

Full Length Research Paper

Influence of farming practices on infestation by red palm weevil *Rhynchophorus ferrugineus* (Olivier) in date palm: a case study

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Abstract

The Kingdom of Saudi Arabia is among the leading date producing countries accounting for nearly 15% of the global date production. Red palm weevil (RPW), *Rhynchophorus ferrugineus* (Olivier) has been identified by the FAO of the United Nations as a 'category-1' insect pest of date palm in the Gulf region of the Middle-East and is a key pest of date palm in the Kingdom. We ascertained the vertical distribution of infestation due to RPW on the palm, age of infested palms, besides determining the influence of various date palm farming practices viz. type of cultivar infested, number of offshoots on infested palm, type of irrigation and spacing adopted on infestation levels by RPW in date palm by inspecting 393 date plantations (234ha) in the Al-Hassa oasis of Saudi Arabia. Our results indicate that infestations were being detected early in the study area, as only 22% of the infested palms were in the advanced stage of attack warranting eradication. However, infestations were wide spread as 21 % of the plantations in this study registered infestation due to RPW. Further, results revealed that nearly 90% of the infestations occurred on the palm trunk between 0-100 cm from the ground with maximum infestations (36%) being recorded in the age group of 6 to 10 years. Khalas, the predominant date palm cultivar in the oasis registered 75 % of the infestations with the least cultivated male palm registering 6% infestation. Further, date palms without any off shoots recorded the highest infestation (79%), indicating that upon removal of offshoots the palm is exposed to attack by RPW especially when the fronds are pruned. Close spacing of palms at planting and open flood irrigation favours increased attack by RPW probably due to enhanced humidity in plantations resulting from these practices. Although, the pest was well managed in the study area, we propose for increased farmer participation in the RPW management programme. Also, educating farmers on latest RPW management techniques in date palm orchards should be encouraged besides implementing plant quarantine regulations.

Keywords: *Rhynchophorus ferrugineus*, *Phoenix dactylifera*, date palm farming practices, infestation.

INTRODUCTION

Date palm *Phoenix dactylifera* L. is the most important crop in the Arabian Peninsula and has been of considerable importance in the region for the last 7000 years (Thomson, 1949). The Kingdom of Saudi Arabia is among the top three date producing countries of the world accounting for about 15% of the global date

production from an estimated 25 million palms ([http://en.wikipedia.org/wiki/Date_\(fruit\)#Fruit](http://en.wikipedia.org/wiki/Date_(fruit)#Fruit)); Anonymous 2006). More than 400 different date palm cultivars are reported to exist in Saudi Arabia (Anonymous 2009). With an estimated three million palms the Al-Hassa oasis (25° 19' 60" N latitude and 49° 37' 60" E longitude) in the Eastern Province is the largest in the Kingdom where El-Baker (1952) listed 15 date palm varieties of commercial importance, while Asif et al. 1982 listed 25 cultivars from the Al-Hassa oasis.

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Red Palm Weevil (RPW), *Rhynchophorus ferrugineus* (Olivier) has been identified by the FAO of the United Nations as a 'category-1' insect pest of date palm in the Gulf region of the Middle-East where it was first reported in the United Arab Emirates in 1985 (Anonymous, 2004; Zaid et al. 2002). In Saudi Arabia RPW was reported in Al-Qatif in the Eastern Province of the Kingdom from where it spread throughout the country mainly through infested planting material (Al-Abdulmohsin, 1987). In Saudi Arabia the annual loss due to eradication of severely infested palms at 1-5 per cent infestation was estimated to range from \$1.74 to 8.69 million, respectively at a fixed eradication level of 20 percent infested palms. (El-Sabea et al. 2009).

Adult female weevils lay eggs mostly on cracks and crevices of young date palms. The newly hatched grubs bore into the palm causing extensive tissue damage (Abraham et al. 1998). Currently RPW is reported to attack 26 palm species from 16 genera worldwide (Malumphy and Moran 2009). Although the pest is reported in about 15 per cent of the coconut growing countries where it originated in South and South-East Asia, it is recorded in nearly 50 per cent of the date palm growing countries (Faleiro, 2006). In the Mediterranean region RPW also severely damages *P. canariensis* (Esteban – Duran et al. 1998; Dembilio et al. 2009). Early detection of infestation is the key to the success of RPW management in the field. Infested palms if not detected early and treated, usually die after harboring several overlapping generations. However, palms in the early stage of attack respond to chemical treatment with insecticide by stem injection (Abraham et al. 1998; Faleiro, 2006).

RPW has been managed in several countries, employing a food baited-pheromone (ferrugineol) trap based Integrated Pest Management (IPM) strategy comprising of pest surveillance based on periodic field surveys for detecting infestations and also through pheromone traps (monitors), mass trapping of adults in endemic pockets, detection of infestations, treating hidden breeding sites including neglected and closed gardens, maintaining crop and field sanitation, preventive and curative chemical treatments, eradicating severely infested palms, implementing quarantine measures and training and education (Abraham et al. 1998; Faleiro, 2006).

Recently El-Shafie et al. 2011 assessed the efficacy of trap free "attract and kill" pheromone technology for managing RPW in date plantations, while Faleiro et al. 2010 developed models to validate area-wide RPW-IPM programmes in date plantations of Saudi Arabia. Various farming practices viz. varietal selection, age of palms, irrigation, offshoot management etc are known to impact infestation levels due to RPW in date palm (Abraham et al. 1998; Aldryhim and Al- Bukiri, 2003; Al-Ayedh, 2008; Azam et al. 2000). Alhudaib et al. 2008 highlighted the importance of understanding and regulating date palm farming practices for the successful management of

RPW. This study was conducted in date plantations of Al-Hassa, Saudi Arabia to ascertain the influence and quantify the impact of the above practices adopted by the farmer on infestation levels due to RPW in date palm.

MATERIALS AND METHODS

The Directorate of Agriculture, Ministry of Agriculture, Al Hassa operates a pheromone trap based area-wide RPW-IPM control programme in over 60 operational areas of the oasis where adult weevils are mass trapped at a trapping density of 1trap/1.5ha. Under the agro-climatic conditions prevailing in Saudi Arabia, infestation due to RPW in date palm is known to peak during the summer (Faleiro, 2006). We therefore selected a period of four months between 13 April to 14 August, 2011 for this study and inspected 393 plantations (234ha) in Al-Suhemia-1 in the North of the Al-Hassa oasis to record infestations and other data. As per the protocol recommended by Abraham et al. 1998 plantations within 100m radius of pheromone traps recording high weevil captures were inspected to detect infestations if any. Special inspections drives were also taken up in and around plantations where severely infested palms were eradicated. In all 39330 date palms were inspected in which 167 infestations were detected (Table 1).

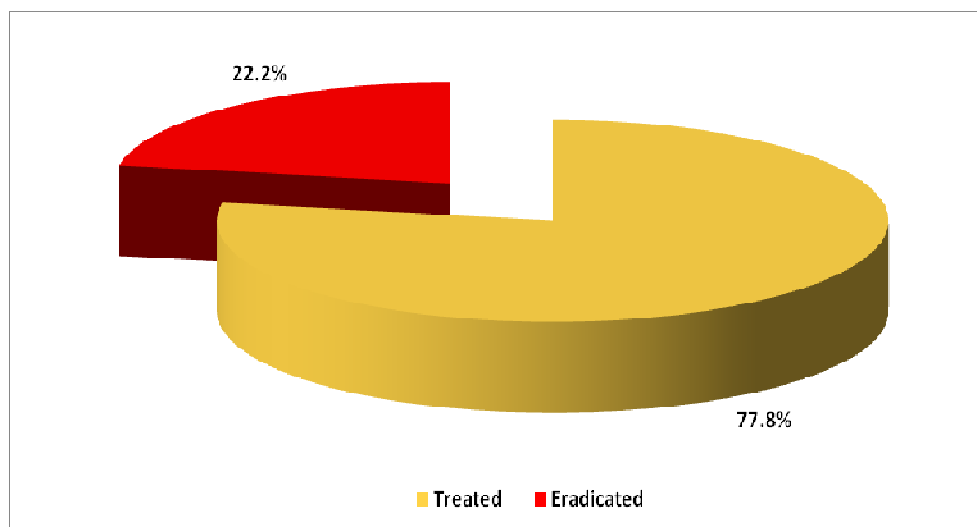
Besides recording the number of infested palms that were treated and cured the number of severely infested palms that had to be eradicated was also noted. In addition, data pertaining to the vertical distribution of the infestation (height of infestation from the ground), age of infested palm, type of cultivar infested, number of offshoots, type of irrigation and spacing adopted in the plantations inspected were recorded. Data on these aspects were compiled at the end of the study. Results of the study are presented and discussed below.

RESULTS AND DISCUSSION

Infestation reports indicate that 21 % of the farms inspected recorded infestation. However, based on the number of palms checked only 0.42% palms were infested. From figure 1 it is evident that during the period under study 22.2% of the infested date palms were severely infested and eradicated while 77.8 % of the infestations were treated with insecticide and saved. Abraham et al. 2000 recommend maintaining eradication of severely infested date palm by RPW at around 20%. This suggests that infested palms are being detected early and the IPM strategy is having the desired impact as seen in the present study. However, infestation of a large number of farms (21%) calls for intensifying the IPM strategy in and around severely infested plantations and pheromone traps recording high weevil captures besides, facilitating active participation by the farmers in the

Table 1. Basic data on infestation in Al-Suhemia-1 (13 April to 14 August, 2011)

Parameter	Number
Farms Checked	393
Farms Infested	83
Palms Checked	39330
Palms Infested	167

**Figure 1.** Number of palms treated and eradicated in date palm plantations after infestation by *R. ferrugineus*

control programme. At present the Ministry of Agriculture, Kingdom of Saudi Arabia operates the entire RPW-IPM programme in Al-Hassa. Models developed for the management of a common mobile pest faced by many heterogeneous farmers in the past have shown that area-wide pest management is superior to farm-by-farm control, and that co-operation of these heterogeneous farmers is crucial for the success of the control programme (Yu and Leung 2006).

With regard to vertical distribution on the palm it is seen from figure 2 that that 70 % of the infestations due to RPW in date palm occur between the ground level and 50 cm on the trunk above the ground. Furthermore, nearly 90% of the infestations were found to be restricted on the palm between 0-100cm from the ground. This finding is in agreement with previous reports from the Al-Qatif region of the Kingdom (Vidhyasagar, et al.2000). The cracks and crevices near the collar region are known to predispose the base of the palm to infestation by RPW (Abraham et al. 1998). Thus, this portion of the date palm most prone to attack by RPW needs to be protected by periodic application of insecticide. In this context developing a RPW repellent (Oehlschlager, 2005) that will eliminate dependence on hazardous insecticides is

essential so that the susceptible region of the palm can be protected from invading adult female weevils that lay eggs and initiate new infestations. Unlike date palm, where infestations mostly occur between 0-100cm from the ground, in *P. canariensis* infestations occur in the crown (Esteban – Duran et al. 1998). In our study we recorded most of the infestations in male date palms in the crown.

Further , 97 % of the infestations detected were in palms below 20 years of age (Figure 3) with maximum infestation (36%) being recorded in palms of 6-10 years of age, which is in agreement with previous findings (Nirula 1956; Abraham et al. 1998).

With regards to RPW infestation on different date palm cultivars, results presented in figure 4 indicate that the highest infestation (75%) was recorded in the cultivar Khalas which is also the most popular date palm cultivar in the Al- Hassa oasis. Although, just four male palms are planted per hectare to harvest pollen for pollinating female flowers (Zaid et al. 2002), 6% of the infested palms recorded in this study were in males suggesting that male palms are preferred for egg laying by gravid RPW females. It is pertinent to mention that most of the infestations in male palms were recorded in the crown of

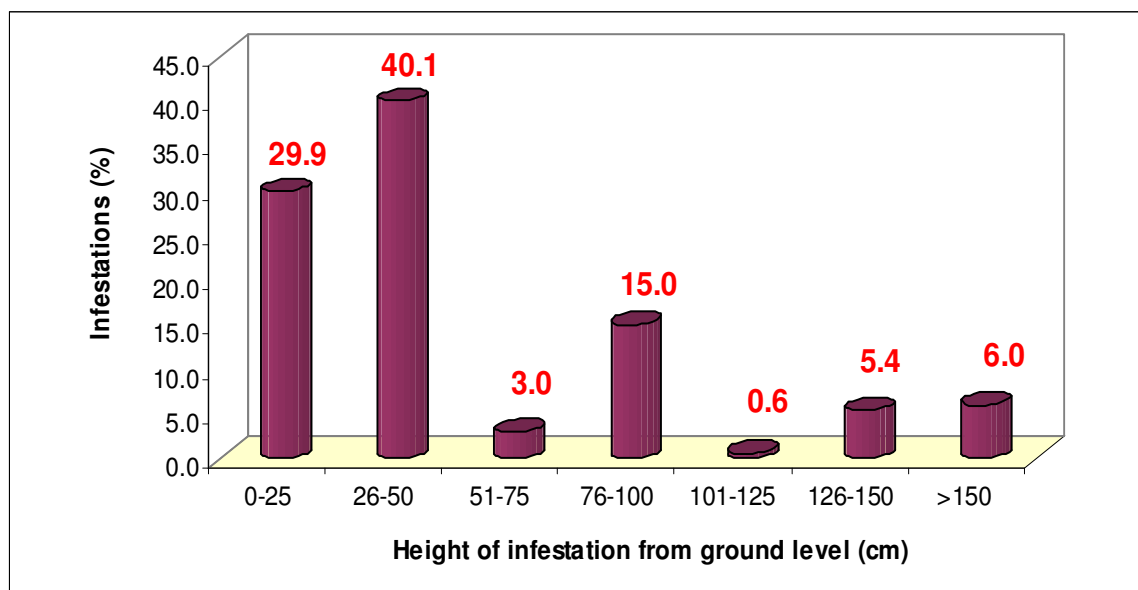


Figure 2. Vertical distribution of infestation due to *R. ferrugineus* on date palm trunk

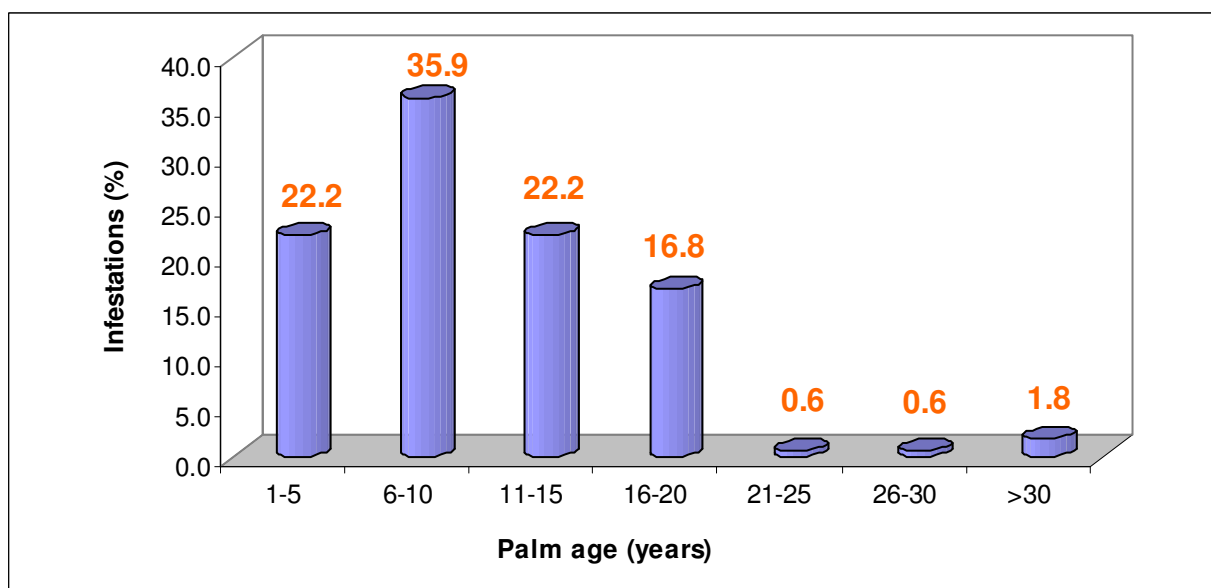


Figure 3. Age group of date palms infested by *R. ferrugineus* in date palm plantations

the palm as seen in *P. canariensis* which is the most preferred host of RPW (Esteban – Duran et al. 1998; Dembilio et al. 2009). In this context the recommendation by Abraham et al. 1998 of treating the cut surface of beheaded male palms with insecticide is vital in the overall RPW-IPM strategy. Under laboratory conditions Al-Bakshi et al. 2008 reported that the date palm cultivar Khalas was highly preferred for oviposition by RPW, while Al-Ayedh, 2008 recorded significantly greater numbers of egg lay in the cultivar Sukkary in laboratory

rearing of RPW on date palm stem logs, while, recording more cocoons from the cultivar Khalas. Considering that Khalas is the predominant cultivar in the Al-Hassa, the RPW-IPM strategy needs to be intensified in the oasis.

From Figure 5 it is evident that date palms without any off shoots recorded the highest infestation, indicating that upon removal of offshoots the palm is exposed to attack by RPW especially when the fronds are pruned. Azam et al. 2000, from the Sultanate of Oman recorded more than 88% infestation by RPW in date palm as a result from off-

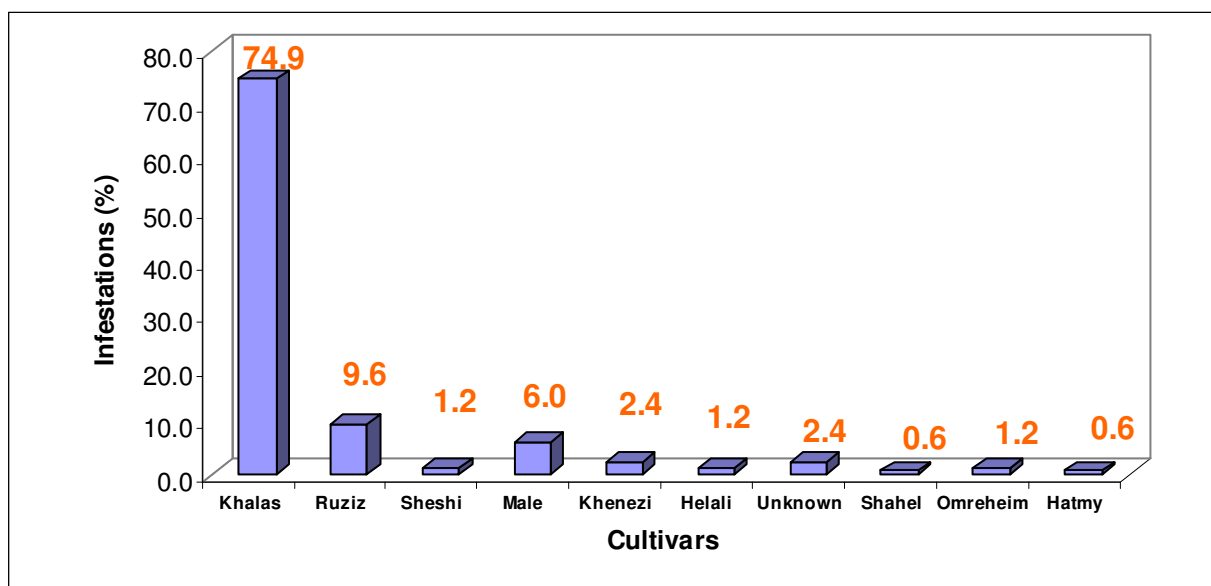


Figure 4. *R. ferrugineus* infestation in different date palm cultivars

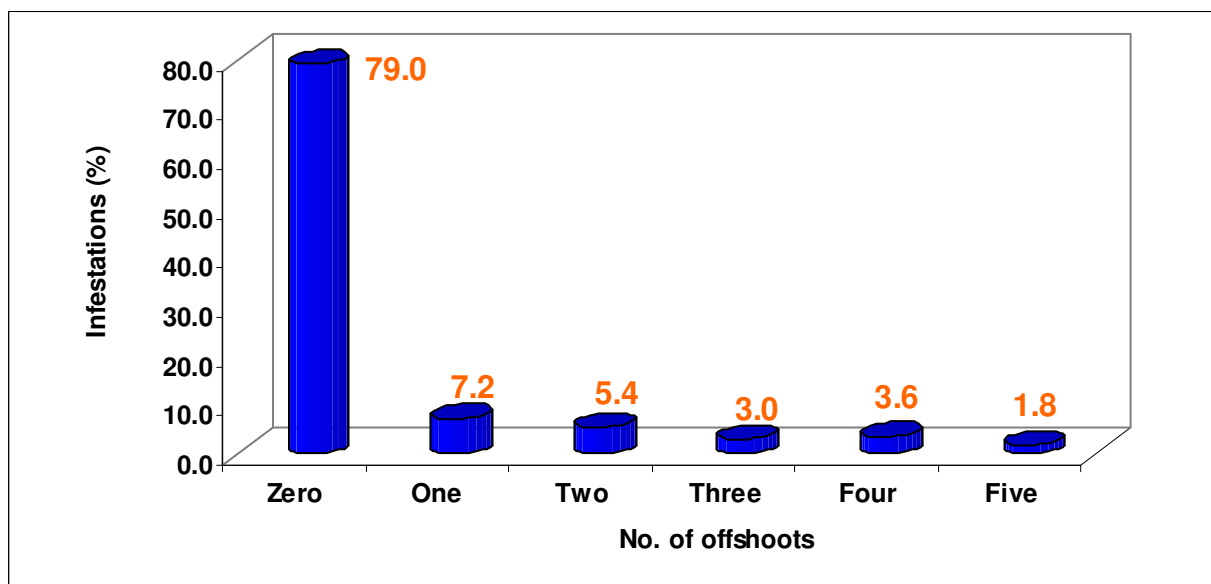


Figure 5. *R. ferrugineus* infestation in date palm vis-à-vis number of off shoots

shoot removal and leaving the wounds without treatment. The need to treat palm wounds with insecticide when fresh to counter emitting palm volatiles from such wounds has been emphasized by several workers (Abraham et al. 1998; Faleiro, 2006; Dembilio et al. 2012). In view of the severity of the RPW problem on date palm in the region, we propose that date palm farming practices which cause injury to the palm tissue (shaving of fronds and removal of offshoots), be taken up when adult weevil activity is the

least viz. during the peak of winter (December-February), as also proposed by Dembilio et al. 2012 for shaving of fronds in *P. canariensis* in the Mediterranean region.

Further, the highest number of infestations were also recorded in farms where palms are planted at a distance of 6 m (Figure 6) which is the most common spacing at which date palm is planted in the Al-Hassa oasis. It is recommended to plant commercial date plantations at a

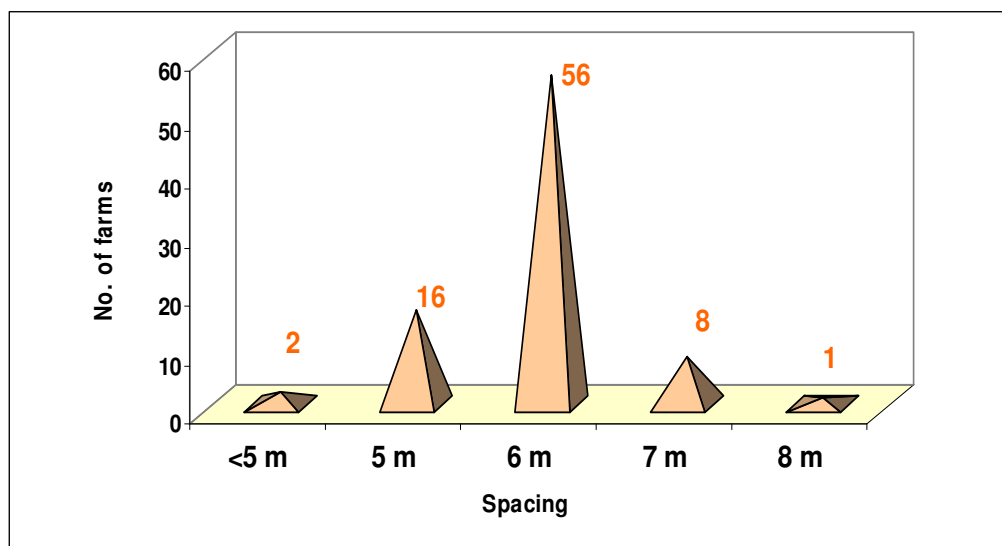


Figure 6. Effect of tree spacing of date palms on *R. ferrugineus* infestation

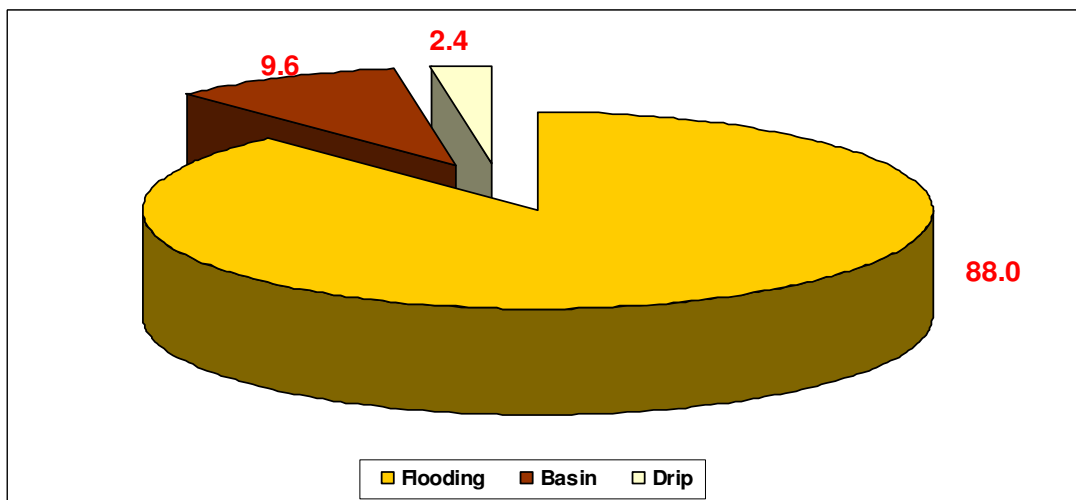


Figure 7. Influence of irrigation methods adopted in date palm plantations on infestation by *R. ferrugineus*

spacing of 10x10 m accommodating 100 palms/ha (Zaid et al. 2002). Closer spacing with higher palm density is likely to retain in-groove humidity. Also, from Figure 7 it is seen that 88% of the infestation in the Al-Hassa oasis were recorded in plantations that were flood-irrigated as compared to 9.6 and 2.4 % infestation in plantations that were irrigated through open basins and drip lines, respectively. High soil moisture and open flood irrigation is known to favour in-groove habitat for RPW (Aldryhim and Khalil, 2003; Aldryhim and Al-Bukiri, 2003). In view of our findings it is proposed to reduce excess moisture levels in date plantations of Al-Hassa by adopting the recommended spacing at planting and using drip lines for

irrigation that would not generate excess in-groove humidity and soil moisture besides conserving the precious resource of irrigation water .

The importance of outreach programmes to educate farmers on the management of RPW along with the development of early detection methods and implementation of plant quarantine regulations to stop the movement of infested planting material has been highlighted in the past (Abraham et al. 1998; Faleiro, 2006). Recently, these aspects of the RPW-IPM strategy including the need for a unified strategy to combat RPW have been emphasized by Mukhtar et al. 2011.

This study has shown that several farming practices

adopted in date plantations significantly influence infestation levels due to RPW in date palm and need to be suitably modified to curtail infestation levels. Besides, enhanced farmer cooperation and participation in the RPW-IPM programme will go a long way in combating this lethal pest.

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