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Bio-insecticidal and Growth inhibitory Activity of Leaf Extract of *Ricinus communis* Linn on Life Cycle of *Corcyra cephalonica*, Rice Moth and *Callosobruchus chinensis*, Pulse Beetle

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Abstract

Acetone extraxct of leaves of *Ricinus communis* Linn. was tested on the life cycle of two serious stored grain insect pests i.e *Corcyra cephalonica* , rice moth and *Callosobruchus chinensis*, pulse beetle to assess their bio-activities by studying their effects on mortality of different life stages i.e. egg, larvae, pupa , adult; Av. Developmental period and as grain protectant. Each experiment consisted of 3 replicates, 4 sub-treatments (25, 50, 75 & 100%, conc. of extract) and a control having only solvent. 20 gm food (sorghum for rice moth and cowpea seeds for pulse beetle) was treated with 20 ml of dose. Observations were made to find out mortality at each developmental stage, reduction in adult emergence till next generation, prolongation of Av. developmental period and seed protection over control. Extract revealed maximum toxicity to eggs showing 54.34%, and 81.35%, egg corrected mortality (at 100% conc.) of rice moth and pulse beetle respectively. Only 18% and 16.48% adult emergence was observed in rice moth and pulse beetle respectively in comparison to control where it was 78 and 77.86%. Extract significantly exerted its phago-detterent effects by revealing 68.05% and 64.79% seed protection over control at 100% conc. against rice moth and pulse beetle respectively. It also prolonged Av. Developmental period effectively of rice moth (53 days) and pulse beetle (26 days) at 100% conc., as it was only 42 and 19 days in control dose. Thus disruption of population build up of these pests can be achieved from this bio-pesticide exerting combined effects of toxicity, mild growth regulatory and as potential phago-detterent.

Keywords: *Ricinus Communis*, *Corcyra Cephalonica*, *Callosobruchus Chinensis*, Seed Protectant, Av. Developmental Period.

Introduction

Disease and pests are the major limiting factors in the production of high quality agricultural products. Though, chemical pesticides have proved very effective in controlling pests at maximum level, but uncontrolled and extensive use of these chemical pesticides has created many negative consequences such as environmental degradation, pest resistancy, and toxic to non target animals. Plants have the richest sources of renewable natural pesticides as they have vast variety of bioactive compounds. These compound acts as effective contact insecticides, repellent, antifeedant, fumigant, sterillent and adversely affect the growth rate, life span and fertility of pests. Specially plant extracts provide a safe and viable alternative to synthetic pesticides. These are compatible with the use of beneficial organisms, pest- resistant plants and more environment friendly as they provide reduced environment degradation, increased safety for farm workers, increased food safety and improved profitability of production. (Adline, J.D., 2015; Kosar, H. and Srivastava, M., 2016, Jhala, A et. al., 2018)

In order to offer more choice in plants having effective pesticidal properties, there is a need to access indigenous botanical pesticides which have better potential of extension and their inherent pesticidal effectiveness must be rustic, perennial and easily cultivable in local areas. In fulfil of these properties, castor oil plant, *Ricinus communis* (Malpighiale:

Euphorbiaceae) may be a good choice, as it is a wild growing plant species. It contains ricin toxin, one of the most toxic and easily produced plant toxic world wide. (Thomas et al,1980; Bojean 1991)

Present study has been conducted to investigate the pesticidal action of acetone extract of leaves of *Ricinus communis* on the life cycle of two serious pests of stored grains i.e. *Corcyra cephalonica*, rice moth and *Callosobruchus chinensis*, pulse beetle. The rice moth *Corcyra cephalonica* (Stainton) is the major and serious pest of stored grain in tropics, Asia, South America and Africa (Allotey and Azelekor, 2000; Haung et. al., 2004) .The larval stage of rice moth cause substantial loss to wheat ,rice, sorghum, maize, millets, cocoa beans by feeding grains and leaving silken threads which produces dense and hard webbing with their faecal matter and cast skin which contaminate the grains and make it unfit for consumption.

Pulse beetle, *Callosobruchus chinensis* Linn., is widely distributed and known as a major destructive insect pest of stored chick pea and other pulses (Park et al 2003). The larvae destroy seeds by feeding inside the seed and make them completely unfit for human consumption (Atwal and Dhaliwal 2005). Pulses can be completely destroyed by pulse beetle infestation with in 3 months of storage. (Jat et al, 2013).

Material and Methods

Insect

The eggs of *Corcyra cephalonica* and newly emerged adults of *Callosobruchus chinensis* were used in this study. These were obtained from tropical forest research institute, Durgapura, Jaipur. Culture of rice moth was maintained in laboratory in a dietary medium composed of coarsely ground sorghum and 5 % powdered yeast in large glass containers at 26 ± 1 ^{O}C Temperature and 75 ± 5 % RH (Relative humidity). Adults of pulse beetle were also reared in the sterilized glass jars containing cowpea seeds at 28 ± 2 ^{O}C Temperature and 60 ± 10 % RH.

Extraction of Plant Extract

For extraction procedure, leaves of *Ricinus communis* were collected in and around the Rajasthan University, Jaipur. Plant extract was prepared in acetone solvent using Soxhlet extraction method. 30 gms. of powder of shade dried leaves was extracted for 8 hrs. in 300 ml. of acetone. Final crude extract was filtered and considered as stock solution (100%). Different concentration of this extract viz. 75 %, 50% and 25% were prepared from stock solution by serial dilution with acetone.

Insect Mortality, Grain Damage and Growth Index Bioassay

In the present study, each experiment consisted 3 replication of 4 sub treatments (25, 50, 75 and 100%) of different concentration of extract. One control only with solvent also run along with each experiment. 20 gms food of grains (Sorghum for rice moth and cowpea seeds for pulse beetle) were treated with 2 ml. of dose. 50 eggs of rice moths and 3 pairs of newly emerged adults were introduced in each experimental vial. They were allowed to develop in treated medium and observation were made to find out mortality at different developmental stage (Ovicidal, larvicidal, pupicidal and adulticidal in rice moth and ovicidal in pulse beetle); reduction in adult emergence, growth index and seed protection by using following formulas (Abbott, 1925).

Abbott's corrected mortality:

$$= \frac{\text{\% kill in treated - \% kill in control}}{\text{100 - \% kill in control}} \times 100$$

Percent seed protection over control:

$$= \frac{\text{\% seed protection in treated - \% seed protection in control}}{\text{100 - \% seed protection in control}} \times 100$$

$$\text{Growth index} = \frac{\text{\% of adult emergence}}{\text{Av. total developmental period}}$$

Result and Discussion

The data tabulated (table no.1) showed the mortality action of this extract against rice moth. It revealed 41.30%, 46.36%, 50% & 54.34% corrected ovicidal mortality at 25, 50, 75 & 100% conc. in comparison to control (only 8% mortality). It gave promising values of larvicidal action at higher doses as observed 49.18% & 47.87% larval corrected mortality at 75 & 100% conc. However no significant toxic effects could be registered on pupal stage and toxicity to pupae was found to be non-significant. Total adult emergence was significantly decreased in treatment groups as compared to control (78%), as it exhibited only 40%, 34%, 24% and 18% adult emergence at 25, 50, 75 & 100% conc. respectively.

In the case of C. chinensis (table no.2) , it also proved very effective by revealing 66.65%, 70%, 78.35% & 81.65% corrected ovicidal mortality and only 33.55%, 27.14%, 21.77% & 16.48% adult emergence (77.86% in control) at 25, 50, 75 & 100% con. respectively.

The developmental period found to be dose dependent as it increases with increase in dose level. In rice moth, it prolonged by 5, 7.5, 8 & 11 days at 25, 50, 75 & 100% conc. respectively. Growth index declined significantly at all conc. accounting 0.7766, 0.6181, 0.4247 & .3185 values at 25, 50, 75 & 100% conc. respectively with 1.6421 in control.. In the case of pulse beetle, Av. developmental period prolonged 3, 3.5, 4.5 & 6 days and revealed 1.0180, 0.8690, 0.8390, 0.7740 growth index values (1.6410 in control) at 25, 50, 75 & 100% conc. respectively (table no.3).

This extract showed promising antifeedent properties as the damage in term of percent loss in seed weight was significantly mitigated in treatment groups in both insect pests. Only 34.39%, 29.72% 16% & 14.45% loss in seed weight was recorded in rice moth infestation (45.23% in control) and it was 39.58, 33.66%, 26.38% & 19.48% in pulse beetle infestation (54.48% in control) at 25, 50, 75 & 100% conc. respectively (table no.4). Delayed development can be attributed to inhibit feeding on treated seeds which may lead to suspended development of malnourished larvae.

30-40% deformed adult emergened was observed having one or both crumpled wings folding back on themselves. Even, a few number of eggs were laid by these abnormal females, did not show hatching. Reduction in egg laying by morphologically normal females was also recorded upto 40% at higher conc. which revealed continued toxic effects in next generation. This can be explained because of growth regulating hormonal imbalance and inhibition of chitin synthesis leading adverse effects on moulting process and irregular biometric properties of different parts of pupal body leading to malformed adults. (Novak,1966; Jamil et. al., 1988.)

These results unambiguously demonstrated the efficacy of acetone extract of leaves of *Ricinus communis* Linn. The results from this investigation are similar to the observations of Obembe, O.M. and Kayode (2013) who obtained 82.50% mortality of pulse beetle in cowpea seeds treated with aqueous extract of *Ricinus communis*. They also observed significant reduction in oviposition, adult emergence and drastic reduction in seed weight loss. Upasani, SM et. al. (2003) have demonstrated flavonoids (quercetin & kaempferol) from leaf extract of *Ricinus communis* by using HPLC, HPTLC techniques and showed excellent insecticidal, ovicidal and ovipositinal deterrent properties against pulse beetle. Flavonoids are reported as a major class of phytochemicals constituting 5-10% of known secondary metabolites in plants. They are involved besides other things in plant defense mechanism by exerting toxic effects on insect pests.

Insecticidal activity is mainly the result of inhibition of vital enzymatic pathways, such as action of cytochrom-450 dependent oxidases and flavonoids such as quecertin block steroid hydrolases enzymes involved in the regulation of the moulting process of insect pests. On the other hand, these flavonoids can be metabolically activated to generate free radicals sp. in insects upon ingestion, can cause cellular toxicity.

Kwon et. al.(1991, 1992) also isolated and identified natural alkaloids toxicants ricin & ricinin from *Ricinus communis* testing on *Nilaparvata lugens*. Insecticidal, phagodeterrent and growth regulatory effects of alkaloids contents rich plant sp. have been reported at different storage grain pests.(Mani et.al, 1993; Ghatak and Bhushan, 1995; Dwivedi and Kumar, 1999). Well investigated alkaloids such as pyrethrum and nicotine have been appreciated as neurotoxins which interrupt synaptic transmission and adversely affect the vital body functions. (Mutsumura, !985).

Conclusion

Based upon the present study it could therefore, be stated that leaf extract of *Ricinus communis* in acetone, possesses potent insecticidal activity and is worth exploiting for the integrated management of stored commodities especially cereals and pulses to prevent insect infestation.

Table No.1: Effect of Leaf Extract (Acetone) of *Ricinus communis* on The Life Cycle of Rice Moth

S.No.	Conc.%	% egg mortality	% egg corrected mortality	% larval mortality	% laeval corrected mortality	% pupal mortality	% pupal corrected mortality	% adult emergence
1.	25	46	41.30	21	13.48	6.32	-	40
2.	50	50.66	46.36	24.32	17.11	8.94	1.93	34
3.	75	54	50	53.60	49.18	12.21	5.45	24
4.	100	58	54.34	52.38	47.84	10	3.7	18
5.	Control	8	-	8.69	-	7.14	-	78

Table No. 2 : Toxic Effects of *Ricinus communis* Leaf Extract In Acetone on Pulse Beetle

S. No.	Conc.%	% egg mortality	% egg corrected mortality	% adult emergence
1.	25	13.33	66.65	33.55
2.	50	14	70	27.14
3.	75	15.67	78.35	21.77
4.	100	16.33	81.65	16.48
5.	Control	0	-	77.86

Table No.3: Effect of *Ricinus communis* Leaf Extract (Acetone) on the development of Rice moth And Pulse Beetle

S. No.	Conc.%	Av. developmental period (in days)		Growth index value	
		Rice moth	Pulse beetle	Rice moth	Pulse beetle
1.	25	47	21	0.7766	1.0180
2.	50	49.5	21.5	0.6181	0.8690
3.	75	50	22.5	0.4247	0.8390
4.	100	53	26	0.3185	0.7400
5.	Control	42	19	1.6421	1.6410

Table no. 4: Antifeedent activity of *Ricinua communis* leaf extract (acetone) against rice moth.

S. No.	Conc.%	% Loss in Seed Weight		% Seed Protection Over Control		C-Value	
		Rice Moth	Pulse Beetle	Rice Moth	Pulse Beetle	Rice Moth	Pulse Beetle
1.	25	34.39	39.58	23.91	27.90	0.863	0.724
2.	50	29.72	33.66	34.29	38.76	0.793	0.567
3.	75	16	26.38	64.62	52.12	0.522	0.312
4.	100	14.45	19.48	68.05	64.79	0.484	0.082
5.	Control	45.23	54.48	-	-	-	-

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