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Comparative fumiganttoxicity of lambda cyhalothrinand *Ziziphus mauritiana,* against pulse beetle, *Callosobruchus chinensis* (L.) (Coleoptera; Bruchidae)

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Abstract
Lambda cyhalothrin, insecticide and *Ziziphus mauritiana* plant extract were applied to adult pulse beetle *Callosobruchus chinensis (L.)* by filter paper impregnation method. The percent mortality was assessed after 24h & 48h of treatment. The LD_{50} values were calculated as 52.75µg/cm^2 and 14.25µg/cm^2 for L. cyhalothrin, whereas, 97.5µg/cm^{2}and 152.5µg/cm^{2}for*Z. Mauritiana* after 24h & 48h of treatment respectively. Among the fumigant toxicity after 120 hours of treatment the*Z. Mauritiana* also showed mortality even in low doses as in low doses of Lambda cyhalothrin so it can be further evaluated for botanical use as a fumigant.

Keywords: toxicity, lambda cyhalothrin, *Ziziphus mauritiana*, *Callosobruchus chinensi*s (L.), fumigant toxicity

Introduction

Food legumes (pulses) act as major vegetable protein source and cultivated around 5% of the total cropped area, Rani *et al*. (2018) [8] because of their importance as food for both poor & rich and the demand is rapidly increased. Presently 0.336 to 0.52 million tons of food legumes worth of Rs.12.7 to 1.5 billion per annum is importing Chickpea, lentil, mung bean & mash beans that are the major food legumes grown in country (Rani *et al*. 2018) [8]. About 1.5 million of area is under major food legume in the country & the major winter & summer food legumes is chickpea (73%) and mung (76%). Chickpea is most important as it contributes 70-80% to the total pulses area & production (Aslam *et al*. 2000) [1] and it is third important crop in food legumes but number of constraints like food losses caused by insect pests in field & storage affect its yield & caused tremendous losses to post harvests commodity during storage level in different ways. The FAO estimates that (5-10%) of grain is lost between harvest & consumption. Several bruchid species attack cereal and pulses in the store & cause a loss of 10-15% with germination loss ranging from 50-92% (Adugna *et al*. 2003) [3]. Among them Callosobruchus chinensis (L.) (Coleoptera: Bruchidae) attack different legumes & considered as a pest of economic importance (Ahmed *et al*. 2003) [2]. Synthetic insecticides play a significant role to control insect pest during storage and reducing the losses (Tapondjou *et al*. 2002) [8] but toxic effects of grain protectants caused several problems, i.e. killing of non-target species, high mammalian toxicity, toxic residues in food (Tahir *et al*. 2001 and Anwar *et al*. 2011) [4], risk to human health (Tahir *et al*. 2012) [4] development of genetic resistance, increased cost of application & destruction of the balance of the ecosystem (Shaheen and Kahliq, 2005) [7]. In different parts of the world farmers and scientists worked on successful use of plant extracts in insect pest control including essential oils of different medicinal plants and it is reported that certain plant extracts are much safer to an ecosystem than chemical insecticides (Islam *et al*. 2020) [4] so, the present work was carried out to evaluate the efficacy of the locally available botanical plant extract Ziziphus mauritiana and compared it with synthetic pesticide Lambda cyhalothrin.

Materials and Methods

Insect Rearing

The test insects *Callosobruchus chinensis* (L.) were used in this study. The culture strain obtained from the Grain Storage Research Laboratory (GSRL), Southern zone Agricultural Research Centre (SARC), Pakistan Agricultural Research Council (PARC), University campus Karachi, and reared at the laboratory of toxicology Pest Management Research Institute, SAR Cunder controlled environmental conditions in sterilized jars covered with muslin cloth tied with rubber bands. Whole 500 grams chickpea seeds were used as culture medium. The culture was maintained in the laboratory at 30+50C temperature and 65+5% relative humidity. The newly emerged adults were utilized for toxicological studies.

Insecticide and Botanical

Commercial grade insecticide Lambda Cyhalothrin2.5 EC purchased from the local market and different dilutions were prepared by dissolving 1% stock solution in distilled water i.e. 0.078%, 0.156%, 0.3125%, 0.625% and 1.25% concentrations. The fresh leaves of 50 gm of Ziziphus mauritiana (Indian Ber leaves) were collected from Karachi University Campus and GSRL SARC, PARC, University campus, then, washed with distilled water and grind to a solution with an electric blender with addition of ethanol 50% C2H5OH (1:1 H2O and C2H5OH). The macerated leaves left for 3 to 4 days in 250 ml of 50% ethanol. Finally, it was filtered and stored in refrigerator at 100C. From the Ziziphus mauritiana leaves extract (100%) different concentration were prepared i.e. 0.0625%, 0.125%, 0.25%, 0.5% and 1% and used for toxicity assessment.

Insect Bioassay

Toxicity

Different dilutions of insecticide and plant extract were used in bioassay. The 7.0cm diameter of Whatmann filter paper impregnated with one ml of different concentrations of test compounds were placed in 7.0cm diameter Petri plates. The control plates had no compound and check plates had only solvent. Three replicates of each dose were run after evaporation and drying of petriplates. Ten number of adults of same size and age were introduced to each petriplate. The mortalities were recorded after 24h and 48h of treatment and corrected by Abbot's formula (Abbot 1925) the data was statistically analyzed and LC50 and LC90 doses for each chemical was calculated.

Toxicity

Whatmann filter paper of 7.0cm diameter were placed in 7.0cm diameter petri plates and were impregnated with different doses, i.e. 1.25%, 0.625%, 0.3125%, 0.156% and 0.078% of the insecticide and plant extract, i.e. 1%, 0.5%, 0.25%, 0.125% and 0.0625% along with control and checked with three each batches of replicate. Air dried and 10 adult insects per petri plates were released and kept in the laboratory under controlled environmental conditions, i.e. 30±20C temperature and 65±5 % related humidity. Mortalities were observed daily in each petri plate until end point mortality was released. After 12 – 15 days mortality rate decreased and 0% mortality was observed in each control petri plates. The result from all replicates for each insecticide and plant extract were statistically analyzed.

Residual Toxicity

Residual toxicity of Lambda cyhalothrin against Callosobruchus chinensis (L.) was observed. After 1st day residual effect of Lambda cyhalothrin showed 10%, 0%, 0%, 0%, 0% mortality. At 2nd day the percent mortalities were 60%, 50%, 40%, 30%, 10% observed, on3rd day % mortality gradually increased due to the residual effects 80%, 70%, 70%, 50%, 30% observed. 4th day % mortality 40%, 40%, 30%, 30%, 20% observed. On 5th day percent mortalities of 30%, 20%, 20%, 10%, 10% were observed at 1%, 0.5%, 0.25%, 0.125% and 0.0625%respectively. (Fig.5)

Residual toxicity of Ziziphus mauritiana against Callosobruchus chinensis was observed. After 1st day residual effect of Z. mauritianare corded as20%, 10%, 10%, 10%, 0% mortality. 2nd day % mortality was 30%, 20%, 20%, 10%, 10% observed.3rd day % mortality gradually increased due to the residual effects 60%, 40%, 30%, 30%, 20% observed. 4th day % mortality 40%, 30%, 20%, 20%, 20% observed.5th day % mortality 30%, 20%, 20%, 10%, 10% observed at 1%, 0.5%, 0.25%, 0.125% and 0.0625% respectively. (Fig.6)

Result & Discussion

The toxicity of Lambda cyhalothrin against C. chinensis after 24h (Fig.1) was 87.5%, 71.7%, 62.4%, 52.6% & 30.8%and after 48h (Fig.2) was 81.1%, 65.2%, 61.9%, 52.6%& 42.6% at 1.25%, 0.625%, 0.3125%, 0.156% and 0.078% concentration respectively. The toxicity of Z. mauritiana against C. chinensis after 24h (Fig.3) was 69.6%, 63.7%, 46.7%, 38.6% &29.4%& after 48h (Fig.4) 66.5%, 47.4%, 38.3%, 25.9% & 13.2% at 1%, 0.5%, 0.25%, 0.125% and 0.0625% concentration respectively. The LD50 values of L. cyhalothrin obtained after 24h & 48h were 52.75µg/cm2and 14.25µg/cm2 & for Z. mauritiana were 97.5µg/cm2 and 152.5µg/cm2respectively.

Bindhu *et al*. (2015) [5], Ashwin *et al*. (2017), Alves *et al*. (2019), Omi *et al*. (2019) and Islam *et al*. (2020) [4] reported the high efficacy of essential oil and plants extracts against stored product pests like Callosobruchus spp. respectively. Trivedi *et al*. (2017) [12] reported the fumigant toxicity of different essential oils against C. chinensis whereas, Tarigan *et al*. (2016) [10] reported the highest toxicity of cinnamon oil against C. maculatus, Islam *et al*. (2020) [4] evaluated the comparative efficacy of four botanicals and reported that all were significantly effective against C. chinensis, whereas the sesame oil proved as best protectant of gram seed against pulse beetle as compared to the mahogany powder, similarly in the present study the Ziziphus mauritiana efficacy was tested along with an insecticide L. cyhalothrin and it was observed that pesticide killed insects even at lowest doses whereas the highest doses of plant extracts controlled pulse beetle significantly. The present results were consistent with the results reported by Trivedi *et al*. (2017) [12] who reported that essential oil of botanicals provide significant protection of grain against C. chinensisinfestation, whereas the Tarigan *et al*. (2016) [10] reported that at LC50 doses of 0.01%, 0.132% & 0.186% the cinnamon oil showed highest efficacy against egg, larvae & adult of C. maculatus, respectively. Tesema *et al*. (2015) investigated leaf powders of basil, neem, cow dung and malathion against C. chinensis& found that all plant extracts were effectively control the bruchid as compared to control whereas the malathion found most effective, similarly Ziziphus effected bruchid as compared to control on insecticide cyhalothrin was found most effective but due to side effects of synthetic chemicals these plants derivates can give a promising alternatives as they have repellent & deterrent effects & it was reported that they also effect on fecundity, have growth inhibitory effect's & fumigant toxicity Isman *et al*. (2020). In the present investigation on their repellency detterency & growth inhibitory effect will be further evaluated & it might be useful for managing Callosobruchus spp.

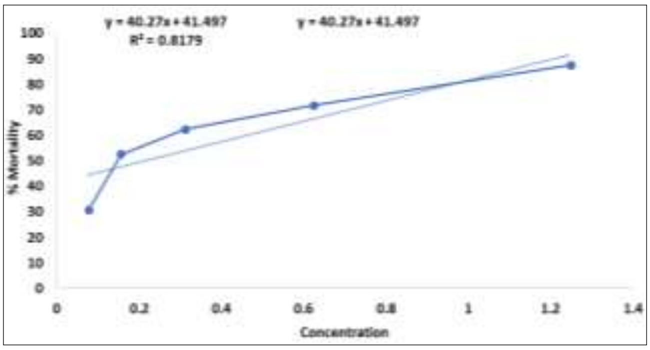

Fig 1: Regression model of toxicity of Lambda cyhalothrin against *Callosobruchus chinensis* after 24h

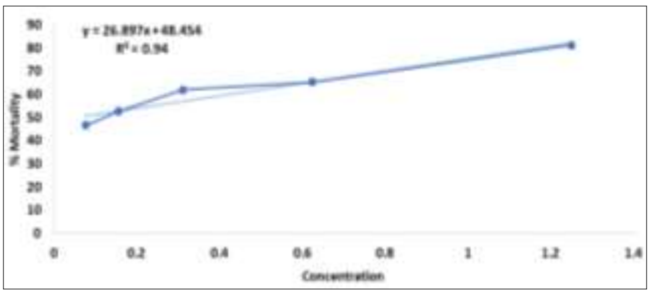

Fig 2: Regression model of toxicity of Lambda cyhalothrin against *Callosobruchus chinensis* after 48h

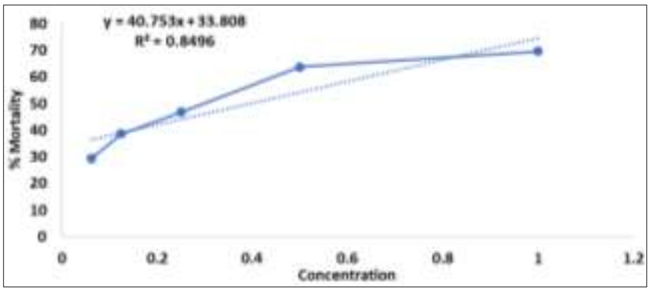

Fig 3: Regression model of toxicity of *Ziziphus mauritiana* against *Callosobruchus chinensis* after 24h

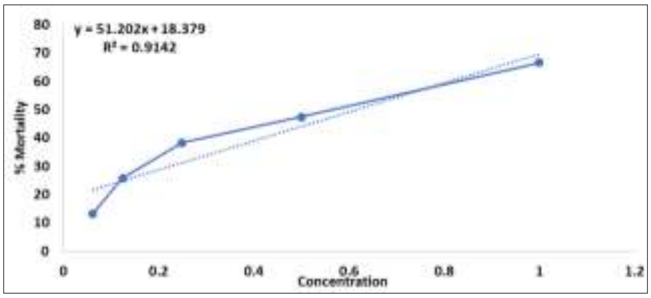

Fig 4: Regression model of toxicity of *Ziziphus mauritiana* against *Callosobruchus chinensis* after 48h

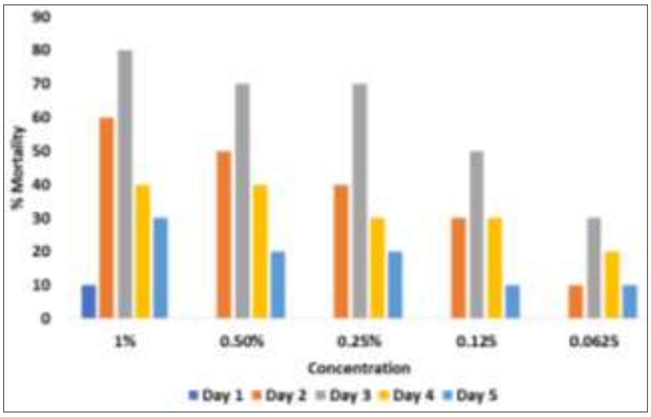

Fig 5: Residual toxicity of Lambda cyhalothrin against *Callosobruchus chinensis* (L.)

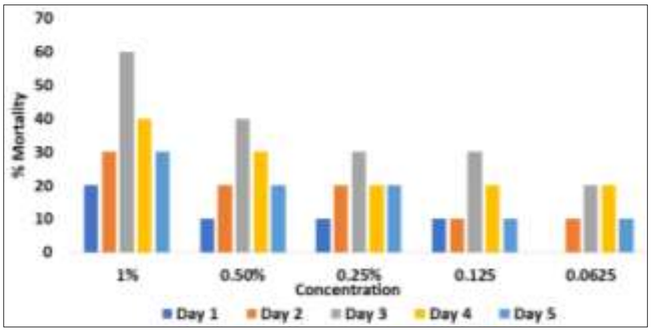

Fig 6: Residual toxicity of *Ziziphus mauritiana* against *Callosobruchus chinensis* (L.)

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