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Management of termites in sub zoba Hamelmalo in state of Eritrea

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Abstract

The studies was carried out in and around Hamelmalo Agricultural College for management of termites by using some plant smokes *i.e., Lantana camara, Azadirachta indica, Otostegia integrifolia* and Chloropyrifos with comparing manual destruction of termite mounds by killing of queen. Active mounds were selected and exposed to the prepared plant material smokes as well as decanted by a chemical. Findings showed that Chloropyrifos was very effective in controlling the termites reducing up to 95% population strength. The plant smoke and neem exhibited comparable effectiveness succeeding after chemical treatments. The study also compared the effectiveness of the treatments on different castes of termites. The worker population was reduced, and neem was found effective in managing the population as compare to other plant smokes. However, every plant smokes were observed being efficient to manage termites economically.

1. INTRODUCTION:

The African continent is climatically and geographically diverse and contains the world's largest desert and also one of the highest mountain peaks. Termite diversity reflects this topological and climatological diversity. More than 1,000 of the about 2,600 recognized species are found on the African continent. Mound-building species of termites occur throughout most of the African landscape. Genera infesting wooden structures include *Reticulitermes, Coptotermes*, *Psammotermes*, *Anacanthotermes* and several species of Kalotermitidae. However, some species of termites have been transported over of Africa due to commerce and nomadic migration. The tropical forests of central Africa and all of southern Africa also contain a diverse and abundant termite fauna.

The diet of termites is varied. The majority of the species eat wood and others eat grass and plant debris, however, few species have the same life style as leaf cutter ants, making and tending fungus garden (Gullan and Cranston, 1994). To obtain their food, termites may make foraging expedition, but generally they prefer to remain under cover and tunnel their way to dinner. In addition to any fallen timber that may be in contact with the soil in which they live, the termites will attack living grasses and trees, and of course any man made timber structures. A number of species make covered way on the surface of the ground to reach their goal, passing over rock and stone and even up bricks foundations to attack timber on buildings (Gullan and Cranston, 1994).

The toxic chemical barrier includes the use of chemical termiticides in soil around the building and creation of a zone of poisoned soil under and around the structure to prevent termites entering from the ground (Ewart, 2000). However, repeated digging and ploughing of the soil may reduce termite damage, and manual and explosive destruction of nests followed by the removal of the queen is also effective (HDRA, 2001). On the other hand, chemical fumigation have usually used for drywood and aerial colonies of subterranean termites infestation. It includes the use of toxic gas (carbon dioxide, methyl bromide, phosphine and sulfuryl) inside the structure and removal of all chemical absorbent materials from the building to be fumigated (Verma et al., 2010). These gases must be used with extreme care, because they are extremely toxic to humans, as well as other animals, and plants. Improper or careless use can result in death or injury.

The use of plant parts and plant extracts can be used effectively. The plant part, such as toxic fruit juices, pulps or shavings and leaves or branches can be applied directly by burning and leading its smoke to enter to the nests and by reaching to the reproductive causing to suffocate with the lack of oxygen and abundance of toxic smokes. Therefore,

present investigations have been designed to study the chemical as well as plant products to manage the termites in and around Hamelmalo Agricultural College, State of Eritrea.

2. MATERIALS AND METHODS:

2.1. Experimental Site:

The study area Hamelmalo Agricultural College is located in the region of Anseba north from the town of Keren about 12 km on the road to Nakfa. The altitude of the study area is about 1286 m with its geographical position of 15°54.16"N and 38°27.38"E. This area has an average rainfall of about 450 mm with a range of temperature of 16 to 38°C during the winter and summer seasons with a mean temperature of 27°C. The area has a soil type of sandy loam and with a vegetation type of mostly *Acacia tortils, Acacia seyal* and *Acacia Senegal* (Tsaeda Kenteb). The major type of crops grown in the area are grasses like sorghum and pearl millet and legumes like groundnut and broad beans, also grown horticultural crops like citrus fruits and vegetables like tomato, pepper, cabbage and okra.

2.2. Experimental Design:

The experiment was designed in randomized complete block design (RCBD) with five treatments *viz.*, manual removal/ destruction of queen, chemical insecticide chlorpyrifos and three botanical smokes of *Lantana camara*, *Azadirachta indica* and *Otostegia integrifolia*. Each experiment replicated thrice, and the blocks were taken according to geographical positions that is the northern side, southern side and eastern side with the exception of the western side as it is cleared out for governmental integrated farming plans, which made it to have few distribution of mounds and mostly inactive.

2.2.1. Application of Plant Products:

To removal of termite queen from selected mounds, medicinal plant *Azadirachta indica, Lantana camara,* and *Otostegia integrifolia* smokes were used. Sites were carefully identified not to be located near foundation of houses or trees. Then plant branches, leaves and twigs of Lantana, neem were cut with the help of axe from different places of the college surrounding but *Otostegia* spp. was obtained from highlands of Eritrea specifically some villages near Asmara and sub zone of Adi-Tekeliezan. After that on the selected mounds by the southeast position, a pit was dug out to get a space for the burning plant parts of about depth of 50-75 cm with consideration of mound size and position or elevation on the fields. Then branches and twigs along with their leaves dried and tender mixed and was put in the hole, followed by starting fire in the pit, then covered with metal sheet in order to control the smoke for escaping out. Three kg of branches, twigs and leaves are prepared per mound and burned for about 2.5- 3 hours with maximum possible care to acquire a firm intensity of smoke with nonstop during the time range in the pit.

2.2.2. Application of Chemicals:

As same as the other treatments, the mounds for chemical treatment were selected very carefully but differently, in which they were far apart from places where the people resided or the place their domestic animal herds graze, as the chemical is persistent and fatal enough that definitely can cause health trouble to humans and animals as well. And also all the safety garments and goggles were put on for safety during the application time. After that the selected mounds were cut open on their upper part till the galleries are found which lead on to the place where the queen is found. Simultaneously, a chemical solution was prepared with 10 ml of chlorpyrifos measured through a measuring cylinder and was mixed with 10 lit of water in a jar. Prepared solution was dispensed per mound quickly so as to prevent termite workers to cover the cell case of the reproductive.

2.3. Data Collection:

In all treatments, the data were collected by counting alive number of soldiers, workers and nymphs in all treatments. Prior to all the treatments data were collected by taking one kilogram of soil mound, contained termites from the upper, middle and lower part, respectively. The populations were counted separately, and then a mean number was obtained to take the average population per mound. After 7th and 14th days of application, same procedure was repeated to observe the population reduction. For sampling the soil, a cylindrical box was used of exact capacity to hold 1 kg of soil.

2.4. Data Analysis:

The data collected by different means were analysis by standard statistical method. The data was analyzed statistically by the application of software GENSTAT and Sigma plot for correlation, analysis of variance (ANOVA) and further subjected to test of significance by Duncan's multiple range test (DMRT).

3. RESULTS:

3.1. Effect of Treatments on Worker Population:

The termite population was observed in the active mounds selected in and around the Hamelmalo College before application of treatments, in which it was taken as mean population of the sample obtained from upper, lower and the middle parts of the mounds, and again with the same procedure of inspection was done after seven days and fourteen days of application.

At day one no significant difference was found with a range of mean population ranged from 187.30 to 140.70. At second day of inspection, again there was no significant difference found among the treatments but the effectiveness of treatments was quite good in comparison population recorded on first day. In this sense, chloropyrifos showed an active population reduction of more than 70%, though it was non-significant among the other treatments (Table 1). Third inspection was carried out on the fourteenth day of application, and highly significant differences were obtained in the population of workers. Again chloropyrifos showed lowest population count (7 workers) followed by neem (*Azadirachta indica*) and manual/ mechanical treatments with mean population count were recorded 30.00 and 33.00 workers, respectively. While *Lantana camara* and *Otostegia integrifolia* was found with highest mean population values of 36.30 and 38.30 workers, respectively (Table 1).

Table 1. Effect of plant smoke on termite worker groups

S. No.	Treatments	Average population of workers		
		Day1	Day 2	Day 3
1.	Neem, *Azadirachta indica*	169.70a	52.70a	30.00b
2.	Lantana, *Lantana camara*	187.30a	75.70a	36.30b
3.	Otostegia, *Otostegia integrifolia*	164.70a	56.70a	38.30b
4.	Chloropyrifos	140.70a	35.70a	7.00a
5.	Manual	157.30a	65.70a	33.00b
CV %		**14.50**	**16.40**	**11.90**
F prob		**0.278**	**0.008**	**<0.001**
L.S.D. (5%)		**44.81**	**17.65**	**6.49**

Table 2. Effect of smoke of different medicinal plants on termite soldier group

S. No.	Treatments	Average population of soldiers		
		Day1	Day 2	Day 3
1.	Neem, *Azadirachta indica*	113.30ab	63.70b	39.70b
2.	Lantana, *Lantana camara*	115.00ab	35.00a	45.00b
3.	Otostegia, *Otostegia integrifolia*	103.70a	66.70b	48.70b
4.	Chloropyrifos	135.00b	40.30a	11.70a
5.	Manual	117.30ab	62.00b	30.70b
CV %		**12.00**	**7.70**	**13.70**
F prob		**0.188**	**<0.001**	**<0.001**
L.S.D. (5%)		**26.31**	**8.67**	**9.03**

3.2. Effect of Treatments on Soldier Population:

On first day, there was no significance among the counts as it was only a concern of population distribution. The mean population ranged from 113.30 to 135.00 individuals of soldiers (Table 2). On second day of inspection, the data was found highly significant, in which lowest population count was obtained from *Lantana camara* with mean value of 35.00 soldiers and chloropyrifos of 40.30 soldiers

followed by manual/ mechanical with 62.00 soldiers, neem with 63.70 soldiers and *Otostegia integrifolia* with 66.70 soldiers. There were no significant comparison with first two and then third inspection, which accommodated at the fourteenth day after application. The resulted showed high significance among the treatments. Application of chloropyrifos showed lowest mean population count with a value of 11.70 succeeded by manual with 30.70, neem with 39.70, *Lantana camara* with 45.00 and *Otostegia integrifolia* with 48.70 soldiers, showed highest count of individuals which resulted lower population reduction among the treatments.

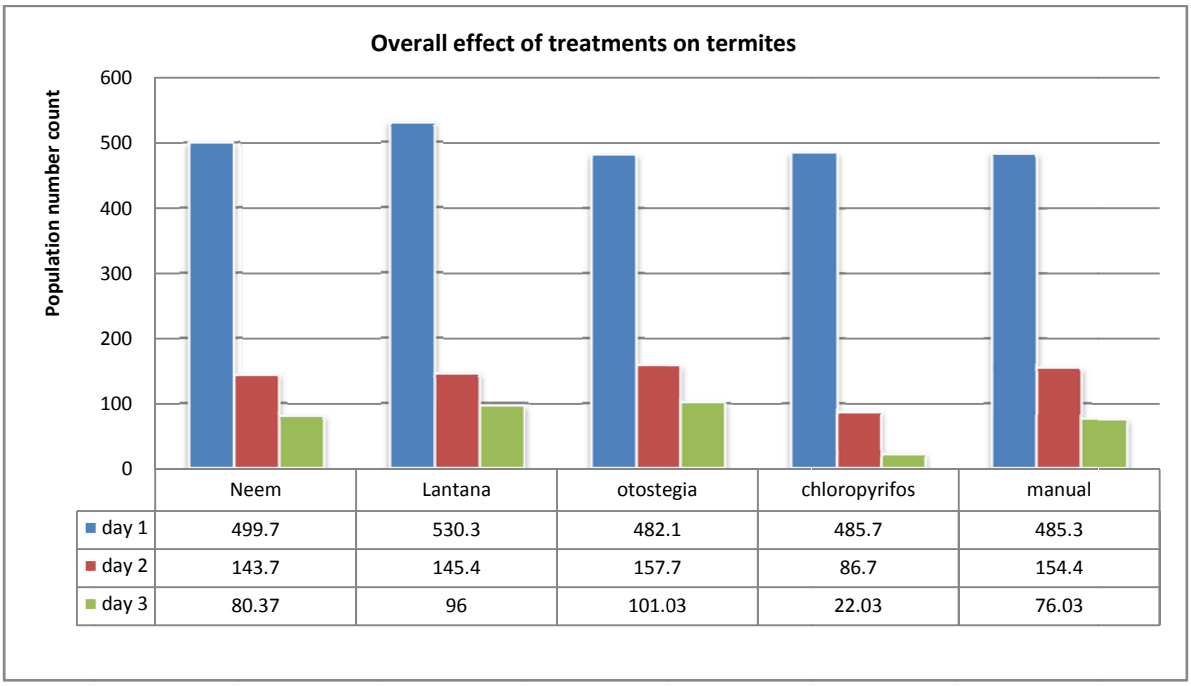
Table 3. Effect of plant smokes on termite nymphal stage

S. No.	Treatments	Average population of nymph		
		Day1	Day 2	Day 3
1.	Neem, *Azadirachta indica*	216.70a	27.30b	10.67b
2.	Lantana, *Lantana camara*	228.00a	34.70b	14.67b
3.	Otostegia, *Otostegia integrifolia*	213.70a	34.30b	14.00b
4.	Chloropyrifos	210.00a	10.70a	3.33a
5.	Manual	210.70a	26.70b	12.33b
CV %		**11.70**	**17.70**	**23.70**
F prob		**0.90**	**0.002**	**0.004**
L.S.D. (5%)		**47.44**	**8.91**	**4.904**

3.3. Effect of Treatments on Nymph Population:

In case of nymph population, there was obviously non significance with no application on first day of inspection and no concern of reduction of population was recorded. After one week, a significance different was recorded with the treatments. Here, chloropyrifos expressed significance result with lowest population of 10.70 individuals followed by manual and neem population of 26.70 and 27.30, respectively. However, *Lantana camara* (34.70) and *Otostegia integrifolia* (34.30) were with highest population and showed no significant difference (Table 3). On third inspection, chloropyrifos showed high significance among other treatments with a mean nymph population of 3.33 succeded by neem and manual of 10.67 and 12.33, respectively. Later on, *Lantana camara* with mean count of 14.67 and *Otostegia integrifolia* with mean count of 14.00 showed lowest reduction performance among comparison of treatments.

Fig. 1. Overall performance of treatments for management of termites



3.4. Effect of Treatments on Overall Termites Population:

The overall performance of the treatments (Fig. 1) showed non-significance difference in population counted on day 1, where, population ranged from 482.10 to 530.30 individuals with no application. Later on, second day of inspection, significant difference of the treatments was observed. Lowest population was obtained from chloropyrifos with a mean population of 86.70 individuals (82% reduction from day 1). Then, it succeeded by *Lantana camara* with mean of population 145.40 individuals (73.60% reduction) and neem with a mean count of population 143.70 individuals (72.25% reduction). The lowest carrying was observed from manual treatment with mean count of 154.40 individuals (69.2%) followed by *Otostegia integrifolia* with population of 157.70 individuals (68.3%). On the other hand, on day 3 inspection, which was final performance of treatments, chloropyrifos showed mean population count of 22.00 individuals (95% reduction) succeeded by manual with population count of 76.03 individuals (85.4% reduction) and neem with count of 80.37 individuals (84% reduction) again followed by *Lantana camara* with a population of 96.00 individuals (82.9% reduction) and least one with *Otostegia integrifolia* and population count was 101.00 individuals (79.2% reduction).

4. DISCUSSION:

Termites readily tunnel through the barrier of soil where plants grow and early study reported the insecticidal activity of *Lantana camara* against variety of insects in different orders like bees, beetles, mosquitoes, flies and termites (Ogendo et al., 2004; Abdel-Hady et al., 2005; Verma and Verma, 2006; Ding and Hu, 2010; Dua et al., 2010; Yuan and Hu, 2011) and chloropyrifos with 5% concentration was also found effective against termite workers (Verma and Verma, 2006). The results were irrespective to the tests applied in the current study as *Lantana camara* showed lowest performance with comparison of the other treatments against termite workers. In the present study, *Lantana camara* showed effect over the population, more than 82% individuals. Similarly, Ghisalberti (2000) suggested that *Lantana* have active alkaloids like triterpenes, glycosides and flavonoids that destruct the nervous system over time through feeding or fumigating through the extracted gasses for termite reduction.

Neem extraction or by removing plant part boiling in hot water to obtain the volatile gasses from the parts and disposing to termite infested spaces and nests showed effective significance management (HDRA, 2001). Schmuterrer et al. (1980) obtained similar result and reported that neem smoke showed a reduction of 84% termites and also comes to agreement as the study showed an effective reduction in the population. They also reported that neem compounds specifically *Azadirachtin* and its derivatives are also effective against other insects such as coleoptera, Lepidoptera and orthoptera (Schmuterrer et al., 1980).

The results of manual removal of queen is in line with the survey made by Malaka (1972) who reported that by removing the royal couples alone, decreased dramatically the population of termites, and also reported that the queen was removed from the mound, the population further declined and disintegrated due to lack of regeneration or egg laying carried out by the other members of colony. In addition, the colony members get dispersed and disturbed, because there is no organizing queen that releases pheromones to control the population. And this comes to agreement with present study as manual destruction reduced 85.4% of the population. But also the limitations can be found if the colony gets conducive environment to generate other alternate reproductive. In Ethiopian plateau, the smoke of burning branches and leaves is used as an insecticide and disinfectant and gave significant effect on colony forming insects over other medicinal plants. Although, this was irrespective to the current study as neem and lantana gave more effective results than Otostegia (Anonymous, 2011).

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Toxic effect of neem (*Azadirachta indica*) extracts against the eggs and adults of *Dysdercus koenigii* (Fabricius)

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Abstract

Neem (*Azadirachta indica*) belongs to family Meliaceae, is an indigenous tree to India. In Ayurveda, it is also known as the "Arishat" which meaning in Sanskrit is "relieving sickness". In the present study, toxic effect of neem leaves, neem green seed coat, neem yellow seed coat and neem seed kernel were studied against eggs and adults of red cotton bug, *Dysdercus koenigii*. The concentrations of above components used were 0.005%, 0.01%, 0.025%, 0.05%, 0.1%, 0.25%, 0.5% and 1.0% (v/v). The adult insects were allowed to feed upon the cotton seeds soaked in the respective extracts of neem. Result showed that adults *D. Koenigii* showed highest mortality of 76.00% at concentration of 1.0% *Azadirachta indica* (neem yellow seed coat), whereas, the least mortality was recorded nil (0.00%) at concentration (0.005%) of neem yellow seed coat. When eggs of *Dysdercus Koenigii* were treated with above neem extracts, the mortality of eggs were recorded highest (21.75%) at concentration of 0.005%) and lowest (9.25%) at concentration 0.005% of neem green seed coat and neem seed kernel, respectively. The least survival of egg was observed at neem seed kernel and green neem seed coat after 72 hours.

1. INTRODUCTION:

Red cotton bug, *Dysdercus koenigii* (Fabricius) is worldwide distributed but minor pest of cotton in India, particularly in Punjab and Uttar Pradesh. Apart from cotton, it also feeds on okra, maize, pearl millent etc. it remains active throughout the year and passes winter as adult. During the spring, the bug becomes active and lay about 100-130 eggs. The eggs are spherical, bright yellow and are laid in dusts or in loose irregular masses of 80 eggs. There are 5 nymphal stages and development is completed in 49-89 days. The life span of adult is variable in summer, but in winter it may live up to three months.

India ranks fourth among cotton producing countries of the world, but productivity of our country is far less than other cotton growing countries in the world. One of the major reasons for the low yields is magnitude of insect pests which attack the cotton crop from sowing till harvest (Dhawan, 1998 and Dhawan et al., 2000).

Plants are the richest source of organic chemicals on the earth. It is estimated that total number of plant chemicals may be 40,000 or more, but only 10,000 secondary plant metabolites have been defined as chemicals. Neem, *Azadirachta indica* is a systemic insecticide and acts in two ways, firstly as a repellent and feeding inhibitor (antifeedant). Extracts from the Indian neem or its most active principle, the limonoid *Azadirachtin* (AZA), have been extensively used against the insect pests in recent years (Sharma, 2011). Sharma et al. (2004) also studied the toxicity of different concentrations of neem products on *Acrida exaltata* as a production enhancement measure.

In order to enhance the cotton, the toxic effect of neem *(Azadirachta indica)* extracts *viz.,* neem leaves, neem green seed coat, neem yellow seed coat and neem seed kernel were evaluated against eggs and adults of *Dysdercus koenigii*.

2. MATERIALS AND METHODS:

2.1. Culture of *Dysdercus koenigii*:

Adults and nymphs of *Dysdercus koenigii* were collected from Agriculture Farm of Aligarh Muslim University, Aligarh. The culture of this pest was maintained in the insectory under controlled

conditions (28±2°C and 70-80% relative humidity). They were maintained in the glass rearing jars (measuring 20 x 15 cm) containing a layer of moist sand (4 cm thick), which was previously sterilize in autoclave. The mouth of these jars was covered with a piece of muslin cloth, fixed with rubber band. All the stages were fed on the fresh healthy soaked cotton seeds and overcrowding was avoided.

2.2. Collection and Identification of Neem:

The neem leaves, neem seed kernel and neem seed coat were collected from the University premises during spring seasons. The identification of these collected plants was confirmed by Former Professor Wajahat Ali Khan, Plant Taxonomist, Department of Botany, Aligarh Muslim University, Aligarh.

2.3. Preparation of Neem Extract:

Neem leaves, neem seed kernel and seed coat were washed thoroughly with distilled water, dried at room temperature for the preparation of fine grinding. The crystals obtained after grinding were considered technically 100% pure. From this pure material 2% stock solution was prepared as per recommendation of Pearson's square method, using double distilled water with the help of magnetic stirrer in order to dissolve the material completely and stock solution was refrigeration until needed.

2.4. Evaluation of Neem Extracts Against *Dysdercus Koenigii*:

Different concentrations of neem extracts were prepared from stock solution of neem extracts by sterilized double distilled water. The cotton seeds were soaked into solutions containing different concentration of neem extracts. After treatment, insects were examined after an hour and the mortality were recorded. The dead specimens were removed carefully with the help of brush. The above experiments were replicated thrice for each set of concentrations with respect to eggs and adult of *D. koenigii*.

2.5. Bioassay of Neem Extracts:

To study the bioassay of different concentration of neem extracts, clean and healthy 0-6 hour old eggs of *D. koenigii* were collected from the culture, and neem extracts were applied at 0.005% concentration on 25 eggs in each set. In each experiment, 25 eggs with different concentration of neem extracts were arranged equidistantly in the glass Petri dish, the base of which was covered with a whatman No. 1 filter paper. We applied neem extracts on eggs and seen its effects after 72 hours. Parallel control set was maintained where the eggs were heated with solvent only (DDW).

In view of the specificity of bio-insecticidal action, the neem extracts were used against adults of *D. koenigii*. The cotton seeds were soaked into solutions containing different concentrations of neem extracts separately. The concentrations were prepared in fresh and sterilized double distilled water. From the stock solution of neem extracts further dilutions *viz.,* 0.005%, 0.01%, 0.025%, 0.05%, 0.1%, 0.25%, 0.5% and 1.0% were prepared. After treatment, insects were removed carefully with the help of brush. The mortality was noted after 24hours. All experiments were repeated thrice with respect to 50 specimen of adult *D. koenigii*.

2.6. Statistical Analyses:

For preparation of final table following statistical procedures were used:

2.6.1. Arithmetic Mean (AM) and Standard Deviation (SD):

Arithmetic Mean (AM) and Standard Deviation (SD) were calculated for each neem extracts, concentration as well as experimental pest used

$$\text{A.M.} = \frac{\sum fx}{f}$$

Where 'x' number of insect and 'f' corresponding frequency and ∑ f is sum of all frequencies:

$$\text{S.D.} = \sqrt{\frac{\sum x^2 - (\sum fx)^2}{\text{N-1}}}$$

Where, 'x' is percent mortality and 'N' is number of observations.

2.6.2. Chi-square (x^2) Analysis:

X was used for homogeneity/heterogeneity and applied to verify the significant difference between samples;

$$x^2 = \sum \left[\frac{fo - fe^2}{fe} \right]$$

Where, (fo) and (fe) are the observed and expected frequencies respectively.

2.6.3. Coefficient of Correlation (r):

Coefficient of correlation was used and calculated as:

$$r = \frac{\sum xY - \frac{(\sum x)(\sum y)}{N}}{\sqrt{\left(\sum x^2 \frac{(\sum x)^2}{N}\right)\left(\sum Y^2 \frac{(\sum Y)^2}{N}\right)}}$$

Where, 'x' is concentration applied and 'y' is the percent mortality noted after the respective treatment.

2.6.4. Linear Regression Equation:

The coefficient of linear regression B (slope) of Y on x is calculated as follows:

$$\frac{\triangle Y}{\triangle X} = \frac{\text{change in the value of x}}{\text{change in the value of y}}$$

Y, is intercept is calculated as, Y= a+bx

This equation has been obtained to study the effect in terms of transformed mortality as a linear regression of different neem extracts at different concentrations.

2.6.5. Lethal Concentrations:

LC50 values were calculated from the transformed mortality concentration graph.

2.6.6. Relative Ratio (RR)/Toxicity Ratio:

Relative ratio for neem extracts was calculated by taking LC_{50} as unity and divided it by the respective LC_{50} of the same ventricle column.

3. RESULTS:

Toxic effect of plant extracts was evaluated against the *Dysdercus koenigii* to suggest a safe method for their control. The adult of the pest were reared and subjected to the toxic effect of four neem extracts *i.e.,* neem leaves, neem green seed coat, neem yellow seed coat and neem seed kernel. The concentrations used were 0.005%, 0.01%, 0.25%, 0.5%, 0.1%, 0.25%, 0.5% and 1.0% of each neem extract.

Table 1. Toxic effect of neem (*Azadirachta indica*) extracts on *Dysdercus koenigii* (Fabricius) adults.

Neem Extracts	Percent Mortality at Various Concentrations							
	0.005%	0.01%	0.025%	0.05%	0.1%	0.25%	0.5%	1.0%
Neem Leaves	12.00±0.707	17.00±0.829	28.00±1.870	38.00±1.500	45.00±2.586	69.00±3.960	71.00±3.491	72.00±3.741
Neem Green Seed Coat	4.00±1.000	9.00±0.829	13.00±0.829	15.00±1.299	19.00±1.299	24.00±1.581	47.00±5.356	62.00±6.837
Neem Yellow Seed Coat	0.00±0.000	12.00±1.224	16.00±1.224	21.00±1.299	33.00±1.479	42.00±3.354	54.00±4.717	76.00±5.244
Neem Seed Kernel	8.00±0.707	28.00±2.549	31.00±2.277	35.00±2.586	47.00±3.491	49.00±3.112	69.00±1.299	73.00±2.046

3.1. Toxicity of Neem Extracts:

The observations revealed that the highest mortality (76.0%) was observed when the insects were allowed to feed on cotton seeds treated with 1.0% concentration *A. indica* (neem yellow seed coat), whereas, the least mortality was nil recorded with neem yellow seed coat (Table 1). The toxic effect of leaves, neem green seed coat and neem yellow seed coat was found to be significant at 5%,

whereas, neem seed kernal was found to be significant at 1% level as obtained from chi-square test (x) (Table 2). The slope (B) was highest (99.627) for leaves and lowest (71.345) for green seed coat (Table 2).

Table 2. Statistical analysis of LC_{50} and other parameters with respect to neem extracts on adult *Dysdercus koenigii* (Fabricius)

Neem Extracts	No. of Insects (N)	Chi-square (χ^2)	Coefficient of Correlation (r)	Regression equation	Slope (β)	Intercept (t)	LC_{50}	Relative Ratio (RR)	Order of Toxicity
Neem Leaves	100	13.92*	0.7809	y = 54.62x + 30.75	99.627	36.542	0.475	1.0526	1
Neem Green Seed Coat	100	5.47*	0.9721	y = 55.86x + 10.57	71.345	21.560	0.487	1.0266	2
Neem Yellow Seed Coat	100	6.18*	0.9338	y = 66.38x + 15.65	89.285	27.954	0.487	1.0266	2
Neem Seed Kernel	100	19.93**	0.8461	y = 52.43x + 29.78	96.017	35.277	0.475	1.0526	1

* = Significant at 5% level, ** = Significant at 1% level, *** = Significant at 0.01% level

3.2. Lethal Concentrations of Neem Extracts:

The value of LC_{50} were found to be highest (0.487) for neem green seed coat and neem yellow seed coat, however, a lowest value (0.475) was observed for neem leaves and neem seed kernel (Table 2).

3.3. Coefficient of Correlation:

A positive correlation (r=0.9721) was noted for neem green seed coat and least value (r=0.7809) was obtained for neem leaves in case of *D. Koenigii* adults (Table 2).

3.4. Relative Ratio:

The statistical analysis shows that the leaves and neem seed kernel are most effective (relative ratio=1.0526) (Table 2) and neem green seed coat and neem yellow seed coat were least effective (Relative ratio =1.0266) at LC_{50} (Table 2). The order of toxic effect showed neem leaves and neem seed kernel (1.0526) > neem yellow seed coat (1.0266) = neem green seed coat (1.0266) (Table 2).

3.5. Application of Neem Extracts Against Eggs of *Dysdercus koenigii*:

The application of neem extracts on the eggs showed that highest survival (21.75%) at 0.005% concentration of neem yellow seed coat. The least survival of egg (9.25) was also observed at 0.005% neem green seed coat and neem seed kernel extract after one weak (Table 3).

Table 3. Toxic Effect of neem (*Azadirachta Indica*) extracts on eggs of *Dysdercus koenigii* (Fabicius)

Neem extracts @ 0.005%	Survival of Eggs (25 individuals in each Replicate)		
	After 1 day old (egg) 24h	After 2 days old (egg) 48h	After 3 days old (egg) 72h
Neem Leaves	20.75 (±3.491)	16.25 (±4.656)	13.50 (±4.387)
Neem Green Seed Coat	19.25 (±3.766)	13.50 (±1.50)	9.25 (±1.479)
Neem Yellow Seed Coat	21.75 (±3.269)	15.00 (±1.414)	12.25 (±0.829)
Neem Seed Kernel	18.75 (±4.145)	12.25 (±0.829)	9.25 (±0.829)

4. DISCUSSION:

Research conducted during the last 10-15 years have demonstrated diverse behavioral and physiological effects of neem on insects repellent (Jacobson, 1981), antifeedant (Pradhan et al., 1962),

oviposition deterrent (Singh and Srivastava, 1983), growth inhibitor and production of malformed adult (Leuschner, 1972), sterilent (Dron et al., 1987) and also direct toxicity (Singh et al., 1988). Azadirachtin is found to be the most potent neem fraction that adversely effects the growth and development of different insects in specific manner by its multifarious actions like repellent, morphogenetic variation, oviposition inhibition and sterilent (Rembold, 1996 and Immaraju, 1998).

The data (Table 2) showed that the extracts of leaves, neem green seed coat, neem yellow seed coat and neem seed kernel showed significant lethal effect on the *D. koenigii*. At 1.0% concentration, neem yellow seed coat showed 76% mortality of *D. koenigii*. Chakraborti and Chatterjee (1999) also reported the effect of Azadirachtin and other neem pesticides on survival, growth and development of red cotton bug *Dysdercus koenigii*. In another experiment, biological activity of four neem formulations *viz., Azadirachtin*, *Azadirachtin- iodine,* neem seed kernel extract (NSKE) and oil was discussed against the eggs and nymphs of *D. Koenigii* in the laboratory by Bream (2001). They obtained ovicidal nymphicidal deterrent growth regulatory and antifertility activity of Azadirachtin. On the other hand, ether and ethanol extracts of various parts of neem against red cotton bug *Dysdercus koenigii* has been studied by Singh et al., (1997). When the eggs of *D. koenigii* were treated with various neem extracts the highest survival (13.50) was observed at 0.005% concentration of *A. indica* (Leaves). Similar results were also obtained by Sharma et al., (2010) on evaluation of neem (*Azadirachta indica)* extracts against eggs and adults of *Dysdercus cingulatus*.

The present findings revealed that neem leaves, neem green seed coat, neem yellow seed coat and neem seed kernel showed adverse lethal effects against the *Dysdercus koenigii*. The present data shows that neem leaves and neem seed kernel found to be most toxic to *D. koenigii* (RR =1.0526) and neem yellow seed coat, however, neem green seed coat (R.R=1.0266) found to be least toxic. This finding showed completed agreement the result of Jamal and Qamar, (2002). They also reported changes in fecundity, longevity and loss of weight in *Dysdercus cingulatus* due to the application of neem followed by Monocrotophos. Similarly, Mandal and Bhattacharya (2003) also observed that Azadirachtin is a most potent neem derivative has diverse effect on *Spilosoma obliqua.* However, topical application of Azadirachtin failed to proved any insecticidal affect on this insect (Sharma, 2011).

It could be accomplished from present findings that the farmers of under study area may formulate their own neem based insecticides for management of the red cotton bug, *D. koenigii* on cotton. The products may also be prepared by farmers on their own field with cheapest cost. They are also advice to use neem leaves and neem seed kernel for significant management of red cotton bug *D. koenigii*.

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A new species of genus *Phanerotoma* Wesmael (Hymenoptera: Braconidae) from Saudi Arabia

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Abstract

Phanerotoma asiri sp. nov., (Hym., Braconidae) is described from Saudi Arabia. Morphological diagnostic characters of the new species are figured, and it is compared with those of the related species from Arabian region. A key to Saudi Arabian species is also provided.

1. INTRODUCTION:

Phanerotoma is a cosmopolitan genus containing parasitoids of Lepidoptera with 194 known species from the almost all Zoogeographic regions (Zettel, 1990; Achterberg, 1990; Tobias, 2000 and Yu et al., 2006). The genus is characterized by glabrous eyes, 23 segmented antenna, clypeus with three teeth, vein 2-R1 of forewing absent, vein CUlb of forewing more or less developed giving rise to a closed first sub-discoidal cell, carapace with transverse sutures distinct and third metasomal tergite without side teeth.

Wesmael (1838) erected the genus *Phanerotoma* with the type species *Chelonus dentatus* Panzer. Tobias (1972 & 1986) divided the genus *Phanerotoma* into four subgenera: *Bracotritoma* Csiki, 1909, *Phanerotoma* s.str., Wesmael, 1838 *Phanerotomina* Shestakov, 1930 and *Unica* Snoflák, 1951. Achterberg (1990) recognized only two of these subgenra *viz.*, *Bracotritoma* Csiki and *Phanerotoma* s.str., Wesmael and considered that the use of the rest subgenre *viz.*, *Phanerotomina* Shestakov and *Unica* Snoflák is superfluous. In this work the author has adopted the approach proposed by Achterberg (1990). Only four species of *Phanerotoma* have been described previously from Saudi Arabia *viz.*, *Phanerotoma arabica* Ghrmah, *Phanerotoma* (*Bracotritoma*) *graciloides* Achterberg, *Phanerotoma* (*Bracotritoma*) *masiana* Fahringer and *Phanerotoma* (*Bracotritoma*) *robusta* Zettel (Achterberg, 1990; Gharmah,2011 and Zettel, 1988). A fifth species of this genus from this region is described below and a key to Saudi Arabian species is also provided.

2. MATERIALS AND METHODS:

Specimens were collected by sweeping net and malaise traps from different regions of Abha and Khamis Mushait, Saudi Arabia. The samplings were conducted between 2011 in the Asir province. The collected specimens were killed with ethyl acetate and mounted on triangular labels and were examined with a stereoscopic binocular microscope Nikon SMZ1200. Classification, nomenclature and distributional data of Braconidae suggested by Yu et al. (2006) have been followed. The terminology for morphology follows that used by Achterberg (1993). The types of new species are deposited in Department of Zoology, King Khalid University, Abha, Kingdom of Saudi Arabia.

3. RESULTS:

3.1. Key to Saudi Arabian species of *Phanerotoma* Wesmael:

1a. Maximum width of pterostigma more than 1.1 times length of vein 3-SR of fore wing; vein 1-SR of fore wing as long as pterostigma or distinctly shorter; veins 2-SR and SRI of fore wing (nearly)

straight; middle tibia usually without distinct blister ……..2

1b. Maximum width of pterostigma less than l. 1 times vein 3-SR of fore wing; vein 1-R1 of fore wing longer than pterostigma; veins 2-SR and SRI curved; middle tibia with whitish blister.....3

2a. Marginal cell of fore wing shorter than pterostigma; parastigma usually pale yellowish; vein r of fore wing vertical; middle tibia whitish sub-basally……..
.....*P. (B.) masiana* Fahringer

2b. Marginal cell of fore wing about as long as pterostigma; parastigma dark brown; vein r of fore wing slightly reclivous; middle tibia yellowish sub-basally……..
……..*P. (B.) graciloides* Achterberg

3a. Fore tarsus long setose, several setae about as long as twice width of tarsal segments; length of fore wing about 5.5 mm, of body about 7 mm; maximum width of head 0.8 times maximum width of mesoscutum ……..
.....*P. (B.). robusta* Zettel

3b. Fore tarsus normally setose, setae at most as long as width of tarsal segments; length of fore wing 2.5 mm or shorter, of body less than 4.5 mm; head wider than maximum width of mesoscutum 4

4a. Metasoma oval in shape dorsally, its third medial tergite length 1.2 times medial length of second tergite; ovipositor sheath not protruding beyond apex of metasoma ……..
.....*P. (B.) arabica* Ghrmah

4b. metasoma slender in shape dorsally, its third medial tergite length 1.8 times medial length of second tergite; ovipositor sheath protruding beyond apex of metasoma .....
……. *P. (B.) asiri* sp. nov.

3.2. Description:

***Phanerotoma* (*Bracotritoma*) *asiri* sp. nov.**

3.2.1. Female: Length of fore wing 2.7 mm, of body 4.9 mm (Fig. 1).

3.2.2. Colour: Yellowish; apex of antenna, pterostigma (but basal half pale) and apical one third of metasoma, tegulae, parastigma dark brown; metasomal tergite one and two, veins M+CU1, basal half of 1-1A, cu-a, apical half of 2-Cu1, basal half of 2-SR, 2M and m-cu of fore wing pale yellowish to creamish; wing membrane below pterostigma somewhat infuscated; remainder of veins largely brown; middle tibia whitish subbasally.

3.2.3. Head: Sub-apical antennal segments of female robust and beadlike; AOL:POL:OOL= 6:4:14; frons and vertex granulate; length of eye in dorsal view 2.3 times temple; face ruglose-granulate, about twice as wide as high; clypeus smooth and shiny about 2 times as wide as high; length of molar space 0.8 times basal width of mandible; inner tooth of mandible 0.7 shorter than outer tooth and little inverted below; head in frontal view about as wide as high.

3.2.4. Thorax: Mesoscutum punctate with granulate background. Scutellum with same sculpture as mesoscutum; mesosternum granulate-ruglose as most of mesopleuron; propodeum reticulate-rugulose, without distinct strong carinae; Fore wing r 2.1-2.5 times vein 3-SR, vertical; 2-SR and SRI curved; marginal cell 2.5 times as wide as high; 1-R1 1.4 times as long as pterostigma; parastigma medium-sized, dark brown; 1-SR+M not dark brown, less than vein 2-CU1; maximum width of pterostigma about 0.8 times 3-SR. Middle tibia slender, with distinct blister.

3.2.5. Metasoma: Shape of metasoma slender and rather flate; first and second tergites finely longitudinally reticulate-rugulose, shiny, different from sculpture of third tergite, which is granulate-rugulose; third tergite of female distinctly emarginate, with slightly protruding corners latero-apically (Fig. 2), its medial length 1.8 times medial length of second tergite; ovipositor sheath protruding beyond apex of metasoma.

Fig. 1. Fore wing *Phanerotoma* (*Bracotritoma*) *asiri* sp. nov., (holotype, female)

Fig. 2. Habitus *Phanerotoma* (*Bracotritoma*) *asiri* sp. nov., (holotype, female)

3.2.6. Male: Unknown.

3.2.7. Distribution: Saudi Arabia: Asir region, Abha and Khamis Mushait.

3.2.8. Host: Unknown

3.3. Material Examined:

3.3.1. Holotype: Female (on card), 10.viii. 2011, ABHA, Asir region, Saudi Arabia, coll. Hamed, (Malaise trap).

3.3.2. Paratypes: 2 females (on card) with same data as holotype. All the material is housed in Museum Collection, Department of Biology, King Khalid University, Abha. (All the type material presently in the personal collection of author and will be deposited in King Saud University Museum, Riadh, Kingdom of Saudi Arabia).

3.4. Etymology: The species name is derived from its type locality.

4. DISCUSSION:

Phanerotoma (*Brantoma*) *asiri* sp.nov has the resemblance from *Phanerotoma* (*Brantoma*) *arabica* Ghrmah. However, it can be easily separated in having: mesopleuron punctate with granulate in background; metasoma oval in shape dorsally, its third medial tergite length 1.8 times medial length of second tergite; ovipositor sheath protruding beyond apex of metasoma and mesosoma and apical half of metasoma and hind tibia not infuscated.

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Studies on population dynamics of ladybird beetles on cauliflower in some districts of Uttar Pradesh, India

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Abstract

An extensive survey has been conducted in farmer's field of cauliflower at three districts (Mathura, Agra and Firozabad) of Uttar Pradesh in experimental year 2009-10 and 2010-11. Aphid, *Lipaphis erysimi* (Kalt.) was found to attack on cauliflower field at every experimental site. However, three species of ladybird *viz.*, *Coccinella septempunctata* Linnaeus, *Coccinella transversalis* Fabricius and *Menochilus sexmaculatus* Fabricius was also obtained to be associated with aphid colonies. The highest population of *L. rrysimi* was recorded as 368, 388 and 310 aphids/plant at Farah, Mathura and Chhatikaran in district Mathura in the month of March of year 2010, respectively. In the successive experimental year (2010-11), diversity in population of aphids was recorded as 377, 298 and 318 aphids/plant at above experimental sites, respectively. The populations of coccinellids have been synchronized with inhabitants of aphids. The maximum number of ladybeetles (*C. septempunctata*, *C. transversalis* and *M. sexmaculatus*) was obtained as 5.00, 3.00 and 3.50; 7.00, 3.50 and 4.00; 9.00, 4.00 and 3.00 in March 2010; and 5.00, 3.50 and 2.50; 5.00, 4.00 and 3.00; 8.00, 5.00 and 3.50 during March 2011, respectively. Similar deviation in the population of aphid as well as ladybeetles also recorded at district Agra and Firozabad during experimental year 2009-10 and 2010-11. It was also interestingly noticed that *C. septempunctata* was found to be dominating species at every experimental site than other ladybeetle species.

1. INTRODUCTION:

Cauliflower, *Brassica oleracea* is one of the important vegetable of family Brassicaceae. It is closely related to cabbage and has a long history. The cauliflower originally came from Cyprus. It is thought to have been used since the 6th century and grown in Turkey and Egypt since 400 B.C. Thereafter, it had been introduced to France from Genoa in the 16th century. In India, it was cultivated during the Mughal period. Usually, India produce about 0.50 mt cauliflower from 0.30 mha with an average yield of 17.1 tonne/ha. It is grown mainly in Punjab, Uttar Pradesh, Bengal and Karnataka. This crop is less hardy than cabbage, requires cold and moist climate for its satisfactory growth. It is rich in minerals, namely, iron, magnesium, phosphorous etc (Rizvi et al., 2009).

Survey is a vital component of basic research, provides information on different aspects including key pest status and role of natural enemies. It also provides information of individuals from a population in the field, with a view towards making statistical inferences about the population using the sample. It is always based on a sampling of the population; the success of the research is dependent on the representativeness of the population of concern. The collection of natural enemies along with their prey in cauliflower crop ecosystem and subsequently their identification is an important task for initiation of research on biological control of pest management (Ali and Rizvi, 2008). Among different natural enemies of aphids *i.e.*, coccinellid, syrphid, aphidids, crisopids etc, ladybird beetles are dominating species to manage aphids throughout the world. Therefore, in the present study an extensive survey has been made to collect indigenous species of coccinellids in some districts of Utter Pradesh.

2. MATERIALS AND METHODS:

An extensive survey has been conducted in farmer's field of cauliflower at Farah, Mathura and Chhatikaran in district Mathura; Sikandra, Khandauli and Chhalesar in district Agra; and Tundla, Firozabad

and Shikohabad in district Firozabad during experimental year 2009-10 and 2010-11. The aphid species (*Lipaphis erysimi*, Kalt.) was found dominating to attack on cauliflower field at every experimental site. However, three species of ladybird *viz.*, *Coccinella septempunctata* Linnaeus, *Coccinella transversalis* Fabricius and *Menochilus sexmaculatus* Fabricius was also obtained to be associated with the aphid colonies. The cocinellids were quite round in shape and small in size, ranging from 1-10 mm. Body colour was yellow and orange or scarlet with small black spots on their elytra. The head, antennae and legs were black in colour. The populations of above coccinellid species are synchronized in inhabitants of aphids.

The survey has been conducted in the farmers field of cauliflower (each replicated thrice) at every experimental sites of each districts on the basis of one month intervals and population of associated coccinellid species were recorded for making the population index. To construct ***POPULATION INDEX*** of different coccinellid species in given area and time, following assumption has been used for different set of populations in the experimental field:

0 = no coccinellid in the field
1 = 1 coccinellid present on each plant
2 = 2 coccinellids present on each plant
3 = 5 coccinellid present on each plant
4 = 5-10 coccinellids present on each plant
5 = > 10 coccinellids present on each plant

3. RESULTS:

Table 1. Population record of different coccinellid species in cauliflower crop at some villages/ places of district Mathura

Year/Months	FARAH				MATHURA				CHHATIKARAN			
	Aphid	Ladybeetle sps.			Aphid	Ladybeetle sps.			Aphid	Ladybeetle sps.		
		Sp1	Sp2	Sp3		Sp1	Sp2	Sp3		Sp1	Sp2	Sp3
Experimental year 2009-10												
February, 2009	212	3.00	2.50	2.50	239	4.00	3.00	3.00	255	5.00	3.00	2.50
March, 2009	368	5.00	3.00	3.50	388	5.00	3.50	4.00	310	5.00	4.00	3.00
April, 2009	65	1.00	0.75	1.00	79	1.00	0.75	1.00	88	1.00	1.00	0.75
May, 2009	*	*	*	*	*	*	*	*	*	*	*	*
June, 2009	*	*	*	*	*	*	*	*	*	*	*	*
July, 2009	*	*	*	*	*	*	*	*	*	*	*	*
August, 2009	*	*	*	*	*	*	*	*	*	*	*	*
September, 2009	*	*	*	*	*	*	*	*	*	*	*	*
October, 2009	*	*	*	*	*	*	*	*	*	*	*	*
November, 2009	18	0.00	0.00	0.00	11	0.00	0.00	0.00	17	0.00	0.00	0.00
December, 2009	126	1.00	1.00	0.75	141	1.50	1.50	1.00	161	1.00	1.00	1.00
January, 2010	178	3.00	2.00	2.00	187	3.50	2.50	2.50	192	2.50	2.50	2.00
Experimental year 2010-11												
February, 2010	227	4.00	3.00	2.00	253	4.00	3.00	2.00	273	7.00	4.00	3.00
March, 2010	377	5.00	3.50	2.50	298	5.00	4.00	3.00	318	5.00	4.50	3.50
April, 2010	59	0.75	0.75	0.75	85	0.75	0.75	0.75	94	1.50	1.00	0.75
May, 2010	*	*	*	*	*	*	*	*	*	*	*	*
June, 2010	*	*	*	*	*	*	*	*	*	*	*	*
July, 2010	*	*	*	*	*	*	*	*	*	*	*	*
August, 2010	*	*	*	*	*	*	*	*	*	*	*	*
September, 2010	*	*	*	*	*	*	*	*	*	*	*	*
October, 2010	*	*	*	*	*	*	*	*	*	*	*	*
November, 2010	6	0.00	0.00	0.00	8	0.00	0.00	0.00	19	0.00	0.00	0.00
December, 2010	132	1.00	0.75	0.75	139	1.00	1.00	0.75	177	2.00	1.00	1.00
January, 2011	189	3.00	3.00	2.50	197	3.00	2.50	2.00	214	3.50	3.50	3.00

* = Crop not available, Sp1 = *C. septempunctata,* Sp2 = *C. transversalis*, Sp3 = *M. sexmaculatus*

An extensive survey has been made in the farmer's field of cauliflower at three districts (Mathura, Agra and Firozabad) of Uttar Pradesh; the study revealed that farmers were prepared nursery-bed of cauliflower in the first week of October and transplanted them in the field during last week of October. On which, aphid attack initially recorded in the month of November at every experimental site.

In biosphere, some aphidophagous ladybeetles also appeared in the farmer's fields in the month of November to manage the aphids and their population has been increased with inhabitants of aphid. The fauna of ladybeetles associated with aphid colonies were *Coccinella septempunctata*, *Coccinella transversalis* and *Menochilus sexmaculatus*.

Table 2. Population record of different coccinellid species in cauliflower crop at some villages/ places of district Agra

Year/Months	SIKANDRA				KHANDAULI				CHHALESAR			
	Aphid	Ladybeetle sps.			Aphid	Ladybeetle sps.			Aphid	Ladybeetle sps.		
		Sp1	Sp2	Sp3		Sp1	Sp2	Sp3		Sp1	Sp2	Sp3
Experimental year 2009-10												
February, 2009	263	5.00	2.50	3.50	279	5.00	2.50	3.00	283	5.00	2.50	3.50
March, 2009	321	5.00	4.00	3.50	436	5.00	3.50	4.00	453	5.00	4.00	4.50
April, 2009	79	2.00	0.75	1.00	87	2.00	0.75	1.00	76	2.00	1.00	1.00
May, 2009	*	*	*	*	*	*	*	*	*	*	*	*
June, 2009	*	*	*	*	*	*	*	*	*	*	*	*
July, 2009	*	*	*	*	*	*	*	*	*	*	*	*
August, 2009	*	*	*	*	*	*	*	*	*	*	*	*
September, 2009	*	*	*	*	*	*	*	*	*	*	*	*
October, 2009	*	*	*	*	*	*	*	*	*	*	*	*
November, 2009	25	0.00	0.00	0.00	21	0.00	0.00	0.00	17	0.00	0.00	0.00
December, 2009	167	1.50	1.00	1.50	173	1.50	1.00	1.00	164	1.00	1.00	1.50
January, 2010	211	3.00	1.50	2.50	223	3.50	2.00	2.00	215	3.00	1.50	3.00
Experimental year 2010-11												
February, 2010	257	5.00	3.00	2.00	243	3.50	2.50	2.00	255	4.00	3.00	2.50
March, 2010	302	5.00	3.50	2.50	287	4.00	3.00	3.00	295	5.00	4.00	3.50
April, 2010	97	2.50	1.50	1.00	52	1.50	1.00	1.00	69	2.00	1.50	1.00
May, 2010	*	*	*	*	*	*	*	*	*	*	*	*
June, 2010	*	*	*	*	*	*	*	*	*	*	*	*
July, 2010	*	*	*	*	*	*	*	*	*	*	*	*
August, 2010	*	*	*	*	*	*	*	*	*	*	*	*
September, 2010	*	*	*	*	*	*	*	*	*	*	*	*
October, 2010	*	*	*	*	*	*	*	*	*	*	*	*
November, 2010	18	0.00	0.00	0.00	15	0.00	0.00	0.00	20	0.00	0.00	0.00
December, 2010	166	1.50	1.50	1.50	153	1.00	1.00	0.75	173	1.50	1.00	0.75
January, 2011	202	2.50	2.50	2.50	194	2.00	1.50	1.00	217	2.50	2.00	1.50

* = Crop not available, Sp1 = *C. septempunctata*, Sp2 = *C. transversalis*, Sp3 = *M. sexmaculatus*,

A variation in the population of different coccinellid species was quite evident with change in experimental site and year. The highest population index of *C. septempunctata* was recorded 5.00 at Farah, Mathura and Chhatikaran in district Mathura during March, 2009-10and 2010-11, respectively (Table 1). The population index of *C. transversalis* also showed different pattern and recorded as 3.00 and 3.50 at Farah; 3.50 and 4.00 at Mathura; and 4.00 and 4.50 at Chhatikaran in March, 2009-10 and 2010-11, respectively (Table 1). On the other hand, *Menochilus sexmaculatus* exhibited maximum index (3.50 and 2.50), (4.00 and 3.00) and (3.00 and 3.50) at Farah, Mathura and Chhatikaran in the month of March during experimental year 2009-10 and 2010-11, respectively (Table 1).

At Agra, the population index of *C. septumpunctata* showed significant variation in the

population index and recorded highest as 5.00 at every experimental site (Sikandra, Khandauli and Chhalesar) during the month of March in year 2009-10 and 2010-11, respectively; with exception of Khandauli, where it was found 4.00 index in the month of March during 2010-11 (Table 2). The result on the population index of *Coccinella transversalis* also showed difference with *C. septempunctata* and attained maximum index of 4.00 and 3.50 at Sikandra, 3.50 and 3.00 at Khandauli, and 4.00 and 4.00 at Chhalesar in March, 2009-10 and 2010-11, respectively (Table 2). On the other hand, the highest index of *M. sexmaculatus* was recorded (3.50 and 2.50), (4.00 and 3.00) and (4.50 and 3.50) at Sikandra, Khandauli and Chhalesar during the month of March in year 2009-10 and 2010-11, respectively (Table 2).

At district Firozabad, the highest population index of *C. septempunctata*, *C. transversalis* and *M. sexmaculatus* was recorded (5.00 and 5.00), (5.00 and 3.50) and (5.00 and 4.00); (3.00 and 4.00), (3.00 and 3.00) and (4.00 and 3.50); and (4.00 and 3.00), (4.33 and 2.50) and (3.00 and 3.00) at Tundla, Firozabad and Shikohabad in the month of March during 2009-10 and 2010-11, respectively (Table 3).

Table 3. Population record of different coccinellid species in cauliflower crop at some villages/ places of district Firozabad

Year/Months	TUNDLA				FIROZABAD				SHIKOHABAD			
	Aphid	Ladybeetle sps.			Aphid	Ladybeetle sps.			Aphid	Ladybeetle sps.		
		Sp1	Sp2	Sp3		Sp1	Sp2	Sp3		Sp1	Sp2	Sp3
Experimental year 2009-10												
February, 2009	207	3.00	2.50	3.00	254	5.00	2.00	4.00	248	5.00	3.00	4.00
March, 2009	365	5.00	3.00	4.00	302	5.00	3.00	4.33	288	5.00	4.00	3.00
April, 2009	55	1.00	0.75	1.00	45	1.50	0.75	1.00	52	1.50	1.00	0.75
May, 2009	*	*	*	*	*	*	*	*	*	*	*	*
June, 2009	*	*	*	*	*	*	*	*	*	*	*	*
July, 2009	*	*	*	*	*	*	*	*	*	*	*	*
August, 2009	*	*	*	*	*	*	*	*	*	*	*	*
September, 2009	*	*	*	*	*	*	*	*	*	*	*	*
October, 2009	*	*	*	*	*	*	*	*	*	*	*	*
November, 2009	7	0.00	0.00	0.00	10	0.00	0.00	0.00	10	0.00	0.00	0.00
December, 2009	123	1.00	1.00	1.50	137	1.50	1.00	1.50	135	1.50	1.00	1.00
January, 2010	165	2.50	2.00	2.50	178	2.50	1.50	2.50	183	2.50	1.50	2.00
Experimental year 2010-11												
February, 2010	235	5.00	3.50	2.50	244	**3.00**	2.50	2.00	237	3.50	3.00	2.00
March, 2010	273	5.00	4.00	3.00	263	3.50	3.00	2.50	259	4.00	3.50	3.00
April, 2010	62	1.00	1.00	0.75	35	0.75	0.75	0.75	41	1.00	1.00	0.75
May, 2010	*	*	*	*	*	*	*	*	*	*	*	*
June, 2010	*	*	*	*	*	*	*	*	*	*	*	*
July, 2010	*	*	*	*	*	*	*	*	*	*	*	*
August, 2010	*	*	*	*	*	*	*	*	*	*	*	*
September, 2010	*	*	*	*	*	*	*	*	*	*	*	*
October, 2010	*	*	*	*	*	*	*	*	*	*	*	*
November, 2010	8	0.00	0.00	0.00	9	0.00	0.00	0.00	12	0.00	0.00	0.00
December, 2010	134	1.50	1.00	0.75	141	1.00	0.75	0.75	137	1.00	1.00	1.00
January, 2011	183	3.00	2.50	2.00	184	2.00	1.50	1.00	199	2.50	2.00	1.50

* = Crop not available, Sp1 = *C. septempunctata*, Sp2 = *C. transversalis*, Sp3 = *M. sexmaculatus*

4. DISCUSSION:

In the present investigations, the variation in the population index of different coccinellids has been recorded with change in the experimental sites and experimental years. This shows complete collaboration with the findings of the Honek (1985), Kieckhefer and Elliott (1990), Elliott et al. (1996), Hodek and Michaud (2008) and Ali and Rana (2011 & 2012). However, other workers of ladybeetles also reported variation in the population of coccinellids, which could be attributed to the change in population of aphids (Chattopadhyaya et al., 2005 and Rai and Mishra, 2007). In another experiments some author also believe that the variation in population of coccinellids also depend on the change of environmental factors (Srivastava et al., 1995; Prasad, 2003; Chattopadhyaya et al., 2005 and Ansari

et al., 2007). However, few report are available on the variation with the change in the plant characteristics (Honek and Martinková, 2005; Yano, 2006 and Hodek and Michaud, 2008). In the present findings, *C. septempunctata* was found to be dominating species than *C. transversalis* and *M. sexmaculatus* at every experimental site. It is quite possible due to the suitability of habitat and this species can survive in every habitat including gardens, orchards, nurseries, forest and agricultural fields (Turnock et al., 2003; Honek and Martinková, 2005; Hodek and Michaud, 2008 and Ali et al., 2010).

The study on survey of cauliflower in three districts *viz*. Mathura, Agra and Firozabad of Uttar Pradesh can be concluded that *C. septempunctata*, *C. transversalis* and *M. sexmaculatus* were indigenous species of ladybeetle at selected locations. However, the population dynamics of these ladybird beetle species showed highest population in the month of March at in every experimental site in both experimental years. Among all the indigenous species, *C. septumpunctata* was found to be dominating species at every experimental site due to habitat preference.

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Studies on the biological attributes of *Oedaleus abruptus* Thunberg (Orthoptera: Acrididae) under laboratory conditions

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Abstract

The field collected *Oedaleus abruptus* reared in specialised wooden cages in thermo-regulated insectary. Oviposition behaviour was observed to be on typical acridiidian pattern. Eggs were incubated at 27±1°C and 37±1°C and 70±5% R.H. The hoppers completed their development through five nymphal stages. The nymphal duration for different experimental set-ups are as follows: At 37±1°C, it was 33.4 days in isolated/male, 30.8 days in crowded/male, 37 days in isolated/female, 32.3 in crowded/female when fed on *Z. mays* and 37.2 days in isolated/male, 33.9 days in crowded/male, 43.1 days in isolated/female, 35.7 days in crowded/female condition when fed on *C. dactylon*. At 27±1°C, it was 37 days in isolated/male, 32.8 days in crowded/male, 42.8 days in isolated/female, 35 days in crowded/female when they were fed on *Z. mays*; and 36.6 days in isolated/male, 33.4 days in crowded/male, 42.6 days in isolated/female, 36.4 days in crowded/female when fed on *C. dactylon.*

1. INTRODUCTION:

In general, grasshoppers are polyphagous, meaning feed on plants belonging to multiple families. They have also been extensively studied on food selection and adequately reviewed by Uvarov (1966) and Chapman (1990). Polyphagy has been demonstrated in different species of grasshoppers *i.e., Acrida exaltata*, *Sphingonotus rubescens*, *Schistocerca gregaria* and *Anacridium rubrispinum* by Sword and Dopman (1999), Chapman (1990) and Chapman and Sword (1997).

Oedaleus abruptus is also a species of grasshopper, which belongs to the subfamily Oedipodinae of family Acrididae. It is a devastating pest of graminaceous crops in north India and widely distributed in Pakistan, Bangladesh, Afghanistan, Sri Lanka, Thailand, Malaysia etc. This pest inflicts damage to maize (*Zea mays*), sorghum (*Sorghum vulgare*), pearl millet *(Pennisetum typhoideum*), wheat (*Triticum aestivum*), sugarcane (*Saccharum offcinarum*), paddy (*Oryza sativa*) and while attacking these crops, it shows a peculiar behaviour of band formation. Beside these crops, it also found to attack on some vegetable crops in India (Khan and Aziz, 1975) and damage is caused mostly by young nymphs in nurseries (Irshad, 1977).

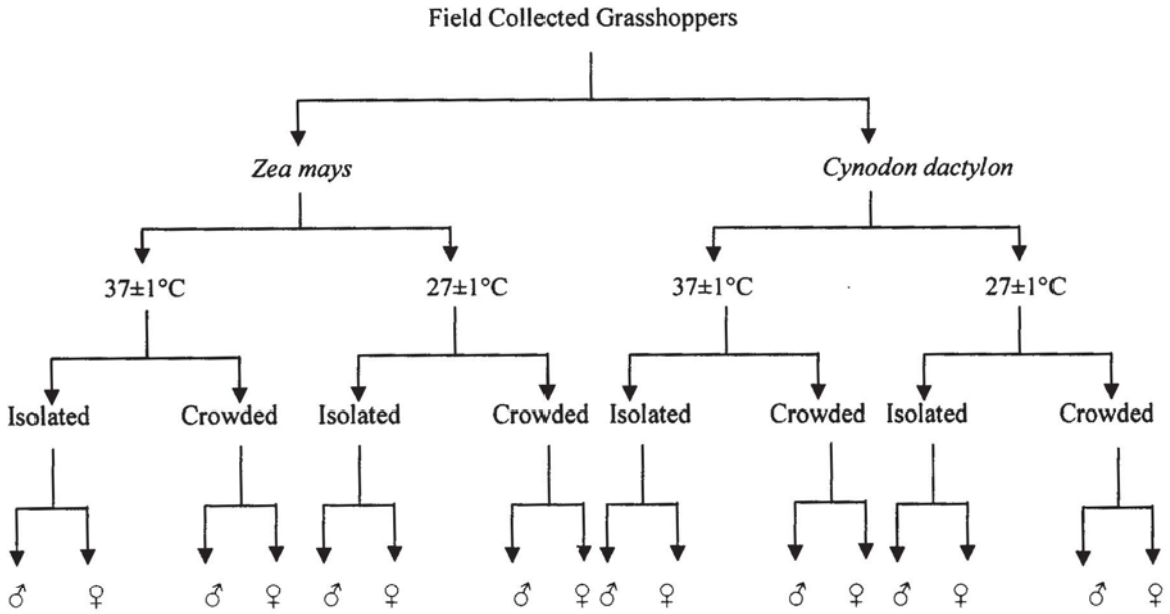
The objective of the present work was to study the biology of *Oedaleus abruptus* under the influence of different environmental setups. There is no information available on its life cycle except little sporadic information. Therefore, present article is an attempt to provide significant information on growing population of *Oedaleus abruptus*, which is assuming new dimension in India especially in northern part of the country.

2. MATERIALS AND METHODS:

Mature and immature stages of *Oedaleus abruptus* were collected from the fields of different graminaceous crops *viz.*, maize, sorghum, barley, wheat, sugarcane by sweeping nets and reared in specially designed wooden cages (53 × 40 × 30 cm). Each cage was provided with a few dry sticks for perching, moulting, basking and also for supporting the leaves supplied as diet. The leaves of *Zea mays* and *Cynodon dactylon* were provided as food.

The field collected grasshoppers were separated into two groups; one fed on *Z. mays* while other on *C. dactylon* and reared in wooden cages in thermo regulated insectary at 37°C and 27°C, respectively. The egg laying tubes from both wooden cages were kept separately in glass jars (15 x 20), covered with muslin cloth and incubated at 27±1°C and 37±1°C and relative humidity of 70±5%. The egg pods were moisturized daily according to the requirement. After definite incubation period, newly hatched grasshoppers were transferred to glass jars (15 x 20 cms) by using aspirator and again separated in two groups. One kept in isolated condition and other in crowded condition. When hoppers attained adult stages, they were transferred to the cages. In isolated condition, a single individual was reared; however, in crowded condition 50 individuals were kept together in the same size of jars. The time taken for copulation, moulting and egg laying was recorded by using stop clock. Mortality in the main experimental setup may affect the results, therefore, three set of parallel experiments were run to maintain the number of grasshoppers in the main experimental setup (Fig.1).

Fig. 1. Experimental plan of study



3. RESULTS AND DISCUSSION:

The hoppers and adults are gregarious and are found in small grasses of *Cynodon dactylon* basking in the sun. Being a polyphagous pest, *O. abruptus* feeds on variety of forbs and grasses and preferably on graminaceous plants. In morning, when the temperature is low they remain sluggish but as the temperature rises they become active and start taking to wings, and in peak hours (noon) they again become sluggish and rest in shadow. In early stages of development, hoppers feed on soft part of leaves and leave the veins and petioles, but in the mature stages they consume all parts of leaves. When adults or hoppers are caught, they emit a blackish offensive secretion with a pungent smell. Similar observations have been made by Katiyar (1955) and Majeed and Aziz (1975) on *Aularches punctatus* (Drury) and *Gastrimargus transverses* Thunberg, respectively, in which *Aularches punctatus* can discharge up to a teaspoon of slimy, bitter tasting froth which smell like vomited to thwart the attack of enemies.

Among the various field crops, *Zea mays* L., *Oryza sativa* L., *Pennisetum typhoideum* Rich., *Saccharum officinarum* L., *Triticum aestivum* L., *Sorghum vulgare* Pers. and *Hordeum vulgare* L. are most susceptible. Also, weeds such as *Echinochloa colonum* Link., *Hemarthria compressa* R., *Setaria verticillata* Beauv., *Cynodon dactylon* Pers., *Cyperus rotundus* L. and *Sorghum halapense* Pers. are common food of *O. abruptus* (Roffey, 1979).

During field trips marching was occasionally observed in the hoppers of *Oedaleus abruptus* primarily in response to availability of food, radiant energy from the sun and air movement, though other factors may involve in the process of marching. Actually marching is a predominantly locust instinct prior to their gregarization in solitary phase of locusts, it was observed previously in *Schistocerca* and *Locusta* by various workers. Sometime marching has been noticed quite unusually when fresh grass present but hoppers of *Oedaleus abruptus* marched

from one plot to another. At that time high radiant heat from sun and wind movement may involve in marching. All these factors would amount to an increase in irritation, which is necessary for marching (Strelnikov, 1936).

3.1. Copulation:

Both male and female *O. abruptus* do not attain maturity at the same time. The maturity is determined by bright colour of the body as in *Schistocerca gregaria* that is closely correlated with the maturation of gonads (Norris, 1964). After attaining maturity they usually underwent in a definite pre-copulation period which vary according to their rearing condition for both the sexes (Table 1 & 2).

The copulation is usually preceded by definite courtship behaviour unlike other grasshopper species. At the start of courtship, male and female come close to each other in head-to-head position and both sexes move their antenna briskly followed by touching of maxillary palps and entire courtship behaviour lasts for an hour. Then male may abruptly jump on the dorsal side of female or may mount female from the hind end of abdomen. A responsive female rarely struggles while the male produces burst of femur shaking and attaches his genitalia, while an unresponsive female may kick away the male.

Oedaleus abruptus exhibits sexual dimorphism, males are of relatively smaller in size than female. The pairs adopted different copulation postures. Generally dorso-lateral posture was observed that initially start with usual 'riding' posture and then changed to 'dorso–lateral' but sometimes hanging posture and back-to-back postures were also noticed. The time taken for copulation is presented in table 3.

The extreme variability in copulation period under different experimental set-ups were observed (Table 3); may be because of short duration of copulation, possibly refer to uncompleted attempts of copulation, while very lengthy ones refer to cases of copulation commencing late in day and continuing overnight when lower temperature slows down or inhibits all activities.

The data obtained can be attributed to the gregarization of the species. The work of Jhingran (1944) on the mode of copulation in *Heteracris capensis* and Popov (1958) in *Schistocerca gregaria* supports the present findings on copulation in *Oedaleus abruptus* on locust pattern.

Table 1. Life history of *Oedaleus abruptus* at 37±1°C when fed on *Zea mays* and *Cynodon dactylon*

Periods (in days)	*Zea mays*				*Cynodon dactylon*			
	Male		Female		Male		Female	
	Isolated	Crowded	Isolated	Crowded	Isolated	Crowded	Isolated	Crowded
Total hopper duration	33.40±2.75 (21-49)	30.80±2.31 (18-40)	37±20.72 (26-49)	32.30±2.20 (20-40)	37.20±3.26 (23-51)	33.90±2.57 (20-48)	43.10±2.81 (31-55)	35.70±2.08 (23-46)
Pre-copulation period	6.30±0.86 (3-10)	6.30±0.52 (3-10)	7.80±0.84 (4-12)	6.60±0.44 (4-10)	8.70±0.91 (4-13)	8.30±0.66 (4-11)	9.70±0.95 (5-15)	8.90±0.77 (4-14)
Pre-oviposition period	--	--	7.30±0.70 (4-10)	5.60±0.67 (2-9)	--	--	8.30±0.74 (4-11)	6.10±0.79 (2-9)
Oviposition period	--	--	19.90±2.37 (9-31)	17.20±2.11 (8-28)	--	--	20.70±3.14 (7-35)	18.60±2.49 (9-30)
Post-oviposition period	--	--	4.10±0.45 (2-7)	4.50±0.52 (2-7)	--	--	4.30±0.55 (2-7)	5.10±0.55 (2-7)
Longevity of adults	41.40±3.58 (20-55)	34.40±2.54 (18-45)	39.90±4.07 (22-58)	33.70±2.16 (22-42)	39.70±4.12 (20-59)	34.50±3.20 (16-25)	37.30±2.96 (22-51)	32.50±2.57 (20-42)
Total life span	74.80±2.69 (63-92)	65.20±3.06 (49-80)	76.90±3.34 (53-92)	66.00±2.94 (50-82)	78.20±5.65 (52-105)	68.80±3.94 (47-85)	89.80±5.80 (57-115)	71.60±3.09 (56-82)

Values in parentheses are range of duration

3.2. Oviposition:

A brief pre-oviposition period (Table 1 & 2) precedes oviposition. Just after the completion of pre-oviposition period, females start probing for suitable oviposition site in the cages where moist sand filled, egg laying tubes were placed in the holes on one side of the cage. The mechanism involves typical acrididian pattern such as digging, making false holes and preferential behaviour regarding soil conditions as female prefer to lay eggs in moist and compact soil to provide a firm structure to the egg pods. Female used antennae, maxillary palps and abdomen to ascertain nature of the surface. In an experiment, a choice was offered for egg laying, in which female preferred moist sand over dry sand as

recorded in *Nomadcris septemfasciata* by Woodrow (1965). Similar observations were also made by Iqbal and Aziz (1974) and Amatobi (1985) in *Spathosternum prasiniferum* and *Oedaleus senegalensis* on the life history and ovipositional preference, respectively.

Table 2. Life history of *Oedaleus abruptus* at 27±1°C when fed on *Zea mays* and *Cynodon dactylon*

Periods (in days)	*Zea mays*				*Cynodon dactylon*			
	Male		Female		Male		Female	
	Isolated	Crowded	Isolated	Crowded	Isolated	Crowded	Isolated	Crowded
Total hopper duration	37.00±3.74 (23-53)	32.80±2.40 (21-41)	42.80±2.96 (30-54)	35.00±1.98 (23-44)	36.60±3.32 (24–51)	33.40±2.83 (19–42)	42.60±3.03 (29–53)	36.40±2.12 (22–44)
Pre-copulation period	7.80±0.80 (4-11)	7.70±0.02 (4-10)	7.90±0.97 (4-12)	6.30±0.77 (4-11)	9.40±1.00 (6–15)	8.30±0.71 (6–14)	10.90±0.93 (6–16)	9.30±0.72 (5–15)
Pre-oviposition period	--	--	7.60±0.65 (4-11)	6.30±0.70 (3-10)	--	--	7.60±0.65 (4–11)	6.30±0.70 (3–10)
Oviposition period	--	--	22.60±2.61 (12-35)	21.50±1.60 (15-30)	--	--	22.60±2.61 (12–35)	21.50±1.60 (15–30)
Post-oviposition period	--	--	4.20±0.46 (2-6)	4.40±0.56 (2-7)	--	--	4.20±0.46 (2–6)	4.40±0.56 (2–7)
Longevity of adults	40.20±3.43 (22-56)	34.20±2.55 (20-48)	46.10±3.49 (22-59)	34.70±2.56 (21-44)	44.40±4.09 (23–61)	36.30±2.54 (20–46)	45.40±3.58 (24–59)	35.00±2.13 (22–43)
Total life span	77.20±3.97 (60-97)	67.00±3.89 (46-88)	88.90±5.11 (52-111)	69.70±3.60 (44-82)	81.00±4.74 (51–107)	88.00±4.75 (65–110)	69.70±4.22 (39–85)	71.40±3.54 (52–85)

Values in parentheses are range of duration

Table 3. Copulation, egg laying and moulting period of *Oedaleus abruptus* under different experimental conditions

Process (in minutes)	*Zea mays*		*Cynodon dactylon*	
	Isolated	**Crowded**	**Isolated**	**Crowded**
Copulation period	141.2±14.804 (97-248)	136.2±13.802 (85-246)	153.3±16.009 (83-244)	143.8±15.829 (88-262)
Egg laying period	159.4±11.327 (117-223)	161.2±12.514 (114-234)	155.6±11.805 (112-221)	155.6±11.805 (112-221)
Moulting period	33.7±1.7745 (25-42)	31.9±1.882 (22-40)	34.7±1.745 (26-43)	43.2±1.821 (24-41)

Values in parentheses are range of period

After locating suitable oviposition site female digs a hole, raises itself on fore and mid legs so that its abdomen is almost vertical. The ovipositor valves are extended and the abdomen telescoped out and pressed into substrate by a series of jerks coinciding with alternate opening and closing of dorsal and ventral valves.

After making hole, female retracted its abdomen slightly and frothy secretion of accessory glands was emitted; this was partly absorbed by the soil and it hardened the walls of egg pod. At the same time, pulsating movements of VII and VIII sternites propelled the eggs, and it came out between ventral and dorsal valves. The egg appear with micropylar end first, the end being held between dorsal valves. As the ovipositor closes, eggs slipped out and set itself into the bottom of hole, so that finally it lies in a position ensuring that the head of future embryo will point upwards. Pulsating movement of terminal segments were then resumed, more frothy secretion was emitted and second egg was laid. The process continued with the contraction of abdomen and the walls of holes were smeared with frothy secretion. When all eggs were laid, upper portion of hole was filled with froth forming a plug of egg pod. The time taken for egg laying is given in table 3.

Generally, a female oviposited 5-6 times during her life span. The phenomenon of repeated copulation was frequently observed before every oviposition as recorded in *Schistocereca gregaria* by Hunter-Jones (1960).

3.3. Egg-Pod and Eggs:

In the laboratory, mostly, egg pods were arranged vertically or obliquely but sometimes when watering in egg laying tube was delayed or when eggs were repeatedly laid in the same tube, the egg pods were found vertical initially and then bent

posteriorly, which might be due to obstruction in the passage of ovipositor by previously laid egg pods.

Table 4. Fecundity of *Oedaleus abruptus* in isolated and crowded conditions at 37±1°C when fed on *Zea mays* and *Cynodon dactylon*

Conditions	Total no. of egg pods collected		Average no. of egg pods /Female (±S.E.) (a)		Total no. of eggs laid		Average no. of eggs / egg pod (±S.E.) (b)		Average fecundity/ Female (a×b)	
	Z. mays	*C. dactylon*	*Z. mays*	*C. dactylon*	*Z. mays*	*C. dactylon*	*Z. mays*	*C. dactylon*	*Z. mays*	*C. dactylon*
Isolated	92	91	4.4±0.21 (3-7)	4.55±0.20 (3-8)	1125	1107	34.00±5.83 (36-47)	28.16±4.98 (23-41)	154.70	129.56
Crowed	76	83	3.8±0.20 (2-5)	4.15±0.196 (3-7)	1104	1096	38.81±6.23 (35-43)	25.90±4.92 (19-38)	161.09	98.42

Sample size = 20 females

Values in parentheses are range of egg pods/female or eggs/pod

Table 4. Fecundity of *Oedaleus abruptus* in isolated and crowded conditions at 27±1°C when fed on *Zea mays* and *Cynodon dactylon*

Conditions	Total no. of egg pods collected		Average no. of egg pods /Female (±S.E.) (a)		Total no. of eggs laid		Average no. of eggs / egg pod (±S.E.) (b)		Average fecundity/ Female (a×b)	
	Z. mays	*C. dactylon*	*Z. mays*	*C. dactylon*	*Z. mays*	*C. dactylon*	*Z. mays*	*C. dactylon*	*Z. mays*	*C. dactylon*
Isolated	84	82	4.20±0.17 (4-7)	4.10±0.18 (4-6)	1118	1091	27.89±5.04 (26-31)	24.43±4.21 (23-28)	117.17	100.17
Crowed	73	71	3.90±0.19 (3-6)	3.70±0.19 (3-6)	1113	1078	25.9±4.78 (25-29)	23.23±4.20 (23-27)	101.32	85.96

Sample size = 20 females

Values in parentheses are range of egg pods/female or eggs/pod

Though, female *O. abruptus* lay eggs hypodephically but sometimes epidephic and epiphytic oviposition were noticed. The reason for this changed behaviour may be due to super maturation of gonads or may be due to failure in finding of suitable sites for egg laying. Such eggs were observed very frequently on wood surface and on wire mesh but none of these eggs hatched. Table 4 and 5 shows the average number of eggs per egg pod at 37±1°C and 27±1°C under different experimental setups. Different experimental setups clearly shows the influence of environmental factors on the fecundity, which can be attributed to the locust type behaviour and also shows similar difference in fecundity under isolated and crowded condition (Albrecht, 1953). Though quantitative difference in the numbers of eggs is not so striking, mainly because of lesser range of suspicious phase variability in species but they showed a tilt towards the locusts. Norris (1950) has also reported similar observation in *Locusta* with the same contention.

In the present study, fecundity was influenced with variation in the diet of *O. abruptus* (Table 4 & 5). An average fecundity per female at 37±1°C on *Z. mays,* reared in isolated and crowded conditions was recorded as 154.70 and 161.09, respectively; when they were fed on *C. dactylon* it was recorded as 129.56 and 98.42 eggs/female for isolated and crowed condition, respectively. At 27±1°C on *Z. mays*, *O. abruptus* laid average eggs of 117.175 per female in isolated condition, and in crowded condition, fecundity was 101.322 eggs/female. While feeding on *C. dactylon*, the average fecundity was recorded as 100.17 and 85.96 eggs/female in isolated and crowded conditions, respectively. Pickford (1958), Karelina (1960) and Khan (2008) have also observed difference in fecundity in *Melanoplus bilituratus, Chorthippus albomarginatus and Chroedocus illustris* when they fed on different food plants and also strengthen the present findings.

3.4. Incubation and Hatching:

The shortest incubation period (17.80 days) with highest hatching percentage (66.07) was recorded at 37±1°C, while incubation period (20.9 days) was extended and hatching percentage (58) was lower at 27±1°C (Table 6). Eggs did not hatch at 10°C and 45°C, which indicates that very low and high temperatures do influence hatching (Khan and Aziz, 1973).

3.5. Nymphal Instar:

The freshly hatched nymphs of *O. abruptus* moulted four to five times but four times is most common having five nymphal stages and the nymphal duration ranges from minimum of 30.80 days in crowded/male/*Z .mays* condition and maximum of 43.10 days in isolated/female/*C. dactylon* condition at 37±1°C and at 27±1°C, minimum hopper duration was a mean of 32.80 days for crowded/Male/*Z. mays* condition and maximum of 42.80 days recorded for isolated/Female/*Z. mays* (Table 1 & 2). The newly hatched nymphs are light brown in colour and measure on an average of 0.56 mm in length. The young nymphs soon begin to feed on soft and succulent leaves of *Z. mays* and *C. dactylon*. The nymphs fed on *C. dactylon* showed relatively lengthy hopper duration as compared to those fed on *Z. mays* (Table 1 & 2).

Table: 6. Effect of different temperatures on incubation period and hatching of eggs of *Oedaleus abruptus*

Temp. (°C)	Total no. of egg–pods	Average no. of eggs/pod	Total no. of egg counts	Incubation periods (in days)	Development of eggs/day (%)	No. of eggs hatched	Hatching %
27	20	26.03	781	20.900±1.448 (14–27)	4.78	453	58.00
37	20	28.76	863	17.800±1.152 (12–24)	5.61	569	66.07

Values in parentheses are range of period

The shortest life span was 65.2 days and was recorded for crowded/Male/*Z. mays* condition and longest was 89.8 days for isolated/Female/*C. dactylon* condition at 37±1°C (Table 1). At 27±1°C, the life span was recorded minimum of 67 days in crowded/Male/*Z. mays* condition and maximum of 88.9 days in isolated/Female/*Z. mays* condition (Table 2). The impact of experimental conditions on different vital processes of life although low, but it clearly depict significant difference.

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Performance of different sprayer nozzles on deposition of infective juveniles of three entomopathogenic nematodes species on pigeon pea

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Abstract

Experiments were conducted to evaluate the shredding and deposition of entomopathogenic nematodes (EPN) through different types of nozzles on pigeon pea. Five common nozzles *viz.,* flood jet nozzle, fan flat nozzle, broad cone nozzle, hollow cone nozzle (Plastic type) and hollow cone nozzle (brass) were used for deposition of nematodes. Spray of three EPN species (*Steinernema masoodi*, *Steinernema seemae*, and *Oscheius amsactae*) @ 50,000 IJs/lit were made on pigeon pea leaves kept on plastic tray. The number of infective juveniles (IJs) deposited on leaves were counted and concluded the maximum number of IJs of all the three species. Among different nozzle, flood jet nozzle (922, 867, 790 IJs/leaf) showed superior deposition over others, as this type of nozzle resulted in least shredding of EPN. It was followed by flat fan nozzle (400, 350, 293 IJs/Leaf) and broad cone nozzle (360, 300, 287 IJs/leaf). However, hollow cone nozzle, either plastic type or brass type and were recorded as detrimental to EPN. Hollow cone nozzle plastic type showed performance with a population of 240, 220,130 IJs/ leaf and hollow cone nozzle brass type @ 220, 190,128 IJs/leaf deposition of *S. masoodi*, *S. seemae*, and *O. amsactae*, respectively.

1. INTRODUCTION:

Indiscriminate use of pesticides has raised many environmental problems such as ground water contamination, residues problems, development of resistance, mortality of natural enemies, and also resulted in prohibitive legislation, and thus raised interest for safer alternatives (Zimmerman and Cranshaw, 1990). The use of entomopathogenic nematodes (EPN) are excellent biological control agents for soil-dwelling stages of many insect pests and are fast killing target insect pests (Gaugler et al., 2000). Large-scale application and demonstration of EPN has been dominated in the western countries covering thousands hectares of land. So far, more than 30 species of these EPN have been described (Hominick et al., 1997), among them nine species belongs to Steinernema and three of Heterorhabditis have been commercially exploited globally (Kaya, 2002). Nematodes belong to family Steinernematidae and Heterorhabditidae are potential EPN because of their symbiotic association with bacteria *Xenorhabdus* and *Photorhabdus* sp., respectively (Boemore et al., 1993).

The awareness and interest of entomopathogenic nematodes (EPN) as biopesticide has increased exponentially over the past two decades. EPN based biopesticides are the most successful against soil-dwelling insects but have limited success against foliar insect due to some inherent problems like, quick evaporation of suspension, desiccation of EPN at high temperature and overall shredding and deposition of EPN in spraying nozzles etc (Arthurs et al., 2004). However, three indigenous heat tolerant entomopathogenic nematodes namely *Steinernema masoodi* and *S. seemae* and *Oscheius amsactae* were isolated from the soil of Kanpur, and the laboratory bioassays and field evaluation of these species showed high efficacy against *Helicoverpa armigera* and other insect species (Ahmad et al*.,* 2010).

While spraying the nematodes, precaution should be taken *i.e.,* which type of nozzle would be used for spraying EPN because nematodes get shredded and clogged in the nozzle's opening on account of spraying through incompatible nozzle.

Therefore, present study has been carried out to find nozzle suitability for spraying *Steinernema masoodi* and *S. seemae* and *Oscheius amsactae* on pigeon pea.

2. MATERIALS AND METHODS:

Three species of EPN *viz.*, *Steinernema masoodi*, *Steinernema seemae*, and *Oscheius amsatace* were cultured on fully grown larvae of *Galleria mellonella* L. (Lepidoptera: Pyralidae) in the laboratory. For each species one ml of nematode suspension (approx 200 IJs/ml) was evenly distributed on a 9 cm filter paper in a lid of 100 x 15 mm Petri dish. Ten *G. mellonella* larvae were added to the Petri dishes. The lid was covered with the inverted Petri dishes and stored in BOD incubator at 28±1°C and 92% RH. After 2-3 days, nematode infected dead larvae were removed and placed on modified white trap (Kaya and Stock, 1997). Infective juveniles emerged from *G. mellonella* larvae were harvested thrice a week until production dropped (within three weeks). Infective juveniles were rinsed in 0.1% hyamine solution (Methylbenzethonium chloride) and allowed to settle in a beaker. Then the supernatant were decanted and distilled water was added until the suspension was clear. The nematodes were stored in Petri dishes (diameter 15 cm) at a concentration of 2,000 IJs/ml. The depth of water was 2 cm to assure sufficient aeration. The fresh culture was either used for the experiment or stored in incubator at 20^{o}C. Greater wax moth, *Galleria mellonella* required for *in vivo* production of entomopathogenic nematodes, were reared on semi-synthetic diet as per procedure described by Ali et al. (2005). *Steinernema masoodi* and *S. carpocapsae* were multiplied on last larval instar of *G. mellonella* and freshly harvested infective juveniles were used in the present study.

To evaluate performance of different nozzle types on the shredding and extent of deposition of live EPNs (*Steinernema masoodi*, *S. seemae*, and *Oscheius amsatace*) on pigeon pea leaves, different nozzles (flood jet nozzle, fan flat nozzle, broad cone nozzle, hollow cone nozzle plastic type and hollow cone nozzle brass type were used through hand compression sprayer (Fig. 1). For spraying EPN, a 5 litre hand compression knap sac sprayer were used. Each EPN @ 50,000 IJs per litre were used for spraying the pigeon pea leaves. A total of 10-12 leaves of pigeon pea (UPAS 120) were kept in a plastic tray for spraying the EPN. A through coverage of leaves by maintaining uniform pressure was done for the deposition of live EPNs on leaves and thereafter the leaves were dipped into beaker containing distilled water immediately. The treatments were replicated thrice for each species of EPN and the number of live EPN deposited on each leaf was counted.

3. RESULTS:

Three species of EPN *viz.*, *Steinernema masoodi*, *Steinernema seemae*, and *Oscheius amsatace* were cultured on fully grown larvae of *Galleria mellonella* L. in the laboratory. For each species one ml of nematode suspension (approx 200 IJs/ml) was evenly distributed on a 9 cm filter paper in a lid of 100 x 15 mm Petri dish. Ten *G. mellonella* larvae were added to the Petri dishes. The lid was covered with the inverted Petri dish and stored in BOD incubator at 28±1°C and 92% RH. After 2-3 days, nematode infected dead larvae were removed and placed on modified white trap (Kaya and Stock, 1997). Infective juveniles emerged from *G. mellonella* larvae were harvested thrice a week until production dropped (within three weeks). Infective juveniles were rinsed in 0.1% hyamine solution (Methylbenzethonium chloride) and allowed to settle in a beaker. Then the supernatant were decanted and distilled water was added until the suspension was clear. The nematodes were stored in Petri dishes (diameter 15 cm) at a concentration of 2,000 IJs/ml. The depth of water was 2 cm to assure sufficient aeration. The fresh culture was either used for the experiment or stored in incubator at 20^{o}C. Greater wax moth, *Galleria mellonella* required for *in vivo* production of entomopathogenic nematodes, were reared on semi-synthetic diet as per procedure described by Ali et al. (2005). *Steinernema masoodi* and *S. carpocapsae* were multiplied on last larval instar of *G. mellonella* and freshly harvested infective juveniles were used in the present study.

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thereafter the leaves were dipped into beaker containing distilled water immediately. The treatments were replicated thrice for each species of EPN and the number of live EPN deposited on each leaf was counted.

Fig. 1. Different sprayer nozzles for EPN based biopesticide spray

A. Hand compression knap sac soprayer, EPN biopesticide and crop
B.1 Different nozzles – Front view
B.2 Different nozzles – Top view
i. Broad cone nozzle ii. Flat fan nozzle
iii. Flood jet nozzle iv. Hollow cone nozzle (plastic type)
v. Hollow cone nozzle (brass type)
C. Spraying EPN biopesticide with flood jet nozzle
D, E, F. EPN sticking/shredded inside the nozzles after spray

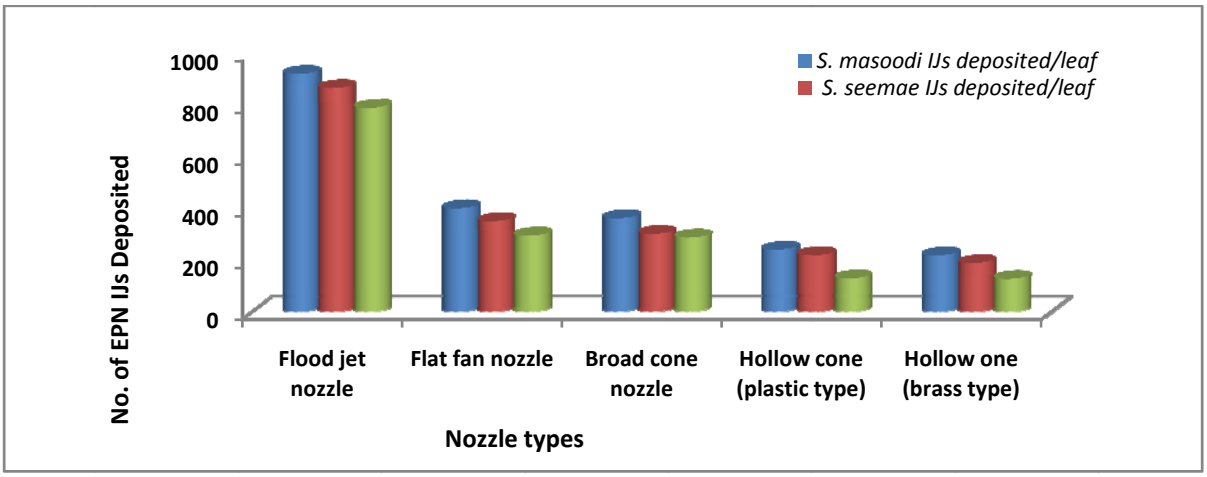
4. DISCUSSION:

Application and utilization of EPN though suitable nozzle is an important task for pest management program. Use of EPN is a delicate tactic since it needs special attention for effective management of insect pest and hence have to provided with adjuvant in the form of anti desiccant, UV retardant, humectants and the timing of sprays (morning and evening) to retain their activity for more duration, it is also very important to know that which of sprayer nozzle best for EPN spray (Ahmad et al., 2010). The present study revealed that flood jet nozzle is best for spraying EPN (*S. masoodi*, *S. seemae*, *O. amsacte*) followed by flat fan nozzle, broad cone, hollow cone brass type and plastic type.

The variable size of EPN species made attention on the use of different type of nozzles for spray (Shapiro-Ilan et al., 2006). In the present observations, smallest IJs were of *S. masoodi* followed by *S. seemae* and *Oscheius amsacte* was largest one. So there is difference in the differential deposition of IJs also recorded in same nozzles. The study opens a new dimension in biopesticide

application technology especially in considered in pest management programme. entomopathogenic nematode and must be

Fig. 2. Deposition of different EPNs on pigeon pea leaves when applied through different types of nozzle



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Studies on the feeding behaviour of Indian Blackbuck, *Antilope cervicapra* L. in semi-wild habitat of Sikandra at Agra, India

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Abstract

The feeding patterns of blackbuck were studied in the semi-wild conditions at Sikandra Tomb, Agra. The observations were recorded for seven animals of different age-groups (dominant male, adult male, sub-adult male, juvenile male, adult female, sub-adult female and juvenile female). It revealed differences in feeding behaviours among males and females, and a variation was also noted during rutting and non-rutting seasons.

1. INTRODUCTION:

The Indian blackbuck, *Antilope cervicapra* (Linn. 1758) belongs to family Bovidae and also regarded as the most graceful and majestic of all Asiatic Antelopes. Its significant numbers exist in and outside protected areas. Due to its diminished number, it has been placed in Schedule I of Wildlife Protection Act, 1972. Although, several workers have poured in their contributions regarding feeding behaviour at other places, it was found that no scientific work exists on the population residing at Sikandra (Emperor Akbar's Tomb), Agra in semi-captive conditions. The present study was conducted to fulfil this lacuna.

The monument at Agra stretches in about 123 acres of land, where, 95 acres is field area with a variety of flora and fauna. The conditions are suitable for free ranging animals in natural conditions in different seasons. The present study extended over a time span of one year, in which, it was established that animals relied chiefly on grass.

2. MATERIALS AND METHODS:

The sampling techniques used for recording the observations were: focal and scan. Focal sampling involves the observation of behaviour of a single animal for a specified amount of time. Each observation hour is divided in four equal parts of fifteen minutes sample period. Each sample period has a sample time of 10 minutes. A performance sheet is prepared prior to recording of the observations. However, scan sampling is a rapid scanning of a whole group at regular intervals. It involves recording the activities and interactions of each individual at that instant.

All observations were taken with the help of 7 X 50 'NIKON' binoculars during field visits. The animals were also photographed using a Sony digital camera (20 X, 28-140 Zoom).

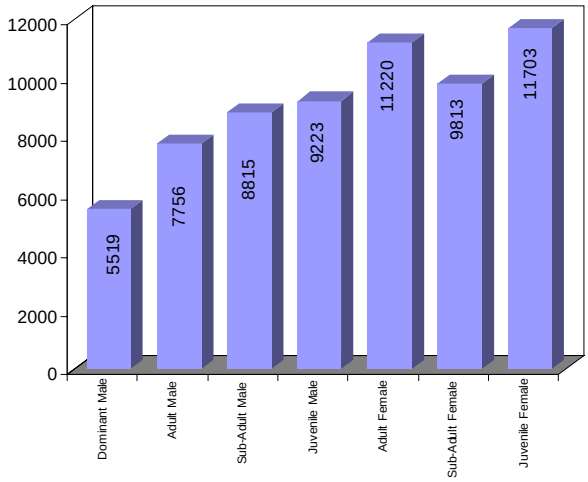
3. RESULTS:

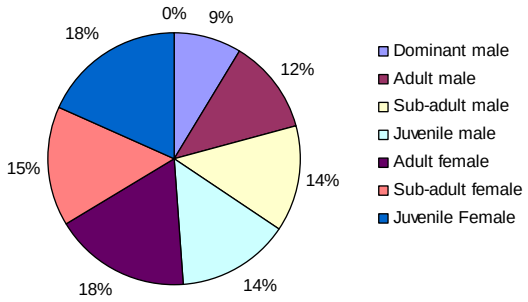
The field observations made on seven animals of different age groups *viz.*, dominant male, adult male, sub-adult male, juvenile male, adult female, sub-adult female and juvenile female; revealed that the animal is an exclusive grazer. Browsing is very rare. It was found that early mornings and late afternoon and evenings were the peak feeding hours. A slight difference of time period was found in feeding pattern of males and females (Fig. 1). The data showed that males spent less time in feeding as compared to females (Fig. 1). The time

devoted in feeding reduced during rutting season (Fig. 2).

This difference was much more marked in case of dominant male as the time spent on feeding in rutting season declined (1586 sec) sharply as compared to non-rutting season (3933 sec) (Fig. 2). However, this variation is not so pronounced in case of other males.

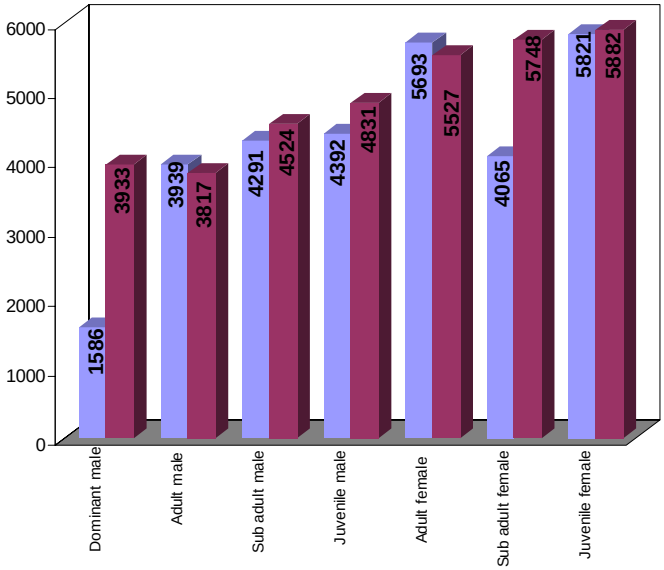
Table 1. Total time spent in feeding among different age groups of *Antilope cervicapra*





Females of all age groups spent slightly more time in grazing than their male counterparts (Fig. 1). They were observed to graze avidly throughout the year. Juvenile female was found to be the most intense grazer among all the seven animals observed (11703 sec, Fig. 1). Feeding did not show much variation during rutting and non-rutting season (Fig. 2).

Fig. 2. Time spent in feeding among different age groups of *Antilope cervicapra* in rutting and non-rutting seasons



4. DISCUSSION:

There is always a correlation between the type of habitat in which the blackbuck live and food intake. Blackbuck is mainly a grazer, browsing is rare (Ranjitsinh, 1989). Observations at Sikandra established that they relied entirely on grass (*Cynodon dactylon*), which also confirm the studies of Jhala (1997), who evaluated seasonal effect on nutritional ecology of blackbuck. On few occasions they were noticed to be drawn by gram, which was actually given to langurs (*Presbytis entellus*) by the tourists, this is in accordance to the observations made by Ranjitsinh (1989), who states that gram continues to draw blackbuck throughout its harvest in habitats, where they feed on agricultural crops.

During the present studies browsing was almost negligible except on one or two occasions when they were observed to feed on leaves of small shrubs in the forest area at Sikandra, however, in

different habitats they are reported to feed on rice, mas dal, wheat and mustard in Banke and Bardia regions of Nepal (Lehmkuhl, 1980). In another study, Ranjitsinh (1989) found blackbuck feeding on berries of *Zizyphus jujuba* and also on fallen legumes of *Prosopis cineraria,* while short grasses such as *Chrysopogan*, *Pasapalum* and *Sporobolus* formed bulk of their diet in Kanha National Park (Schaller, 1967).

In the present study, blackbucks were found to graze avidly in early morning and evenings hours. In summer, their feeding schedule was observed between 7 to 8 am in the morning and around 6 pm in the evening, while in winters animals grazed in morning between 9 to 10 am and then late afternoon was a period when maximum animals were observed grazing. These findings correspond with observation made by Ranjitsinh (1989) and Chattopadhyay and Bhattacharya (1986). However, at Sikandra, during winters, it was noticed that after a short period of rest after morning's feed, blackbuck grazed throughout the day in open lawns. They usually moved back into the forest in noon. The probable reason which could be attributed for this retrieval can be aggregation of visitors between 12 noon to 3 pm. Thus, the anthropogenic pressure kept the animals away from their feeding grounds.

Fig. 3. Knit formation and raised heads during grazing at Sikandra, Agra

Fig. 4. Cement tubs for water consumption of *Antilope cervicapra* at Sikandra, Agra

The members of a herd preferred to remain in a close knit formation (Fig. 3) and infrequently raised their heads while grazing at Sikandra. Blackbuck have been reported to raise heads more frequently while feeding in areas, where fear of predators exists like in Kanha National Park, although, they feed in a close knit formation (Ranjitsinh, 1989). In the present investigations, it was observed that blackbuck have become adapted to the noise created by the tourists. Moreover, the fear of predators does not exist. Animals got awestruck and retreated back into the forest only when the visitors tried to approach them, otherwise blackbuck were seen standing alert because of movements of the workers in the vicinity of their feeding areas.

In the present investigations, females were seen to graze slightly more than males throughout the year. However, males spent less time in feeding, particularly, in rutting season, which coincides with the observations made by Chattopadhyay and Bhattacharya (1986).

Jhala (1997) also observed that with extremely low intake of forage in summer, blackbucks face a severe energy and protein deficit and mainly rely on body reserves, thus, their body condition declines in summer and improves in monsoon and winter months. Similar observations were made during the current study among blackbuck at Sikandra, where they depended entirely on grasses. At Sikandra, no death was witnessed due to starvation because the grasses in pastures were watered through pipes in summers.

For water consumption cement tubs have been provided at Sikandra and water was filled in them through pipes (Fig. 4). Blackbuck never showed a regular necessity of water, they were usually seen drinking water during summers. Identical observations were also made by Schaller (1967) that blackbuck do not require water regularly and Ranjitsinh (1989) state that water consumption becomes essential occasionally when moisture contents in the pastures is very low.

5. ACKNOWLEDGEMENTS:

First author is thankful to the authorities of Sikandra Tomb, Agra for allowing me to visit the tomb and also for taking observations on blackbuck regularly.

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Efficacy of tannery chemicals on the heart of *Catla catla* (Ham.), a freshwater teleost

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Abstract

The histopathological effects of two tannery chemicals *i.e.,* basic chromium sulphate @ 3 mg/lit, 4 mg/lit and 5 mg/lit and nigrosine black @ 7 mg/lit, 8 mg/lit and 9 mg/lit on a freshwater fish, *Catla catla* were observed at different time intervals (24 hrs, 48 hrs, 96 hrs and 1 week). The findings showed complications in heart of fishes treated with basic chromium sulphate as well as nigrosine black. The histopathology of hearth showed splitting of muscle, spaces, pyknosis and thickening of msucle with infiltration treated with basic chromium sulphate. On the other hand, treatment of nigrosine black showed splitting of muscles spaces, degeneration and pyknosis in the heart of *Catla catla*.

1. INTRODUCTION:

Most aquatic invertebrates and vertebrates are effective from tannery chemical. Toxicology is the study of poisons, their identification, chemistry, degree of toxicity, and physiological actions. The major aim of toxicologist should be to protect the organisms from potential exposure to the harmful chemical in the environment. History of aquatic toxicology has been briefly reviewed by Macek (1980), who traces its early development in the 1930s through the stimulus that occurred from quality legislation in the 1960s and finally in the 1970s, when several parallel branches evolved. One of these involves the use of aquatic organisms as animal models for human toxicological research, which is a merging of biomedical research and aquatic toxicology. The tannery chemicals adversely affect the physiology, histopathology and biochemistry of fish fauna (Kulshrestha and Arora, 1984; Rana and Raizada, 2000). These tannery chemicals are sublethal for fish and their toxicity leads towards the mortality of fish. Therefore, present study has been designed to observe the effect of tannery chemicals on histopathology of fresh water fish *Catla catla*.

2. MATERIALS AND METHODS:

Catla catla were collected from the Government fish farm Laramada village and also from local market of Agra. The fish were acclimated in glass aquariums filled with de-chlorinated water in the laboratory for about 15 days before experiments. Water quality characteristics were determined by APHA (1989). For histopathological observations fish were exposed to each sublethal concentration of basic chromium sulphate @ 3 mg/lit, 4mg/lit, 5mg/lit and Nigrosine black @ 7mg/lit, 8mg/lit, 9mg/lit for at 24hrs, 48hrs, 96hrs, and 1 week, respectively. The fish were washed through tap water and dissected out to separate the heart from body of *Catla catla*. Thereafter, heart was fixed in aqueous Bouins solution for 24hrs. The heart was cut into small pieces (2-3 mm) and washed repeatedly in 70% alcohol and further dehydrated in graded series of alcohol in ascending order, cleared in xylene and finally embedded in paraffin then 4-6μ thick sections were cut. The sections were stained with haematoxylin and eosin and studied under microscope.

3. RESULTS AND DISCUSSION:

3.1. Histopathology of Heart (Untreated Control):

The observations were taken with respect to heart of untreated control, the slide revealed no significant change in the epicardium, myocardium and endocardium of heart. The heart tissue exhibited cardiac muscle fibers arranged systematically (Fig. 1a & 2a).

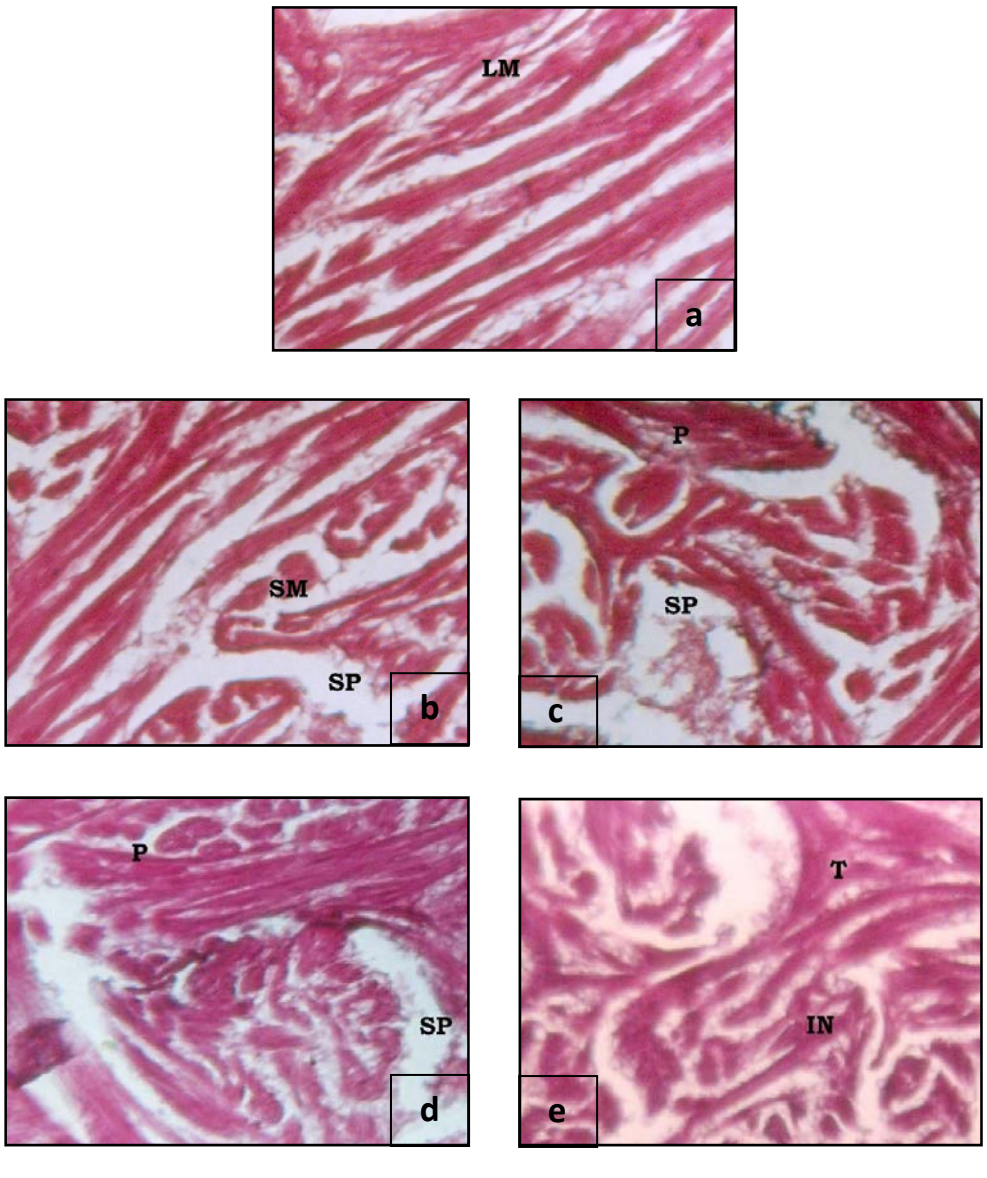

Fig. 1. Histopathology of heart of *Catla catla* after treatment of Basic Chromium Sulphate

a. untreated control **b. After 24 hours**
c. After 48 hours **d. After 96 hours**
e. After one week

Abbreviation: **T = Thickness, IN = Infiltration, LM = Longitudinal muscle, SM = Splitting of muscle, P = Pyknosis, SP = Space**

3.2. Histopathology of Heart Treated with Basic Chromium Sulphate:

The histopathological changes in the heart of *Catla catla* after 24hrs of treatment showed spaces and splitting of muscles (Fig. 1b). After 48hrs of treatment, spaces and pyknosis were observed in the heart (Fig. 1c). However, after 96hrs of treatment, section appeared similar to that of 48hrs with spaces and pyknosis (Fig. 1d). In one week infection of basic chromium sulphate, thickening of

cardiac muscles was observed with infiltration (Fig. 1e).

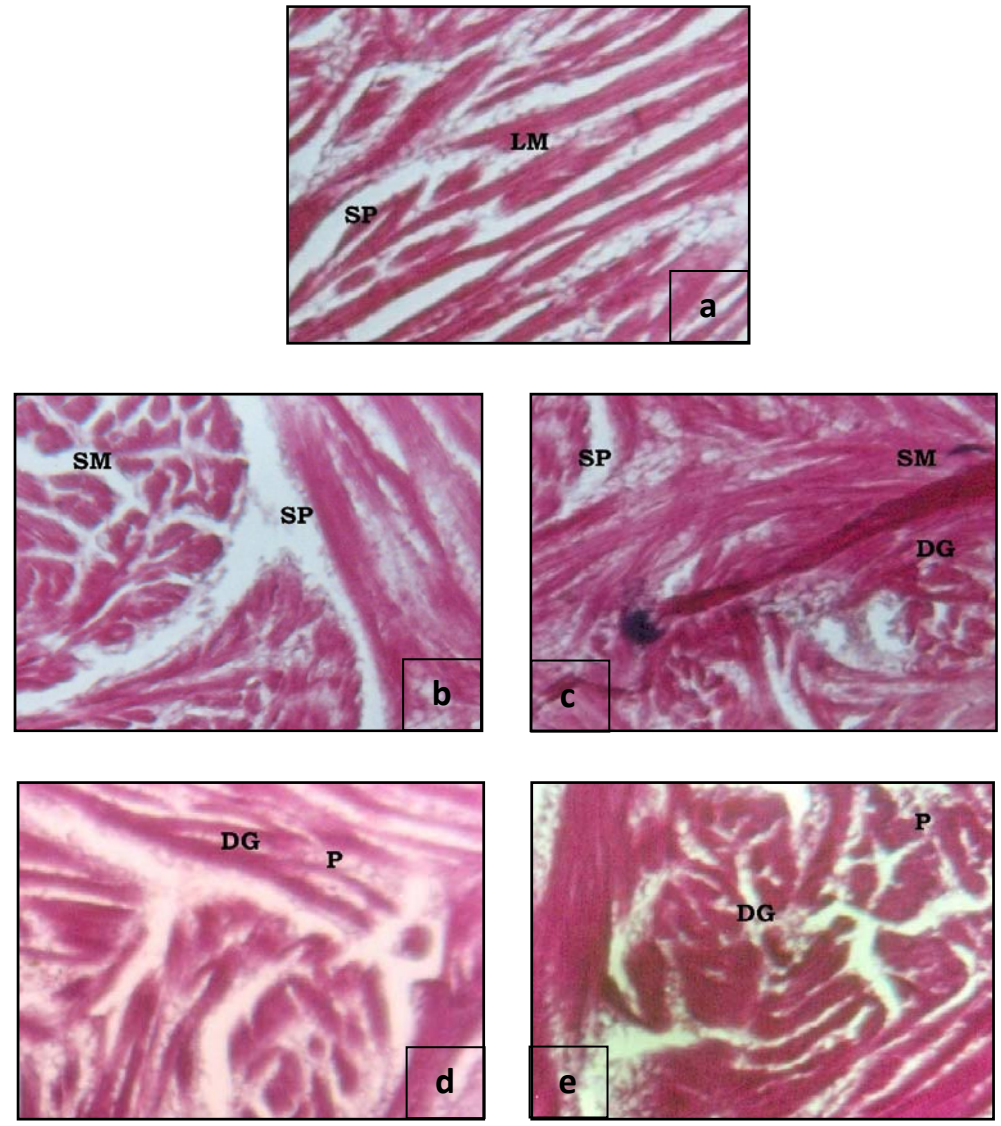

Fig. 2. Histopathology of heart of *Catla catla* after treatment of Basic Chromium Sulphate

a. untreated control **b. After 24 hours**
c. After 48 hours **d. After 96 hours**
e. After one week

Abbreviation: **T = Thickness, IN = Infiltration, LM = Longitudinal muscle, SM = Splitting of muscle, P = Pyknosis, SP = Space, DG = Degeneration**

3.3. Histopathology of Heart Treated with Nigrosine Black:

The histopathological changes with respect to nigrosin black after 24hrs of treatment showed spaces and splitting of muscles in the heart of *Catla catla* (Fig. 2b). Similarly, after 48hrs of treatment, splitting of muscles and spaces with degeneration was recorded in the heart (Fig. 2c). After 96hrs of treatment, degeneration and pyknosis in the muscles were observed (Fig. 2d). However, after one week of infection, section appeared similar to that of 96hrs treatment as pyknosis and degeneration were visible in the cardiac muscle of *Catla catla* (Fig. 2e).

In the present investigations, when fishes were treated with toxic chemicals, their cardiac tissue exhibited remarkable changes in the pericardium as well as myocardium, splitting of muscle, spaces and pyknosis. The pericardium was moderately thickened and infiltrated extensively by leucocytes. Myocardial tissue was severely infiltrated by polymorphs and macrophages. It can be inferred that after passing through the blood vascular system the toxic substance could have targeted the cardiac muscles, causing extensive damage. Similar observations were also reported by Das and Mukherjee (2000) in pericardium and myocardium of *Labeo rohita*. The decreased thickness and infiltration by polymorphs and macrophage were observed while studying the effect of hexachlorocyclohexane on the heart of *Labeo rohita*.

The effect malathion on the cardiac muscle of freshwater gobiid fish, *Glossogobius giuris* also studied by Venkataramana (2001) and reported inflammation of cardiac muscles, shrinking of muscles due to excessive accumulation of leucocytes in the interspaces of muscle fibers and given further strengthen to present findings. In another study, Borges et al. (2003) reported effect of vanadate oligomers on the heart of toad fish and observed inflammation and pericardial degeneration of cardiac muscle. Similarly, Dagmara et al. (2005) reported effect of TCDD pesticide on the heart of zebrafish, which supports the result of the present findings. Recently, Daksh et al. (2009, 2011) studied impact of tannery chemicals on the histopathology of fresh water teleost, *Catla catla* (Ham.), thus work done in these finding showed corroboration with the present research.

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Studies on biotic and abiotic factors of river Yamuna at Agra, Uttar Pradesh, India

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Yamuna river water, phytoplankton, turbidity, zooplankton

Abstract

The pollution in the river Yamuna originates from domestic, industrial and agricultural activities apart from a totally mismanaged solid waste collection and disposal. Mass bathing in the river, open defecation and disposal of dead animals also add to the problem. Variation in abiotic parameters of Yamuna at Agra revealed that pH, temperature, turbidity, BOD, COD and DO ranged from 6.99 to 8.67, 9.20 to 28.20°C, 81.00 to 345.00 NTU, 7.40 to 19.30 ppm, 26.00 to 52.00 ppm and 4.10 to 14.90 ppm, respectively. The population of biological indicators *i.e.* phytoplankton and zooplankton ranged from 0.763 to 2.375 lac/lit, and 1.25 to 0.651 lac/lit in different seasons, respectively. In present investigations, the river water was most favorable for higher fish production during winter season as compare to rainy as well as summer.

1. INTRODUCTION:

The Yamuna River at Agra and the surrounding region has high religious importance. It is seriously unhealthy, and calling for a right cure. The pollution in the river Yamuna creates from industrial effluents and domestic waste disposal. The management for the collection and disposal of the city's waste is neither effective nor scientific and therefore add more to the river pollution. The public is equally responsible, for mainly because of ignorance, indiscipline and an unhygienic culture. The various strategies for the control of Yamuna river pollution are grouped into defensive and proactive approaches. Apart from adopting the various control strategies, there is a sincere need to punish the polluters and defaulters through a system of fines with adequate bonus to the fine collectors to keep them duty bound and honest. Creation of public awareness on the suggested lines and keeping away from persons not qualified in environmental technology will also expedite the Yamuna River cleaning. Therefore, the present study has been designed to know the status of pollution in river Yamuna in different seasons.

2. MATERIALS AND METHODS:

Surface water samples were collected in clean containers from Yamuna at Agra during first fortnight of May to last week of January in experimental years 2010-2011 and 2011-2012. The temperature and pH were recorded at experimental sites during collection of the samples. The collected samples brought to the laboratory for estimation of various biotic and abiotic parameters. The procedures for estimation of different parameters were followed as per suggestions of APHA (1998). To determine turbidity, the instrument was settled at 100 with 40 NTU (Nephelometric Turbidity Unit) for standard suspensions and measured with the Nephelometric Method (Parashar et al., 2006). However, the chemical parameters, Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were observed from the collected sample as the procedure followed by Dhakad and Chaudhary (2005). The Dissolved Oxygen (DO) was analyzed by using Winkler's modification methods. On the other hand, the number of available phytoplankton can be counted by using haemocytometer, whereas, zooplankton was calculated by using Sedgewick Rafter Cell (Sharma, 2002).

3. RESULTS:

3.1. Biotic Factors:

The phytoplanktons and zooplanktons are biological indicators in water bodies of river Yamuna. The population of these indicators was documented as 0.56±0.184 to 2.45±0.070 lac/lit phytoplankton, and 0.16±0.018 to 0.58±0.036 lac/lit zooplankton in year 2010-11. In the successive year, the minimum and maximum population of above planktons was recorded as 0.78±0.038 to 2.56±0.101 lac/lit and 0.23±0.050 to 0.58±0.036 lac/lit, respectively (Table 1 & 2).

Table 1. Studies of biotic and abiotic factors in the river water Yamuna at Agra during 2010-2011

Parameters	Winter		Summer		Rainy	
	December	January	May	June	August	September
Biotic						
Phytoplankton (lac/l)	1.45±0.057 (1.368-1.563)	1.34±0.054 (1.254-1.442)	0.79±0.017 (0.763-0.821)	0.56±0.184 (0.911-0.839)	2.45±0.070 (2.450-2.375)	2.28±0.034 (2.241-2.354)
Zooplankton (lac/l)	0.40±0.053 (0.340-0.509)	0.51±0.041 (0.495-0.596)	0.16±0.018 (0.145-0.203)	0.22±0.051 (0.125-0.301)	0.58±0.036 (0.525-0.651)	0.52±0.035 (0.465-0.587)
Abiotic						
pH	8.18±0.131 (7.99-8.43)	8.37±0.162 (8.11-8.67)	7.59±0.141 (7.40-7.87)	7.83±0.363 (7.11-8.21)	7.55±0.271 (7.08-8.02)	7.45±0.306 (7.03- 8.05)
Water temp (°C)	15.23±0.664 (14.10–16.40)	12.63±1.244 (10.20–14.30)	23.63±1.419 (21.30–26.20)	23.56±1.507 (21.50–26.50)	25.43±1.820 (22.00–28.20)	25.43±1.745 (22.10–28.00)
Turbidity (NTU)	242.33±69.441 (110.00-345.00)	193.00±47.961 (112.00– 278.00)	152.33±36.539 (83.00-207.00)	182.00±52.348 (83.00–261.00)	197.00±47.961 (112.00– 278.00)	163.00±22.538 (123.00-201.00)
BOD (ppm)	18.26±0.523 (17.60–19.30)	14.06±0.260 (13.60-14.50)	7.56±0.088 (7.40– 7.70)	9.46±0.088 (9.30– 9.60)	11.04±0.401 (10.90–11.80)	11.90±0.057 (11.80–12.00)
COD (ppm)	48.10±1.985 (45.50–52.00)	42.93±2.436 (38.20–46.30)	35.90±2.783 (32.40–41.40)	42.03±0.352 (41.50–42.70)	28.66±1.726 (26.00–31.90)	31.46±1.414 (29.00–33.90)
DO (ppm)	14.16±0.371 (13.70–14.90)	10.90±0.550 (9.90–11.80)	4.76±0.480 (4.10–05.70)	7.23±0.433 (6.50–08.00)	7.73±0.145 (7.50–08.00)	8.23±0.145 (8.00–08.50)

Table 2. Studies of biotic and abiotic factors in the river water Yamuna at Agra during 2011-2012

Parameters	Winter		Summer		Rainy	
	December	January	May	June	August	September
Biotic						
Phytoplankton (lac/l)	1.35±0.054 (1.254-1.442)	1.46±0.056 (1.368-1.563)	0.78±0.038 (0.911-0.839)	0.78±0.017 (0.763-0.821)	2.28±0.034 (2.241-2.354)	2.56±0.106 (2.450-2.375)
Zooplankton (lac/l)	0.52±0.033 (0.495-0.596)	0.43±0.050 (0.340-0.509)	0.23±0.054 (0.125-0.301)	0.17±0.016 (0.145-0.203)	0.51±0.037 (0.465-0.587)	0.58±0.036 (0.525-0.651)
Abiotic						
pH	7.93±0.449 (7.12-8.67)	7.54±0.444 (6.99-8.42)	7.54±0.284 (7.21-8.11)	7.56±0.078 (7.41-7.67)	7.69±0.333 (7.03- 8.05)	7.43±0.338 (7.08-8.11)
Water temp (°C)	10.83±4.017 (13.20–16.30)	11.90±1.479 (9.20–14.30)	22.20±2.065 (19.30–26.20)	22.74±1.888 (20.50–26.50)	25.67±1.603 (22.70–28.20)	24.13±2.113 (21.10–28.20)
Turbidity (NTU)	223.33±67.459 (112.00-345.00)	168.66±35.469 (102.00– 223.00)	143.33±39.666 (81.00-217.00)	175.00±49.386 (91.00–262.00)	189.33±53.991 (102.00– 288.00)	166.66±34.478 (113.00-231.00)
BOD (ppm)	13.96±0.272 (13.60-14.50)	17.73±0.825 (16.50–19.30)	9.46±0.088 (9.30– 9.60)	7.56±0.088 (7.40– 7.70)	11.90±0.057 (11.80–12.00)	11.30±0.264 (10.90–11.80)
COD (ppm)	41.26±2.536 (38.20–46.30)	48.23±1.946 (45.50–52.00)	42.00±2.808 (41.50–42.70)	37.96±2.808 (32.40–41.40)	31.40±1.415 (29.00–33.90)	29.06±1.707 (26.00–31.90)
DO (ppm)	10.86±0.548 (9.90–11.80)	14.23±0.352 (13.70–14.90)	7.20±0.435 (6.50–8.00)	4.73±0.491 (4.10–05.70)	8.23±0.145 (8.00–8.50)	7.70±0.152 (7.50–8.00)

3.2. Abiotic Factors:

The pH, temperature and turbidity of river Yamuna was recorded during summer, winter and rainy seasons, it showed maximum value of pH 8.37±0.162 and 7.93±0.449 in the month of January and December 2011, respectively. However, minimum pH was recorded 7.43±0.306 and 7.43±0.338 in the month of September 2010 and 2011, respectively (Table 1 & 2). The water temperature and turbidity also varied from 10.83±4.017 to 25.67±1.603°C and 223.33±67.459 to 242.33±69.441 NTU during both the experimental years (Table 1 & 2). The other factors including biological oxygen demand (BOD), Chemical oxygen demand (COD) and dissolved oxygen (DO) showed a significant variation in different seasons from 7.56±0.088 to 18.26±0.523 ppm, 28.66±1.226 to 48.23±1.946 ppm and 4.73±0.491 to 14.23±0.352 ppm, respectively (Table 1 & 2).

4. DISCUSSION:

Both phytoplanktons and zooplanktons are the chief producers of any aquatic body and directly affect the growth of other herbivorous and carnivorous animals. Physiochemical factors directly influence the growth of planktons (Davis, 1954). The population of planktons in river Yamuna were found to be more in the rainy as well as winter season and less in the summer season because the rainy and winter seasons are more productive in comparison to the summer season, which is probably due to the moderate water temperature and other optimum conditions required for higher productivity of aquatic life (Rana, 1997 and Jones et al., 2004).

In the present investigations, a higher pH was observed during the winter season. This may be due to the fact that the mud concentrated in to the water which resulted in increase of pH. On the other hand, the pH was alkaline presumably due to reduced rate of photosynthetic activity, which reduces the assimilation of CO_2 and bi-carbonates (Sawane et al., 2006). However, the variations in water temperature may be due to different timings of collection, influence of the season and the effect of atmospheric temperature. The high turbidity during summer season may also be responsible for higher water temperature because suspended particles absorb heat from the sun light making the water warm (Thirumala et al., 2006). The higher turbidity value affects the aesthetic quality of river water of Yamuna. In the present investigations, maximum turbidity was observed during the winter season and showed corroboration with the findings of Parashar et al. (2006) and Pawar and Mane (2006).

The dissolved oxygen is the most important sources of the aquatic atmosphere and photosynthetic process for the green plants and also determining factor of the water quality of an aquatic ecosystem. In a system where the rate of respiration and organic decomposition are high, the DO values usually remain lower than those systems where the rate of photosynthesis is high. A high pollution load may also decrease the DO values to a considerable level (Yeole and Patil, 2005). In the present findings, the DO and BOD was recorded higher in winter season, which showed complete agreement with findings of Devaraju et al. (2005).

The chemical oxygen demand is also considered as the amount of oxygen consumed by the chemical breakdown of organic and inorganic matter and mainly serves to measure the ability of organic substances to consume oxygen in water. In present findings, the higher value of COD was recorded in the winter which might have been due to less water and high turbid conditions, as higher turbidity shows the presence of higher concentration of organic and non biodegrable components in the lake water which require higher amount of oxygen for their decomposition (Tiwari, 2005 and Sharma and Capoor, 2009).

The present investigations can be concluded that phytoplankton and zooplankton are showing direct relationship with favorable conditions of alkalinity, maximum DO, minimum BOD and COD during the rainy and winter seasons, which develop most favorable environment for fish production in the river Yamuna at Agra.

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Histopathological observations on argulosis in Indian major carp, *Labeo rohita* (Ham.)

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Abstract

In Indian major carps argulosis disease is caused by the crustacean parasite. The parasites are leaf like in appearance and were found to attach with skin, fins and gills of fishes. These sites were haemoarrhagic ulcerated and mucus studded, however, kidney, liver and spleen also found infected and become pale in color. The histopathological changes in the skin of affected fish were epidermal desquamation and dermal necrosis inflammatory cell infiltrations also occur. The infected gills showed hyperplasia, hypertrophy, telangiectasis, aneurism and fusion of lamellae. The tubular degeneration, necrosis and haematopoetic tissue proliferation were observed in the kidney of diseased fishes. The infected liver exhibited hypertrophy, cordal disruption of hepatocytes, sincesoidal and blood vessel congestions. While as, spleen showed white pulp necrosis and increase of melanomacrophage centre. The histopathological observations on the presence of pathogens in fish also play a vital role in disease control and health management in aquaculture.

1. INTRODUCTION:

Argulosis is a disease caused by crustacean parasite (*Argulus* sp.) and commonly known as "Fish louse". The larvae and adults of argulus are parasitic to fish. This parasite penetrates the upper layers of the host skin and feeds on blood and body fluids (VanDer et al., 2000). The major fishes affected with this disease are fry, fingerlings and adults of Indian major carps (Sheila et al., 2002). The affected fishes become restless with erratic swimming movements and attachment sites shows sign of ulceration. The argulus can be seen quite clearly with the naked eye. Adult parasites are oval, flat and leaf like in appearance with transparent to whitish in color along with two conspicuous black spots (Sheila et al., 2002). Generally, they found to attach with the skin, fins or gills of Indian major carps. But sometime, kidney, liver and spleen are also found to distress with argulus parasites (Hasan, 2005).

Histopathology is an important modern tool for quick correct and reliable diagnosis of fish diseases. It helps to identify and extent to damage in the organs of diseased fish and also the etiological agents harbored in target organs of the fish (Sheila et al., 2002). It play significant role for understanding the mechanism of disease processor and the course of diseases ranking from acute and chronic stages through fish level reactions in host fish by pathogens. Therefore, present study also helps to develop fish quarantine and certification programmes for fish health monitoring.

2. MATERIALS AND METHODS:

The samples were collected from hatcheries, ponds and tanks of Darbhanga and brought to the laboratory for patho-morphological and anatomical examinations. Collected samples were comprised of fry, fingerlings and adults of Indian major carps. The patho-morphological examinations were comprised of identifying and locating any visible external lesions emissions haemorrhages, and formations of vista and patches on body surfaces gills and fins. The patho-anatomical examination was thus carried out for finding any viable lesions or inflammations in internal organs.

For pathological observations, small bits of tissues (3-4 mm) from the vital organs like skin, gills, kidney, liver, spleen and intestine of moribund or freshly killed diseased fish samples were collected

and fixed in 10% neutral buffered formalin for 18-24 hours. Fixed tissue samples were then processed and paraffin embedded block of all the tissues was prepared using the standard histological methods (Luna, 1968). However, calcified tissues like skin and gills were decalcified with 10% nitric acid, which helped in getting perfect and unbroken serial sections of these tissues during microtome. These blocks were cut into serial sections of 5 to 7µ by a rectory microtome. Thereafter, histological sections were stained with Ehrlich's Haematoxylin (H) and alcoholic Eosin (E) stains as per suggestions of Luna (1968).

3. RESULTS AND DISCUSSION:

The present observations have been taken on the histopathological changes due to infection of *Argulus* in different organs such as skin, gill, kidney, liver and spleen of *Labeo rohita*.

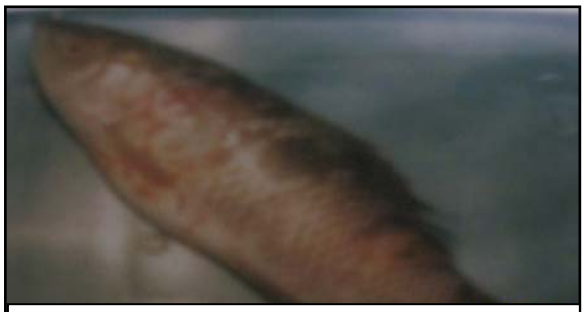

Fig. 1. Argulus Infection in skin of *Labeo rohita*

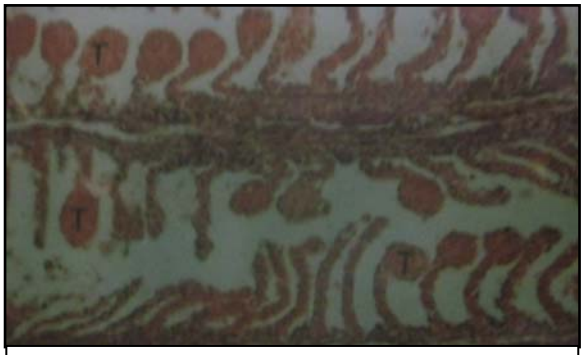

Fig. 2. Argulus infection in gills of *Labeo rohita* (T = telangiectatic)

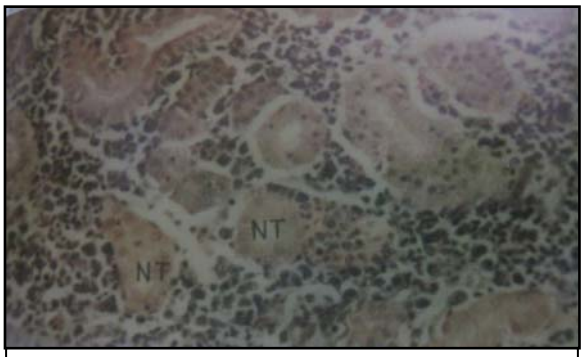

Fig. 3. Argulus infection in kidney of *Labeo rohita* (GS = glomerular shrinkage, NT = necrotic tubules, HT = proliferation of hematopoietic tissue)

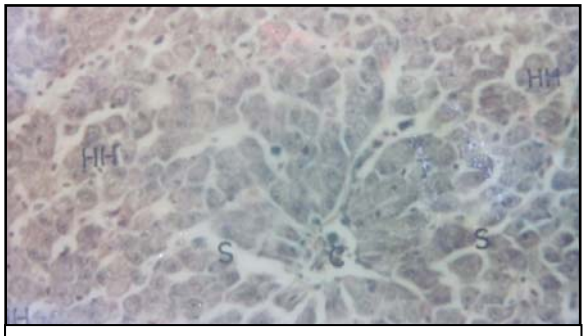

Fig. 4. Argulus infection in liver of *Labeo rohita* (HH = hypertrophied hepatocytes, C = congestion of blood vessels, S = dilation of sinusoids)

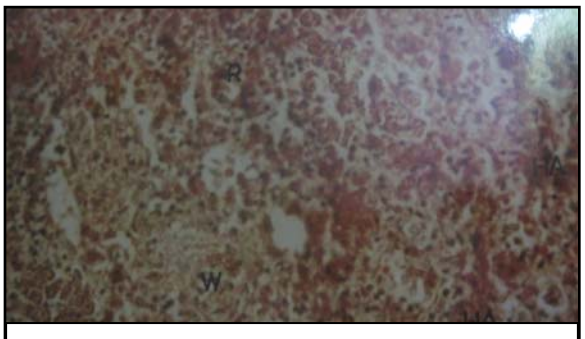

Fig. 5. Argulus infection in *Labeo rohita* (R = necrosis of red, HA = haemorrhagic areas)

The visual observations revealed that the parasites were found to attach on the ventral surface of the body, and skin ever the head and operculum were the favorite sites of attachment. These sites were haemorrhagic, ulcerated and mucus studded, and the skin of *Argulus* affected fishes was pale and sometimes abnormally pigmented. Gills also become pale in color. The affected fishes shared weight loss, retarded growth, restlessness, erratic swimming behavior and loss of appetite. The kidney, liver and spleen of the affected fishes were also subjected to histopathological observations.

Argulus parasites caused extensive damage to skin epithelium by insertions of stylets into epidermal cells of *Labeo rohita*. The dermis showed inflammatory reactions and haemorrhages. The scales also become loose in the scale pockets and fell (Fig. 1). *Argulus* parasites released some toxic substances from the proboscis glands and certainly have adverse effects on the fish and localized reddening or haemorrhages and also swelling of tissues at the sites of infection Dulin (1979).

The most significant lesions are the gills of *Labeo rohita* were: secondary lamellar hyperplasia, haemorrhages in the lips of the primary lamellae and fusion of both secondary and primary gills lamellae. However, the lips of many secondary lamellae became swollen and balloon like in appearance (Fig. 2). Nandp and Das (1991) reported significant mortality in Indian major carps due to infection of *Argulus* parasites. They observed heavy infestation in juvenile (6-8 month old, and 14-18 cm size) of *L. rohita*. The population of parasites *(Argulus siamensis)* was also recorded as 2-6/cm^2 at highly infested portions of the body.

The histopathological observations of kidney showed multifocal enlargement of glomeruli but having the glomerular tufts in many places shrunken, fragmented and necrotized. In some areas of kindly section, large melanomacrophage centers were also seen in the tissue (Fig. 3).

In the liver of *Labeo rohita*, most of the central veins were encored with red blood gills and some fibrinous materials. The hepatocytes were swollen and hypertrophied in many regions of the section, in which swollen cells were found and they were pycnotic and dark stained. Some focal areas of haemorrhages were also seen in the liver (Fig. 4).

The spleen of infected *Labeo rohita* also showed extensive necrosis of both the red and white pulp, and there were multifocal areas of haemorrhage in the tissue (Fig. 5). Also there were many large melano-macrophage centres were seed in certain areas of tissue sections and these centres contained haemosiden pigments.

The histopathological changes recorded in the liver, kidney and spleen of the diseased samples are in accordance to Kabata (1970), Schaperclaus (1986), Dey (1989), Singh and Srivastava (1992) and Hasan (2005), and they reported hyperplasia of dense connective tissue Kidneys which exhibited marked glomerular changes and tubular degeneration and necrosis. However, degeneration and lymphocyte aggregations can also be observed on the places where *Argulus* parasites infect.

The findings accomplished that disease argulosis are serious threats in Indian major carps especially in nurseries, where it can caused extensive damage to the yield of fishes. The infection may visualize with necked eyes and need to manage promptly to secure the health of Indian major carps.

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Medicinal importance of weed plants of district Fatehpur, Uttar Pradesh, India

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Abstract

In India, the medicinal plants are used from the time of Vedas, then it was only way to occur diseases and ailments. These medicinally useful wild plants are popularly known to Indians as 'Jari-buties'. Even today in most of the rural areas, people depend on local traditional healing system for their family health care. Most of these naturally occurring plants are said to be a weed or the unwanted plants. But a large number of weeds have medicinal properties. The aim of present study was to study the traditional medicinal uses of weeds growing in crop fields, road sides and open spaces of Fatehpur District of Uttar Pradesh. A total of 52 species of weed plants were collected out of which 26 weed species of 25 genera belonging to 16 families have utilized by the inhabitants for their health care. These weeds are mostly ones which are common unwanted and easily grown in any place. It is found that area is rich in indigenous knowledge related to weeds. However, traditional knowledge is getting eroded rapidly because of interference due to modern cultural changes. Continuity of this practice will result in total loss of such knowledge. Therefore, present study was made to understand the importance of weeds with special reference to their medicinal uses in this area.

1. INTRODUCTION:

Plants are vital for existence of life on earth. The plants around the habitats of rural people not only provide food for living organisms but also meet the requirement for healthy life. Plants have been and still are a rich source of many natural products most of which have extensively used for human welfare especially in loss of vitality or general debility and also to elevate human sufferings and various diseases. In India, from ancient times of Vedas, people have used many plants for medicinal purposes. These medicinally useful wild plants are popularly known to Indians as 'Jari-buties'. Even today in most of the rural areas, people depend on local traditional healing system for their family health care. World Health Organization (WHO) has listed 21,000 plant species of medicinal use in the world. In India, about 2,500 plant species are used for medicinal purposes by traditional healers (Chandel et al., 1996 and Sarkar et al., 2007).

Most of these medicinal plants are grown in natural ecosystem and are named as weeds. In India, many unwanted plants or so called weeds are very common and wide spread in crop fields, road sides, forest and waste lands. They spread like wild fire, grow abundantly and almost occupy all open spaces. Weeds may be defined as "a plant out of place or an unwanted plant or a plant with a negative or plant that compete with soil" (Kasera et al., 1998). In fact, all unwanted plants are weeds, but all weeds are not unwanted ones. Many of these naturally occurring plants are traditional herbal medicine (Patnaik, 1956 and Govindiah, 1981). A number of weed plants in modern science have significant value in ethno botany. Due to lack of awareness about medicinal importance of weeds, these are discarded by the farmers. By the use of herbicides in farming practices, a group of weeds is killed creating a threat to weeds in near future.

Diversity of weed plants is available but on the traditional uses of weeds, a limited work has been carried out in India by Patnaik (1956), Govindiah (1981), Bhattacharya (1996), Swami et al. (1996), Dobhal et al. (2006), Nath et al. (2007), Sarkar et al. (2007) and Dhole et al. (2009). Therefore, present investigation has been carried out on the medicinal values of weed plants of district Fatehpur, Uttar Pradesh, India.

2. MATERIALS AND METHODS:

2.1. Study Area:

District Fatehpur is located at 122 km south east from capital Lucknow of Uttar Pradesh. Elevation from sea level covering 4152 km between 26.16 North latitude and 81.20 East longitudes. At the north side of district River Ganges- District Unnao are present and Rae-Bareli and River Yamuna in South, whereas, District Hamirpur, Banda, and Kanpur in West side and Kaushambi and Allahabad in East.

2.2. Culture and Life of Study Area:

The area has a rural culture of old traditions. Local people are very close to the natural vegetation. There are also many medicinal weeds growing along road sides, forest, crop fields and waste lands. These weeds are familiar to the inhabitants of the place. The local people in various villages of the area gather native medicinal weeds in different seasons of the year for personal use and whole community uses within the area. So, in this way, the ethno-medicinal knowledge of weedy plants is interactively linked to local culture and history. Though the area is rich in indigenous knowledge related to weeds, still there is a large number of underutilized weeds which could be prove useful yet. The knowledge is going to be lost because of interference due to modern cultural changes and modern development into the indigenous knowledge system. Continuity of this practice will result in total loss of such knowledge. Therefore, the objective of this study was to assess the richness of ethno-botanical weeds used by local people in Fatehpur and traditional medical practice of the people. Documenting the indigenous knowledge through ethno-medico studies is important for conservation of biological resources as well as their sustainable utilization.

2.3. Collection of Weeds:

The collection of various weeds was made from different crop fields, road sides, waste lands and open spaces. Collected plants were identified with the help of available literatures (Hooker, 1973 and Duthie, 1960). The identified weeds were further studied for their medicinal values as per suggestions of Kirtikar and Basu (1933), Chopra et al. (1956), Jain (1968 & 1991). Information about the medicinal uses of weeds was also obtained from the local people.

3. RESULTS AND DISCUSSION:

The present study reveal that out of 52 problematic weeds collected, 26 ethno-medico important weed species of 25 genera belonging to 16 Families are used against many diseases. Euphorbiaceae is the leading family with 4 species followed by Asteraceae and Solanaceae families with 3 species each. Local people have unique knowledge to cure different human diseases or disorders by using these weeds. These are administered in the form of medicinal recepies such as extract, powder, juice, paste, decoction, oil and pellets or sometimes simply wrapped around affected body parts. The various domestic substances like milk, Ghee, jiggery, oil, turmeric powder etc are also employed for preparing medicinal recepies. Plant parts like roots, seeds, stem, leaves, fruits or entire plants are used in medicinal preparations. All these ethno-medicinal valued weeds with their botanical names, vernacular names, family and medicinal uses are documented in Table1. Many workers have been reported medicinal values of weed plants from different places in India and also gave further strengthen to the present findings *viz.,* Patnaik (1956) from Cuttack, Bhattacharya (1996) from Saurashtra, Swami et al. (1996) from Udhampur, Dobhal et al. (2006) from Pauri, Nath et al. (2007) from Darrang, Sarkar et al. (2007) from Tamil Nadu, Dhole et al. (2009) from Marathwara, Sharma and Khandelwal (2010) from Rajasthan and Rao (2011) from Gorakhpur.

These weeds grow along with crop plants and are regarded as nuisance for crops but are boon to the pharmaceutical industries as these weeds yield chemicals used in formulations of various important drugs (Sarkar et al., 2007). These plants we call weeds can have many useful functions and also provide valuable information about the condition of our land. Nearly 80% of world population depends upon traditional system of health care. Allopathic drugs have brought a revolution throughout the world but the plant based medicines have their own status (Patnaik, 1956; Govindiah, 1981; Sarkar et al., 2007). Local uses of plants as a cure are common particularly in those areas which have little or no facility of modern health services. Hence due to poverty, ignorance and unavailability of modern health facilities, most of rural people are dependent on traditional medical practices for their treatment (Patnaik, 1956 and Govindiah, 1981). Now, some people especially young and new generations prefer alternative modern treatment and also becoming ignorant about the indigenous knowledge of plants. Therefore, there is a need to create awareness among the local people for the importance as well as conservation of the plant resources of the region;

otherwise many weed species may be lost forever. However, it is a well known fact that weeds have negative value but if grown properly can be converted to useful for the mankind.

Table 1. List of weed plants showing medicinal value

Sl.	Botanical Name	Local Name	Family	Medicinal Uses
1.	*Abutilon indicum* L.	Kanghi	Malvaceae	Seeds used in piles and gonorrhoea. Leaf decoction are given in tooth ache and bleeding gums.
2.	*Achlypha indica* L.	kuppi	Euphorbiaceae	Leaf paste with lime juice is given in ring worm infections. Roots and leaves are laxative. Properties of this drug resemble those of Ipecac.
3.	*Achyranthus aspera* L.	Apamarg/Latjeera	Amaranthaceae	Root powder used as antidote to snake bite. Root decoction used in stomach pain fever, cough.
4.	*Ageratum conyzoides* L.	Neel Phool	Asteraceae	Leaves used in headache, muscular pain and wound healing. Seeds used in diarrhoea.
5	*Amaranthus spinosus* L.	Kateli chaulai	Amaranthaceae	Used in cough, fever, diarrhoea, leucorrhoea. Also used as an antidote to snake bite and as blood purifier.
6	*Boerhhavia diffusa* L.	Punarnava	Nyctaginaceae	Use as a diuretic. Root decoction is given in jaundice. Also used as myocardial stimulant.
7	*Calotropis procera* R.Br.	Aak/madar	Asclepidiaceae	Milky juice used for treatment of leprosy, and rheumatic pain.
8	*Calotropis gigantea* L.	Safed aak	Asclepidiaceae	Leaves warmed in oil applied in inflammatory part of the body.
9	*Cannabis sativus* L.	Bhang/Ganja	Cannabinaceae	Leaves used in ear troubles, cuts and wounds. Crushed leaves in skin diseases. Narcotic intoxicant and sedative.
10	*Cassia tora* L.	Chakwar	Caesalpinaceae	Whole plant decoction used as laxative. Root and leaf paste are applied all skin diseases, eczema, acne, psoriasis, boiled and cuts. Seed paste is mixed with lime juice to treatment of ring worms.
11	*Chenopodium album* L.	Bathua	Chenopodiaceae	Used in bleeding piles, cough, fever, dysentery, as laxative.
12	*Cleome viscose* L.	Hur-hur	Capparidaceae	Leaf decoction applied in ear to relieve inflammation and to cure pus formation. Also used in cough, leprosy, malaria and uterus trouble. Leaf is boiled with ghee and applied to treatment of wound. Leaf paste is applied to reduce the swellings. Seed decoction is used to control of gastric problems.
13	*Coccinia grandis* L.	Jangali kundru	Cucurbitaceae	Leaf juice in diabetes, skin diseases.
14	*Datura innoxia* Mill.	Datura	Solanaceae	Used in diarrhoea, oedema and bronchial asthma. Seed power used in rheumatism. It is antispasmodic and narcotic. Poultice of leaves checks inflammation of breasts due to excessive formation of milk.
15	*Eclipta alba* L.	Bhangra/ Bhringaraj	Asteraceae	Leaf extract used to head to relieve dandruff and to naturally blacken grey hair. Leaf juice boiled with coconut oil used to treat headache and to promote hair growth. Plant decoction used in jaundice, urinary infection and liver enlargement.
16	*Euphorbia hirta* L.	Dhudhi	Euphorbiaceae	Leaf juice is used as expectorant, in fever, dysentery, bronchial asthma, roots in leucoderma. Useful in removing worms in children. Milky juice of plant is applied on warts.
17	*Evolvulus alsinoides* L. *syn. Convolvulus alsinoides* L.	Shankhap-ushpi	Convolvulaceae	Used as nerve tonic. Also used in sexual debility and urinary troubles.
18	*Ipomea aquatica* Forsk.	Nari ka saag/ Karemua	Convolvulaceae	Plant paste applied over body to cure itching. Whole plant is used in digestive problems. Plant juice used in cases of opium poisoning. Leaves and stem are cooling and given in nervous and general debility.
19	*Oxalis debilis* H.B.K.	Khatti booti	Oxalidaceae	Used in fever, diarrhoea, scurvy and piles. Also antidote to snake bite. Whole plant used to treatment of fever, indigestion, chronic dysentery and also useful to patients who are suffering from insomnia.
20	*Phyllanthus niruri* L.	Bhui amla	Euphorbiaceae	Decoction of plants given in malarial fever. Also used in diabetes and diarrhoea. Plant juice is mixed with goat milk and taken internally for 3 to 4 days to cure jaundice. The plant is used as antiseptic, astringent, diuretic, febrifuge. Plant used to treatment of liver infection, diarrhoea and dropsy.
21	*Ricinus communis* L.	Arandi /rendi	Euphorbiaceae	Leaves coated with mustard oil and warmed are applied externally over joints in rheumatism. Seed oil used as purgative,

				skin diseases, piles.
22	*Sida cordifolia* L.	Kharenti	Malvaceae	Extract of plant used in spermatorrhoea. Roots in urinary diseases, leucorrhoea. Root juice used for promoting healing of wounds.
23	*Solanum nigrum* L.	Makoi	Solanaceae	Plant decoction used in diarrhoea and fever. Leaf paste and fruit decoction is given to treat rabies. Plant paste is used as emollient, diuretic. Green fruits are pounded and applied locally on ringworm.
24	*Solanum xanthocarpum* L.	Nili kanteli	Solanaceae	Root is used to treatment of cough, asthma, chest pain. It is diuretic and considered useful in stones in bladders.
25	*Tinospora cordifolia (*Willd.) Hook	Giloya	Menispermaceae	Stem decoction with sugar is given to cure typhoid. Also used for cold, fever, heart problems.
26	*Tridex procumbens* L.	Jakamjudi	Asteraceae	Used in fresh cut to check bleeding. Powder is given with water to cure leucorrhoea. Leaf juices are applied over the wounds as antiseptic. The leaf paste are mixed with equal amount of turmeric paste is used to treatment of all skin infections. Whole plant used in treatment of piles. Three centimetre length of cut root are used for inducing abortion up to 3 months of pregnancy.

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Electrical conductivity study of polyaniline-polymethylmethacrylate composite fibers

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Abstract

The optimal conditions for preparing conductive fibers from polymethylmethacrylate (PMMA) and polyaniline (PANI) were determined. The electrical conductivity of the fibers was found to be strongly dependent on the nature of dopant ion and the doping time. The stability of the prepared fibers in terms of dc electrical conductivity retention was investigated at different temperatures. The prepared fibers were characterized using FTIR and SEM. The fibers have good potential for preparing conductive fabrics, smart clothing and conductive yarns.

1. INTRODUCTION:

Research in the field of conductive polymers has attracted considerable attention for more than twenty years. Among the family of conjugated polymers, polyaniline is one of the most useful polymers because of its economical importance, good environmental stability and significant electrical conductivity when doped. The electrical conductivity of the composite fibers can be tailored to desired applications by changing the doping level and the amount of conductive filler. Polyaniline is also unique among conducting polymers as it has a very simple acid/base doping/dedoping chemistry. PMMA is one of the most popular polymeric materials used for the preparation of fibers and fabrics in textile industry due to its high strength, resistance to shrinkage and abrasion. A number of conducting composites/blends have been synthesized with a wide range of exciting properties in the form of films as well as coatings using polyaniline along with polyvinyl alcohol (Gangopadhyay and Ghosh, 2001), polyvinyl chloride (Gupta and Singh, 2004) and polyacrylonitrile (Park and Park, 2001). Recently, electrically conductive and mechanically robust composite materials have found application in electronics (Ramamurthy et al., 2004), electro-optical (Angelopoulos, 2001) and energy storage devices (Gall et al., 2003). The production of fibers is a challenging area and active research is being pursued worldwide in this particular field. There has been however very few studies reported on the synthesis of electrically conducting composite fibers. The preparation of electrically conductive fibers by using polymers such as nylon-6,6 and polyacrylonitrile with polyaniline has been reported earlier (Du et al., 1997; Khalid and Mohammad, 2009). In the present work a simple technique for the preparation of conductive fibers based on PANI and PMMA and its physico-chemical characterization is reported. The stability of the fibers was investigated under ambient conditions by carrying out thermal studies. The role of doping time on the electrical characteristics has also been discussed.

2. MATERIALS AND METHODS:

The following reagents and chemicals were used for the preparation of composite fibers: aniline, 99% (CDH, India), PMMA (Research, Design and Standard Organization, India). Other chemicals were used as received (E. Merck, India). The electrical conductivity of the fibers was measured at isothermal temperature (50, 70 and 90 °C) by using four probe instrument (DMV 001, LCS 002) of Central Instrumentation Facility of Indian Institute of Technology, Roorkee, India. The electrical

conductivity (σ) was calculated using the following equations:

$$\rho = \rho_o / G_7(W/S) \quad (1)$$

$$G_7(W/S) = (2S/W)\ln 2 \quad (2)$$

$$\rho_o = (V/I)2\pi S \quad (3)$$

$$\sigma^o = 1/\rho \quad (4)$$

where $G_7(W/S)$ is a correction divisor which is a function of thickness of the sample as well as probe-spacing where I, V, W and S are current (A), voltage (V), thickness of the film (cm) and probe spacing (cm) respectively. The conducting polymer PANI is difficult to polymerize in its fibrous form directly. Electrically conductive fibers of PANI-PMMA composites were therefore prepared in various amounts of aniline prepared in PMMA solution (in THF) by stirring vigorously using magnetic stirrer at room temperature. In the PMMA matrix, PANI was grown by in situ oxidative polymerization using ammonium peroxidisulphate to obtain PANI-PMMA composite fibers. The fibers were doped in 1 M *p*-toluenesulfonic acid as well as 1M sulfuric acid to convert emeraldine base into its salt form and to render the fibers electrically conductive. The electrical conductivity was measured using pellet of the fibers. The fibers were compressed in pellet form by applying a hydraulic pressure (20 kN).

3. RESULTS AND DISCUSSION:

Figure 1 shows a representative plot of electrical conductivity as a function of doping time. It is observed that the electrical conductivity of the fibers increased with the increase in doping time. It is further observed that the fibers doped with *p*-TSA showed nearly one order of magnitude higher conductivity in comparison to fibers doped with sulfuric acid. This perhaps could be due to cumulative steric as well as electronic effects of the bulky methoxy substituent present on the benzene ring of *p*-TSA. It seems that the nature of the counter ion of the dopant as well as doping time play a significant role in determining the electrical characteristic of the final product. The appearance of electrical conductivity in a time period as short as 1 min of doping is indicative of relatively fast protonation process.

Figure 2 shows a plot of electrical conductivity as a function of volume of aniline added in the PMMA matrix. It is observed that the electrical conductivity of the *p*-TSA doped fibers showed a saturation trend beyond three hours of doping. It is observed that the electrical conductivity of the fibers was in the range of ~ 10^{-6}-10^{-2} S/cm. It was further observed that the electrical conductivity was significantly influenced by the loading of aniline. The enhancement in electrical conductivity on exposure to acid solution has been attributed to charge-transfer reaction between conducting fibers and doping agents by Du et al. (1997).

The stability of electrical conductivity of the prepared fibers under isothermal conditions was studied at 50, 70, and 90^{o}C by pelletizing the fibers and maintaining them at required temperatures. Figure 3 shows a representative plot of the temporal behaviour of electrical conductivity of such pellets. It can be inferred from the figure that the electrical conductivity of the fibers seems to be reasonably stable at 50, 70 and 90^{o}C temperature. This observation lends further credence to the fact that the prepared fibrous materials have potential for application in ambient environment where temperatures below 50^{o}C degrees centigrade are normally encountered.

Figure 4 shows the Fourier transform infrared spectroscopy (FTIR) spectra of PMMA and PANI-PMMA composite. The transmission intensity is plotted in terms of percentage as a function of wave number (cm^{-1}). The bands corresponding to stretching vibration of N-B-N and N=Q=N structures appeared at 1498 cm^{-1} and 1587 cm^{-1} respectively where –B- and =Q= stand for benzenoid and quinoid moieties of the polyaniline, corroborating the formation of polyaniline in the PMMA matrix. The relative lower frequencies of benzenoid and quinoid ring stretching are due to the salt formation with *p*-TSA (Sung and Seung, 1998). The presence of such carbonyl group has been observed in figure 4. The bond 1742 cm^{-1} is assigned to free carbonyl group absorption of PMMA. Furthermore, in PANI-PMMA composite the above stated band is observed to have slightly shifted towards lower wave number (1732 cm^{-1}) perhaps due to hydrogen bonding between imine of PANI and carbonyl of PMMA. The characteristic peaks of sulfonated bands can be seen clearly 669, 749 and 1023 cm^{-1}.

Figure 5A and 5B show representative digital and SEM micrographs of conducting fibers of PANI-PMMA. The digital micrograph shown in Fig 5 A brings out very clearly the fibrous nature of the prepared composite. The dark region observed in Fig 5 B is ascribed to conductive PANI phase, while the bright region is ascribed to non conducting PMMA phase. It is further observed that PANI content is markedly localized in the PMMA matrix.

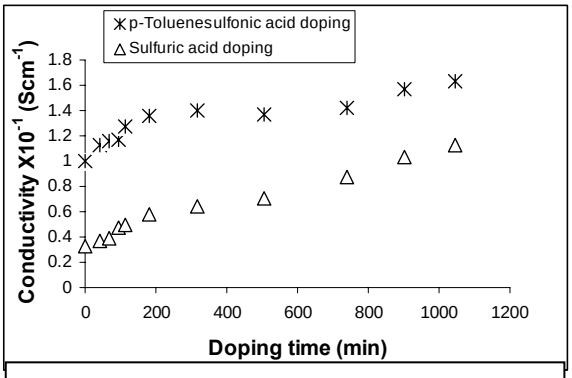

Fig. 1. Plot of electrical conductivity as a function of doping time

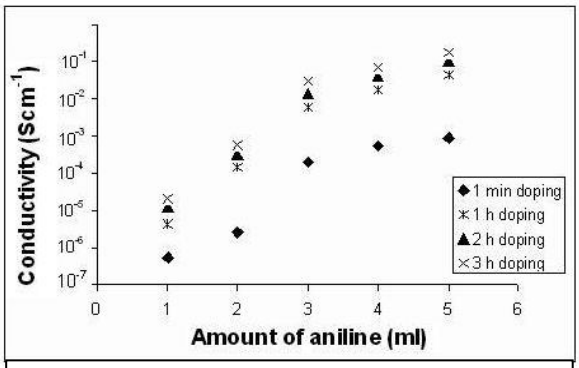

Fig. 2. Plot of electrical conductivity as a function of aniline fraction for 1M *p*-toluenesulfonic acid doped fibers at various doping time

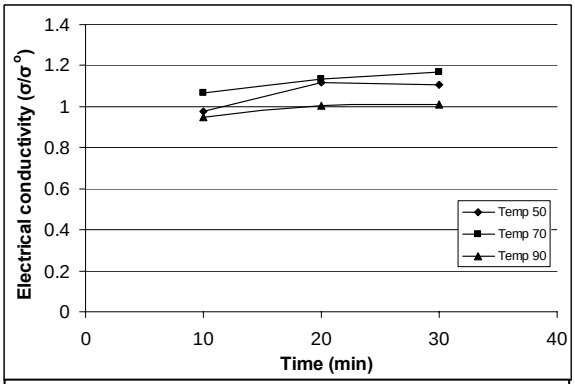

Fig. 3. Plot of isothermal stability in terms of dc electrical conductivity of PANI-PMMA fibers

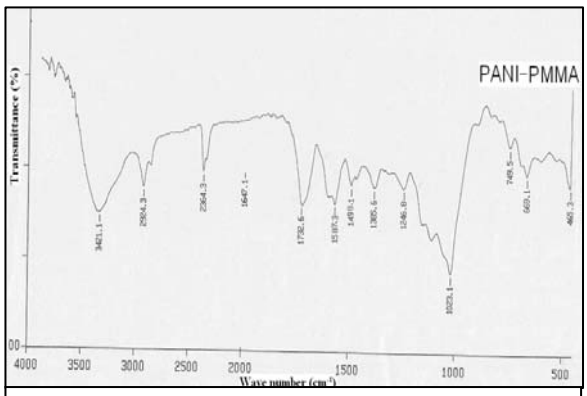

Fig. 4. FTIR spectra of PANI-PMMA composite fiber and PMMA

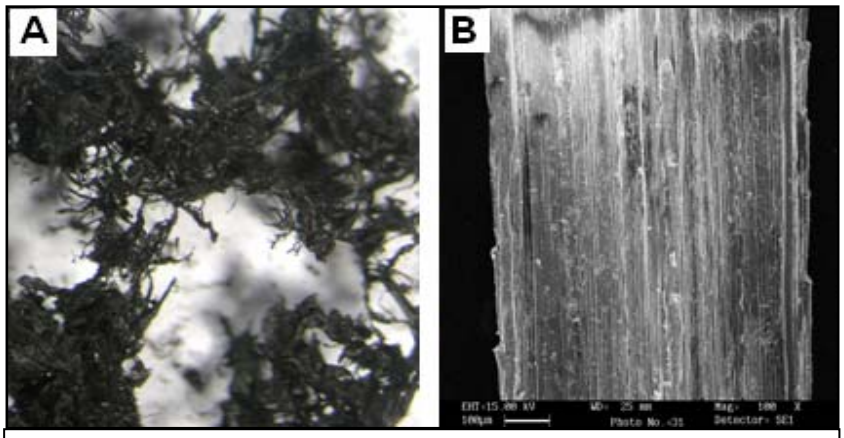

Fig. 5. (A) Digital micrograph of PANI-PMMA fibers and (B) SEM micrograph of the PANI-PMMA fiber

In conclusion it can be stated that optimal conditions for preparation of electrically conductive PANI-PMMA composite fibers using in situ polymerization of aniline in PMMA matrix were determined. These fibers can be exploited for preparing conductive fabrics, smart clothing and conductive yarns. Fourier transform infrared spectroscopy and SEM micrographs were used for structural confirmation of PANI-PMMA composite fibers. TGA was carried out to understand the thermal behaviour. The present study showed that the electrical conductivity of the fibers strongly depends on the nature of dopant ion and the doping time.

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SHORT COMMUNICATION

Histopathological observations on helminth infection of some air breathing fishes of India

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Air breathing fish, helminth, histopathology, metacercariae

Abstract

The air breathing fishes cultivated in oxygen deficient water bodies and the culture of these fishes are subjected to various parasitic diseases. The present investigation observed that helminthes and their various stage metacercariae are often associated with extensive damage to various somatic and visceral organs of the fishes. The histopathological changes like necrosis, fibrosis, and other mechanical damages of tissue were observed due to infection of helminth parasites. The deleterious effects of helminthes on air breathing fish production could be assessed from accurate histopathological examination of the invaded regions. Therefore, present studies provide a clear picture of pathogenesis of helminth infection in air breathing fish.

1. INTRODUCTION:

In the water bodies of India especially North Bihar, air breathing fishes usually thrive and constitute important fishery resources. These fishes are cultivated in oxygen deficient water by systematic and scientific culture, and also subjected to various parasitic infections. The diseases not only deplete the fish race but also affect human beings. The harmful effects of helminth and their metacercariae are often associated with extensive damage to various somatic and visceral organs, but this important aspect of fish histopathology continue to be unexplored unfortunately. In consequence of the great stress that has been placed lately on the development of air breathing fishes to becomes essential and make a scientific assessment on the role of helminthes as potential pathogen in India. Therefore to provide a clear image of infections and also to examine the effect of these diseases, histopathological examinations of the infected tissues have been done.

2. MATERIALS AND METHODS:

Healthy and parasitized air breathing fishes *i.e., Clarias batrachus, Channa punctatus* and *Heteropneusts fossilis* were collected from derelict swamps and ponds of district Darbhanga, Bihar. Routine investigation of skin, muscles, gills, eyes and viscera were made through naked eyes. Thereafter, for detailed examination of organ, they preserved in 0.6% saline solution and further studied under dissecting microscope.

If metacercariae found, artificial digest along with 0.5% pepsin and 0.5% HCl in 0.65% saline solution was used to segregation of encysted metacercariae, when it associated with muscles, skin, liver and eyes. The affected parts were preserved in 10% neutral formaline, Bouin's fluidand Zerker's fixatives for 24-28 hours prior to processing. Paraffin sections were cut at 5-7 µ and stained with haematoxyline and eosin, and subjected to study under microscope.

3. RESULTS AND DISCUSSION:

3.1. Skin Infection:

The present observations reported on the histopathological changes in some vital organs in air breathing fishes (*Clarias batrachus, Channa punctatus* and *Heteropneusts fossilis*) due to infection of helminth parasites. Histopathological observations of skin revealed haemorrhage, hyperemia, patches

and necrosis in the superficial areas of body musculature and skin. The tissue elements were merely pushed aside to make room for the strigeoid metacercariae (Fig. 1 and 2).

In the previous study, Hoffman (1975) has reported that many cercariae penetrate the skin of fish and produce cyst wall. Later, Bell and Margolis (1976) reported hemorrhage in the superficial areas of the body musculature of fishes. Similarly, Dubey (1981) reported muscle necrosis and marked cellular response of the host tissue around the encysted worm, showed complete corroboration to the present findings. The observations have also been reported by Pandey (1971) on the skin infection of *Heteropneusts fossilis* with metacercariae of *Prohemistomulum* also given strengthen to present findings.

Fig. 1. Strigeoid metacercarial cysts scated deep in muscles of *Clarias batrachus*

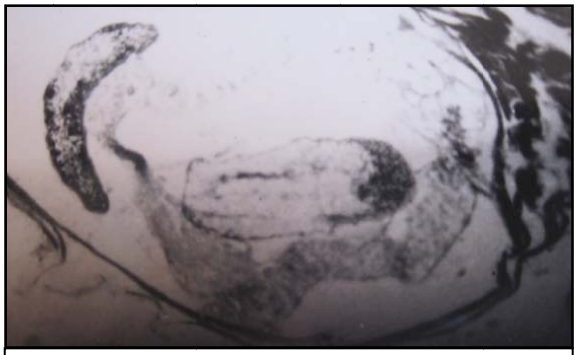

Fig. 2. Photomicrographs of portions of sections of lesioned patches of skin and muscles

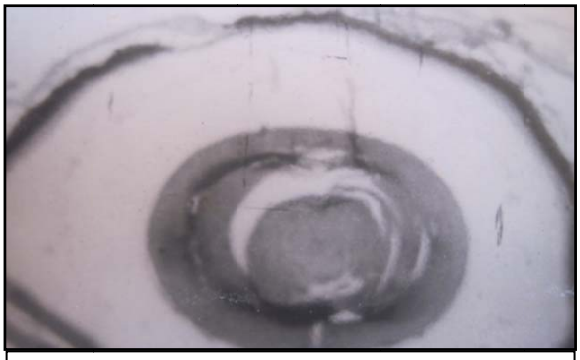

Fig. 3. Section of photomicrographs of the parasitized eye of *H. fossilis*

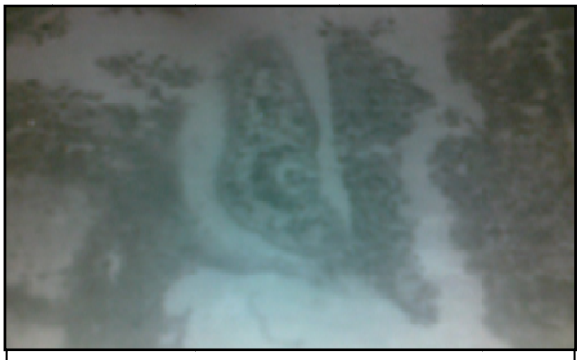

Fig. 4. Photomicrographs of portions of parasitized liver of *H. fossilis*

3.2. Eye Infection:

While studying eyes of infected fishes, whitish and opaque eye were found, and disoriented photoreceptor cells and parasites were located in the peripheral retina. However, in some cases, retina was displaced abnormal in position (Fig. 3). Lesion of the eye are numerous and varied in their etiology, and literatures dealing with lesions of the eyes of fish due to infection of metacercariae have been contributed by Sato et al. (1975), Pandey (1970) and Dubey et al. (1981), Amin et al. (2000) and Akinsanya, (2007) showed complete agreement with present findings.

In another experiment, Davis et al. (1973) has reported strigeoids from the retina of infected salmon. However, Hoffman (1975) found that lenses become opaque causing blindness of the diseased fish. On the other hand, Datta (1993) reported lens herniation in infected eye of trout, whereas, no such herniation of lens was observed in the present investigations.

3.3. Liver Infection:

As far as liver was concern, the color of infected liver was pale in comparison to the bright brown color of healthy liver of fish. Infected liver contain white dots throughout its surface without cyst. The sinusoids and blood vessels were engorged and hepatic cords lost. The hepatocytes had undergone degeneration (Fig. 4). The liver of teleost does not show the diversity of pathology in the higher animals. But liver is susceptible to a number of toxic and metabolic disturbances. Camargo et al.

(2007), Hassan (2005), and Butchiram et al. (2009) have reported various types of histopathological effects on the liver of fishes infected north various helminth parasites.

In the Present investigation the strigeoids present in the liver of air breathing fish were not of the cyst forming type, rather they were all actively moving and feeding on the liver tissues. Thus, histopathological changes like necrosis, fibrosis and other mechanical damages of the tissues were pronounced nature than those observed by Hoffman (1975) in the liver of sunfish and blue gill, infected with strigeoids of *Posthodiplostomum*. The observations made by Sinha et al. (1988) on yellow grub disease in *Channa punctatus*, showed histopathological effect on the liver, kidney and spleen. Similarly, Chakravaty and Tandon (1989) have reported some histopathological deviations in *Clarias batrachus* with mixed infection of trematode and cestode.

The finding of present study concluded that infection of helminth parasites in air breathing fish *i.e.*, *Clarias batrachus, Channa punctatus* and *Heteropneusts fossilis* produce some deleterious effects that have been assessed from histopathological examination of the invaded regions. The skin, eyes and liver of fishes found highly infected with helminth parasites, showed lethal effects and also subject of the fish mortality.

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SHORT COMMUNICATION

Morphological observations on female *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae)

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Abstract

Scirtothrips dorsalis Hood belong to the family Thripidae of order Thysanoptera. Thrips are opportunist species exploiting intermittently occurring environments. In the present study, imago of female thrips was collected from the host plants from Bichpuri Horticultural Farm, R.B.S. College, Agra. They were studied under stereo binocular microscope in the laboratory. The morphological observations revealed that the antennae are long, eight segmented and measured as 299 – 309 µm in length. Measurements of each antennal segment are 18, 34, 50, 56, 46, 43, 37 and 25 µm in length, and 25, 28, 25, 21, 21, 21, 20 and 12 µm in width. The abdomen is long, narrow and tapering into a tubular structure and measured as 1.45 mm in length and 0.380 mm in width. One pair of spiracles occurs on mesothorax, second and eighth abdominal segments.

1. INTRODUCTION:

Thrips have their primary and independent status since first described by DeGeer (1744). The systematics of these groups has extensively been studied by Haliday (1836), who coined order thysanoptera and divided into two suborders: terebrantia and tubulifera. However, the detailed study on *Scirtothrips dorsalis* was made by Mound and Plamer (1981), and they provided a pest status of peanuts. In India, some workers are believed that it is a polyphagous pest feed on varieties of plants including cashew, tea, chilli, cotton, tomato, mango, castor, bean, tamarind and grape vine (Ananthakrishnan, 1984), and severe infestations may resulted in complete defoliation of plants (Ananthakrishnan, 1980).

The infested plant of groundnut showed dull yellowish-green patches on upper surface of leaf, and brown necrotic areas also seen on the lower surface of leaf. On severe infestation, leaves become thickened, curling and blighted (Amin and Palmer, 1985). The economics on damage potential in other crops such as cotton and onion also recorded by Parajulee et al. (2006), Pobozniak et al. (2006) and Pobozniak (2007). They also provide sampling methods and dispersion patterns of thrips.

2. MATERIALS AND METHODS:

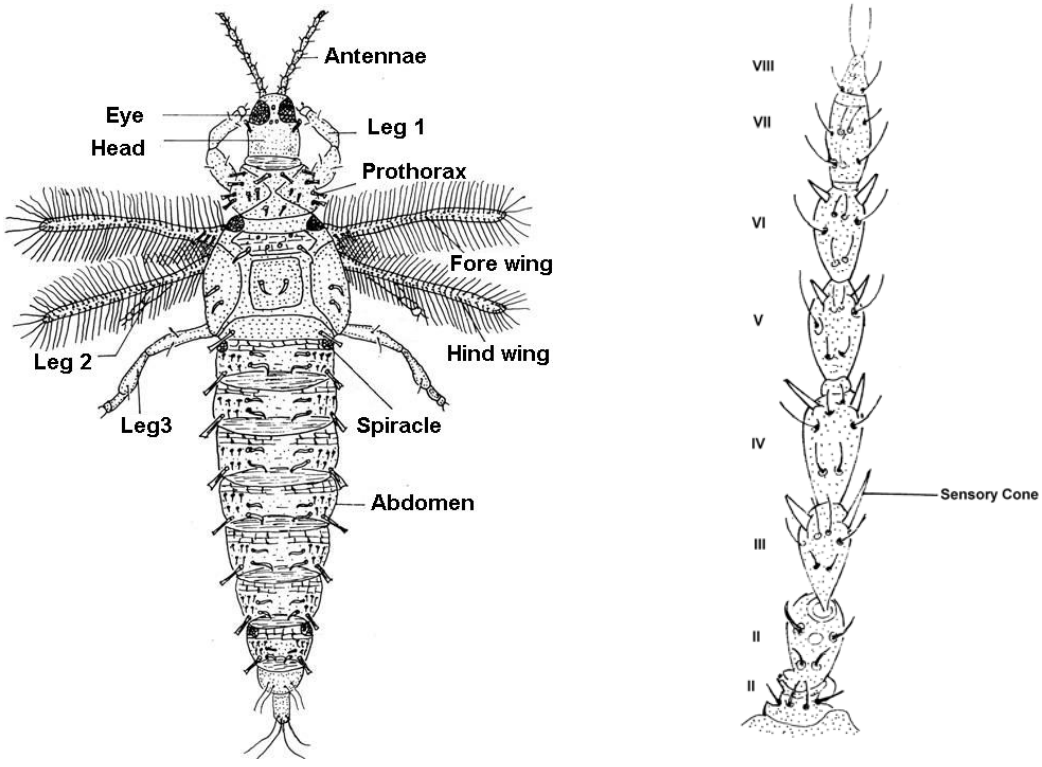
To accomplish above experiment, female *Scirtothrips dorsalis* were collected from *Citrus limon, Capsicum* species and *Mimusops elengi* plant of Bichpuri Horticultural Farm of R.B.S. College, Agra. Thereafter, they were transferred to the laboratory for preservation and also reared to develop colonies for experimental works. After preservation and card mounting, they were subject to study under stereo binocular microscope.

3. RESULTS AND DISCUSSION:

The morphological observations on female *Scirtothrips dorsalis* revealed that they are deeply pigmented pale yellowish in color. It body is heavily sclerotized. Antennae are long eight segmented and measured as 299 to 309 µm in length. Measurements of individual antennal segment showed length of 18,

34, 50, 56, 46, 43, 37 and 25 µm and width of 25, 28, 25, 21, 21, 21, 20 and 12 µm, respectively (Fig. 1). Eyes are redish in color, 75 to 89 µm long and 63 to 70 µm wide and at the middle of eye three occeli are arranged in triangular manner (Fig. 1). Prothorax is of 162 to 176 µm long and 249 to 264 µm wide and two prominent dorsal plates also occur at the base. Pterothorax is of 332 to 349 µm long and of 380 to 404 µm wide (Fig. 1). Wings are well developed with clear veins and setae. The abdomen is long, narrow and tapering into a tubular structure and measured as 1.45 mm in length and 0.380 mm in width (Fig. 1). One pair of spiracles has also been recorded on mesothorax, second and eighth abdominal segments.

Fig. 1. Morphological observations on female *Scirtothrips dorsalis*



A. Adult **B. Antennae**

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SHORT COMMUNICATION

Studies on mechanical transmission of chilli mottle virus disease in *Capsicum annuum* L.

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Abstract

A virus with flexuous particles designated as chilli mottle virus (ChiMV). They causes dark green spot, green vein banding and leaf distortion on *Capsicum annuum* at Agra and its adjoining area. The virus was readily transmitted by mechanical sap inoculation, grafting, insect and seeds. Mechanical transmission is accomplished by transfer of sap through contact between diseased and healthy surface of leaves and also rub together. It is most useful for experimental work and also moderately occurs in nature. The inoculum was prepared in 0.01M phosphate buffer at pH 7.0 from the leaves showing severe symptoms of mottle virus. The inoculations were made on the carborundum powder (600 mesh) dusted leaves. Carborundum powder showed a significant role in the mechanical transmission of chilli mottle virus. Therefore, present studies give a significant importance of ChiMV transmission and also provide physiological changes in the plants.

1. INTRODUCTION:

Chilli (*Capsicum annuum* L.) is the dried ripe fruit of the genus Capsicum. Chili has been a part of the human diet since at least 7500 BC. It is a rich source of vitamin A, C and E and help in digestion. There is archaeological evidence at sites located in southwestern Ecuador that chili peppers were domesticated more than 6000 years ago. Chilli is reported to be a native of South America and is widely distributed in all tropical and sub tropical countries including India. It was first introduced in India by Portuguese towards the end of 15th Century. Now it is grown all over the world except in colder parts. A global significant loss in the yield of chilli has been found by the infection of Chilli mottle virus disease and the virus transmitted was found by mechanical transmission, grafting, dodder, insect (Miczynski et al., 1997; Honda et al., 1982 and Ruppel and Duffer, 1971).

2. MATERIALS AND METHODS:

The mottle virus infected capsicum plants showing dark green mottling and reduced leaf size were collected during survey of district Agra. The collected samples were also tested by Enzyme Linked Immuno-sorbent Assay (ELISA) as per suggestions of Hobbs et al. (1987).

The inoculum was prepared in 0.01 M phosphate buffer at pH 7.0 from young leaves of chilli showing sever symptoms of the mottle virus. The inoculations were made by the carborundum (600 mesh) dusted leaves. Other mechanical means also applied for the transmission of virus from chilli. Source of infections i.e., plant were sap inoculation, prick method, brush method, rapid leaf rubbing method (Yarwood, 1957) close contact method were applied.

3. RESULTS AND DISCUSSION:

The mechanical transmission is indispensable to understand the viral properties and various in vitro aspects of diversified interests. Crude sap and standard virus inoculum were used for sap transmission. The mechanical transmission assumes great significance in studying the physical properties of the plant virus. Inoculation was made on the leaves of 3-7 days old healthy seedling of tested

plants by gently rubbing of the sap with the help of forefinger. On the other hand, carborundum powder (600 mesh) was used as an abrasive. Control plants were inoculated with the sterilized distilled water in the same manner. In each set, 10 plants were inoculated and the experiment was repeated five times. The results of the experiments are depicted in the table 1.

Table 1. Transmission of the chilli mottle virus by crude sap and standard virus inoculum to tested plants of *Capsicum annuum* L.

Method of Inoculation	S. No.	Number of Plants		Incubation Period (in day)	% Transmission
		Inoculated	Infected		
Crude Sap	Control	10	0	0	00
	1	10	3	10	30
	2	10	5	12	50
	3	10	4	14	40
	4	10	5	13	50
	5	10	6	15	60
	6	10	6	15	60
	7	10	8	16	80
	8	10	7	14	70
	9	10	9	12	90
	10	10	5	14	50
Mean	**--**	**10**	**5.8**	**13.5**	**58.0**
Standard Virus Inoculum	Control	10	10	0	00
	1	10	10	9	100
	2	10	10	8	100
	3	10	10	14	100
	4	10	10	10	100
	5	10	10	10	100
	6	10	10	12	100
	7	10	10	14	100
	8	10	10	12	100
	9	10	10	13	100
	10	10	10	14	100
Mean	**--**	**10**	**10**	**11.6**	**100**

In the present investigation, it was observed that the chilli mottle virus gave 58% transmission with crude sap. The use of carborundum powder (600 mesh) as an abrasive increased the infection up to 100%. Similar pattern of infection by carborundum powder was also reported by Kado (1962) and Hady et al. (1980).

The use of phosphate buffer (pH 7.0) enhanced the infectivity of the virus and the uniform symptoms appeared one or two days earlier. In another experiment, Prakash et al., (2001) reported that use of phosphate buffer has also been reported to increase the infectivity of virus. They studied mechanical transmission of the virus, inocula were prepared by triturating in a cold 0.1M phosphate buffer (pH 7.0) containing 0.1% sodium di-ethyl-di-thi-carbamate (DIECA) or 0.1M tris buffer (pH 7.0) @ 1 ml/gm of fresh leaf tissue.

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Manuscripts, Libraries and Preservation of the Cultural Heritage

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Abstract

The focus of this article is on the role of libraries in preserving the cultural heritage. An attempt is made to discuss how the book, libraries and culture are interrelated with each other. The nature of documentary collection, its urgent need and the national mission for manuscripts are also discussed

Introduction:

The ancient used a variety of mediums to records their ideas and thoughts. The Sumerians and Indus people used clay tablets. The Egyptians also cut and painted on the walls of their temples and pyramids. Later they made use of papyrus to write on some other made use of skins, birch barks, palm leaves etc. The Chinese & Koreans invented paper and used it for writing. In the modern times, besides paper, film, magnetic tape, disc and computer are used to stock file the" rich fruits" of the human brain. Human civilization largely depends on the recorded knowledge, which enables human thoughts and ideas to transcend space and time, so that every generation does not have to learn everything by direct experience over and over again. The recorded knowledge is the social memory and the cultural asset of the people of all nations.

The recorded information had taken various forms such as inscriptions, manuscripts, achieves, books, films, discs, tapes, CD- ROMs etc. Inscriptions, records, archives and manuscript books were housed for centuries. Recorded information however in itself is of no use unless it is stored in such a way that it can be retrieved easily and made accessible for use.

Books, Libraries and Culture:

All these three are interrelated. One helps creation of other, one leads to growth and development of the other, one influences the nature and character of the other. In such a process of mutual help and care, Books, Libraries and Culture have been

continuing their life cycle from early days of civilization-- immensely benefiting humanity and its society as a whole.

Library is no more repositories of books and the librarian a vibrant institution treasuring the knowledge by countless generations of seekers. Since time immemorial human being were communicating with one another through gestures, symbols, sounds, words and written and printed books and other types of documents and of late through electronic media. These documentary sources enabled human civilizations to communicate with each other and thus enrich themselves with the help of this communication process. It was evident that the intellectual products of human thought and endeavor were being procured, processed and the thought content embodied in them is disseminated through various methods, and documents are conserved and preserved in various types of libraries throughout the world for posterity.

Libraries are examples of repositories of human civilization and culture. In Libraries, books would be our prime concern and no way allowing us to ignore the society and the people. In fact the impact of public libraries on their neighboring society has always been a much talked- about subject has constantly involved us to explore the possibility of its development. Community Information services (CIS), a vibrant theme of modern public library services, has thus occupied our careful attention to trace its evolution through decades in different countries and to discuss its present status and future prospects for the growing needs of the society and the people.

Not only and individual, but a nation as a whole is known by its culture, which is a manifestation of its way of life as well as its intellectual creativities. Beginning from an individual's life style, food habits, dresses, housing patterns, customs and festivals, even his moral values, or values of life and intellectual pursuits--all such human activities bear the distinct imprints of his culture, which is mostly integrated with the national tradition. Man lives with his tradition and derives inspiration from his inherited culture.

Culture generally has two aspects. One is material and other is spiritual. Buildings and cottage, architecture and art objects, dresses and clothing, indigenous agricultural techniques and tools etc. as made by man are the material aspect of his culture and civilization. On the other hand, its spiritual aspects are manifested in the world of thoughts and ideas, his literary creations, his tastes and behavior, his humanitarian feelings etc. Although culture varies from age to age, country to country or from one region based cluster of people to other, still culture has an overall universal character and human face.

Nature of Documentary Collection: The documentary collection available in some of the old and famous public libraries both government and private include-- paper and palm leaf manuscripts. Especially the collections available in some of the prominent public libraries is in South India are in Sanskrit, Tamil, Telgu, Kannada, Malayalam, Arabic, Persian, Urdu, Marathi and of course in English.

The valuable documentary collections is the prominent and old public libraries in various parts of the country mirror the culture and civilization of India and the richness of Indian Languages and also social political and cultural conditions of the people. These libraries regarded as social and cultural institutions of the nation and reflect the documentary heritage of our country.

There is an urgent need to conserve and preserve such invaluable documentary collections. The protection and safeguards extended to our ancient sites, monuments and buildings through legislative and administrative measures should equally be extended to our rare and invaluable library collections available in the public and other libraries.

Before invention of paper knowledge is recorded, preserved and made available in different formats and in different shapes to all those who needed. Different parts of the world used different materials for recording information and or knowledge depending on the availability of these materials.

Following is the description of different forms of material:

Palm Leaf: Leaves of a Palm tree trimmed to uniform size, flattened and polished for use as a writing surface in India, and Southeast Asia. The text was scratched in the surface then rubbed with dark pigment to make the characters more visible.

Parchment: It was made of goatskin that had been soaked in lime & craped to remove hair. The surface was then burnished with pumice to create a smooth surface for writing.

Clay: The method of writing varied according to the material. On stone letters could be incised or written with ink, clay could be impressed before drying and metal could be cast in a mold.

Coins & Wood: The hard surface of stone, wood or metal were not easily inscribed, and this difficulty restricted both the choice and the amount of text recorded in this fashion.

Papyrus: Although similar in appearance papyrus, parchment and paper are quite different. Papyrus is made of reeds that grow in marshes and along riverbanks like Nile.

Paper: Paper was invented by the Chinese about 2000 years ago. paper is made of randomly oriented (a felt) plant fiber.

Bark: In the Islamic world, where the word was more highly valued than image, calligraphy played a special role in making of the Qur'an. In many pacific cultures, "bark cloths" was made by beating moistened sections of bark with a serrated beater. Sections of this bark cloth were joined with vegetable adhesives and gums to produce sheets of considerable size.

Manuscripts: Historically manuscripts were produced in the form of scrolls or books. Manuscripts were produced on vellum and other parchments, on the papyrus and on paper.

Manuscripts constitute our most precious national heritage as rare pieces of recorded knowledge. The wealth of manuscripts is spread all over India. This wealth of manuscripts consists of spiritual, artistic, intellectual and scientific heritage. These are in paper, palm leaf, birch bark popularly known as *"Brurja patra".* To

preserve this treasure "The National Mission For Manuscripts " was started on 7th February 2003 by honorable former Prime Minister Shri Atal Bihari Vajapayee, under the Ministry of Tourism and Culture. Then mission activities are time bound for five years. This mission has created awareness about conservation and preservation of manuscripts. But trained personnel for this job are not available as required.

So, a library is a repository of wisdom of great thinkers of the past and the present. It is a social institution charged with the responsibility of disseminating knowledge to the people without any discrimination. The holdings of the libraries are the priceless heritage of mankind as they preserve facts, ideas, thoughts, accomplishments and evidences of human development in multifarious areas, aged and directions. The past records constitute a natural resource and are indispensable to the present generation as well as to the generations to come. Any loss of such material is simply irreplaceable. Therefore preserving this intellectual, cultural heritage becomes not only the academic commitment but also the moral responsibility of the information scientists/ librarian, who are in charge of these repositories. Besides proper dissemination of library materials is possible if the documents are in good & usable condition. This demands for the proper preservation and conservation of the library materials.

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