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Evaluation of different indigenously developed trap designs with baits for attraction of fruit sucking moths in pomegranate

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ABSTRACT: A field experiment was conducted to evaluate indigenously designed fruit baited trap to attract and kill fruit sucking moths during 2018 in a farmer field at Hiriyur Taluk, Chitradurga district, Karnataka. Mean number of moths trapped per week was highest in the nylon net trap with inverted cone and ripen banana hanging at two positions which was significantly superior (23.00 moths /trap/week). Major fruit sucking moths like *Eudocima materna, Rhytia hypermenstra, Eudocima salamina, Thyas coronata, Thyas honesta* etc, were attracted and trapped. This trap was followed by nylon net with plastic tub and ripen banana hanging at one position (16.60 moths /trap/week). The present study identifies the attraction of fruit sucking moths to banana and guava as baits with nylon net trap along with insecticide serve as an economically viable control strategy. The results of the present study may have practical application in fruit sucking moth management.

Keywords: Banana, guava, fruit baited traps, nylon net

INTRODUCTION

The adult fruit sucking moths are an important and serious polyphagous pest and known to occur in India causing widespread damage on pomegranate and numerous commercial fruits and vegetables (Zilli and Hogens, 2002). Unlike other lepidopteran moths where the larvae cause the economic damage, here adult stage is more injurious causing enormous damage to fruits, including citrus, guava, mango, papaya, banana, pomegranate, *etc.* The female fruit sucking moths oviposit on creepers of the Menispermaceae family that grow in forests and wastelands. In this regard, Cochereau (1972) postulated that the occurrence of the alkaloid cocculobidine in Cocculus and Erythrina was responsible for the oviposition and larval feeding behaviour of *Eudocima.* The hatched larvae complete their life cycles on the host plants, thus making control of immature stages difficult as spraying larval hosts is not feasible (Jayanthi *et al.,* 2015).

Banziger (1982) recorded 86 species of fruit piercing moths from Thailand and grouped them as primary and secondary fruit piercers. Bhumannavar and Viraktamath (2001) recorded 29 species of moths on guava and pomegranate in Karnataka. Studies of Cherian and Sundaram (1936) revealed that *E. materna* was the most dominant species comprising 95% of total moth catches in Cuddapah. These moths cause serious damage to wide range of fruit crops, by piercing the ripened fruits with their strongly sclerotized proboscis, macerate the pulp and suck the fluid (Sands and Schotz, 1989). Management of fruit sucking moths using insecticides has not been an option because of inadequate contact of the moth with the fruit and also pesticide residue issues. Traditionally farmers are practicing watch and ward with torches to swat the moths alighting on the fruit. But the fact that the moths are nocturnal, it is difficult to visit each and every fruit and hence its results are impractical. Other methods of management like fruit-bagging, netting trees/orchards, hand collection of moths, light traps, advancing/delaying the cropping have their own limitations and flaws (Jayanthi *et al.,* 2010). However, management of *Eudocima* species in the field through baits is less explored. Several studies established the feeding preference of these moths to aromatic fruits, *viz*. banana, guava and tomato at laboratory level. Nevertheless, the efficacy of these bait fruits in attracting the moths in the field was not explored. An integrated method for management involving biological control, bagging of fruit with polythene, netting orchard, destroying larval host plants has been recommended, but yet it is not economically viable in suppressing the damage caused by fruit sucking moths (Muniappan *et al.,* 1995).

Earlier studies clearly showed that the fruit sucking moths can be lured from the main crop by hanging of ripe banana fruits in pomegranate orchards to reduce moth

Table 1.Number of moths collected per trap per day in different indigenous trap designs

Treatment	Number of moths per trap							
	4/9/2018	5/9/2018	6/9/2018	7/9/2018	8/9/2018	9/9/2018	10/9/2018	Total
T1	1.60 (1.32)^{b}	1.07 (1.25)^{d}	1.33 (1.35)^{cd}	1.20 (1.30)^{d}	1.27 (1.33)^{cd}	1.93 (1.52)^{b}	2.00 (1.58)^{bc}	9.90 (3.22)^{e}
T2	1.27 (1.31)^{b}	1.00 (1.22)^{d}	0.60 (1.05)^{e}	1.93 (1.56)^{c}	2.20 (1.64)^{ab}	1.00 (1.21)^{c}	1.87 (1.54)^{c}	10.00 (3.24)^{e}
T3	1.40 (1.37)^{b}	1.60 (1.41)^{cd}	1.00 (1.22)^{d}	2.33 (1.68)^{bc}	1.13 (1.27)^{d}	1.60 (1.44)^{bc}	2.13 (1.62)^{bc}	11.20 (3.42)^{de}
T4	1.73 (1.49)^{ab}	1.00 (1.22)^{d}	1.73 (1.49)^{bc}	0.93 (1.19)^{d}	2.53 (1.73)^{ab}	2.80 (1.81)^{a}	1.80 (1.50)^{c}	12.30 (3.57)^{cd}
T5	2.60 (1.76)^{ab}	3.07 (1.87)^{ab}	2.00 (1.58)^{b}	1.07 (1.25)^{d}	1.93 (1.56)^{bc}	2.07 (1.59)^{ab}	1.20 (1.30)^{c}	13.04 (3.80)^{bc}
T6	2.80 (1.81)^{ab}	2.33 (1.66)^{bc}	1.73 (1.49)^{bc}	2.73 (1.80)^{b}	2.60 (1.76)^{ab}	1.33 (1.35)^{bc}	3.73 (2.06)^{a}	16.60 (4.14)^{b}
T7	3.27 (1.94)^{a}	3.93 (2.08)^{a}	3.53 (2.01)^{a}	3.87 (2.09)^{a}	3.07 (1.88)^{a}	1.73 (1.49)^{b}	3.33 (1.94)^{ab}	23.00 (4.85)^{a}
F value	*	*	*	*	*	*	*	*
SEM±	0.17	0.10	0.06	0.05	0.08	0.09	0.12	0.11
CD@ 0.05	0.51	0.31	0.16	0.15	0.24	0.26	0.38	0.33
CV%	18.32	11.21	6.19	5.29	8.52	9.84	12.96	5.06

* Significant @ P=0.05
Figures within the parenthesis indicates that square root x+0.5 transformed value
Means followed by same letter do not differ significantly by DMRT (P=0.05)

damage, as moths preferred banana over pomegranate (Jayanthi *et al.,* 2010). However, the issue of monitoring the hanged fruits is difficult throughout out the night period In the present study, various designs of fruit baited traps were evaluated to know the efficacy of attraction and trapping. The main aim was to fabricate the traps with high catch efficiency by constructing escape proof traps for moths. The description of each type of trap designed is given in methodology.

MATERIALS AND METHODS

The present study was carried out in a pomegranate farmers field at Babbur, Hiriyur (Chitradurga13^{0}96$^{'}$ N76^{o} 63', 609m above MSL). The selected pomegranate orchard had seven-year-old plants with fruit sucking moth incidence during fruiting season (August and September). The trials were conducted during September for one week. Numbers of moths attracted and trapped were recorded at daily interval. A comparative performance of seven different types traps designed along with fruit baits were evaluated in three replications to attract and trap fruit sucking moths.

Treatment details of fruit bait traps evaluated against fruit sucking moths: T_1: Open pan with star fruit puree as bait (100 gram of blended star fruit + 2 ml of Deltamethrin); T_2: Open pan with banana puree as bait (100 gram of blended banana fruit + 2 ml of Deltamethrin); T3:Open pan with guava puree as bait (100 gram of blended guava fruit + 2 ml of Deltamethrin);T4: Open pan with ripen banana as bait (100 grams weighed ripen banana + 2 ml of Deltamethrin);T5: Open pan with ripen guava as bait (100 grams weighed ripen guava +

T1- Open pan with star fruit puree as bait

T2- Open pan with banana puree as bait

T2- Open pan with guava puree as bait

T4- Open pan with ripen banana as bait

T5- Open pan with ripen guava as bait

T6- Nylon net with plastic tub and ripen banana hanging at one position

T7- Nylon net with inverted cone and ripen banana hanging at two positions

Plate 1: Different traps and fruit baits used in the study

2 ml of Deltamethrin);T6: Nylon net with plastic tub + ripen banana hanging at one position;T_7 : Nylon net with plastic tub + ripen banana hanging at two position. The location of the traps was changed every night to avoid any errors.

Traps fabrication

Open pan with star fruit puree as bait (T_1): It was designed by using plastic open pan measuring 20cm diameter and 3 cm depth. Four holes were made at equal distances in the edges of pan. Hooks were fitted to the rim so that plate was easily hanged. One end of the plastic ropes (length 20 cm) was tied to the hook and other end was hanged to the edges. Star fruit was blended using a blender and made into puree (smooth cream); 200 ml of fruit puree was prepared and mixed with two ml of deltamethrin. The puree thus prepared was then placed in an open pan (Plate 1 T_1).

Open pan with banana puree as bait (T_2): Materials used and trap fabricated is same as mentioned above, except star fruit puree was replaced by banana puree along with two ml of deltamethrin insecticide and then placed in an open pan (Plate 1-T_2).

Open pan with guava puree as bait (T_3): The open pan used here is same as mentioned above, starfruit puree was replaced by fully ripened guava puree along with two ml of deltamethrin insecticide and then placed in an open pan ((Plate 1-T_3).

Open pan with ripen banana as bait (T_4): The open pan used here is same as mentioned above, fully ripened whole banana was placed in a pan and two ml of deltamethrin insecticide was injected by using syringe (Plate 1-T_4).

Open pan with ripen guava as bait (T_5): The open pan used here is same as mentioned above, fully ripened whole guava was placed in a pan and two ml of deltamethrin insecticide was injected by using syringe (Plate 1-T_5).

Nylon net with plastic tub and ripen banana hanging at one position (T_6): This trap is designed using nylon net (20mesh/cm), cylindrical dimensions measuring height 80cm x diameter 45cm. Two Metal wires were bent into hoops measuring 45 centimeters in diameter. For body of trap, cut piece of cylindrical net was sewed to two hoops which act as upper and lower rim. For the top of the trap, circular piece of net was cut approximately 25cm larger in diameter, and then the wire hoop was attached by sewing. A hook was fitted to the top of the trap so that it was easily hanged to the lower branch. Plastic tub measuring about (30 cm dia. X 10 cm depth was attached with the help of chain links to the lower rim of the trap. At the base, 6 cm spacing was given between hoop and plastic tub. The space given at the base allows the moths to enter the trap. At the centre core of the trap one over ripened banana was hung at one position with the help of thread. Insecticide was injected to the banana as mentioned above (3.3) and trap was fitted with a hook and was hanged in different positions on the crop canopy (Plate 1-T_6).

Nylon net with plastic tub and ripen banana hanging at two positions (T_7): This trap is similar in design to the nylon net with plastic tub except, an inverted cone of nylon netting is suspended by two threads from the upper rim of the trap and was sewed to the lower rim (Plate 1). The white nylon cone first was cut using a quarter-circle pattern having a diameter of 45 cm and with a height of 40cm. An inverted cone shaped net was attached to inner surface of lower rim of the trap. Apex of the cone shaped net had an opening of 14cm diameter; allowing a killing jar and hand to pass through it easily. It was strengthened with a light wire hoop so that, it would hold its shape. The metal wire rim was sewed to both the bottom of the cone and apex at the same time, in the same way that the upper rim of the trap by thread. The height of the cone was adjusted by tying slip knots. The baits used in the traps consisted of a small ripened banana which was hung at two positions with the help of a thread. The top of the trap was fitted with a hook and was hanged to lower branches of the canopy (Plate 1-T_7).

RESULTS AND DISCUSSION

The results of the multiple choice experiment indicated that mean number of moths trapped per week was highest in the nylon net trap with inverted cone and ripen banana hanging at two position (Plate T_7) which was significantly superior (23.00 moths /trap/week), followed by nylon net with plastic tub and ripen banana hanging at one position (16.60 moths /trap/week). These were followed by open pan with ripen guava as bait (13.09 moths /trap/week), open pan with ripen banana as bait (12.30 moths/trap/week), open pan with guava puree as bait (11.2/moths/trap/week) and open pan with banana puree as bait. However, open pan with star fruit puree as bait proved to be least effective by registering lowest number of moths (9.90 moths/trap/week) (Table 1).

In nylon net trap with plastic tub and ripen banana hanging at one position, moth species such as *E. materna, Erebus macrops, Spirama retorta, Thyas coronata* etc., were attracted to the banana bait. However, the moths after feeding moved inside the netting tube and settled

for some time. Due to the space present between the lower rim of the trap and the removable plastic tub, it resulted in the escape of the moth.

In order to avoid escape of fruit sucking moth from bait trap, a little modification was done to this trap. The plastic tub was replaced by an inverted cone of nylon netting which was suspended by two threads from the upper rim of the trap. The attracted moths to the banana bait gained entry through the inverted cone, the space present between the inverted cone and outer nylon netting acted as an escape barrier for the moths. This study has shown that nylon net with inverted cone net and ripen banana hung at two positions was more effective in attraction and trapping of the fruit sucking moths. Major fruit damaging moths like *Eudocima materna, Rhytia hypermenstra, Eudocima salamina, Thyas coronata, Thyas honesta* etc., were trapped.

Trap designs evaluated with different fruit baits showed variable capture rates of fruit sucking moths. The open pan trap with blended fruit puree of star fruit, banana, guava, whole ripen banana and guava as bait was least effective. However, moths like *Eudocima materna, Thyas coronata,* were attracted to the open pan trap with bait and found feeding on them. After feeding on the baits if not hand collected, the moths easily flew away from the trap, because no netting proof as a barrier was provided for trapping the moths. However, the mortality of the moths could not be observed. Among the different traps designed, nylon net with inverted cone net and ripen banana hanging at two position (23 moths/ trap/week) and nylon net trap with plastic tub and ripen banana hanging at one position (16.60 moths/trap/week) trapped more number of moths compared to other traps. The data of T_1 to T_5 were hand collection of attracted and bait feeding moths.

Banana is an ideal choice to serve as trap bait to attract the fruit-sucking moth away from a more commercially valuable pomegranate. The strong attraction of fruit sucking moth to ripe banana fruits was found compared to matured ones. The trap designed consisted of bait along with an insecticide that helped for attracting and trapping the fruit sucking moths. For further confirmation and validity, the study may be repeated for one more year in different location, so that the information generated in the study may act as base for further research. This will play a key role in developing effective monitoring, attract and kill systems for these economically important pests.

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