Pak. j. sci. ind. res. Ser. B: biol. sci. 2024 **67B**(2) 141-145

Evaluation of Lure Traps to Capture Adult Red Palm Weevil (*Rhynchophorus ferrugineus*) at the Date Palm Orchards of Sindh, Pakistan

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(received June 22, 2021; revised August 16, 2022; accepted August 23, 2022)

Abstract. This study deals with the field application of lure traps for trapping of the adult red palm weevil (*Rhynchophorus ferrugineus*) at the date palm orchard of Sindh, Pakistan. The pheromone traps, were installed at the date palm orchard under the field conditions such as aggregation pheromone dosage, food material (molasses), ester (isoamyl acetate) and trap density.

During the field trials, it was observed that the 3 mg/trap dose of aggregation pheromone along with the 500 g of molasses and 4 mg/trap of ester trapped maximum female adult insects. The 10 traps/ha was the optimized trap density. Moreover, the higher number of insects were trapped in March and the minimum catches were observed in the month of November, December, January and February. The total male and female adult weevils captured were (N=18 females 60% and N=12 males 40%) and the sex ratio was 2:3 male and female, respectively.

Keywords: red palm weevil, lure traps, IPM pest managements, food baited traps, aggregation pheromone, date palm pests

Introduction

Date palm (*Phoenix dactylifera* L.) is a famous economic crop of Pakistan that belongs to the family of Arecaceae that has been originated in Saudi arabia, Iraq, Iran and northern areas of Africa (Abul-Soad *et al*., 2017; Moussouni *et al*., 2017). Red palm weevil (RPW), lesser date moth (LDM) and termites are important insect pest of date palm. The RPW (*Rhynchophorus ferrugineus* L.) is a serious problem to date palm trees among all insect pest which reduces up to 10-20% loss in products of dates. Besides date palm plantations, RPW also targets the coconut and oil palm as well (Soomro *et al.*, 2021). Mostly, RPW infestations are not detected at the attacking time but visible signs of attacks are discharge and flow of sap and viscous crude oily type fluid is observed due to larval extensive boring and mining into the trunk of date palm tree. However, recovery of the tree itself is not possible (Al-Ayedh, 2020).

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Previously, different methods were applied with Integrated pest management (IPM) to survey the date palm orchards and identify the infested palm trees. The infested tree is burned and buried in the mud but due to incomplete burning some larvae and pupa may survive and develop into new adult RPW and also the time for identification of infested tree provide a chance to larval development into new adult (Ahmed, 2020). Another method is use of insecticide which is injected by boring the holes into date palm trunk. This method is also successful to kill the red palm weevil and sometime provide a chance to recover the tree. The use of insecticide has negative effect on environment and human health inside tree. Moreover, the injection of insecticide through trunk remains incomplete due to the thick mass of frass and larvae.

Among all these methods, the use of pheromone lure trap is very efficient and environment friend and cheaper one (Vacas *et al*., 2017; Aldryhim and Al Ayedh, 2015). The pheromone lure of red palm weevil is chemically composed of 90% of 4-methyl-5-nonanl and 10% of 4-

methyl-5-nonanone. The lure traps are very helpful to monitor and mass trap of adult red palm weevil (Oehlschlager, 2016). The use of pheromone traps loaded with plant food material or plant tissue are the major component of IPM for the trapping of red palm weevil (Al-Saoud and Ajlan, 2013). The efficacy of synthetic aggregation pheromone lures (*ferrugineol*) can be increased by addition of plant food material (Shukla, 2017). It has reported in many research papers that the most efficient trapping can be achieved by loading the plant food material into lure traps (Firdaus *et al.*, 2020). Moreover, it has also reported that the pheromone traps baited with food material are very beneficial because of catching more female insects. The trapping of female insects are helpful to reduce the population and growth before egg laying stage (Soroker *et al*., 2015). In another study, ethylacetate instead of food material in pheromone traps and studied their effect by changing the food material with synthetic kairomones and observed that the traps had trapped more adult female weevils. The synthetic kairomone ethyl acetate shows three times more attracting power as compared to food material (Gries *et al.*, 1994).

In the light of the above studies, current research deals with the evaluation of lure traps baited with aggregation pheromone molasses and ester at date palm orchards of Khairpur Mir's Sindh under the various field parameters.

Experimental section. ***Study location.*** This study was carried out the at the date palm orchards of Pir Jo Goth district Khairpur Mir's Sindh-Pakistan during the January 2017 to December 2017. The date palm orchard has an area about 3 hectors comprises mixed ages trees (12-18 years).

Preparation of lure traps and field experiments. The lure traps were prepared using 15 L polypropylene buckets. The four equidistant rectangular (4×8 cm) windows were made from sides and lid of each trap for the entrance of RPW. The pheromone dispenser contained ferrugineol (4-methyl-5-nonanol 90% and 4-methyl-5-nonanone 10% ChemTica International S.A., Costa Rica) was hanged in the lid of bucket and baited with 500 g of molasses and ester (isoamylacetate). The experiment used complete randomized block design with 4 treatments and were replicated 3 times. The four treatments consisted of pheromone dosage, effect of food material, effect of ester and control. The traps were monitored weekly and trapped insects were transferred to the laboratory for statistical analysis where the male and female were identified and separated.

All the traps were settled at the date palm orchards and placed under the shade of the date palm tree as to maintain their temperature and lure release rate from direct sunlight effect. The trap density were optimized using 1-20 traps/ha. All traps were dumped in the ground near to trunk of tree. The lure traps were covered from sides by mud and fringes to prevent it from being overturned by wind or animals. The trapped adult weevils were checked every week.

Statistical analysis. Total adult red palm weevil captured were pooled for further analysis and trapped male and female insects were separated. ANOVA was used to test whether or not there are differences of the total red palm weevil captures among the treatments. The Bonferonni test was applied to determine which means were most a like (or different) and to test the equality of means for each pair of variables. Moreover, the total 30 adult weevil were collected and male: female ratio was determined and subjected to paired t-test for statistical significant difference. All statistical analyses were conducted with SPSS 19.0 statistical software.

Results and Discussion

Pheromone dosage. During the field study, pheromone doses were optimized (1-5 mg/trap) as shown in Fig. 2. It is clear in Fig.1 that the maximum trapping ratio of insects were obtained at 3 mg/trap and further higher doses were not significant. Therefore, all other field trials were performed at the optimized dosage of aggregation pheromone i.e. 3 mg/trap.

Effect of trap density. In field trials, the trap density has been optimized as shown in Fig. 2. The results show that the maximum weevil were trapped using 10 traps/ha, further increasing trap density has no significant difference.

Effect of molasses and ester. The effect of molasses and ester (isoamylacetate) for the trapping of adult red palm weevil was optimized (Fig. 3). It is clear that the lure traps loaded with molasses and ester effectively trapped more weevils as compared to alone aggregation pheromone. The addition of molasses as a food and ester as an attractant, enhance the trapping, therefore all the trials were performed using lure traps baited with molasses and ester.

Seasonal effect. The trapping of red palm weevil has been affected under the influence of environmental temperature. During field study, it has noticed that the maximum trappings were obtained in month of March and slightly reduced in April-September. The environmental temperature observed during the March-September was ranged from 30-45 °C, while from November-February trapped less number of insects where environmental temperature ranges from 25-16 °C shows in Table 1.

The pheromone traps made up of plastic buckets have been used all over the world for trapping the red palm weevil. In the Mediterranean region when red palm weevil attack was observed, the pheromone traps system was the best choice to capture the adult red palm weevil. In Spain, different types of bucket traps were introduced commercially but there is still need to design such traps which have better efficacy. The performance of traps can be increased by addition of plant tissue material and water into bucket base. The fermentation of pant material is the synergistic source of odour (Firdaus *et al*., 2020). Therefore, number of studies were performed to show the synergistic effect of plant volatiles odour and pheromone (Junejo *et al*., 2021). The traps loaded with plant material along with pheromone capture more number of adult red palm weevil (Milosavljević *et al*., 2020; Hallett *et al*., 1999). The efficacy of traps can be increased by servicing and replacement of new plant material. The adult red palm weevil capture depends upon the number of traps per hector, (Oehlschlager *et al.*, 1993) recommended the trapping density of 1 trap/ha.

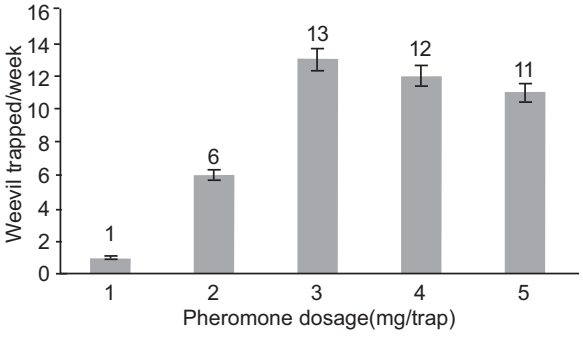

Fig. 1. Effect of pheromone dose (mg/trap) for the trapping of red palm weevil. (The values at the bar show the total number of trapped weevils).

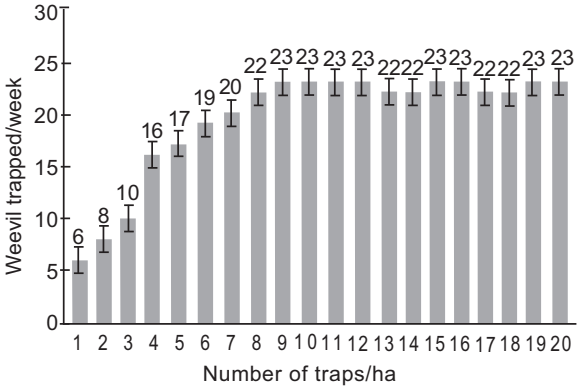

Fig. 2. The effect of number of traps/ha for the trapping of red palm weevil under the optimized aggregation pheromone dose. (The values at the bar show the total number of trapped weevils.).

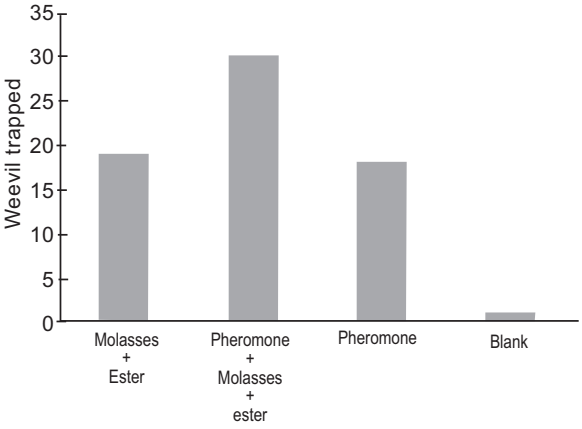

Fig. 3. Effect of molasses and ester on trapping the red palm weevil.

Table 1. Effect of temperature on adult weevils trapped

Months	Average T °C	Weevil trapped
January	15±1	2±0.201
February	19±1	3±0.331
March	24±1	30±0.410
April	32±1	29±0.433
May	36±1	29±0.441
June	35±1	25±0.429
July	34±1	18±0.338
August	36±1	18±0.336
September	35±1	13±0.322
October	25±1	2±0.191
November	22±1	1±0.101
December	19±1	1±0.121

However, the different trapping density 10 to 1 trap/1.5 ha have been implemented by IPM in date palm plantation for trapping the RPW (Soroker *et al*., 2005). In Israel the weevil mass trapped at 10 traps/h in 1999 and 2001 (Soroker *et al*., 2005). In this study, the 10 traps/h were optimized in the orchards of khairpur Sindh Pakistan. Increasing number of traps show no significant effect.

Conclusion

The present study is concerned with evaluation of lure traps for trapping the adult palm weevil under the field optimized parameters. It has noticed that the trapping efficiency of traps can be increased with addition of food material (molasses) and ester (isoamyl acetate). The aggregation pheromone dose was optimized 3 mg/trap that catches maximum weevils while the 10 traps/ha trapped maximum insects and further higher trapping density was not significant. The lure traps under the optimized parameters were installed at the date palm orchards of Khairpur Mir's Sindh.

Acknowledgement

Authors are thankful to Sindh Agricultural Growth Project (SAGP) for financial support and cooperation, National Centre of Excellence in Analytical Chemistry University of Sindh Jamshoro Pakistan for their help.

Conflict of Interest. The authors declare that they have no conflict of interest.

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