days interval. The trapped insects were counted at 3 days interval in each trap. Male, female and other species of fruit fly were counted separately in each trap. The weather data were collected from Tribhuvan International Airport (TIA), Kathmandu. Varietal screening was conducted during spring-summers of 2012 at Manamaiju-5, Kathmandu. There were three plots and area of each plot was 12 m^2. Each plot consists of 6 different varieties containing of total 12 plants two plants of each variety that were replicated thrice. The varieties were Kathmandu local, Kamini, Malini, Kusle, Kasinda and Mahyco Green Long. The cultural practice like weeding, staking, irrigation etc were carried out as per necessities. The observation was made 24 hours before spray at 57 DAT, 3 days after spray, 7 days after spray and 10 days after spray. Related to cucumber yield and yield attributes, plant height, no. of leaves, primary branches, secondary branches, male flower, female flower, no. of fruits (marketable and unmarketable) and weight of fruits (marketable and unmarketable) were taken into consideration. The raw data obtained from field experiment were tabulated by using EXCEL and analyzed by using MSTATC software package. Duncan's multiple range test (DMRT) was used to compare the mean at 5% level of significance.

Results and Discussion

The total numbers of *B. cucurbitae* trapped in eighteen counting were 1628, 72, 275 and 14 in cue-lure, banana pulp bait, sticky traps and fly catcher, respectively (Table 1). Similarly, the percentage of *B. cucurbitae* was found 92.68%, 87.05%, 90.61%, and 69.38% in cue-lure, banana pulp bait, sticky traps and fly catcher, respectively. Out of total fruit flies captured in cue-lure traps, the abundantly captured species was *B. cucurbitae* (92.68%). Other two species *B. scutellaris and B. caudata* were also noted during monitoring period. *B. scutellaris* infested the young flowers of cucurbits, such as pumpkin and gourds and the males were attracted to cue-lure. It is generally not regarded as a pest as it infests the flowers only and not the fruits. Out of three recognized species of *Bactrocera*, only one *B. cucurbitae* was found damaging to cucurbits crops. Anonymous (2007) categorized two groups of para-pheromone traps for *Bactrocera* spp. and cue-lure (BioCue) is recommended for *B. cucurbitae, B. frauenfeldi, B. neohumeralis, B. newmanii* and *B. tryoni.* Messing (1999) mentioned that five types of fruit fly para-pheromone traps and concluded that cue-lure was mainly for *B. cucurbitae*, however it may attract other species too.

The highest number of fruit fly catch was in cue-lure traps, i.e. 167.5 adults (80.55%) followed by sticky traps (14.21%), banana pulp bait (3.96%) and fly catcher, i.e. 2 adults (1.28%). The sex attractant cue-lure traps are more effective than the food attractant tephritlure traps for monitoring the *B. cucurbitae* in bitter gourd (Pawar). Methyl eugenol and cue-lure traps have been reported to attract *B. cucurbitae* males from mid-July to mid-November (Ramsamy et al., 1987; Zaman, 1995; Liu and Lin, 1993) (Fig. 1). Thus, cue-lure was one of the most effective tools for monitoring the population of fruit fly.

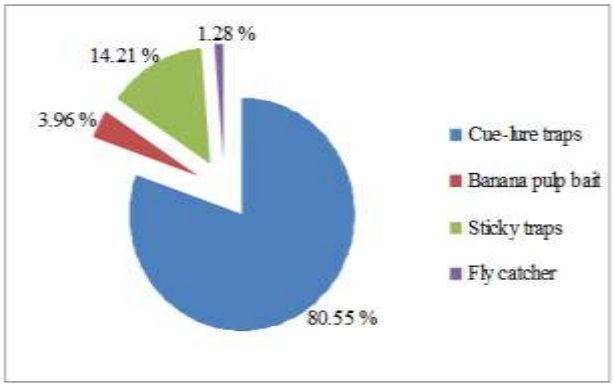

Fig. 1: Fruit fly catches in four different traps

Table 1: Number and percentage of fruit flies captured in four different types of traps in cucumber field, Sipadol, Bhaktapur, 2012

Date	Total fruit fly captured							
	Cue-lure traps		Banana pulp bait		Sticky traps		Fly catcher	
	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)
12-July	24 (10)	70.59	4	100.00	41 (3)	93.18	2 (1)	66.67
15-July	60 (8)	88.24	0 (2)	0	11	100.00	1	100.00
18-July	48 (2)	96.00	4 (1)	80.00	20 (2)	90.91	(1)	0
21-July	57 (5)	91.94	0	0	29	100.00	1	100.00
24-July	49 (1)	98.00	8	100.00	21 (1)	95.45	1	100.00
27-July	27 (4)	87.10	3	100.00	36 (3)	92.31	1 (1)	50.00
30-July	80	100.00	8 (1)	88.89	9 (1)	90.00	0	0
2-Aug	64 (6)	91.43	6	100.00	5	100.00	0	0
5-Aug	50 (4)	92.59	10	100.00	10 (4)	71.43	2	100.00
8-Aug	83	100.00	12 (1)	92.31	13	100.00	1	100.00
11-Aug	99	100.00	4	100.00	12	100.00	(1)	0
14-Aug	140 (9)	93.96	2	100.00	15 (3)	83.33	0	0
17-Aug	131 (7)	94.93	1	100.00	24	100.00	2	100.00
20-Aug	103 (8)	92.79	4 (2)	66.67	11 (1)	91.67	0	0
23-Aug	135 (16)	89.40	2	100.00	2 (1)	66.67	1	100.00
26-Aug	143 (7)	95.33	1	100.00	8 (3)	72.73	(1)	0
29-Aug	160 (16)	90.91	3 (1)	75.00	3	100.00	2	100.00
1-Sep	175 (9)	95.11	0	0	5 (1)	83.33	0	0
Total	1628 (112)	92.68	72 (8)	87.05	275 (23)	90.61	14 (5)	69.38

Figures in parenthesis indicate the number of other species of *Bactrocera.*

The number of fruit flies captured was strongly related with the climatic factors, such as temperature, rainfall and relative humidity. Daily maximum and minimum temperature had positive correlation while there was negative relation with rainfall. Also relative humidity had strong relation with cucurbit fruit fly population over the crop growing period. The lowest number of fruit flies (38 flies/3 traps) was trapped at high rainfall of 18 mm and high temperature 30° C on 29th July, 2012 in cue-lure traps. In cue-lure traps, the highest number of fruit fly population was recorded on 1st September with the peak population of 167.5 male fruit flies/3 traps where the temperature ranging from 22-25°C and relative humidity of 85%. Population of fruit fly drastically increased after the rainfall reaching the population of 135.5 male fruit flies/3 traps during 19th August. Looking at the weekly counts of flies, the highest number of flies were recorded in the week of September (167.5 male fruit flies/3traps) followed by August third and fourth week with 139 and 135.5 flies per 3 traps, respectively. The weekly mean catches of males in cue-lure showed that populations declined in June-July but increased again in August, reaching another peak in September in Pakistan (Abdullah, 2008). He further reported that fruit fly population gained two major peaks, one in spring (March) or late spring while (April) other in early fall (September) or late summer (August). Whereas the fruit fly population dropped either in summer (June) or in fall (December and January). Khan *et al*. (2003) reported a peak of fruit flies catches was observed from last fortnight of August to first fortnight of September in Shekhupura, Pakistan. Similar trend was observed in present studies. The positive relation of temperature and fruit fly catches observed in the present studies was supported by Mehmood and Mishkatullah (2007) who observed positive relation between temperature (maximum and minimum) and population dynamics of fruit fly. Bhatia and Mahato (1969) found that the shortest life cycle was at 27.5°C while Hollingsworth *et al.* (1997) recorded that development of cucurbit fruit fly from egg to adult was optimum at 29°C. Similarly, Dhillon *et al.* (2005) reported that fruit fly actively bred when temperature was below 32°C and relative humidity around 70%. He further reported that fruit flies hide under dried leaves that ultimately reduced the insect activity during winter season.

In sticky traps, the highest number of fruit fly population was recorded in 29th July with the peak population of 28.5 male fruit flies/3traps. Sticky trap was the second effective trap after cue-lure trap as it also contains very few amount of cue-lure. But it catches both harmful as well as beneficial insect.

Varietal screening

Morphological characteristics

Among six different varieties of cucumber plants, Kathmandu Local is local variety, Kusle is open pollinated variety and remaining varieties are hybrid. The plant height of different cucumber varieties were found between 148.70 to 203 cm. The highest plant height was observed in Kathmandu Local (203 cm) and the lowest in Kasinda

(148.70 cm). Average height of the plants was found to be 177.45 cm. Variety Kusle contained the more number of leaves (120.63/plant) than other varieties whereas Kasinda contained the lowest number of leaves (86/plant) and average number of leaves was 103.89/plant (Table 4). The highest number of primary (57.33/plant) and secondary branches (56.33/plant) was recorded in Kathmandu Local, whereas the lowest primary branches (43.83/plant) was recorded in Malini and the lowest secondary branches (39.17/plant) in Mahyco Green Long.

The highest number of male flower (38.17 flowers/plant) was found in Mahyco Green Long at maximum flowering stage of plants and the lowest (8 flowers/plant) in Malini (Table 2). The highest number of female flower (27.33 flowers/plant) was recorded in Kamini and the lowest (7.83 flowers/plant) in Kusle at maximum flowering stage of plant. Also the female flower percent ranged from 59.50% in Kamini to 19% in Kusle. Varieties like Malini, Kamini and Kasinda possesed dark green leaf colour, whereas Kathmandu Local, Kusle and Mahyco Green Long possess light green leaf colour. Heavy branching was observed in Kathmandu Local and Mahyco Green Long with maximum number of male flower. But in Malini, Kamini and Kasida there was light branching with maximum number of female flower. Early flower was also observed in Malini and Kasinda at 43 DAT.

Table 2: Morphological character of different varieties of cucumber in varietal screening, Manamaiju-5, Kathmandu, 2012

Varieties	Plant height (cm)	Number of leaves/plant	Number of Primary branches/plant	Number of Secondary branches/plant	No. of male flower/plant at maximum flowering stage	No. of female flower/plant at maximum flowering stage	Female Flower (%)
Kathmandu Local	203.00^{a}±12.82	110.8±11.70	57.33±4.09	56.33±4.06	33.50^{a}±1.76	13.67^{c}±1.76	28.84^{c}±2.43
Kusle	169.80^{bc}±11.29	120.63±7.74	47.83±2.68	45.83±2.05	33.70^{a}±2.29	7.83^{d}±0.17	19.00^{d}±8.35
Kamini	188.90^{ab}±7.40	105.83±10.94	56.33±9.38	44.67±4.76	19.00^{b}±4.58	27.33^{a}±3.88	59.50^{b}±14.81
MGL	189.80^{ab}±3.63	108.40±12.7	54.00±2.02	39.17±2.85	38.17^{a}±2.49	13.83^{c}±0.60	26.69^{cd}±12.05
Kasinda	148.70^{c}±13.01	86.00±7.94	44.17±9.93	42.00±8.00	10.53^{c}±0.74	12.33^{c}±1.09	53.83b±13.78
Malini	164.50^{bc}±3.75	91.67±15.18	43.83±7.17	41.00±7.57	8.00^{c}±1.06	20.17^{b}±2.08	71.57^{a}±2.12
Grand Mean	177.450	103.88	50.583	44.833	23.817	15.844	43.238
LSD at 0.05	28.01*	NS	NS	NS	5.015**	4.502**	8.081**
CV%	8.69%	17.45%	22.88%	18.60%	11.57%	15.62%	10.27%

* indicates significant, ** indicates highly significant, NS indicates non-significant at 0.05 level of significance, means followed by the same letter are not significant by DMRT at 5% level, values after ± indicate standard error

Table 3: Fruit fly damage (post set) to fruit of different varieties of cucumber in varietal screening, Manamaiju-5, Kathmandu, 2012

Varieties	Number of marketable fruit set	Number of unmarketable Fruit set	Number of total fruit set	Marketable fruit set (%)	Unmarketable fruit set (%)
Kathmandu Local	6.93 ^{c} ±0.96	6.29^{b}±1.77	13.22^{bc}±2.70	52.42^{ab}±4.71	47.58^{ab}±4.71
Kusle	4.60^{c}±0.89	4.67^{b}±0.66	9.27^{c}±1.53	49.62^{b}±1.47	50.37^{a}±1.47
Kamini	21.23^{a}±3.40	22.29^{a}±2.82	43.53^{a}±6.22	48.77^{b}±0.97	51.21^{a}±0.97
MGL	7.90^{bc}±1.14	5.50^{b}±1.19	13.40b^{c}±1.76	58.96^{a}±5.25	41.04^{b}±5.25
Kasinda	8.27^{bc}±2.14	8.93^{b}±2.22	17.19^{bc}±4.36	48.11^{b}±0.48	51.95^{a}±0.48
Malini	12.53^{b}±2.08	10.28^{b}±1.49	22.82^{b}±2.26	54.91^{ab}±5.58	45.05^{ab}±5.58
Grand Mean	10.24	9.66	19.91	52.13	47.87
LSD at 0.05	4.793**	5.997**	10.26**	9.355	9.355
CV%	25.72%	34.13%	28.33%	9.83%	10.78%

** indicates highly significant, NS indicates non-significant at 0.05 level of significance, means followed by the same letter are not significant by DMRT at 5% level, values after ± indicate standard error

Stage of fruit damage by cucurbit fruit fly

The fruit damage of less than 100g size is called post set damage. In varietal screening, out of total set fruits, nearly half (47.87%) (Table 3) of the fruits were damaged or dropped just after set (<100 g). Among the different varieties, the highest percent of unmarketable fruit set was observed in Kasinda (51.95%) followed by Kamini (51.21%) and the lowest in Mahyco Green Long (41.04%). But, there was comparatively less fruit damage (33.39%) during harvesting due to cucurbit fruit fly (Table 4). From above data it is clear that young and immature fruits are highly prone to fruit fly damage than mature fruits. Among the different varieties, Mahyco Green Long was found little damaged due to fruit fly as there was high marketable yield as compared to other varieties.

Marketable and damage yield of cucumber

There was a significant difference between the varieties on the total number of harvested fruits per plant. The total number of marketable fruit per plant was higher in Kamini (13.10 fruits/plant), whereas it was the lowest in Kusle (2.30 fruits/plant). The result indicated that 79.75% fruits were marketable out of total harvested fruit in Mahyco Green Long (Table 4).

The marketable fruit yield, damaged fruit yield and total fruit yield of cucumber differed significantly among the varieties. The marketable fruit yield of Kamini was more than double (26.66 mt/ha) as compared to the other varieties. On the other hand, the lowest marketable fruit yield was recorded in Kusle (5.05 mt/ha) that was five times lower than Kamini. Kamini variety was found superior as compared to the other varieties in terms of yield. Damaged fruit yield was also high (11.04 mt/ha) in Kamini as compared to other varieties (Table 5). Although the yield of Kamini varieties was found higher, however it was not preferred by the consumer due to its taste as well as low keeping quality.

A plant produced 2-13 marketable fruits with an overall average of 7 (6.75 fruits/plant). Kamini gave the highest marketable fruit yield 26.66 mt/ha followed by Malini (12.19 mt/ha), Mahyco Green Long (10.91 mt/ha), Kasinda (9.40 mt/ha), Kathmandu Local (9.22 mt/ha) and Kusle (5.05 mt/ha). All the varieties were affected by cucurbit fruit fly. There was no resistance found in any varieties. The experiment was conducted in the farmers' field conditions at Yampaphant, Tanahun, Nepal during April - July 2000 included one commercial cultivar namely Bhaktapur Local and the four exotic cultivars and hybrids namely Malini, Korean White, Japanese Green and Green Long. The hybrid Malini was found significantly more vigor and earlier (first picking at 42 days) and produced significantly higher number of fruits (252 thousands/ha) and significantly higher yield (69.6 t/ha) (Sharma and Bhattarai, 2006).

Table 4: Number of unmarketable, marketable and total harvested fruits of different varieties of cucumber, Manamaiju-5, Kathmandu, 2012

Treatments	Number of unmarketable fruit	Number of marketable Fruit	Number of total harvested Fruit	Unmarketable fruit (%)	Marketable fruit (%)
Kathmandu Local	2.00^{c}±0.25	4.93b^{c}0.57	6.93^{c}± 0.79	28.90^{bc}±1.0	71.10^{ab}±1.70
Kusle	2.30^{c}± 0.40	2.30^{c}±0.33	4.60^{c}±0.73	49.54^{a} 1.71	50.46^{c}±1.71
Kamini	8.13^{a}±1.27	13.10^{a}±1.53	21.23^{a}±2.78	37.88^{b}±1.53	62.12^{b}±1.53
MGL	1.60 ^{c}±0.25	6.30^{b}±0.73	7.90^{bc}±0.93	20.25^{c}±1.83	79.75^{a}± 1.83
Kasinda	2.17^{c}±0.53	6.10^{b}±1.22	8.27^{bc}±1.75	25.66^{c}±0.87	74.34^{a}±0.87
Malini	4.77^{b} ± 0.78	7.77^{b}±1.18	12.53^{b}±1.70	38.12^{b} 4.60	61.88^{b}±4.60
Grand Mean	3.494	6.750	10.244	33.391	66.609
LSD at 0.05	2.112**	3.120**	4.793**	9.580**	9.580**
CV%	33.23%	25.41%	25.72%	15.77%	7.91%

** indicates highly significant at 0.05 level of significance, means followed by the same letter are not significant by DMRT at 5% level, values after ± indicate standard error

Table 5: Marketable and unmarketable fruit yield of different varieties of cucumber, Manamaiju-5, Kathmandu, 2012

Varieties	Unmarketable fruit (mt/ha)	Marketable fruit (mt/ha)	Total fruit weight (mt/ha)	Unmarketable fruit (%)	Marketable fruit (%)
Kathmandu Local	3.18^{c}±0.43	9.22^{bc}±1.54	12.40^{bc}±1.93	25.88^{cd}±1.72	74.12^{ab}±1.72
Kusle	3.71^{c}±0.83	5.05^{c}±1.23	8.76^{c}±2.04	42.55^{a}±2.38	57.45^{d}±2.38
Kamini	11.04^{a}±1.45	26.66^{a}±2.16	37.70^{a}±3.12	29.15^{bc}±2.62	70.85^{bc}±2.62
MGL	2.92^{c}±0.60	10.91^{b}±1.75	13.83^{bc}±2.27	21.04^{d}±2.03	78.96^{a}±2.03
Kasinda	2.79c±0.52	9.40^{bc}±2.20	12.19^{bc}±2.71	23.20^{cd}±2.03	76.80^{ab}±1.25
Malini	5.93^{b}±0.31	12.19^{b}±1.52	18.11^{b}±1.83	33.03^{b}±1.54	66.97^{c}±1.54
Grand Mean	4.93	12.24	17.17	29	71
LSD at 0.05	0.48**	0.94**	1.24**	6.66**	6.66**
CV%	24.05%	18.74%	17.65%	12.57%	5.17%

** indicates highly significant at 0.05 level of significance, means followed by the same letter are not significant by DMRT at 5% level, values after ± indicate standard error

Table 6: Number of natural enemies in varietal screening, Manamaiju-5, Kathmandu, 2012

Varieties	30 DAT	Difference (a-c)*	40 DAT	Difference (a-c)*	50 DAT	Difference (a-c)*	60 DAT	Difference (a-c)*
Kathmandu Local	4	4 (50.00)	9	3 (75.00)	12	7 (63.16)	16	10 (61.54)
Kusle	3	5 (37.50)	6	6 (50.00)	11	8 (57.89)	19	7 (73.08)
Kamini	7	1 (87.50)	11	1 (91.67)	19		24	2 (92.31)
MGL	4	4 (50.00)	7	5 (58.33)	10	9 (52.63)	15	11 (57.9)
Kasinda	5	3 (62.50)	6	6 (50.00)	9	10 (47.37)	13	13 (50.00)
Malini	8		12		18	1 (94.74)	26	

*Indicate differences in total numbers of natural enemies in different varieties (a) over the highest number of natural enemies (c): and data inside parenthesis shows the differences in percent. DAT: Days after transplanting

Natural Enemies

The populations of different natural enemies counted in the varietal screening plots at every 10 days interval were mostly predators and some unidentified parasitic wasps. The major predators recorded were different kinds of ladybird beetles, spiders, hover fly, paper wasp bees and staphylinids. The highest numbers of natural enemies were recorded in Malini after 30, 40 and 60 DAT. Kamini recorded the highest number of natural enemies at 50 DAT. The least number of natural enemies were recorded in Kusle and Kasinda throughout the study period. (Table 6).

Conclusions

A cue-lure trap was found to be the most effective for monitoring the population of fruit fly and could be one of the best tools for taking decision for its management. Among the different varieties tested for the resistance to cucurbit fruit fly, there was no resistance found in any varieties. All the varieties were damaged by cucurbit fruit fly. However, Kamini gave the highest yield.

Acknowledgements

The research fund provided by Sustainable Soil Management Programme (SSMP), Bakhundole, Lalitpur is highly acknowledged. Mr. Rajiv Das Rajbhandari will always be remembered for his critical suggestion on data analysis and other research related concern. Ms. Bhakta Laxmi Maharjan is also highly acknowledged for her tireless effort, unforgettable hospitality and help rendered during field research.

References

Abdullah K (2008) Studies on behavioral responses of adult fruit flies to food and sex lures in relation to their management. Ph.D. Thesis, Gomal University, Dera Ismail Khan. Pakistan. P. 239.

Anonymous (2007) Fruit fly traps: An introduction. The Sundarman Overseas Operation. Available at: http// www.soo.co.in/bactrocera_fly_traps.htm-23k. [Retrieveved on: 26th July, 2007].

Bhatia SK and Mahato Y (1969) Influence of temperature on the speed of development of melon fly, *Dacus cucurbitae* Coq. (Diptera: Tephritidae). *Indian Journal of Agriculture Science* **40**: 821-828.

Dhillion MK, Naresh JS, Singh R and Sharma NK (2005) Evaluation of bitter gourd (*Momordica charantia* L.) genotypes for resistance to melon fruit fly, *Bactrocera cucurbitae*. *Indian Journal of Plant Protection* **33**(1): 55-59.

Hollingsworth R, Vagalo M and Tsatsia F (1997) Biology of melon fly with special reference to the Solomon Islands. In: Allwood AJ and Drew RAI (Eds) Management of fruit flies in the Pacific. Proceeding of Australian Country. *Industrial Agriculture Research* **76**: 140-144.

Khan M, Ashfaq AM and Khaliq A (2003) Population of fruit fly species trapped by methyl eugenol and cue lure versus infestation in guava orchards. *Pakistan Entomologist* **25** (1): 63-67.

Liu YC and Lin JS (1993) The response of melon flies *Dacus cucurbitae* Coquillett to the attraction of 10% MC. *Plant Prot. Bull*. (Taipei). **35**:79-88.

Mehmood K and Mishkatullah (2007) Population dynamics of three species of genus *Bactrocera* (Diptera: Tephritidae: Dacinae) in BARI Chakwal (Punjab). *Pakistan Journal of Zoology* **39 (2):** 123-127.

Messing R (1999) Managing fruit flies on farm in Hawaii. CTAHR-Sept. 1999, IP-4 [Online] Available at: http//www.ctahr.hawaii.edu/oc/>. [Retrieved on: 25th October, 2007].

NARC (1998) Annual report. Entomology Division, Nepal Agriculture Research Council, Khumaltar, Nepal. P. 59.

Pandey IR and Adhikari KP (1996) Research for vegetable development in Nepal. Paper presented at the National Seminar on Vegetable Development, 11-12 June 1996. Vegetable Development Division, Khumaltar, Kathmandu, Nepal. P.79 .

Pawar DB, Mote UN and Lawande KE (1991) Monitoring of fruit fly population in bitter gourd crop with the help of lure trap. *Journal of Research, Maharashtra Agricultural Universities* **16:** 281.

Pradhan RB (1976) Relative susceptibilities of some vegetables grown in Kathmandu valley to *D. cucurbitae* Coq. *Nepalese Journal of Agriculture* **12:** 67-75.

Ramsamy MP, Rawanansham T and Joomaye A (1987) Studies on the control of *Dacus cucurbitae* Coquillett and *Dacus d'emmerezi* Bezzi (Diptera: Tephritidae) by male annihilation. *Revue Agricole et Sucriere de ltle Mauriee*. **66:** 1-3.

Satpathy S and Rai S (2002) Luring ability of indigenous food baits for fruit fly *B. cucurbitae* (Coq.). *Indian Journal of Entomological Research* **26(3):** 249-252.

Sharma MD and Bhattarai SP (2006) Performance of cucumber cultivars at low hill during Summer-rainy seasons. *Journal of Institute of agriculture and animal sciences, Rampur, Chitwan, Nepal*. **27:** 169-171.

Tatlioglu T (1993) Cucumber; *Cucumis sativus* L. In: Kallo G and Bergh BO (Eds) *Genetic Improvement of Vegetable Crops*. Pergamon Press, Ltd; Tarrytown New York, USA. pp. 1-5.

VDD (2012) Annual report. Vegetable Development Directorate, Department of Agriculture, Khumaltar, Nepal. P.146.

Zaman M (1995) Assessment of the male population of fruit flies through kairomone baited traps and the association of the abundance levels with the environmental factors. *Sarhad J. Agric*. **11:** 657-670.