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DETECTION OF INFESTATION OF RED PALM WEEVILS (*RHYNCHOPHORUS FERRUGINEUS*) ON DATE PALM TREE IN DISTRICT PANJGUR

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Abstract

Background: *Date palm (Phoenix dactylifera L.) is an important fruit crop of Pakistan, particularly in District Panjgur.*

Objective: *The present study was conducted during 2024 (April–October) to assess the infestation of Red Palm Weevil (Rhynchophorus ferrugineus) in three tehsils of Panjgur (Khudabadan, Washbood, and Essai) on three major date varieties (Muzaiti, Hilani, and Shakri).*

Materials and Methods: *Pheromone traps were installed and monitored regularly, and pest populations were recorded before and after pesticide application.*

Results: *Results revealed that there are significant differences in infestation among date varieties, whereas location had no significant effect. Shakri showed the highest infestation, followed by Muzaiti, while Hilani exhibited the lowest infestation.*

Conclusion: *Pest monitoring and pesticide application effectively reduced Red Palm Weevil infestation, indicating that pest management practices can improve date palm protection, sustainability, and yield production in the study area.*

Keywords: *Date palm (Phoenix dactylifera L.), Date varieties, Pest infestation, Pheromone traps, Panjgur, Red palm weevil (Rhynchophorus ferrugineus)*

INTRODUCTION

Panjgur is home of dates in Balochistan. Date palm is commonly known as Khajoor in Urdu and Harmung in Balochi. Pakistan has date palms covering 74.80 thousand hectors of area producing 426.80 thousand tons of dates annually. The fruit grows in all the provinces of Pakistan. Among which Sindh and Balochistan lead the nation in the production and cultivation of date palms. Balochistan contributes significantly to the nation's production of dates, making up to 51% of the total output. Makran division makes up a sizeable 45% of Balochistan's overall date fruit production. More than 90 % of the date's population is represented by these main cultivars "Begum jangi "Mozatti" and "Halani" with 10% of the remaining cultivars being Shakri "Cebra" (1). Due to their popularity in the international market, the Mozatti date palms variety has a large number and high-quality plants planted through the region (2). The region has historically been known for its population, because the geography and climate of the area make it perfect for date palm cultivation (3). Notably, Date palm cultivation in Pakistan has been under severe attack from the red palm weevil for the last few decades. This invasive pest has caused massive destruction to palm cultivation in many countries and is known to have a severe impact on palm farming globally (4). RPW (Red Palm Weevil) being a notorious pest is destroying date trees and making serious economic problems for the cultivators (5). This destructive pest burrows into the palm trunks and feeds on the internal layer of the tissues, making it impossible to detect until it is far too late (6). The biology and life cycle of red palm weevil are complex, which makes these insects highly invasive and adaptable. A female weevil deposits her eggs in the soft parts or wounds of the palm, and once the larvae emerge, they join the trunk and eat the soft vascular tissues which results in the tree' s structural failure and death (7). The immature stages grow inside the host plant, destroy the vascular mechanism, which finally bring about the tree's death and collapse (8). In the Middle East peak weevil activity is recorded between March and May while a second peak in captures occurs during October and November (9). Given distinct weather patterns and the extensive farming of date palms within Panjgur, the red palm weevil now poses a greater threat to date palms, resulting in huge economic damage and endangering the sustainability of the local date. In Panjgur, the date palm cultivars Muzaiti, Sabza, Sharifa, Jan Shur, Shakri, Rabie, Halini, Karaba, Koroch and Begum Jangi produce the highest yield (7). Due to lack of modern processing technique numerous disease-causing pests attack the host plants in Panjgur district (10). Recently, modern insecticides such as neonicotinoids (imidacloprid) and phenyl pyrazoles (fipronil) have been employed to prevent treating RPW *(Rhynchophorus ferrugineus*) infestations in date palms (11). Pheromone traps are essential to effectively manage the RPW in date plantations; the use of pheromone traps is commonly employed (12). Bucket traps have been used for beetles and weevils. It has been found that larger traps with 9– 10-L plastic buckets demonstrated better results than smaller ones. Various factors, including trap design, placement, and the specific pheromone used, can shape how pheromone traps influence other arthropod groups (13).

The infestation of Red Palm Weevil poses a significant threat to the date palm production in Balochistan, Pakistan. Due to the pest concealing and destructive nature, as it burrows in the trunk of trees that weakens and eventually causes the death of the tree. Despite the importance of Panjgur as a major date producing area, no research has been conducted to evaluate effective management of Red Palm Weevil in the natural environment of the region. Therefore, effective management of RPW is an important concern for maintaining dates production in Panjgur.

Current study was conducted to detect the infestation of Red Palm Weevil (RPW) and to evaluate the efficacy of chemical pesticides against RPW in date palm trees in Panjgur, Balochistan.

MATERIALS AND METHODS

STUDY AREA

The study was carried out in district Panjgur situated in the Balochistan. In the mentioned district three union councils were selected, Washbood, Khudabadan and Essai with hot and arid climate. These areas were selected based on the presence and importance of date palm cultivation, reported occurrence of RPW and accessibility of the study sites.

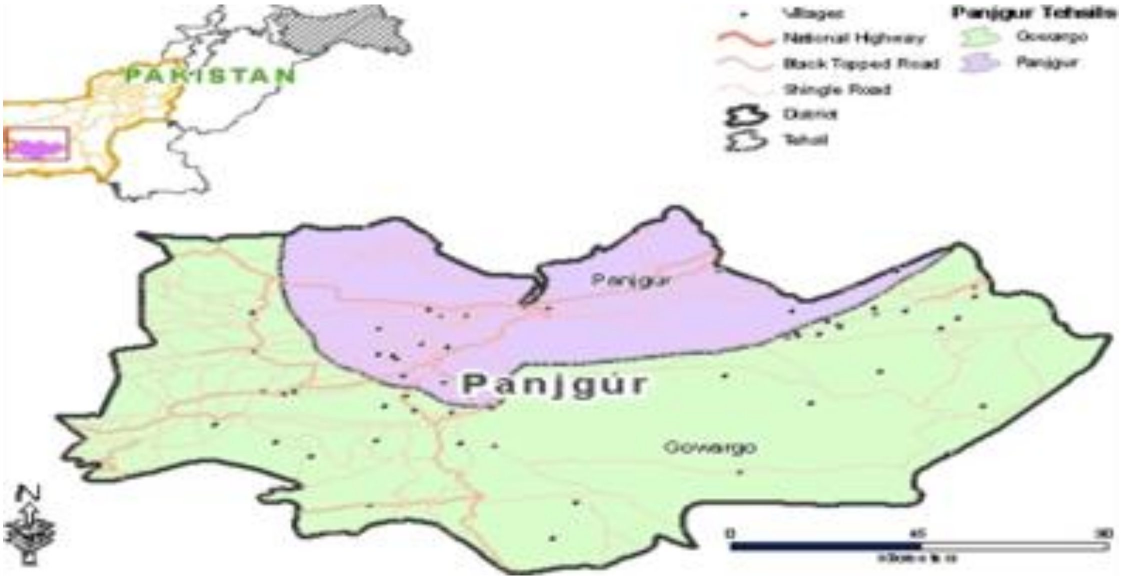

Fig 1. Map of Pnjgur

SAMPLE SIZE

The 135 date palm trees were taken as research sample, 45 trees per locality of three dominant date varieties; Muzaiti, Hailni and Shakri to observe or assess the RPW population. Samples were taken as;

Total number of date palm trees sampled:135

Samples from khudabadan:45 (Muzaiti:15, Hilani :15, Shakri :15)
SamplesfromWashbod:45 (Muzaiti:15, Hilani :15, Shakri :15)
SamplesfromEssai:45 (Muzaiti:15, Hilani :15, Shakri :15)

A total of 135 date palm trees were included in the study, with 45 trees randomly chosen from each research location. This sample comprised 15 trees from each of the three selected varieties. Among these randomly selected trees, those showing clear, characteristic symptoms of red palm weevil infestation were identified and marked for insecticide treatment.

MATERIALS

The material utilized in study contains gloves, face mask, sharp knife, forceps, trap lure (ferro lure), trap bucket, water, detergent, copper wires, spry bottles or manual pump spryer and insecticide.

SAMPLING PROCEDURE

Sampling was conducted from April to October 2024 to assess the infestation of RPW through visual symptoms and pheromone trap monitoring (6). The warm conditions during these months (April to October) favor RPW activity, reproduction and development resulting in peak pest activity in date palm. Infestation indicators included wilting or yellowing fronds, leaf chlorosis and drop, holes and tunnels in the trunk, brownish gum oozing, larval chewing sounds, dust-like material at the tree base, and the presence of adult and larval RPW. A tree was classified as infested when one or more characteristic symptoms were observed.

PREPARATION OF PHEROMONE TRAPS

To assess the infestation and to monitor the population of RPW, pheromones trapes were prepared and installed. For pheromone trap preparation, a red plastic bucket with a lid was modified by making side openings for weevil entry and rectangular openings on the lid for pheromone release. A Ferro lure+ aggregating pheromone was fixed inside the lid using iron wire for RPW population sampling. Two liters of detergent water were added to trap and kill attracted weevils. The detergent solution was replaced weekly, while the pheromone lure was changed monthly.

INSTALLATION AND MONITORING OF THE PHEROMONE TRAPS

After preparation, pheromone traps were installed on infested date palm trunks at a height of 1.5 m using iron wires for maximum Red Palm Weevil (RPW) capture. The traps were monitored every 15 days for four months (April–July) during the peak activity season, and pest population observations were recorded. During each 15-day inspection, the pheromone traps were checked for cleanliness, proper placement and physical damage. Captured weevils were collected and counted and damaged traps or pheromone lures were replaced when necessary. Traps position were kept constant throughout the entire observation period to maintain data consistency.

PREPARATION OF INSECTICIDE

For the treatment trial, 30 g of Fipronil was dissolved in 25 L of water and applied to infested date palm trees using a manual pump sprayer at 15-day intervals.

APPLICATION OF INSECTICIDAL SPRAY

Infested date palm trees were sprayed with insecticide every 15 days from August to October using a manual sprayer. A total of seven sprays were applied, and pest captures were recorded after each treatment.

PRE-TREATMENT DATA COLLECTION

Before treatment, adult Red Palm Weevils were collected from pheromone traps, counted, and recorded every 15 days from April to July.

POST-TREATMENT DATA COLLECTION

After treatment, trapped adult weevils were collected, counted, and recorded every 15 days from August to October.

STATISTICAL ANALYSIS

Data were analyzed by using 2-way ANOVA. The SPSS was used to compare the effects of varieties and location and their interaction. Significant differences among the means were compared by the LSD test at 5% significant level.

RESULTS

The research was conducted to study RPW infestation in Panjgur district of Balochistan. Three commercial dates producing tehsils; Washbood, Khudabadan and Essai were selected. For pest data collection trees of three dominant date varieties; Muzaiti, Hilani and Shakri were selected. Total 135 trees were observed as sample size, 45 trees of each variety from each location. Results about pest infestation, pests' numbers before and after insecticidal application were observed and noted.

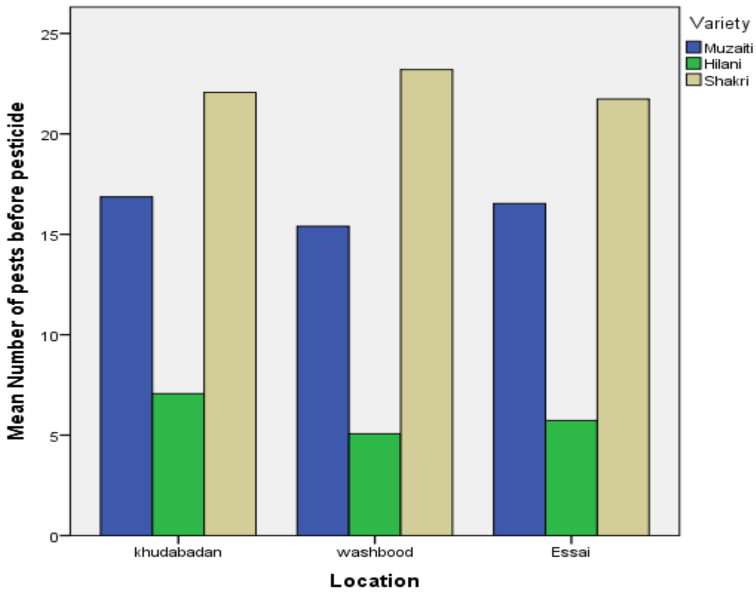

Fig. 2. Mean number of pests before pesticides application

Fig. 2 shows the mean value of number of pests before the application of pesticide in concern locations (Khudabadan, Washbood and Essai) across all 3 varieties (Muzaiti, Hilani and Shakri). It is clear from the figure that Shakri has highest pest population followed by Muzaiti and then Hilani with least pest population.

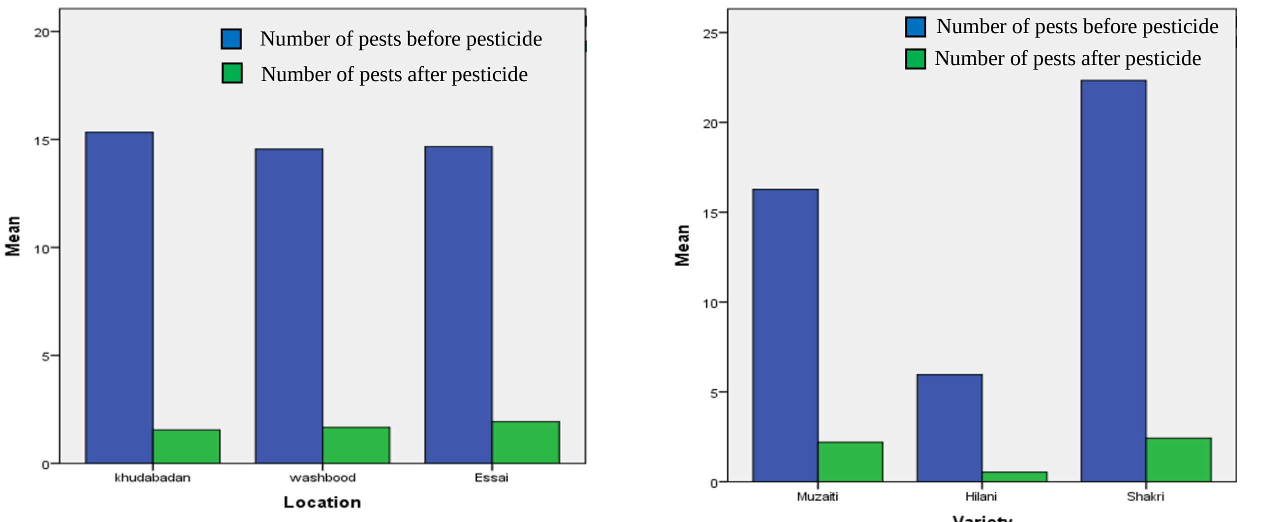

Fig. 3a. Mean number of pests before and after pesticide application at different location; **(b).** Mean number of pests on selected date varieties after the application of pesticide

Fig. 3(a) shows that the pest population decreased in all 3 locations after the application of pesticides. These results indicate that pesticides were effective at all locations. Fig. 3(b) shows that the pest population decreased in all 3 varieties after the application of pesticides. This result indicates that pesticides were effective to control the population of pests among all three varieties.

Table I shows the description of paired samples t-test. Where the mean number of pests before application of pesticide is 14.85 which dropped to 1.72 after the application of pesticide among 135 observations. Standard deviation is 8.584 and 1.296 before and after application respectively. To test the difference between the average number of pests before and after the application of pesticides, we applied the paired-t-test and where the value of t- test is 19.212 and the p value was observed less than 0.05, it indicates that there is significant difference between the mean number of the pests before and after the application of the pesticides.

Table I. T-Test Paired-Sample

	Average	Sample	Standard deviation	SME
Number of pests before pesticides	14.85	135	8.584	.739
Number of pests after pesticide	1.7185	135	1.29668	.11160

Table II shows the effect of location, variety and their interaction on pest population before pesticides application. It represents that there are significant differences among variety with (p-value =.000) but no significant differences were observed among locations with p-value=.759. Where the interaction between variety and location with (P-value =.790) also represents no significance

Table II. Analysis of variance for the number of pests before pesticides application

Source	Adjusted Sum of Squares	Df	Mean Square	F	Sig
Adjusted Model	6236.904a	8	779.613	27.015	.000
Intercept	29777.963	1	29777.963	1031.872	.000
Variety	6170.326	2	3085.163	106.908	.000
Location	15.926	2	7.963	.276	.759
Variety* Location	50.625	4	12.663	.439	.780
Error	3636.133	126	28.585		
Total	39651.000	135			
Adjusted total	9873.037	134			

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Table III presents the post-hoc LSD results, showing significant differences (P < 0.05) in pre-treatment pest populations among the varieties. Shakri had the highest means (16.3), followed by Muzaiti (10.31) and Hilani (6.07), indicating that RPW infestation varies among different verities.

Table III. Multiple comparison (LSD) for pest population among varieties before pesticides application

Variety comparison	Mean variety difference	Std. Error	Sign	95% Confidence interval	
				Lower Bound	Upper Bound
Hilani	10.31*	1.133	.000	8.07	12.55
Muzaiti					
Shakri	-6.07*	1.133	.000	-8.31	-3.83
Muzaiti	-10.31*	1.133	.000	-12.55	-8.07
Hilani					
Shakri	-16.38*	1.133	.000	-18.62	-14.14
Muzaiti	6.07*	1.133	.000	3.83	8.31
Shakri					

Hilani	16.38*	1.133	.000	14.14	18.62

Table IV shows that the overall two-way ANOVA model was significant (F = 13.821, P < 0.001), explaining 46.7% of the variation in pest numbers. Variety had a significant effect (F = 50.361, P < 0.001), while location (F = 1.781, P = 0.173) and the variety × location interaction (F = 1.571, P = 0.186) were not significant.

Table IV. Analysis of variance for pest population after pesticides application

Source	Adjusted Sum of Squares	Df	Mean Square	F	Sig
Adjusted Model	105.304a	8	13.163	13.821	.000
Intercept	398.696	1	398.696	418.631	.000
Variety	95.926	2	47.963	50.361	.000
Location	3.393	2	1.696	1.781	.173
Variety*Location	5.985	4	1.496	1.571	.186
Error	120.000	126	.952		
Total	426.000	135			
Adjusted total	225.304	13			

Table V presents the post-hoc LSD results after pesticide application. A significant difference was observed between Muzaiti and Hilani (1.6667) and between Hilani and Shakri (-1.8889), while Muzaiti and Shakri (-0.2222) showed no significant difference. Overall, LSD analysis confirms that Hilani differed significantly from the other two varieties.

Table V. Multiple comparison (LSD) among fixed factors (variety) for number of pests after pesticide application

Variety comparison	Mean variety differences	Std. Error	Sig.	95% Confidence interval	
				Lower bound	Upper bound
Hilani	1.6667*	.20574	.000	1.2595	2.0738
Muzaiti					
Shakri	-2222	.20574	.282	-.6294	.1849
Muzaiti	-1.6667*	.20574	.000	-2.0738	-1.2595
Hilani					
Shakri	-1.8889*	-20574	.000	-2.2960	-1.4817
Muzaiti	.2222	.20474	.282	-.1849	.6294
Shakri					
Hilani	1.8889*	.20574	.000	1.4817	2.2960

Table VI shows a comparative analysis of pest infestation reduction in three varieties (Shakri, Muzaiti and Hilani) across three different locations (Khudabadan, Washbood and Essai). The highest reduction was observed in muzaiti variety at Washbood (84.40%), while the lowest reduction was noted in shakri at Washbood (77.07%).

Table VI. Percentage reduction in pest population across varieties and location

Variety	Location	%age reduction
Shakri	Khudabadan	78.38
Shakri	Washbood	77.07
Shakri	Essai	78.63
Muzaiti	Khudabadan	78.78
Muzaiti	Washbood	84.40

Muzaiti	Essai	77.48
Hilani	Khudabadan	78.88
Hilani	Washbood	79.91
Hilani	Essai	77.63

DISCUSSION

The present study evaluated the infestation of Red Palm Weevil (RPW), the effectiveness of pheromone traps for pest monitoring, and the efficacy of Fipronil against RPW on three major date palm varieties grown in District Panjgur. The findings demonstrated that pheromone traps were effective for monitoring RPW populations throughout the study period, while Fipronil application significantly reduced the number of pests after treatment. Statistical analysis further revealed that date palm variety had a significant effect on RPW infestation, whereas location had no significant influence on pest population.

The present study showed significant differences among all three varieties. Shakri exhibited the highest level of infestation before pesticide application, whereas Hilani showed the lowest infestation and showed better response after treatment. These findings are consistent with the previous findings (14) which also reported greater susceptibility of Shakri compared with other date palm cultivars.

These differences may be related to variations in environmental conditions, geographical location, pest population, tree characteristics and varietal traits. The highest infestation observed in Shakri during this study may indicate greater susceptibility, whereas the lowest infestation in Hilani suggests greater tolerance.

The successful performance of pheromone traps observed in this study is consistent with previous findings reported (7) which stated that trap efficiency depends on trap design, lure quality, trap placement, and regular maintenance. The use of Ferro lure with detergent water in the present study resulted in effective attraction and capture of adult weevils, confirming that pheromone-based monitoring is a reliable component of Integrated Pest Management (IPM) programmers for RPW.

Similarly scientists (14) reported that regular inspection of pheromone traps, replacement of lures, and maintenance of traps improve the effectiveness of RPW monitoring. The present findings support these observations, as continuous monitoring enabled timely detection of infestation and assessment of insecticide effectiveness.

The application of Fipronil resulted in a marked reduction in the mean number of RPW after treatment. The paired sample t-test confirmed that the reduction in pest population after pesticide application was highly significant, indicating that Fipronil effectively suppressed RPW infestation under field conditions. These findings agree with the reports (3) that Fipronil is among the most effective insecticides for controlling both larval and adult stages of Red Palm Weevil.

The higher efficacy of Fipronil against *Rhynchophorus ferrugineus* may be attributed to its insecticidal properties and mode of action. As a phenyl pyrazole insecticide, Fipronil disrupts the insect's central nervous system, ultimately inducing paralysis and death. Its effectiveness against RPW aligns with earlier literature; for instance, (15) demonstrated that Fipronil is more effective than Methidathion and Chlorpyrifos.

No significant differences were observed in RPW infestation among the three locations. While (16-19) observed that RPW infestation typically varies with environmental factors and geographical regions. These non-significant differences here are likely due to the close geographical proximity and highly similar weather conditions across Panjgur. Similar weather conditions probably created identical environments for the infestation and development of weevils. However, other factors such as host availability and orchard might have also played a role in shaping this uniform pattern.

Despite these findings, certain limitations must be acknowledged. Security challenges in District Panjgur restricted access to several areas, and the fieldwork was bound to a specific season. Additionally, detecting the infestation proved difficult because red palm weevil larvae feed hidden deep inside the palm trunks. Limited time and resources also restricted the total number of orchards we could survey. Consequently, this data should be interpreted by keeping these practical boundaries in mind.

CONCLUSION

The present study assessed Red Palm Weevil (RPW) infestation, pheromone trap monitoring, and the effectiveness of Fipronil on three date palm varieties in District Panjgur. The results showed a significant reduction in pest population after insecticide application, confirming the effectiveness of Fipronil across all locations and varieties.

Ferro lure-based pheromone traps proved to be an efficient tool for RPW monitoring and management. Among the studied varieties, Hilani showed the lowest infestation and better response to treatment, indicating greater resistance compared with Muzaiti and Shakri. The statistical analysis also revealed that location had no significant effect on pest population, suggesting that RPW infestation is mainly influenced by date palm variety rather than geographical location.

Hilani variety may be recommended to farmers for cultivation because, it was found to be the most suitable variety due to its resistance to pest infestations. Overall, the combined use of pheromone traps and Fipronil can be recommended as an effective strategy for sustainable management of Red Palm Weevil in date palm orchards.

Conflict of interest:

The authors declare that they have no competing interest.

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Author’s Contributions:

AJ Conducted research; GM Supervised the study, provided guidance throughout the research and wrote the manuscript; RK Analyzed all the statistical data and interpreted the results; BR Wrote the manuscript, HB, NR & ZB Supported and helped in throughout the research journey in every way.

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