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Influence of Ethanol Leaf Extract of *Nerium oleander* on the Life-Table Characteristics and Developmental Stages of *Paederus fuscipes*

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ABSTRACT: The life-table characteristics of *Paederus fuscipes* individuals surviving (l_x) at the emergence of adults when reared on *T. granarium* (treated with 5% ethanol leaf extract of *N. oleander*) was recorded 6%. The highest rate of mortality in the developmental stage was observed at the egg stage (31.6%) followed by only 34.69% in L_1, 73.8% in L_2 and 48.8% in pupae stage. The average life expectancy of individual stages were significantly lower (eggs = 1.80; L_1 = 1.41; L_2 = 0.89; pupae = 1.01 and adults = 0.50 days) *vis-e-vis* controls. The dry biomasses, however of pupae and adults at 1% treatment as well as those reared on 5% treatment were significantly lower than those of control. The absolute growth-rate increased up to L_2 stages in all the experiments. Beyond L_2 stage the growth rates also declined in pupae (0.047 mg/day at 1% treatment and 0.010 mg/day at 5% treatment) and became severely negative in adults (-0.001 mg/day at 1% treatment and -0.007 mg/day at 5% treatment) were lower than those of controls. The growth rates of the adults always exhibited negative values on account of the losses of body tissues in minimally feeding adults. These observation suggested that the leaves of *N. oleander* may be a new safer, eco-friendly insecticide for the control of *P. fuscipes.*

Key words: *Paederus fuscipes,* Growth-Rate, Life-Table Characteristics and *Nerium oleander.*

I. INTRODUCTION

Paederus fuscipes is commonly known as "Rove beetle'' belong to Staphyilinidae, one of the biggest family of beetles of order coleoptera with a number of species distributed throughout the worldwide [1]. *P. fuscipes* inhabits moist areas such as river banks and the edges of freshwater lakes, streams, dung, marshes, nest of vertebrate, carrion and cropped areas preferably in maize, berseen and rice fields [2-3] as the larvae are highly susceptible to desiccation [4]. It is also useful insect in agricultural fields being a major polyphagous predator of several agricultural pests, populations in aggro-ecosystem [2]. *P. fuscipes* cause dermatitis linearis in urban and rural human living spaces [5-8], which is commonly known as spider lick. Most species of *Paederus* contain vesicating fluids [9]. The toxin is manufactured not by the beetles themselves, but by the endosymbiotic bacteria, probably some species of *Pseudomonas* [10]. The toxic haemolymph of the beetle is known as paederin causes necrotic blisters when the insect is crushed on human skin. The plant possess antimicrobial [11] and antibacterial [12-13] activity. Roots, stem, leaves and flowers of *Nerium oleander* are reported to posses insecticidal and antifeedant activity against *Plutella xylostella* [14-16]. Further, the plant has also been screened for larvicidal activity against *A. aegypti* [17] and insect growth regulatory activity against *Culex quinquefasciatus* and *Anopheles stephensi* [18]. The aqueous leaf extract of *N. oleander* were tested for the larvicidal, ovicidal and repellent activity against *C. gelidus* and *C. tritaeniorhynchus* [19] whereas against *A. stephensi* for adulticidal and ovicidal activity [20]. Therefore, the purpose of the present investigation to explore the mortality and ovicidal nature of ethanol leaf extracts of *Nerium oleander* given access to *T. granarium* as food supplement to *P. fuscipes* thoroughly under laboratory conditions.

II. MATERIAL AND METHODS

A. Extraction Procedure

Green leaves of *Nerium oleander* were collected from its natural habitats and washed thoroughly to remove dust and other particles. After washing, kept for shade drying at room temperature for 10-15 days and finally ground to fine powder. The powdered plant material was extracted with absolute ethanol as solvent in Soxhlet Apparatus for 72 hrs. After extraction the extract was evaporated to dryness using rotatory vaccum evaporator. The semi-solid crude extract was then transferred in glass vials and stored in refrigerator for experiments. To assess the efficacy of leaf extracts, 1% and 5% concentrations were prepared in distilled water and mixed in diet of *T. granarium.*

Nerium oleander

B. Bioassay

The individuals of *P. fuscipes* were reared in the laboratory at 30±2°C and 70±5% RH in BOD incubator. Initially, the desired number of eggs were collected by allowing the untreated adults of both sexes of similar age-groups to lay eggs in prepared control diets and sifting the eggs. Batches of 100 eggs (n=3) were kept separately in beakers covered with muslin cloth, containing various dietary formulations (the dietery compound *T.granarium* is treated with 1% and 5% ethanol extraxt of *Nerium Oleander* using the direct contact method, that was feeded by *P. fuscipes*) and control with normal diets [21].

The life-table characteristics of *P. fuscipes* were determined [22,23]. Accordingly, the following parameters were determined.

Paederus fuscipes

Equations

$l_x = n_x/n_0$ (i)

$dx = n_x - (n_x + 1)$ ...(ii)

$q_x = d_x / n_X$ ...(iii)

$$T_x = \sum_{X}^{\infty} L_x \quad \text{...(iv)}$$

$e_x = T_x / n_x$ ...(v)

where

X = age interval

N_0 = number of individuals at the beginning of the study.

n_x = number of alive individuals at the start of age interval x.

l_x = proportion surviving to start of age interval x.

d_x = number of individuals dying within age interval x to x +1.

q_x = mortality during age interval x to x+1.

T_x = units of individuals times time unit.

e_x = expectation of life for organisms alive at the start of age x.

L_x = number of individuals alive during the age interval x to x +1.

To determine the growth - rate of the developmental stages of *Paederus fuscipes,* its fresh and dry weights (samples were taken at 60°C for 24 hrs) were determined using the standard methods [24-26].

Absolute daily growth (mg/day) = $w_2 - w_1 / t_2 - t_1$
Where
w_1 and w_2 = the mean biomasses of the individuals at times t_1 and t_2 respectively.

C. Statistical Analysis
All the data of the present study was statistically analyzed using SPSS computer software. The differences in the mean values were subjected to oneway ANOVA.

III. RESULTS AND DISCUSSION

The observation on various age-specific life-table parameters of *P. fuscipes* reared on untreated *T. granarium* (control) (Table 1) revealed that 65.3% of the eggs could successfully develop into adults and the mortality figures (q_x) were higher in eggs (19.4%). The individuals of *P. fuscipes* individuals surviving (l_x) at the emergence of adults when reared on *T. granarium* (treated with 5% ethanol leaf extract of *N. oleander*) was recorded 6% (Table 1). The highest rate of mortality in the developmental stage was observed at the egg stage (31.6%) followed by only 34.69% in L_1, 73.8% in L_2 and 48.8% in pupae stage. The average life expectancy of individual stages were significantly lower (eggs = 1.80; L_1 = 1.41; L_2 = 0.89; pupae = 1.01 and adults = 0.50 days) *vis-e-vis* controls and 1% treatment.

On the basis of above said observation it can be concluded that the leaf extract of *N. oleander* (5%) adversely affected the survival of immature stages of *P. fuscipes.* The L_1 and L_2 stage when given access to 5% ethanol leaf extract of *N. oleander* were subjected to higher deleterious effects causing heavy mortality presumably either on accounts of its insecticidal, larvicidal, antifeedant properties and repellent effects as reported in case of *Bemisia tabaci* [27-28]. Few researcher have reported that *N. oleander* is effective in causing high mortality in *Rhyzopertha dominica* [29]. The conclusion of present study is that ethanol leaf extract of *N. oleander* leaves are highly effective in controlling the *P. fuscipes* by causing mortality at the developmental stages.

Table 1 : The life-table characteristics of *P. fuscipes* reared on *T. granarium* at 30±2°C. (L_1- L_2=Larval Instars).

Treatment	LIFE STAGE	DURATION DAYS	n_x	l_x	d_x	q_x	L_X	T_X	e_x
Untreated *T. granarium* (Control)	**EGG**	3.5	100	1.0000	19.4	0.194	90.30	335.90	3.359
	L_1	3.0	80.6	0.806	08.6	0.106	76.30	245.60	3.047
	L_2	4.5	72.0	0.720	04.0	0.055	70.00	169.30	2.351
	PUPA	6.0	68.0	0.680	02.7	0.081	66.65	99.30	1.460
	ADULT	4.0	65.3	0.653	65.3	1.000	32.65	32.65	0.500
T. granarium treated with 1% ethanol leaf extract of *N. oleander*	**EGG**	3.5	100	1.000	28.00	0.280	86.00	255.32	2.553
	L_1	3.0	72.00	0.720	16.00	0.222	64.00	169.32	2.351
	L_2	4.5	56.00	0.560	11.67	0.208	50.16	105.32	1.880
	PUPA	6.0	44.33	0.443	11.33	0.255	38.66	55.16	1.244
	ADULT	4.0	33.00	0.330	33.00	1.000	16.50	16.50	0.500
T. granarium treated with 5% ethanol leaf extract of *N. oleander*	**EGG**	3.5	100	1.000	31.67	0.316	84.16	180.64	1.806
	L_1	3.0	68.33	0.683	23.67	0.346	56.49	96.48	1.411
	L_2	4.5	44.66	0.446	33.00	0.738	28.16	39.99	0.895
	PUPA	6.0	11.66	0.116	05.66	0.485	08.83	11.83	1.014
	ADULT	4.0	06.00	0.060	06.00	1.000	03.00	03.00	0.500

The biomasses of the developmental stages of *P. fuscipes* reared on *T. granarium* treated with 1% and 5% ethanol leaf extract of *N. oleander* were recorded. When the *P. fuscipes* were subjected to a dietary material 1% treated *T. granarium* the dry weights were considerably lower ($P<0.01$) in and beyond L_2 stage (pupae = 0.69 mg and adults = 0.69 mg). At 5% treatment however, the dry body weights declined in pupae (0.42 mg) and adult (0.39 mg) *vis-e-vis* controls (Table 2).

These results suggested that the leaf extract of *N. oleander* adversely affected the dry matter accumulation in the immature and adult stages of *P. fuscipes*. [30]. Toxic constituents are Neandrin, Neritaloside, Odorside and Oleandrigenin found in the *Nerium* species. Oleandrigenin is a deglycosylated metabolite of oleandrin. It has however a more mild effect, deleterious for the development of a pests.

These compounds are being toxic, affect insects by causing a delay in larval growth and can act as antifeedant [31-32]. The adults were more sensitive than larvae against several plant extracts. Sharma and Kalra, Deepa and Remadevi [33-35] have reported their achievement as resistant in the various developmental stages of stored grain insects against the synthetic insecticide. The repellency exercised by the *N. oleander* for *P. fuscipes* may also have affected the body growth in the immature and adult stages of its development.

Table 2: The dry weights of immature and adult stages of *P. fuscipes* reared on *T. granarium* at 30±2°C.

Dietary Mixture	**Wt. of life stages of *P. fuscipes* (mg) (Mean ± SE)**				
	EGG	**L_1**	**L_2**	**PUPA**	**ADULT**
Untreated *T. granarium*	0.015 ± 0.0005	0.077 ± 0.0140	0.447 ± 0.0591	0.946 ± 0.0106	0.914 ± 0.0062
T. granarium* treated with 1% ethanol leaf extract of *N. oleander	0.0148 ± 0.0001	0.057 ± 0.0037	0.413 ±0.0240	0.695** ± 0.0332	0.69** ± 0.0208
T. granarium* treated with 5% ethanol leaf extract of *N. oleander	0.014 ± 0.0004	0.048 ± 0.0032	0.366 ± 0.02603	0.426** ± 0.0218	0.396** ± 0.0145
CD at 0.01 LEVEL	0.00216	0.04512	0.20848	0.12472	0.07910
CD at 0.05 LEVEL	0.00142	0.02978	0.13762	0.08232	0.05221

Significant at *P < 0.05; **P < 0.01

The absolute growth rate of different development stages of *P. fuscipes* (Table 3) reared on *T. granarium* treated with 1% and 5% ethanol leaf extract of *N. oleander* revealed almost identical increase in growth-rate from L_1 to L_2 stages in all the experiments. Beyond pupae stage the growth rates also declined in pupae (0.047 mg/day at 1% treatment and 0.010 mg/day at 5% treatment) and became severely negative in adults (-0.001 mg/day at 1% treatment and -0.007 mg/day at 5% treatment) were lower than those of controls (Table 3). The growth rates of the adults always exhibited negative values on account of the losses of body tissues in minimally feeding adults. These observations suggested that incorporation of *N. oleander* leaf extract adversely affected the growth of larvae and pupae of *P. fuscipes* presumably on account of either prevention of feeding in the developmental stages or some kind of mild dietary repellent, fumigant toxicity due to which their growth declined [29]. It had reported that these compounds affect insects by causing a delay in larval growth and can act as antifeedant [31] also the toxic extracts inhibit growth and development of many species of insects [36].

Table 3: Absolute growth rates (mg/day) of developmental stages of *P. fuscipes* reared on *T. granarium.*

Life Stage	**Life span (days)**	**Untreated *T. granarium* (Control)**	***T. granarium* treated with 1% ethanol leaf extract of *N. oleander***	***T. granarium* treated with 5% ethanol leaf extract of *N. oleander***
EGG	3.5	-	-	-
L_1	3.0	0.020	0.011	0.013
L_2	4.5	0.082	0.079	0.070
PUPA	6.0	0.083	0.047	0.010
ADULT	4.0	-0.008	-0.0012	-0.0075

The present study indicated that the applications of crude ethanol leaves extract of *N. oleander* are highly effective in controlling the *P. fuscipes* by causing heavy mortality at the larval and pupal stages under laboratory conditions. This plant product is also eco-friendly, easily available and economically safe. Bio-pesticides are safe natural products and free from any residue problem on the crop and in the environment [36]. Keeping in mind the overall performance, the ethanol extract of *N. oleander* leaves may be utilized in the management of *P. fuscipes* after evaluating its effects under field conditions.

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