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Evaluation of Existing Commercial and Innovative Traps for Managing Fruit Fly on Summer Squash (*Cucurbita pepo* L.)

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A B S T R A C T

In the present investigation, twelve types of lure traps with different combinations were evaluated for monitoring the fruit fly population for two seasons i.e. during 2017-2018 and 2018-2019. The studies revealed that, there was a significant difference recorded among all the twelve traps in both seasons. For 2017-2018 season, in commercial traps, Green victory methyl eugenol (ME) fruit fly trap showed the best performance in capturing adult fruit fly population throughout the cropping period with catch of 479.33 fruit flies/trap. However, among innovative traps, low cost mineral bottle trap (ME + wooden block + spinosad) was found superior with 436.33 fruit flies/trap. Similarly, for 2018-2019 season, in commercial traps, Green victory methyl eugenol (ME) fruit fly trap showed the best performance in capturing adult fruit fly population throughout the cropping period with catch of 475.00 fruit flies/trap. However, among innovative traps, low cost mineral bottle trap (ME + wooden block + spinosad) was found superior with 440.00 fruit flies/trap.

Introduction

The increasing awareness and health consciousness among population increased the demand of safe vegetables to fulfill the needs of food and nutritional security for urban masses. Now a days, cultivation of exotic vegetables got momentum and became popularized in the urban market due to taste, food supplements and nutritional requirement. These vegetables also became source of income generation, increased employment opportunities and livelihood to the rural families and farming community. The unique agro-ecological situation of Jammu region encourages the cultivation of diverse categories of vegetables. Among the vegetable crops, cucurbitaceous crops constitute a large

group of important vegetables. Although, cucurbits are basically summer season crops, but the introduction of thermo and photo insensitive high yielding cultivars make them available round the year for cucurbits cultivation.

Cultivation of summer squash (*Cucurbita pepo* L.) is now gaining the momentum and popularization among farmers' as a short duration cash crop. The edible young fruits of *Cucurbita pepo*, a highly diverse species are adapted to grow in wide range of climatic conditions from temperate to sub-tropical countries. It is native to United States and Mexico, which are the largest producers of summer squash. It ranks high in economic importance and good source of fiber, vitamin C, beta-carotene and potassium. According to FAO statistics, the worldwide production of Summer squash exceeded 22413.24 metric tons per annum during 2012 (FAO, 2012) and indicates that production and per capita consumption of Summer squash have risen sharply during the past decade. In India, squash and gourd crops are grown in about 4.77 m ha area with production of about 4.42 million tones with average productivity of 9.27 tonnes/ha which is very low in comparison to its potential (FAO, 2012). In Jammu region, the total area under cucurbits is 2486 ha with production of about 51707.11 MT (Anonymous, 2017).

Like other vegetables insect pests are the major limiting factors in causing damage to the crop at different stages from nursery raising to the harvest. Among them, Tephritid fruit flies, *Bactrocera* spp. are the most serious and destructive insect pests (Kapoor *et al.,* 1980). The pest is distributed in the tropical and sub tropical regions of the world infesting over 70 hosts (Narayanan and Batra, 1960; Fletcher, 1987). It causes severe damage to the crop, which results in considerable reduction in the yield and marketable value. Nearly 50 per cent of cucurbits are reportedly partially or completely damaged by the pest every year in India (Agarwal *et al.,* 1987). Sapkota *et al.,* (2010) studied that cucurbit fruit fly, *Bactrocera cucurbitae* (Coquillett), is one of the most important pests of cucurbits and squash (*Cucurbita pepo* L.). The extent of losses inflicted by these Dipteran flies is varying from 30 to 100 per cent depending upon cucurbit species and environmental conditions (Gupta and Verma, 1992; Dhillon *et al.,* 2005; Shooker *et al.,* 2006). Female fly punctures the early tender fruits and lays its eggs into the fruits. On hatching, the maggots feed inside the pulp of the fruit and the infested fruits can be identified by the presence of brown resinous juice which oozes out of the punctures which also serves as an entry for various bacterial and fungal pathogens as a result the infested fruits start rotting, get distorted and malformed in shape and fall off from the plants prematurely (Srivastava and Butani, 1998). Their attack not only reduces the yield but also affect fruit quality and rendering them unfit for the consumption and unprofitable farming. The infestation often reaches cent per cent leading to complete loss of the crop (Jayraj, 2013).

Thus the study was carried out with the objective of evaluation of existing traps and to study the effectiveness among the commercial and innovative existing traps for managing fruit fly and to tackle fruit fly related problems and to reduce the cost of its applications through low cost innovative traps to make summer squash cultivation more profitable and environmentally safe.

Materials and Methods

In the present investigation, twelve types of lure traps with different combinations were studied for monitoring the fruit fly population during 2017-2018 and 2018-2019 season. The experiment was conducted at experimental

farm Division of Entomology, SKUAST-Jammu. The comparative study was done among different types of traps used for the mass trapping of male fruit fly to disrupt the mating of fruit fly. The summer squash variety "DON 17" was sown in polybags in month of March 2017 and transplanted in main field in the month of April 2017 and similarly, for 2018-2019 season, it was sown in polybags in month of March 2018 and transplanted in main field in the month of April 2018.

All cultural practices were adopted according to the package of practices of SKUAST-Jammu recommended for summer squash for both seasons.

The experiment comprised of 12 treatments and was conducted in randomized completely block design (RCBD) with three replications with plot size 5×3 m^2.

The following materials were used for preparing the innovative fruit fly traps

Wooden block (To sustain the lures for longer period)

Absorbent plastic (To sustain the lures for longer period)

Aloe Vera gel (To enhance the durability from dessication)

Use of proteinax powder from pharma shops in place of costly chemical like protein hydrozylate.

The treatment details were as follows:

TREATMENTS	
T1	Cue-lure + wooden block+aloe vera gel
T2	Cue-lure + absorbent plastic+aloe vera gel
T3	Protein hydrolyzate+ wooden block+aloe vera gel
T4	Proteinax powder+ absorbent plastic+aloe vera gel
T5	Low cost used mineral bottle traps (ME+wooden block+spinosad+aloevera gel)
T6	Low cost used mineral bottle traps (ME+absorbent plastic+spinosad+aloevera gel)
T7	Fish meal + aloe vera gel + Diazinon
T8	Meshed banana + aloe vera gel + imidacloprid
T9	Low cost used mineral bottle traps (ME + wooden block + spinosad)
T10	Low cost used mineral bottle traps (ME + absorbent plastic + spinosad)
T11	Green victory Methyl Eugenol (ME) fruit fly traps (Commercial trap)
T12	PCI Methyl Eugenol (ME) fruit fly traps (Commercial trap)

Recording of observations

The traps count of fruit fly was recorded at weekly interval by emptying the traps and constituents were refilled. For this purpose the traps were brought to the laboratory and replenished again with fresh solution before setting them in the field at their place. The number of flies retrieved from each trap

determined the population build up of the pest during the week and it also helped in the comparative study of different traps using Tukey's HSD test statistically using SPSS software.

Results and Discussion

For 2017-2018 Season

The mean numbers of adult fruit fly captured/trap in the experimental plot against different traps for 2017-2018 season are shown in table 1, Fig 1. The data revealed that among all traps, commercially available Green victory Methyl Eugenol (T11) fruit fly showed the best performance in capturing adult fruit fly throughout the cropping period with 479.33 fruit flies/trap.

In innovative traps low cost mineral bottle trap i.e T9 (ME + wooden block + spinosad) was the second best with 436.33 fruit flies/trap in capturing the fruit fly population. T9 was followed by T10 in which low cost used mineral bottle traps (ME + absorbent plastic + spinosad) was used with 419.00 fruit flies/trap.

Among all the fruit fly traps, the minimum catch of 181.00 fruit fly/trap was trapped in T4 (Protein hydrolyzate + absorbent plastic + aloevera gel).

Thus the innovative low cost mineral bottle trap was found most effective for trapping the fruit fly on summer squash. The findings are in similarity with the findings of Manzella (1993) and Singh *et al.*, (2007).

They also reported that low cost used mineral bottles along with various insecticides were effective for trapping and management of fruit fly in different cucurbit vegetables.

Table.1 Comparison of different traps on population of fruit fly for 2017-2018.

Tukey HSD

Treatments		Adult fruit fly catched (mean)
T1.	**Cue-lure + wooden block+aloevera gel**	280.33^{h}
T2.	**Cue-lure + absorbent plastic+aloevera gel**	290.00^{g}
T3.	**Protein hydrolyzate+ wooden block+aloevera gel**	201.67^{k}
T4.	**Protein hydrolyzate + absorbent plastic+aloevera gel**	181.00^{l}
T5.	**Low cost used mineral bottle traps (ME+wooden block+spinosad+aloevera gel)**	353.67^{e}
T6.	**Low cost used mineral bottle traps (ME+absorbent plastic+spinosad+aloevera gel)**	393.67^{d}
T7.	**Fish meal+aloevera gel+Diazinon**	234.33^{j}
T8.	**Meshed banana+aloe vera gel+imidacloprid**	246.33^{i}
T9.	**Low cost used mineral bottle traps (ME+wooden block+spinosad)**	436.33^{b}
T10.	**Low cost used mineral bottle traps (ME+absorbent plastic+spinosad)**	419.00^{c}
T11.	**Green victory Methyl Eugenol(ME) fruit fly traps**	479.33^{a}
T12.	**PCI Methyl Eugenol(ME) fruit fly traps**	329.00^{f}
	F-value (P-value)	7735.00^{**} (<0.01)

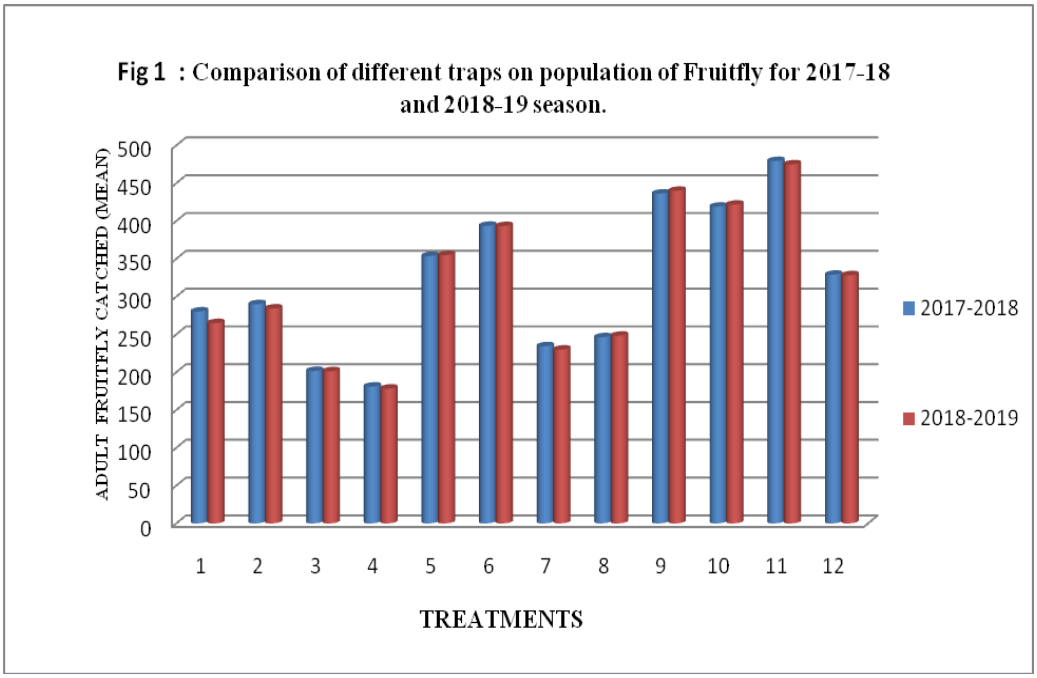
Data are means of three replications

Table.2 Comparison of different traps on population of fruit fly for 2018-2019.

Tukey HSD

Treatments	Adult fruit fly catched (mean)
T1. Cue-lure + wooden block+aloevera gel	265.00^{h}
T2. Cue-lure + absorbent plastic+aloevera gel	284.33^{g}
T3. Protein hydrolyzate+ wooden block+aloevera gel	201.33^{k}
T4. Protein hydrolyzate + absorbent plastic+aloevera gel	178.33^{l}
T5. Low cost used mineral bottle traps (ME+wooden block+spinosad+aloevera gel)	355.00^{e}
T6. Low cost used mineral bottle traps (ME+absorbent plastic+spinosad+aloevera gel)	393.33^{d}
T7. Fish meal+aloevera gel+Diazinon	230.00^{j}
T8. Meshed banana+aloe vera gel+imidacloprid	248.33^{i}
T9. Low cost used mineral bottle traps (ME+wooden block+spinosad)	440.00^{b}
T10. Low cost used mineral bottle traps (ME+absorbent plastic+spinosad)	421.67^{c}
T11. Green victory Methyl Eugenol(ME) fruit fly traps	475.00^{a}
T12. PCI Methyl Eugenol(ME) fruit fly traps	328.33^{f}
F-value (P-value)	1122.00** (<0.01)

Data are means of three replications.



For 2018-2019 Season

The mean numbers of adult fruit fly captured/trap in the experimental plot against different traps for 2018-2019 season are shown in table 2, Fig 1. The data revealed that

among all traps, commercially available Green victory Methyl Eugenol (T11) fruit fly showed the best performance in capturing adult fruit fly throughout the cropping period with 475.00 fruit flies/trap. In innovative traps low cost mineral bottle trap i.e T9 (ME + wooden block + spinosad) was the second best with 440.00 fruit flies/trap in capturing the fruit fly population. T9 was followed by T10 in which low cost used mineral bottle traps (ME + absorbent plastic + spinosad) was used with 421.67 fruit flies/trap. Among all the fruit fly traps, the minimum catch of 178.33 fruit fly/trap was trapped in T4 (Protein hydrolyzate + absorbent plastic + aloevera gel). Thus the innovative low cost mineral bottle trap was found most effective for trapping the fruit fly on summer squash. The findings are in similarity with the findings of Manzella (1993) and Singh *et al.*, (2007). They also reported that low cost used mineral bottles along with various insecticides were effective for trapping and management of fruit fly in different cucurbit vegetables.

It is evident from the experiments during both seasons that among commercially traps in Jammu, Green victory trap was the best. However, among innovative traps Low cost used mineral bottle traps (ME + wooden block + spinosad) was the best. The lost cost used mineral bottle traps was highly effective and was cheaper to farmers. Thus the low cost used mineral bottle traps would be suggest to the farming community against control of fruit fly and can be also incorporated in any IPM programme.

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