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Effectiveness of some insecticides on some biological aspects of the spider *Parasteatoda tepidariorum* Koch

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ABSTRACT:

The effect of some insecticides on survival of the spider *Parasteatoda tepidariorum* Koch has been investigated under constant laboratory conditions 25±1°C and 70±5%RH. Mortality after 48h of treatment with LC_{50} of Abtar® 90%SP, Andros® 7.5%WG and Grand® 5%EC has been examined. The effectiveness of selected insecticides on the biological aspects such as longevity periods, prey consumption of adults and fecundity of females has been investigated. As well Andros® showed to be the most effective due to its high acute toxicity, on biological aspects for both female and male and prey consumption. In addition, the study revealed that Andros® was also to be the most drastically effective on fecundity of females.

KEYWORDS: Spiders- *Parasteatoda tepidariorum*- Insecticides- Biology.

1- INTRODUCTION:

Spiders (Araneae) are a diverse order of arthropods with more than 44,000 described species **Platnick (2013).** Because of their importance as predators in many terrestrial settings, they have the potential to reveal subtle changes in environmental variables **(Turnbull, 1973)**; **(Weeks &Holtzer, 2000)**. The spiders are high sensitive to insecticides than insects **(Ravi et al. 2008**); some spiders not only tolerate the harmful effects of pesticides but some resistance as reported by **Tanaka et al., 2000**. The comb-footed spider, *Parasteatoda tepidariorum* Koch, (Arachnida: Araneae: Theridiidae) also called common house spider has a worldwide distribution, halving been carried around the world by man on plants **(Saaristo, 2006)**. In a survey carried out by **(El-Khouly et al., 2016)** on tomato plants to estimate spider's density and population during two years, the common house spider *P. tepidariorum* was found out. Therefore, the present study has been designed to assess of the toxicity effectiveness of commonly used insecticides, Abtar® 90% SP, Andros® 7.5% WG and Grand® 5% EC on the spider *P. tepidariorum*, as for the biological aspects and mortality.

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2- MATERIALS AND METHODS:

1. Rearing of prey *S. littoralis*:

Egg batches of *S. littoralis* were collected from cotton fields, kept in glass jars (20 cm dia. x 15cm ht.), provided with wetted filter papers in based, covered with muslin cloth held by rubber bands until egg hatched. The jars of larvae were provided daily with newly castor oil leaves. Pupae were later collected and placed in glass chimnies until moth's emergence. Each chimny was provided with a small vial provided with wall contain 10 % sugar solution for adult feeding. Leaves of dafla, *Nerium oleander* Poir, were used as oviposition sites. From this culture, 4th larvae were obtained as prey for the spider.

2. Rearing of the spider *P. tepidariorum*:

The adults collected from tomato plants have been cultured in the laboratory under constant conditions, 25±1°C and 70±5%RH at Cairo University (Faculty of Agric.). Females have been held in small plastic containers (5cm dia. x 6cm ht.) for deposition egg sacs. Each of one emerged juveniles have been transferred to new containers and from this test culture spiders were taken. Juveniles and adults were fed on 4th larval instar of cotton leaf worm, *Spodoptera littoralis* Boisd (Lepidoptera, Noctuidae). Adult spiders were allowed copulation, introducing one male to each female immediately after the last molt. Males were separated after mating. After starvation for one week, according to (**Benamu et al., 2013**) adults were placed each in a Petri dish (9 cm dia.) for experimentation.

3. Insecticides tested:

As presented in table (1), three insecticides were selected for this study namely; Abtar® 90%SP, Andros® 5.7%WG and Grand® 5%EC. For each insecticide four concentrations and four replicates were used, and compared with control. The LC_{50} of the mentioned above insecticides were 0.100, 0.017 and 0.037, respectively.

Table1. Insecticides were used in application of *S. littoralis* larvae.

Trade Name	Active Ingredient	Field Concentration	Concentration/ 200ml water				LC_{50} ppm
			1st	2nd	3rd	4th	
Abtar®90%SP	Methomyl	300 gm/Fed	0.30	0.15	0.075	0.038	0.100
Andros® 5.7%WG	Emamectin benzoate	60 gm/Fed	0.06	0.03	0.015	0.008	0.017
Grand® 5%EC	Lufenuron	50cm^3/100Liter water	0.10	0.05	0.025	0.013	0.037

4. Toxicity tests:

The leaf-dip technique developed by **Amalin et al., 2000** has been used. Clean castor oil leaves were dipped in the required concentration of insecticide for 1minute and dried for 30 minutes. The test 4th instar larvae of *S. littoralis* were kept on such treated leaves, for one hour, four of these larvae were introduced to each one adult spider. Mortality was recorded after 48h from treatment. Rearing of survived spiders continued by feeding on untreated prey to observe adult longevity periods, prey consumption and female fecundity.

3- RESULTS AND DISCUSSION:

A) Toxicity of insecticide-treated *S. littoralis* larvae on adult spiders *P. tepidariorum*:

1. Effect of insecticides on pre, ovi and postoviposition periods:

1.1. Pre-oviposition period:

This period was affected by using the insecticides and ranged between 5.2-6.3 days with used Abtar® 90% and Grand® 5% compared with the control (8.2days), while the most effective recorded at Andros® 5.7% (0.0day) with significant differences between treatments (table 2).

1.2. Oviposition period:

In control (untreated), this period was 12.7 days with insignificant differences with Abtar® and Grand® (12.20 and 12.30 days), respectively. High significant effect at this period compared with the other treatments and control was observed with Andros® treatment (5.20 days in means and ranged between 4-6 days).

1.3. Post-oviposition period:

At treatments of Abtar® and Andros®, all individuals were died during the period of oviposition and failed to reach the period of postoviposition. This period was 3.1 days (0-4 days) at Grand® treatment. All treatments were effected significantly compared with untreated (35.2 days).

2. Adult longevity:

2.1. Adult longevity of female:

The periods of female longevity were 18.6, 5.2, 16.7 and 95.2 days for Abtar®, Andros®, Grand® and control, respectively. The differences between means were high significant compared with untreated, especially the application of the insecticide, Andros® (Emamectin benzoate).

2.2. Adult longevity of males:

This period took the same trend and recorded less days compared with female longevity. The values of this period were 12.7, 4.2, 11.8 and 80.1 days for the treatments of Abtar®, Andros®, Grand® and control, respectively.

3. Fecundity of females:

The untreated female laid 2.7 ootheca and has been affected non-significantly when the female treated with other pesticides (1-2 ootheca). The number of eggs/ootheca has not been affected by treatment with the pesticides, Abtar®, Andros® and Grand®, the values of these data were 30.9, 23.7 and 33.2 eggs compared with control (40.7 eggs/ootheca).

4. Prey consumption :

The number of prey consumed per female ranged between 160-310 larvae for the control. The untreated individuals consumed at means 270.2 larvae compared with 80.2, 27.2 and 70.1 larvae with the respective treatments, Abtar®, Andros® and Grand® (table 2). Prey consumption took the same trend in the males, the account of prey were 60.3, 14.2, 60.12 and 140.3 larvae for Abtar®, Andros®, Grand® and control, respectively. All differences between means were high significantly. As recoded in table (2), the abamectin benzoate (Abtar®) was the highest effect on periods of ovipositions, adult longevity and fecundity of females. The number of consumed prey were affected significantly under the treatments of all insecticides for females and males of *P. tepidarorium*, especially when treating the larvae of *S. littoralis* with LC_{50} of Andros® and increased insignificantly under the insecticides, Abtar® 90%SP and Grand® 5%WG.

Table 2. Latent effect of some insecticides on biological aspects of *P. tepidariorum* adults under laboratory conditions.

Treatment*	Period of (in day)			Adult Longevity		Fecundity of Females	
	Pre-oviposition	Oviposition	Post -oviposition	Female	Male	No. of ootheca/Female	No. of Eggs/ootheca
Abtar® 90%SP	5.2±0.12 4-8	12.20±0.18 10-14 **	0.0	18.6±0.13 13-20 80.2±11.2 20-100	12.7±0.14 8-16 60.3±2.20 40-90	1.3±0.11 1-2	30.9±3.11 26-40
Andros® 5.7%WG	0.0	5.20±0.11 4-6 **	0.0	5.2±0.11 4-6 27.2±0.13 20-29	4.2±0.13 2-6 14.2±0.12 12-18	1.2±0.01 1-2	23.7±2.11 21-30
Grand® 5%EC	6.3±0.14 4-8	12.30±0.19 10-15 **	3.1±2.11 0-4	16.7±0.13 13-18 70.1±0.14 30-90	11.8±0.22 9-12 60.12±0.20 40-70	1.5±0.13 1-2	33.2±4.12 20-30
Control	8.2±0.70 6-12	12.70±1.7 10-23	35.2±4.2 20-60	95.2±5.22 65-120 270.2±12.1 160-310	80.1±4.2 50-110 140.3±6.22 50-210	2.7±0.22 2-4	40.7±3.21 20-50
New L.S.D	2.70	7.22	10.7	62.6	55.9	1.5	15.3

***This insecticides were used at LC_{50}**
**** Show the prey consumption for females and males.**

B) Toxicity of insecticides- treated *S. littoralis* larvae on immature instars of *P. tepidariorum*:

1. Incubation period and hatchability: As shown in table (3), the incubation periods ranged between 5-9 days in untreated larvae with mean 6.9 days, this period decreased insignificantly with the application of insecticides to reach 6.2, 6.8 and 6.2 days for Abtar®, Andros® and Grand® treatments, respectively. The number of the newly hatched spiderlings from the deposited eggs increased in untreated application (75.9% hatching) compared with insecticides (68.2% for Abtar®), (50.9% for Andros®) and (62.9% for Grand®).

Table 3. Latent effect of some insecticides on duration of immature stages of *P. tepidariorum* reared on *S. littoralis* larvae treated with LC_{50} insecticides under laboratory conditions.

Treatment	Incubation period (in days)	Eggs hatchability %	Duration of spiderling instars (in day)									
			1st		2nd		3rd		4th		Total	
			♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
Abtar® 90%SP	6.2 ±0.22 5-8	68.2 ±1.12 50-80	12.1 ±1. 2 9-14	14.3 ±1.2 10-15	12.8 ±0.11 11-13	13.6 ±0.13 12-15	15.6 ±2.11 7-16	16.8 ±0.15 9-30	17.2 ±2.10 12-20	17.9 ±0.41 16-25	62.4 ±0.11 40-70	60.8 ±2.6 40-63
Andros® 5.7%WG	6.8 ±0.11 6-8	50.9 ±1.12 20-60	10.1 ±0.03 9-11	10.2 ±0.01 9-12	9.2 ±0.02 8-10	10.1 ±0.11 9-11	14.7 ±1.20 8-15	13.7 ±0.31 12-19	15.2 ±2.1 12-21	12.9 ±3.1 10-23	50.2 ±0.31 38-60	48.7 ±2.9 40-56
Grand® 5%EC	6.2 ±0.12 5-7	62.9 ±0.11 50-60	12.2 ±0.31 8-12	13.1 ±1.2 10-14	13.9 ±2.1 12-14	12.6 ±2.1 9-13	15.9 ±0.11 12-16	15.6 ±2.1 12-22	21.7 ±0.42 17-30	17.2 ±0.11 11-22	65.1 ±0.13 40-80	61.2 ±1.36 38-72
Control	6.9 ±0.30 5-9	75.9 ±2.11 60-80	13.2 ±1.5 7-20	14.2 ±1.3 10-19	15.9 ±2.1 12-20	13.5 ±2.0 9-18	16.7 ±2.5 9-20	17.1 ±2.1 12-30	22.7 ±0.21 16-30	18.3 ±2.3 11-23	66.2 ±5.0 41-92	62.7 ±3.6 40-80
New L.S.D	0.82	16.2	3.2	3.6	3.8	8.2	2.1	3.2	6.3	1.9	12.7	9.8

Table 4. Mean of prey consumption of spiderlings of *P. tepidariorum* fed on *S. littoralis* larvae treated with LC_{50} insecticides under laboratory conditions.

Treatment	Prey consumption of spiderlings instars									
	1st		2nd		3rd		4th		Total	
	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
Abtar® 90%SP	18.2±1. 2 15-20	16.9±0.32 15-20	12.6±1.11 5-16	13.6 ±1.7 8-14	8.2±1.12 6-9	6.2 ±2.11 4.7	6.5±0.51 3-8	7.9 ±0.86 5-14	50.1±0.19 36-60	40.2±1.36 30-50
Andros® 5.7% WG	9.7±0.11 5-12	12.8±0.08 10-12	10.2±0.60 8-12	9.2±1.11 8-10	5.2±0.09 4-8	4.1± 0.66 3-5	4.9±0.19 3-5	5.4±0.01 4-6	40.9±0.14 28-32	29.8±0.15 18-39
Grand® 5%EC	18.9±0.22 16-20	17.2±0.35 15-19	12.7±1.11 9-13	12.6±0.35 8-13	8.5±1.11 5-12	6.7±1.0 5-7	6.2±0.19 4-7	8.2±1.11 7-12	50.2±0.19 38-62	38.6±1.33 30-62
Control	20.1±1.0 16-25	18.1±0.4 15-28	13.6±1.2 6-18	13.7±1.9 9-20	8.7±1.1 6-16	6.9±1.2 3-10	6.9±0.5 5-11	8. 9±1.2 4-11	50.3±2.1 39-60	42.3±2.8 36-60
NewL.S.D.	2.22	1.9	2.7	1.6	0.65	1.2	1.7	2.1	8.7	4.3

2. Duration of spiderlings instars:

As shown in table (3), the development periods of spiderlings varied with sex. Individuals passed through four immature instars; for untreated females these period ranged between 7-20, 12-20, 9-20 and 16-30 for the 4th instars with total duration 41-92 days, the respective means for the sequence instars and the total were 13.2, 15.9, 16.7, 22.7 and 66.2 days. As shown in table (3), all insecticides (Abtar®, Andros® and Grand®) affected significantly on all instars of spiderlings for females, especially the abamectin benzoate (Andros® 5.7% WG), these period shortened compared with control to record, 10.1, 9.2, 14.7, 15.2 and 50.2 days. The effectiveness of insecticides on the male spiders *P. tepidariorum*, took the same trend in females and recorded periods shorter than the females.

3. Prey consumption of spiderlings:

Data in table (4) indicated that the adult females of *P. tepidariorum*, generally consumed high numbers of prey than that for males. Four instars of untreated females a total 50.3 larvae with significant differences between means of treatments to record, 50.1, 40.9 and 50.2 larvae for Abtar®, Andros® and Grand®, respectively. As mentioned above in table (4), the prey consumption of males took the same trend to record 40.2, 29.8, 38.6 and 42.3 larvae for Abtar®, Andros®, Grand® and control, respectively. The differences between these means were significant with Andros application and non-significantly with the other insecticides.

Spiders are important predators of insect pests in agro-ecosystems throughout the world. They are highly sensitive to insecticides (**Rezac et al., 2007).** In the present study Abtar®, Andros® and Grand® insecticides for use in tomato fields against the cotton leaf worm, at Fayoum Governorate, these insecticides were evaluated for their effect on the biology of *P. tepidariorum*. Mortality of adult spiders and
some biological aspects, prey consumption, longevity periods, number of eggs laid, incubation period, and% hatch were investigated in the laboratory. **Daane et al., 2004**, proved that Lorsban® and Wantt® caused 100% mortality in black widow spiders after 1 day exposure. **Armenta et al., (2003**) claimed that Chlorpyrifos® exposure produced up to 73% reduction in abundance of natural enemies in the agricultural fields. **Pekar (2002)** proved that Alpha cypermethrin® and Fluvalinate+ Thiometon® produced the highest mortality in spiders two days after application while Bifenthrin® and Deltamethrin® showed highest mortality after three days after the application. Decis® caused 80% mortality in *Philodromus cespitum* **(Rezac et al., 2007). Bajwa and Aliniazee (2001**) also, claimed that organophosphate Azinphosmethyl® (25g/100 liters) and carbamate Carbaryl® (60g/100L) produced 25-75% mortality of spiders while pyrethroids, esfenvalerate® (2.5g/100L) and Permethrin® (4g/100 liters) produced 50-75% mortality.

Tahir et al., (2014) demonstrated the effects of Thiodan® (insecticide) on the survival, locomotion, behaviour and predation rate of the jumping spider *Plexippus paykulli*. Thiodan® caused 40% mortality at the recommended field rate concentration of *P. paykulli* didn't avoid the surface treated with the Thiodan® (1/4recommended field rate). **El-Khouly et al., (2016)** demonstrated the effect of three insecticides Lannate®, Reldan® and Match® on the spider, *Anelosimus aulicus*, Lannate® was the most effective due to high acute toxicity, causing 66.7% mortality in females and 91.6% in males. It was also the most drastically effective on fecundity of females where no egg sacs were laid under the recommended field concentration. Reldan® caused 58.3% mortality in females and 83.33% in males. The least effective was in Match® causing 50% mortality in females and 58.33% in males. Obviously, males were more affected than females.

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الملخص العربي

تأثير ثلاثة مبيدات حشرية علي بعض المظاهر البيولوجية للعنكبوت *Parasteatoda tepidariorum*

تم دراسة تأثير استخدام ثلاث مبيدات حشرية بثلاث تركيزات مختلفة لكل منهم وهم أبتار 90% وأندروس5,7% وجراند 5%علي بعض المظاهر البيولوجية للعنكبوت باراستياتودا تبيداروريام, بعد تغذية العناكب علي فرائس دودة ورق القطن المتغذية سابقا علي أوراق الخروع المعاملة بالمبيدات السابقة, وقد سجّل مبيد الأندروس5,7% تأثيراً كبيراً علي العنكبوت المفترس, وقد لوحظت هذه التأثيرات علي معظم المظاهر البيولوجية للأطوار الكاملة وغير الكاملة, وكذلك علي معدل إستهلاك الغذاء لكلا من الإناث والذكور.

الكلمات الدالة:- المبيدات الحشرية- بيولوجي- العنكبوت *Parasteatoda tepidariorum*