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BIO EFFICACY OF SOME INSECTICIDES AGAINST FRUIT FLIES INFESTING RIDGE GOURD

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ABSTRACT

Field Experiment was carried out at College of Agriculture, Farm, Dr. B.S.K.K.V., Dapoli during *kharif* 2011 and *kharif* 2012, the relative efficacy of different insecticides were evaluated under field conditions. The cumulative pooled data of the year 2011 and 2012 pertaining to the fruit damage by fruit fly revealed that treatment deltamethrin (0.0016 %) recorded significantly the lowest (20.15 %) fruit damage, however it was statistically at par with DDVP (0.05 %), emamectin benzoate (0.0016 %) and azadirachtin (0.0025 %) with 22.83, 24.05 and 24.79 % fruit damage, respectively. The highest marketable yield was obtained in treatment of deltamethrin 0.025 % (20.95 t ha^{-1}) which was significantly more than rest of the treatments except DDVP 0.05 % (19.96 t ha^{-1}), whereas, DDVP 0.05 % was also found at par with emamectin benzoate 0.0016 %. The treatment emamectin benzoate 0.0016 per cent recorded 18.80 t ha^{-1} yield which was at par with azadirachtin 0.0025 per cent (17.54 t ha^{-1}).

The highest incremental benefit : cost ratio (ICBR) of 1:47.38 was obtained in deltamethrin 0.0025 per cent followed by DDVP 0.05 per cent (1:26.51).

(Key words: Cucurbit fruit flies, ridge gourd, insecticides, bio pesticides, bioefficacy, econimics)

INTRODUCTION

Cucurbits are vegetable crops belonging to family Cucurbitaceae which are consumed as food worldwide. The family consists of about 118 genera and 825 species. In India, number of cucurbits *viz.,* ridge gourd [*Luffa acutangula* (L.) Roxb.], snake gourd (*Trichosanthes anguina* L.), cucumber (*Cucumis sativus* L.), bitter gourd (*Momordica charantia* L.), bottle gourd [*Lagenaria siceraria (Malina)* Standl.], watermelon [*Citrullus lanatus* (Thunb)], sponge gourd (*Luffa cylindrical* Roem), pumpkin [*Cucurbita moschata* (Ducherne)], winter squash [*Cucurbita maxima* (Duchesne)], ash gourd [*Benincasa hispida* Thunb], sweet gourd (*Momordica cochinchinensis*) etc. are cultivated on about 9 million ha with the production of 10.52 t ha^{-1} (Anonymous, 2012).It is estimated that India will need to produce 215,000 tons of vegetables by 2015 to provide food and nutritional security. In recent era of globalization, it has become a challenge for the country not only to feed its own population but also to export fruits and vegetables to various developed countries with strict quality control. Being large group of vegetables, cucurbits provide better scope to enhance overall productivity and production (Rai *et al.,* 2008). The melon, fly also called as fruit fly, *Bactrocera cucurbitae* is a major pest of cucurbitaceous vegetables, particularly ridge gourd, bittergourd, muskmelon, snapmelon and snakegourd causing losses to the extent of even upto 100% (Pareekh and Kavadia, 1995 and Kapoor, 2005). The field experiment on assessment of losses caused by cucurbit fruit fly in different cucurbits has been reported in terms of yield loss to the tune of 28.7-59.2, 24.7-40.0, 27.3-49.3, 19.4-22.1 and 0-26.2% in case of pumpkin, bittergourd, bottlegourd, cucumber and spongegourd respectively (Pradhan, 1976). Nath and Bhushan (2006) screened thirteen cucurbit crops *viz.,* bottle gourd, cucumber, water melon, round gourd, musk melon, bitter gourd, long melon, pumpkin, sponge gourd, smooth gourd, ridge gourd, ash gourd and snake gourd for their resistance to the *B. cucurbitae* in Varanasi, Uttar Pradesh during summer and rainy season and observed maximum damage in bitter gourd (26.11 and 31.96 %) during summer, and minimum in pumpkin (2.78 and 1.39 %). Similarly during rainy season, damage was maximum in bitter gourd (46.8 and 45.3 %) and minimum in pumpkin (7.44 and 11.1 %) in 2011 and 2012, respectively which revealed that bitter gourd followed by bottle gourd was the most preferred host of *B. cucurbitae.* Whereas, the percentage of fruit damage by the melon fruit fly was observed 28.5% and 31.27% in watermelon and bittergourd respectively (Singh *et al.,* 2000).

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The adult female is directly involved in initiating the damage by way of preparing the place in the fruit by scrapping and then depositing the eggs within the fruit. The maggots emerged from eggs feed on the fruit tissue and cause damage in the growing fruit and damage varies a lot on the prevailing climatic condition and the diversity of other hosts in a particular agro-ecosystem. Banerji *et al.* (2005) recorded the activity of melon fly at Kalyani, West Bengal during *kharif*, initial activity was noticed during first week of August, however, the highest incidence was noticed during middle of October and then infestation started declining. In *rabi* season, the peak population of the fruit fly (33.33%) was recorded during 2nd and 3rd week of April. The highest infestation level was found in the first week of June (43.33%) during summer. Dhillon *et al.* (2005) while investigating on melon fly, *B. cucurbitae,* stated that the losses vary from 30 to 100 % depending on the cucurbit species and the season and abundance of the fly which increases when the temperature fall below 32°C and the relative humidity ranges between 60 and 70 %. However, Raghuvanshi *et al.* (2012) monitored seasonal abundance of fruit fly, *B. cucurbitae* in cue lure baited traps at Varanasi, indicated that there were two peaks in summer and *kharif* coincided with 14 SW (1st week of April) and 43 SW (4th week of October), respectively. As regarding bitter gourd fruit damage, 62.70 % damage was occurred at 45 SW (2nd week of November) and the second peak was in the 15 SW (2nd week of April) with 49.70 % fruit damage. Morde (2003) reported *B. cucurbitae* and *B. tau* infesting little gourd, cucumber, bottle gourd and wild cucurbits. However, *B. cucurbitae* observed to be predominant in bottle gourd, bitter gourd and sponge gourd in Panvel area of Maharashtra to the extent of 100 %. Whereas, *B. tau* was observed to be the predominant and recorded 100 % population in sponge gourd and ridge gourd from Wakawali area in Maharashtra, whereas both the species were found infesting ridge gourd, snake gourd cucumber and wild cucurbits in Dapoli area of Maharashtra.

In India, an approximate loss of Rs. 26,902 million occurred in case of cucurbits from such a single dreadfull insect pest where control measures were not applied (Stonehouse, 2001). Ravindranath and Pillai (1986) observed Deltamethrin 15 g a.i. hectare^{-1} effective in reducing damage of *D. cucurbitae* in bitter gourd as compared to malathion. Bhatnagar and Yadava (1992) evaluated efficacy of the five insecticides *viz.* carbaryl 50 WDP, fenitrothion 50 EC, malathion 50 EC, quinalphos 25 EC and dichlorovos 100 EC against fruit fly (*D. cucurbitae*) infesting bottle gourd, sponge gourd and ridge gourd. Among them, malathion 0.05 % proved to be the best treatment with minimum infestation of 6.9 % followed by carbaryl, quinalphos, dichlorovos, and fenitrothion which recorded 11.1, 12.9, 14.9 and 17.9 % fruit damage, respectively in ridge gourd.

Thus, apart from nutritional management, the menace by the fruit flies is a serious bottleneck in enhancing production of cucurbits. In this context, the present investigation was undertaken to evaluate bio efficacy of some insecticides against fruit flies infesting ridge gourd.

MATERIALS AND METHODS

A statistically designed field experiment with randomised block design was conducted during *kharif* season of 2011 and 2012 at College of Agriculture Farm, Dr.B.S. Kokan Krishi Vidyapeeth, Dapoli, District Ratnagiri using eight treatments replicated thrice (Table 1). A promising variety of ridge gourd, 'Kokan Harita' was transplanted in plots measuring 3 m x 2 m with a spacing of 3 m x 0.6 m on 28/06/2011 and 11/06/2012. The recommended package of practices was followed for successful cultivation of ridge gourd crop. The desired concentrations of test insecticides were prepared on the basis of active ingredient present in respective trade products. The actual quantity of spray volume required treatment^{-1} plot^{-1} was calibrated by using water. For preparation of spray emulsion, the measured quantity of insecticides was mixed with desired quantity of water and one per cent each Jaggery and Hydrolysed yeast were added in spray solution. The spray solution was thoroughly stirred with the help of wooden stick before application. Total three sprays were taken on date 16/9/2011, 1/10/2011, 16/10/2011 and 18/8/2012, 1/9/2012, 16/9/2012 during 2011 and 2012 respectively at an interval of 15 days, commencing from initiation of fruit set. Care was taken to wash the spray pump with water thoroughly well before switching to other treatment. For spraying, Knapsack sprayer was used. The healthy and the infested fruits were plucked separately after 7 days of the first, second and third

sprays and subsequent pickings were undertaken in each treatment as per the growth of fruits to marketable size. Total 8 pickings and 11 pickings were undertaken in 2011 and 2012 respectively and the number of fruits damaged on the basis of the cumulative number of fruits during entire cropping season was recorded in each treatment. The cumulative per cent fruit infestation was worked out on the basis of healthy and damaged fruits from each treatment plot from all the pickings. The yield data of healthy marketed fruits was compiled from all the pickings to report the yield of fruits ha^{-1}. The data, thus, obtained were subjected to arc sin transformation and were analysed statistically. Economics of application of various insecticides with respect to yield under each treatment was calculated and ICBR was determined.

Table 1. Treatment details

Treatment No.	Treatments	Trade Name	Concentration (%)
T_1	DDVP 76WSC	Doom	0.05
T_2	Malathion 50 EC	Milthion	0.05
T_3	Emamectin Benzoate 5 SG	Proclaim	0.0016
T_4	Spinosad 45 SC	Tracer	0.016
T_5	Carbaryl 50 WDP	Sevin	0.1
T_6	Deltamethrin 2.8 EC	Decis	0.0025
T_7	Azadirachtin 10,000 ppm	Neem Fighter	0.0025
T_8	Control (Water spray)		--

RESULTS AND DISCUSSION

Bioefficacy of some insecticides against fruit fly (2011) :

The results of *kharif* 2011 are presented in table 2. The observations on cumulative percentage of fruit infestation recorded upto last picking indicated that the fruit damage varied from 19.94 to 45.40 % in various treatments. The treatment deltamethrin (0.0025%) was found to be the most effective with 19.94 % fruit damage, however, it was at par with DDVP (0.05%) and emamectin benzoate (0.001%) wherein 24.58 and 24.70 % fruit infestation were noticed, respectively. On the other hand, the treatment emamectin benzoate was also found at par with rest of the treatments except control.

Bioefficacy of some insecticides against fruit fly (2012) :

The data presented in table 2 of *kharif* 2012, indicated that the cumulative percentage of fruit infestation ranged from 20.25 to 46.13 %, in various treatments. The treatment deltamethrin (0.0025%) was also found significantly effective with 20.25 % fruit damage and it was at par with DDVP (0.05%), emamectin benzoate (0.0016%), azadirachtin (0.0025%) and spinosad (0.016%) with 22.04, 23.80, 24.27, 24.96 % fruit infestation, respectively. Whereas, treatment DDVP was also at par with rest of the all treatment except control (46.13 % fruit damage).

Pooled per cent fruit damage by fruit fly in different treatments (2011 and 2012) :

The cumulative pooled data of the year 2011 and 2012 pertaining to the fruit damage by fruit fly (Table 2 and Fig. 3) revealed that the treatment deltamethrin (0.0025%) recorded significantly the lowest fruit damage of 20.15 % however, it was statistically at par with DDVP (0.05%), emamectin benzoate (0.0016%) and azadirachtin (0.0025%) with 22.83, 24.05 and 24.79% fruit damage, respectively. For the remaining treatments, the order of efficacy was spinosad (0.016%) > malathion (0.05%) > carbaryl (0.1%) with 25.44, 26.84 and 27.72 % fruit damage, respectively. The highest fruit damage was recorded in the control plot (44.95%).

The results envisage that the insecticide deltamethrin observed to be the most effective treatment against fruit fly. Ravindranath and Pillai (1986) observed Deltamethrin 15 g a.i. $hectare^{-1}$ effective in reducing damage of *D. cucurbitae* in bitter gourd as compared to malathion and Sood and Sharma (2004) reported the bioefficacy of synthetic pyrethroids alongwith gur solution 1 per cent. The treatment deltamethrin (37.5 g $a.i.ha^{-1}$), cypermethrin (75 g a.i. ha^{-1}) and fenvalarate (75 g a.i. ha^{-1}) gave significantly less fruit infestation of fruit fly on summer squash as compare to malathion (37.5 g a.i. ha^{-1}). The neem derivatives *viz,*. achook, econeem and neemjeevan were found comparatively less effective than synthetic insecticides.

Similarly, dichlorovos (DDVP) was also observed equally effective to that of deltamethrin. Deshmukh and Patil (1996) reported that DDVP (0.05%) + hydrolyzed yeast + gur gave maximum protection and malathion (0.05%) + 1.0 % gur was found next best treatment against fruitflies infesting ridge gourd. Emamectin benzoate was observed effective and at par with DDVP in the present study. However, earlier it was reported comparatively less effective than spinosad and neem derivatives by Waseem *et al.* (2009). The effectiveness of neem oil at 1.2 per cent was reported by Ranganathan *et al.* (1997) in reducing damage of fruit fly on cucumber. They also observed neem cake at 4.0 per cent and dichlorovos at 0.2 per cent the most effective against fruit fly on ridge gourd. Nath *et al.* (2007) reported NSKE @ 5 per cent bait spray with Malathion 50g + Molasses 500g + 50 litre water and cypermethrin applied one after another as per schedule, resulted in minimum fruit damage by the fruit fly in bottle gourd fruits.

Marketable fruit yield :

(a) *Kharif* 2011 :

The yield data presented in table 3 indicated that the highest yield of marketable fruits was recorded in the plots treated with deltamethrin 0.0025 % (14.50 ton ha^{-1}) which was significantly more than rest of the treatments. The next treatments which recorded comparatively good yield were DDVP 0.05 % (12.92 ton ha^{-1}), emamectin benzoate 0.0016 % (12.82 ton ha^{-1}), azadirachtin 0.0025 % (12.50 ton ha^{-1}) and were found at par with each other. The treatment carbaryl 0.1 % recorded significantly more yield than malathion 0.05 %, however, it was also at par with azadirachtin 0.0025 % and spinosad 0.016 %. The lowest yield of 7.53 ton ha^{-1} was recorded in control.

(b) *Kharif* 2012 :

The maximum marketable fruit yield of ridge gourd (Table 3) was obtained in the treatment deltamethrin 0.0025 % (27.40 ton ha^{-1}), however it was at par with DDVP 0.05 % (26.99 ton ha^{-1}) and both were significantly superior over rest of the treatments. The treatment emamectin benzoate 0.0016 % (24.77 ton ha^{-1}) recorded significantly more yield over rest of the treatments except azadirachtin 0.0025 % (22.85 ton ha^{-1}). On the other hand, azadirachtin 0.0025 % was also at par with spinosad 0.016 % (22.63 ton ha^{-1}) and malathion 0.05 % (21.69 ton ha^{-1}).

Pooled results of marketable fruit yield (2011 and 2012) :

The pooled yield data of the year 2011 and 2012 presented in table 3 and depicted in fig. 6, indicated that the highest yield was obtained in deltamethrin 0.0025 % (20.95 t ha^{-1}) which was significantly more than rest of the treatments except DDVP 0.05 % (19.96 t ha^{-1}). However, DDVP 0.05 % was also at par with emamectin benzoate 0.0016 %. Treatment emamectin benzoate recorded 18.80 t ha^{-1} yield and was at par with azadirachtin 0.0025 % (17.68 t ha^{-1}) and spinosad 0.016 % (17.54 t ha^{-1}) followed by malathion 0.05 % (16.24 t ha^{-1}) and carbaryl 0.1 % (16.04 t ha^{-1}). However, the minimum yield of 11.00 t ha^{-1} was obtained in the control plot.

Economics :

Economics of different insecticidal treatments are presented in table 4. The highest ICBR 1:47.38 was obtained in deltamethrin 0.0025 % followed by DDVP 0.05 % (1:45.40) and malathion 0.05 % (1:26.51). The remaining treatments in descending order of ICBR were emamectin benzoate 0.0016 % (1:20.43), azadirachtin 0.0025 % (1:20.27), carbaryl 0.1 % (1:19.20) and spinosad 0.016 % (1:19.03).

Considering the effectiveness of the treatments, deltamethrin 0.0025 %, DDVP 0.05 %, emamectin benzoate 0.0016 % and azadirachtin 0.0025 % were found effective in reducing the fruit damage, which in turn resulted in higher yield. These treatments gave higher net returns over control, which was worked out to Rs. 2,18,177 (deltamethrin 0.0025 %), Rs. 1,96,670 (DDVP 0.05 %), Rs. 1,67,292 (emamectin benzoate 0.0016 %) and Rs. 1,43,750 (azadirachtin 0.0025 %) $hectare^{-1}$. The remaining treatment viz., spinosad 0.016 %, malathion 0.05 % and carbaryl 0.1 % gave comparatively less net returns to the tune of Rs. 1,40,385, 1,14,830, 1,09,080, respectively over control.

Table 2. Bio-efficacy of some insecticides against fruit fly (Pooled 2011 - 2012)

Tr. No.	Treatment	Concentration (%)	Cumulative Effect- 2011	Cumulative Effect- 2012	Pooled
T_1	DDVP 76 WSC	0.05	24.58 (29.69)	22.04 (27.99)	22.83 (28.53)
T_2	Malathion 50 EC	0.05	27.88 (31.86)	26.54 (31.00)	26.84 (31.20)
T_3	Emamectin benzoate 5 SG	0.0016	24.70 (29.73)	23.80 (29.17)	24.05 (29.32)
T_4	Spinosad 45 SC	0.016	26.67 (30.98)	24.96 (29.96)	25.44 (30.29)
T_5	Carbaryl 50 WDP	0.1	27.25 (31.45)	27.72 (31.70)	27.72 (31.74)
T_6	Deltamethrin 2.8 EC	0.0025	19.94 (26.52)	20.25 (26.73)	20.15 (26.66)
T_7	Azadirachtin 10,000 ppm	0.0025	26.09 (30.70)	24.27 (29.45)	24.79 (29.82)
T_8	Water spray (Control)	---	45.40 (42.36)	46.13 (42.77)	44.95 (42.09)
	SEm +	---	**1.27**	**1.36**	**1.13**
	CD (p=0.05)	---	**3.86**	**4.13**	**3.43**

Figures in the parenthesis are arc sin value

Table 3. Effect of insecticidal spray on marketable fruit yield

Tr. No.	Treatments	Concentration (%)	Fruit yield (ton ha^{-1})		
			2011	2012	Pooled
T_1	DDVP 76 WSC	0.05	12.92	26.99	19.96
T_2	Malathion 50 EC	0.05	10.79	21.69	16.24
T_3	Emamectin benzoate 5 SG	0.0016	12.82	24.77	18.80
T_4	Spinosad 45 SC	0.016	12.45	22.63	17.54
T_5	Carbaryl 50 WDP	0.1	11.96	20.13	16.04
T_6	Deltamethrin 2.8 EC	0.0025	14.50	27.40	20.95
T_7	Azadirachtin 10,000 ppm	0.0025	12.50	22.85	17.68
T_8	Water spray (Control)	---	7.53	14.47	11.00
	S.Em. ±		**0.30**	**0.67**	**0.42**
	CD (p=0.05)		**0.92**	**2.02**	**1.32**

Table 4. Economics of different treatments for the control of fruit flies infesting Ridge gourd

Treatments	Marketable fruit yield (tons ha^{-1})	Cost of cultivation (Rs) (excluding cost of treatment)	Total quantity of insecticide required for kg ha^{-1} (3 sprays)	Total quantity of insecticide required	Price of insecticide (Rs/lit or Kg)	Total cost of insecticide ha^{-1} (Rs)	Cost of jaggary + hydrolysed yeast ha^{-1} (Rs)	Labour charges (Rs ha^{-1}) (3 sprays)	Total cost of treatmen (Rs ha^{-1})	Total cost of cultivation (Rs ha^{-1})	Gross realization (Rs.)	Net return (Rs.)	Net realization over control	ICBR ration
DDVP 76 WSC	19.96	1,15,349	0.33	0.99	450	450	1770	2112	4332	119681	4,39,120	319439	196670	1:45.40
Malathion 50EC	16.24	1,15,349	0.50	1.5	300	450	1770	2112	4332	119681	3,57,280	237599	114830	1:26.51
Emamectin benzoate 5 SG	18.80	1,15,349	0.16	0.49	8,600	4,308	1770	2112	8190	123539	4,13,600	290061	167292	1:20.43
Spinosad 45 SC	17.54	1,15,349	0.077	0.23	15,000	3,495	1770	2112	7377	122726	3,85,880	263154	140385	1:19.03
Carbaryl 50 WDP	16.04	1,15,349	1.0	3	900	1,800	1770	2112	5682	121031	3,52,880	231849	109080	1:19.20
Deltamethrin 2.8 EC	20.95	1,15,349	0.44	1.33	540	723	1770	2112	4605	119954	4,60,900	340946	218177	1:47.38
Azadirachtin 10,000 ppm	17.68	1,15,349	1.24	3.73	700	3,210	1770	2112	7092	122441	3,88,960	266519	143750	1:20.27
Water spray (Control)	11.00	1,15,349	---	---	---	---	1770	2112	3882	119231	2,42,000	122769	---	---

Market value of ridge gourd fruits – Rs. 22 kg^{-1},
12 Labours ha^{-1} @ Rs. 176/-
15 kg jaggary@ Rs. 40 kg^{-1} & Hydrolysed yeast @ Rs. 78 kg^{-1}

Mehta *et al.* (2000) recorded the highest fruit yield of cucumber in deltamethrin + molasses treatment (13.00 and 12.78 kg plot^{-1}) and was significantly superior than other treatments viz., malathion, endosulfon, carbaryl, cypermethrin, deltamenthrin alone and acephate varying from 5.26-7.68 and 5.76-8.13 kg as compared to 3.80 and 4.10 kg in untreated control during 1998 and 1999, respectively. Sood and Sharma (2004) also reported maximum fruit yield of summer squash in the deltametherin treatment (205.61 q ha^{-1}) followed by cypermethrin (186.13 q ha^{-1}), fenvalerate (174.71 q ha^{-1}), malathion (168.22 q ha^{-1}), deltametherin + achook(163.29 q ha^{-1}) as compared to control (95.73 q ha^{-1}).

REFERENCES

Anonymous 2012. FAO Statistics available at http://www.fao.stat.

Banerji, R. K. Shyamal, K. Sahoo, S. K. Das and S. Jha, 2005. Studies on incidence of melon fly *Bactrocera cucurbitae* coq. in relation to weather parameters on bitter gourd in new alluvial zone of west Bengal. J. ent. Res. **29**(3) : 179-182.

Bhatnagar, K.N. and S.R.S. Yadava, 1992. An insecticidal trial for reducing the damage of some cucurbitaceous fruits due to *Dacus cucurbitae*. Indian J. Ent. **54**(1) : 66-69.

Deshmukh, R.P. and R.S. Patil, 1996. Comparative efficacy of baited and non baited sprays of insecticides and chemical attractants against fruit flies infesting ridge gourd. J. Maharashtra agric. Uni. **21** : 346-349.

Dhillon, M. K., Ram Singh., J. S. Naresh and H.C. Sharma, 2005. The melon fruit fly. *Bactrocera cucurbitae* : A review of its biology and management. J. Insect Sci. **5**(40). 1-16.

Kapoor, V. C. 2005. Taxonomy and Biology of Economically Important fruit flies of India. Biotaxonomy of Tephritoidea. Israel. J. Ent. 35-36 : 459-475.

Mehta, P.K., R.S. Chandel and N.P.Kashyap, 2000. Control of fruit fly, *Bactrocera cucurbitae* (Coq.) on cucumber in Himachal Pradesh. Pestology. **24** (10):53-55.

Morde, S.C. 2003. Studies on fruit fly complex of the Konkan region. Unpublished M.Sc. (Agric.) Thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli (M.S.), India.

Nath, P. and S. Bhushan, 2006. Screening of cucurbits crops against fruit fly. Ann. Plant. Prot. Sci. **14**(2): 472-473.

Nath, P. S. Bushan and Akhilesh Kumar, 2007. Efficacy of certain ecofriendly insecticides and bait spray against fruit fly *(B. cucurbitae)* infesting fruits of bottle gourd. Veg. Sci. **34** : 150-152.

Pareek, B. L. and V. S. Kavadia, 1995 Screening of muskmelon varieties against fruit fly. *Dacus cucurbitae* Coquillett under field conditions. Indian J. Ent. **57** (4) : 417-420.

Pradhan, R. B. 1976. Relative susceptibilities of some vegetables grown in Kathmandu valley to *D. cucurbitae Coq.* Nepalese J. Agric. **12** : 67-75.

Raghuvanshi, A. K., S. Satpathy and D. S. Mishra, 2012. Role of abiotic factors, seasonal abundance and infestation of fruit fly. *Bactrocera cucurbitae* (Coq.) on Bitter gourd J. Plant Prot. Res. **52** (2). 264-267.

Ranganathan, H.R., M.A. Suryanarayana and K. Veenakumari, 1997. Management of melon fly (*Bactrocera (Zeugodacus) cucurbitae* Coq.) in cucurbits in South Andaman. Insect Environ., **3** : 32-33.

Rai, M., S. Pandey and S. Kumar, 2008. Cucurbit research in India: a retrospect cucurbitaceae, Proceeding of IXth EUCARPIA meeting on genetics and breeding of cucurbitaceae (Pihat M, ed.), INRA, Avignon (France), May 21-24th 2008.

Ravindranath, K. and K.S. Pillai, 1986. Control of fruit fly of bittergourd using synthetic pyrethroids. Entomon. **11**(4) : 269-272.

Singh, S. U., Alok Mishra, Bisen R. S. and Y. P. Malik, 2000. Host preference of red pumpkin beetle and melon fruit fly. Indian J. Ent. **62** (3): 242-246

Sood, P. and P.C. Sharma, 2004. Bioefficacy and persistent toxicity of different insecticides and neem derivatives against cucurbits fruit fly. *B. cucurbitae* (Coq.) on summer squash. Pesticide Res. J. **16**(2) : 22-25.

Stonehouse, J. 2001. An overview of fruit fly research knowledge and needs in the Indian Ocean region. Proc. Second national Symp. Integrated Pest Management (IPM) in Horticultural crops. New molecules, Biopesticides. Enviorn. Bangalore, pp. 21-23.

Waseem, M.A., A. Nagungoud, B.V. Patil, A. Prabhuraj and A. Hussain, 2009. Efficacy of some insecticides against melon fly, *Bactrocera cucurbitae* Coquillett on cucumber. Karnataka J. agric. Sci. **22**(3, Spl. issue) : 701-702.

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