Journal of Entomology

ISSN 1812-5670

Academic Journals Inc.

www.academicjournals.com

Journal of Entomology 7 (1): 54-59, 2010
ISSN 1812-5670

Effect of Color on the Trapping Effectiveness of Red Palm Weevil Pheromone Traps

[1]A.H. Al-Saoud, [2]M.A. Al-Deeb and [3]A.K. Murchie
[1]Agriculture Research and Experiment Station, Bani Yas,
General Agricultural Directorate of Abu Dhabi, Abu Dhabi, P.O. Box 5044, UAE
[2]Department of Biology, College of Science, UAE University,
Al-Ain, P.O. Box 17551, UAE
[3]Agri-food and Biosciences Institute, Newforge Lane, Belfast, BT9 5PX, UK

Abstract: The Red Palm Weevil (RPW), *Rhynchophorus ferrugineus* Olivier (Curculionidae: Coleoptera), is the most serious and difficult to control insect pest on date palm (*Phoenix dactylifera* L.) in the United Arab Emirates. The aim of this study was to evaluate the effect of trap color on trap effectiveness in catching *R. ferrugineus*. Traps baited with the male aggregation pheromone of the red palm weevil were installed in four date palm farms in Abu Dhabi, United Arab Emirates, in 2007. Seven trap colors were tested for attraction to the red palm weevil (red, green, blue, orange, pink, yellow and white). The highest weevil catch was achieved in the red trap ($p<0.05$). Present results indicate that trap color has a significant effect on trap effectiveness, which suggests that dark-colored traps in general and the red in particular, catch more weevils. Therefore, the use of red traps will be more effective in the control programs of this economic pest.

Key words: *Rhynchophorus ferrugineus*, *Phoenix dactylifera*, trap color, UAE

INTRODUCTION

The red palm weevil, *Rhynchophorus ferrugineus* Olivier (Curculionidae: Coleoptera), is one of the most important insect pests attacking date palm trees (*Phoenix dactylifera* L.) in the Arabian Gulf states. It is an invasive pest, native to Pakistan, which was first recorded in the northern United Arab Emirates (UAE) in 1985 and has since spread to almost the entire UAE (El-Ezaby *et al.*, 1998) and to Oman. In addition, this pest is currently spreading in Mediterranean European countries and posing a threat to both date production and the appearance of the landscape (Ferry and Gomez, 1998; Khalid, 2007; Murphy and Briscoe, 1999). The high pest status of *R. ferrugineus* is attributed to its presence throughout the whole year, the severe damage it causes to infested trees and the difficulty of discovering early infestations. As an internal plant borer, *R. ferrugineus* is difficult to detect in palms in the early stages of an attack (Abraham *et al.*, 1998). Females deposit eggs in concealed places on the tree and the resultant larvae bore inside the tree trunk causing severe damage. Furthermore, Abraham *et al.* (2002) reported that the pupa is protected by the thick and strong cocoon and the adult weevil has a dense exoskeleton making control by natural enemies difficult.

Corresponding Authors: A.H. Al-Saoud, Agriculture Research and Experiment Station, Bani Yas, General Agricultural Directorate of Abu Dhabi, Abu Dhabi, P.O. Box 5044, UAE
M.A. Al-Deeb, Department of Biology, College of Science, UAE University, Al-Ain, P.O. Box 17551, UAE

Several methods are used to control the red palm weevil. The most effective and environmentally sound method is the food-baited pheromone trap (Abraham *et al*., 1998; Faleiro *et al*., 1998). These traps have been successfully used as mass trapping devices to manage the red palm weevil on date palm in the Middle East. It has been reported that using aggregation pheromone traps was very effective in catching the adults of the red palm weevil and curtailing population growth in the field (Abraham *et al*., 1999, 2000; Faleiro, 2000). Abraham *et al*. (1999) found that the weevils captured by using pheromone traps were female dominated and the use of the traps reduced insect numbers over time. Oehlschlager *et al*. (1995) reported a 90% decrease in the numbers of the American palm weevil (*Rhynchophorus palmarum* L.) captured in the oil palm plantations after two years of pheromone trapping in Costa Rica. They also indicated that the traps caught more females than males. Similar results were reported by other scientists (Abraham *et al*., 1999; Faleiro and Rangnekar, 2000; Vidhyasagar *et al*., 2000; Al-Saoud, 2006, 2007). Catching female weevils is desirable in any Integrated Pest Management (IPM) program because they are the precursors of the damaging larval stages.

Traps of different designs and colors have been used to capture adults of *R. ferrugineus*. Hallett *et al*. (1999) reported a greater response of red palm weevil to black bucket traps than to white traps. Similarly, Ajlan and Abdulsalam (2000) found that green reusable bucket traps captured more red palm weevils compared to white and yellow traps and Sansano *et al*. (2008) working in Spain reported that brown-reddish traps were more effective than white traps.

The purpose of this study was to evaluate the effect of trap color on trap effectiveness in catching *R. ferrugineus*.

MATERIALS AND METHODS

Study Sites

The experiment was conducted at four date farms at Al-Rahba, Abu Dhabi (Lat. 24° 28' N; Long. 54° 22' E), UAE in 2007. Each farm contained at least 140 date palm trees of different ages (3-20 years).

Traps

Pheromone traps were fabricated using a 10 L polypropylene bucket with four rectangular (3×8 cm) windows cut equidistantly below the upper rim of the bucket. The distance between each window and the bottom of the bucket was 16 cm. The bucket was covered with a lid that had three windows similar to the ones on its sides. The upper surface of the lid had a small handle to ease opening the trap and the lower side had a small knob on which a wire was fixed to hold the pheromone and kairomone dispensers. The outer surface of the bucket was rough with small projections (1-2 mm) to help the weevils cling to the trap and enter. Each trap contained the following materials: (1) 300 g of dates, (2) dispenser of the *R. ferrugineus* male aggregation pheromone containing 70 mg of the active ingredient (4-Methyl-5-Nonanol (9 parts) + 4-Methyl-5- Nonanol (one part)) at 95%, purity, (3) dispenser of the kairomone containing 40 mL of the active ingredient Ethyl Acetate at 98% purity and (4) 5 L of water. The water was always replenished to keep sufficient moisture in each trap. Food bait (dates) was changed every two weeks. Based on the dispensing rates, the pheromone was replaced every three weeks and the kairomone every month. The original color of the bucket trap was white, which was changed by painting with commercial acrylic paint sprays. Seven colors were tested: white, yellow, red, orange, blue, pink and green. All paints were sourced from Al Muqarram Insulation Material Industry LLC (Sharjah, UAE: www.muqarram.com).

Experimental Design and Trap Installation

The experimental design was a randomized complete block design with seven treatments (colors) and four replicates (farms). A total of 28 traps were installed for a trapping period from 1 February until 1 July 2007. This time period (5 months) was selected because it includes the part of season in which the adults of *R. ferrugineus* are more active and reach their population peak. Large beetle population in the field amplifies the effect of trap color on beetle catch. In each farm, the traps were installed near the farm peripheries with two rows of trees left as an outer border. The distance between traps was 50 m and each trap was 4 m away from date palm trees. Traps were buried in the ground down to the level of side windows to facilitate entrance of *R. ferrugineus*. Part-burying the trap also prevented it from being over-turned by wind or animals. Captured weevils were collected weekly. In order to minimize the effect of trap location on the number of captured insects, the position of each treatment was re-randomized each week.

Statistical Analysis

The data were subjected to ANOVA using the PROC GLM procedure and the means were compared by carrying out the Least Significant Difference (LSD) procedure of the SAS statistical package (SAS, 2001).

RESULTS

There were significant differences between trap colors in the number of captured weevils ($F = 10.83$, $df = 6, 18$, $p<0.001$) (Fig. 1). During the trapping period, the maximum number of *R. ferrugineus* per farm was captured in the red traps (127.8), which was significantly different from blue ($t = -2.33$, $df = 18$, $p = 0.03$), green ($t = -3.45$, $df = 18$, $p = 0.003$), Orange ($t = -5.07$, $df = 18$, $p<0.0001$), pink ($t = -5.54$, $df = 18$, $p<0.0001$), yellow ($t = -5.74$, $df = 18$, $p<0.0001$) and white ($t = -6.63$, $df = 18$, $p<0.0001$). Blue and green traps ranked second (108.0 and 98.5,

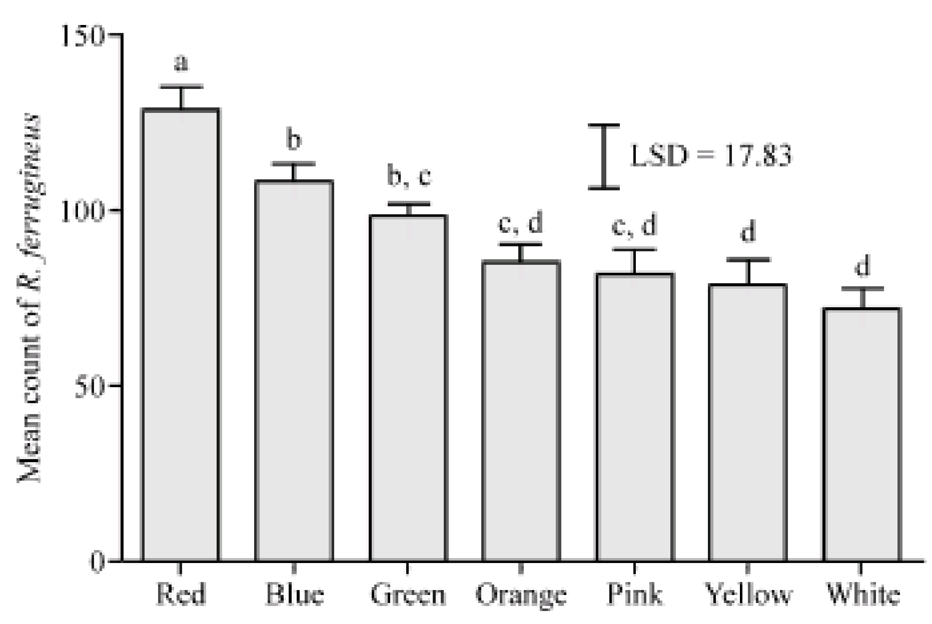

Fig. 1: Mean±SEM number of adult *R. ferrugineus* captured per pheromone trap per farm at Abu Dhabi, UAE, totaled over the period 1 February to 1 July 2007. Columns labeled with the same letter are not significantly different ($p>0.05$, PROC GLM, LSD, SAS, 2001)

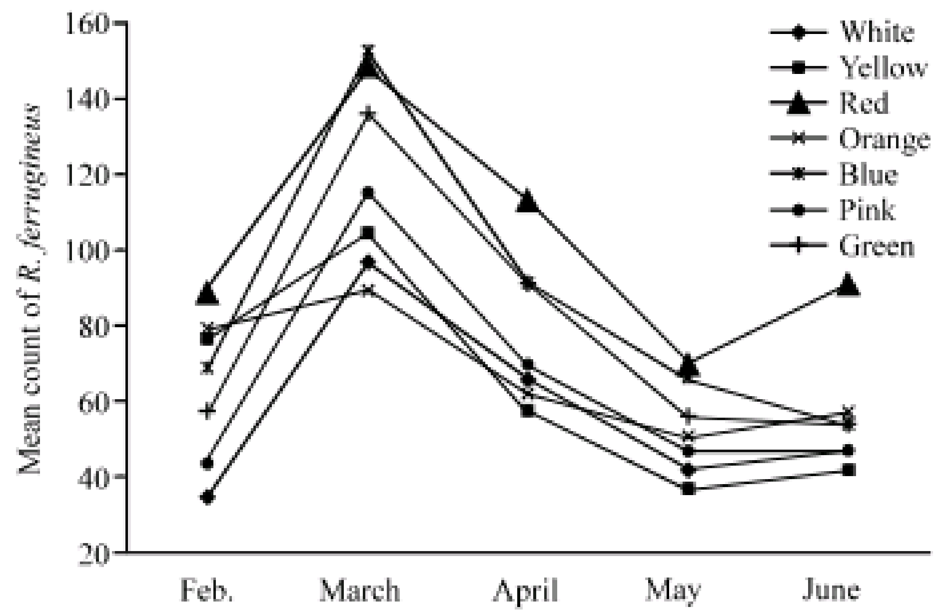

Fig. 2: Population dynamics of adult *R. ferrugineus* captured per pheromone trap in four farms at Abu Dhabi, UAE, totalled over the period 1 February to 1 July 2007

respectively) and no significant differences occurred between them (t = -1.12, df = 18, p = 0.28). They were followed by orange and pink traps (84.8 and 80.8, respectively) which were also not significantly different (t = -0.47, df = 18, p = 0.64). Yellow (79.0) and white (71.5) traps caught the least number of *R. ferrugineus* and did not significantly differ from each other (t = -0.88, df = 18, p = 0.39). It appeared that dark-colored traps captured more *R. ferrugineus* weevils than the light-colored traps.

There was temporal variation in number of *R. ferrugineus* per trap per month during the trapping period (Fig. 2). *Rhynchophorus ferrugineus* population attained a peak in March for all trap colors. Red traps captured more *R. ferrugineus* weevils compared to the other trap colors in February, April, May and June (89,103, 70 and 91, respectively). The only exception was March in which blue traps collected slightly more weevils than red traps (152 and 148, respectively).

DISCUSSION

In the past ten years, mass trapping with pheromone-baited traps has been successfully used to control *R. ferrugineus* in several countries, including the UAE. Many phytophagous insects respond positively to light reflectance patterns of their host plant and these responses can be quite specific (Prokopy and Owens, 1983). Therefore, trap color plays a major role in the effectiveness of mass trapping. Ajlan and Abdulasalam (2000) reported that the green-colored traps captured more *R. ferrugineus* compared to the white and yellow traps. Similarly, present results demonstrated that green traps were more effective than white traps. However the red traps were most effective, catching significantly more weevils compared to the other colors. This finding is in agreement with that of (Sansano *et al*., 2008) who also found that brown-reddish colored traps caught more weevils compared to their white counterparts. This is important because the *R. ferrugineus* mass-trapping program in the UAE recommends the use of white traps. Also, most of the date palm growers use white and yellow traps. Yet, in our study the red traps caught approximately 1.8 times as many weevils as the white traps. The most plausible explanation is simply that *R. ferrugineus* uses dark colors as visual cues to locate the date palm tree trunk and the trap. The weevil responds more positively to dark objects and uses them in the visual short-range host finding. Kirk (1984) postulated that both Coleoptera and Lepidoptera with wood boring larvae are attracted to red, brown and black, although mainly as a contrast with the background rather than any specific visual cue. Temporal variation in numbers of *R. ferrugineus* captured per trap per month for each of the seven colors may reflect seasonal changes in temperature and other weather parameters. The population dynamics showed that date palm growers in UAE should maintain the traps during the season and particularly in March when the *R. ferrugineus* population reaches its peak in order to capture the maximum number of insects.

In conclusion, present results demonstrated that red is a better trap color compared to white and yellow, which are currently used by UAE date palm growers. Although, more work could be done to fine-tune trap efficiency, in the meantime, the use of red traps would be a simple means to improve the effectiveness of the *R. ferrugineus* mass-trapping control programs.

REFERENCES

Abraham, V.A., M.A. Al-Shuaibi, J.R. Faleiro, R.A. Abozuhairah and P.S.P.V. Vidyasagar, 1998. An integrated management approach for red palm weevil *Rhynchophorus ferrugineus* Olivier. A key pest of date palm in the Middle East. Agric. Sci., 3: 77-83.

Abraham, V.A., J.R. Faleiro, T.P. Kumar and M.A. Al-Shuaibi, 1999. Sex ratio of red palm weevil *Rhynchophorus ferrugineus* Olivier captured from date plantation of Saudi Arabia using pheromone traps. Indian J. Entomol., 16: 201-204.

Abraham, V.A., J.R. Faleiro, M.A. Al-Shuabi and T.P. Kumar, 2000. A strategy to manage red palm weevil, *Rhynchophorus ferrugineus* oliv on date palm, *Phoenix dactylifera* its successful implementation in Al-Hassa, Kingdom of Saudi Arabia. Pestology, 24: 23-30.

Abraham, V.A., J.R. Faleiro, C.P.R. Nair and S.N. Saritha, 2002. Present management technologies for red palm weevil *Rhynchophorus ferrugineus* Olivier (Coleoptera: Curculionidae) in palms and future thrust areas. Pest Manage. Hortic. Ecosyst., 8: 69-82.

Ajlan, A.M. and K.S. Abdulsalam, 2000. Efficiency of pheromone traps for controlling the red palm weevil *Rhynchophorus ferrugineus* Olivier (Coleoptera: Curculionidae), under Saudi Arabia conditions. Bull. Int. Soc. Egypt. Econ. Ser., 27: 109-120.

Al-Saoud, A.H., 2006. Control of red palm weevil *Rhynchophorous ferrugineus* Olivier (Coleoptera: Curculionidae) using aggregation pheromones. Damascus Univ. J. Agric. Sci., 22: 147-164.

Al-Saoud, A.H., 2007. Importance of date fruits in the red palm weevil *Rhynchophorous ferrugineus* Olivier (Coleoptera: Curculionidae). Proceedings of 3rd International Date Palm Conference, Feb. 19-22, Abu Dhabi, UAE., pp: 405-413.

El-Ezaby, F.A., O. Khalifa and A. El-Assal, 1998. Integrated pest management for the control of red palm weevil *Rhynchophorus ferrugineus* Oliv in the United Arab Emirates, Eastern Region, Al Ain. Proceedings of 1st International Conference on Date Palms, Mar. 8-10, UAE. University, Al-Ain, UAE., pp: 269-281.

Faleiro, J.R., V.A. Abrahamand and M.A. Al-Shuaibi, 1998. Role of pheromone trapping in the management of Red Palm Weevil. Indian Coconut J., 29: 1-3.

Faleiro, J.R., 2000. Investigation of the role of pheromone trapping in the suppression of red palm weevil *Rhynchophourus ferrugineus* Oliv, population in coconut plantations. Proceedings of International Conference on Managing Natural Resources for Sustainable Agricultural Production in the 21st Century, Feb. 14-18, New Delhi, India, pp: 1338-1339.

Faleiro, J.R. and P.A. Rangnekar, 2000. Sex ratio of pheromone trap captured red palm weevils *Rhynchophorus ferrugineus* Olivier in coconut gardens of Goa. Proceedings of the International Conference on Plantation Crop (PLACROSYM XIV). Hyderabad, India, Dec. 12-15, 2000. Session IV.

Ferry, M. and S. Gomez, 1998. The red palm weevil in the Mediterranean area. J. Int. Palm Soc., 46: 172-178.

Hallett, R.H., A.C. Oehlschlager and J.H. Borden, 1999. Pheromone trapping protocols for the Asian palm weevil, *Rhynchophorus ferrugineus* Olivier (Coleoptera: Curculionidae). Int. J. Pest Manage., 45: 231-237.

Khalid, A.A., 2007. Red palm weevil home. http://www.redpalmweevil.com/.

Kirk, W.D.J., 1984. Ecologically selective coloured traps. Ecol. Entomol., 9: 35-41.

Murphy, S.T. and B.R. Briscoe, 1999. The red palm weevil as an alien invasive: Biology and the prospects of biological control as component of IPM. Biocontrol News Inform., 20: 35N-46N.

Oehlschlager, A.C., R.S. McDonald, C.M. Chinchilla and S.N. Patschke, 1995. Influence of a pheromone-based mass-trapping system on the distribution of *Rhynchophorus palmarum*(L.) (Coleoptera: Curculionidae) in oil palm. Environ. Entomol., 24: 1005-1012.

Prokopy, R.J. and E.D. Owens, 1983. Visual detection of plants by herbivorous insects. Ann. Rev. Entomol., 28: 337-364.

Sansano, J.M.P., S.G. Vives, M. Ferry and G.D. Espejo, 2008. Field trials for the improvement of the effectiveness of the trapping system of the red palm weevil, *Rhynchophorus ferrugineus*, Olivier (Coleoptera: Dryophthoridae). Boletin Sanidad Vegetal Plagas, 34: 135-145.

SAS (Statistical Analysis System), 2001. SAS Users Guides: Statistics. 8th Edn., SAS Institute Cary, NC, USA.

Vidyasagar, P.S.P.V., A.A. Al-Saihati, O.E. Al-Mohanna, A.I. Subbei and A.M.A. Mohsin, 2000. Management of red palm weevil (*Rhynchophorus ferrugineus* Oliv.) a serious pest of date palm in AlQatif, Kingdom of Saudi Arabia. J. Plantation Crops, 8: 35-43.