Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(3): 1795-1800

Received: 08-03-2018
Accepted: 11-04-2018

Abhilash J
Department of Entomology, College of Agriculture, Shivamogga, Karnataka, India.

Naveen NE
Scientist, Agronomy, K. V. K., Brahmavar, Karnataka, India

Patil SU
Professor, Department of Entomology, ZAHRS Brahmavar, Karnataka, India.

Sharanabasappa
Assistant professor, Department of Entomology, College of Agriculture, Shivamogga, Karnataka, India.

Correspondence
Abhilash J
Department of Entomology, College of Agriculture, Shivamogga, Karnataka, India.

Assessment of efficacy of botanicals against melon fruit fly (*Bactrocera cucurbitae*) Col. (Diptera: Tephritidae) in ridge gourd

Abhilash J, Naveen NE, Patil SU and Sharanabasappa

Abstract
The management of melon fruit fly (*Bactrocera cucurbitae*) simply through the application of chemical pesticides is very difficult. Keeping in mind the aforesaid hazardous impact of chemicals on human's health. The present study on assessment of botanicals against melon fruit fly in ridge gourd was carried out at farmer field at Basavangangur, Shivamogga during *Rabi* 2016-17. During the course of investigation, among six different botanicals, the lowest fruit infestation of 26.53% was registered from Azadirachtin 1% EC @ 2ml/l treatment followed by NSKE 5 % treatment with 29.06 % fruit infestation. Similarly, Azadirachtin 1% EC treatment gave highest fruit yield of 91.85 q/ha. Among various botanical treated fruits of ridge gourd, Azadiractin 1 % EC and NSKE 5 % treated fruits recorded higher per cent ovipositional deterrence over control of 74.26 and 68.26 %, respectively and lower egg hatchability of 60.50 and 62.25 %, respectively. Thus the present results concluded that spraying with Azadiractin 1 per cent EC and NSKE 5 per cent could prove the substitute to commonly used chemical pesticides for the management of melon fruit fly on ridge gourd.

Keywords: *B. cucurbitae*, melon fruit fly, ridge gourd, botanicals, assessment

1. Introduction
Ridge gourd [*Luffa acutangula* (L.) Roxb.] belongs to genus *Luffa* of Cucurbitaceous family and has a chromosome number 2n = 26 and is native to India. Tender fruits are green in colour, which are used in soups and curries or as a cooked vegetable. In India, ridge gourd is cultivated in an area of 10,037 hectares with a production of 3,16,925 tons and 31.6 tons/hectare productivity [2]. In Karnataka, the crop is grown in an area of 4970 hectares with a production of 42856 tons and productivity of 8.62 tons/hectare [1]. Insect pests are the major constraint for increasing the production and productivity of ridge gourd crop. *Bactrocera cucurbitae* (Coquillett) (Diptera: Tephritidae) affects as much as 0.44 lakh metric ton fruits in ridge gourd and render an annual loss of 21.80 crore rupees in India [14]. At present in India, the control measures for *B. cucurbitae* mainly rely on contact poison or baits. Contact poisons may have the deleterious effect on health. It is very difficult to manage the pest simply through the application of chemical pesticides since three of its life stages are hidden and only the adult stage is the usual target of the pest control measures [7]. Therefore, there is a dire need to explore alternate methods of management and develop an integrated eco-friendly effective management strategy for this pest.
Keeping in mind the aforesaid hazardous impact of chemicals on the environment, human's health and economic importance of this pest. The present study on evaluation of botanicals against melon fruit fly was conducted.

2. Materials and Methods
2.1 Efficiency of botanicals against fruit fly infestation in ridge gourd
The experiment was conducted during *Rabi* 2016- 2017 at farmer's field Basavangangur, Shivamogga, Karnataka, India. In a randomised block design with seven treatments and three replication, using a variety Naga F1 in a plot size of (5.5 x 2.5m) at spacing (95x150cm) with recommended package of practices excluding plant protection. Six different botanicals *viz.* NSKE 5% aqueous extract, Azadirachtin 1% EC (2ml/l), *Acorus calamus* 5% aqueous rhizome extract, Garlic bulb extract 5%, Turmeric powder extract 5% and *Vitex negundo* leaf extract 5% were assessed for its efficacy against melon fruit fly on ridge gourd and a control

was also maintained. At five per cent incidence of fruit fly damage, the first foliar spray of each treatment was taken. Sprays were taken up using high volume knapsack sprayer. Three rounds of sprays were taken at ten days interval; subsequently there were two pickings of fruits between every interval of application of treatment. Thus, there were totally seven pickings.

The following observations were recorded one day before spray as pre count and 5th and 10th days after each spray from each plot.

Per cent fruit damage

$$\text{Cumulative per cent fruit damage} = \frac{\text{Number of infested fruits (kg)}}{\text{Total number of fruits harvested (kg)}} \times 100$$

Per cent reduction of infestation over control

This observation was recorded for every application of treatments separately by the formula of:

$$\frac{\text{Mean infestation in control - mean infestation in respective}}{\text{Mean infestation in control}} \text{ X } 100$$

Marketable Yield

The data on marketable yield were recorded after deducting damaged yield in each treatment after every application of treatment separately and these observations were converted per hectare basis.

2.2. Effect of botanicals on oviposition, egg hatchability and maggot survivability by melon fruit fly, *B. cucurbitae*

Selection of fruits to study the oviposition deterrence and egg hatchability

Fruits with light brown resinous fluid over oviposition punctures were collected from the field after five to six days of treatment. A single fruit was collected from each treatment in respective replication to count the number of eggs laid and number of eggs hatched in order to calculate ovipositional deterrence and per cent egg hatchability.

Per cent oviposition deterrence was calculated using the formula

$$\text{Oviposition Deterrence (\%)} = \frac{C - T}{C} \text{ X } 100$$

C = Number of egg count in control,
T = Number of egg count in respective treatment.

Per cent egg hatchability was calculated using the formula

$$\text{Hatchability (\%)} = \frac{H}{L} \text{ X } 100$$

H= Number of egg count,
L = Number of egg hatched count.

Selection of fruits to study the maggot survivability

The fruits showing fruit fly damage symptoms were selected ten days after fresh infestation from each treatment randomrly in respective replication to record the number of maggots per fruit in order to calculate maggot survivability.

Per cent reduction of maggot survivability over control

$$\frac{\text{Mean number of maggot count in control - mean number of maggot count in respective treatment}}{\text{Mean number of maggot count in control}} \text{ X } 100$$

3. Results

3.1 Efficiency of different botanicals against melon fruit fly infestation in ridge gourd

Observations taken during pre-treatment picking of fruits (a day before imposition of treatments) indicated that there was no significant difference among treatments with fruit damage ranging from 49.25 to 53.22 per cent (Table 1).

First application of treatments

The data recorded at first picking of fruits (5 days after imposition of treatments) revealed that among the various botanicals, Azadirachtin 1 per cent EC found superior over other treatments by recording significantly lesser infestation of 30.07 per cent followed by Neem seed kernel extract (NSKE) 5 per cent observed 34.51 per cent infestation. The next best treatment was *Acorus calamus* rhizome extract 5 per cent (41.91 %) followed by *Vitex negundo* leaf extract 5 per cent (48.85 %). Higher infestation was registered in the treatments like garlic bulb extract 5 per cent (54.17 %) and turmeric powder extract 5 per cent (56.08 %) which was on par with each other. The untreated check (61.21 %) was significantly inferior over other treatments (Table 1).

During second picking of fruits (10 days after imposition of treatments), Azadirachtin 1 per cent EC recorded least infestation of 27.91 per cent which was on par with the NSKE 5 per cent (30.09 %). The next best treatment was *A. calamus* rhizome extract 5 per cent (46.14%) followed by *V. negundo* leaf extract 5per cent (51.66 %). As that of first picking spraying with garlic bulb extract 5 per cent (55.38%) and turmeric powder extract 5 per cent (58.12 %) registered higher infestation but superior to untreated check (66.78 %) (Table 1).

Second application of treatments

At five days after second application (third picking), Azadirachtin 1 per cent EC recorded significantly lowest per cent infested fruits of 26.14 per cent followed by NSKE 5 per cent with 28.30 per cent infested fruits. *A. calamu* rhizome extract 5 per cent was the next best treatment (44.43 %) followed by *V. negundo* leaf extract 5 per cent (51.22 %). However, highest infestation of fruits was observed in garlic bulb extract 5 per cent (53.27%), which was on par with the turmeric powder extract 5 per cent (56.36 %) but both the treatment found significantly superior over the untreated check with 70.84 per cent fruit infestation (Table 1).

At fourth picking (ten days after imposition of treatments), where Azadirachtin 1per cent EC (25.85 %) was on par with NSKE 5 per cent (27.82 %). The next best treatment was *A. calamus* rhizome extract 5 per cent (46.76 %). The per cent fruit infestation 54.12 per cent was recorded in *V. negundo* leaf extract 5 per cent, garlic bulb extract 5 per cent (56.58 %) and turmeric powder extract 5 per cent (58.60 %), which were on par with each other. The highest infestation recorded in the untreated check (72.70 %) (Table 1).

Third application of treatments

At five days after third application (fifth picking), Azadirachtin 1 per cent EC (24.11 %) was significantly on par with NSKE 5 per cent (26.50 %). The next best treatments

were *A. calamus* rhizome extract 5 per cent (45.22 %), *V. negundo* leaf extract 5 per cent (53.06 %) and garlic bulb extract 5 per cent (55.87 %). Whereas, higher infestation of fruits was observed in the treatment of turmeric powder extract (57.42 %) but it was superior to untreated check (72.57 %) (Table 1).

Similar trend was followed at ten days after imposition of treatments (sixth picking) where Azadirachtin 1 per cent EC (23.06 %) was significantly on par with the NSKE 5 per cent (25.37 %). Efficacy of other treatments was similar as that of five days after third application with *A. calamus* rhizome extract 5 per cent (47.27 %) as next better treatment, followed by *V. negundo* leaf extract (55.03 %), garlic bulb extract (58.52 %) and turmeric powder extract (59.95 %). Significantly highest infestation was recorded in the untreated check (75.50 %) (Table 1).

Overall mean percent fruit damage

Among different botanicals lowest mean percent fruit damage noticed from Azadirachtin 1 per cent EC (26.53 %) and stood significantly on par with NSKE 5 per cent with 29.06 per cent infestation. The next least infestation was evident in *A. calamus* rhizome extract 5 per (45.18 %) which was followed by *V. negundo* leaf extract 5 per cent (52.02 %). The highest infestation was recorded in garlic bulb extract 5 per cent (55.21 %) and on par with turmeric powder extracts 5 per cent (57.58 %). Highest fruit damage noticed from untreated control (69.65 %) (Table 1).

Overall mean percent reduction of fruit damage over control

Highest fruit damage per cent reduction over control was recorded in Azadirachtin 1per cent EC (62.14 %) followed by NSKE 5 per cent (58.37 %). *A. calamus* rhizome extract 5 per cent, *V. negundo* leaf extract 5 per cent and garlic bulb extract 5 per cent registered 35.05, 25.01 and 20.22 per cent fruit damage reduction, respectively over untreated control. The least per cent reduction of fruit damage was registered in turmeric powder extract (17.11%) (Table 1).

Total marketable yield

Application of various botanicals resulted in significantly highest marketable yield than untreated control. However, the treatment Azadirachtin 1 per cent EC registered significantly highest total marketable yield of 91.85 q/ha followed by NSKE 5 per cent (84.82 q/ha) which were on par with each other. The treatments with *A. calamus* rhizome extract 5 per cent recorded 61.91 q/ha which was on par with *V. negundo* 5 per cent leaf extract which recorded 59.19 q/ha yield. The untreated check was found to be the significantly lowest yield of 39.92 q/ha as compared to other treatments (Table 1).

Table 1: Efficiency of different botanicals against melon fruit fly infestation in ridge gourd

Treatments	Per cent infested fruits at							Over all mean per cent damage	Overall Mean per cent reduction over control	Total marketable yield (q/ha)
	PTP (1DBT)	1st spray		2nd spray		3rd spray				
		First picking (5 DAT)	Second Picking (10 DAT)	Third picking (5 DAT)	Fourth Picking (10 DAT)	Fifth picking (5 DAT)	Sixth picking (10 DAT)			
NSKE 5%	51.55 # (45.86)	34.51 (35.90)^{cd}	30.09 (33.08)^{c}	28.30 (31.90)^{cd}	27.82 (31.62)^{c}	26.50 (30.92)^{c}	25.37 (29.99)^{c}	29.06# (32.58)^{d}	58.37	84.82 ^{a} $
Azadirachtin 1% EC	52.35 (46.35)	30.07 (32.67)^{d}	27.91 (31.73)^{c}	26.14 (30.47)^{d}	25.85 (30.35)^{c}	24.11 (29.29)^{c}	23.06 (28.44)^{c}	26.53 (30.86)^{d}	62.14	91.85 ^{a}
A. calamus rhizome extract 5%	52.27 (46.30)	41.91 (40.31)^{bcd}	46.14 (42.81)^{b}	44.43 (41.70)^{bc}	46.76 (43.11)^{b}	45.22 (42.21)^{b}	47.27 (43.39)^{b}	45.18 (42.20)^{c}	35.05	61.91 ^{b}
Garlic bulb extract 5%	53.22 (46.85)	54.17 (47.39)^{ab}	55.38 (48.09)^{ab}	53.27 (46.90)^{ab}	56.58 (48.85)^{b}	55.87 (48.30)^{b}	58.52 (49.97)^{ab}	55.21 (47.98)^{b}	20.22	53.07 ^{cd}
Turmeric powder extract 5%	49.25 (44.55)	56.08 (48.47)^{ab}	58.12 (49.68)^{ab}	56.36 (48.70)^{ab}	58.60 (49.95)^{b}	57.42 (49.36)^{ab}	59.95 (50.85)^{ab}	57.58 (49.35)^{b}	17.11	48.59 ^{d}
V. negundo leaf extract 5%	50.9 (45.50)	48.85 (44.33)^{abc}	51.66 (45.94)^{b}	51.22 (45.68)^{b}	54.12 (47.38)^{b}	53.06 (46.75)^{b}	55.03 (48.00)^{b}	52.02 (46.14)^{bc}	25.01	59.19 ^{bc}
Untreated check	51.32 (45.75)	61.21 (51.48)^{a}	66.78 (54.86)^{a}	70.84 (57.61)^{a}	72.70 (58.55)^{a}	72.57 (58.60)^{a}	75.50 (60.78)^{a}	69.65 (56.58)^{a}	--	39.92 ^{e}
SEm±	2.97	2.75	2.40	3.41	2.62	2.92	3.63	1.31	--	2.56
CD (P=0.0 5)	9.00	8.34	7.27	10.35	7.95	8.85	11.02	3.96	--	7.75
CV (%)	11.21	11.10	9.49	13.66	10.25	11.57	14.14	9.10	--	7.14
F value	NS	*	*	*	*	*	*	*	--	*

PTP- pre treatment picking; DBT-Days before treatment; DAT-Days after treatment, $- Total marketable yield from first picking to sixth picking. #- Figures in parentheses indicate arc sine transformed values. Means followed by the same letters do not differ significantly at p=0.05 by DMRT,*- Significant, NS- Non significant.

3.2. Effect of botanicals on oviposition, egg hatchability and maggot survival ability by melon fruit fly, *B. cucurbitae*

The present study was conducted to know the effect of different botanicals on oviposition, egg hatchability and maggot survival ability of *B. cucurbitae* on ridge gourd after exposing to different botanicals in the field.

Effect of botanicals on egg count

Ridge gourd fruits which were treated by different botanicals caused significant reduction in egg laying of *B. cucurbitae*. The least number of eggs with 14.33 eggs per fruit were recorded from the fruits treated with Azadirachtin 1 per cent EC, followed by NSKE 5 per cent treated fruits with 17.67 eggs per fruit. Moderate numbers of eggs were laid from the fruits treated with *A. calamus* rhizome extract 5 per cent

(26.00 eggs/fruit) and *V. negundo* leaf extract 5 per cent (28.67 eggs/ fruit). Highest egg count was recorded from garlic bulb extract 5 per cent and turmeric powder extract 5 per cent treated fruits with 38.67 and 40.33 eggs per fruit, respectively. In untreated check the highest number of eggs was laid by *B. cucurbitae* with 55.67 eggs per fruit (Table 2).

Per cent ovipositional deterrence over control

Among different botanicals highest per cent of oviposition deterrence over control of 74.26 per cent was recorded from Azadirachtin 1 per cent EC, followed by NSKE 5 per cent of 68.26 per cent. The next best treatments were *A. calamus* rhizome extract 5 per cent and *V. negundo* leaf extract 5 per cent with 53.30 and 48.50 per cent ovipositional deterrence over control. Garlic bulb extract 5 per cent and turmeric powder extract 5 per cent showed least ovipositional deterrence over control of 30.54 and 27.56 per cent, respectively (Table 2).

Effect of botanicals on egg hatchability

The per cent hatchability of eggs, reduced significantly in botanical treated fruits of ridge gourd compared to untreated fruits. Azadirachtin 1 per cent EC recorded least hatchability of 60.50 per cent, followed by NSKE 5 per cent with 62.25 per cent. *A. calamus* rhizome extract 5 per cent and *V. negundo* leaf extract 5 per cent were the next better treatment with 67.96 and 66.27 per cent hatchability, respectively. The higher per cent of hatchability was recorded from turmeric powder extract 5 per cent (69.44 %) and garlic bulb extract 5 per cent (77.58 %). Maximum hatchability was recorded from untreated control fruits of 89.22 per cent (Table 2).

Effect of botanicals on maggot survival ability over control

The Azadirachtin 1 per cent EC treated fruits recorded the least number of maggots (10.33 maggots per fruit) with higher per cent reduction of maggot survivability over control (79.88 %) followed by NSKE 5 per cent (14.33 maggots per fruit) with 72.08 per cent reduction of maggot survivability over control. *A. calamus* rhizome extract 5 per cent (19.00 maggots per fruit) and *V. negundo* leaf extract 5 per cent (21.33 maggots per fruit) were the next best treatment with 62.98 and 58.45 per cent reduction of maggot survivability over control. Lower per cent reduction of maggot survivability over control was recorded from turmeric powder extract 5 per cent (48.04 %) followed by garlic bulb extract 5 per cent (42.20 %) with 26.67 and 29.67 maggots per fruit, respectively. Whereas in untreated check maximum number of maggots (51.33 maggots per fruit) survived (Table 2).

Table 6: Effect of botanicals on oviposition, egg hatchability and maggot survival percentage of melon fruit fly, *B. cucurbitae* in ridge gourd

Treatments	Mean number of egg counts	Per cent ovipositional deterrence over control	Mean number of eggs hatched	Egg hatchability (%)	Mean number of maggot counts	Per cent reduction of maggot survivability over control
NSKE 5%	17.67* (4.25)^{ef}	68.26	11.00* (3.38)^{f}	62.25	14.33* (3.84)^{de}	72.08
Azadirachtin 1% EC	14.33 (3.84)^{f}	74.26	8.67 (2.99)^{g}	60.50	10.33 (3.28)^{e}	79.88
Acorus calamus rhizome extract 5%	26.00 (5.14)^{de}	53.30	17.67 (4.25)^{de}	67.96	19.00 (4.41)^{cd}	62.98
Garlic bulb extract 5%	38.67 (6.26)^{bc}	30.54	30.00 (5.52)^{b}	77.58	29.67 (5.49)^{b}	42.20
Turmeric powder extract 5%	40.33 (6.37)^{b}	27.56	28.00 (5.29)^{bc}	69.44	26.67 (5.16)^{bc}	48.04
Vitex negundo leaf extract 5%	28.67 (5.35)^{d}	48.50	19.00 (4.41)^{d}	66.27	21.33 (4.34)^{c}	58.45
Untreated check	55.67 (7.49)^{a}	--	49.67 (7.07)^{a}	89.22	51.33 (7.20)	--
S.Em ±	0.28	--	0.26	--	0.25	--
CD (P=0.0 5)	0.85	--	0.81	--	0.78	--
CV (%)	8.65	--	9.74	--	9.03	--
F value	*	--	*	--	*	--

*Figures in parentheses are √ x+0.5 transformed values, Means in the columns followed by the same alphabet do not differ significantly by DMRT (P=0.05)

4. Discussion

4.1 Efficiency of different botanicals against melon fruit fly infestation in ridge gourd

Among various botanicals, Azadirachtin 1 per cent EC found quite effective over other botanicals from 1st spray to 3rd spray. The effectiveness of the treatment was found even in 2nd picking after each spray. The per cent infested fruits reduced from 52.35% at 1 Day before treatment to 23.06% at seventh picking *i.e.*, after the 3rd spray and the overall mean per cent reduction of Azadirachtin 1 per cent EC over the untreated check was 62.14 per cent. The results are in close agreement with the findings of Babu *et al.* (2002) [3] who observed NeemAzal (@ 3 and 5 ml/l) provided significant control of melon fruit fly and recorded a reduction of 70.5 per cent damage over control.

Khursheed and Desaraj (2012) [5] reported that spraying of Azadirachtin 1 per cent EC was superior to Malathion for controlling melon fruit fly with less percent fruit damage of 16.66 per cent as against 28.89 per cent in Malathion in cucumber. Similarly, Waseem *et al.* (2009) [16] reported the lowest fruit damage of 7.33 per cent due to neem product (nimbex 0.15%) as against untreated check damage (54.33%) in cucumber against melon fruit fly.

The total marketable yield obtained by Azadirachtin 1 per cent EC (45.99 q/ha) was comparatively higher over other botanicals. These results are in accordance with the results obtained by Ranganath *et al.* (1997) [9] who recorded higher yield from Azadirachtin 1 per cent EC over neem soap in cucumber. Similarly, Sharma *et al.* (2016) [11] recorded higher yield from Nimbicidine over other botanicals in organically grown cucumber.

The next best treatment in the present study was NSKE 5 per cent which reduced the per cent infested fruits from 51.55% at 1 Day before treatment to 25.37% at final picking after the 3rd spray with overall mean per cent reduction over untreated control was 58.37 per cent. However the total marketable yield (42.48 q/ha) obtained from the NSKE 5 per cent treatment was also next to that of Azadirachtin 1 per cent EC. This might be due to ovipositional deterrence or anti-feedant nature of neem to *B. cucurbitae.* The present results are in

close agreement with the findings of Kattak *et al.* (2009) [4] who recorded lower fruit fly infestation from the neem seed kernel extract next to that of neem oil treatment.

Mondol and Ghatak (2009) [6] observed reduction in fruit damage in the range of 53.57 to 68.63 per cent in NSKE 5 per cent spray. Singh (2003) [13] also recorded the efficacy of an aqueous extract of NSKE 5 per cent to inhibit the fertility, fecundity and adult emergence of *B. cucurbitae*. Sharma *et al.* (2016) [11] recorded higher yield from NSKE 5 per cent next to that of Nimbicidine.

In the present study, *Acorus calamus* rhizome extract 5 per cent satisfactorily reduced the per cent infested fruits from 52.27 % at 1 Day before treatment to 47.27 % after the 3rd spray at final picking with overall mean per cent reduction over untreated control was 35.05 per cent. A total marketable yield of 30.99 quintal per hectare was recorded from the *A. calamus* 5 per cent. However, leaf extract of *Vitex negundo* 5 per cent did not have effect on per cent infestation of fruits but showed about 25.01 per cent reduction of fruit damage over control and gave a satisfactory total marketable yield of 30.09 similar to the yield of *A. calamus* 5 per cent. This may be due to the alkaloids present in these are efficient to deter the growth and development of *B. cucurbitae* to a significant level.

However, Mondol and Ghatak (2009) [6] reported that petroleum ether extract of *A. calamus* rhizome 5 per cent showed 43.46 to 63.72 per cent reduction in fruit damage against the melon fruit fly in cucumber. Nair and Thomas (2001) [8] noticed reduction in size of the reproductive organs in *A. calamus* 5 per cent treated *B. cucurbitae* flies compared to untreated flies.

There were no satisfactory results obtained in the treatment with garlic bulb extract 5 per cent and turmeric powder extract 5 per cent. This may be due to the alkaloids present in these are inefficient to deter the growth and development of *B. cucurbitae* to a significant level. Vignesh (2015) [17] also found lower effectiveness in reducing the per cent infested fruits and yield from garlic bulb extract over other botanicals.

4.2. Effect of botanicals on oviposition, egg hatchability and maggot survival percentage of B. cucurbitae in ridge gourd

In the present study, among various botanical treated fruits of ridge gourd, Azadirachtin 1 per cent EC and NSKE 5 per cent recorded higher deterrence of oviposition, lower egg hatchability of *B. cucurbitae*. Similarly, Azadirachtin 1 per cent EC and NSKE 5 per cent treated fruits also recorded higher per cent reduction of maggot survivability over untreated control fruits. This might be due to ovipositional deterrence and anti-feedant property of neem based products. These results were in close accord with the findings of Thakur and Divender (2013) [15] who reported that *Azadiracta indica* plant extract 1 per cent EC was more effective opposition deterrent botanical and also reported its effectiveness on reduction over egg hatchability per cent over other botanicals. Similarly, Singh and Srivastava (1985) [12], Rehman *et al.* (2009) [10] and Khattak *et al.* (2009) [4] also recorded deterrence of oviposition by *B. cucurbitae* on neem seed oil treated bitter gourd fruit.

5. Conclusion

The experiment conducted at Basavanagangur, Shivamogga during *Rabi* 2016-17 on assessment of efficacy of botanicals against melon fruit fly in ridge gourd. It was found that spraying with Azadirachtin 1 per cent EC and NSKE 5 per cent were effective in reducing the fruit damage and increasing marketable fruit yield. Similarly, spraying with Azadirachtin 1 per cent EC and NSKE 5 per cent also recorded its effectiveness over ovipositional deterrence, egg hatchability and larval mortality of melon fruit fly.

6. References

1. Anonymous. Crop wise area and production of horticultural crops in Karnataka. http://www. horticulture.kar.nic.in. 2014.
2. Anonymous. Ridge gourd cultivation guide. http//www.farmnest.com. 25 May, 2016.
3. Babu PG, Reddy DJ, Jadhav DR, Chiranjeevi C, Khan MAM. Comparative efficacy of selected insecticides against pests of watermelon. Pesticide Research Journal. 2002; 14(2):57-62.
4. Khattak MK, Rashid MM, Abdullah M. Effect of neem derivatives on infestation, settling and oviposition of melon fruit fly (Bactrocera Cucurbitae Coq.) (Tephritidae: Dipetra). Pakistan Entomologist. 2009; 31(1):11-15.
5. Khursheed S, Deshraj. Bio-efficacy of certain insecticides and biopesticides against melon fruit flies, *Bactrocera* spp. Pest Management in Horticulture Ecosystem. 2012; 18(2):143-148.
6. Mondal S, Ghatak SS. Field testing of some indigenous plant products against fruit fly, *Bactrocera cucurbitae* (Coq.) infesting cucumber. Journal of the Entmological Research society. 2009; 33(2):133-137.
7. Muhammad DG, Muhammad A, Muhammad AJ, Muhammad KA, Fiaz A. Co-administration of insecticides and butanone acetate for its efficacy against melon fruit flies, *Bactrocera cucurbitae* (Diptera: Tephritidae). Pakistan Journal of Entomology. 2007; 29(2):111-116.
8. Nair S, Thomas J. Evaluation of the chemosterilant effect of *Acorus calamus* L. extracts on melon fly, *Bactrocera cucurbitae* (COQ.). Journal of Tropical Agriculture. 2001; 5(1):27-28.
9. Ranganath HR, Suryanarayana MA, Veenakumari K. Management of melon fly (*Bactrocera (Zeugodacus) cucurbitae*) in cucurbits in South Andaman. Insect Environment. 1997; 3(3):32-33.
10. Rehman JU, Jilani G, Khan AK, Masih R, Kanvil S. Repellent and oviposition deterrent effects of indigenous plant extracts to peach fruit fly, *Bactrocera zonata* Saunders (Diptera: Tephritidae). Pakistan Journal of Zoology. 2009; 41(2):101-108.
11. Sharma SK, Punam, Kumar R. Management of fruit fly (*Bactrocera* spp.) in cucumber (*Cucumis sativus Linn.*) grown organically. Journal of Biopesticides. 2016; 9(1):73-79.
12. Singh RP, Srivastava BG. Alcohol extract of neem (*Azadirachta indica* Juss) seed oil as oviposition deterrent for *Dacus cucurbitae* (Coq.). Indian Journal of Entomology. 1985; 45(1):497-498.
13. Singh S. Effect of aqueous extract of neem seed kernel and azadirachtin on fecundity, fertility and post embryonic development of melon fruit fly, *Bactrocera cucurbitae* and *B. dorsalis* (Diptera: Tephritidae). Journal of Applied Entomology. 2003; 27(10):540-547.
14. Stonehouse JM, Mummord JD, Verghese A, Patel RK, Jhala RC, Patel ZP et al. Key informative survey of production, value, losses and protection of fruit fly hosts in India. Crop Protection Progress Report. New Delhi.

2006, 48-54.
15. Thakur M, Divender D. Plant extracts as oviposition deterrents against fruit flies, *bactrocera* spp. infesting vegetable crops. Pesticide Research Journal. 2013; 25(1):24-28.
16. Waseem MA, Nagangoud A, Patil BV, Prabhuraj A, Hussain A. Efficacy of some insecticides against melon fly, *Bactrocera cucurbitae* (Coq.) on cucumber. Karnataka Journal of Agriculture Science. 2009. 22(3):701-702.
17. Vignesh R. Population dynamics and management of melon fruit fly, *Bactrocera cucurbitae* (Coquillett) through ecofriendly techniques in cucumber. M.Sc. (Agri.) Thesis, University Agricultural Sciences. Dharwad, 2015.