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Garden spurge, *Euphorbia hirta* Linn: Toxicity against pulse beetle, *Callosobruchus maculatus* F.

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Abstract
Storing the grains is a traditional practice which includes different storage structures providing aeration and protection from pest and diseases with the assurance of grain quality. Insect pests are one of the important constrains for maintaining quantity and quality of the grains in storage. Pesticides are one of the management practices for storage pests which may brought changing behavior of insects towards the chemical molecule and also to made the grains unfit for consumption with more residues. It is necessary to find out alternative control measures and the plant derivatives are the best choice because of their efficacy and safety to environment. *E. hirta* leaves were collected, dried and made into solvent extraction by using different solvents. The pulse beetle *C. maculatus* was exposed at different concentration *viz.*, 1%, 5%, 10%, 15% and 20% of different solvent extracts and mortality was observed on 12, 24, 36, 48, 60 and 72 hrs after treatment. All the solvent extracts shown more than 50% mortality of *C. maculatus* at 15% concentration. Among which methanol ranked first with the mortality of 66.04%.

Keywords: Green gram, *C. maculatus*, *E. hirta* and toxicity

Introduction
In India, pulses are the important group of crops that provide high quality protein and several amino acids. The annual production potential of India is about 22.95 million tonnes. As a field and storage pest *C. maculatus* is a major factor for pre and post-harvest losses of green gram. The damage by *C. maculatus* not only reduce the weight of the grain but also the nutrient value and viability of the grains. In the consideration of economics of crop to prevent both pre and post-harvest losses several pesticides are used to control bruchids. These pesticides in any form either fumigants or liquid formulations led to resistance and residue. To identify an effective and eco-friendly alternative method *E. hirta* was selected to test against *C. maculatus.*

E. hirta was a well-known traditional medicinal plant and commonly distributed in all tropical countries. The plants of Euphorbiaceae family has excellent toxicity effect on insect pests especially the aqueous leaf extracts. All the species of *Euphorbia* exudes a milky juice when broken, which is more or less toxic (Diwan and Saxena, 2010) [2]. The *E. hirta* leaves contains flavonoids, polyphenols, sterols, alkaloids, tannins, glycosides and triterpenoids (Kumar *et al.*, 2010) [1].

Materials and Methods
Extraction from Leaves of *E. hirta*
E. hirta leaves were collected from cultivable lands of Madurai district. The collected leaves were washed thoroughly, after that air dried at room temperature 30±2^{0}C for 30 days. Air dried leaves were grinded and powdered about 40-60 mesh sieve to obtaining uniform size of particles, weighed and stored it in a containers for further use. From 1 kg of leaves 810g of leaf powder was collected. Different solvents *viz.*, methanol, ethyl acetate, hexane, chloroform, acetone were used for extraction. Soxhlet apparatus was used for extraction with 30g of leaf powder and 300ml of solvent. The apparatus was run for 6 hrs with 55^{0}C temperature. The crude extract was get after evaporating the solvents by using rotary vacuum evaporator at 45^{0}C for 30 minutes (Diwan and Saxena, 2010) [2].

Mass Culturing of Pulse Beetle, *C. maculatus*

Two hundred gram of green gram seeds with uniform moisture content were taken in 59×21×18 cm size plastic container. Ten pairs of adult beetle were released in each container and tightly covered with muslin cloth by using rubber band. The containers were kept in dark condition at a temperature of 30±5^{0}C and 70% relative humidity. (Ramazeame *et al*., 2014) [7]. The adult beetles were emerged with in 25-30 days. The male beetles are comparatively smaller than the female beetles and the pigidium present in male beetle have no stripes, but the female have dark stripes.

Contact Toxicity Test

Filter paper method was used for contact toxicity which was followed by Kim and Ahn, (2001) [1]. About 9 cm diameter of whatman no.1 filter paper was used for this experiment. The filter paper was applied with 1ml of different concentrations *viz.,* 1%, 5%, 10%, 15% and 20% of different solvent extracts and then dried under a hood for 2min.The *C. maculatus* adults of 3-5 days old were released into the treated filter paper kept in the petridish with lid. The treatment was replicated four times and the control was maintained by using distilled water. The observations were taken after 12,24,36,48, 60 and 72 hrs exposure. The percent mortality in different solvent extracts and at different concentrations was analyzed under CRD. The data were subjected to angular (Arcsine) transformation prior to analysis and the mean were separated by DMRT (Gomez and Gomez, 1984) [4].

Results and Discussion

The Table.1 depicts the bio efficacy of different solvent extracts of *E. hirta* against *C. maculatus.* Among the different solvent extracts 20% methanolic extracts shown highest percent mortality (66.04%). All the solvent extracts at 15% concentration resulted in above 50 per cent mortality. The second best treatment was 20% ethyl acetate extract which caused 64.33% mortality followed by hexane extract (61.59%) and chloroform extract (60.58%).

The least per cent mortality was observed in acetone extract of 20% concentration (57.08%).

Table 1: Bio efficacy of *E. hirta* leaf extracts against Pulse beetle, *C. maculatus*.

S. No	Concentration (%)	Mean percent mortality				
		Methanol	**Ethyl acetate**	**Hexane**	**Chloroform**	**Acetone**
1.	1%	47.92 (43.53)e	37.31 (37.13)e	27.35 (30.81) ^{e}	31.75 (33.87)^{e}	26.25 (30.29)e
2.	5%	58.13 (50.29) ^{d}	45.68 (42.33)d	35.70 (36.25) d	37.40 (37.14) d	31.67 (33.81)^{d}
3.	10%	63.33 (54.23) c	55.33 (48.27)c	42.59 (40.43) ^{c}	47.41 (43.38) ^{c}	38.54 (38.07)^{c}
4.	15%	63.96 (55.12)^{b}	60.77 (52.01)b	50.94 (45.54)^{b}	56.18 (49.17)^{b}	51.67 (45.99)b
5.	20%	66.04 (56.75)^{a}	64.33 (55.36)^{a}	61.59 (52.50)a	60.58 (51.47)^{a}	57.08 (49.35)^{a}
S. Ed		2.56	2.05	2.10	1.64	1.84
CD (0.05)		5.08	4.07	4.16	3.26	3.66
*Data are mean values of four replications						

The present study is in accordance with Pannerselvam *et al.* (2013) who reported the toxicity of *E. hirta* leaves against *Anopheles stephensi*. *E. hirta* toxicity was also proved by Kiran *et al.* (2015) [5] and experiment was concluded that *E. spp.* had toxicity against *Plutella xylostella*. Diwan and Saxena (2010) [2] reported that 3% of *E. hirta* leaf extracts shown 100 per cent mortality of *C. chinensis.*

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