

A study of insecticidal effects of leaf extracts of *Aegle marmelos* L. Correa and *Ricinus communis* L. on *Callosobruchus chinensis* L

Abstract:

Laboratory experiments were conducted to evaluate the efficiency of leaf powders of *Aegle marmelos* and *Ricinus communis* against the pulse beetle, *Callosobruchus chinensis*. which infests stored pulse seeds. Stored pulses are primarily attacked by major insect pest particularly the pulse beetle, *Callosobruchus chinensis*. Though chemicals provide effective control of *Callosobruchus* sp., but the efficiency of the chemicals mostly depends on the mode of exposure. The maximum effectiveness is given when the insecticides are provided by gustatory a method, but majority of these are toxic to human. Stored product to be many synthetic insecticides have been found effective against pests, but proved to be hazardous to men and domestic animals. These chemical compounds pose a serious risk to human health, so these chemical compounds should not be used in stored pulses that are consumed. The over reliance on and nonjudicious use of synthetic pesticides, especially insecticides since last four decades led to wide the spectrum of pests resistance to chemicals, resurgence of pests, Pulse beetles cause losses of more than 50% of protected grains, control of which generally depends on synthetic bio pesticides involving fumigants, this results in residual and unintended contamination of food and soil which can prove hazardous to human and animal health. The extracts of the different fraction of bio insecticides may play a key role in troublesome insect pests controlling program in near future. The leaves of the plants *Aegle marmelos* and *Ricinus communis* have proven to be well effective for the control of *Callosobruchus chinensis*, by using methanol and chloroform solvents.

Keywords: *Aegle marmelos* and *Ricinus communis*, leaf powders, *Callosobruchus chinensis*, pulse protection, biopesticides.

Introduction: -

Pulses are an important source of nutrition for billions of people around the world providing abundant protein. The terms beans and pulses are interchangeable because all pulses can be called legumes but not all beans as pulses.

Pulses, usually in the form of stored grains, belongs to the leguminosae family and do not include oilseed pulses or legume, mainly peanuts and soybeans. In this, such species are kept which can be mainly included in the edible form of humans. The International and protein benefits of pulses were announced by the united nation and the agricultural organisation in 2016, with the aim of human food security and nutrition.

Pulses can provide sufficient quantity of minerals (iron, zinc, calcium, magnesium), to human through nutrition **Tiwari and Singh, (2012)** deficiency of minerals world led to various type of cardiovascular disease and imbalance in biological pathways in human **Dahl et al, (2012)**. Adequate minerals include a group of essential compounds that include phenolic acids, tannins and flavonoids **(Casey et al 1998; Machuca, 2000)** various pulses varieties contain high levels of Phenolic compounds and antioxidant activity **(Vazquez et al ,2008)**. In countries around the world including India, pulses are being produced to supply the nutrition whose use is increasing day by day in our lives **(Warsame and Kimani 2014)**. High yielding varieties having high yield in terms of processing efficiency and raw yield were given first priority for thermal processing by the processors **(Wassimi et al, 1990; Hosfield et al, 2000)**.

Varieties of Pulses which have uniform size and low water holding capacity should be used for canning during which their growth can be faster. on the basis of anti-nutritional factors like protein inhibition, phenolics tannin lectins, saponins etc, conventional processing methods like soaking, soaking, should be evaluated on a larger scale and new methods should be used to development **(Patterson et al. 2017)**. Pulses are produced in many countries, but due to keeping them in plastic containers, a decrease in their phenolic content has been observed **(Parmar et al, 2016)**.

In countries like India, pulses are considered the best source for diet and they also play an effective role, pulses are also considered an important source of protein, minerals and fiber. Green gram, chickpea and all varieties of pulses contain twice as much protein as wheat and three times more than rice. It is very important to think about reaching the pulses among the poor class because the consumption of dairy and animal products among the poor class people is relatively low due to which adequate amount of protein and minerals are not available to them, **(Nahar, 2013)**. To improve the health of soil, pulses cultivation of pulses should be provided through inter cropping system so that it can contribute in increasing the crop production **(Rawal and Navarro, 2019)**.

Commodity group contributes to all topics of future Initiative towards eradicating poverty and hunger, enhancing their nutritional status and protecting the environment (**Maredia, 2012**).

Major pulses are grown chickpeas (Gram/Chana), pigeon pea (Tur/Arhar), Mungbeans, Uradbeans (Blackgram), Masur (lentil), Peas and various kinds of beans (minor pulses). · The main regions with high productivity are Madhya Pradesh, Rajasthan, Maharashtra, Karnataka, Uttar Pradesh, Coastal Andhra Pradesh, Gujarat, Tamil Nadu, Jharkhand, Odisha, Chhattisgarh, Telangana, Bihar and West Bengal delta region.

According to the Indian Council of Medical Research, the consumption of pulses should be 50 gm per person per day which has reached only 48 gm per person in India till 2019. The production of main crop like pulses and other legumes can be increased only when farmers should be made self-reliant with good fertilizers and irrigation facilities, (**FAO et al., 2020**).

Material and Methods: -

Insect (*Callosobruchus chinensis*-

Callosobruchus chinensis (L.) (Coleoptera: Chrysomelidae) is a serious internal feeder of seeds of several legume species and an economically important insect pest (**Tuda et al. 2005**). This insect causes maximum damage during February to August, it hibernates between March to November. The entire life span of *C. chinensis* is 29 to 39 days. The incubation period is from 4 to 6 days depending on the pulses in which they grow (**Johnson, 1981**). Its life span ranges from larva to adult stage, its shape is oval shaped and its antennae are about 3 to 4 mm in length, and chocolate brown colour (**Johnson, 1981**).

Select of the plant-

Aegle marmelos and *Ricinus communis* were selected due to their bio-pesticides. In these plants, medicinal qualities, and are found in good abundance in the field of study.

Collect of materials-

Leaves of native plants *Aegle marmelos* family Rutaceae and plant *Ricinus communis* family Euphorbiaceae collected from Laharpur roadside in Bhopal, in the month of January.

Categorisation of the plants-

Research institute Govtmodel science college Rewa (M.P.) the collected plants received recognition from the Branch of Botany.

Aegle Marmelos(Bael)-

Kingdom - Plantae

Order - Sopindales

Family - Rutaceae

Sub family – Aurantioideae

Genus - *Aegle*

Species - *marmelos*

Bael leaf extract are insecticidal contains several active compounds, alkaloids,terpenoids, cumerins, phenylpropenoids, tannins the pesticidal activities of the leaves of *Aegle marmelos* are aegleinmarmesin and ethyl p-cumerate.The compound obtained from the constituents of *Aegle* are used for heart diseases as these compounds contain toxic less or non toxic plant hence the demand of these compounds is increasing across the world due to its efficacy and trust(**Prashant et al., 2008**).Whole of plants of the world or their parts are being used medicines because about 72-95% of the world's population has been following these traditional remedies and this is also true because no poisonous substance is found in the plants(**Robinson, 2011**).

Ricinus communis (castor): -

Kingdom - Plantae

Division - Magnoliophyta

Class - Magnoliopsida

Subclass - Rosidae

Order - Euphorbiales

Family - Euphorbiaceae

Genus - *Ricinus*
Species - *communis*

The leaf is applied to boils and swelling and leaves promote menstrual flow in women. Tender leaves are cure pain in bladder, leaves are also recommended to relieve headache and joints pains(**Jena J and Gupta, 2012.**)

The leaves are mixed with alcohol, rectified spirit and water respectively after which the leaves are dried in the shade and made into powder then the collected material is used for chemical analysis of the plants the collected material after recognition was used for phytochemical analysis of plants.

First the leaves were dried at room temperature, after then the leaves were ground finely with the help of a mixer. After that 450ml of n- hexane was mixed in 500 gm of powder and kept for 72 hours so that the powder could be defatted properly. After that the solution was filtered through whatman's filter paper no. 1 and stored in the reagent bottle. And then 400ml chloroform and 300 ml methanol solvent is added to the dried powder and kept for 72 hours. To conduct biotest against *C. chinensis*, first of all the semi-solid extract is kept in the refrigerator at room temperature about 40⁰C and working pressure 25-30 mm until it is used and then through water bath, it is evaporated and filtered through filter paper **Abbott, (1925).**

Identifying compounds through chemical analysis

First of all, the crude extract of the plant was defatted by added n- hexane, then after adding concentrated chloroform and methanol it obtained a greenish yellow colour. This sample of pure leaf extract was sent to central drug research institute, Lucknow so that the spectral analysis of this sample could be identified.

Studying *Callosobruchus chinensis* through the plant *Aegle marmelos* and *Ricinus communis* leaf extracts

Callosobruchus chinensis was the first collected from infested grains. After collecting insects from various types of pulses, wash 20 beakers washed with distilled water, dry them and then put 100 grains of black gram in it.

Two drops of chemical with different fractions are added to the beaker, such as 50 ppm fractions 50 ppm, 100 ppm, 150 ppm, 200 ppm, 250 ppm.

Three pairs of *C. chinensis* (3 males and 3 females) were placed in each beaker was covered with muslin cloth and tightly with a rubber band, so that the pest could be controlled.

After a week, open the beaker and take out the insect.

After counting the eggs of insects inserted, the beaker was covered with muslim cloth as before.

After 7 days, the beaker is opened and the number of larvae hatched from the eggs is counted and the beaker is closed again.

After 7 days, the beaker is opened to count the pupae and after counting the beaker is covered again with muslin cloth.

After 7 days, after opening the beaker and counting the adult insects that have emerged from the pupae, the beaker is closed again.

To observe germination, remove the seeds from each beaker into a petri dish with water.

The number of seeds germinated was counted and noted.

The same experiment was also done with wrinkled seeds.

Table 1:

Percentage loss in weight of the plant materials

S. No.	Name an of the plant	Wet weight of plant material in (gms)	Weight on drying of the plant material (gms)	Loss in weight on drying (gms)	Percentage loss in weight
1.	<i>Aegle marmelos</i>	2000	180	1920	96.2%
2.	<i>Ricinus communis</i>	2000	190	1932	98.4%

Result and Discussion

Hemantha piris et al. (2021), reported highly significant repellency 96.91% and 98.99% of dried leaf and seed kernel to be extract of *C. thevetia* and *O. tenuiflorum* against pulse beetle after 24 hour of exposure which indicates that botanicals have high repellency qualities, **Gitahi et al. (2021)**.

Elhag (2000), tested the extracts of plant species against *Callosobruchus chinensis* and resulted that highest repellency was found in *Rhazya stricta* leaves (76.8%) followed by *Azadirachta indica* (76.8%), *Heliotropium bacciferum* (59.2%) and citrus peel (58.6%). Repellent action of plants was also reported by **Kokate and Chintalwar (2003)**, **Dwivedi and Shekhawat (2004)** and **Kachhwaha et.al. (2008)**

The repellent activity of *C. chinensis* was controlled by adding *Aegle marmelos* leaf extract to a minimum concentration of five in a solution of methanol and chloroform. In the present investigation of the methanol and chloroform and minimum in the controlled the repellent activity of *C. chinensis* by *Aegle marmelos* leaf extract in five concentrations.

Aliyu and Ahmed (2006), reported that non-edible oils, it was observed that larval mortality of *callosobruchus chinensis* reached 100% in the presence of ovipositional deterrence, control using oils extracted from some plants revealed that peanut and *Mentha arvensis* (L), *M. spicata* (L), *M. piperata* (L) and *Cymbopogon nardus* (L) oil have an effect on *C. chinensis*.

In the present work to control the mortality of larval *callosobruchus chinensis* by using chloroform and methanol extracts, of *Aegle marmelos* and *Ricinus communis* leaf of minimum in the control.

Chakraborty et al., 2004, it is clear from the literature that on the basis of overall life span of *C. chinensis* on different pulses, the order of pulses was for larger sized seeds like chickpea, black gram and green gram, while higher seed weight and thick layer reduced the time of growth period despite higher nutrition. Which slow down development of the seed coat which hinders entry of young larvae into the seed and emergence of the insect adult stage from the seed.

In the present study, we observed that the adult emergence of *C. chinensis* was well controlled by adding chloroform and methanol at a concentration of 250 ppm to the leaf extracts.

Conclusion: -

Intensive studies are essential to discover eco-friendly and safe methods for controlling Bruchids and other pests. By conducting thorough research, we can identify effective strategies that minimize environmental impact and ensure the safety of agricultural practices.

This pursuit is critical for developing sustainable pest management solutions that support both crop health and ecosystem well-being.

The objective of the present research is to make farmers aware about the damage caused by beetles and the safety of pulses and pave the way to provide them new technical facilities, and to make new pest controls easily accessible to the farmers.

Disclaimer (Artificial intelligence)

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Details of the AI usage are given below:

- 1.
- 2.
- 3.

Table 2:

Statistical data of purified fraction of *Aegle marmelos* CH₃OH extract against pulse beetle (*Collosobruchus chinensis*) on fresh Urad bean seeds-

Concentration	24 hr. larval mortality	Regression equation ($y = a \pm bx$)	Chi - Square $\chi^2(n-1)$	LC ₅₀ (ppm)	Variance (V)	S.E.	Fiducial limits (ppm)
50	68	-3.669 ± 1.773 x	6.347	117.372	0.0243	0.156	L = 89.224 U = 147.830
100	92						
150	145						
200	158						
250	175						

Table 3:

Statistical data of purified fraction of *Aegle marmelos* CHCL₃ extract against pulse beetle (*Collosobruchus chinensis*) on fresh Urad bean seeds-

Concentration	24 hr. larval mortality	Regression equation ($y = a \pm bx$)	Chi - Square $\chi^2(n-1)$	LC ₅₀ (ppm)	Variance (V)	S.E.	Fiducial limits (ppm)
50	73	-3.775 ± 1.832 x	20.703	115.082	0.0243	0.156	L = 56.150 U = 183.278
100	99						
150	119						
200	159						
250	195						
Control	6						

Table 4:

Statistical data of purified fraction of *Aegle marmelos* CH₃OH extract against pulse beetle (*Collosobruchus chinensis*) on Wrinkled Urad bean seeds-

Concentration	24 hr. larval mortality	Regression equation (y = a±bx)	Chi - Square x ² (n-1)	LC ₅₀ (ppm)	Variance (V)	S.E.	Fiducial limits (ppm)
50	79	-3.82±1.922 x	9.606	98.665	0.0246	0.157	L = 66.191 U = 127.892
100	104						
150	149						
200	173						
250	197						
Control	6						

Table 5:

Statistical data of purified fraction of *Aegle marmelos* CHCl₃ extract against pulse beetle (*Collosobruchus chinensis*) on Wrinkled Urad bean seeds-

Concentration	24 hr. larval mortality	Regression equation (y = a±bx)	Chi - Square x ² (n-1)	LC ₅₀ (ppm)	Variance (V)	S.E.	Fiducial limits (ppm)
50	71	-4.262±2.109 x	11.656	104.906	0.0252	0.159	L = 71.848 U = 136.552
100	99						
150	142						
200	176						
250	199						
Control	6						

Table 6:

Statistical data of purified fraction of *Ricinus Communis*CH₃OH extract against pulse beetle (*Collosobruchus chinensis*) on fresh Gram/chickpea seeds-

Concentration	24 hr. larval mortality	Regression equation (y = a±bx)	Chi - Square x ² (n-1)	LC ₅₀ (ppm)	Variance (V)	S.E.	Fiducial limits (ppm)
50	79	-3.873±1.929 x	14.774	101.805	0.0246	0.157	L = 58.895 U = 140.919
100	99						
150	144						
200	170						
250	199						
Control	9						

Table 7:

Statistical data of purified fraction of *Ricinus Communis*CHCl₃ extract against pulse beetle (*Collosobruchus chinensis*) on fresh Gram/chickpea seeds-

Concentration	24 hr. larval mortality	Regression equation (y = a±bx)	Chi - Square x ² (n-1)	LC ₅₀ (ppm)	Variance (V)	S.E.	Fiducial limits (ppm)
50	60	-5.018±2.416 x	32.378	119.360	0.02689	0.164	L = 62.022 U = 190.732
100	79						
150	128						
200	166						
250	209						
Control	9						

Table 8:

Statistical data of purified fraction of *Ricinus Communis*CH₃OH extract against pulse beetle (*Collosobruchus chinensis*) on Wrinkled Gram/chickpea seeds-

Concentration	24 hr. larval mortality	Regression equation (y = a±bx)	Chi - Square x ² (n-1)	LC ₅₀ (ppm)	Variance (V)	S.E.	Fiducial limits (ppm)
50	89	-4.317±2.224 x	35.106	87.411	0.0259	0.161	L = 18.279 U = 137.155
100	110						
150	149						
200	189						
250	223						
Control	9						

Table 9:

Statistical data of purified fraction of *Ricinus Communis*CHCl₃ extract against pulse beetle (*Collosobruchus chinensis*) on Wrinkled Gram/chickpea seeds-

Concentration	24 hr. larval mortality	Regression equation (y = a±bx)	Chi - Square x ² (n-1)	LC ₅₀ (ppm)	Variance (V)	S.E.	Fiducial limits (ppm)
50	63	-4.880±2.386 x	30.443	111.045	0.0268	0.164	L = 55.138 U = 169.725
100	94						
150	134						
200	165						
250	216						
Control	9						

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