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Evaluation of Phytopesticides as Eco-Friendly Alternatives to Synthetic Pyrethroids in Grain Protection

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Abstract

Toxicity of two phytopesticides, Acours calamus, Euclaptus oil was observed Glass Film Method (GFM) in different time intervals, 5, 10 and 15 minutes, similary toxicity of pyrethroid Deltamethrin was also observed. The result showed that Deltamethrin was more toxic than phytopesticides, and Euclaptus oil was more toxic than Acorus calamus. Results demonstrated a clear dose- and time-dependent increase in mortality across all treatments. Deltamethrin exhibited the highest toxicity at all exposure periods, confirming its rapid knockdown effect. Among the phytopesticides, Eucalyptus oil showed greater toxicity than Acorus calamus oil, particularly at longer exposure durations. Mortality rates increased substantially with extended exposure time, highlighting the importance of contact duration in toxicity assessment.

Keywords: Tribolium castaneum, Toxicity, Phytopesticides, Acorus calamus, Eucalyptus oil, Pyrethroid, Glass Film Method.

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Introduction

Arthur (1994) used wheat and stored corn (maize) for the toxicity of deltamethrin plus chlorpyrifos. –methyl and unsynergised deltamethrin combinations. Malek et al (1996) reported Tribolium castaneum Herbst. Malek et al (1996) reported Tribolium castaneum Herbst. Used the insecticidal Properties of four Indigenous plant extracts against adults of the CR-1 strain. Daglish (1998) reported the efficacy of six grain safeners applied alone or in combination against the Coleoptera three species. Boeke et al (2001) reported the use of plant insecticides to protect stored leguminous seeds against seed beetles. Hall and Harman (2001) worked on storage fungi and weevils: the mechanism of action of oilseed treatment for the protection of stored legume seeds. Park et al. (2002).Reported the pesticidal activity of asarones identified in Acorus gramineus rhizome against stored-product insects, three coleopteran species. Adedire and Akinkurolere (2005) reported coleopterous pests of stored cereals and grain legumes in Nigeria for the bioactivity of some plant extracts. Ceruti and Lazzari. (2005) reported the powder of a combination of diatomaceous earth for stored corn insect control. Mondal and Khalequzzaman (2006) reported the insecticidal activity of essential oils against red flour beetle, Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae). Akrami (2008) reported the pesticidal effect of essential oils from Mentha longifolia andThymus kotschyanus on some stored product Insects.

Material and method:

Rearing procedure:

Tribolium castaneum was initially cultured in the Laboratory of the Department of Zoology, Federal Urdu University, Karachi and reared on Flour at 30 ± 5.0°C. A humidity of 25 ± 5 ° C was inserted into the mountain humidity. Food and egg-laying media were used as flour. Within around 25-30 days, new adults appeared. The insects were contained in jars of one litre of glass.

Experiment for toxicity:

After preliminary tests, six sets were prepared to add the selected pesticide volume to the inner surface of five petri dishes, while the sixth petri dish was not handled, i.e. control. Seeds were taken from six sets of perti dishes in each 90 mm. The protocol for normal and candidate phytopesticides was followed by the Glass Film Process. Then, ten pairs of Tribolium castaneum were released to determine the level of toxicity and the laying of eggs. The plates were kept at a mortality rate of 30 ° C ± 5.0 ° C daily.

For mean mortality = $\frac{\text{Average mortality}}{\text{Total insects}} \times 100$

Standard deviation = $\sqrt{\frac{\sum x^2 - n(x)}{n}}$

Annexure (A)

Annexure (B)

Annexure (C)

Result:

Toxicity of pesticides are observed by Glass Film Method (GFM) in different time intervals 5, 10, and 15 minutes Tribolium castenum treated with Acorus calamus at the dose 0.555, 0.2777, 0.1388, 0.6944 and 0.3466 µl/cm2 mortality observed after 5 minutes 8,13,18,25 and 28%, while after 10 minutes mortality noticed 37, 57, 63, 67 and 69%, similarly after 15 minutes mortality observed 70, 72, 73, 82 and 88%. Presented in Table 1. Correspondingly Euclaptus oil toxicity at doses 0.2777, 0.1388, 0.6944, 0.3466 and 0.1733 µl/cm2, mortality was observed after 5 minutes, 7, 12,18, 33 and 38%, while after 10 minutes mortality notices as 22, 28, 33, 38 and 43%, similarly after 15 minutes mortality observed 58, 67, 72, 82 and 92%. Presented in Table 2. Correspondingly, Deltamethrin toxicity at the doses of 0.003466, 0.00694, 0.01388, 0.02777 and 0.0555 µl/cm2. After 5 minutes of observation mortality rate is 8, 13, 22, 32, and 38%, while after 10 minutes, 37, 38, 48, 58 and 63% similarly after 15 minutes mortality found to be 73, 80,83, 88 and 93%. Presented in Table 3. Short-interval toxicity assessment using the Glass Film Method. Direct comparison of botanical oils with a synthetic pyrethroid. Rapid exposure evaluation relevant to contact insecticides.

Discussion:

Juan J.Y et al (2009) reported extraction of β-asarone from the rhizome of A. calamus had a significant lethal impact and knockdown on the pests. It is observed that the extraction of β-asarone from A. calamus has distinctive fumigant toxicity on four pests examined, and as a possible fumigant, it can thus be exploited for exposure after 120 hours. The LC_{50} values for R. dominica, S. zeamais, C. maculatus and T. castaneum adults were 4.42, 17.82, 0.73 and 116.48 µL/L, respectively. After the pests were treated with a concentration of β-asarone of 50 µL/L for 120 hours, S. zeamais, R. dominica and C. maculatus 100% adults, and T. castaneum 50% adults were knocked down; the mortality rates of C. maculatus, R. dominica, S. zeamais and T. castaneum adults were100%, 97. 78% 81.23% and 8.89%, respectively. After twenty-four hours of exposure, the KC50 values for C. maculatus, T. castaneum, R. dominica, and S. zeamais adults were 1.07, 124.04, 102.96 and 49.38 µL/L, respectively. Toxicity of pesticides are observed by Glass Film Method (GFM) in different time intervals 5, 10, and 15 minutes Tribolium castenum treated with Acorus calamus at the dose 0.555, 0.2777, 0.1388, 0.6944 and 0.3466 µl/cm2 mortality observed after 5 minutes 8,13,18,25 and 28%, while after 10 minutes mortality noticed 37, 57, 63, 67 and 69%, similarly after 15 minutes mortality observed 70, 71, 73, 82 and 88%. The present study shows that the A. Calamus are toxic to T. Cataneum by the Glass Film Method. Talukdar and Khanam (2009) Acorus calamus + T. neriifolia products showed the lowest LC_{50} values (43.27 µgcm-1) against Sitophilus oryzae at twenty four hours treatment but it varied at forty eight hours where Acorus calamus (L.) alone (13.72 µgcm-1) was found to be the most effective toxicant and the LC_{50} values of Acorus calamus alone products were 13.30 and 6.59 µgcm-1 and for A. calamus + T. neriifolia were 18.37 and 4.45 µgcm-1 against C. chinensis adults after 24 and 48 hours treatment respectively. Acorus. Calamus alone showed the lowest $LC._{50}$ values (166.78 and 123.55 µgcm-1) against Tribolium castaneum adults after twenty-four and forty eight hours of treatment. In the present study A. calamus used against T. Castaneum in different time intervals mortality was observed at the dose the dose 0.555, 0.2777, 0.1388, 0.6944 and 0.3466 µl/cm2 mortality observed after 5 minutes 8,13,18,25 and 28%, while after 10 minutes mortality noticed 37, 57, 63, 67 and 69%, similarly after 15 minutes mortality observed 70, 71,73, 82 and 88%. The present study was not comparable, possibly due to different methodologies and doses. Tayoub et al (2012) reported the fumigant activity of essential oil vapours distilled from Eucalyptus globulus Labail (Myrtaceae) and Origanum syriacum L. (Lamiaceae). The larvae were exposed to essential oil vapours of eucalyptus and oregano, which resulted in more than 95% mortality at concentrations of 312 µl/l air and 187.5 µl/l air, respectively. The LC_{50} values of Trogoderma granarium Everts larvae were 28.75 and 176.3 µl/l air for oregano and eucalyptus oils, respectively. In the present study toxicity of Euclaptus oil against T.

castaneum by Glass Film Method at dose 0.2777, 0.1388, 0.6944, 0.3466 and 0.1733 µl/cm2 mortality observed after 5 minutes 7, 12,18, 33 and 38%, while after 10 minutes mortality notices as 22, 28, 33, 38 and 39%, similarly after 15 minutes mortality observed 58, 67, 72, 82 and 92%. In the present study, result was not comparable, possibly due to different Species and methodology.

Conclusion:

The findings support the potential use of botanical pesticides as safer alternatives to synthetic insecticides for stored-product pest management, although their efficacy remains lower than that of deltamethrin under short exposure periods. This study contributes valuable baseline data on rapid toxicity responses of Tribolium castaneum to plant-based and synthetic insecticides and underscores the relevance of exposure time in evaluating insecticidal performance.

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Annexure (A)

Table 1. Toxicity of Acorus calamus oil, Euclaptus oil and Deltamethrin against Tribolium castaneum after 5minutes of treatment by the Glass Film method.

Acorus calamus				Euclaptus oil			Deltamethrin		
S.No	**Dosein µl/cm²**	**Mortality %**	**S.D**	**Dose in µl/cm²**	**Mortality %**	**S.D**	**Dose in µl/cm²**	**Mortality %**	**S.D**
0	Control	-	-	Control	-	-	Control	-	-
1	0.34	8.33	0.812	0.1733	7	0.597	0.003466	8	0.608
2	0.69	13	0.927	0.3466	12	0.6	0.00694	13	0.624
3	0.13	18	1.029	0.6944	18	0.640	0.0138	22	0.624
4	0.27	25	0.00	0.1388	33	0.707	0.02777	32	0.707
5	0.55	28	1.208	0.2777	38	0.707	0.0555	33	0.707

Annexure (B)

Table 2. Toxicity of Acorus calamus oil, Euclaptus oil and Deltamethrin against Tribolium castaneum after 10 minutes of treatment by the Glass Film method.

Acorus calamus				Euclaptus oil			Deltamethrin		
S.No	**Dosein µl/cm²**	**Mortality %**	**S.D**	**Dose in µl/cm²**	**Mortality %**	**S.D**	**Dose in µl/cm²**	**Mortality %**	**S.D**
0	Control	-	-	Control	-	-	Control	-	-
1	0.34	37	0.640	0.1733	22	0.616	0.003466	37	0.707
2	0.69	57	0.670	0.3466	28	0.670	0.00694	38	0.707
3	0.13	63	0.768	0.6944	33	0.685	0.0138	48	0.741
4	0.27	67	0.685	0.1388	38	0.7	0.02777	58	1.00
5	0.55	69	0.778	0.2777	43	0.755	0.0555	63	3.451

Annexure (C)

Table 3. Toxicity of Acorus calamus oil, Euclaptus oil and Deltamethrin against Tribolium castaneum after 15 minutes of treatment by the Glass Film method.

Acorus calamus				Euclaptus oil			Deltamethrin		
S.No	**Dosein µl/cm²**	**Mortality %**	**S.D**	**Dose in µl/cm²**	**Mortality %**	**S.D**	**Dose in µl/cm²**	**Mortality %**	**S.D**
0	Control	-	-	Control	-	-	Control	-	-
1	0.34	70	0.00	0.1733	58	0.754	0.003466	73	0.806
2	0.69	72	0.692	0.3466	67	0.685	0.00694	80	0.815
3	0.13	73	0.793	0.6944	72	0.692	0.0138	83	0.00
4	0.27	82	0.707	0.1388	82	0.707	0.02777	88	1.00
5	0.55	88	0.830	0.2777	92	5.956	0.0555	93	1.00