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Research Article

MONITORING, POPULATION DYNAMICS AND INFESTATION RATE OF RED PALM WEEVIL IN DIFFERENT LOCAL DATE PALM VARIETIES IN BAHAWALPUR

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Abstract

The date palm, or *Phoenix dactylifera* L., is a valuable fruit crop and source of income for many nations. It is a member of the Arecaceae family of palm trees. Red palm weevil (RPW), *Rhynchophorus ferrugineus* (Olivier, 1790) is an invasive pest that causes damage to palm trees worldwide by eating their stems inside. The objective of this study is to identify susceptible and resistant varieties among as well as identify the population dynamics of *R. ferrugineus.* Our results showed that most affected variety was Khurma in both age date palm e.g., five-ten old plants and in eleven-fifteen years old. While most superior least effected variety was Begum Jangi among Zhaidi, Aseel, Begum Jangi, Haleeni, and Shamran with no population. The most vulnerable date palm variety is Khurma. For both immature and mature *R. ferrugineus*, January through March and October through December are the ideal months to execute management measures. According to recent research, the Bahawalpur region needs to introduce resistant date palm varieties.

Keywords: *Monitoring, Phoenix dactylifera, Rhynchophorus ferrugineus, RPW. Date Palm*
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1. INTRODUCTION

The date palm, or *Phoenix dactylifera* L. (Arecaceae; Arecales), is a valuable fruit crop and source of income for many nations. With over 2400 varieties spread across 200 genera, it is the world's oldest crop in fruits, having been cultivated since prehistoric times, mostly in arid places (Hadrami and Hadrami, 2009; Johnson et al., 2015). Worldwide, more than 100 million date palms planted on one million hectares of land yield about 7.5 million metric tons of date fruit each year (El Hadrami and Al-Khayri, 2012). In addition to its medicinal properties. significance, date fruits may be the key to addressing vitamin deficiencies in poor nations worldwide (Shabani et al., 2016).

Red palm weevil (RPW), *Rhynchophorus ferrugineus* (Olivier, 1790), (Coleoptera. Curculionidae) is an invasive pest that causes damage to palm trees by eating their stems from inside in gulf countries. Cases of RPW infestation have been reported in South East Asia, that affecting economical palm species like *Cocos nucifera* (Arecaceae; Arecales), *Elaeis guineensis* (Arecaceae; Arecales), *Livistona decipiens* (Arecaceae; Arecales), and *Livistona chinensis* (Arecaceae; Arecales). The infestation of RPW has been reported from Thailand, Malaysia, Indonesia, the

Philippines, India, and Sri Lanka (Azmi et al., 2017). Every year, 8 million $ is spent in the Middle East and the Gulf countries merely to remove infected palm palms (FAO, 2017). The RPW causes the most damage when it is a larva. The eggs hatch in the host palm's crown, primarily inside the soft tissue fissures and divots (Murphy and Briscoe, 1999; Wahizatul et al., 2013; Rochat et al., 2017). The larvae then begin to chew through the delicate tissues, progressively creating deep tunnels that penetrate the tree's structure. Because there aren't any overt signs, especially in the initial stages, it is challenging to detect afflicted palm trees in palm plantations. Physical symptoms become more noticeable as the infestation gets worse (Kontodimas et al., 2017; Farooq et al., 2019).

In an effort to identify infected palms as soon as possible, alternate techniques for infestation detection are now being investigated. Using trained smelling dogs and keeping an eye on auditory cues linked to RPW larvae munching are two instances (Salem, 2015; Hetzroni et al., 2016). All of the options, nevertheless, had shortcomings, such as low precision or restricted applicability for large-scale plantations. Because of this, the traditional method of identification still depends on identifying the outward signs of RPW infection on palm plants. Infestation physical symptoms for Coconut, Date Palm, and Pineapple palm have all been thoroughly reported (Güerri-Agulló et al., 2011). The most dependable way for producers to detect RPW infestation is by eye inspection via stethoscope (Soroker et al., 2013; Kontodimas et al., 2017). One of study reported that infestation (%) of RPW was varies in different date palm varieties e.g., Muzawati (8%) was found to be the most tolerant variety followed by Pathri (12%), Thothar (15%), Khar (16%), and Shakri (16%) (Kontodimas et al., 2017). The cultivars that saw a high rate of infestation were Eidan Shah, Dhedhi, Fasli, Karbalain, and Aseel (Shar et al., 2012).

Current study aimed to find out the hidden time of RPW in the different varieties of date palm. In the present study, we used 6 different varieties e.g., Zhaidi, Aseel, Begum Jangi, Khurma, Haleeni, and Shamran of date palm and in future can be used as trap crop.

2. MATERIALS AND METHODS

2.1. Experimental site

Monitoring of RPW adults (males and females), larvae and pupae were observed in a date palm orchard located at Gulberg Road, Model Town A, Bahawalpur, Pakistan.

2.2. Detection of RPW

The base of the tree trunk is where the RPW typically attack. We used stethoscope to detect the RPW inside the date palm tree. Because larval feeding cause noise and we can detect the RPW infested tree. Another severs attack by RPW showed symptoms like yellowish oozing discharges that emerge from the infected palm trunk and eventually turn into dried gum with a dark brown color. An unpleasant stench also emanates from the injured tissue and larval feces.

However, we randomly selected the date palm trees in the different orchard located in Bahawalpur, Pakistan. The population dynamics of RPW (mature and immature) inside the trunk of date palm was recorded each month. Six different varieties of date palm e.g., Zhaidi, Aseel, Begum Jangi, Khurma, Haleeni, and Shamran were selected for detection of RPW. Number of larvae, pupae, and adults were recorded on above mentioned six verities.

2.3. Data recording

In this study, a total of 18 date palm trees were inspected for Red Palm Weevil infestation from 3 different orchard. Three trees were randomly selected of each date palm variety. Immature and mature stages of RPW were collected via making holes via drill machine in trunk of date palm tree. After counting the immatures and mature stages of RPW placed back inside the trunk and the holes were covered with soil paste that was made chlorpyrifos mixed water at

rate 1ml / liter water. And each month data of population dynamics was recorded.

2.4. Statistical Analysis

The effect of seasons on the population of immatures (larvae/grubs and pupae) and mature red palm weevils (per date palm tree) were analyzed using one-way ANOVA for each variety of date palm separately. The statistical differences existing for a factor ($P < 0.05$), the means were separated using Fisher's LSD test SPSS Statistics 15.0 (SPSS Inc., Chicago, IL, USA).

Two-factors ANOVA statistics for analyzing the population dynamics of red palm weevil on six date palm varieties with age of tree among four different seasons (Table 1) in Pakistan via using SPSS Statistics (Stehlik-Barry and Babinec, 2017).

3. Results

3.1. Number of Immature Red Palm Weevil

Different varieties responded differently. The number of immature red palm weevils per tree were observed. Most affected variety in five-ten old plants was Khurma (from January to March) with 542 immatures and in eleven-fifteen years old (October to December) with 300 immatures per plant while most superior least effected variety was Begum Jangi from least effect

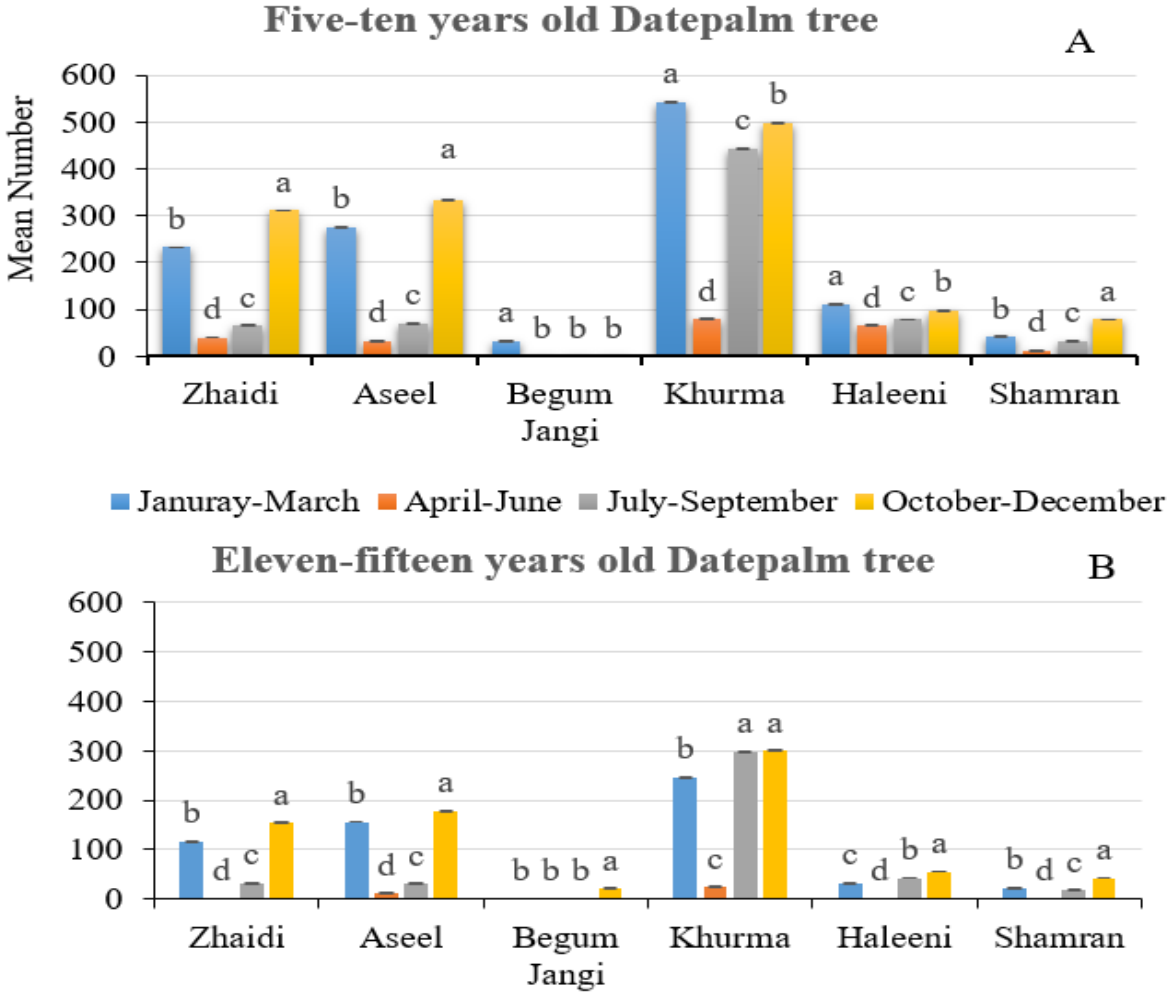

Figure 1. Mean number of immatures (larvae/grubs and pupae) of red palm weevils inside the trunk of different date palm varieties, A) Five-ten years old trees, B) Eleven-fifteen years old trees. Different small letters above each bar indicate significant difference within a block of each date palm varieties (difference in no of RPW among four season) using one-way ANOVA, LSD test, and at $P < 0.05$.

(from January to March, April to June and July to September) with no population as shown in figure 1.

3.2. Number of Mature Red Palm Weevil

Different varieties responded differently. The number of mature red palm weevils per tree were observed. Most affected variety in five-ten old plants was Khurma (from January to March) 13 per plant and in eleven-fifteen years old (October to December) 8 per plant while most superior least effected variety was Begum Jangi from least effect (from April to June and July to September) with no population as shown in figure 2.

3.3. Month-Wise Red Palm Weevil Population

The most population of 10 insects per plant was found in the months of March and November. Our results show that population rate of *R. ferrugineus* was least in May and June as shown in figure 3, So management strategies should be done from Jan to march and again from Oct to December.

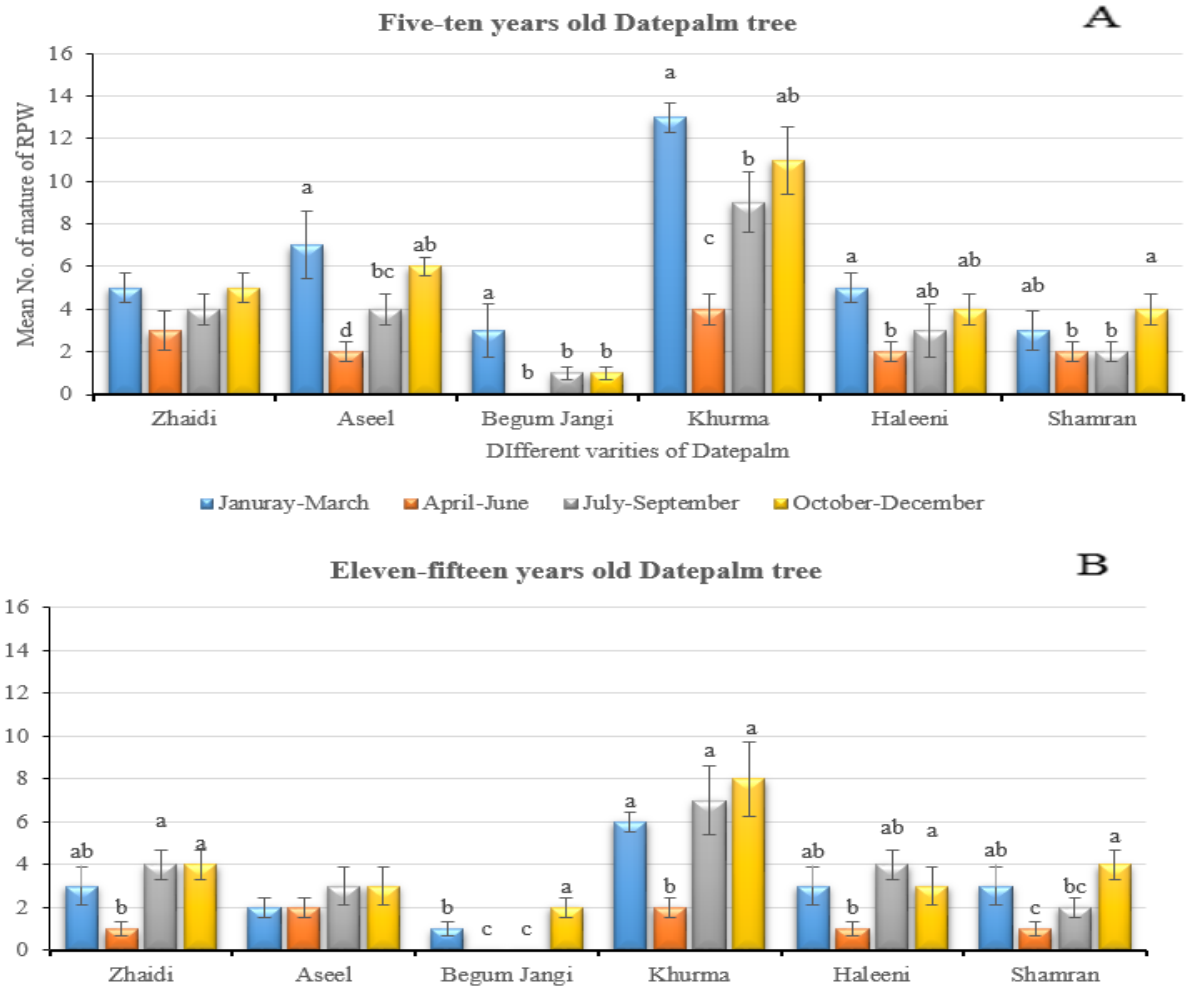

Figure 2. Mean number of mature (adults) red palm weevils inside the trunk of different date palm varieties, A) Five-ten years old trees, B) Eleven-fifteen years old trees. Different small letters above each bar indicate significant difference within a block of each date palm variety (difference in no of RPW among four season) using one-way ANOVA, LSD test, and at $P < 0.05$. RPW: Red palm weevil.

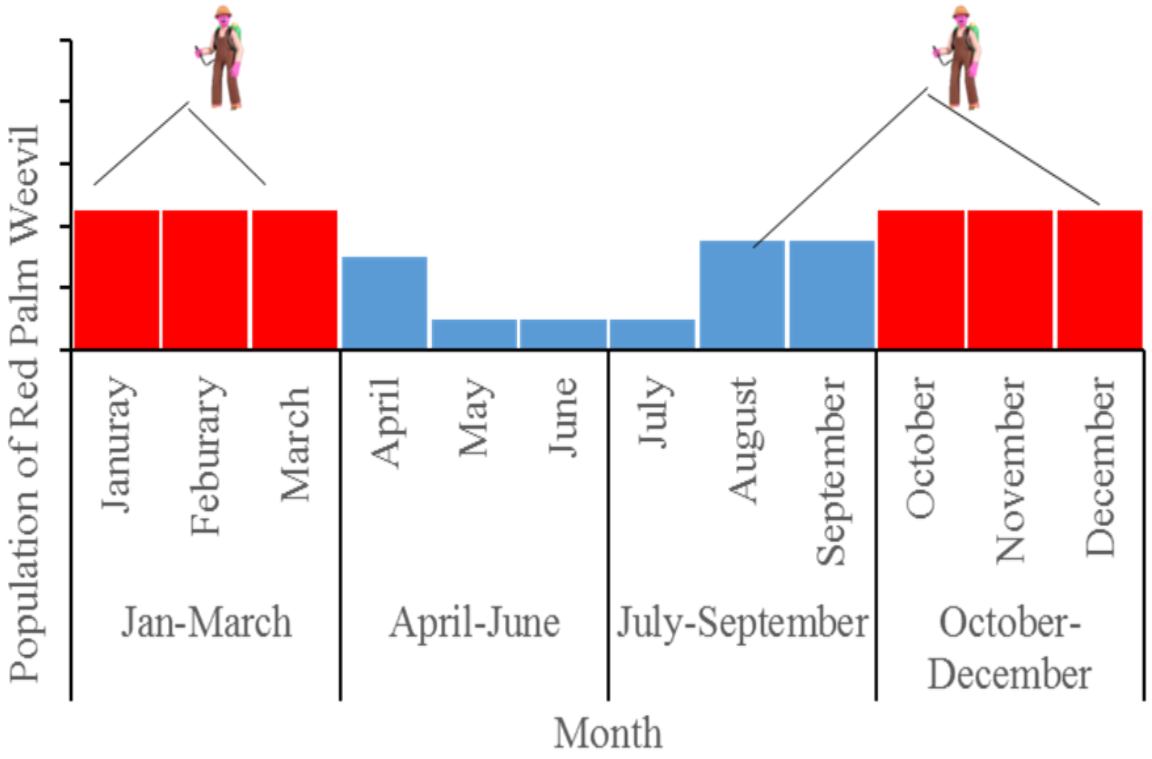

Figure 3. Management strategies should be done in start and end of year. Red color shows that management strategies should be done for RPW.

Table 1. Two-factors ANOVA statistics for analyzing the population dynamics of red palm weevil on six different date palm varieties with age of tree among four different seasons in Pakistan.

Indexes (Plant age)	**Factors (Immature & mature stages)**	**Treatments**	***df***	***F***	***P***
Five-ten years	**Immatures**	**a**	3	21805.4	< 0.001
		b	5	38142.4	< 0.001
		a * b	15	4274.50	< 0.001
Eleven-fifteen years	**Immatures**	**a**	3	10033.9	< 0.001
		b	5	15618.4	< 0.001
		a * b	15	1950.64	< 0.001
Five-ten years	**Matures**	**a**	3	23.33	< 0.001
		b	5	41.12	< 0.001
		a * b	15	2.25	< 0.009
Eleven-fifteen years	**Matures**	**a**	3	15.23	< 0.001
		B	5	18.09	< 0.001
		a * b	15	1.59	< 0.001

a: Weather, b: fruit species.

4. Discussion

Date palm genotypes vary in their ability to withstand various insect races that pose a threat to their health. The most tolerant variety found was Begum Jangi in case of both mature and immature insects no matter which age of plant it is either five-ten years or eleven to fifteen years. Among 10 commercial varieties of date palm (Karbalain, Aseel, Dhedhi, Fasli, Eidan Shah, Shakri, Khar, Thothar, Pathri, and Muzawati), Muzawati was reported most tolerant against *R. ferrugineus* (Sher et al., 2012). While in our study Khurma was most susceptible variety. Aseel and Karbalain varieties were particularly vulnerable to an attack by *R. ferrugineus* (Baloch et al., 1995). While, in our study, Aseel was found 2nd susceptible variety after Khurma in five-ten year and eleven-fifteen-year-old trees in both of cases e.g., immature and mature insects. While Begum Jangi was most tolerant variety against both stages of *R. ferrugineus*. Highest proportion of infestation was seen in Kechanr (Manzoor et al., 2020), which was extremely similar to the Aseel type in the Bahawalpur.

The population of *R. ferrugineus* adults was captured in first, second, and third weeks of July, as well as the second week of June (Shar et al., 2012). While current study show that population rate of red palm weevil was high in January to March and October to December which is totally different from the literature which may be due to difference in various environmental conditions. In April, largest number of adult red palm weevil (RPW) was captured using pheromone traps (Arafa and Barakatt, 2021). While these studies reported the population of adults of *R. ferrugineus* only While our study reports the both stages of *R. ferrugineus*. Moreover, difference due to various abiotic factors like weather and climatic conditions. Once study reported that in December less population was trapped in sex pheromone trap while maximum in April (Manzoor et al., 2020). This clearly showed that *R. ferrugineus* population remain inside the tree and creating damage and our study reported that maximum adults and larvae were collected in December. The number of adult weevils in Punjab Province climbed progressively from 6.34 adults per trap in January 2014 to 18.76 adults per trap in April at a relative humidity (R.H.) of 41.93%, and then decreased to 1.66 adults per trap while our study indicates that the most population of 10 insects per plant was found in the months of March and November.

5. Conclusion

Khurma is most susceptible variety of date palm. January through March and October through December are the best times to implement management initiatives for both immature and mature of *R. ferrugineus*. The current research recommend that resistant types of date palm varieties needs to be introduced in Bahawalpur region.

6. Acknowledgments

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7. Conflicts of Interest

The authors declare no conflict of interest.

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