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RESEARCH ARTICLE

EVALUATION OF INSECTICIDAL ACTIVITY OF *BOERHAVIA DIFFUSA* AGAINST CERTAIN STORED PRODUCT INSECTS.

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Abstract

Stored grains, cereals, and their products are the important sources of the world food; therefore effective conservation of this prime resource is important for subsistence of mankind. Maize, rice, and wheat are a few of the most consumed grains, while, chickpea supplement world food demands and is also a major source of animal feed. Globally, insect pest of stored grains causes the highest qualitative and quantitative losses to stored commodities that may range from 10-40%. Most of this damage is caused by *Triboliumcastanineum*causing up to 40% reduction in grain weight. It consumes endosperm of the seeds leaving them with coagulating consistency and moldy smell. In order to save these grains from spoilage, there is a need of an efficient control measure. *Callosobruchuschinensis* that may be found attacking pulses, the larvae and pupae are normally only found in cells bored within the seeds of pulses. Plant derived insecticides have distinct advantages over organic synthetic insecticides. They do not leave residues in food chain and are more readily biodegradable. Therefore, they are less likely to contaminate the environment and may be less toxic to mammals and other useful organisms. Present study was under taken to evaluate the insecticidal/toxiceffect of the leaves extract of *Boerhavia diffusa*(Thazhuthama / Punarnava) on stored product pests such as *Tribolium castanineum*and *Callosobruchus chinensis.*

Introduction:-

Insect pests and disease-causing microorganisms are the most serious competitors of man for food. Synthetic pesticides though helped in increasing food production, have created some serious problems includes human pesticide poisoning, development of resistance, resurgence of insect pests to insecticides, hazards of pesticide residues and the adverse effects on non-target organisms. In addition, phytotoxicity, environmental pollution and an alarming increase in the cost of pesticides have made it essential to find suitable alternatives like some botanical pesticides which are safe, effective, renewable, biodegradable and compatible with nature (Usha rani and Reddy,2009).

"Nature's chemical factories", the plants offer an excellent source of biologically active material products which can limit insect population. The secondary metabolites of the plants are defensive against insects. These chemicals

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which now been identified belongs to various chemical categories (Terpenoids, alkaloids, glycosides, phenols, etc.) have diverse biological effects on variety of pests. These bioactive chemicals which act as toxicants, repellents, hormonal analogues, behavioral and physiology of insects in various ways in insects (Rajendran and Sriranjini, 2008). Agricultural stored products are attacked by more than 20,000 field insects, including 600 species of beetles, 70 species of moths and about 355 species of mites causing quantitative losses. The losses are more prominent in developing countries because of bad sanitary conditions during procurement, transportation and storage; leaky and poorly maintained godowns. Worldwide, 10-20% of the stored cereal grains are estimated to be lost through infestation. Stored grain industry currently relies upon synthetic grain protectant. Not only these chemicals have severe effects on environment but also cause serious health issues to the consumers (Harish et al., 2005). The effective compounds that can be used these pests without pausing much threat to human health and deteriorating grain quality. Studies have identified several promising natural extracts of plant exhibiting insecticidal activities in stored grain systems (Islam and Talukder, 2005)).

Boerhavia diffusa is a species of flowering plant in the four o' clock family which is commonly known as Punarnava (Meaning that which rejuvenates or renews the body in Ayurveda) red spidering, spreading hogweed or tarvine. It is taken in herbal medicine for plain relief and other uses. The leaves of Boerhaviadiffusaare used as a green vegetable in many parts of India. It having inflammatory and expectorant properties, Boerhaviadiffusa(Punarnava) is said to be a good cure of Amavata (a disease in which reduction of VataDosha and accumulation of Ama takes place in joints and simulates rheumatoid arthritis (RA)). The root acts as an anticonvulsant, anagesic, laxative medication that when rubbed in honey can be locally applied for cataract, chronic conjunctivitis and blepharitis. It is useful for curing heart diseases, anaemia and oedema.

The *Tribolium castanineum*(Red flour beetle) is a species of beetle in the family Tenebrionidae, the darkling beetles. It is a worldwide pest of stored products, particularly food grains, and a model organism for ethological and food safety research. Triboliumcastanineumattacks stored grains and other food products including flour, cereals, pasta, biscuits, beans and nuts, causing loss and damages. The United Nations, in a recent post-harvest compendium, estimated that Triboliumcastanineumand Triboliumconfusumthe confused flour beetle are the two most common secondary pests of all plant commodities in stores throughout the world.

Callosobruchus chinensisis a common species of beetle formed in the bean weevil subfamily, and is known to be pest to many stored legumes. Also, it is commonly known as the adzuki bean weevil it is in fact not a true weevil, belonging instead to be least beetle family, Chrysomelibae. Other common names include the pulse beetle, Chinese bruchid and cowpea bruchid. *Callosobruchus chinensisis* one of the most damaging crop pests to the stored legume industry due to their generalized legume diets and wide distribution. In the present paper the insecticidal activity of the leaves extract of Boerhaviadiffusaon stored product pests such as Triboliumcastanineumand Callosobruchuschinensis were studied.

Materials AndMethods:-

Culture of adults of *Tribolium castaneum* and *Callosobruchus chinensis* were collected from local granaries and reared separately in the insectary of the Department of Zoology of PSMO College. Insects were reared in separate glass jars (size 15 cm height x 10 cm diameter) containing the diet (wheat flour, grains, pulses, cereals etc.). Insects were maintained at laboratory setup. Every month, newly emerged insects were separated and transferred into clean jars containing fresh food.

Leaves of *Boerhavia diffusa* were collected from the Kuttipala village area in Malappuram district of Kerala. Fresh leaves were thoroughly washed in water and shade dried at laboratory room temperature for a week and was further dried for one day in a hot air oven at 35-38°C. The dried leaves were then powdered using a domestic grinder and then sifted through fine mesh of sieve. The leaf powder was kept in air-tight glass bottle and stored at about 4°C. The dried leaf powder was used for the preparation of methanol (polar solvent) extract of Boerhaviadiffusa.

For preparing methanol extract of *Boerhavia diffusa*, 100g of powdered material was extracted with 700ml of methanol. Powdered material 25g each was taken in 4 conical flasks of 250 ml capacity and 100ml of methanol added to each conical flask. Mouth of the conical flasks were covered with aluminum foil and polythene cover and fastened by rubber bands. The mixtures were agitated on an automatic shaker (approx.60 shakes per min.) for 24hr at room temperature and the extract was filtered through Whatman No.1 filter paper by negative pressure using

Buchner funnel. The filtrate was kept in a fridge. The residues were re-extracted using another 75ml of methanol and filtered after 24 hours.
The combined filtered was allowed to dry in a hot air oven maintained at 40°C. The weight of dried residue was determined, after ascertaining the final weight of the residue, 10% stock solution was prepared in methanol and stored in an air tight standard flask and kept refrigerated until used. For preparing the working extracts, the stock extract was diluted to different concentrations (1%, 2%, 4%, and 8%) with methanol and stored in an air- tight glass container in a refrigerator.

For evaluating the insecticidal / toxic effect of BME (BoerhaviadiffusaMethanol Extract) on TriboliumCastaneumand Callosobruchuschinensisadults by the topical application, different concentration of BME, viz., 1, 2, 4 and 8% were taken for treatment. Methanol alone was used in the control. In the study mortality percentage calculated by the equation % Mortality = (No. of Insect Killed / Total Insect) x 100.

By using % mortality value we can calculate LD50 of the BME.The present investigation, the data obtained for insecticidal / toxic activities of methanol extract of Boerhaviadiffusa(BME) were subjected to probit analysis and LD50 value of the extract were determined.

Results:-

Toxic effect of various concentrations of methanol extract of Boerhaviadiffusaon certain stored product insects, TriboliumCastaneumand Callosobruchuschinensisfor the exposure period of 12, 24, 48, 72 and 96 hours by topical application method. Toxicity of BME (BoerhaviadiffusaMethanol Extract) on TriboliumCastaneumAdults.The percentage mortality of *Tribolium castaneum* and *Callosobruchus chinensis i*n the response to different concentration of 1, 2, 4 and 8% of the BME during 12, 24, 48, 72 and 96 hours are recorded in Table 1. At 12 hours, the mortality of insects to 1, 2, 4 and 8% of BME were 0, 0, 2, 1, 2 respectively. 1% of BME which shows zero mortality at both 12 and 24 hours. 4% BME, there is no zero mortality. There is zero mortality at 96 hours of 8% BME and shows maximum mortality at 48 hours which is 4. The probit analyses for the calculation of cumulative frequency percentage mortality of 96-hour exposure were showed in Figure 1. Maximum 100% mortality takes place of 8% BME. There is increase in the mortality rate of insect with the concentration of BME increases. The data obtained from the toxicity studies on Triboliumcastaneum adults by topical application of BME were subjected to probit analysis for calculating LD50 value of the extract (Figure.3).

The figure 2 shows the probit analysis table which used for the calculation of cumulative frequency percentage mortality of 96 hours exposure using probit value. There is zero mortality observed at 12- and 24-hours exposure, both in 1 and 2% BME. Also 8% BME shows zero mortality at 96 hours exposure. 8% BME shows maximum mortality at 48 and 72-hours exposure and also 4% BME shows maximum mortality at 96 hours which is 3. The data obtained from the toxicity studies on Callosobruchuschinensisadults by topical application of BME were subjected to probit analysis for calculating LD50 value of the extract (Figure.4).

Discussions:-

Insecticidal / toxic effect of BME on certain stored product insects, *Tribolium castaneum* and *Callosobruchus chinensis* for 12 to 96 hours of exposure by topical application were showing strong contact toxicity against these insects. The results of study show that the 8% of BME adversely affected the survival capacity of the insect pests. The insecticidal activity of TrigonellaFoenumGraecumagainst TriboliumCastaneumand Acanthoscelidesobtectuswas reported by Pemong et al (1997 and Bhakavathiappan etal.,2012). The principal constituent of the Punarnava plant (Boerhaviadiffusa) contains b-sitosterol, a-2-sitosterol, palmitic acid, ester of b-sitosterol, tetracosanoic, hexacosanoic, urosilic acid etc. Besides these chemical constituents Boerhaviadiffusacontains rotenoids, flavonoids, xanthones etc. The chemical marker for Boerhaviadiffusabelongs to rotenoid category namely boeravinone B.

These chemical constituents in the leaf extract of Boerhaviadiffusa, which may act singly, additively or synergistically on these experimental insects. Boerhaviadiffusaused since long times for treatment of liver disorders such as jaundice and hepatitis. Throughout the tropical region, it is used as a natural remedy for guinea worms.

Table 1. Mortality of *T.castaneum* and *T.chinensis* at different time intervals

(BME: *Boerhavia diffusa* Methanol Extract)

Conc. of BME (%)	Mortality during different periods (hours)									
	12		24		48		72		96	
	T.castaneum	C.chinensis	T.castaneum	C.chinensis	T.castaneum	C.chinensis	T.castaneum	C.chinensis	T.castaneum	C.chinensis
1	0	0	0	0	2	1	1	2	2	2
2	0	0	1	1	1	2	2	2	2	2
4	1	1	1	1	2	2	2	2	2	3
8	2	2	2	2	4	3	2	3	0	0
control	0	0	0	0	0	0	0	0	0	0

FIGURE. 1

Mortality of *Tribolium Castaneum* adults

exposed to BME during different periods (TAM).

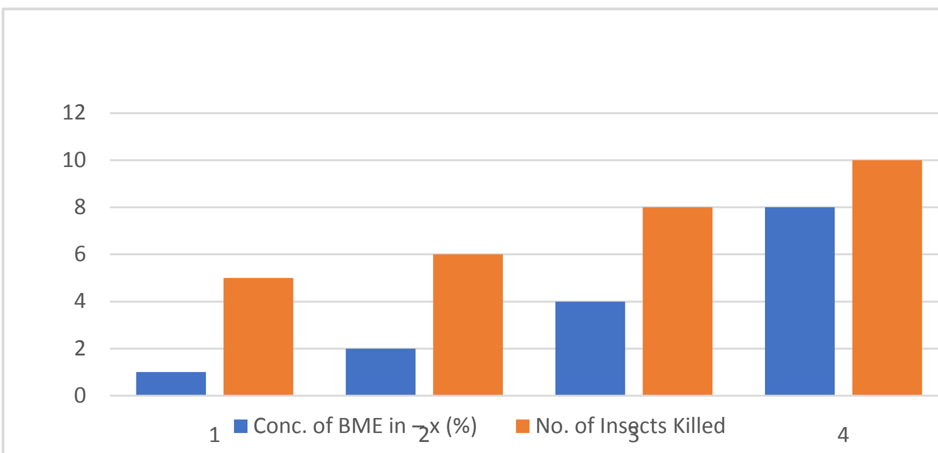


FIGURE. 2

Mortality of *Callosobruchus chinensis* adults

exposed to BME during different periods (TAM).

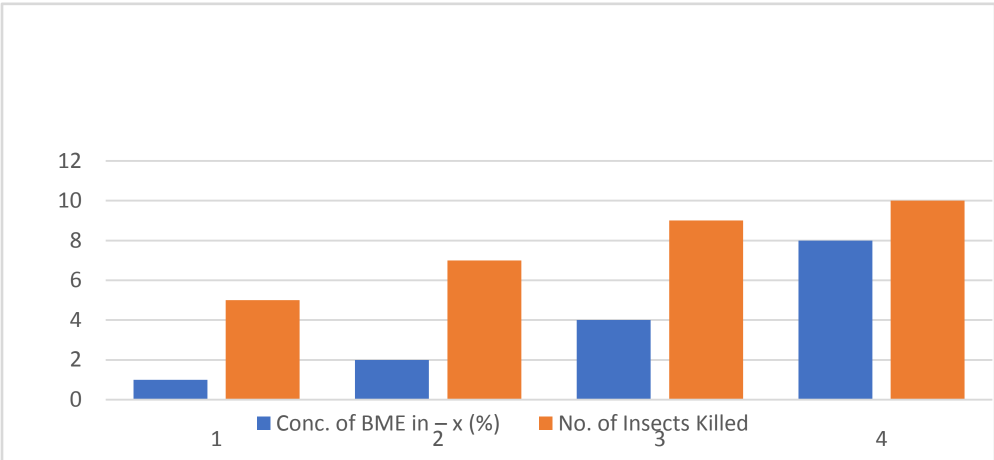


FIGURE.3

Probit Analysis of *Tribolium Castaneum* adults

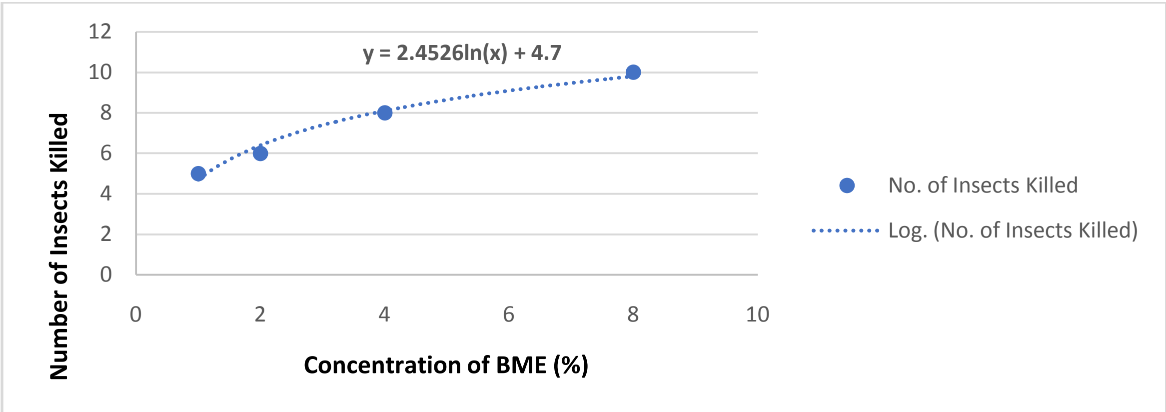
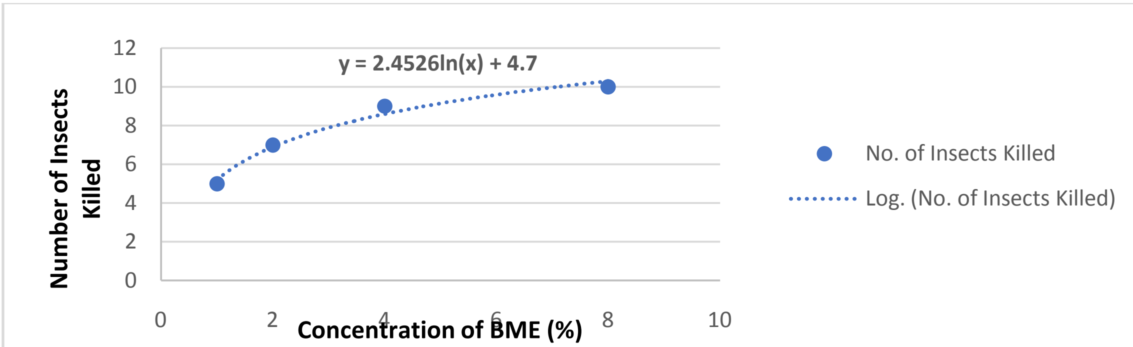


FIGURE.4

Probit Analysis of *Callosobruchus chinensis* adults



Conclusion:-

It was clearly seen that the pattern of the toxic effects of various concentration of BME were more obvious. In the case of TriboliumCastaneum8% BME was most efficient in controlling stored product pests *Tribolium castaneum* and *Callosobruchus chinensis*. Plant derivatives possessing insecticidal activity thus offer a novel approach in the management of insect pests. Most agricultural scientists and specialists agree that pesticides are needed and they are the essential tools in pest control programmes. However, their misuse, over use and unnecessary use are must be avoided at all times. This study therefore, opens a new line of work for the management of stored product pests, *Tribolium castaneum* and *Callosobruchus chinens* is using solvent extract in a very safe way avoiding operational and residual hazards that are involved in the use of synthetic insecticides.

In this study suggest that 8% BME was most efficient in controlling stored product pests, TriboliumCastaneumand Callosobruchuschinensis. These studies also suggest that further investigations using non polar solvent and on the fumigant properties of the Boerhaviadiffusa against these insects are desirable. Moreover, it would be worthwhile if the commercial production of the isolated and identified toxic components of Boerhaviadiffusa is considered.

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