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Screening of toxicity of plant extracts against Acridid Grasshopper, *Chrotogonus trachypterus* Blanchard

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ABSTRACT

Present study was carried out to investigate the toxic effect of plant extracts of Annona squamosa, Ailanthus altissima, Calotropis procera, Syzygium aromaticum and Azadirachta indica on pest grasshopper, Chrotogonus trachypterus Blanchard. This is a widely distributed polyphagous insect pest causing severe damage to a wide variety of plants and crops in seedlings stage. Percent mortality was recorded for newly hatched nymphs (0-2 day old) when treated residually whereas adult grasshoppers were treated with topical application method. LC_{50} *and* LC_{90} *value of A. indica possessed the highest toxic activity against newly hatched nymphs with 1.998 and 9.238 percent. Similarly, maximum toxic activity with* LC_{50} *and* LC_{90} *value (11.487 and 14.982 percent) recorded for adult males and females, respectively on the same. Amongst five plant extracts, A. indica was proved more toxic than all other plant extracts while, females required higher concentration of extract than males. Decreasing order of toxicity was recorded to be Azadirachta indica > Annona squamosa > Ailanthus altissima > Syzygium aromaticum > Calotropis procera. Using plant products could be considered as possible means in integrated pest management (IPM) programs for C. trachypterus grasshopper.*

Key words: *Chrotogonus trachypterus* Blanchard, pest, plant extracts, integrated pest management

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INTRODUCTION

Grasshoppers have been threatened and unpredictable agricultural pests that can severely disrupt local economies and cause severe crop loss. Surface grasshopper, *Chrotogonus trachypterus* Blanchard (Orthoptera: Acrididiae) is one of the important polyphagous pest, which occurs through the year in semi arid area. The nymphs as well as adults both voracious feeder of leaves and tender shoots of plants and crops *i*.e. wheat, jowar, maize, groundnut, rice, sugarcane, millet etc. In recent years, attention has been focused on the use of plant products for managing insect pests. According to [1] most terpenes and phenols found in plant essential oils, the biologically active extracts used to control pests, have minimal vertebrate toxicity and were USDA-approved as GRAS (Generally Regarded As Safe). Now day's insect pests are developing resistance not only to the synthetic insecticides but also to synthetic natural pyrethroids and rotenoids. Hence, it is necessary to search for novel plant-based pesticides that are more efficacious and environment friendly [2]. Thus, the present investigation has been undertaken to screen out some plant products against *C. trachypterus*.

MATERIALS AND METHODS

Culture of test insect: *C. trachypterus* was collected from the field and reared under laboratory conditions (32±2˚C and 60±5% R.H.) on cabbage leaves. The newly hatched nymphs and adults were used during experimentation.

Collection of plant material: Fresh leaves of selected plants were collected from the Jhalana area, jaipur during study. The plants were identified in Department of Botany, University of Rajasthan, Jaipur, Rajasthan.

Preparation of plant extract: Plant leaves of *Annona squamosa* L. (Sitaphal) (Annonaceae), *Ailanthus altissima* (Mill.) (Ardoo) (Simarobaceae), *Calotropis procera* (Akada) (Asclepiadaceae), *Syzygium aromaticum* (Laung) (Myrtaceae), *Azadirachta indica* (Neem) (Meliaceae) were cleaned manually and thoroughly washed and dried in shade place then coarse powder is prepared in electric mixer and stored in a closed air tight container for further use. The meshed leaves were extracted using soxhlet extraction method in 80% acetone as solvent. 30 gms of meshed leaf powder was extracted with 300 ml of solvent, for 8 hour over a mantle heater at 50˚C. The extract was filtered through Whatman's filter paper no. 1 and concentrated on a water bath. After complete evaporation of the plant extract, was weighed in an electric balance. Leaf extract represented 6% of total dry weight of powdered leaves. The extract was stored in refrigerator and dissolved in acetone to prepare standard stock solution marked 'S'. The desired percent solutions were prepared by adding acetone to the stock solution.

Experimental protocol: The screening of plant extracts were tested in two ways-
1. Residual film exposure method (For nymphs): The film of plant extract was prepared by delivering 1 ml of the test concentrations in each half of petri dish (10.0 cm in diameter). The petri dishes were swirled till the solution spread uniformly and the solvent evaporated off to give a uniform dry film of the solute known deposit. Thus five replications (ten insects in each replica) of each concentration including control were run simultaneously.
2. Topical application method (For adults): 5 µl of concentration of plant extracts were applied at the base of the wing by using a micro syringe (Hemilton-Bonadoz, Schwez). Control insect had 5 µl of acetone only applied at the same site.

Mortality counts in both treatments were recorded for five replications at the end of 24 hrs for acute toxicity.

Statistical Analysis: The data related to percent mortality were expressed as means ± SEM. The percent hatchability data were corrected to account for control mortality as per Abbott's formula [3].

Abbott's corrected mortality:

$$\frac{\text{\% kill in treated - \% kill in control}}{\text{100 - \% kill in control}} \text{ X100}$$

The assessment of efficacy of extract was based on subsequent mortality in newly hatched nymphs and adults. LC_{50} and LC_{90} values were evaluated by using method of Finney [4].

RESULTS AND DISCUSSION

Effect of plant extracts revealed that percent mortality of newly hatched nymphs (0-2 day old) of *C. trachypterus* was recorded to be 66±0.66, 49.5±0.57, 33.3±0.33, 19.8±0.57 and 39.2±0.33 percent at 5 % of *A. indica*, *A. squamosa*, *A. altissima*, *S. aromaticum* and *C. procera* extracts, respectively (Table-1). 10% of *A. indica* extract caused 100 % mortality while, 20 % of *A. squamosa* and *C. procera* extracts gave cent percent mortality when treated residually. Adult males and females of *C. trachypterus* were treated topically at various concentrations of plant extracts. At 5 % concentration 29.7±0.57, 16.5±0.33, 9.9±0.57, 6.6±0.66, 13.2±0.33 and 19.8±0.57, 13.2±0.33, 6.6±0.33, 3.3±0.66, and 9.9±0.33 % male and female were died when treated with *A. indica*, *A. squamosa*, *A. altissima*, *S. aromaticum* and *C. procera* extracts, respectively. Mortality percentage was nil in control condition (Table-2). Percent mortality increases with increasing in percent concentration (10 % and 20%) for both male and female respectively.

According to lethal concentration, *A. indica* was found to possess the highest toxic activity against newly hatched nymphs with LC_{50} value of 1.998 and LC_{90} value of 9.238 percent (Table-3). LC_{50} value of *A. indica* recorded to be 11.487 and 14.982 percent for adult males and females, respectively and this was followed by *A. squamosa* (LC_{50} 19.355 and 22.177 %), *A. altissima* (LC_{50} 23.563 and 33.27 %), *S. aromaticum* (LC_{50} 44.603 and 75.757 %) and *C. procera* (LC_{50} 22.359 and 30.999 %), respectively. Similarly LC_{90} values was recorded to be (23.438 and 27.856 %), (35.368 and 39.285 % (41.246 and 58.239 %), (81.503 and 136.363 %) and (39.675 and 54.937 %) for males and females, respectively (Table-4).

Table-1: Percent mortality of newly hatched nymphs (0-2 day old) of *C. trachypterus* treated with plant extracts

% Doses	*Azadirachta indica*		*Annona squamosa*		*Ailanthus altissima*		*Syzygium aromaticum*		*Calotropis procera*	
	Percent mortality	Corrected mortality	Percent mortality	Corrected mortality	Percent mortality	Corrected mortality	Percent mortality	Corrected mortality	Percent mortality	Corrected mortality
5	66±0.66	59.23	49.5±0.57	39.44	33.3±0.33	20.02	19.8±0.57	3.83	39.2±0.33	27.09
10	all	100	82.5±0.33	79.01	53.3±0.66	44.00	36.6±0.33	23.98	69.3±0.57	63.18
20	all	100	all	100	79.2±0.57	75.05	53.3±0.33	44.00	all	100
control	16.6±0.33		16.6±0.33		16.6±0.33		16.6±0.33		16.6±0.33	
F- value	2.473**		1.872**		1.156**		0.586**		1.824**	
S-Em±	0.0983		0.0901		0.0943		0.1231		0.0898	
C.D. at 5% level	0.3402		0.2939		0.3075		0.4015		0.2928	
CV	6.93		6.24		7.47		11.42		6.57	

***= F- test significant*

Table-2: Percent mortality of adults of *C. trachypterus* treated with plant extracts

% Doses	*Azadirachta indica*		*Annona squamosa*		*Ailanthus altissima*		*Syzygium aromaticum*		*Calotropis procera*	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
5	29.7±0.57	19.8±0.57	16.5±0.33	13.2±0.33	9.9±0.57	6.6±0.33	6.6±0.66	3.3±0.66	13.2±0.33	9.9±0.33
10	42.9±0.33	33.3±0.33	23.1±0.66	16.5±0.33	16.5±0.33	9.9±0.0	13.2±0.33	6.6±0.66	16.5±0.88	9.9±0.57
20	79.2±0.88	66±0.66	52.8±0.66	46.6±0.33	42.9±0.33	29.7±0.33	23.1±0.66	13.2±0.33	46.2±0.33	33.3±1.73
control	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
F- value	2.413**	2.012**	1.463**	1.236**	1.168**	0.594**	0.492**	0.220**	1.275**	0.796**
S-Em±	0.1169	0.1191	0.142	0.0919	0.145	0.0989	0.1502	0.1357	0.1336	0.198
C.D. at 5% level	0.3813	0.3885	0.4637	0.2998	0.4728	0.3224	0.4899	0.4425	0.4356	0.6457
CV	10.64	11.68	15.81	11.01	18.14	14.39	21.87	23.61	18.3	24.06

***= F- test significant*

Table-3: Lethal concentration of plant extracts vis-a-vis newly hatched nymphs (0-2 day old) of *C. trachypterus*

% Doses	*Azadirachta indica*	*Annona squamosa*	*Ailanthus altissima*	*Syzygium aromaticum*	*Calotropis procera*
LC_{50}	1.998	2.95	9.909	17.913	6.684
LC_{90}	9.238	15.709	23.278	36.5	16.909

Table-4: Lethal concentration of plant extracts vis-a-vis adults of *C. trachypterus*

% Doses	*Azadirachta indica*		*Annona squamosa*		*Ailanthus altissima*		*Syzygium aromaticum*		*Calotropis procera*	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
LC_{50}	11.487	14.982	19.355	22.177	23.563	33.27	44.603	75.757	22.359	30.999
LC_{90}	23.438	27.856	35.368	39.285	41.246	58.239	81.503	136.363	39.675	54.937

During the present study it was revealed that early instar nymphs (0-2 day old) were quite susceptible to acetone extract of plants while no significant mortality in later instar nymphs was noted when applied residually. *Azadirachta indica* was proved more toxic than all other plant extracts and order of toxicity was recorded to be *Azadirachta indica* > *Annona squamosa* > *Ailanthus altissima* > *Syzygium aromaticum* > *Calotropis procera.* Earlier examined, azadirachtin influenced biology of fifth instar nymphs of *Locusta migratoria.* Low concentration resulted in adults with curled wing tips and reduced longevity while, higher concentrations resulted in death during the imaginal moult [5]. Similarly, effect of azadirachtin on larval mortality recorded [6]. Further, the extracts of *Azadirachta indica* (Meliaceae) and *Calotropis procera* (Asclepiadaceae) were tested against the migratory locust, *Locusta migratoria* where up to 99% mortality was achieved by direct spraying of water or ethanol extracts [7]. It was also revealed that azadirachtin caused a significant reduction in the feeding behavior of *Schistocerca americana* [8]. According to [9] all parts of neem are biologically active. The antifeedent activity of neem was attributed to various terpenoids (Tera-cyclic terpenses and tetranortriterpenoids). Pyrrolizidinic alkaloids of *Calotropis procera* are known for their high toxicity against locust nymphs [10, 11]. Effect of *A. indica* (L.) products on feeding, metamorphosis, mortality and behavior of the variegated grasshopper, *Zonocerus variegatus* (l.) and *Heteracris littoralis* Ramb. was proved by [12] and [13]. *Annona squamosa* and *Azadirachta* showed high larval mortality of *Hieroglyphus banian* [14]. Injection of *Calotropis procera* latex induced toxic effect on the nervous system of desert locust [15]. As evident by [16] cumulative mortality rates of locust, *Schistocerca gregaria* attained 83%, 66%, 52% fed with alkaloids extracted from *C. procera, Z. gaetulum* and *P. harmala,* respectively. Aceton extracts of *Syzygium cumini* caused 53.3% mortality in eggs at 100% dose level in stored pest, *Callosobruchus chinensis* [17]. Effect of *Syzygium cumini* seed extract on the nervous system of insects due to presence of saponins was reported [18]. Our findings are in agreement with that of [19] who revealed maximum percent mortality achieved with *Azadirachta* and *Calotropis* LP against *C. trachypterus*. *A. altissima* stem bark methanol extract exhibited strong herbicidal effects which contain ailanthone as one of the major herbicidal compounds [20]. Recently, [21] illustrated combined effect

of some bio-agents on the grasshopper, *Hetiracris littoralis* and [22] observed cytogenetic effects of ethanol extract of sun dried seeds of soursop (*Annona muricata)* on the male germ line cells of the african pest grasshopper *Zonocerus variegatus* L.

CONCLUSION

The results obtained in the present study suggest that the different plant extracts possess toxic activity. It may be possible to use extracts to protect economic pest population of *C. trachypterus* in agricultural fields as they may lead to the production of more eco-friendly control agents than synthetic insectisides. We would like to suggest quantitative isolation of various phytochemicals for further research.

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