Menoufia J. Plant Prot., Vol. 2 December (2017): 321 - 330

THE PROTECTIVE AND TOXIC EFFECT OF CERTAIN MINERAL SALTS ON PALM FROND BEETLE, *ENNEADESMUS TRISPINOSUS* OLIV. (COLEOPTERA: BOSTRYCHIDAE)

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Received: Aug. 30 , 2017 **Accepted: Sep. 24 , 2017**

ABSTRACT: *The effectiveness of some mineral salts, as wood preservative, against Palm powder post beetle, Enneadesmus trispinosus Oliv., were studied under laboratory conditions. The obtained results detected that sodium fluoride and copper sulfate are good materials for protection palm fronds from the infestation by bostrychid beetle, E. trispinosus . Dipping technique of palm fronds cutting revealed high toxic effect and complete protection against palm frond beetle, E. trispinosus, at the concentration 8% (8 x 10^4 ppm) of sodium fluoride gave 100% protection, while copper sulfate appeared 100 % reduction at concentration 12% (12 x 10^4 ppm). The lost wood weight resulting from infested cuttings with this borer was decreased with increasing the salt concentration, the percentages of loss wood of palm fronds was 9.05 % at concentration of 0.8% of sodium fluoride, and was 29.49% at the concentration of 0.25% sodium fluoride. As well as, the percentage of lost wood weight was 9.17% at the concentration of 12% of copper sulfate, and 30.34% at the concentration of 0.25% of copper sulfate.*

Key words: *Enneadesmus trispinosus - mineral salts - sodium fluoride - copper sulfate*

INTRODUCTION

Palm fronds are used nowadays in some places in different governorates for several purposes as popular furniture, desks, chairs, tables, boxes, seats, cages, fencing and other domestic uses.

The collective fronds at manufactories instituted for making different popular furniture are liable to infestation with bostrychid powder post beetle, *Enneadesmus trispinosus* Oliv., causing intensive damage and loss of infested things (Materials) as shown in Photo (1).

In Egypt some articles were published on powder post beetles such as: Helal and El-Sebay (1981), Abd-Allah and Tadrous (1995), Batt *et al*. (1996), Batt and Girgis (1996), Haggag and Batt (2000) and Batt and Ahmed (2013). Also ,other works carried out on the effect of inorganic salts on some insects, such as, Gay *et al*., (1958) and Pantua, (1965) who demonstrated that the boric acid protected some timber kinds and chip-board effectively against several termite species, whereas Kerner and Becker (1969) reported that fluoride compound gave the best control against the termite *Kalotermes spp., Heterotermes spp., Reticulitermes spp. and Comptotermes spp.*, while Chen *et al*. (1986) stated that the toxic dosage of copper compound prevent feeding of termite on treated wood and protect nearby untreated wood.

In some studies, El- Sabay (1995), revealed that vacuum impregnation of wood by 4% boric acid equivalent (BAE) 117 ppm of borone element is the most effective technique against wood borers (*Lyctus africanus and Sinoxylon sudanicum*). The recommended concentration gave 100% mortality for new infestation and over years of protection**.** Abdel Nur (1980) showed that the brushing and dipping wood treatments in chemicals such as creosote oil and chromated copper arsenate (CCA) afforded the tested timber protection for up to eight years. Whereas, Abd El-Latif *et al.* (2014) at Fayoum governorate found that the wood preservative chromated copper arsenate (CCA) led to prevent the infestation to Poinciana, willow, mulberry, casuarinas and poplar wood against *Psammotermes hybostoma* Desneux termite for 2 years.

Photo (1). Exit holes of *Enneadesmus trispinosus* beetles on palm fronds infested

The current work aimed to study the protective and toxic effect of sodium fluoride and copper sulfate on palm frond beetle, *E. trispinosus*, as well as determination of lost wood weight (Consumed wood by beetles and larvae).

MATERIALS AND METHODS

Infested cuttings of palm fronds with *Enneadesmus trispinosus* Oliv. beetles were collected from infested fronds at Shanawan village, Shebin El-Kom district, Menoufia governorate and transferred to laboratory of wood borer and termites department, Plant Protection Research Institute, ARC., at Giza governorate. These cuttings were kept in cylindrical plastic containers (80 cm height and 45 cm diameters) covered with muslin cloth. Continued observation was conducted until the beetles emerged.

Stock solution for each mineral salt {sodium fluoride (NaF) and copper sulfate ($CuSo_4$)} was made. For this purpose, 20 grams of each salt were dissolved in 100 ml distilled water to obtain the concentration of 20×10^4 ppm. of each mineral salt, then the chosen concentrations 0.25, 0.50, 1,2,4,6 and 8% for Sodium Fluoride and concentrations 0.25, 0.50, 1, 2,4,6,8,10 and 12% for Copper Sulfate were prepared.

Intact cuttings of palm fronds were collected from frond factories at Shanawan village and prepared at 15 cm length and 2.5 - 3 cm thickness. These cuttings were left under laboratory conditions of 28.4°C average temperature and 44.6% RH in wired cages.

The cuttings were grouped of each 10 cuttings. Ten cuttings (as replicates) for each concentration of each mineral salts were dipped in different concentrations of each mineral salts solutions for 5, 10 &15 minutes and left in laboratory air for 48 hours to dryness. Each cutting was kept in glass jar (18cm x7cm) and exposed to 10 couples (male & female) of tested insect; these Jars were covered with muslin clothes and fixed with rubber bands. Ten untreated cuttings were used as check.

Continuous observation was made to record the mortality beetles, number of entrance holes and the number of emerged beetles after infestation (for one generation). The reduction percentages were counted according by Abbott's formula (1925).

To determine the effect of mineral salts on weight of lost wood each ten intact fronds were prepared at 15 cm length and 2.5 -3 cm thickness and dipped for 15 minute in each concentration of two tested salts. The cuttings were left for dryness for 48 hours in laboratory and weighted then each cutting was kept in glass jar (18cm x7cm) and exposed to 10 couples (male & female) of

tested insect, these Jars were covered with muslin clothes and fixed with rubber bands. The cuttings were weighted after emergence of beetles. Also, ten untreated cuttings were exposed for 10 couples of beetles used as check. Beside 10 intact cutting without treatment and beetles to determine moisture content.

The statistical analysis for obtained results was carried out by SAS program (2001).

RESULTS AND DISCUSSION

A. Effect of mineral salts on the infestation

1-Effect of sodium fluoride

Data on the effect of sodium fluoride on infestation of palm frond cuttings with *E.trispinosus* Olive. by dipping technique are illustrated in Table (1).

The mortality percentage of *E. trispinosus* beetles exposed to palm frond cuttings treated with sodium fluoride at different concentrations appeared that the highest mortality percentage was 100%, recorded for concentration 8% ,while the lower concentration 0.25% showed the least mortality percentage 2-5% , after 3 days, 11-18% after 7 days and 24-28% after 14 days**.** The obtained data clearly showed that the mortality percentages increased with the increase of immersing time (5, 10 and 15 min.) of date palm fronds in different concentrations of salt solutions.

In this respect, the number of entrance and emergence holes decreased with the increase of salt solution concentration. The reduction percentage for each entrance and emergence beetles was 100% at concentration of $8x10^4$ ppm, while the reduction values ranged between 8.14 - 11.63 % and 5.79-10.09 % for number of entrance and emergence holes at concentration of 0.25 x 10^4 ppm, respectively.

The obtained results agree with those of Moein and Farrag (1997) who stated that the sodium fluoride at 0.5% and 5% concentration gave 6.67% and 43.33% mortality of *Cryptoterms brevis* Walk termite, respectively. after two days of exposure, while after 21 days the concentrations induced 100% mortality, except 0.5% concentration performed to 88.89% mortality. Also, Mohamad (2013) on *Luctus linearis* Goeze, found that the 4% and 8% concentrations of the sodium fluoride salt gave 80% and 90% mortalities .respectively, with no emerged beetles.

Statistical analysis for the obtained values Table (5) on the effect of sodium fluoride salt on mortality percentages, reduction of entrance holes and reduction of emergence holes, indicated that there were high significant effect between each of concentration of salts, days of death and percentage of mortality (P = 0.0001), while insignificant effect between immersing time and % mortality (P = 0.1390) ; the explained variance detected the effective percent for these variables was 85.99%.

The effect of concentrations appeared also high significant effect on the percentage of reduction on each entrance and emergence holes (P= 0.0001), while the immersing time was insignificant of the % of reduction on each entrance and emergence holes (P= 0.2847 and 0.2202) respectively. Whereas the explained variance recorded 91.97% and 89.67% , respectively.

2- Effect of copper sulfate:

Data in Table (2) show the effect of copper sulfate on infestation of palm frond cuttings with *E. trispinosus* beetles.

The highest mortality percentage of *E. trispinosus* beetle (100%) was recorded on palm frond cuttings treated with copper sulfate at 12% concentration, while the lowest percentages were (1-4%), (8-12%) and (21-25%) after 3,7 and 14days exposure, recorded for 0.25% concentration**.**

The palm frond cuttings which dipped in various concentrations of copper sulfate

solution for different periods (5, 10 and 15min) appeared clear effect on each of the mortality percentages, reduction percentages of entrance holes and of emerged beetles. The highest reduction was 100% recorded of each entrance and emergence holes at the concentration 12 x 10^4 ppm at different immersing times, while the lowest percentage of reduction recorded 2.41 - 4.82% for entrance holes and between 3.70 -5.56% for emergence holes at the concentration 0.25 x 10^4 ppm at different immersing times.

Table (1): Effect of sodium fluoride on infestation of palm frond cuttings with *Enneadesmus trispinosus* beetles.

Conc.	Immersing time (min)	Mortality percentages on various days			Number of entrance holes		Number of emergence holes	
Percent (ppm)		3	7	14	Mean ± Sd.	Reduction %	Mean ± Sd.	Reduction %
0.25 (0.25 x 10^4)	5	2	11	24	7.9 ± 0.34	8.14	43.9 ± 0.32	5.79
	10	3	13	25	7.8 ± 0.28	9.30	43.3 ± 0.28	7.08
	15	5	18	28	7.6 ± 0.22	11.63	41.9 ± 0.44	10.09
0.50 (0.50 x10^4)	5	7	26	58	6.4 ± 0.39	25.58	38.5 ± 0.39	17.38
	10	9	28	59	6.2 ± 0.35	27.91	36.6 ± 0.31	21.46
	15	13	31	63	5.8 ± 0.23	32.56	33.9 ± 0.25	27.25
1 (1 x 10^4)	5	21	54	68	5.4 ± 0.34	37.21	31.7 ± 0.37	31.97
	10	23	56	70	5.1 ± 0.29	40.70	29.8 ± 0.31	36.05
	15	26	59	73	4.8 ± 0.23	44.19	26.4 ± 0.25	43.35
2 (2 x 10^4)	5	38	68	86	4.1 ± 0.31	52.33	22.3 ± 0.33	52.15
	10	42	71	88	3.9 + 0.19	54.65	20.2 ± 0.42	56.65
	15	46	74	92	3.6 ± 0. 28	58.14	17.6 ± 0.25	62.23
4 (4 x 10^4)	5	59	84	100	3.0 ± 0.24	65.12.	12.5 ± 0.33	73.18
	10	63	86	100	2.7 ± 0.19	68.60	9.5 ± 0.26	79.61
	15	68	89	100	2.3 ± 0.16	73.26	7.6 ± 0.41	83.69
6 (6 x 10^4)	5	77	96	100	1.1 ± 0.17	87.21	5.3 ± 0.17	88.62
	10	81	100	-	09 ± 0.25	89.53	3.1 ± 0.25	93.35
	15	84	100	-	0.5 ± 0.16	94.19	1.1 ± 0.36	97.64
8 (8 x 10^4)	5	100	-	-	0.0	100	0.0	100
	10	100	-	-	0.0	100	0.0	100
	15	100	-	-	0.0	100	0.0	100
Check	-	0	0	0	8.6 ± 0.08	-	46.6 ± 0.66	-

Table (2): Effect of copper sulfate on infestation of palm frond cuttings with *Enneadesmus trispinosus* beetles.

Conc.	Immersing time (min)	Mortality percentages on various days			Number of entrance holes		Number of emergence holes	
Percent (ppm)		3	7	14	Mean + Sd.	Reduction %	Mean + Sd.	Reduction %
0.25 (0.25×10^4)	5	1	8	21	8.1 ± 0.31	2.41	41.6 ± 0.37	3.70
	10	2	9	22	8.0 ± 0.31	3.61	41.3 ± 0.12	4.40
	15	4	12	25	7.9 ± 0.23	4.82	40.8 ± 0.14	5.56
0.50 (0.50×10^4)	5	6	22	34	7.7 ± 0.18	7.23	40.4 ± 0.22	6.48
	10	5	24	36	7.6 ± 0.24	8.43	40.2 ± 0.11	6.94
	15	8	27	39	7.4 ± 0.36	10.84	39.9 ± 0.25	7.64
1 (1×10^4)	5	13	36	42	7.2 ± 0.34	13.25	39.6 ± 0.17	8.33
	10	15	37	43	7.1 ± 0.19	14.46	39.2 ± 0.21	9.26
	15	18	39	48	6.9 ± 0.12	16.87	38.1 ± 0.53	11.81
2 (2×10^4)	5	22	43	50	6.6 ± 0.34	20.48	37.5 ± 0.48	13.19
	10	23	45	52	6.4 ± 0.17	22.89	36.9 ± 0.44	14.58
	15	26	48	56	6.1 ± 0.26	26.51	35.7 ± 0.67	17.36
4 (4×10^4)	5	32	53	68	5.7 ± 0.32	31.33	33.3 ± 0.52	22.92
	10	34	56	70	5.4 + 0.39	34.94	31.9 + 0.69	26.16
	15	37	59	74	5.1 ± 0.18	38.55	28.8 ± 0.62	33.33
6 (6×10^4)	5	41	61	85	4.4 ± 0.21	46.99	25.3 ± 0.51	41.44
	10	43	64	88	4.2 ± 0.27	49.40	23.7 ± 0.39	45.14
	15	46	68	93	3.8 ± 0.34	54.22	20.2 ± 0.48	53.24
8 (8×10^4)	5	52	79	100	2.5 ± 0.23	69.88	14.9± 0.67	65.51
	10	55	81	100	2.2 ± 0.27	73.49	12.3 ± 0.73	71.53
	15	58	84	100	1.8 ± 0.18	78.31	10.7 ± 0.61	75.23
10 (10×10^4)	5	81	100	-	1.2 ± 0.29	85.54	8.8 ± 0.55	79.63
	10	87	100	-	1 ± 0.27	87.95	7.9 ± 0.48	81.71
	15	92	100	-	0.7 ± 0.19	91.57	6.4 ± 0.51	85.19
12 (12×10^4)	5	100	-	-	0.0	100	0.0	100
	10	100	-	-	0.0	100	0.0	100
	15	100	-	-	0.0	100	0.0	100
Check	-	0	0	0	8.3 + 0.17	-	43.2+0.96	-

The obtained results on the effectiveness of copper sulfate salt preservative on *E. trispinosus* beetle are agree with Salmen and Sayed (1990) in Kharga, New Valley, Egypt who reported that 10% insecticidal barriers of copper sulfate or borax inhibited at take of termite *Psammotermes hybostoma* Desneux for 6-12 months respectively**.** Whereas, Moein and Farrag (1997) showed that Copper sulfate was the pest effective salt against *Cryptoterms brevis* Walk, The concentration 0.5% gave 8.33% mortality after 2days and increased to 83.33 after28 days. The highest concentration 5% induced 68.89 and 100% mortality after 2 and 21days respectively, also Abd-El-Malak(2002) reported that the increasing concentration of the Copper sulphate salt led to mortality percentage increase of *Cryptoterms brevis* Walk termite and effected on incubation period and rate of hatchability**.** While, Mohamad (2013) reported that the highest mortality percentage (100%) of *Lyctus linearis* Goeze was at concentration (10x 10^4 ppm) while, the lowest mortality (7%) recorded at concentration (2x 10^4 ppm) by Copper sulfate salt.

Statistical analysis for obtained values of effect copper sulfate salt on each the percentage of mortality, reduction of entrance holes and reduction of emergence holes, Table (5), indicated to high significant effect between each of concentration of salts, days of death and percentage of mortality (P = 0.0001), while significant effect between immersing time and % mortality was recorded (P = 0.0277); the explained variance detected that the effective percent for these variable was 94.76%.

The effect of salt concentration also appeared high significance on the percentage of reduction of each entrance and emergence holes (P= 0.0001), as well the immersing time was high significant with the reduction of holes each entrance (P= 0.0021).and percentage of reduction for emergence holes (P= 0.0051).Whereas, the explained variance recorded 99.22% and 98.96, respectively.

B. Effect of mineral salts on lost wood weight:

The lost wood weight by boring and consumed food by beetles and larvae, resulting from cuttings of palm fronds treated with sodium fluoride or copper sulfate salts and infesting by *E. trispinosus* was obviously apparent from the following results:

1- Effect of sodium fluoride

The lost wood weight of palm frond cuttings treated by sodium fluoride infesting with *E. trispinosus* beetles, Table (3) showed that the weight of lost wood decreased with increase of concentration of sodium fluoride preservative. The highest loss ratio in weight was 29.49 % recorded for cuttings treated with concentration 0.25 x 10^4, while the minimum loss ratio was 9.05 % recorded for concentration 8 x 10^4. In this respect**,** Mohamad (2013) found that the rate of wood loss by *Lyctus linearis* Goeze beetle at 4% and 8% concentrations of sodium fluoride preservative were 4.9 % and 4.7 %, respectively.

Statistical analysis for obtained values of effect sodium fluoride salt (Table 5) showed high significant between concentration and lost wood weight (P=0.0032), the simple regression was negative (b=-2.5019), Table (5).

2-Effect of copper sulfate

Cuttings of palm fronds treated with copper sulfate salts appeared that the least ratio of lost wood weight (9.17 %) recorded at concentration 12 x 10^4, while the highest loss ratio was (30.34%) recoded when the concentration of copper sulfate was 0.25 x 10^4 Table (4).

Table (3): Effect of sodium fluoride salt on lost wood weight of palm frond cuttings infesting with *Enneadesmus trispinosus* beetles.

Concentration		Weight of cutting (g)		Lost wood	
Percent	ppm	Before treatment	After treatment (emergence)	Weight (g)	Loss ratio (%)
0.25	0.25×10^4	213.22	150.35	62.87	29.49
0.50	0.50×10^4	217.54	164.57	52.97	24.35
1	1×10^4	209.28	169.32	39.96	19.09
2	2×10^4	216.64	183.32	33.32	15.38
4	4×10^4	214.15	185.84	28.31	13.22
6	6×10^4	218.27	194.16	24.11	11.05
8	8×10^4	219.69	199.81	19.88	9.05
Infested cuttings untreated		216.64	149.31	67.33	31.08
Moisture content		211.82	193.18	18.64	8.80

Table (4): Effect of copper sulfate salt on lost wood weight of palm frond cuttings infesting with *Enneadesmus trispinosus* beetles.

Concentration		Weight of cutting (g)		Lost wood	
Percent	ppm	Before treatment	After treatment (emergence)	Weight (g)	Loss ratio (%)
0.25	0.25×10^4	211.15	147.08	64.07	30.34
0.50	0.50×10^4	216.35	152.47	63.88	29.53
1	1×10^4	213.32	152.09	61.23	28.70
2	2×10^4	211.77	155.13	56.64	26.75
4	4×10^4	209.11	162.22	46.89	22.42
6	6×10^4	214.53	176.34	38.19	17.80
8	8×10^4	217.28	184.84	32.44	14.93
10	10×10^4	214.25	187.36	26.89	12.55
12	12×10^4	217.41	197.47	19.94	9.17
Infested cuttings untreated		218.13	151.18	66.95	30.69
Moisture content		216.54	197.82	18.72	8.65

Table (5): Statistical analysis for obtained values to effect some mineral salts on percentage of mortality, entrance holes, emergence holes and loss wood by *Enneadesmus trispinosus* beetles

Variables		Simple regression		Partial regression			
		b	P	b	P	E.V%	P
Sodium fluoride							
Mortality percentages	Concentration	10.811	0.0001**	12.366	0.0001**	85.9	0.0001**
	Immersing time	0.2571	0.8130^{ns}	0.621	0.1390^{ns}		
	Days of death	2.2236	0.0218*	3.644	0.0001**		
%Reduction entrance holes	Concentration	10.480	0.0001**	10.463	0.0001**	91.9	0.0001**
	Immersing time	0.7374	0.6886^{ns}	0.586	0.2847^{ns}		
%Reduction emergence holes	Concentration	11.365	0.0001**	11.365	0.0001**	89.7	0.0001**
	Immersing time	0.7880	0.6781^{ns}	0.788	0.2202^{ns}		
Lost wood weight	Concentration	-2.5019	0.0032**	--			
Copper sulfate							
Mortality percentages	Concentration	7.3171	0.0001**	8.015	0.0001**	94.7	0.0001**
	Immersing time	0.4625	0.6022^{ns}	0.463	0.0277*		
	Days of death	1.6438	0.0396*	2.903	0.0001**		
%Reduction entrance holes	Concentration	8.1739	0.0001**	8.174	0.0001**	99.2	0.0001**
	Immersing time	0.4953	0.7672^{ns}	0.495	0.0021**		
%Reduction emergence holes	Concentration	8.2235	0.0001**	8.224	0.0001**	98.9	0.0001**
	Immersing time	0.5351	0.7510^{ns}	0.535	0.0051**		
Lost wood weight	Concentration	-1.8348	0.0001**	-			

*: Significant * *: highly significant ns = not significant
E.V% = Explained variance% P= Probability

Previous results on lost wood weight indicated that the loss wood weight decreased with increase concentrations of sodium fluoride and copper sulfate salts, where reduction of infestation percentage was increased with increase of concentration, in same time emergence of beetles was decreased with increasing of salt concentration.

Statistical analysis for obtained values of effect copper sulfate (Table 5) appeared high significant effect for salt concentration on lost wood weight (P=0.0001), the simple regression was negative (b=-1.8348), Table (5).

REFERENCES

Abbott, W.S. (1925). A method for computing the effectiveness of an insecticide. J.Econ.Entomol.18:265-277

Abd-Allah, F.F and A.W.Tadrous (1995): Biological aspects of *Enneadesmus trispinosus* Oliv .(Coleoptera : Bostrichidae) on data palm leaves in Egypt. Egypt. J. Agric. Res. 73 (2): 359-389.

Abd El-Latif, N.A., F.F. Mostafa and H.R.K. Ali (2014). Efficiency of certain chemical compounds on the infestation of some wood species by subterranean sand termite, *Psammotermes hybostoma* Desneux at Fayoum governorate, Egypt. Minufiya J.Agric.Res.39.2 (2):747-757.

Abd-El-Malak, N.N. (2002). Studies on unconventional methods for the control of dry-wood termites. Ph.D. Thesis, Fac. of Agric. Moshtohor Zagazig Univ. Egypt

Abdel Nur, H.A. (1980). The natural durability of building wood and use of wood preservatives in the Sudan. Sociobiology, 5(2); 175-182.

Batt, A.M. and G.N. Girgis (1996). Certain studies on borers attacking data palm trees in Egypt. Menofiya J. Agric. Res. 21 (4): 945-954.

Batt, A.M., A.M. Okil, G.N. Girgis and S.M. Haggag (1996). Biological and ecological study of date palm fronds borer, *Phonapate frontalis* Fahr., on mango trees in Egypt Fayoum J. Agric. , Res. & Dev. 10 (1): 156-162.

Batt, A.M. and M.S. Ahmed (2013). Toxicity of some plant extracts to wood powder post beetles, *Sinoxylon sudanicum* Lesne. (Bostrychidae : Coleoptera). Egypt J. Agric. Res. 91 (3): 959-974.

Chen, G.C., G.R. Esenther and R.M. Rowell (1986). Termite resistance of wood treated with Copper II-compound derived from tri-and dialkylamine-bored complex. Forest Prod. J. 36(5): 18-20.

El-Sabay, Y. (1995). Studies on wood preservation against certain wood borer attack. Egypt J. Agric. Res., 73((1): 83 – 94.

Gay, F.J., K.M. Harrow and A.H. Wetherly (1958). Laboratory studies of termite resistance.III-A comparative study of the anti-termitic value of boric acid, zinc chloride and " Tantalith U''. CSiRO Div. of Entomol. Austalia Technical Pa-per 4, 1-14.

Haggag, S.M. and A.M. Batt (2000). Biolgogical and ecological studies on the lyctid beetle, *Lyctus impressus* Lom. (Coleoptera: Lyctidae) on citrus trees. Egypt J. Agric.Res., 78((1): 79 – 89.

Kerner, G.W. and G. Becker (1969). Influence of mould fungi on untreated wood particle boards .Material U. organism Beih 2: 73-79.

Moein S.I. and R.M. Farrag (1997). Efficacy of some organic salts against the dry-wood termite *Cryptotermes brevis* Walker. Egypt J. Agric. Res., 95(3)646-651.

Mohamed, M.H. (2013). Biological, ecological and control studies on some wood tree borers in Egypt. Ph.D. Thesis. Fac. Agric. Al-Azhar Univ. Cairo, 123pp.

Pantua, P.C. (1995). Study of termite resistance of foreign chipboard treated with boric acid and other compounds. Forest leaves. Univ. of Phillipines Laguna. Phillipines 14:51-58

Salmen, A.G.A. and A.A. Sayed (1990). Construction techniques for the control of the sand termite *Psammotermes hybostoma* Desneux in traditional housing in Egypt. Tropical pest management 36 (1): 68-70.

SAS institute (2001). Version 8.02.SAS Institute, Cary, N C.

التأثير الوقائى والسام لبعض الأملاح المعدنية على خنفساء جريد النخيل *Enneadesmus trispinosus* Oliv.(Coleoptera : Bostrychidae)

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معهد بحوث وقاية النباتات- مركز البحوث الزراعية- الدقى – الجيزة- مصر

الملخص العربى

تعتبر خنفساء جريد النخيل *Enneadesmus trispinosus* من أهم الآفات التى تحطم الأثاث الشعبى المنزلى المصنع من جريد النخيل ويهدف هذا العمل لدراسة تأثير فعالية بعض الأملاح ضد خنفساء جريد النخيل الساحقة حيث أوضحت الدراسة أن فلوريد الصوديوم وكبريتات النحاس تعتبر مواد هامة لوقاية جريد النخيل ضد الإصابة بخنافس جريد النخل حيث أظهر تكنيك غمر الجريد تأثير سام عال وأعطى وقاية كاملة ضد الخنافس عند التركيز 8٪ من فلوريد الصوديوم التى أعطت 100٪ وقاية ، بينما أعطت كبريتات النحاس وقاية 100٪ عند التركيز 12٪ .

تناقص الوزن التالف الناتج من الخنافس واليرقات بزيادة تركيز محلول الملح وقد تراوحت النسبة المؤية للخشب التالف مابين 9.05٪ عند تركيز 8 ٪ و 29.49٪ عند تركيز 0.25 ٪ لفلوريد الصوديوم بينما تراوحت مابين 9.17٪ عند تركيز 12٪ و 30.34٪ عند تركيز 0.25 ٪ لكبريتات النحاس.