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**RED PALM WEEVIL CHEMICAL TREATMENTS ON DATE PALMS IN SAUDI ARABIA:  
RESULTS OF EXTENSIVE EXPERIMENTATIONS**

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**ABSTRACT**

Among various control tactics endeavored against Red palm weevil (RPW), *Rhynchophorus ferrugineus* Olivier (Coleoptera: Curculionidae), chemical control is essential quick and reliable way of recovering infested date palm trees. In present study, we evaluated several chemical control programs against RPW at different localities in the Kingdom of Saudi Arabia. Date palm trees were selected at random, based on visual symptoms. Two methods of chemical delivery were used: injection and spray. In the injection method, trunks of the selected date palms were drilled up to 60 cm deep at 5-places around the trunk, 1.5 meters above the ground level. Pesticide was delivered into the date palm trunk using specialized pesticide delivering system. In the spray method, each tree was thoroughly sprayed with pesticide using high pressure sprayers. Treatments in both methods were done once or twice for each tree with one month interval. Treated date palm trees were chopped off to count dead vs. live RPW stages. Data from the above extensive experimentation will be presented in the symposium.

**RESUME**

Parmi les différentes techniques de lutte contre le charançon rouge des palmiers (CRP) *Rhynchophorus ferrugineus* Olivier (Coleoptera: Curculionidae), la lutte chimique est un moyen essentiel, rapide et fiable pour sauver les palmiers dattiers infectés. Cette étude présente différents programmes de lutte chimique en différentes localité du Royaume d'Arabie Saoudite. Les palmiers dattiers ont été choisis au hasard sur la base de symptômes visuels. Deux méthodes d'application ont été utilisées : l'injection et la pulvérisation. En injection les troncs des palmiers ont été percés à 5 endroits, sur une profondeur de 60 cm, à 1,5 m de hauteur par rapport au niveau du sol. Les produits ont été injectés dans le tronc à l'aide de matériel spécifique. En traitement par pulvérisation, chaque palmier a été traité soigneusement à l'aide de pulvérisateurs à haute pression. Dans les deux méthodes, les traitements ont été réalisé un ou deux fois par arbre, à un mois d'intervalle. Les palmiers traités ont été coupés pour compter les CRP morts ou vivants. Les données de ce vaste essai sont présentées dans cette communication.

## INTRODUCTION

The red palm weevil (RPW), *Rhynchophorus ferrugineus* Olivier (Coleoptera: Curculionidae), is an economically important insect pest, damaging date palm plantations in many parts of the world. The larval stage is the most destructive and responsible for damaging the palm. Once RPW get access to the internal date palm tissues, the pest develops and reproduces inside date palm resulting severe damage leading to the death of the plant. The concealed behavior of the pest makes it difficult to detect the infestation at early stage therefore, effective methods for the management of the red palm weevils have difficulties to be developed (Murphy and Briscoe, 1999). The damage caused by few numbers of larvae is astonishing even only one larva may cause severe damage on young plant. And undoubtedly it decreases the yield. In the last 30 years, it has caused large economic losses in date palms worldwide (Murphy and Briscoe, 1999; Faleiro, 2006a), and still there are no effective control measures.

The chemical control of this pest has been discouraging, since it leads to the pollution of water sources around application areas (Moura *et al.*, 1995; Abuzuhairah *et al.*, 1996). To reduce the risk of environmental pollution, therefore, effort is needed to develop for safer and more effective chemicals application methods, such as pesticide injection and entomopathogenic pathogens-chemicals synergism, for both preventive and curative treatments against the pest. For prevention purpose against RPW on date plantations, insecticide injection of the date palms for three years periods reduce the infestation rates range from 0.6 to 0.7% (El Ezaby, 1997). The application of chemical insecticides also can be synergetic with entomopathogenic nematodes, bacteria, entomopathogenic fungi, and aggregation pheromone traps (Abbas, 2010).

Red palm weevil is difficult to control, several combination of integrated pest management methods should be applied involving strict quarantine, good field sanitation and cultural practices, develop biological control agents, an effective and efficient chemical applications and as well as develop the farmer's awareness through training and education (Faleiro, 2006a). Recently, new IPM method also already develop such as establishment of host plant resistant and male sterile technique (Faleiro, 2006b).

The use of insecticides against red palm weevil is only one part of integrated pest management (IPM) strategy. The cultural technique and sanitation are the main component of IPM (Murphy and Briscoe, 1999). The study of irrigation effects on red palm weevil distribution has been studied by Aldryhim and Al-Bukiri (2003). It was shown that irrigation and soil moisture are the key factors of RPW infestation. More frequent irrigation and higher soil moisture increase the rate of RPW infestation up to 89%.

Five insecticides, viz., Trichlorphon 80 SP, Aflix (endosulfan + dimethoate) 38.5 EC, dimethoate 40 EC, Marshal (carbosulfan) 25 EC and Nogos (dichlorvos) 50 EC were evaluated by spraying the date palms at 0.1% concentration as prophylactic sprays for the control of red palm weevil and result showed that all the palms sprayed with dimethoate and dichlorvos were free of infestation for up to four months after application (Azzam and Razvi, 2001).

The objective of the present study was to evaluate chemical control programs for red palm weevil (RPW) designed by the Ministry of Agriculture and ESCO pesticide company in infested date palm orchards at Alwaseel area in Riyadh and AlHasa, Kingdom of Saudi Arabia.

## MATERIALS AND METHODS

This research was carried out using completely randomized design with three variables. The variables are Ministry of Agriculture Mix, Company Mix, Control (water), Injection machines (Italian injection machine, Saudi injection machine), No. of applications (one and two applications). Each treatment was replicated five times.

Basically, 90 RPW infested date palm trees were selected at random at Alwaseel and 20 RPW infested trees in AlHasa. The trees were selected based on the symptoms such as holes and cavities with frass material and dead RPW bodies or body remnants on the date palm trunk, in the date palm orchard.

The trees were divided into 3 groups each containing 30 RPW infested date palm trees. In first two groups the treatments included: Ministry of Agriculture Mix (Azdar 10EC, Thripguard 50EC, Dozer 235 EC, and Biorynktree Vital O10), Company Mix: Bioweevil, (35% jasmine oil, 30% citronella oil, 25% solvent and 10% volvic acid), Control (water), Italian injection machine, Saudi injection machine, single time application and two times application. Each treatment was replicated 5 times. In 3<sup>rd</sup> group 30 trees were divided into 3 groups each containing 10 trees, one group was sprayed with Ministry pesticide (Mixtures of 1 kg of Meco-Top 2% WP (Abamectin 0.1% and *Bt* 1.9%) and 1 liter Bereal in 600 liter water) for one time, second group was also sprayed with Ministry pesticide but twice and 3<sup>rd</sup> group was sprayed with Company pesticide (Bioweevil in which 1 liter diluted into 100 liters of water) twice (Figure 1).

In AlHasa 20 RPW infested date palm trees were treated. The trees were divided into two groups each containing 10 trees. Group 1 was treated with Ministry pesticide and Group 2 was treated with company pesticide using similar methodology adopted at Alwaseel farm, Riyadh.

In treatment with two applications, the next treatment, both injections and sprays were repeated 30 days after the first application. Pesticide application was made via two routes, one through injection using a specialized pesticide delivery system containing 5-delivery nozzles and other via direct spray with high pressure sprayer.

In injection treatment, 3 liters pesticide was delivered into the date palm trunks using Saudi injection machine at 2.5 bar in pressure, while Italy machine were 3 bar. To inject the pesticide, five holes on date palm trunk at 10, 30, 60, 80 and 135 cm above ground level were made using drilling machine (Hilti SF22-A). To accommodate the Saudi's machine injection needles, holes were made in d: 8 mm and l: 36 cm, while for Italian machine were 6 mm and 25 cm respectively. After that, thoroughly spraying of pesticide onto date palm trees was done at 20 kg/cm<sup>3</sup> in pressure and 50 liters of pesticides was applied on each tree.

Data was analyzed using the analysis of variance (ANOVA) PROC GLM procedure of SAS (SAS, 2009) and means of RPW populations in different treatments were separated using the Duncan's Multiple Range Test (P = 0.05).

## RESULTS AND DISCUSSION

Slicing off of the pesticide treated date palm trees did not show any uniformity in RPW infestation level. Out of 100 selected date palm trees 15 were found completely healthy, 13 date palm trees showed little infestation but no RPW stage was found whereas, 2 trees having old infestation without any stage of RPW. We also omitted 19 trees because they had only one or two insects that were badly effecting the results (Table 1).

Comparison of Ministry of Agriculture and ESCO pesticide company chemical control programs for RPW indicated no significant difference for RPW mortality percentage between each other but both programs presented significantly high RPW mortality as compared to control. Results did not show any significant difference between Italian, Saudi and only spray treatments in company RPW control program. In Ministry RPW control program, injection with Italian and Saudi machine caused significantly greater mortality than only spray (Table 2).

In AlHasa, 20 date palm trees were treated in total while it was known upon slicing off the trees that 12 date palm trees were healthy and one date palm trees was already chopped off by the farmers. Therefore, data were taken for only 7 trees (6-company and 1-from Ministry control program). As there was only one replication in Ministry control program that did not permit statistical analysis but the mortality percentage has been presented in Table 3.

Based on the results of the present and previous studies we proposed a more comprehensive study with a uniform experimental material in a quarantine greenhouse. In that study, similar aged healthy date palm trees should be artificially infested with similar number of red palm weevils and after RPW development inside the trees should be treated with chemicals. This way we will get a more reliable uniform data for the evaluation of the chemical control programs.

Table 1. No. of palm trees in various categories not included in the analysis  
 Nombre de palmiers des différentes catégories exclus de l'analyse

Place	No. of trees found Healthy	No. of Old infested trees without RPW	No. of trees with little infestation without RPW	No. of trees with one or two individuals badly effecting mortality percentage	Grand Total
AlWaseel Farm 1, Riyadh	12	2	4	19	49
AlWaseel Farm 2, Riyadh	3	0	9		
AlHasa	12	1 (Already chopped off by the farmer)	1	0	13

Table 2. Comparison of Ministry of Agriculture and ESCO pesticide company chemical control programs for RPW based on RPW mortality percentage at Alwaseel farm Riyadh.  
 Comparaison des programmes de lutte chimique du Ministère de l'Agriculture et de la société phytopharmaceutique ESCO basée sur le taux de mortalité du CRP à la ferme Alwaseel à Riyadh.

Treatment	Machine	N	RPW Stage			Total
			Larva	Pupa	Adult	
Company	Italian	11	62.25 ± 14.4ab	93.33 ± 6.67a	85.87 ± 6.74a	79.70 ± 6.43ab
	Saudi	3	90.91 ± 9.09a	100a	60 ± 40a	85.59 ± 14.41ab
	spray	4	50.61 ± 25.53abc	100a	86.59 ± 6.22a	80.72 ± 9.56ab
Ministry	Italian	9	100a	100a	85.19 ± 11.26a	94.71 ± 3.84a
	Saudi	4	100a	--	98.53 ± 1.47a	89.07 ± 9.26a
	Spray	12	37.34 ± 15.11bc	--	71.34 ± 10a	55.61 ± 11.04b
Control	Italian	6	13.32 ± 6.36bc	0b	20.09 ± 11.65b	18.31 ± 4.69c
	Saudi	2	0c	--	--	0c

<sup>1</sup>Means followed by the same letter in the same column are not significantly different at LSD, α=0.05

<sup>2</sup>All data were analyzed using SAS program ver. 9.2 (2008). One-way ANOVA test was used in analysis with PROC GLM followed by performing multiple comparison using Least Significant Difference (LSD) test (α: 0.05). Analysis were done without considering the normal distribution assumption.

<sup>3</sup>Some values contain zero (0) which mean there was no any mortality. Period (--) indicating there was no any data on that cell.

Table 3. Comparison of Ministry of Agriculture and ESCO pesticide company chemical control programs for RPW based on mortality percentage at AlHasa<sup>1</sup>.  
 Comparaison des programmes de lutte chimique du Ministère de l'Agriculture et de la société phytopharmaceutique ESCO basée sur le taux de mortalité du CRP à AlHasa

Treatment	N	Stage			Total
		larva	Pupa	Adult	
Company pesticide	6	90 ± 10	100	100	94.44 ± 5.56
Ministry pesticide	1	100	-----	-----	100

<sup>1</sup>Statistical analysis was not possible due to insufficient replication number

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