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Management of *Amsacta moorei* Butl (Lepidoptera Arctiidae) through botanical products

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Abstract

A laboratory experiment was conducted at D.B.S. P.G. College Kanpur to study the insecticidal effect of 10 indigenous plant extracts (*A. calamus*, *A. vasica*, *A. galanga*, *C. sativum*, *C. tiglium*, *J. curcus*, *S. indica*, *S. acmella*, *T. asthmatica* and Neemgold) their different concentrations (0.5%, 1.0% and 2.0%) over three exposure periods (6 hrs, 12hrs & 24 hrs.) against red hairy caterpillar, *Amsacta moorei* bult. Significant variation was recorded among plant extracts their concentrations and exposure periods. The highest mean mortality value was recorded with plant extract of A Calamus (80.87%) followed by neem gold (74.26%), *A. vasica* (67.90%) and *T. asthmatica* (66.80%). Likewise, 2% conc. of plants extract and 24 hrs exposure periods were found to be most effective by achieving the highest mortality 69.24% and 78.99% respectively. Combination of *A. calamus* with 2% conc. and 24hrs exposure period (A_1xB_3 &A_1xC_3) exhibited highest mortality value 87.95and 90% respectively. Similarly, interaction between 2%conc. with 24hrs exposure period (B_3xC_3) was found to be most useful by achieving 83.24% mortality value of the insect. The performance of A_1xB_3 x C_4 combination was found to be most effective by achieving the highest mortality 87.95%. Thus, *A. calamus* extract with 2% concentration over 24 hrs duration may be used for achieving the highest mortality of *A. moorei,* a serious pest of groundnut, cowpea, sorghum and vegetables in North India, further it may also be an ideal substitute for synthetic pesticides.

Keywords: Plant extracts, exposure period, mortality

Introduction

Food and nutritional security is of most importance for the burgeoning population in the country. On an average 15-20% potential crop production is lost due to the insects, pests, weeds, diseases, nematodes, rodents etc. Thus, plant protection efforts aim at minimizing the crop losses. The plant protection strategies and activities have significant importance in overall crop production programs for sustainable agriculture. The stagnant to the progressive stage by increasing the gross national product, by supplying the physical surplus in the shape of food and raw material, and by providing economy surplus which constitute the material basis for economic development. Unfortunately, a major part of our agricultural production is eaten away and destroyed mercilessly by various pest and plant diseases, pest destroys more than 1/3rd of worlds crop production and cause heavy crop losses, which can be successfully dealt with only use of the pesticides. If pesticides are not used the crop losses may rise to 50% and even in more in developing countries. Presently, at global level more than 2.3 million tons pesticide is used annually. Seeing the hazardous effects on health as well as in ecosystem, alternate methods of pest control have received attention in the recent years. Several researches have depicted the pesticides resistance in insect and pest due to continuous use of synthetic pesticides. Thus, resistance in its term has forced us to increase the doses of pesticides; resultant, toxic hazards have reached at alarming proportion in our country. There are 139 organic chemicals, heavy metals, their compounds, various acids and alkalis are involved in the process of dye manufacturing. Now, a search is being made for alternative technology of pest control which is comparatively safe, eco -friendly and equally effective. Natural products offer better degree of selective toxicity and may form ideal substitute for synthetic pesticides.

The Red hairy caterpillar *Amsacta moorei* (Butl) Lepidoptera Arctiidae is distributed all over India, but it is serious pest of groundnut, cowpea, sorghum and vegetables in North India. (Chandel *et al* 2001)

There are so many plant species present in nature, are not even touched by the insects to feed. Such plants must have some deterring chemicals which exhibit their feeding, may be used for insects –pests management. The selected plants species under this study were tested for their biological efficacy and found that they are not even touched by the target insect to feed.

Therefore, they have been utilized for insect (*A. moorei*) management, which are comparatively cheaper than synthetic insecticides.

Materials and Methods

The laboratory experiment was conducted during 2007-2008 in department of Zoology D.B.S. P.G. College Kanpur. Geographically, the district Kanpur is located in between latitude 25.26º and 26.58º North and longitudes 19.31º and 84.34º East and at an elevation of about (127.117º) meter above mean sea level with semi arid sub tropical climatic conditions.

The targeted caterpillar of *A. moorei* was collected from the groundnut, cowpea, Sorghum, and vegetables field of vegetable research farm Kanpur and village Fattepur Gohi. During the period of study the feeding habit of larvae have been noted that in cloudy weather, the larva continue to feed on upper surface of leaves throughout the day. To obtain regular supply of known aged larvae for laboratory, the culture was raised for Red hairy caterpillar of *A. moorei* on cowpea leaves in laboratory. The food was changed daily and at maturation the larval was provided the sand jar for pupation. The newly emerged insects (adults) were separated according to their sexes and a pair of male and female was released on potted cowpea plants. The leaves having eggs pouches were seen clearly and after hatching, newly hatched caterpillar were transferred to the petridishes containing food over moist filter paper.

The plant material used in the present investigation was collected mainly from wasteland. Wild area and cultivated fields. A preliminary trail was undertaken in the laboratory by crude method to see the toxicity in the form insecticidal effect against *A. moorei*. Out of 25 selected plants, only ten plants (*A. calamus*, *A vasica*, *A. galanga*, *C. sativum*, *C. tiglium*, *J. curcus*, *S. indica*, *S. acmella*, *T. asthmatica* and neemgold) showed the above ability, used for their biological efficacy against *A. moorei*. The different plant parts (Rhizomes, shoots, Leaves, seeds, fruits, and flowers) of ten selected plants with appropriate solvent (petroleum ether and alcohol) were used for getting their pure extract. Later on, 50 ml pure extract in each case was taken into reagent bottle and 50 ml benzene was added to dissolve the constituent of the materials, thus, prepared the 50% stock solution, mouth of the bottles were stopped with air tight corks and kept in refrigerator. The different concentrations (0.5%, 1.0% and 2.0%) of insecticides were prepared from stock salutation using benzene as solvent and Triton X-100 as emulsifier then 0.5% Triton X-100 was accurately measured in to large bottle, then 99.5 ml of distilled water was added and bottle was shaken well to dissolve the emulsifier. Thus emulsifiable water of 0.5 present strength was obtained for preparation of different concentrations of the extracted materials.

The insecticides of plant origins were tested by dry film technique. The spraying of insecticides was done in glass petridishes (10cm diameter) by potters spray tower using 1ml of solution per petridishes. Then their concentrations were tested in the replications. To record the mortality the spray per dishes were gently shaken under an electric fan until the liquid phase evaporated leaving behind a uniform dry film of insecticide on the glass surface inside each pair of petridishes, known aged ten caterpillars were released and allowed remaining there up to 2 hrs. Later on, they were transferred to the fresh petridishes containing fresh food for feeding. These petridishes were kept as such under control conditions (27_+ 2 ºC temp. 75 _+5% RH) and mortality count was taken after 6, 12 & 24, hours of exposure.

Result and Discussion

An experiment was conducted in laboratory to test the insecticidal properties of ten selected indigenous plants extract, their three concentrations over three exposure periods against Red hairy caterpillar (*Amsacta moorei*, Butl).

The mortality of mentioned pest was recorded when exposed to the *Arachis Hypogea* and *phaseolus mungo* leaves, treated with plants extract of three concentrations (0.5%, 1.0%, and 2.0%) of each treatment. The no. of larvae in each petridish were recorded in the basic of percentage reduction of the larvae at the time interval of 6 hrs, 12 hrs.24 hrs respectively.

Effect of plant extracts against Red hairy caterpillar *Amsacta moorei*, *butl* L.

The ANOVA table depicted the highest significant variation among the treatments, concentrations as well as periods of exposure. Significant variation was also recorded with combination of treatments over concentrations (A x B), treatments over exposure periods (A x C), concentrations over exposure periods (B X C) and over all combinations of treatments with concentrations over exposure periods (A x B x C).

Table-1 reveals the significant variation of insecticidal performance among the plant extracts. The plant extract of A. calamus gave the maximum mortality by killing 80.87 percent larvae of *A. moorei* followed by Neemgold (74.26%), *A. vasica* (67.91%) *T. asthmatica* (66.81%) *C. tiglium* (66.35%), *A. galanga* (66.20%), *J. curcus* (64.17%), *S. acmella* (59.38%) and S. indica (50.58%). Least mortality value 56.26 percent was recorded with plant extract of C. sativum.

Similarly, a significant variation was also recorded among different concentrations of extracts for insect mortality value. The highest mortality 69.52 percent was recorded with 2 percent concentration of plants extract followed by 1 percent concentration (64.87%). The least (59.63%) mortality was observed with 0.5 percent concentration of plants extract.

Likewise, duration of exposure periods (Table-2) also exhibited a significant impact on mortality of larvae. Among the three exposure periods, the highest mortality value (78.99%) of larvae was recorded with 24 hrs duration followed by 12 hrs. (63.16%). The least mortality of larvae was recorded with 6 hrs. (51.89%) duration. Similar results have also been recommended by Singh and Rao (2000) [1] tested Ageratum conyzoides ethnal extract at 120/fifth instar caused 51.80 percent S. liture larval mortality. Gautam and Chauhan (2003) [2] tested 24 asteraceous plants against S. obliges and obsess that 1000 ligme extract S. Rappa was most effective (65.30% mortality) followed by cichorium intybus 54.6 percent and vernomia cinera 38.6 percent as compared to extracts of other species. Singh and Kanaujia (2003) [3] evaluated certain bio pesticides against this instor larvae of spilosoma obliquc walk on castor. Out of which NSKE (0.5 percent) exhibited 1.44 percent residual toxicity and have third position of relative toxicity i.e. 158.84 values, Srinivasan *et al*. (2004) [4] tested the efficacy of new insecticides against citrus larvae minor along with neem based formulations. Among different insecticides evaluated neem formulations viz. neem seed kernel, azadiractin were found in coming high mortality of leaf minor larvae.

Data of table -1 also reveals a significant variation among interaction of different factors. the combining ability of 2.00 percent concentration with plants extract was found to be most effective by exhibiting the best insecticidal attribute followed by 1.00 percent and 0.5 percent concentration. The highest mortality 87.95% of *A. moorei* larvae was recorded with combination of A. Calamus with 2.00 percent conc. (A_1 x B_3) followed by A. Calamus with 1.00 percent concentration (A_1 x B_2 -81.15%), Neem gold with 2 percent conc. (A_{10} x B_3- 80.16%) and *T. asthamatica* with 2.00 percent conc. (A_9 x B_3- 73.36%). The combination of plant extract of S. Indica with 0.5 percent conc.(A_7 x B_1) exhibited the least mortality value of 45.67 percent

The combination of plants extract with different exposure periods (6 hrs, 12hrs and 24 hrs) table -2 also exhibited the significant variation. The combination of A. Calamus plant extract with 24 hrs exposure (A_1 x C_3) recorded the highest (90%) mortality of *A. moorei*. The plants extract of *A. varica*, *C. sativum* and *J. curcus* with 24 hrs exposure (A_2 x C_3, A_4 x C_3 and A_6 x C_3) exhibited equal mortality value of 87.95 percent. The concentration of neemgold with 24 hrs exposure (A_{10} x C_3) stood in 3rd rank by killing 85.90 percent of larvae the combination of A. calamus with 12 hrs exposure.

the combination of 2% concentration with 24 hrs duration (B_3xC_3) table -3 was found to be most effective by achieving the highest mortality value (83.23%) followed by B2 x C3-79.71% and B1xC3-74.02. It reflects that 24 hrs exposure periods showed the best combining ability with all deferent concentration for mortality of A. moorie.

Table -4 revels the efficacy of combination of all factors (AxBxC) were found significant. The combination of $A_1xB_3xC_3$ was found to be most effective by achieving the highest (87.95%) mortality value followed by $A_1xB_2xC_3$ (81.15%) and $A_{10}xB_3xC_3$ (80.13%) several studies have shown the positive correlation between extant of conc. of plants extract and their exposure periods with mortality rate of insect. Being it, 2% concentration and 24 hrs exposure period showed the best performance of insect mortality.

From this study it could be concluded that combined application of A. Calamus plant extract, with its 2% concentration over 24 hrs exposure duration was found to be most efficient to achieve the highest mortality of insect *A. moorie* and it may be used as substitute of synthetic pesicide.

Table 1: Combination effect of plants extract with their concentrations (AXB) on mortality of A. moorie.

S.N.	Treatment	B1 0.5 (%)	B2 1.0 (%)	B3 2.0 (%)	Mean
1.	*A. calamus* (A_1)	73.52	81.15	87.95	80.87
2.	*A. vasica* (A_2)	64.36	68.59	70.78	67.91
3.	*A. galanga* (A_3)	61.18	64.81	72.62	66.20
4.	*C sativum* (A_4)	61.18	68.23	69.64	66.35
5.	*C. tiglium* (A_5)	46.28	50.19	54.30	50.25
6.	*J. curcus* (A_6)	59.93	64.57	68.01	64.17
7.	*S. indica* (A_7)	45.67	51.05	55.02	50.58
8.	*S. acmella*, (A_8)	55.57	59.16	63.40	59.38
9.	*T. asthmatica* (A_9)	58.16	68.90	73.36	66.81
10.	Neemgold (A_{10})	70.40	72.21	80.16	74.26
	Mean	59.63	64.87	69.24	64.68
		A	B	AxB	
	SE (m)	0.122	0.067	0.212	
	SE (d)	0.173	0.095	0.299	
	CD (1%)	0.341	0.187	0.591	

Table 2: Combination effect of plants extracts with different exposure periods on mortality of A. moorie

S.N.	Treatment	C1 6hrs	C2 12 hrs	C3 24 hrs	Mean
1.	A_1	68.77	83.85	90.00	80.87
2.	A_2	46.92	68.85	87.95	67.91
3.	A_3	54.19	64.67	79.76	66.20
4.	A_4	50.16	60.95	87.95	66.35
5.	A_5	44.36	51.49	54.92	50.25
6.	A_6	46.96	57.60	87.95	64.17
7.	A_7	43.05	48.88	59.81	50.58
8.	A_8	46.28	59.14	72.70	59.38
9.	A_9	54.28	63.19	82.95	66.81
10.	A_{10}	63.93	72.95	85.90	74.26
	Mean	51.89	63.16	78.99	64.67
		A	C	AXC	
	SE (m)	0.122	0.067	0.212	
	SE (d)	0.173	0.095	0.299	
	CD (1%)	0.341	0.187	0.591	

Table 3: Combination effect of different concentration with exposure periods (B x C) on mortality of A. moorie

Time Period	B1 0.5 (%)	B2 1.0 (%)	B3 2.0 (%)	Mean
C1(6 hrs)	47.25	51.25	57.17	51.89
C2(12 hrs)	57.61	63.69	68.17	63.16
C3(24 hrs)	74.02	79.71	83.24	78.99
Mean	59.63	64.89	69.52	
		B	C	BxC
	SE (m)	0.067	0.067	0.116
	SE (d)	0.095	0.095	0.164
	CD (1%)	0.187	0.187	0.324

Anova Table

Source	D.F.	S.S.	M.S.S.	F-cal	Signifiance
Factor A	9	21852.00	2428.00	5997.118**	0.000
Factor B	2	1146.250	2208.125	5454.031**	0.000
Factor A x B	18	540.00	30.00	74.099**	0.000
Factor C	2	33364.00	16682.125	41204.562**	0.000
Factor A x C	18	5350.375	297.243	734.185**	0.000
Factor B x C	4	60.375	15.094	37.281**	0.000
Factor A x B x C	36	1500.250	41.674	102.933**	0.000
Error	180	72.875	0.405		
Total	269	67156.375			

Table 4: Combination effect of plants extract with their concentrations over exposure periods (AxBxC) on mortality of A. moorie.

	6 Hrs (C_1)				**12 Hrs (C_2)**				**24 Hrs (C_3)**				
Treatments	**0.5%(B_1)**	**1.00%(B_2)**	**2.00%(B_3)**	**Mean**	**0.5%(B_1)**	**1.00%(B_2)**	**2.00%(B_3)**	**Mean**	**0.5%(B_1)**	**1.00%(B_2)**	**2.00%(B_3)**	**Mean**	**G. Mean**
A_1	59.01 (73.5)	71.56 (90.00)	90.00 (100.00)	73.52 (87.83)	63.44 (80.00)	90.00 (100)	90.00 (100)	81.15 (96.66)	83.85 (98.90)	90.00 (100.)	90.00 (100)	87.95 (99.63)	80.87
A_2	43.08 (46.60)	66.15 (83.69)	83.85 (98.90)	64.36 (76.36)	46.92 (53.40)	68.85 (87.00)	90.00 (100.)	68.59 (80.13)	50.77 (160.0)	71.56 (90.00)	90.00 (100)	70.78 (83.33)	67.91
A_3	50.77 (60.00)	61.22 (76.8)	71.56 (90.00)	61.18 (75.60)	52.78 (63.40)	63.93 (80.70)	77.71 (95.50)	64.81 (73.90)	59.01 (73.40)	68.85 (68.80)	90.00 (100)	72.62 (81.06)	66.28
A_4	46.92 (53.4)	52.78 (63.3)	83.85 (98.9)	61.18 (71.86)	50.77 (60.00)	63.93 (80.70)	90.00 (100)	68.23 (80.23)	52.78 (63.30)	66.15 (83.60)	90.00 (100)	69.64 (82.30)	66.35
A_5	41.15 (45.10)	46.92 (46.40)	50.77 (60.00)	46.28 (50.50)	45.00 (50.00)	52.78 (63.40)	52.78 (63.40)	50.19 (58.93)	46.92 (53.40)	54.78 (66.70)	61.22 (76.80)	54.30 (63.48)	50.25
A_6	41.15 (43.30)	54.78 (66.70)	83.85 (98.90)	59.93 (69.63)	46.92 (53.40)	56.79 (70.00)	90.00 (100)	64.57 (74.46)	52.80 (46.95)	61.22 (76.70)	90.00 (100)	68.01 (74.55)	64.17
A_7	37.22 (36.60)	45.00 (50.00)	54.78 (66.70)	48.17 (51.10)	43.08 (46.60)	48.85 (56.70)	61.22 (76.70)	51.05 (60.00)	48.85 (56.70)	52.78 (63.40)	63.44 (80.00)	55.02 (66.7)	50.58
A_8	43.08 (46.60)	54.78 (66.70)	68.85 (87.00)	55.57 (66.76)	46.92 (53.40)	59.01 (73.50)	71.56 (90.00)	59.16 (63.43)	48.85 (56.70)	63.63 (80.70)	77.71 (95.50)	63.40 (77.73)	59.38
A_9	48.85 (56.7)	56.79 (70.00)	68.85 (87.00)	58.16 (71.25)	52.78 (63.40)	63.93 (80.70)	90.00 (100)	68.90 (81.36)	61.22 (76.20)	68.85 (87.00)	90.00 (100)	73.36 (87.73)	66.81
A_{10}	61.22 (76.80)	66.15 83.70()	83.85 (98.80)	70.40 (86.43)	63.93 (80.70)	68.85 (87.00)	83.85 (98.80)	73.21 (88.82)	66.64 (84.30)	83.85 (98.80)	90.00 (100)	80.16 (94.36)	74.26

SE(m)- 0.367
SE(d) - 0.520
CD (1%) - 1.023

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