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Effect of *Sapium indicum, Thevetia neriifolia* and *Jatropha gossypifolia* Seed Extract on the Fecundity and Fertility of *Tribolium castaneum* and *Tribolium confusum*

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Abstract:

An experiment has been conducted to find out the toxic effect of acetone extract of *Sapium indicum* seed, petroleum ether extract of *Thevetia neriifolia* seed kernel and *Jatropha gossypifolia* seed on the fecundity and fertility of *Tribolium castaneum* and *Tribolium confusum*. The results indicated that all the treatments significantly ($P<0.001$) reduced the fecundity and fertility of both the insect species. However *Jatropha gossypifolia* seed extract did not reduce significantly the fertility of *Tribolium castaneum* in comparison with the control but a decline of fertility was observed with the increase of dose of treatment.

Key word: Seed extracts, *T. castaneum, T. confusum*, Fecundity and Fertility.

Introduction

The species *T. castaneum* and *T. confusum* are very widely distributed throughout the world and are largely disseminated as grains transported by commerce (Cotton 1947, Pruthi and Singh 1950). The adults of these beetles are long lived and produce eggs continuously over a long period (Dick 1937, Good 1933). Fecundity and fertility are two important factors of paramount importance offering a great bearing on the number of offspring of an insect produced. Golebiowska (1969) reported that intensive oviposition was depended on intensive feeding rate on the beetle. However a number of plant materials has been reported to reduce the fecundity in stored product insects (Jacob and Sheila 1993, Chaiyaboot 1988, Rahman 1992, Amin 2000). Saxena *et al.* (1976) found that the vapours of *Acorus calamus* reduced fecundity and caused regression in the terminal follicle of the vitellarium in treated females of *T. castaneum, S. oryzae, C. chinensis, T. granarium* and *Anthrenus flavipes*. Fertility constitutes one of the

prime factors for the survival of an insect population (Nandi *et al.* 1990). Malek (2001) reported the ovicidal activity of *Annona squamosa* seed oil and two new compounds on *Tribolium castaneum*. Khanam and Talukder (1993) reported the effects of methanolic extracts of *Polygonum hydropiper* leaf and *Aphanamixis polystachea* seed coat on the fecundity and fertility of *T. confusum*. The following investigation was undertaken to evaluate the toxic action of *Sapium indicum,* Thevetia neriifolia and *Jatropha gossypifolia* seed on the fecundity and fertility of *T. castaneum* and *T. confusum.*

Materials and Methods

Fresh seeds of *S. indicum, T. neriifolia* and *J. gossypifolia* were utilized for preparing the extracts. The seeds were dried in a well-ventilated room under shade from 3 to 7 days depending on weather conditions and finally dried in an incubator at 40^{O}C for 12 hours. Dried plants parts were then powdered in a hand grinder and extraction was carried out serially with petroleum ether, acetone and methanol in a soxhlet apparatus for separating different compounds. After extraction, extracted liquids of different solvent of the plant parts were dried in a rotary evaporator and then collected in reagent bottle. Acetone extract of *S. indicum* seed and petroleum ether extract of *T. neriifolia* seed kernel and *J. gossypifolia* seed were used in this experiment.

From the stock culture a large number of beetles from *T. castaneum* and *T. confusum* were put on a thin layer of wheat flour previously passed through a 60mesh sieve in a medium size beaker and the eggs were collected on the following day, incubated at 300C for hatching. Five different doses of seed /seed kernel extract of *S. indicum, T. neriifolia* and *J. gossypifolia* were used and these are 1000, 2000, 4000, 8000 and 16000 ppm . The required quantities of the extracted material were dissolved with 5ml acetone and then added to wheat flour. A control sample was used with acetone only. The treated food were dried by fanning, kept in an incubator at 30^{O}C for 24 hours and then put in a blender for proper mixing. Neonate larvae (<24) were transferred to glass beaker (50ml) in flour medium treated with different doses of the extracted materials with the aid of a sable hair brush. A batch of larvae without any treatment was also maintained in the glass jar of equal size. Larvae were checked from time to time for pupation. Sex separations of the pupae were conducted following Halstead (1963). Sexed pupae from different treatments and from control of each experiment were put on separate petridishes for adult emergence. Pairs of beetles of opposite sexes were introduced in different glass vials (3.5× 1.8 cm) containing different treated food media. For each treatment and control 20 pairs of adult were employed for oviposition and the total number of eggs laid was recorded. Eggs laid by females were counted by sieving the contents of the vials

at 3 days interval for 33 days. Eggs were observed on separate petridishes till hatching. The method suggested by Rizvi *et al.* (1980) for calculating Percent Reproductive Control (P. R. C.) was followed in this study. The experiment was carried out in an incubator at $30^{O}C \pm 1.5^{O}C$.

$$P.\ R.\ C. = \frac{V1 - V2}{V1}$$

Where V_1= Eggs laid by control female

V_2= Eggs laid by treated female

Results and Discussion

Results on fecundity and fertility of *T. castaneum* and *T. confusum* due to the effect of *S. indicum* seed are shown in Table I and Figure 1. Highest mean number of eggs laid per female was recorded in control while lowest was noted for the highest dose. The mean value of control and highest dose were 226.40 ± 7.62 and 73.65±5.90 respectively in case of *T. castaneum*. The values of percent reproductive control indicated that the treatment 16000 ppm offered the greatest check followed by 8000, 4000, 2000 and 1000ppm. Analysis of variance revealed highly significant results (P>0.001) on the fecundity of *T. castaneum* due to the effect of different doses of the seed extracts. Fertility of *T. castaneum* was drastically affected by the treatment of S. indicum seed extract. With the increase of dose of treatment a decline in the fertility of *T. castaneum* was evident and thus lower eggs hatch were noted in the treatment 16000ppm. The percentage of hatching were 64.62 ± 3.47, 59.45 ± 4.03, 56.57 ± 3.35, 50.94 ± 1.85 and 47.35 ± 3.84, at doses 1000, 2000, 4000, 8000 and 16000 ppm respectively, where the untreated control was 73.02 ± 1.98.

Similarly highest mean number of eggs laid per female *T. confusum* was noted in control (216.90 ± 14.49) while the lowest value was observed at 16000ppm (62.05 ± 7.10). Analysis of variance revealed highly significant results (P<0.001) in comparison with the control. The percent reproductive control indicates that doses 8000 and 16000 ppm suffered very much. A decline of fertility in *T. confusum* was observed with the increase of dose of treatment and reduced significantly (P<0.001). Lowest value was observed in 16000ppm and the highest value in control. The percentage of hatching was 75.20 ± 2.49 and 49.22 ± 2.62 in control and 16000ppm respectively. Non significant 'd' value indicated that dose 1000ppm did not suffer very much.

Results due to the effect of *T. neriifolia* seed kernel extract on the fecundity and fertility of *T. castaneum* and *T. confusum* are presented in Table II and Figure 2. Significant (P< 0.001) reduction of egg laying was observed due to the effect of different doses of *T. neriifolia* seed extract in comparison with the control. Percent reproductive control indicated that the doses 8000 and 16000ppm

Table I. Effect of different doses of *Sapium indicum* seed extract on the fecundity and fertility of *T. castaneum* and *T. confusum*

Test insects	Dose (ppm)	No. of females	No. of eggs (Mean ± SE)	Mean daily eggs lay per female	Percent reproductive control P.R.C.	Fertility % (Mean ± SE)	* d - values
T. castaneum	Control	20	4528 (226.40 ± 7.62)	6.86		73.02 ± 1.98	-
	1000	20	2653 (132.65 ± 9.64)	4.02	41.40	64.62 ± 3.47	2.23 N.S.
	2000	20	2504 (125.20 ± 8.63)	3.79	44.75	59.45 ± 4.03	3.43**
	4000	20	2223 (111.15 ± 7.26)	3.37	50.87	56.57 ± 3.35	4.08**
	8000	20	1580 (79.00 ± 10.17)	2.39	65.16	50.94 ± 1.85	5.43**
	16000	20	1473 (73.65 ± 5.90)	2.23	67.49	47.35 ± 3.84	6.29**
T. confusum	Control	20	4338 (216.90 ± 14.49)	6.57		75.20 ± 2.49	-
	1000	20	2511 (125.55 ± 9.32)	3.80	42.16	65.85 ± 3.84	2.52 N.S.
	2000	20	2404 (120.20 ± 8.57)	3.64	44.60	63.65 ± 4.00	2.96**
	4000	20	2170 (108.50 ± 8.85)	3.29	49.92	57.48 ± 2.40	4.45**
	8000	20	1325 (66.25 ± 5.92)	2.00	69.55	52.22 ± 3.00	5.66**
	16000	20	1241 (62.05 ± 7.10)	1.88	71.39	49.22 ± 2.62	6.37**

** = Significant at 1%; N.S. = Not significant d = Standardized normal deviates.

offered the maximum check in comparison with the others. The mean value of control and highest dose were 216.55 ± 7.03 and 64.85 ± 12.89 respectively. Fertility of *T. castaneum* was significantly ($P<0.001$) reduced by the treatment of *T. neriifolia* seed

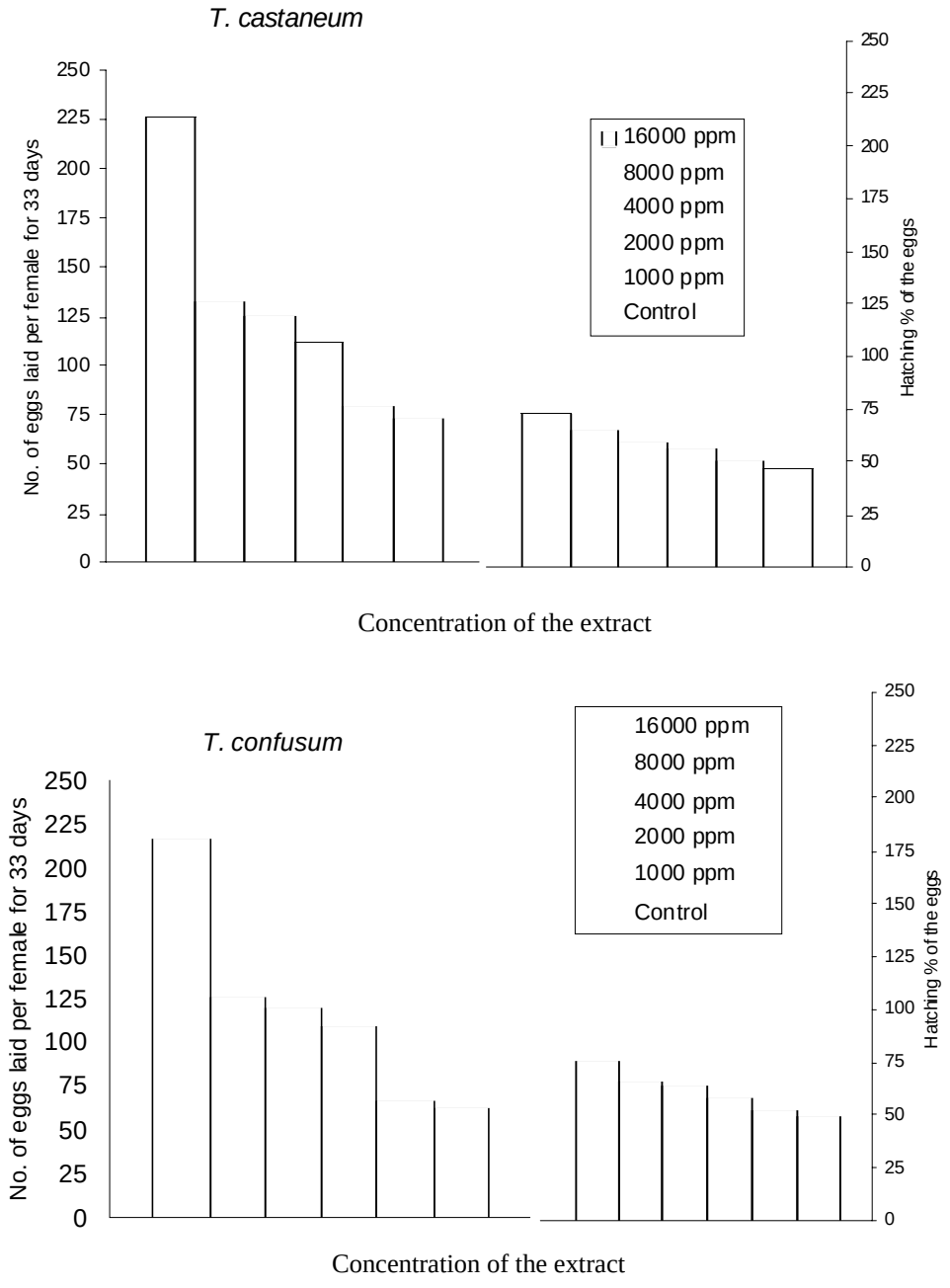

Fig.1. Showing the effect of different concentration of *S. indicum* seed extract on the fecundity and fertility of *T. castaneum* and *T. confusum.*

extract. The percentage of hatching was 71.33 ± 2.04, 67.13 ± 2.25, 62.25 ± 3.04, 54.60 ± 3.45 and 53.62 ± 2.51 at 1000, 2000, 4000, 8000 and 16000 ppm. respectively. Their corresponding hatching percentage of control was 76.22 ± 2.32.

The eggs laying of *T. confusum* reduced significantly due to the effect of different doses of the extract and their percent reproductive control indicated that the treatment 16000ppm would offer the greatest check on offspring production of the beetle. The fertility of the beetle was drastically affected by the treatment of *T. neriifolia* and the percentage of hatching was 62.26 ± 3.10, 59.04 ± 3.85, 54.70 ± 2.97, 50.70 ± 3.32 and 40.72 ± 4.89 at 1000, 2000, 4000, 8000 and 16000ppm respectively. Their control value was 74.05 ± 2.39. Significant d-values indicated the harmful effect of the extract on *T. confusum.*

The efficacy of different doses of *J. gossypifolia* seed extract on the fecundity and fertility of *T. castaneum* and *T. confusum* are shown in Table III and Figure 3. Mean egg laying of *T. castaneum* were 224.00 ± 14.34 and 54.35 ± 14.34 in control and highest dose respectively. The treated food reduced the egg laying of the beetle significantly (P>0.001) and doses 8000 and 16000ppm were found to be the most effective in offspring production of the beetle. Fertility of *T. castaneum* did not reduce significantly but a decline of fertility was observed with the increase of dose of treatment. The percentage of hatching was 66.05 ± 4.16 and 48.82 ± 3.61 in control and 16000ppm respectively.

The doses of the above extract showed the similar trend of egg laying of *T. confusum* and reduced significantly (P <0.001). The values for percent reproductive control indicated that 16000ppm offered the greatest check followed by 8000, 4000, 2000, and 1000ppm. Fertility of *T. confusum* in different doses also reduced significantly (P<0.001). The percentage of hatching was 61.13 ± 3.90, 60.30 ± 2.87, 54.08 ± 2.61, 51.73 ± 4.08 and 44.79 ± 2.81 at the respective doses. Their corresponding control percentage was 74.18 ± 3.03. In all the doses significant 'd' value was observed.

These findings receive support from the report of Amin (2000) who reported antiovipositional and antifertility effect of *Azadirachta indica and Vitex negundo in Tribolium castaneum*. Similarly Yadava (1985) reported that neem oil at the concentration ranging from 40 to 50 mg/ 10gm of green gram completely inhibited oviposition and fertility in *Callosobruchus* species. Chaiyaboot also (1988) reported that the application of neem seed powder at the rate of 5% by weight decreased the number of eggs laid by *Rhizopertha dominica*. Xu *et al.* (1993) reported that anise oil completely inhibited the reproduction of *Rhizopertha dominica and Tenebrio molitor* when mixed

Table II. Effect of different doses of *T. neriifolia* seed extract on the fecundity and fertility of *T. castaneum* and *T. confusum*

Test insects	Dose (ppm)	No. of females	No. of eggs (Mean ± SE)	Mean daily eggs lay per female	Percent reproductive control P.R.C.	Fertility % (Mean ± SE)	* d - values
T. castaneum	Control	20	4331 (216.55 ± 7.03)	6.56		76.22 ± 2.32	-
	1000	20	2938 (146.90 ± 26.93)	4.45	32.16	71.33 ± 2.04	1.36 N.S.
	2000	20	2737 (136.85 ± 22.03)	4.15	36.74	67.13 ± 2.25	2.41*
	4000	20	2118 (105.90 ± 18.90)	3.21	51.07	62.25 ± 3.04	3.58**
	8000	20	1501 (75.05 ± 13.30)	2.27	65.40	54.60 ± 3.45	5.38**
	16000	20	1297 (64.85 ± 12.89)	1.97	69.97	53.62 ± 2.51	5.55**
T. confusum	Control	20	4483 (224.15 ± 7.25)	6.79		74.05 ± 2.39	-
	1000	20	32.15 (160.75 ± 20.47)	4.87	28.28	62.26 ± 3.10	3.13**
	2000	20	2708 (135.40 ± 18.94)	4.10	39.62	59.04 ± 3.85	3.76**
	4000	20	2464 (123.20 ± 11.95)	3.73	45.07	54.70 ± 2.97	4.79**
	8000	20	1613 (80.65 ± 13.11)	2.44	64.04	50.70 ± 3.32	5.73**
	16000	20	1090 (54.50 ± 8.63)	1.65	75.70	40.72 ± 4.89	8.24**

*, ** = Significant at 5% and 1% respectively; N.S. = Not significant,
d = Standardized normal deviates.

with wheat or wheat flour at concentration of 0.1% by weight. Cassia oils completely inhibited the reproduction of *Sitophilus zeamais*, *R. dominica* and *T. castaneum* (Xu and Zhao, 1994).

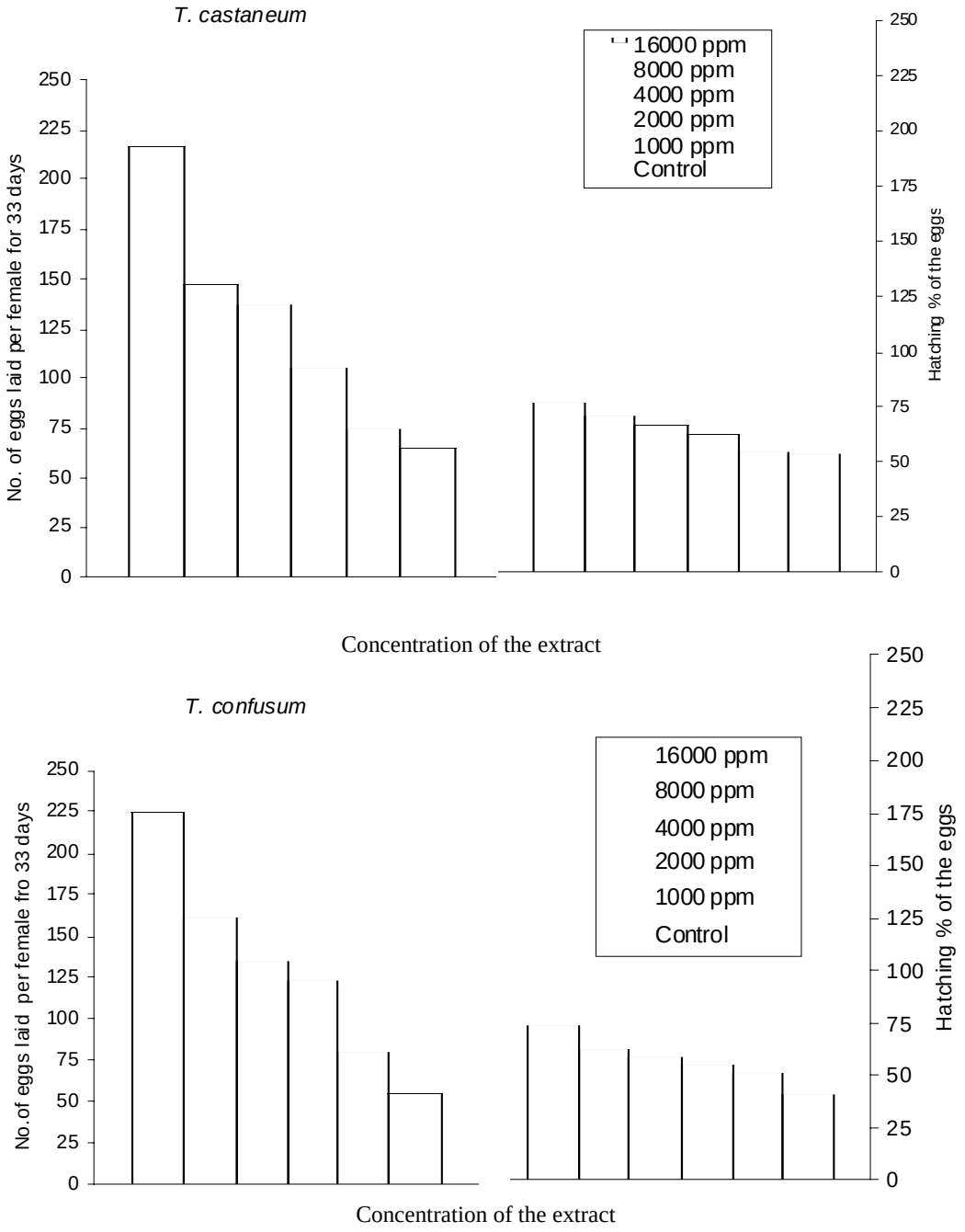

Fig. 2. Showing the effect of different concentration of *T. neriifolia* seed extract on the fecundity and fertility of *T. castaneum* and *T. confusum.*

Table III. Effect of different doses of *J. gossypifolia* seed extract on the fecundity and fertility of *T. castaneum* and *T. confusum*

Test insects	Dose (ppm)	No. of females	No. of eggs (Mean ± SE)	Mean daily eggs lay per female	Percent reproductive control P.R.C.	Fertility % (Mean ± SE)	* d - values
T. castaneum	Control	20	4480 (224.00 ± 14.34)	6.79		66.05 ± 4.16	-
	1000	20	2488 (124.40 ± 14.61)	3.77	44.48	60.57 ± 4.37	1.40 N.S.
	2000	20	2182 (109.10 ± 11.70)	3.31	51.25	57.47 ± 3.82	2.14 N.S.
	4000	20	1456 (72.80 ± 9.36)	2.21	67.45	56.08 ± 2.29	2.46 N.S
	8000	20	1137 (56.85 ± 7.23)	1.72	74.67	50.63 ± 3.02	3.79**
	16000	20	1087 (54.35 ± 14.34)	1.65	75.70	48.82 ± 3.61	4.22**
T. confusum	Control	20	4730 (236.50 ± 8.57)	7.17		74.18 ± 3.03	-
	1000	20	2747 (137.35 ± 17.76)	4.16	41.98	61.13 ± 3.90	2.94**
	2000	20	2206 (110.30 ± 1146)	3.34	53.42	60.30 ± 2.87	3.50**
	4000	20	1858 (92.90 ± 11.63)	2.82	60.67	54.08 ± 2.61	4.99**
	8000	20	1442 (72.10 ± 17.54)	2.18	69.60	51.73 ± 4.08	5.51**
	16000	20	1100 (55.00 ± 8.45)	1.67	70.71	44.79 ± 2.81	7.22**

** = Significant at 1% ; N.S. = Not significant, d = Standardized normal deviates.

In both the insect species the toxicity level of the extract showed more or less similar trends of activity as antiovipositional and antifertility effect. In conclusion it can be said that the results of the present study unveiled the possibility of using *Sapium indicum*, *Thevetia neriifolia* and *Jatropha gossypifolia* seed extracts as a potential

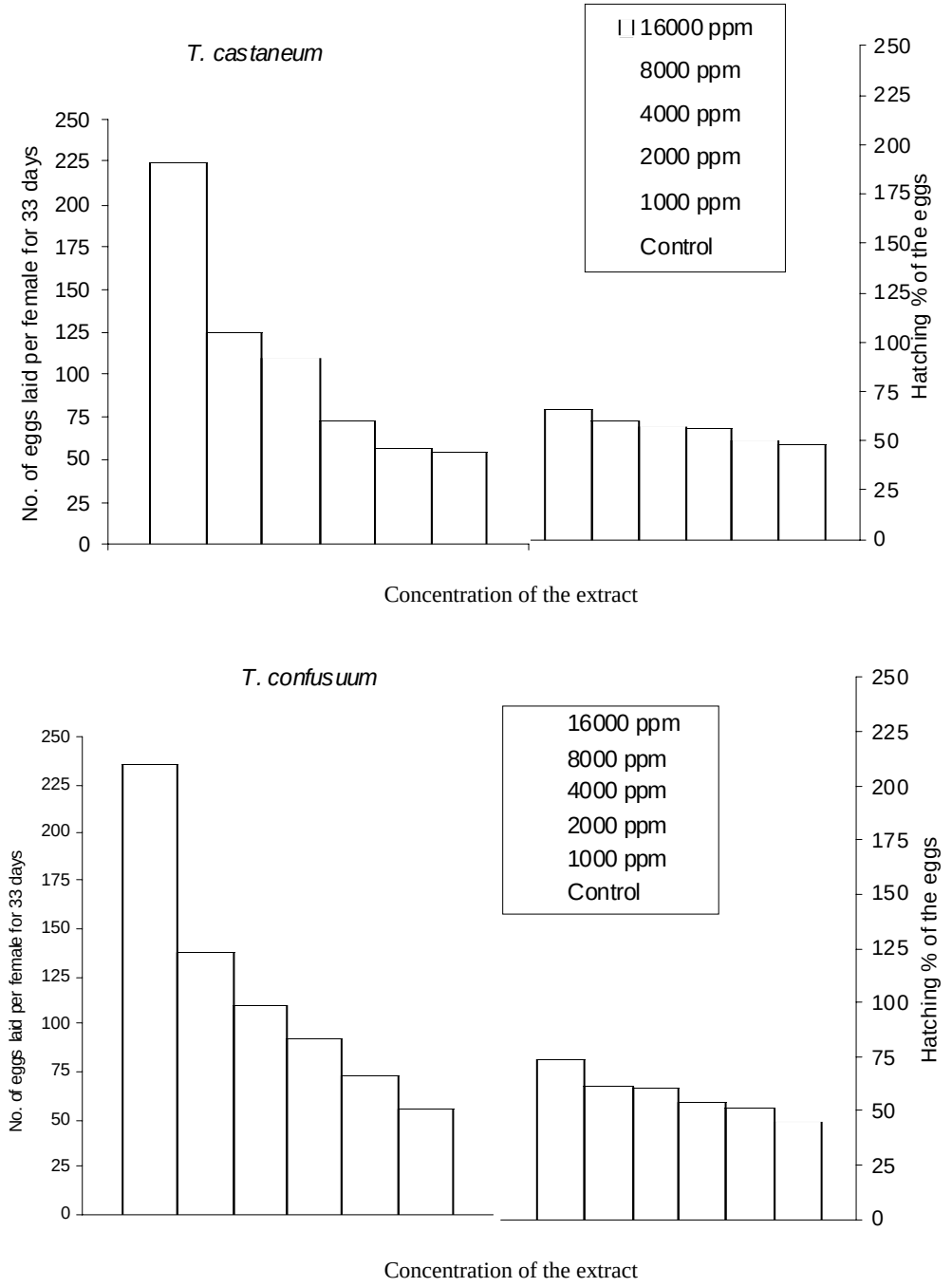

Fig. 3. Showing the effect of different concentration of *J. gossypifolia* seed extract on the fecundity and fertility of *T. castaneum* and *T. confusum.*

material with insecticidal property for the control of *T. castaneum* and *T. confusum in* stores

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