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RESEARCH ARTICLE

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Insecticidal Activity of Leaves Extracts of *Lamium purpureum* (Lamiaceae) against Red Flour Beetle *Tribolium castaneum* (Coleoptera: Tenebrionidae)

Abdullahi AM[1*], Tukur Z[2]

[1]*Department of Biological Science, Federal University Kashere, Gombe, Nigeria*
[2]*Biological Science Department, Bayero University, Kano, Nigeria*

ABSTRACT

In the present study, insecticidal activity of Leaves extracts of Lamium purpureum were evaluated as contact toxicants, fumigant and F1 progeny production inhibitors to red flour beetle Tribolium castaneum, the leaves of L. purpureum were collected around Sharada area Kano by hand picking, identified at herbarium of Department of Biological Sceince, Bayero University Kano, washed with clean water, dried under shade, grounded into fine powder using pestle and mortar, extract were obtained by cold percolation using ethanol as solvents, four extract concentrations were prepared using 50% DMSO solution. T. castaneum were obtained from infested flour at A. Rimi market kano, identified by its morphological appearances maintain and reared under ambient conditions (32 ± 0.64°C, 68 ± 3% R.H and 12L: 12D photoperiods) all bioassays were carried out in small transparent plastic containers (4cm height and 6cm diameter). Data generated were subjected to analysis of variance using SPSS (version 20) means were separated at 5% level by Turkey's tests. Results obtained indicates that leaves extract of L. purpureum were effective as contact toxicant, fumigants and inhibitors of F1 progeny production of T. castaneum hence leaves extracts of L. purpureum has potential to be used as control agent of red flour beetle T. castaneum infesting stored food products. The findings of this study reveal the usefulness of yet another bio pesticide and its incorporation into traditional storage pest management system is recommended.

Keywords: Extract, *Lamium purpureum,* Insecticidal activity, *Tribolium castaneum,* Progeny

INTRODUCTION

Tribolium castaneum (coleoptra: tenebrionidae) has long been associated with human stored food and has been found in association with a wide range of commodities including grains, flour, peas, beans, nuts, dried fruits and spices but milled grain products such as flour appear to be their prepared food [1-4]. All stages (egg, larva, pupa and adults) may be present simultaneously in infested products [5-7]. Current stored-product pest management has relied on the use of Chemical insecticides; however, chemical control methods are restricted because of the development of pest resistance, health hazards and risk of environmental contamination [6]. Therefore, in the current scenario, there is urgent need to develop safer, environmental friendlier and efficient alternatives that have potential to replace synthetic chemical insecticides and convenient to use.

Plant extracts and their components have shown to possess potential for development as insecticides and they may have advantages over conventional insecticides in terms of low mammalian toxicity, rapid degradation and local availability [8-21]. Extracts derived from more than 75 plant species have been evaluated for fumigant toxicity against stored product insect pests so far [18] Plant extract have insecticidal [20] anti-fungal [8] nemacidal [14] virucidal [19] antibacterial [9] effect. Hence in the present study insecticidal activity of leaves extract of *Lamium purpureum* were evaluated as contact toxicant, fumigant and inhibitors of progeny productions against Red flour beetle *T. castaneum.*

MATERIAL AND METHODS

Culturing of insects

Red flour beetles (*Tribolium castaneum*) were collected from infested stock of flour at A. Rimi market Kano in the month of December, 2014. *T. castaneum* was identified by its three segmented club antennae and curved side thorax as described by Bousquest. Twenty pairs of *T. castaneum* were used to infest fresh preserved 1000 g of flour contained in a label transparent buckets (35 cm height and 30 cm diameter) the buckets was capped with piece of nets 10 mesh/ cm which allowed for ventilation but preclude the entry or exit of the insects, the set were maintain under ambient conditions of temperature, relative humidity and photoperiods (32 ± 0.64°C, 68 ± 3% and 12L: 12D) [15] for two weeks of ensured ovipositions then parents stock was sieve out and the set were maintain undisturbed, F1 adults emergence over 24 h periods were collected and preserved in another container and were used for the experiments [13,20].

Collection of plant materials and extract preparation

Purple dead nettle (*L. purpureum*) Leaves were collected around Sharada phase II industrial area Kano by direct hand picking in September, 2014, when the area is still wet and identified at herbarium of the Department of Biological Science Bayero university Kano, washed with clean water and dried under shade at room temperature of about 30°C for five days. Shade dried Leaves of *L. purpureum* were grounded into fine powder using mortar and pestle as describe by Lale [11]. 100 g of the grounded powdered were added into 500 ml of ethanol (95%) contain in a glass jar, the mixture was shaken thoroughly and vigorously for about 10 min daily for one week and then filtered, the filtrate was allowed to stand at room temperature for 120 h during which the solvent was vaporized yielding crude extracts, the process was repeated until desired extract quantity was obtained. 20 g of crude extract was added into 20 ml of 50% DMSO Solution to obtain 1.00 g/ml extract concentration, other concentration such as 0.50, 0.25, and 0.125 g/ml were prepared by serial dilution.

Contact toxicity

One micro liter of each extracts concentration prepared (1.00, 0.50, 0.25, 0.125 g/ml) were applied to the dorsal surface of the thorax of 10 sets of adults (5-14 days old) of *T. castaneum,* using micro syringe individually. Distilled water was used as treatments in the control sets, and quickly transferred into small transparent plastic containers (4 cm height and 6 cm diameter) containing 10 g of Flour, which was then closed with perforated cap to aid ventilation but preclude entry or exist of the insects, each set was replicated two times and insect mortality was recorded after 48 h post-treatment intervals for one week [22].

Fumigant effects

four different concentrations of each plants extract (1.00, 0.50, 0.25 and 0.125 g/ml) were applied onto a small What man's No1 filter paper disc (2cm diameter) separately and the solvent was allowed to evaporate for 10minute, each filter paper disc were attached to the under surface of the perforated cap of small transparent plastic containers (4cm height and 6 cm diameter), containing 10 adults (5-14 days old) of *T. castaneum,* in 10g of Flour, the caps were used to close each container thus exposing the insects to fumigants and aiding ventilation but precluding the entry or exist of the insects, In the control treatment distilled water was used. Each set was replicated two more times and insect mortality was recorded at every 48 h post treatment intervals for one week [17]. In both contact toxicity and fumigant effect assays insect was considered died only if they fail three probing blunt tests, Abbott's formula [2] was used to correct observed mortalities were control mortalities exceed 20%.

$$Correct\ Mortality = \frac{\%\,Test\ Mortality - \%\,Control\ Mortality}{100 - \%\,Control\ Mortality} \times 100$$

Progeny production

Twenty adults (5-14 days old) of *T. castaneum* were introduced into small transparent plastic container (4 cm height and 6 cm diameter) containing 20 g of Flour and then closed with perforated cap to aid ventilation but preclude the entry or exits of the insects and were kept undisturbed for two weeks of ensured oviposition then the parent stock were sieved out, the set were treated with 1.00 g/ml of extract, with controls treated with Distilled water only. Each set was replicated two more time, the set were maintain for another five weeks, then number of insects emerged from each treatment were counted and recorded daily for one week [22].

Data analysis

All data generated from the work were subjected to Analysis of Variance (ANOVA) using SPSS (version 20) for windows, means were separated ($p<0.05$) using Turkey's multiple comparison tests.

RESULTS

Contact toxicity

Toxicity of leaves extracts of *L. purpureum* applied topically to *T. castaneum* is summarized in Table 1. There was increased in mortality (%) of *T. castaneum* with increased in concentrations of extracts and exposure times. There was significant difference ($p<0.05$) among the treatments with 0.50 and 1.00 g/ml concentrations induces highest percentage mortality (100%) each at 96 h and 144 h after treatment respectively.

Table 1: Toxicity of leaves extract of *Lamium purpureum* applied topically to *Tribolium castaneum.* Mean (± SE) represents three replicates of 10 insects each. Mean in the same colomn followed by different letter(s) are significantly different by Turkey's tests

Mean % mortality at different exposure times (hrs)			
Treatment (g/ml)	**48**	**96**	**144**
Control	$0.0^{e} \pm 0.0$	$11.4^{d} \pm 1.2$	$14.2^{c} \pm 1.0$
0.125	$41.2^{d} \pm 0.7$	$73.2^{c} \pm 0.6$	$92.6^{b} \pm 0.8$
0.25	$55.1^{c} \pm 0.5$	$85.4^{b} \pm 0.6$	$100.0^{a} \pm 0.0$
0.50	$73.8^{b} \pm 0.6$	$100.0^{a} \pm 0.0$	$100.0^{a} \pm 0.0$
1.00	$82.4^{a} \pm 0.6$	$100.0^{a} \pm 0.0$	$100.0^{a} \pm 0.0$

Fumigant effects

Fumigant effects of leaves *L. purpureum* were presented in Table 2. Percentage mortality varies with dosage levels and exposure times. There was significant differences ($p<0.05$) among the treatments.

Table 2: Fumigant effects of leaves extra ct of *L. purpureum* against *T. castaneum.* Mean (± SE) represents three replicates of 10 insects each. Mean in the same column followed by different letter(s) are significantly different by Turkey's tests

Mean % mortality at different exposure times (hrs)			
Treatment (g/ml)	**48**	**96**	**144**
Control	$0.0^{e} \pm 0.0$	$10.2^{e} \pm 1.2$	$20.1^{d} \pm 1.0$
0.125	$22.2^{d} \pm 1.0$	$42.1^{d} \pm 0.7$	$52.2^{c} \pm 0.5$
0.25	$36.1^{c} \pm 0.5$	$64.8^{c} \pm 0.4$	$84.2^{b} \pm 0.6$
0.50	$54.3^{b} \pm 0.5$	$83.1^{b} \pm 0.6$	$100.0^{a} \pm 0.0$
1.00	$63.5^{a} \pm 0.6$	$94.6^{a} \pm 0.8$	$100.0^{a} \pm 0.0$

Progeny production

Leaves extract of *L. purpureum* significantly ($p<0.05$) reduced the progeny productions of *T. castaneum*

DISCUSSION

Leaves extracts of *L. purpureum* were toxic to adults *T. castaneum,* thus killing significant percentage of adults *T. castaneum* exposed to treatments as contact toxicant, fumigant and inhibitors to F1 progeny production, this phenomenon suggest the presence of highly pungent secondary metabolites [22]. Alkaloids, Terpenoids, Tannin, Saponin and phenolic compounds were identified in the leaves extracts of *L. purpureum* and these compounds have been reported to possess anti-insect activities [5]. They can affect insects in several different ways such as disruption of metabolic pathways, interference with cuticular developments, acts as attractant, deterrent, phagostimulant and antifeedants [3] The extracts were more effective as contact toxicant as highest mortality (%) was recorded in contact toxicity assay, 100% mortality was recorded in 0.50 and 1.00 g/ml conc. at 96 h post-treatment. This could be due to the direct contacts of extracts with insect thorax hence synergism of several mechanisms such as contact poisoning, blockage of spiracles and interference with cuticular developments [1] by active compounds such as alkaloids, Tannin, Saponin and phenolic compounds present in the *L. purpureum* leaves extracts causes rapid death of *T. castaneum.* Similarly *L. purpureum* leaves extract as fumigant significantly ($p<0.05$) causes mortalities of adults *T. castaneum* with highest percentage mortality observed in 0.50 and 1.00 g/ml concentrations 144 h after treatments, the mortalities of *T. castaneum* causes by fumigant effects of leaves extract could be attributed directly to interferences with insects respiratory system by the active compounds such alkaloids, terpenoids, tannins, saponnins and phenolic compounds present in *L. purpureum* leaves extract which leads to soffocations and death. Also leaves extract of *L. purpureum* significantly ($p<0.05$) reduced F1 progeny production of *T. castaneum* this is evident comparing with

control sets (Figure 1) and this could be due to effects of one or more or synergism of the following by the active compounds in the *L. purpureum* leaves, exterminations or inhibiting development of eggs, larvae or pupae [17], preventing molting of larvae, poisoning of eggs, larvae or pupae and inhibiting of the formation of chitin the substance essential for insect to form an exoskeleton.

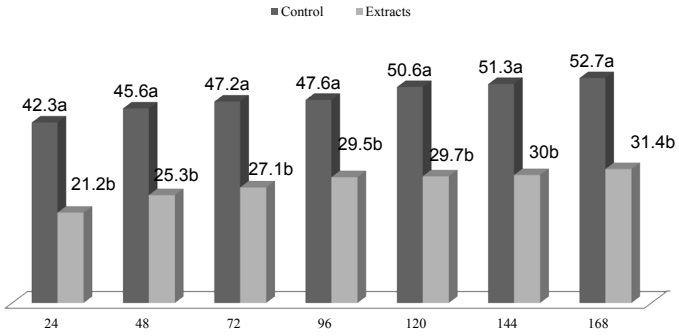

Figure 1: Effects of leaves extracts of *Lamium purpureum* on the number of F1 progeny produced by *Tribolium castaneum* Mean represents three replicate. Mean in the same column followed by different letter(s) are significantly different by Turkey's tests.

The results of this study confirmed the findings of many other previous works on the use of plants extracts in controlling insect pest of stored products. Khoshnoud and Khayamy [10] evaluated the insecticidal and progeny production effects of ethanol extracts of *Verbascum cheiranthifolium* against *S. oryzae* and *T. castaneum* and observed significant mortality and suppression of progeny production. Also the essential oils from *M. fragrans* and *I. verum* were tested for their biological activity against *S. oryzae* and *T. castaneum* by shukla [21] and observed that it inhibited oviposition and toxic to growing larvae. Yankanchi and Gadache [23] also reported that plants extracts from *C. inerma, W. somnifera, G. sepia, C. tora* and *E. odoratum* were effective in suppressing progeny production (F1) and eliminating adults of rice weevils *S. oryzae*. Furthermore, Popoola [16] also reported those powders and whole forms of *A. sativum, A. cepa* and *C. annum* causes' significant mortality and reduction in F1 adults' emergences of *Oryzaephilus dutinamrnsis* infesting Date fruits [24].

The leaves extract of *L. purpureum* acts as contact toxicant, fumigants and inhibitor of *T. castaneum* F1 progeny production, hence leaves extracts of *L. purpureum* has potential to be used as control agents of stored food products from red flour beetle *T. castaneum* infestations, as plants materials have advantages over broad-spectrum conventional pesticides as they affect only target pest and closely related organisms, equally they are effective in very small quantities, decomposed quickly and provide residue free food and are safe to environments.

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