International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(2): 3522-3526

Received: 18-01-2018
Accepted: 19-02-2018

AM Bharadiya
Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh, Gujarat, India

JB Bhut
Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh, Gujarat, India

MV Variya
Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh, Gujarat, India

Correspondence
AM Bharadiya
Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh, Gujarat, India

Eco-friendly modules for management of fruit fly, *B. cucurbitae* infesting sponge gourd

AM Bharadiya, JB Bhut and MV Variya

Abstract
The experiment on Eco-friendly modules for management of fruit fly, *B. cucurbitae* infesting sponge gourd was carried out during consecutive two years *kharif* 2014 and 2015 at Agronomy Farm, Junagadh Agricultural University, Junagadh. The four eco-friendly modules were evaluated against the fruit fly, *B. cucurbitae* infesting sponge gourd for two years. The module-3 [destruction of infested fruits during each picking + poison bait @ 50 l/ha (jaggery 50 g/l + abamectin 1.9% EC 0.0025%) + application of *Azadirechtin* 0.003% at 15 days interval starting from flower initiation stage]and module-2[destruction of infested fruits during each picking + poison bait @ 50 l/ha (jaggery 50 g/l + abamectin 1.9% EC 0.0025%)] were found most effective and economic and were statistically at par with each other. In the module-3 significantly minimum fruit infestation 14.10 per cent with maximum yield increased 44.72 per cent and net return Rs. 28965/ha was recorded. While in module-2, 17.16 per cent fruit infestation with 38.21 per cent yield increased and Rs. 24750/ha net return was recorded.

Keywords: eco-friendly module, management, fruit fly, *Bactrocera cucurbitae*, sponge gourd

Introduction
Cucurbits, a common name given to a number of vegetable crops belonging to botanical family cucurbitaceae which mostly possess trailing habit, are extensively grown all over the tropical and sub-tropical countries and include the largest number of summer and rainy season vegetables. Among the cucurbitaceous vegetables, sponge gourd (*L. cylindrica*) has its own importance as a human food. Sponge gourd is known by different names such as loofah, vegetable sponge, bath sponge or dish cloth gourd and Gujarati farmers called it *Galaka*. In Gujarat and India gourd vegetables are cultivated in area of 0.61 and 1.66 lakh ha with production of 9.27 and 19.46 m tones respectively (DOAC, 2012) [6].

Such an important crop is found to be attacked by various insect pests during its different growth stages. These include melon fruit fly (*Bactrocera cucurbitae* (Coq.)), aphids (*Aphis gossypii* Glower), white fly (*Bemisia tabaci* Gennadius), leaf miner (*Liriomyza trifolii* Burgess), jassid (*Amrasca biguttula biguttula* Ishida) and pumpkin beetles (*Raphidopalpa foveicollis* Lucas) that causes varying degrees of damage to the crop. Among these, melon fruit fly is a serious pest and was first described by Coquillett (1899) as *Dacus cucurbitae* on cucurbit from Hawaii. Later on, it was reported from different parts of the world, *viz.*; Australia, Mayanmar, China, East Africa, Taiwan, Hawaii, Malaysia, Nepal, Pakistan, Phillippines and Sri Lanka (Narayanan and Batra, 1960) [11]. In India, the incidence of the melon fly was first reported by Lefroy (1907) [8] on cucurbits.

Melon fruit fly, *B. cucurbitae* damages over 81 plant species, but plants belonging to the family cucurbitaceae are most preferred hosts (Allwood *et al*., 1999) [1]. Depending on the environmental conditions and susceptibility of the crop species, the extent of losses varies between 30 to 100 per cent (Pareek and Kavadia, 1994; Dhillon *et al*., 2005; Shooker *et al*., 2006) [12, 5, 15, 13]. This pest is reported to cause 80 per cent infestation in cucumber and bottle gourd, 60 per cent in bitter gourd and 50 per cent in sponge gourd (Gupta and Verma, 1992) [7]. For controlling this pest, spray schedules of synthetic insecticides are mostly calendar based with little consideration of detrimental effects like the problems of toxic pesticides residue in fruits, development of insecticidal resistance in pest, disruption of natural balance, biomagnifications and high cost of pesticides involved. In sponge gourd eco-system, it is time, the scientific information for devising and formulating eco-friendly measures against this pest. Hence, the present investigation was carried on eco-friendly module for management of fruit fly, *Bactrocera cucurbitae* on sponge gourd.

Materials and Methods

It is necessary to evaluate the various components of integrated pest management (IPM) individually as well as in combination for framing IPM strategy of a pest. For the effective and economical management of fruit fly, *B. cucurbitae*, various eco-friendly modules were evaluated to find out their bio efficacy against fruit fly infesting sponge gourd. Experiments were conducted during two consecutive year *kharif* 2014 and *kharif* 2015. All the recommended agronomical practices were followed to raise good crop. The experimental details are given below:

1. **Objective:** Eco-friendly modules for management of fruit fly, B. cucurbitae
2. **Location and Agro climatic Zone:** Instructional Farm, JAU, Junagadh South Saurashtra Agro climatic Zone
3. **Season and Year:** Kharif 2014 and Kharif 2015
4. **Crop and Variety:** Crop: Sponge gourd; Variety: Pusa Chickni
5. **Modules (treatment) Details:** Five different modules as under
   - Module 1 (M1): Mass trapping of adult fruit fly using cue lure traps (Sawaj fruit fly trap) @ 30/ha + destruction of infested fruits during each picking
   - Module 2 (M2): Destruction of infested fruits during each picking + poison bait @ 50 l/ha (jaggery 50 g/l + abamectin 1.9% EC 0.0025%)
   - Module 3 (M3): M2 + application of Azadirechtin 0.003% at 15 days interval starting from flower initiation stage
   - Module 4 (M4): M2 + application of NSKE 5% at 15 days interval starting from flower initiation stage
   - Module 5 (M5): Control (water spray)
6. **Experimental Design:** Randomized block design
7. **Replication:** Four
8. **Plot size:** 8.0 m x 5.0 m
9. **Spacing:** 2.0 m x 1.0 m (row to row and plant to plant)

Method for recording observations

Adequate distance between two plots was maintained. The sponge gourd plot allotted to module-1 was kept 50 m away from the rest of the modules. The poison bait was prepared by mixing jaggery 50 g + abamectin @ 0.0025 per cent (1.3 ml) in a litre of water. The spot application of poison bait was made with the help of broom. Total 50 litre of poison bait required for one hectare application. The first application of poison bait, *Azadirechtin* 0.003% and NSKE 5% was made at the time of flower initiation stage and subsequent three applications were made at 15 days intervals. The observations on number of infested fruits and healthy fruits from five randomly selected and tagged plants as well as number of maggots per infested fruits were recorded during fruit picking at 4 to 5 days intervals and continue still last picking (maturity of crop). The fruits which were premature and dropped due to infestation of fruit fly were also considered in the observations. With a view to evaluate the effect of different eco-friendly modules on the yield of sponge gourd, the fruit yield per plot was recorded from each module and per cent increase in yield over control as well as net cost benefit ratio (NCBR) was also calculated.

Results and Discussion

Fruit infestation

2014

The fruit infestation due to fruit fly, *B. cucurbitae* showed significant difference among the modules. Significantly the lowest 13.65 per cent fruit infestation was found in module-3; however, it was statistically at par with the fruit infestation 16.98 per cent in module-2 and 19.54 per cent in module-4. The fruit fly infestation 22.08 per cent recorded in module-1 was significantly superior over module-5 (control) but was significantly inferior to module-3, module-2 and module-4. The significantly maximum fruit infestation 33.07 per cent was recorded in module-5 (control) during first year (*kharif* 2014) of experimentation (Table 1).

2015

The data given in Table 1 revealed that more or less similar trend of efficacy of different modules against fruit fly was observed in second year of experimentation (*kharif* 2015). Significantly the lowest 14.56 per cent fruit infestation was found in module-3; however, it was statistically at par with the fruit infestation 17.34 per cent in module-2 and 20.08 per cent in module-4. The fruit fly infestation 22.23 per cent recorded in module-1 was significantly superior over module-5 (control) but was significantly inferior to module-3, module-2 and module-4. The significantly maximum fruit infestation 33.91 per cent was recorded in module-5 (control).

Pooled results of the two years

Average of two years (pooled) data on fruit infestation recorded in the different eco-friendly modules are presented in Table 1. The data revealed that significantly the lowest 14.10 per cent fruit infestation was found in module-3; however, it was statistically at par with the fruit infestation 17.16 per cent in module-2. The fruit fly infestation 19.81 per cent recorded in module-4 and 22.15 per cent in module-1 was significantly superior over module-5 (control) but was significantly inferior to module-3 and module-2. The significantly maximum fruit infestation 33.49 per cent was recorded in module-5 (control).

Maggot population

2014

The data presented in Table 1 on maggot population in infested fruits due to fruit fly showed significant difference among the modules. Significantly the lowest 2.66 maggots per fruit were found in module-3 and it was statistically at par with module-2 in which 3.68 maggots per fruit was recorded. The maggot population in the Module-4 and module-1 was recorded as 4.21 and 4.48 maggots per fruit, respectively and was significantly lower over module-5 (control). The maximum maggot population 6.47 was recorded in module-5 (control) during *kharif* 2014.

2015

The data presented in Table 1 on maggot population in infested fruits due to fruit fly showed that more or less similar trend of efficacy of different modules was observed in second year of experimentation (*kharif* 2015). Significantly the lowest 2.85 maggots per fruit were found in module-3 and it was statistically at par with module-2 in which 3.62 maggots

per fruit was recorded. The maggot population in the module-4 and module-1 was recorded as 4.38 and 4.488 maggots per fruit, respectively and was significantly lower over module-5 (control). The maximum maggot population 6.82 was recorded in module-5 (control) during *kharif* 2014.

Pooled results of the two years

The pooled data of two different years (2014 and 2015) are given in Table 1 on maggot population in different modules. The data revealed that the maggot population 2.75 per fruit recorded in module-3 was significantly lower over all the modules applied. The maggot population per fruit 3.65 and 4.30 was recorded in module-2 and module-4 which was significantly superior over module-5 (control) but was inferior to module-3. However, the maggot population per fruit 4.68 was recorded in module-1 was significantly superior over module-5 (control) but was inferior to module-3 and module-2 and was statistically at par with module-4. The maximum maggot population 6.64 was recorded in module-5 (control).

From the above results, it can be concluded that module-3 was found relatively effective against fruit fly, *B. cucurbitae* infesting sponge gourd by recording significantly minimum fruit infestation and harbour lower number of pests per fruit. Further, it was found that module-2 was found comparatively effective against fruit fly by recording lower fruit infestation as well as lower number of pests per fruit over rest of the modules. In contrast to this, module-4 and module-1 has no any effect on incidence of fruit fly as they recorded higher amount of fruit infestation 19.81 to 22.15 per cent by the fruit fly and also having higher population of maggots per fruit (Table 1).

Yield

2014

The yield of sponge gourd fruits during *kharif* 2014 in different modules was recorded significantly higher over control (Table 2). The sponge gourd yield 6213 kg/h (43.23% increased over module-5) was received from module-3 treated crop was significantly highest and was at par with the yield 5900 kg/ha (36.02% increased over module-5) from module-2 and 5375 kg/ha (23.92% increased over module-5) from module-4. The sponge gourd yield 5225 kg/ha (20.46% increased over module-5) received from module-1 was significantly higher over module-5 (control) but was lower than yield from module-3, module-2 and module-4. The minimum yield 4338 kg/ha was received from module-5 (control) which was significantly lower over yield from all the modules.

2015

The yield of sponge gourd fruits during *kharif* 2015 in different modules was recorded significantly higher over control. The sponge gourd yield 6288 kg/ha (46.22% increased over module-5) was received from module-3 treated crop was significantly highest and was at par with the yield 6038 kg/ha (40.41% increased over module-5) from module-2. The sponge gourd yield 5463 kg/ha (27.03% increased over module-5) received from module-4 and 5375 kg/ha (25.00% increased over module-5) received from module-1 were at par with each other and was significantly higher over module-5 (control) but was lower than yield from module-3 and module -2. The minimum yield 4300 kg/ha was received from module-5 (control) which was significantly lower over yield from all the modules (Table 2).

Pooled results of the two years

The pooled data given in Table 2 revealed that the sponge gourd yield 6250 kg/h (44.72% increased over module-5) was received from module-3 treated crop was significantly highest and was at par with the yield 5969 kg/ha (38.21% increased over module-5) from module-2. The sponge gourd yield 5419 kg/ha (25.47% increased over module-5) received from module-4 and 5300 kg/ha (22.72% increased over module-5) received from module-1 were at par with each other and was significantly higher over module-5 (control) but was lower than yield from module-3 and module-2. The minimum yield 4319 kg/ha was received from module-5 (control) which was significantly lower over yield from all the modules.

Looking to the pooled data of two years (Table 1) on fruits yield of sponge gourd, it can be concluded that the module-3 and module-2 were found relatively effective against fruit fly infesting sponge gourd as they harvest significantly higher yield over rest of the modules. In contrast to this module-4 and module-1 has no any effect on incidence of fruit fly as they recorded significantly lower yield over module-3 and module-2.

Economics of different eco-friendly modules

The data on economics of the different eco-friendly modules applied against the melon fruit fly, *B. cucurbitae* was worked out along with net cost benefit ratio (NCBR) are present in Table 3.

The data revealed that the gross income of Rs. 93750/ha was highest from the module-3 [destruction of infested fruits during each picking + poison bait @ 50 l/ha (jaggery 50 g/lit + abamectin 1.9% EC 0.0025%) + *Azadirechtin* 0.003%], followed by Rs. 89535/ha from module-2 [destruction of infested fruits during each picking + poison bait @ 50 l/ha (jaggery 50g/lit + abamectin 1.9% EC 0.0025%)]. Gross income of Rs. 81285/ha was obtained from module-4 [destruction of infested fruits during each picking + poison bait @ 50 l/ha (jaggery 50 g/lit + abamectin 1.9% EC 0.0025%) + NSKE 5%] and Rs. 79500/ha from module-1 (mass trapping of adult fruit fly using cue lure traps @ 30/ha + destruction of infested fruits during each picking). Minimum gross income Rs. 64785/ha was received from control (module-5).

The maximum net monitory benefit of Rs. 28965/ha was obtained from the module-3, followed by Rs. 24750/ha from module-2. The module-4 and module-1 gave relatively lower net monitory benefit of Rs. 16500/ha and Rs. 14715/ha, respectively.

Looking to net cost benefit ratio (NCBR), module-2 stood first with 1:29.75 NCBR. The order of NCBR of rest of the module was module-4, 1:10.11, module-1, 1:5.45 and module-3, 1:5.05.

The data given in Table 1, 2 and 3 clearly showed that the eco-friendly module-3 applied in sponge gourd was most effective and economic with the significantly lowest 14.10 per cent fruit infestation, 44.72 per cent higher yield (6250 kg/ha) and maximum Rs. 28965/ha net monitory return. The fruit infestation (17.16%), yield increased (38.21%) and net return Rs. 24750/ha from module-2 was statistically at par with module-3. The eco-friendly module-3 was consisted with destruction of infested fruits during each picking + poison bait @ 50 l/ha (jaggery 50 g/l + abamectin 1.9% EC 0.0025%) + application of *Azadirechtin* 0.003% at 15 days interval starting from flower initiation stage. However, module -2 was consisted with destruction of infested fruits during each

picking + poison bait @ 50 l/ha (jaggery 50 g/l + abamectin 1.9% EC 0.0025%). The fruit infestation, yield and economics were significantly higher in module-4 and module-1 over control (module-5) but significantly lower to module-3 and module-2.

A very little work on eco-friendly modules against melon fruit fly, *B. cucurbitae* on sponge gourd has been done. However, very good amount of research work has been carried out on different cucurbit. It was reported that three applications of poison baits prepared from jaggery @ 50gm/l water and malathion 0.05 per cent (ICBR 1:15.67) or methyl parathion 0.05 per cent (ICBR 1:9..6) or DDVP 0.07 per cent (ICBR 1:8.69) at 15 days interval starting from blooming gave the effective and economical control of the melon fruit fly infesting bitter gourd (Anonymous, 1992) [2]. Further, Deshmukh and Patil (1996) [4] concluded that the fruit fly trap baited with methyl eugenol (3 ml/trap with 0.05% cent dichlorvos) was found the most effective and economical treatment against fruit flies (*Dacus* spp.) with the lowest percentage of fruit infestation. The area wide IPM program including male annihilations with male lures and attractants and protein bait sprays and traps was proved to be economically viable, environmentally sensitive, sustainable and had suppressed fruit flies (*B. cucurbitae*) below economic threshold with the minimum use of organo phosphate and carbamate insecticides (Wood *et al.*, 2001 and Mau *et al.*, 2003) [14, 10]. Mandal (2012) [9] reported that the average mean percentage of fruit damage was the lowest in package of treatment such as installation of sex pheromone traps and spinosad spray along with discarding of infested/damaged fruits at each harvesting. However, in present study eco-friendly module-3 consisting module-2 + application of *Azadirechtin* 0.003% at 15 days interval starting from flower initiation stage and module-2 consisting destruction of infested fruits during each picking + poison bait @ 50 l/ha (jaggery 50 g/l + abamectin 1.9% EC 0.0025%) were found effective against fruit fly, *B. cucurbitae* infesting sponge gourd and harbour lower number of pests per fruit.

Table 1: Bio efficacy of different eco-friendly modules against fruit fly, *B. cucurbitae* infesting sponge gourd during two *kharif* season

Module	Per cent fruit infestation			No. of maggots / damage fruit		
	2014*	2015*	Pooled*	2014**	2015**	Pooled**
M_1: Mass trapping of fruit fly using Cue lure traps @ 30/ha + destruction of infested fruits during each picking	28.02 (22.08)	28.13 (22.23)	28.08 (22.15)	2.23 (4.48)	2.32 (4.88)	2.28 (4.68)
M_2: Destruction of infested fruits during each picking + poison bait @ 50 l/ha (jaggery 50 g/l + abamectin 1.9% EC 0.0025%)	24.34 (16.98)	24.61 (17.34)	24.47 (17.16)	2.04 (3.68)	2.03 (3.62)	2.04 (3.65)
M_3: M_2 + application of *Azadirechtin* 0.003% at 15 days interval starting from flower initiation stage	21.68 (13.65)	22.43 (14.56)	22.06 (14.10)	1.78 (2.66)	1.83 (2.85)	1.80 (2.75)
M_4: M_2 + application of NSKE 5% at 15 days interval starting from flower initiation stage	26.23 (19.54)	26.62 (20.08)	26.43 (19.81)	2.17 (4.21)	2.21 (4.38)	2.19 (4.30)
M_5: Control (water spray)	35.10 (33.07)	35.61 (33.91)	35.36 (33.49)	2.64 (6.47)	2.71 (6.82)	2.67 (6.64)
S.Em.±	1.71	1.73	1.22	0.10	0.07	0.06
C.D. at 5 %	5.27	5.34	3.55	0.27	0.21	0.17
C.V. %	12.64	12.61	12.63	15.18	11.31	13.35
Y						
S.Em.±	--	--	0.77	--	--	0.04
C.D. at 5 %	--	--	NS	--	--	NS
YXT						
S.Em.±	--	--	1.72	--	--	0.08
C.D. at 5 %	--	--	NS	--	--	NS

Application of poison bait, neem oil 1% & NSKE 5% was made at 15 days interval starting from flower initiation stage (total four applications)

* Figures in the parentheses are retransformed values while outside are $\sin^{-1}\sqrt{(X + 0.5)/100}$ transformed value.

** Figures in the parentheses are retransformed values while outside square root $\sqrt{(X + 0.5)}$ transformed value

M: Module

Table 2: Effect of various eco-friendly modules on fruit yield of sponge gourd during two *kharif* season

Module	Fruit yield (kg/ha)			Increased yield over control (%)		
	2014	2015	Pooled	2014	2015	Pooled
M_1: Mass trapping of fruit fly using Cue lure traps @ 30/ha + destruction of infested fruits during each picking	5225	5375	5300	20.46	25.00	22.72
M_2: Destruction of infested fruits during each picking + poison bait @ 50 l/ha (jaggery 50 g/l + abamectin 1.9% EC 0.0025%)	5900	6038	5969	36.02	40.41	38.21
M_3: M_2 + application of *Azadirechtin* 0.003% at 15 days interval starting from flower initiation stage	6213	6288	6250	43.23	46.22	44.72
M_4: M_2 + application of NSKE 5% at 15 days interval starting from flower initiation stage	5375	5463	5419	23.92	27.03	25.47
M_5: Control (water spray)	4338	4300	4319	--	--	--
S.Em.±	315.66	251.49	201.80	--	--	--
C.D. at 5 %	972.73	774.97	589.03	--	--	--
C.V. %	11.67	9.16	10.47	--	--	--
Y						
S.Em.±	--	--	127.63	--	--	--
C.D. at 5 %	--	--	NS	--	--	--
YXT						
S.Em.±	--	--	285.38	--	--	--
C.D. at 5 %	--	--	NS	--	--	--

Application of poison bait, neem oil 1% & NSKE 5% was made at 15 days interval starting from flower initiation stage (total four applications)

M: Module

Table 3: Economics of different eco-friendly module for the control of fruit fly, *B. cucurbitae* in sponge gourd during two *khari*f season

Module	Cost of inputs (Rs.)	Quantity of inputs (l/kg per ha)	Total cost of inputs (Rs.)	Cost of inputs + labourer charges (Rs./ha)	Sponge gourd yield (kg/ha)	Gross benefit (Rs./ha)	Net benefit (Rs./ha)	Net cost benefit ratio (NCBR)
M_1: Mass trapping of fruit fly using Cue lure traps @ 30/ha + destruction of infested fruits during each picking	Rs. 10/trap Rs. 20/lure	30 traps 120 lure	2700	2700	5300	79500	14715	1 : 5.45
M_2: Destruction of infested fruits during each picking + poison bait @ 50 l/ha (jaggery 50 g/l + abamectin 1.9% EC 0.0025%)	Jaggory : Rs. 40/kg Abamectin : Rs. 5100/l	Jaggory : 2.5 kg Abamectin : 0.065 l	432	832	5969	89535	24750	1 : 29.75
M_3: M_2 + application of *Azadirechtin* 0.003% at 15 days interval starting from flower initiation stage	M_2 + Neem oil : Rs. 450/l	-- Neem oil : 10 l	4932	5732	6250	93750	28965	1 : 5.05
M_4: M_2 + application of NSKE 5% at 15 days interval starting from flower initiation stage	M_2	--	432	1632	5419	81285	16500	1 : 10.11
M_5: Control (water spray)	--	--	--	800	4319	64785	--	--

- Application of poison bait, *Azadirechtin* 0.003% & NSKE 5% was made at 15 days interval starting from flower initiation stage (total four applications)
- Labourer charges @ Rs. 200/ha/spray
- Quantity of water required for one spray @ 500 l/ha
- M: Module
- The price of sponge gourd fruit @ Rs. 15/kg
- Quantity of water required for one application of poison bait @ 50 l/ha

References

1. Allwood AJ, Chinajariyawong A, Drew RAI, Hamacek EL, Hancock DL, Hengsawad C *et al*. Host plant records for fruit flies (Diptera: Tephritidae) in South-East Asia. The Raffles Bulletin of Zoology, Supplement. 1999; 7:1-99.
2. Anonymous. Recommendations/Achievements made by the Entomology Discipline, GAU, S.K. Nagar, 1972-1992, 183.
3. Coquillette DW. A new Trypetid form Hawaii. *Ent. News*., 10: 129-130. Deshmukh, RP, Patil RS. (1996). Comparative efficacy of baited and non-baited sprays of insecticides and chemical attractant against fruit flies infesting ridge gourd. J Maharashtra Agric. Univ. 1899; 21(3):346-349.
4. Deshmukh RP, Patil RS. Comparative efficacy of baited and non-baited sprays of insecticides and chemical attractant against fruit flies infesting ridge gourd. J Maharashtra Agric. Univ. 1996; 21(3):346-349.
5. Dhillon MK, Singh R, Naresh JS, Sharma HC. The melon fruit fly, *Bactrocera cucurbitae:* A review of its biology and management. J Insec. Sci. 2005; 5:40.
6. DOAC. Directorate of Economics and Statistics, Directorate of Agriculture and Co-operation, Government of India, New-Delhi, 2012.
7. Gupta D, Verma AK. Population fluctuation of the fruit flies (*Dacus cucurbitae* Coq. and *Dacus tau* Walker) infesting cucurbitaceous crops. Advances in pl. sci. 1992; 5(2):518-523.
8. Lefroy HM. Ento. Memo. Dept. Agril. India (Ent. Ser.). 1907; 1:113-252.
9. Mandal SK. Management of *Bactrocera Cucurbitae* Coq. through pheromone traps and bio-rational insecticides in bitter gourd. Annals Pl. Pro. Sci. 2012; 20(1):24-27.
10. Mau RFL, Sugano JS, Jang EB. Farmer education and organization in the Hawaii area wide fruit fly pest management program. Recent Trends on Sterile Insect Technique and Area-wide Integrated Pest Management: Economic Feasibility, Control Projects, Farmer Organization and Dorsalis Complex Control Study, 47-57. Research Institute of Subtropics, Okinawa, Japan, 2003.
11. Naraanan ES, Batra HN. Fruit flies and their control. Indian Council of Agricultural Research, New Delhi, India, 1960, 1-68.
12. Pareek BL, Kavadia VS. Relative preference of fruit fly, *Dacus cucurbitae* Coquillet on different cucurbits. Indian J Ent. 1994; 56(1):72-75.
13. Shooker P, Khayrattee F, Permalloo S. Use of maize as a trap crops for the control of melon fly, *B. cucurbitae* with GF-120. Bio-control and other control methods, 2006. (http//www.fcla.edu/FlaEnt/fe87;354.pdf.).
14. Wood M. Forcing exotic, invasive insects into retreat: new IPM program targets Hawaii's fruit flies. Agricultural Research Washington. 2001; 49:11-13.
15. Fide Dhillon et al., J Insec. Sci. 2005; 5:40.