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An account concerning arrival and departure time of few selected winter migratory birds in Haryana rural ponds

Rohtash Chand Gupta[1], Tirshem Kumar Kaushik[2] and Surjit Kumar[2]

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Abstract

The present study has been carried out in few selected Northern Districts of Haryana State for a period of three years w.e.f. 2005-08. Attention has been focused on winter migratory birds that sojourn in Haryana and other parts of north Haryana. These birds come to Haryana from far off places, across the rim of great Himalayas and beyond. Only eighteen birds' departure and arrival time was recorded for study convenience. These migratory birds do not arrive in Haryana in one lot, on one date and at one time. Instead, these display a definite, pattern, decorum and time table, specific to species and even specific to place subject to varying temperature barometer.

The present study reveal that Northern Shoveller (*Anas clypeata*) Northern Pintail (*Anas acuta*) Common Teal (*Anas crecca*) and Gadwall (*Anas strepera*) arrive in October; Bar-headed Goose (*Anser indicus*) Graylag Goose (*Anser anser*) Spot billed Duck (*Anas poecilorhyncha*) arrive in November. As far as departure time is concerned, it is interesting to note that Mallard generally depart in February. Birds like Greylag Goose (*Anser anser*) Spot-billed Duck (*Anas poecilorhyncha*), Common Pochard (*Aythya ferina*), Eurasion Wigeon (*Anas penelope*), Tufted Pochard (*Aythya fuligula*) Red-crested Pochard (*Rhodonessa rufina*) and Rudy Shelduck (*Tadorna ferruginea*) departs in March every year. On the other hand, Common Coot (*Fulica atra*) Northern Shoveller (*Anas clypeata*) Northern Pintail *(Anas acuta*), Common Teal, (*Anas crecca*), Gadwall (*Anas strepera*) and Bar-headed Goose (*Anser indicus*) depart as late as April. Simultaneously, another aspect of gradual increase in number from October to December and conversely gradual decrease in number from January to February was also analyzed in case of few birds only. Greatest flocks of nearly 250 or so were in case of Northern Shoveller (*Anas clypeata*), Northern Pintail (*Anas acuta*), Common Teal (*Anas crecca*) and Common Coot (*Fulica atra*). Contrary to this, least number in a flock less than fifteen was seen in case of Bar-headed Goose (*Anser indicus*), Greylag Goose (*Anser anser*) etc.

Keywords: *Arrival patterns, Climax number, Departure patterns, Rural ponds, Winter migratory birds*

Introduction

Migration in animals is a very natural phenomenon which amongst other factors is guided and warranted by environmental related scarcity of food. There are innumerous curious examples of fish migration in high seas corresponding to ambient temperature regimes in consonance with juxtaposed specific water currents loaded with variety of food consisting of plankton and nekton. Similarly, migration has been observed in large sized mammals (Elephants, Beast and Antelopes etc.)

However, migration in birds is an extremely complex phenomenon due to unknown factors and unknown variety of tools of migration, whooping distances of migration and several others puzzling migration related phenomenon. Arctic Tern covers a distance of 17,000 kms during their m from Arctic to Antarctic to avoid the harsh winter of Arctic and moves to the cozy Antarctic summer (Ali, 1996). Eastern Curlews (*Numenius madagascariensis*) migrate from south eastern Queensland to the North eastern Russia by traveling a distance of 12000 kms. Demoiselle crane (*Anthropoides virgo*) migrates from its Southern Russia to breeding ground. Gujarat by traveling approximately 4,917 kms. Eurasian Crane (*Grus grus*) migrates from their Siberian breeding grounds to the Bharatpur National Park, Rajasthan (Javed *et al*., 2003). Bar-headed goose (*Anser indicus*) migrates from China to India over the Himalayas (Javed *et al*., 2003). Arctic loon (*Gavia artica*) migrates from Northern Russia to Southern Europe to avoid the

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harsh condition of the winter (Bodenstlein and Schuz, 1944).

Golden Plover (*Pluviales dominica fulva*) breeds in Western Alaska and North East Siberia. It migrates from its breeding ground to the Hawaiian island by traveling at least 3200 kms across open sea. Also Snipe (*Capella hardwickii*) migrates from Japan (breeding ground) to the East Australia and Tasmania (wintering ground) by covering a distance of 4800 km nonstop over the sea (Ali, 1996). Woodcock (*Scolopax rustica*) migrates from Himalayas to the Nilgiris and other hills of south India (Ali, 1996)

This very phenomenon is also reflected in northern India by way of extensive migratory birds that arrive from far off areas like Eurasia (Eurasion Wigeon, Mallard, Northern Pintail, Common Pochard and Spotted Redshank), China (Bar-headed Goose) and across the length and breadth of Himalayas (Great-Crested Grebe, Bar-headed Goose, Rudy Shelduck and Common Sandpiper Common Redshank and Pallas Gull (Ali and Ripley, 1968).

Haryana provides a very potent example of receiving lakhs of winter migratory birds that arrive in Sanctuary (Bajaj, 2002) and rural ponds (Kaushik, 2008). In the present study, attention has been focused on the migratory birds to understand their "arrival pattern" w.e.f. September to December and conversely "departure pattern" w.e.f. January to March-April in each winter season. It is to mention that some information on birds in Haryana has been made available by Department of Zoology, Kurukshetra University Kurukshetra (Gupta and Bajaj, 1989, 1991; Gupta and Goel, 1994; Gupta and Bajaj, 1996; Gupta and Midha, 1992, 1993, 1994, 1995; Gupta and Bajaj, 1998, 1999, 2000; Gupta and Kumar, 2009 and Gupta *et al.*, 2009.

Materials and Method

Haryana has 21 districts and its geographical position lies between 27^0 37'N to 30^0 35'N latitude and 74^0 28'E to 77^0 36'E longitude. The nodal point of conducting survey work was Kurukshetra University (Kurukshetra district lies between latitude 29^0 52'N to 30^0 12'N and longitude 76^0 26'E to 77^0 04'E in the north-eastern part of the state). Kurukshetra being in the Northern region of Haryana, having seven Northern Districts, *viz.* Panchkula, Ambala, Yamunanagar, Kurukshetra, Kaithal, Karnal and Panipat were selected for the purpose of recording observations on winter migratory birds. Each district was further sub-divided from the view point of sub-divisional blocks and in each sub unit, such villages were marked for observations as possessed perennial ponds. In all, approximately 550 villages were selected and study was conducted for three winter season w.e.f. September 2005 to April 2008. Ponds were visited as per convenience for at least on 2-3 occasion in a given winter seasons. The camera used was Zenith (1986-Model) with Russian made telelens. The identification of birds was done using field guides (Ali and Ripley, 1968; Kumar *et al.*, 2005 and Grimmet *et al.*, 1998).

In so far as arrival pattern is concerned, winter migratory birds were carefully photographed within 2-3 days of their arrival and approximate number of bird species-wise were recorded until their climax number reached in December each year. Similarly, the departure pattern and gradual thinning of numbers through January, February and March was recorded. The arrival and departure patterns were observed in four ponds *viz.* Raipur village pond (Karnal), Dhurala village Pond (Kurukshetra), Gumthala village pond (Yamunanagar) and Brahamsarowar (Kurushetra) considering sixteen wetland winter visitor birds. All these ponds are approximately of 4-5 acres area and were easy to be divided into four parts with the help of permanently posting five poles, one in the centre, and the other four at equal distance from each other on the periphery of the pond. The observations were simply deduced to reflect the arrival and departure patterns in each case. Further analysis was done through software to extrapolate the patterns in the shape of histograms and graphs.

Results and Discussion

Results of arrival and departure time of few selected migratory bird species are given in Table 1 and 2 and Fig. 1-18. As mentioned earlier, the present paper endeavors to understand the arrival (September to December) and departure (January-March) of winter migratory birds that are observed in rural Haryana ponds every winter. In all, eighteen wetland birds *viz.* Northern Shoveller, Northern Pintail, Common Teal, Spot billed Duck, Mallard, Garganey, Eurasian Wigeon, Common

Pochard, Tufted Pochard, Red-Crested Pochard, Bar-Headed Goose, Graylag Goose, Gadwall, Common Coot, Pheasant tailed Jacana and Comb Duck were selected out of forty six species observed during the study period in Northern Haryana (Table 1 and 2). It is evident from Fig. 1 that winter migratory birds start arriving in September and continue to do so until December. However, maximum species do arrive in October and November each year (Fig.1). The first to arrive is Common Coot in September and last to arrive is Eurasian Wigeon in December (Table1). Northern Shoveller, Northern Pintail, Common Teal and Rudy Shelduck arrived in the second quarter of October each year. However, Gadwall, Bar-headed Goose, Greylag Goose, Spot-billed

Table 1: Arrival and departure time of few selected migratory birds species at village ponds in northern Haryana during 2005-2008

S.No	Common name	Month of arrival			Month of departure		
		2005	2006	2007	2006	2007	2008
1	**Common Coot**	25Sept	28Sept	20 Sep.	25April	27April	10 May
2	**Northern Shoveller**	20Oct.	21Oct.	10 Oct.	28April	30April	25 April
3	**Northern Pintail**	20 Oct.	22Oct.	10 Oct	10April	15April	15 April
4	**Common Teal**	20 Oct.	22Oct.	12 Oct	12April	20April	20 April
5	**Gadwall**	25Oct.	10Nov	1 Nov	25Mar.	28Mar	30 Mar
6	**Bar-headed Goose**	1Nov.	5Nov.	30 Oct.	20April	22April	25April
7	**Greylag Goose**	5 Nov	10 Nov	1 Nov	28 Mar	25 Mar	30 Mar
8	**Spot-billed Duck**	25 Oct	22Oct.	25 Oct	22Mar	28Mar	25Mar
9	**Mallard**	25Nov.	30Nov.	20Nov.	5Feb.	10Feb.	20 Feb
10	**Common Pochard**	22Nov.	25Nov.	10 Nov.	25Mar	30Mar	28 Mar
11	**Eurasian Wigeon**	25Nov.	30Nov.	20 Nov.	20Aug	22Aug.	30 Aug
12	**Lesser Whistling Teal**	15Mar.	20Mar.	10 Mar.	20Aug	25Aug	30 Aug
13	**Garganey**	15Mar.	20Mar.	10 Mar.	30May	30May	30 May
14	**Tufted Pochard**	25 Nov	28 Nov	20 Nov	30 Mar	27 Mar	30 Mar
15	**Red-crested Pochard**	22 Nov	25 Nov	20 Nov	28 Mar	30 Mar	30 Mar
16	**Rudy Shelduck**	30 Oct	28 Oct	1 Nov	30 Mar	28 Mar	30Mar
17	**Comb Duck**	30 May	1 June	5 June	10 Sep	15 Sep	02 Sep
18	**Pheasant tailed Jacana**	28 May	30 May	31 May	25Aug	20 Aug	28 Aug

Mallard, Common Pochard, Tufted Pochard and Red-crested Pochard arrived in November (Table1 and Fig.1). It is pertinent to mention that Garganey and Lesser Whistling Teal have been seen to arrive as late as march and Comb duck and Pheasant tailed Jacana in May. Ali and Ripley (1968) reported that Common Teal, Northern Shoveller, Northern Pintail and Gadwall arrived in India by

Table 2: Generalized mannerism of gradual increase in concentration of few selected migratory birds leading to their climax number and the pattern of gradual decline in number at village ponds in Northern Haryana during 2007-08

S.N.	Common Name	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	**Common Coot**	70	150	175	175	175	175	150	140	10	2
2	**Northern Shoveller**	0	125	200	250	250	250	50	20	0	0
3	**Northern Pintail**	0	90	160	210	210	210	40	0	0	0
4	**Common Teal**	0	50	120	140	140	140	30	10	0	0
5	**Gadwall**	0	20	45	65	65	65	40	5	0	0
6	**Bar-headed Goose**	0	0	4	10	10	10	10	8	0	0
7	**Greylag Goose**	0	0	10	15	15	15	15	10	0	0
8	**Spot-billed Duck**	0	5	23	28	28	28	25	20	0	0
9	**Mallard**	0	0	4	12	12	12	2	0	0	0
10	**Common Pochard**	0	0	18	35	35	35	30	25	12	0
11	**Eurasian Wigeon**	0	0	12	30	30	30	17	0	0	0
12	**Lesser Whistling Teal**	0	0	0	0	0	0	8	14	14	2
13	**Garganey**	0	0	0	0	0	0	28	34	30	0
14	**Tufted Pochard**	0	0	8	18	18	18	0	0	0	0
15	**Red-crested Pochard**	0	0	25	45	48	50	10	0	0	0
16	**Rudy Shelduck**	0	40	65	70	70	60	10	0	0	0

end of August and the influx continuing till November. In so far as departure in a specific winter season is concerned, interestingly Mallard, leave here for their original home in February and it arrived in December only. Maximum birds departed in March (Gadwall, Greylag Goose, Spot-billed Duck, Common Pochard, Tufted Pochard, Red-crested Pochard and Rudy Shelduck) (Table 1 and Fig. 2). Further, Common Teal, Northern Shoveller, Northern Pintail and Bar- Headed Goose departed in the last week of April each year during the study period. On the contrary, Comb Duck departed in September in all the three years. Mazumdar *et al* (2005) reported that Lesser Whistling Teal began to depart in the second quarter of January and Gadwall, Northern Pintail and Common Teal were departed in the second quarter of February at Santragachi Jheel, West Bengal. Ali and Ripley (1968) reported that Gadwall, Northern Shoveller, Common Pochard, Eurasion Wigeon, Tufted Pochard, Red-crested Pochard and Northern Pintail mostly departed by end of March and Rudy Shelduck have mostly departed in April. Precisely speaking, winter migratory birds do not arrive in one lot in Haryana rural ponds. Instead, these arrive in a gradual

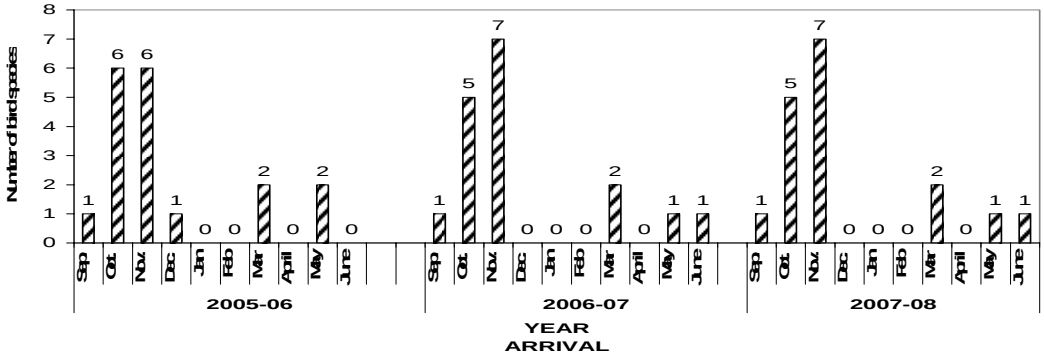

Fig.1

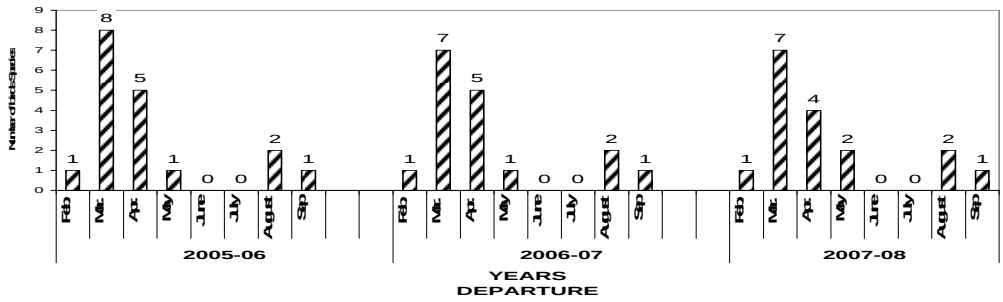

Fig.2

Fig.1-2: Comparative depiction of incidence of arrival time and departure time of some selected migratory birds at village ponds in Northern Haryana during 2005-08 (one bar-diagram stands for total species departed in a month)

manner over successive days, weeks and months (Fig. 3 to 18).

In consequences a "Climax" number is arrived at, more often than not, in the month of December each winter as shown in Fig. 3 to 18, however, in case of Mallard, climax number is generally maintained even after December (Fig.11). Conversely, all these birds display departure mannerism wherein now there is a graded decline of numbers to reach zero level which is seen always in March-April (Fig. 3-18). On the other hand, Comb-Duck and Lesser Whistling Teal departed in June and September respectfully. While comparing the present results, with those of earlier workers in India elsewhere, it is borne out that Comb-Duck and Lesser Whistling Teal show a unique phenomenon of arrive quite late, so much so, that these two birds visit Haryana ponds virtually in summer. Mazumdar *et al.* (2005) reported that Lesser Whistling Teal was first migrants to arrive during last quarter of October and begin to depart in the first week of January from Santragachi Jheel, West Bengal.

Further, Garganey too (Fig.15) arrive in March and depart in May-June. It is pertinent to mention that Comb-Duck observed in Pharal and Pundri village ponds in Kaithal district, Jalubi and Duliyana village ponds in Ambala District,

Hathira village pond in Kurukshetra district, Rugsana and Baras village ponds in Karnal district and Joshi and Alupur village ponds in Panipat district in the month of May-September each year during the study period. Comb-Duck falls in the Schedule II as per CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). Finally it is recommended that concerned authorities take appropriate measure at village ponds like Pharal, Pundri, Jalubi, Duliyana, Rugsana, Baras, Alupur, Raipur Rodan, Gagsina, Jamba, Barana, Samana, Baras, Kirmich, Hathira, Kunjpura, Gheer, Jhinvrehri, Satoundi, Deeg, Dhurala, Chaushalla, Batta, Kalayat, Shergarh, Devigarh, Amin and Sandhir to provide extra protection to winter visitors in Haryana.

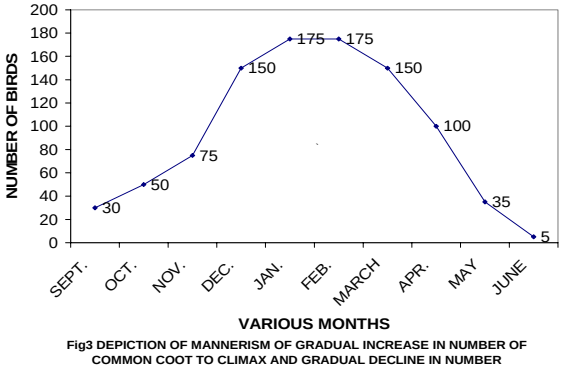

Fig3 DEPICTION OF MANNERISM OF GRADUAL INCREASE IN NUMBER OF COMMON COOT TO CLIMAX AND GRADUAL DECLINE IN NUMBER

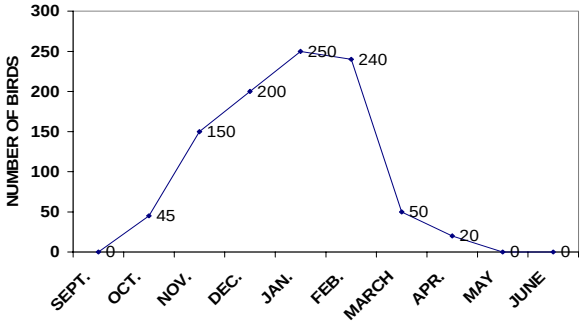

Fig.4 Depiction of mannerism of gradual increase in number of Northern Shoveller to climax and decline in number at Raipur village pond in Karnal District during 2007-08

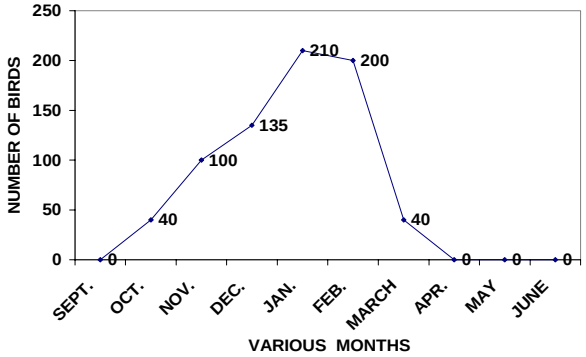

Fig.5 Depiction of mannerism of gradual increase in Number of Northern Pintail to climax and decline in number at Raipur Village pond in Karnal District during 2007-08

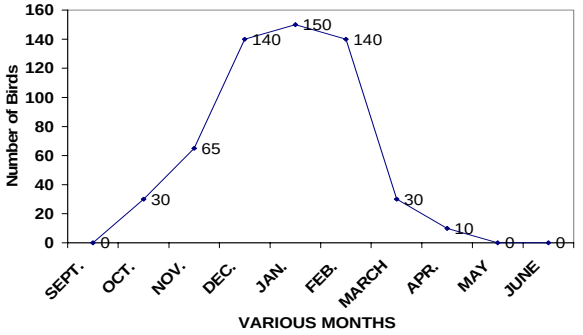

Fig.6 Depiction of mannerism of gradual increase in number of Common Teal to climax and decline in number at Raipur village pond in Karnal district during 2007-08

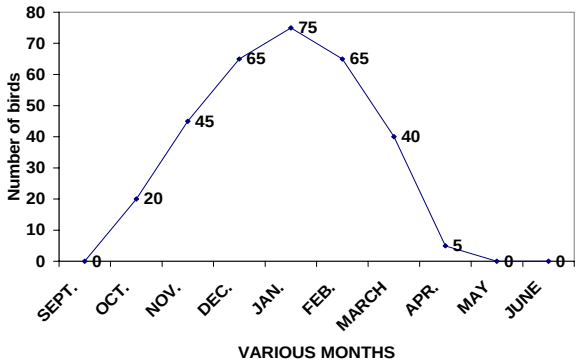

Fig.7 Depiction of mennerism of gradual increase in number of Gadwall to climax and decline in the numberat Raipur village pond in Karnal district during 2007-08

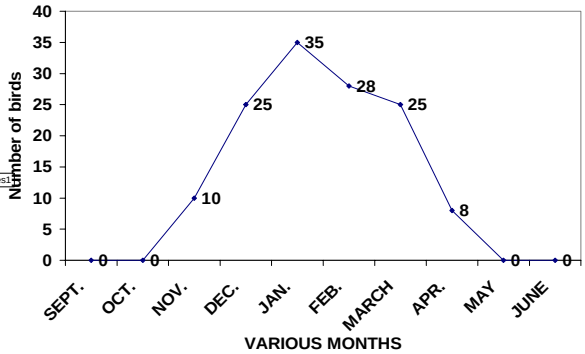

Fig.8 Depiction of mennerism of gradual increase in concentration of Bar-headed Goose to climax and their decline in number at Raipur Village pond during 2007-08

Fig. 3-8: Showing the phenomenon of gradual increase and decrease in number of Common Coot, Northern Shoveller, Pintail, Common Teal, Gadwall and Bar-headed Goose respectively at village ponds in Haryana.

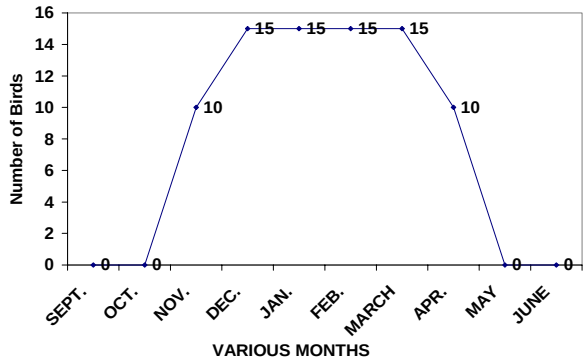

Fig.9 Depiction of mannerism of gradual increase in concentration of Grey lag Goose to climax and decline in number at Raipur village pond in Karnal district during 2007-08

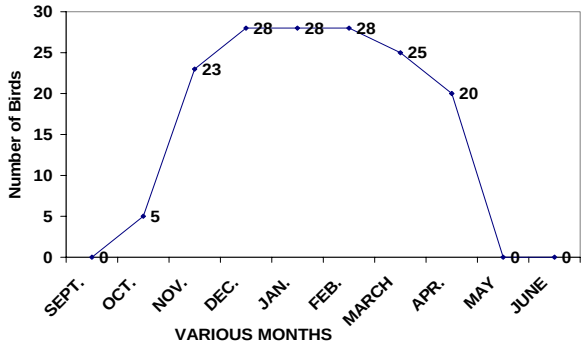

Fig.10 Depiction of mannerism of gradual increase in number of Spot billed Duck to climax and decline in number at Raipur village pond in Karnal district during 2007-08

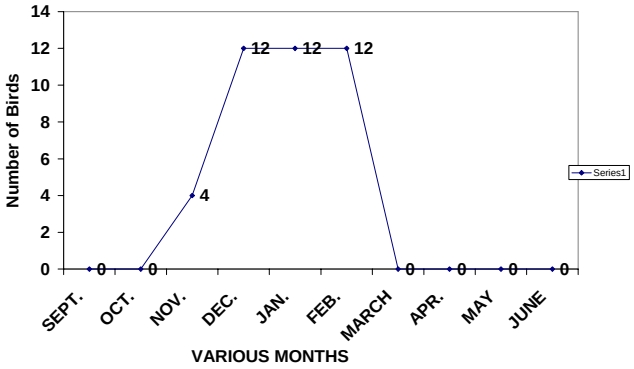

Fig.11 Depiction of mannerism of gradual increase in number of Mallard to climax and decline in number at Brahmsarovar in Kurukshetra district during 2007-08

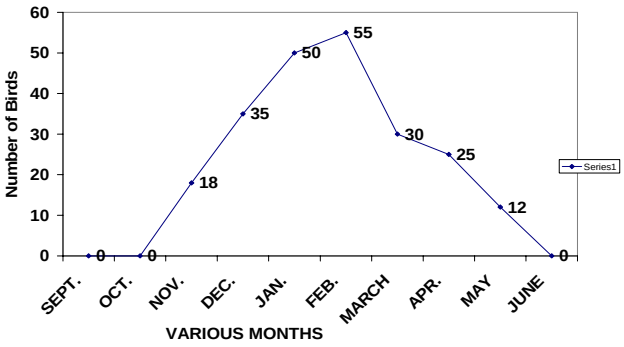

Fig.12 Depiction of mannerism of gradual increase in number of Common Pochard to climax and decling in number at Dhurala village pond in Kurukshetra district during 2007-08

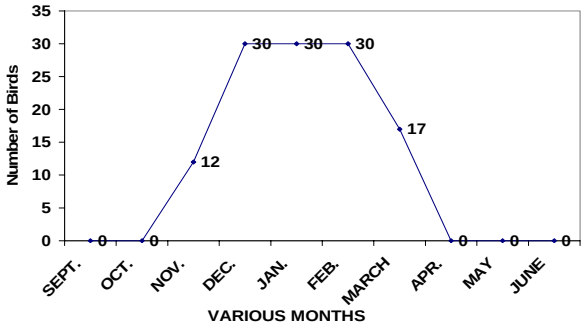

Fig.13 Depiction of mannerism of gradual increase in concentration of Wigeon to climax and decline in number at Raipur village pond in Karnal district during 2007-08

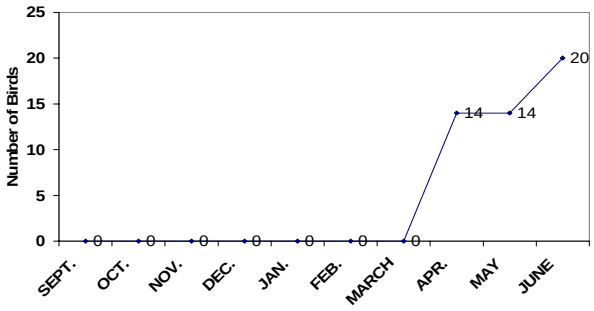

Fig.14 Depiction of mannerism of gradual increase in concentration of Lesser whistling Duck to climax ang gradual decline in number at Raipur village pond inKarnal district during 2007-08

Fig.9-14: Showing the phenomenon of gradual increase and decrease in number of Greylag Goose, Spot-billed Duck, Mallard, Common Pochard, Eurasian Wigeon and Lesser Whistling Teal respectively at village ponds in Northern Haryana

Acknowledgement

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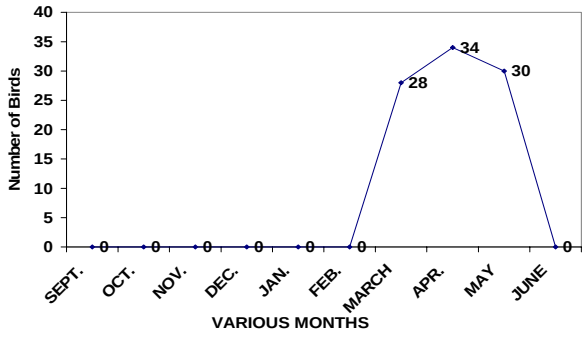

Fig.15 Depiction of mannerism of gradual increase in number of Garganey to climax and gradual decline in number at raipur village pond in karnal district during 2007-08

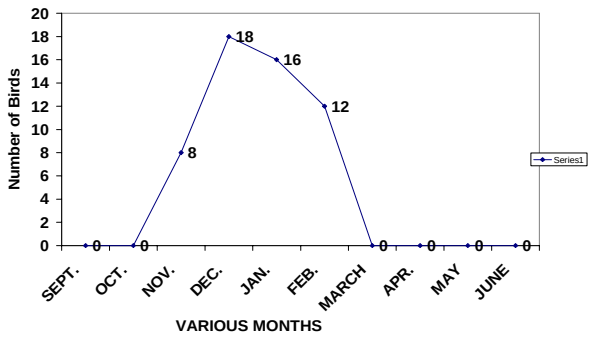

Fig.16 Depiction of mannerism of gradual increase in concentration of Tufted Pochard at Brahmsarovar in Kurukshetra district during 2007-08

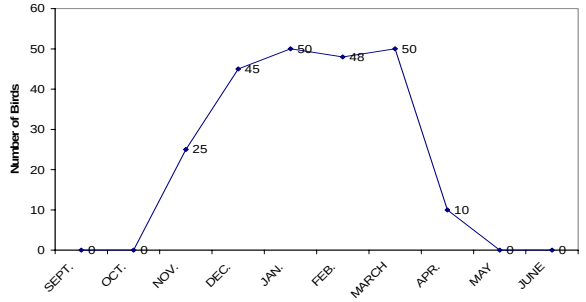

Fig 17. Depiction of mannerism of gradual increase in number of Red-crested Pochard to climax and decline in number at Gumthala village pond in Yamunanagar district during 2007-08

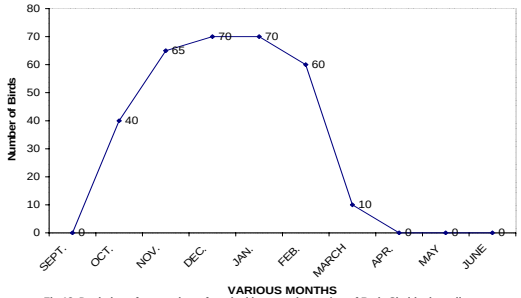

Fig 18. Depiction of mannerism of gradual increase in number of Rudy Shelduck to climax at Garhpur Tapu village pond in Karnal district during 2007-08

Fig.15-18: Showing the phenomenon of gradual increase and decrease in number of Garganey, Tufted Pochard, Red- crested Pochard and Rudy Shelduck respectively at village ponds in Northern Haryana

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Effect of Pb and Zn stress on growth parameters of *Spinach oleracea*

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Abstract

The influence of metals (Pb and Zn) was investigated using plant growth as stress indicators. Spinach plant was treated with various concentrations of Pb and Zn (2, 5, 10 50, 100 and 200 mM). Lead has a stimulating effect upto 5mM concentrations whereas, zinc was find to promote the growth upto 10mM level. Overall, a negative correlation was found between metal concentration and chlorophyll, carbohydrate, nitrogen and protein content of the plant.

Keywords: C*orrelation, Growth response, Metal, Stress, Spinach*

Introduction

Present scenario of industrialization and development gives clear picture of environmental pollution of gaseous as well as metal precipitation. Metal toxicity (especially by pollutants) is an increasing problem in agriculture due to urbanization and industrialization. The uptake of metal by plants is due to the availability of these elements in the soil as a result of agricultural, manufacturing, mining and waste disposal practices (Veerappa and Samy, 1999).

The toxic metal Pb is well known to react with protein, enzymes and amino acids by binding forming tetraethyl lead and gives reduction in photosynthetic rate, resulting to disrupt many metabolic pathways. Zinc is an essential element for both plants and animals. It plays an important role in several plant metabolic processes. However, like other heavy metals (Doncheva *et al*., 1996, Doncheva, 1997, 1998) when Zn is accumulated in excess in plant tissues, it causes alterations in vital growth processes such as photosynthesis and chlorophyll biosynthesis (Doncheva *et al*., 2001) and membrane integrity (De Vos *et al*., 1991). The present study had been taken with the aim of examining the effect of increased lead and zinc concentrations on growth and productivity aspects of spinach plant.

Materials and Method

Seeds of *Spinach oleracea* were sown in circular plastic pots (20 seeds/pot) containing loamy clay soil. The pots were kept in controlled lab conditions, irrigated with water and left until emergence of seedlings. Thereafter, the pots were divided into various lots and were sprayed with different concentrations of lead (Lead acetate) and zinc (Zinc sulphate): control, 2 mM, 5 mM, 10 mM, 50 mM, 100 mM and 200 mM for 7 days. The concentrations were calculated on the basis of metal ion portion. The control sets of pots were irrigated with tap water only.

The data on germination was taken at 6, 8 and 10 days after sowing (DAS) and the germination relative index (GRI) was calculated as per the following equation (Garg and Jasleen, 2004)

$$\mathbf{GRI = (S)\ X_n\ (k\text{-}n)}$$

Where, X_n= number of seeds germinated on n^{th} day

k= number of counts, n = number of days

After 20 DAS, seedlings from each treatment were selected and analysed for the following parameters. Photosynthetic pigments (chlorophyll-

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a, chlorophyll-b, total chlorophyll and carotenoids) were analysed according to the method of Tuba (1987). Carbohydrate content was estimated by anthrone method of Hedge and Horfreiter (1962). Percent nitrogen and crude protein were determined by Micro-Kjeldhal method (Jackson, 1962).

Results and Discussion

GRI of *Spinach oleracea* differed in response to lead and zinc metal stress (Fig.1). GRI of zinc treated samples was higher than that of lead treatment up to 5mM metal concentration while at further higher concentrations, GRI of zinc treated samples had decreased in comparison to lead treated samples which indicates that higher concentrations of zinc causes more toxic effect than lead. The lower level of lead metal upto 5mM induced significant increase in chlorophyll-a, chlorophyll-b, total chlorophyll and carotenoids (59.8%, 35.65%, 21.22% and 27.64% increase respectively) when compared with control untreated plants (Table 1). Further increasing the metal stress, there is decline in all the photosynthetic pigments which decreased significantly at higher levels. However, overall a negative correlation was found between lead toxicity and chlorophyll content having correlation coefficient 'r' –0.901. Same trend was observed in case of zinc toxicity having correlation coefficient of –0.794 (Fig. 2). However, in case of higher metal toxicity, the decrease in total chlorophyll is more pronounced in Zn toxicity as compared to Pb metal. An enhancement of chlorophyll degradation occurs due to increased chlorophyllase activity (Drazkiewicz, 1994).

Table 1: Effect of Pb and Zn metal toxicity on chlorophyll-a, chlorophyll-b, total chlorophyll and carotenoids (mg g^{-1} FW) of *Spinach oleracea*.

Treatment		Chlorophyll-a	Chlorophyll-b	Total chlorophyll	Carotenoids
Pb	Control	0.122 ± 0.019	0.359 ± 0.085	0.589 ± 0.125	0.123 ± 0.006
	2mM	0.124 ± 0.010 (1.64% I)	0.437 ± 0.029 (21.73%I)	0.655 ± 0.040 (11.20%I)	0.147 ± 0.001 (19.51%I)
	5mM	0.195 ± 0.004 (59.84% I)	0.487 ± 0.005 (35.65%I)	0.714 ± 0.061 (21.22%I)	0.157 ± 0.001 (27.64%I)
	10mM	0.163 ± 0.007 (33.60%I)	0.321 ± 0.004 (10.58%D)	0.554 ± 0.016 (5.94%D)	0.169 ± 0.001 (37.39%I)
	50mM	0.105 ± 0.007 (13.93%D)	0.258 ± 0.010 (38.13%D)	0.335 ± 0.010 (43.12%D)	0.093 ± 0.002 (24.39%D)
	100mM	0.053 ± 0.002 (56.55%D)	0.149 ± 0.013 (58.50%D)	0.173 ± 0.020 (70.27%D)	0.091 ± 0.002 (26.01%D)
	200mM	0.045 ± 0.001 (63.11%D)	0.074 ± 0.008 (79.39%D)	0.102 ± 0.015 (82.68%D)	0.090 ± 0.002 (26.82%D)
Zn	Control	0.141 ± 0.008	0.389 ± 0.062	0.604 ± 0.125	0.171 ± 0.022
	2mM	0.167 ± 0.003 (18.44%I)	0.481 ± 0.036 (23.65%I)	0.686 ± 0.061 (13.57%I)	0.179 ± 0.012 (4.68%I)
	5mM	0.255 ± 0.005 (80.85%I)	0.540± 0.002 (38.82%I)	0.743 ± 0.005 (23.01%I)	0.188 ± 0.013 (9.94%I)
	10mM	0.078 ± 0.004 (44.68%D)	0.257 ± 0.011 (33.93%D)	0.332 ± 0.016 (45.03%D)	0.046 ± 0.018 (73.09%D)
	50mM	0.057 ± 0.004 (59.57%D)	0.148 ± 0.007 (61.95%D)	0.204 ± 0.004 (66.23%D)	0.024 ± 0.001 (85.96%D)
	100mM	0.030 ± 0.001 (78.72%D)	0.063 ± 0.005 (83.80%D)	0.127 ± 0.005 (78.97%D)	0.018 ± 0.002 (89.47%D)
	200mM	0.021 ± 0.003 (85.10%D)	0.055 ± 0.010 (85.86%D)	0.079 ± 0.004 (86.92%D)	0.015 ± 0.001 (91.22%D)

Values represent the mean ± SE (% Increase (I)/ Decrease (D) w.r.t. control)

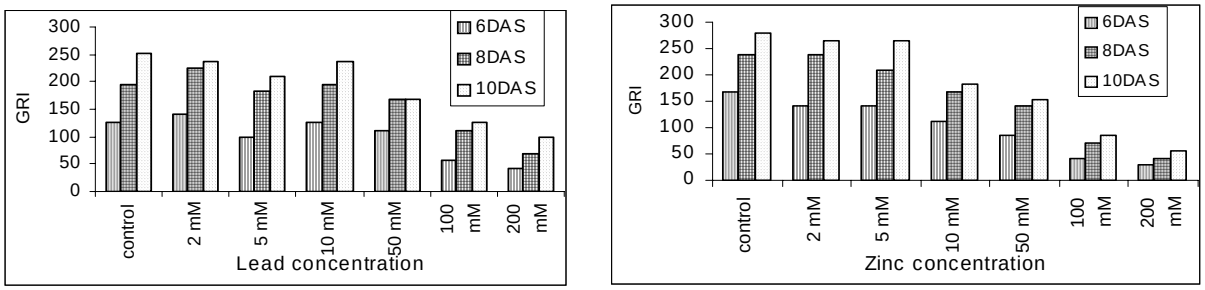

Fig. 1: Effect of different levels of metal toxicity (Pb and Zn) on the germination relative index (GRI)

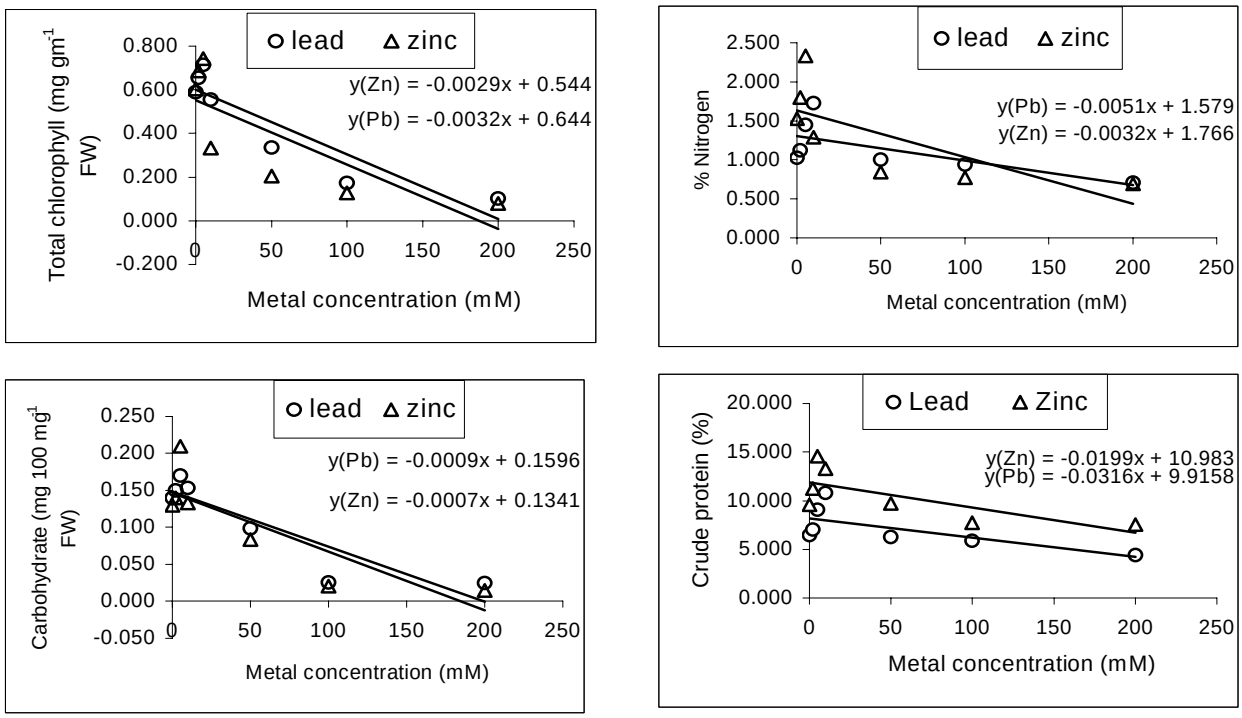

Fig. 2 : Relationship between metal toxicity (Pb and Zn) and productivity parameters of *Spinach oleracea*

The carbohydrate content at low and moderate metal treatment showed significant differences between control and metal stress (Table 2). It has increased with the increasing metal concentration upto 5 mM. Thereafter, there was marked decline as compared to control. The percent increase in carbohydrate content was higher in Zn metal in comparison to Pb metal at 5 mM. The values of correlation coefficient was measured –0.907 and -0.847 with Pb and Zn metal toxicity respectively (Fig. 2). The pattern of changes in carbohydrates was similar to that of chlorophyll which gives a reason to believe that low chlorophyll content causes a relevant reduction of light absorption by leaves (Evass, 1996) and consequently reduces the biosynthesis of carbohydrates. Study of growth in *Spinach oleracea* with respect to % nitrogen and crude protein revealed that over 5 mM, treatment of lead crosses the tolerance limit showing decreasing trend of % nitrogen with further increasing metal levels (Table 2), depicting the correlation coefficient as –0.690. In case of zinc metal treatment, the % nitrogen had increased upto 10mM level after which it had declined with the increasing metal level and having the correlation coefficient as –0.733 (Fig. 2). The crude protein content of Pb and Zn treated samples showed same trend as found in case of % nitrogen. The results of nitrogen and crude protein suggest that plant metabolism and their growth are interrelated parameters. It is thus evident that Pb treatment promotes the growth at lower level of 5 mM in the

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Spinach oleracea. Dabas *et al*. (1995) has reported that lower level of Pb increased the fresh weight and dry weight of roots and shoots of Mungbean. Zn is less toxic than Pb stimulating the growth upto 5mM concentration, whereas, at higher metal concentrations, Zn produces more toxic effects than Pb which shows less % decrease in different productivity parameters as compared to control. Veerappa and Samy (1999) have also reported the promontory role of Zn in *Zea mays* L. at lower levels. Thereafter, both the metals become toxic and the plant suffered metal stress which is significant at higher levels of 100 and 200 mM inhibiting the productivity in plant.

Table 2: Effect of Pb and Zn metal toxicity on carbohydrate content (mg 100 mg^{-1} FW), % nitrogen and crude protein(%) of *Spinach oleracea*

Treatment		Carbohydrate (mg100mg^{-1} FW)	% Nitrogen	% Crude protein
Pb	Control	0.140 ± 0.007	1.030 ± 0.027	6.438 ± 0.167
	2mM	0.150 ± 0.015 (7.14%I)	1.120 ± 0.047 (8.73%I)	7.000 ± 0.294 (8.73%I)
	5mM	0.170 ± 0.071 (21.42%I)	1.450 ± 0.082 (40.77%I)	9.063 ± 0.512 (40.77%I)
	10mM	0.153 ± 0.006 (9.28%I)	1.730 ± 0.117 (67.96%I)	10.812 ± 0.731 (67.96%I)
	50mM	0.099 ± 0.009 (29.29%D)	1.000 ± 0.020 (2.91%D)	6.250 ± 0.127 (2.91%D)
	100mM	0.026 ± 0.007 (81.43%D)	0.940 ± 0.119 (8.73%D)	5.875 ± 0.741 (8.73%D)
	200mM	0.025 ± 0.001 (82.14%D)	0.710 ± 0.035 (31.06%D)	4.437 ± 0.220 (31.06%D)
Zn	Control	0.130 ± 0.015	1.530 ± 0.133	9.563 ± 0.833
	2mM	0.190 ± 0.042 (46.15%I)	1.800 ± 0.231 (17.64%I)	11.250 ± 1.443 (17.64%I)
	5mM	0.200 ± 0.035 (53.84%I)	2.330 ± 0.067 (52.28%I)	14.563 ± 0.417 (52.28%I)
	10mM	0.123 ± 0.049 (5.38%D)	1.290 ± 0.133 (15.68%D)	8.065 ± 0.833 (15.68%D)
	50mM	0.084 ± 0.008 (35.38%D)	0.840 ± 0.023 (45.09%D)	5.250 ± 0.146 (45.09%D)
	100mM	0.021 ± 0.007 (83.84%D)	0.770 ± 0.023 (49.67%D)	4.813 ± 0.144 (49.67%D)
	200mM	0.015 ± 0.003 (88.46%D)	0.690 ± 0.058 (54.90%D)	4.313 ± 0.363 (54.90%D)

Values represent the mean ± SE (% Increase (I)/ Decrease (D) w.r.t. control)

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Physico-chemical parameters and environmental pollution in the Aghlaghan Chie river of Ardabil province in Iran

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Abstract

Aghlaghan chie river of Nir city, is formed by confluence of 5 Bolaughlar springs, two of these springs provide potable water of Nir city. Various physico-chemical and biological parameters were taken into consideration during the course of study these includes DO, BOD, COD, pH, $CaCO_3$, Total dissolved solids, Total coliforms and Fecal coliform. Based on the results of this study it is concluded that there is slight increase of pollutants in downstream of city in comparison to the upstream, hence it is an alarming positing of increasing pollution load in the river.

Keywords: *Aghlaghan river, Bolaughlar, Pollution, Spring*

Introduction

Nir city – with northern latitude of 37º 47’ to 38º 9' and eastern altitude of 47º 51' to 48º 21’, and with the height of 1687 m a.s.l – is one of the highest city of Iran. The city nearly 35km from the Ardabil is located beside the main road of Ardabil east Azerbaijan. Aghlaghan Chie River is originated from Mt. Sabalan and alongside its direction provides water for the fields of several villages (Fig. 1). Its direction up to Fandoghloo village is north to south after which it nearly turn to west east direction the length of its main branch is 37 km. Balikloo River is formed by the joining of Aghlaghan river's branches which joins to Karasu and Aras river's valley and finally pour to Caspian sea. Its water is supplied by the springs of mountainous area and melting of snow Esmali (2005). It flows down from the mountains with stony and sandy beds (Fig. 2) The river flows from the middle of the city and about 35 ton/day of urban, rural and agricultural waste offload to the river. So the importance of studying the conditions of chemical and physical pollution is emerged.

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Materials and Method

For controlling and specifying some factors such as the degree of elements, anions and cations and physical and chemical parameters, 2 stations (sampling points), with the observance of required standards were established. Then by means of Nansen, sampling equipment the sampling was performed. After sampling some factors like external condition of weather, place, time and hour of sampling, geographical and physical position, primary weight and the dimensions of the soils' sampling area, sample's weight at Aven phase, drying, shifting and sizing (size 200) were controlled. Then for stabilizing the sample and for preventing the growth of micro-organisms, it submerged into 65% nitric acid till the pH of the sample reduced to 2-2.5. The physico-chemical and biological parameters were analyzed following the standard methods of APHA (1998) and Khanna and Bhutiani (2004).

Results and Discussion

The results of various parameters studied are given in Fig. 3 to Fig.10. During the course of study it was observed that most of the microbial pollutions of the river’s water is reported from April to June month of each year. Although the amount of nutrient is not high but it can be maintained by temperature variations Ardakani (2008).

In general bacteria in slimes are more than water it-self. According to Daneshvar (2005) the sedimentary slimes of this region include Methane and Hydrogen oxidizing bacteria fermentative non-atmospheric and azotes stabilizing bacteria.

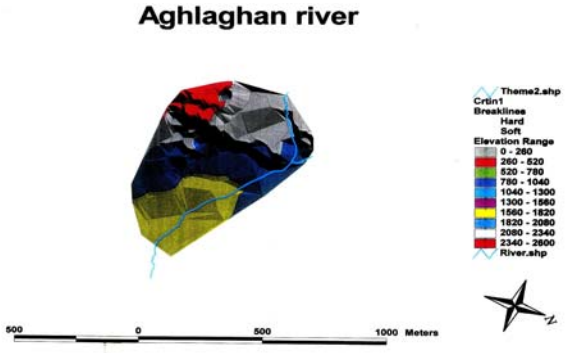

Fig. 1: Map showing Aghlaghan river

Fig. 2: Photo showing samping site

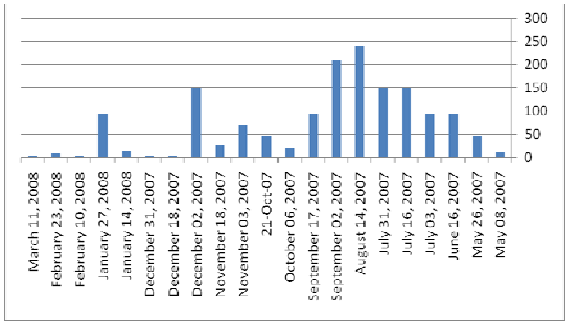

Fig. 3: Fluctuation of Total coliform /100ml

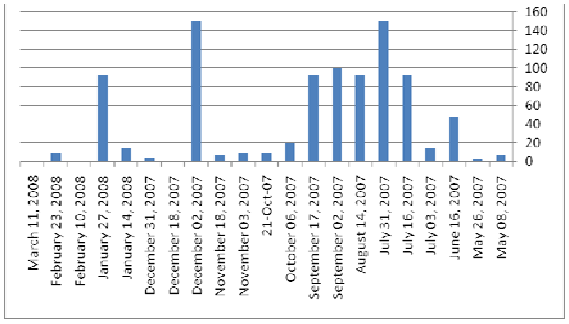

Fig. 4: Fluctuation of Fecal coliform/100ml

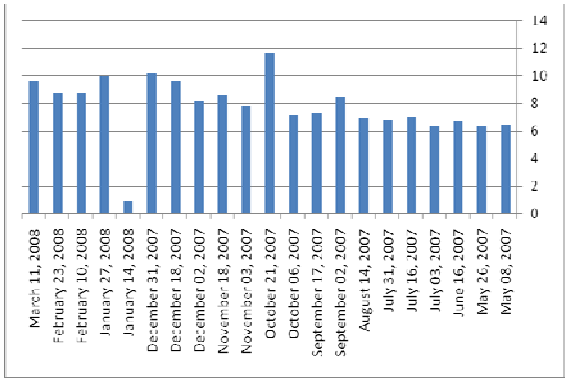

Fig. 5: Fluctuation in value of DO (mg/l)

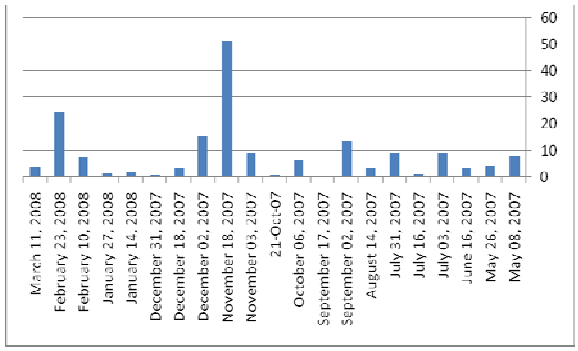

Fig. 6: Fluctuation in value of COD (mg/l)

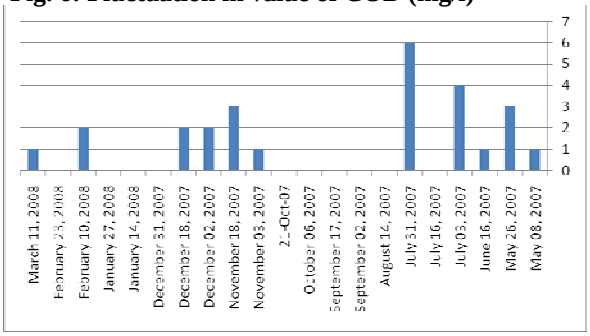

Fig. 7: Fluctuation in value of BOD (mg/l)

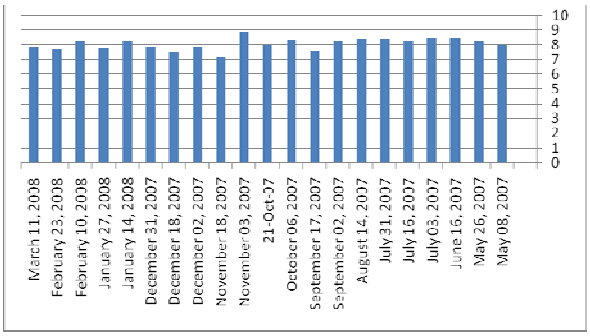

Fig. 8: Fluctuation in pH value

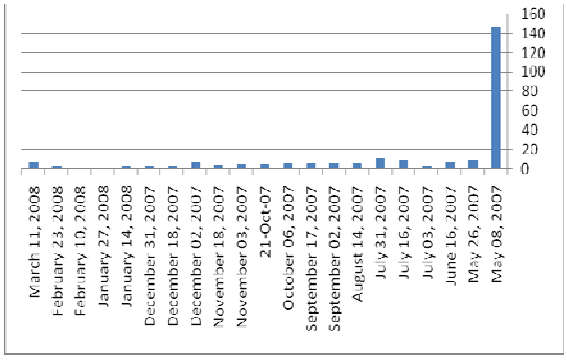

Fig. 9: Fluctuation in total dissolved solid (mg/l)

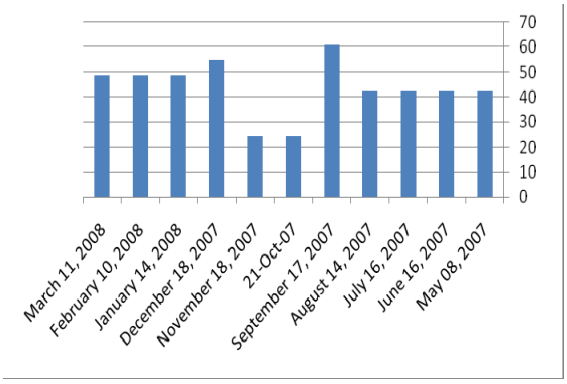

Fig. 10. Fluctuation in calcium carbonate (mg/l)

pH was observed above 7.2 during course of study and it reaches a maximum limit of 8.45 .The degree of dissolved oxygen in all points of the river is above 6.3 mg/l. Khanna and Bhutiani (2003) and Khanna *et al*. (2007) observed similar findings.

Due to the low density of organic materials it includes high dissolved oxygen, in a way that it shows 4mg/l BOD during study.

Discharge of corruptible and biological material to the Aghlaghan chie river caused variation in the density of oxygen and some other physical, chemical and biological changes. Thus these processes and their products along with oxygen resource effect significantly Aghlaghan's ecology.

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Statistical observation on the length weight relationship of brain and body in a cold water cat fish *Amblyceps mangois* from Garhwal region

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Abstract

The paper deals with statistical analysis of fish brain and body parameter in a cold water small cat fish *Amblyceps mangois* (Ham.-Buch.) from Garhwal Central Himalayan region. During the course of study a total of 82 specimens were selected and were carried out for statistical observation. It was observed that standard length of fish fluctuated between 42.38 ± 1.80 mm to 71.00 ± 0.20 mm while the fish weight, brain length and brain weight fluctuated from 1408.69 ± 103.39 mg to 3966.00 ± 202.03 mg , 6.23 ± 0.83 mm to 8.83 ± 0.41 mm and 4.92 ± 0.95 mg to 12.00 ± 2.28 mg respectively.

Keywords: *Amblyceps mangois, Brain length, Brain weight, Correlation, Statistical*

Introduction

The fishes of the Siluroidae genus *Amblyceps mangois* are typical teleosts, which prefer pure-oxygen rich waters with sandy or gravelly bottoms. They are normally small in size. Some authors described the quantitative brain length – brain weight analysis in the fresh water fishes (Bauchet *et al*., 1973; Jafri and Noori, 1978; Bhatt and Singh, 1982, 1983 and Bahuguna *et al*., 2005). But no literature is available which can give information about the small cat fish brain physiology and quantitative length-weight analysis. Present communication deals with the length-weight relationship between body and brain parameters of *Amblyceps mangois*.

Materials and Method

Samples of small cat fish *Amblyceps mangois* were regularly collected during 2006-2007 from a spring fed river, Mandal, tributary of river Ramganga. During the course of study a total of 82 specimens were selected and were carried out for statistical observation. The length-weight measurement of body and brain were taken after about two month of preservation in weak formalin solution (4%). Standard length of fish in mm was taken into consideration to avoid any measurement error. The fish were observed in a length range of 40-71 mm and were divided into seven class intervals with a class interval of 5 mm. For tracing the regression line, first a scatter line was drawn with the original data which was observed to be linear, then the method of least squares (Y=a+bx) was applied in which Y is dependent variable (brain length, brain weight) and X is the independent variable (the fish standard length and fish weight), a = intercept and b = slope or the regression coefficient. The coefficient of correlation (r) and coefficient of determination (r^2) were also calculated.

Results and Discussion

During the present study, the fish *Amblyceps mangois* reached a maximum standard length of 71 mm. Fish less than 40 cm could not be observed in the entire study. The summarised data on the quantitative analysis of the body-brain relationship is presented in Table 1. It was observed that the standard length of fish fluctuated from a minimum of 42.38 ± 1.80 mm to 71.00 ± 0.20 mm. The corresponding fish weight, brain length and brain weight fluctuated from 1408.69 ± 103.39 mg to 3966.00 ± 202.03 mg, 6.23 ± 0.83 mm to 8.83 ± 0.41 mm and 4.92 ± 0.95 mg to 12.00 ± 2.28 mg respectively (Table 1).

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Table 1: Summarised data on the quantitative length-weight relationship between body- brain of *Amblyceps mangois*

S. No.	Class Interval	Length of fish (SL) mm	Body weight of fish (mg)	Brain length (mm)	Brain weight (mg)	Number of fish
1.	40-45	42.38± 1.80	1408.69± 103.39	6.23± 0.83	4.92± 0.95	13
2.	46-50	48.44± 1.76	2116.33± 338.99	6.72± 0.57	7.50± 0.92	18
3.	51-55	52.26± 1.28	2477.31± 367.51	7.05± 0.62	8. 53± 1.87	19
4.	56-60	57.66± 1.80	2591.44± 438.58	7.22± 0.88	9.44± 2.07	09
5.	61-65	63.20± 1.66	3296.07 ±227.78	7.47± 0.64	9.60± 0.63	15
6.	66-70	67.50± 0.71	3540.00± 56.57	8.00± 0.00	10.00± 0.00	02
7.	71-75	71.00± 0.20	3966.00± 202.03	8.83± 0.41	12.00± 2.28	06

Table 2: Regression analysis, coefficient of correlation and coefficient of determination on length-weight relationship between body and brain parameters of *Amblyceps mangois*

S.No	Value		Regression		Coefficient of Correlation	Coefficient of determination
	X	Y	a	b	r	r^2
1.	Body length	Brain weight	-2.74295	0.20174	0.9487	0.9000
2.	Brain Length	Brain weight	-9.22284	2.45632	0.9465	0.8960
3.	Body weight	Brain length	4.77607	0.00093	0.9652	0.9317
4.	Body length	Brain length	2.837789	0.078658	0.9598	0.9212
5.	Body weight	Brain weight	2.21126	0.002398	0.9567	0.9154

Regression analysis, coefficient of correlation and coefficient of determination on length-weight relationship between body and brain parameters of *Amblyceps mangois* (Ham.-Buch.) are presented in Table 2. In the present investigation five linear relationships were traced out between all dependent variables in relation to the selected independent variables. The relationship between body weight and brain length was more close (r = 0.9652, r^2 = 0.9317) followed in decreasing order by the body length and brain length (r = 0.9598, r^2 = 0.9212), body weight – brain weight (r = 0.9567, r^2 = 0.9154), body length-brain weight (r = 0.9487, r^2 =.9000) and brain length-brain weight (r = 0.9465 , r^2 = 0.8960).

Bhatt and Singh (1982) reported straight relationship in *Puntius chilinoides* (Mc Clelland) and *Glyptothorax pectinopterus* (Mc Clelland) and found more positive correlation between body weight-brain weight (r = 0.9872) than body weight-brain weight (r = 0.8736). In latter fish more positive co-relation was observed between brain length and brain weight (r = 0.9818) than body length and brain length (r = 0.8629). Sherly (2004) in *Amblypheryngodon chakiensis* (Bleeker) observed the degree of relationship of the brain length – standard length and brain weight – standard length was higher for female than male. He also stated that in *A. chakiensis* the medium size fish showed higher brain weight rate then adult. Bahuguna *et al.* (2005) reported a continuous increase in body weight and brain weight (r = 0.9805) than body weight and brain length (r = 0.9777).

Acknowledgement

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Fly ash for soil nourishment: A case study for Brinjal and Groundnut

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Abstract

The Deep Nagar Thermal Power Plant, Bhusawal in Maharashtra generates fly ash @ 2000 to 3000 MT per annum and is used for soil nourishment for two local crops namely brinjal (*Solanum melongena*) and ground nut (*Arochis hypogoea* Linn). During the course of study the fly ash obtained from power plant is characterized for its agro- properties and it is blended with black cotton soil in various proportions then further laboratory scale studies were done for growth of brinjal and groundnut plants using various blends of soil and fly ash. Growth parameters of plants including optimum proportion of fly ash for plants growth, edibility of agro-products were observed and examined for its entire life cycle. It was observed during study that fly ash proportion of around 10 to 20% by weight of black cotton soil is optimum for various crops besides this it was observed that while fly ash of higher proportion can also be used without disturbing the natural fertility environment of soil. Thus, use of fly ash for soil nourishment for above-mentioned crops is a viable method of fly ash disposal, added with the benefit of better crop yield.

Keywords*: Agricultural utilization, Fly ash, Optimum proportion*

Introduction

Presently India's 65% electricity is produced by its Thermal Power Plants. There are nearly 85 thermal power plants in India. The number is likely to reach 112 by 2020. These plants generate about 110 MMT of fly ash as waste. If dumped as it is in soil, fly ash gets lifted in air and creates air pollution and may lead to spread of diseases like silicosis, fluorosis, respiratory disorders etc. It may travel to water bodies along with run-off and may increase salinity and heavy metal toxicity to significant level. It even affects ground water table in long turn. In excess quantity it affects soil fertility by altering its salinity and redox potential. Reuse of fly ash as agro-nutrient supplement is getting popular all over the world (Plank and Martens, 1974; Chang *et al.*, 1977; Page *et al*., 1979; Adirano *et al.*, 1980; Gracia *et al*., 1995; Buck *et al*., 1990). It has certain micro nutrients that are beneficial for crops.

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These nutrients are not available in chemical fertilizers.The present work uses locally available fly ash, obtained from Deep Nagar Thermal Power Plant, Bhusawal. It has been characterized for agricultural parameters in the laboratory. Its suitability for various locally available crops including brinjal and ground nut has been investigated by laboratory scale studies. The study indicates that fly ash in the proportion of 10% to 20% by weight of soil can be used advantageously for various crops. It not only enhances the plant growth but also provides a safe alternative for fly ash disposal. The only concern with the fly ash used in agriculture is about the metallic toxicity caused by heavy uptake of element by plants. However the edibility as examined in the laboratories has indicated no such problem for the present case.

Materials and Method

The present study is a laboratory scale study. Plastic tubs, having size 45 cm diameter and 25 cm depth are used as pots for plant growth. Various blends of fly ash with black soil, varying from 0% to 25% at the step of 5% of fly ash have been used. Seven to eight seeds of above-mentioned plants are sowed in each tub. Watering is done regularly. After germination and

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few days growth, three plants are left in the tub and others are removed. The plants are watered regularly. Their growth parameters including stem thickness, height of plant, first day of flowering, number of flowers, first day of fruit formation, number of fruits etc are monitored. The fruit quality from edibility point of view is also examined. Fly ash, soil and water used for experimentation are examined for agricultural parameters.

Results and Discussion

Table 1 shows the characteristics of fly ash that are significant from agricultural point of view. It is clear from the table values that fly ash used here is poor in terms of NPK content but is a rich source of trace elements.Table 2 shows the characteristics of black cotton soil used. Table 3 represents the characteristics of soil-fly ash blend. Table 4 shows the characteristics of water used for plant irrigation

Table 1: Characteristic of fly ash

S. No.	Parameters	Observed value
1	% carbon	0.44
2	N	Not detected
3	P	0.74%
4	K	0.33%
5	% Ca	0.127
6	% Fe	0.229%
7	% Mg	0.0726%
8	Electrical Conductivity	0.36 μmho/cm
9	Mn	264.11 ppm
10	Zn	24.36 ppm
11	Cu	18.51 ppm
12	As	Not detected
13	Ni	1.95 ppm
14	pH	7.6

Table 2: Characteristics of soil

S. No.	Parameters	Observed value
1	% carbon	0.24
2	N	94.08 kg/ha
3	P	8.26 kg/ha
4	K	396.4 kg/ha
5	% Ca	0.274
6	% Fe	Not detected
7	% Mg	-
8	Electrical Conductivity	0.31 μmho/cm
9	Mn	1.1 ppm
10	Zn	0.1 ppm
11	Cu	0.20 ppm
12	As	-
13	Ni	-
14	pH	8.0
15	Bulk Density	103.4 gm/cc
16	Water holding capacity	0.45 ml/g

Table 3: Characteristics of soil – fly ash blend

S. No.	Soil-fly ash blend	Conductivity μmho/cm	pH of Blend	Permeability mm/sec
1	0%	0.70	7.0	0
2	5%	0.62	7.0	0
3	10%	0.62	7.0	0
4	15%	0.66	7.0	0
5	20%	0.71	7.0	2.23
6	25%	0.84	7.0	2.65
7	Soil with Urea	0.77	7.0	3.01

Brinjal:

Effect of fly ash on plant height:

Fig. 1 and 2 shows the height of plant after four and eighteen weeks of seeding.

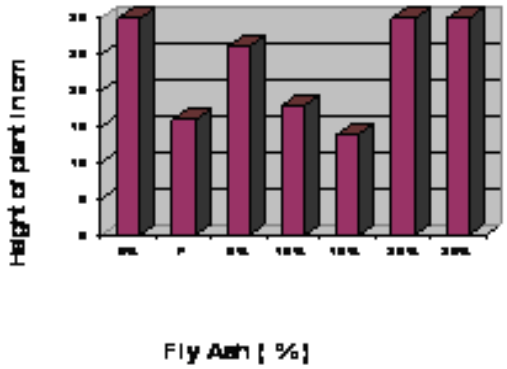

Fig 1: Brinjal Plant height after 4 weeks

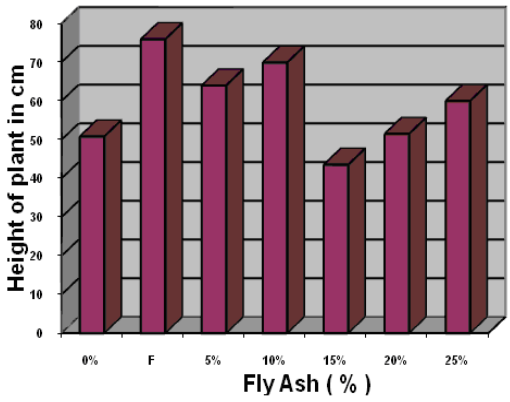

Fig 2: Brinjal Plant height after 18 weeks

The plant growth parameters are monitored for the complete life cycle of plant. Only representative results are presented here.

Table 4: Characteristics of water

S. No.	Parameter	Observed value
1	pH	7.0
2	Conductivity	113 µmho/cm
3	Alkalinity	213.4 mg/l

Effect of fly ash on stem thickness

The effect after 16 weeks is shown in Fig 3

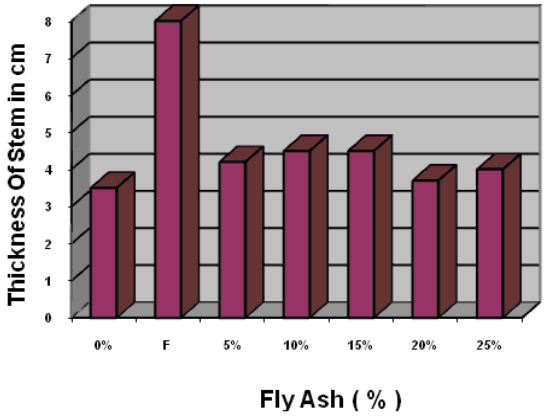

Fig 3: Thickness of brinjal stem after 18 weeks

Effect of fly ash on number of flowers:

No. of flowers in 18th week are shown in Fig 4

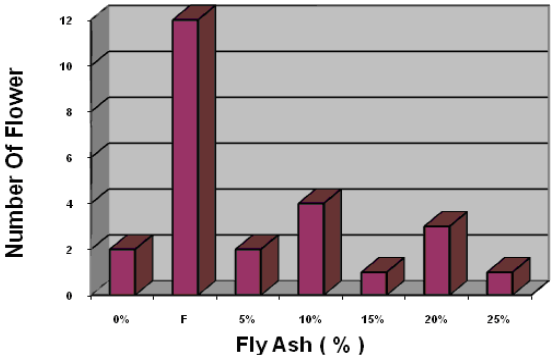

Fig 4: No. of brinjal flowers after 18 weeks

Effect of fly ash on number of fruits

The effect is shown in Fig 5

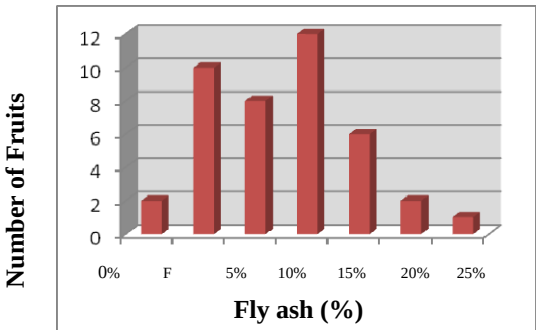

Fig 5: No. of fruits after 18 weeks

Groundnut:

In case of groundnut plant, height of plant is irrelevant as the stem is spiral.

Effect of fly ash on number of leaves:

No. of leaves after 6 week are given in Fig 6.

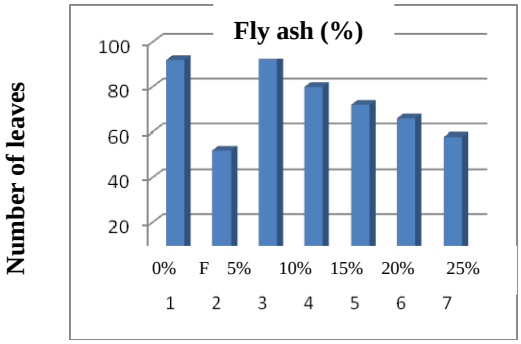

Fig. 6: No. of leaves in ground nut plant after 6 weeks

Effect of fly ash on fruits in Groundnut

No. of fruits after 14 weeks are given in Fig 7

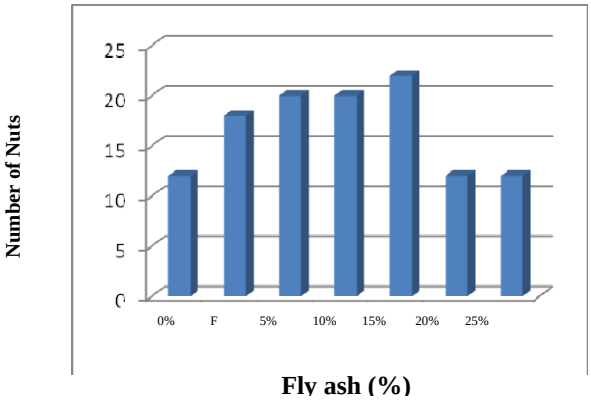

Fig 7: No. of fruits in groundnut after 14 weeks

Edibility examination of fruits

Brinjal, and groundnut are examined from edibility point of view. The results are given in Table 5.

It can be seen that the heavy metals in fruits are within limits. Hence the fruits are safe for consumption.

Table 5: Observed values for brinjal and Groundnut

Parameter	Permissible limit (ppm)	Observed value for brinjal	Observed value for ground nut
Copper	-	2.55	2.43
Iron	-	28.49	26.34
Lead	0.1	Not detected	0.03
Cadmium	0.05	0.05	0.02
Zinc	-	2.99	1.56
Arsenic	-	Not detected	Not detected

Conclusion

The present work reveals that addition of fly ash in the soil improves the yield of brinjal and groundnut. The fly ash is a potential source of plant nutrients. It is found that blend of 10 % fly ash with soil improves the yield of brinjal and blend of 15 % fly ash with soil improves the yield of groundnut. Characterization of fly ash confirmed the report of Tripathi and Sahu (1997), that fly ash contain all nutrients for plant growth except Nitrogen. In fact a blend of fly ash with fertilizer can provide both nutrients as well as trace elements required by plants and may prove to be most effective.

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Production of phenolics by *Rhizoctonia bataticola* (taub.) Butler during pathogenesis

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Abstract

***Rhizoctonia bataticola* is a facultative parasite, which causes damping of seedlings and root rot in vegetables, cereals, fruits, oilseed crops and ornamental plants. The present paper deals with the *in vitro* studies of the production of phenolics by this parasitic fungus.**

Keywords: *Facultative parasite, Fungi, Host-parasite relationship, Plant pathology*

Introduction

Phenolic compounds are characterized with an aromatic ring bearing one or more hydroxyl groups in their chemical constitution. Aromatic compounds are widespread in microorganisms as well as in plants whereas lignins, flavonoids and phenolic glycosides are generally restricted to specific families and species. The initial steps of biogenesis of aromatic compounds are same in fungi as in higher plants. In course of reaction sequences, aromatic amino acids are produced from carbohydrates. These amino acids in turn serve as precursors for the synthesis of phenols.

According to Farkas and Kiraly (1962), the accumulation of aromatic compounds in diseased plants is an extremely widespread phenomenon. The compounds, which accumulate in infected plants include mono and dihydric phenols, phenolic glycosides, flavonoids, anthocyanins, aromatic amino acids and coumarin derivatives. On comparing the resistant and susceptible combinations, it is found that a more rapid accumulation of phenolics takes place in the incompatible host-pathogen complex than compatible ones. However, a comparison of susceptible and resistant infected varieties has not always revealed a positive correlation between phenol content and resistance. Reason for these variations has been partly attributed to variations in models of this enquiry. In many infections, there is increase in phenol oxidizing enzymes accompanying enhanced phenol biosynthesis in diseased tissue (Fuchs and Kotte, 1954). Farkes and Ledingham (1959) and Oku (1960) have reported synthesis of polyphenoloxidase and peroxidase in infected tissue by *Cochliobolus miyabeanus* and *Puccinia gramins tritici.*

Certain plant pathogens are also known to produce phenolic compounds in culture (Reddy and Rao, 1975; Suresh, 1982) and in such cases tissue substances may be produced in host tissue and directly responsible for development of necrotic lesions (Cruickshank and Perrin, 1964). After infection, various types of phenols are observed to accumulate around the site of infection *viz.* simple phenol, hydroxyl aromatic compounds of mono- and polyphenolic types and their derivatives. Higher accumulation of phenols and its altered metabolism after infection in underground and subaerial parts of resistant combination of cotton wilt was recorded by Rubin and Ivanova (1960) and Babajan *et al.* (1955). Phenolic compounds get readily oxidized and may act as donor or acceptor in metabolism of diseased tissue (Manaskaya, 1948). Thus each host pathogen combination is unique in relationship between phenolic levels and disease development. Hence in

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Sapru and Mahajan

order to work out the role of phenolic compounds in root rot and leaf blight of mung bean, attempts were made to detect phenolics in culture and mung bean cultivar K 851.

Materials and Method

Phenolics produced by *R.bataticola root* (R1) and leaf (L1) isolates in *vitro* were analysed both qualitatively as well as quantitatively. These isolates of mung bean cultivar K 851 were employed throughout the study. Culture media for phenolic production was Czapeck solution (having 3% sucrose) for 15 and 25 days. Phenolics were extracted from the culture filtrate following the procedures described by Das and Rao (1964) and Reddy and Rao (1975) and extraction of phenolics from culture filtrate and mycelium was done with the help of Whattman No.1 filter paper. For quantitative analysis of phenolics, the method described by Harborne (1973) was followed for the separation and identification of phenolic compounds. Both paper chromatographic and Thin Layer Chromatographic methods were used to separate simple phenols, phenyl propanoids (hydroxyl coumarins, uranocoumarins, and phenyl propenes) and flavonoids. In quantitative analysis of phenolics, the phenolic extracts of culture filtrate and mycelium were analyzed for total phenols (Bray and Thorpe, 1954), Ortho-dihydric phenols (Arnow,1937) and flavonols (Swain and Hillis, 1959).

Results and Discussion

The results of this study are given in Table 1-9. From Tables 1 to 9, it is indicated that six simple phenol compounds were detected in *R. bataticola* R1 and L1 isolates *in vitro.* Out of which 4 were common in culture filtrate of both the isolates. Of the remaining two, one compound was found in the filtrate of R1 and the other in L1 isolate. Healthy tissue extracts of 1 and 3 day old K851 seedling differentiated into 5 and 6 compounds respectively. Tissue infected with R1 isolate accumulated 3 compounds in young seedlings. The number rose to 6 in 3 days old seedlings. The infected tissue contained 2 compounds (R_f 0.19 and 0.39) which were of fungal origin. Similarly in lesions produced by L1 isolate, one compound of pathogen origin was recorded. In these pathogen-suscept combinations, no phenol compound accumulated which could be due to pathogen-suscept interaction. In K 851 mung bean number of accumulated compounds increased both in healthy as well as in old seedlings although these were not associated with increased resistance. Reddy and Rao (1979) observed the presence of many phenolics including chlorogenic,

Table 1: Simple phenols in 25 day old culture of *R.bataticola* isolates

S.No.	R_f*	Color in			Root isolate (R1)		Leaf isolate (L1)	
		Follin ciocaltue	Follin $+NH_3$	Vanilline + HCl	Filtrate	Mycelium	Filtrate	Mycelium
1	0.05	Blue			+	+	-	+
2	0.19	Blue			+	-	+	-
3	0.25			Brick red	-	+	+	+
4	0.39	Blue			+	+	+	-
5	0.78			Dark pink	+	-	+	-
6	0.79		Blue		+	+	+	-

*** Acetic acid: chloroform (1:9) and ethylacetate: benzene (9:11)**

protocatechuic acid, caffic acid, ferrulic acid and 16 undifferentiated compounds in infected groundnut hypocotyls. Some of these compounds were recorded only from the healthy tissue. This observation favored the inference of the present study that less number of phenols (qualitatively) was present in healthy tissue. Accumulation of phenolics, both quantitatively and qualitatively have been reported in tomato wilt (Pierson *et al.*, 1955), in bean seedling infected by *Colletotrichum lindi muthianum* (Romanowski *et al.,* 1962), *Rhizoctonia* disease of bean (Pierre and Bateman,

1967) and potato infected by *R. solani* (Mall and Suresh,1989). A few records however, showed that total phenols decreased in lesion tissue (Arora and Bajaj, 1978).

Table 2: Phenylpropanoids in 25 day old culture of *R.bataticola* isolates

S. No.	R_f	Hydroxycinnamic* Colour in		Hydroxycoumarin* Colour in		Furanocoumarin>		R1		L1	
		UV	UV+NH_3	UV	UV+NH_3	UV	UV+10% In Methanol	Filtrate	Mycelium	Filtrate	Mycelium
1	0.15				Dark Blue			+	-	+	-
2	0.16					Blue	Intensified	+	+	+	-
3	0.24					Blue	Intensified	-	-	-	+
4	0.28					Blue	Intensified	+	-	+	+
5	0.32	Pink						-	-	+	-
6	0.53			Blue				+	-	+	-
7	0.88		Yellow					+	-	+	+

*** n-butanol: acetic acid :water, 4:1:5 (Top Layer) > Chloroform**

Table 3: Phenolics* in 15 and 25 day old cultures of *R.bataticola* isolates

Isolate No.	Source	15 days			25 days		
		Total Phenol	Ortho-Dihydric phenol	Flavanol	Total Phenol	Ortho-Dihydric phenol	Flavanol
R1	Filtrate	0.08	Nil	Nil	1.32	0.08	0.04
	Mycelium	Nil	Nil	Nil	0.71	0.49	0.04
L1	Filtrate	0.12	0.08	Nil	3.64	1.62	0.09
	Mycelium	Nil	Nil	Nil	1.19	1.29	0.05

***mg/ml of culture filtrate. g/g of mycelial mat.**

Table 4. R_f and colour of simple phenols in healthy seedling tissues of mung bean cultivar K 851 and tissue infected with *R.bataticola* isolates.

S. No.	R_f*	Colour in			Healthy 1 day	Lesion		Healthy 3 day	Lesion	
		Folin Cio-caltue	Folin+ NH_3	Vanilline + HCl		R1	L1		R1	L1
1	0.19	Blue			-	+	-	-	+	-
2	0.39	Blue			-	-	-	-	+	-
3	0.51	Blue			+	-	+	+	-	+
4	0.64	Blue			+	+	-	+	+	-
5	0.67		Blue		+	-	+	+	-	+
6	0.79		Blue		-	-	-	+	+	+
7	0.82	Blue			+	-	-	+	-	-
8	0.83			Pink	-	-	+	+	-	+
9	0.86		Blue		-	+	+	+	+	+
10	0.93		Blue		+	-	-	+	+	+

***Acetic acid : Chloroform (1:9) and ethylacetate benzene (9:11)**

Table 5: R_f and colour of hydroxycinnamic acids in healthy seedling tissues of mung bean cultivars K 851 and tissues infected with *R.bataticola* isolates.

S. No.	R_f*	Colour in UV / UV+NH_3	K 851					
			Healthy		Lesion			
			1 day	3 day	1 day		3 day	
					R1	L1	R1	L1
1	0.28	Dark pink	+	+	-	-	-	-
2	0.44	Mauve	-	-	-	-	-	-
3	0.44	Dark absorbance	-	-	-	-	-	-
4	0.53	Blue	-	-	-	-	-	-
5	0.61	Blue	-	-	-	-	-	-
6	0.88	Mauve	+	+	-	-	-	-
7	0.88	Yellow	+	+	-	+	-	+
8	0.95	Blue	-	-	+	-	+	-
9	0.97	Mauve	-	-	-	-	-	-

*** n-butanol acetic acid water, 4:1:5 (Top Layer)**

Table 6 : R_f and colour of hydroxycoumarins in healthy seedling tissues of mung bean cultivars K851 and tissue infected with *R.bataticola* isolates

S. No.	R_f*	Colour in UV / UV+5%NaOH	K 851					
			Healthy		Lesion			
			1 day	3 day	1 day		3 day	
					R1	L1	R1	L1
1	0.26	Dark pink	+	+	-	+	-	+
2	0.57	Yellow	-	-	-	-	-	+
3	0.61	Blue	+	+	+	-	+	-
4	0.64	Blue	-	-	-	-	-	-
5	0.94	Yellow	+	+	+	-	+	-
6	0.94	Mauve Mauve	-	-	-	-	-	-

*** n-butanol acetic acid water, 4:1:5 (Top layer)**

Table 7: R_f and colour of furocoumarins in healthy seedling tissues of mung bean cultivars K851 and tissues infected with *R.bataticola* isolates

S. No.	R_f*	Colour in		K 581					
		UV	UV+10%KOH in methanol	Healthy Lesion	Lesion			Healthy	
				1 day	R1	L1	3 Day	R1	L1
1	0.11	Blue	Intensified	-	-	-	-	-	-
2	0.21	Blue	Intensified	-	-	-	-	-	-
3	0.51	Blue	Intensified	-	-	-	-	-	-

*** Chloroform**

Table 8: R_f and colour of flavonoid in healthy seedling tissues of mung bean cultivar K 851 and tissue infected with *R.bataticola* isolates

S. No	R_f		Colour in		K 851			
					Healthy		Lesion	
	BAW*	5% Acetic acid	UV	UV+NH_3	1 day	3 day	R1	L1
1	0.32	0.89	Mauve		-	-	+	-
2	0.38	0.80	Mauve		-	-	-	-
3	0.44	0.52	Blue		-	-	-	-
4	0.90	0.43	Light blue	P.yellow	-	-	+	-
5	0.91	0.56	Mauve		-	-	-	-
6	0.92	0.57	Blue		-	-	+	-
7	0.92	0.58	Mauve	Pink	-	-	-	-
8	0.94	0.85	Light blue	Yellow	-	-	+	-
9	0.95	0.52	Light blue	P.yellow	+	+	-	-
10	0.96	0.36	Blue	Mauve	+	+	-	-
11	0.98	0.52	Blue	Dull yellow	+	+	+	+
12	0.99	0.62	Mauve		+	+	-	+

***n butanol acetic acid water, 4:1:5 5% Acetic acid**

Table 9: Estimation of phenolics* in healthy seedling tissues of mung bean K 851 and tissues infected with *R. bataticola* isolates

Isolate No.	Age of seedling	Healthy tissue			Lesion tissue			% change		
		Total Phenol	Ortho - Dihydric phenol	Flavanol	Total Phenol	Ortho - Dihydric phenol	Flavanol	Total Phenol	Ortho - Dihydric phenol	Flavanol
R1	1 day	1.8	1.9	0.02	3.2	2.4	0.02	+77.77	+26.31	00
	3 day	1.8	2.0	0.01	3.2	2.6	0.02	+77.77	+30.00	+100
L1	1 day	1.8	1.9	0.02	2.6	1.7	0.02	+ 44.44	-10.50	00
	3 day	1.8	2.0	0.01	2.5	2.2	0.02	+38.88	+10.00	+100

*** mg/g of fresh weight**

More number of flavanols has also been reported in infected mung bean, compared to healthy hypocotyle (Arora and Bajaj, 1978). Concentration was more in susceptible gram against *R.bataticola* (Singh *et al.,* 1982) and in bacterial leaf spot (Jalali *et al.,* 1976). The above result states that pathogenic interaction between mung bean cultivar and *R. bataticola* R1 and L1 caused enhanced biosynthesis of Total phenols, Ortho di - hydric phenols and Flavanols in infected tissue. This hints the additional aromatization of host plant (Kiraly and Farkas, 1962; Cruickshank and Perrin, 1964; Kuc, 1966). Thus all phenols play an important role during infection and disease development. It was observed that phenolics were accumulated during infection in younger seedlings of the K cultivar K851. However, this accumulation was not sufficient so as to resist the infection.

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Assessment of fungi and suspended particulate matter in the indoor air of households of Jammu city (J&K)

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Abstract

The present study was conducted to assess status of suspended particulate matter (SPM) and fungi in the indoor air of households located at different sites in Jammu city. The study area was divided into seven sites. At each site, two households were selected randomly and in each household sampling of SPM (µg/m^3) and Fungi (CFU/m^3) were done twice at three sub sites *i.e.* bedroom, kitchen and drawing room. *Alternaria alternata, Mucor* sp., *Alternaria* sp., *Aspergilus niger, A. fumigatus, A. clavatus, A. versicolor, A. glaucus, Fusarium oxysporum, Geotrichum* sp. were observed to be the most common fungi in the study area. SPM was found to be maximum (1006µg/m^3) in households near water body and minimum (659µg/m^3) in the households near hospital. The minimum value of fungal count (20076 CFU/m^3) was exhibited by households near National Highway I-A whereas maximum value of fungal count (2 7 2 2 6 CFU/m^3) was exhibited by the Households located in commercial area. A significant positive correlation (r) was also found between SPM and fungi (+0.06 to +0.62) as well as fungi and relative humidity (+0.10 to +0.60) in the study area.

Keywords: *Air pollution, Biological contamination, Fungi, Indoor air, Suspended particulate matter*

Introduction

Air pollutants pollute both indoor and outdoor environment. Indoor air pollution can be traced to prehistoric times when man first moved to temperate climate and used fire for cooking and warming. Our buildings have undergone radical changes over past few decades thereby resulting in less opportunity to exchange indoor air with outdoor air. This has led to concentration of air pollutants like dust, CO_2, bacteria etc within the building (Purohit and Ranjan, 2005). In urban areas, exposure to indoor air pollution has increased due to variety of reasons, including the construction of more tightly sealed buildings, reduced ventilation, the use of synthetic materials for building and furnishing and the use of chemical products, pesticides and household care products. Indoor air pollution can begin within a building or drawn from outdoors.

The impact of bio pollutants on the environment is man's basic problem. The causal agents of illness and stress can be of chemical, physical or biological origin and have a sizeable impact on productivity. Biological contamination of environment has received great attention in recent years as a possible cause of illness at home and at work place (Nair *et al*., 1996). Many people spend more than 90% of their times indoors in tightly sealed, poorly ventilated work places, commercial and public buildings (Reijula, 1996). Insufficient ventilation, excess temperature, chemicals, dust and microorganisms are the main indoor air problems (Husman, 1996). Microorganisms are always present in outdoor air but their number and types changes with time of day, weather, season, geographical location and with the local spore sources. Microorganisms and airborne spores in dwellings may enter from outdoors or from moulds growing on walls and windows or on food scraps and other organic material in house dust or retained in crevices or from humidifiers of air conditioning systems (Nair *et al.*, 1996).

Fungal spores constitute a major component of airspora. The presence of fungal propagules in air can cause health hazard in all segments of population. In present study attempt has been

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made to assess the status of fungi, SPM, relative humidity and their correlations in the indoor air of households of Jammu city.

Materials and Method

The study area was divided into seven sites:

Site I : Households located near G.B. Pant Hospital, Nai Basti
SiteII :Households in Commercial area, Jain Bazar
Site III :Households near National Highway I-A
Site IV : Households at Crossing, Satwari
Site V : Households in residential area but near Water Body, Jullaka Mohalla
Site VI : Households in residential area but away from big open drain, Sainik Colony
Site VII :Households in residential area but near big open drain, Bakshi Nagar.

At each site two households were selected randomly and in each household sampling of SPM and Fungi was done twice (i.e. once during July–Sept.2008 and once during Oct.–Dec.2008) at three sub sites i.e. Bedroom, Kitchen and Drawing room. Average value of each parameter with standard deviation for an average household at each site was compiled from data of twelve readings in a period of six months. Correlation coefficients (r) of SPM and Fungi and Fungi and Relative Humidity were calculated using Pearson product moment method.

Air Sampling for SPM was done by using Handy Air Sampler Envirotech APM 821 for two hours at a height of 5 ft above the ground. SPM was determined by formula:-

$$\text{SPM } (\mu g/m^3) = \frac{(W_2 - W_1) \times 10^3}{T \times \frac{R_1 + R_2}{2}}$$

Where,

W_1 &W_2 = initial and final weight of filter paper
R_1& R_2 = initial and final flow rate in cubic metre
T = sampling time in minutes

Air sampling for fungi was done using Handy Air Sampler Envirotech-APM 821 for 10 min at a height of 5 ft above the ground using sterile impingers containing 8 ml of distilled water. Four Petri plates i.e. one with Nutrient Agar (peptic digest of animal tissue, beef extract, yeast extract, sodium chloride, agar, pH 7.4±0.2), second with Potato Dextrose Agar (potato infusions, dextrose, agar, pH 5.6±0.2), third with Rose Bengal Agar Base (papaic digest of soyabean meal, dextrose, monopotassium phosphate, magnesium sulphate, rose bengal agar, pH 7.2±0.2) and fourth with Czapek Dox Agar (sucrose, sodium nitrate, dipotassium phosphate, magnesium sulphate, potassium chloride, ferrous sulphate, agar, pH 7.3±0.2) were inoculated with 2ml. of impinged water from each impinger in Laminar flow and incubated at 25-30^{0}C for 7 days in BOD incubator.

The quantification of fungal count was done by using the formula:-

No. of microbes per volume (l) of air (CFU/m^3)

$$= \frac{\text{No. of microbes collected by impinger}}{\text{Volume of air}}$$

No. of microbes collected by impinger
= Sum total no. of colonies in all the four plates

Volume of air = Sampling time X Flow rate of air in cubic metre

Sampling of fungi was also done directly by exposing Petri plates with above said media to ensure that all the existing fungi have been impinged. Fungal study from each colony was carried out using Aniline blue and Lacto phenol stain. Relative humidity was calculated using Psychrometer having wet bulb and dry bulb thermometers. The value of RH (%) was calculated from the temperature in dry bulb thermometer and depression in temperature in wet bulb thermometer using standard table of relative humidity. A control set for each culture media was prepared and the colonies found growing on the culture medias were subtracted from the respective exposed culture medias.

Results and Discussion

The analysis of data revealed that households near Hospital (Site I) exhibited minimum indoor SPM of 659±253µg/m^3 whereas households near Water body (Site V) exhibited maximum indoor SPM of 1006±225 µg/m^3. The bedroom located in Site III (Households near National Highway I-A) exhibited minimum average fungal count of 6405 CFU/m^3 whereas bedroom located in Commercial

Table I: -Indoor SPM and Fungi in households at different sites of Jammu city

Households	SPM (µg/m^3)	Relative humidity (%)	Average Number of fungi (CFU/m^3) in			
			Average Bedroom	Average Kitchen	Average Drawing room	Average Household
SITE I	659±253 (293-1055)	76±7.0 (60-83)	6969±1575 (5742-9241)	6831±2316 (4655-9870)	7201±1916 (5332-9857)	21002 ±5628 (16092-28967)
SITE II	900±327 (446-1561)	73±6.0 (64-82)	8336±1548 (6037-9368)	9855±1413 (8004-11443)	9035±1154 (7999-10666)	27226 ±915 (26012-28038)
SITE III	708±239 (292-1055)	74±8.0 (60-83)	6405±2019 (4471-9241)	6769±2345 (4655-9870)	6902±2192 (5147-9857)	20076 ±6368 (14911-28967)
SITE IV	859±161 (586 -1055)	74±8.0 (64-83)	8321±1487 (6105-9241)	8624±2647 (4655 -10033)	8033±1954 (5332-9857)	24979 ±5977 (16092-28967)
SITE V	1006±225 (624 -1393)	76 ±7.0 (69-91)	8099±3402 (4746-11758)	8262±3716 (5012-13583)	7957±2460 (5684-11300)	24318 ±9230 (16394-36641)
SITE VI	799±303 (224 -1393)	71±7.0 (60-84)	7859±3746 (3718-11758)	7878±4049 (4271-13583)	7249±3331 (3440-11300)	22987 ±10899 (11428-36641)
SITE VII	700±404 (293 -1561)	75±4.0 (68-82)	6984±1649 (5742-9368)	8062±2498 (5463-11443)	8203±1846 (6529-10666)	23249 ±4541 (18292-28038)
Average Household in study	804±296 (224-1561)	74±7.0 (60-91)	7568±2218 (3718-11758	8040±2695 (4271-13583	7797±2068 (3440-11300)	23405 ±6498 (11428-36641)

area *i.e.* Site II exhibited maximum value of average fungal count of 8336 CFU/m^3. The kitchen located in Site III Households near National Highway I-A) exhibited minimum average fungal count of 6769 CFU/m^3 whereas kitchen located in commercial area i.e. Site II exhibited maximum value of 9855 CFU/m^3. The drawing room located in Site III (households near National Highway) exhibited minimum average fungal count of 6902 CFU/m^3 whereas drawing room located in Commercial area *i.e.* Site II exhibited maximum value of 9035 CFU/m^3(Table I). The average count of fungi in the indoor air exhibited minimum value of 20076 CFU/m^3 at Site III *i.e.* households near National Highway I-A and maximum value of 27226 CFU/m^3 at Site II *i.e.* households located in commercial area. Overall analysis at different sites of study area revealed that households in the study area exhibited average indoor SPM of 804±296 µg/m^{3}with range of 224 -1561µg/m^3. Analysis of data further revealed that fungi exhibited average fungal count of 23405 ± 6 4 9 8 CFU/m^3 with 87% ascomycota, 10% zygomycota and 3% sterile hypha. The critical analysis of data revealed that maximum fungal count was exhibited by the kitchen, followed by drawing room and bedroom of the study area. (Table I).Overall analysis of data revealed that households near Hospital exhibited minimum indoor SPM which might be due to maintenance of best sanitation conditions whereas Households near water body exhibited maximum indoor SPM due to dumping of silting material on banks of water body and households at Site III i.e. households near National Highway I-A exhibited minimum value of fungal count this might be due to concentration of SO_2 and NOx. Subba Rao *et al.* (1988) and Subramanyam (1991) while studying microbial air quality of Madras city also reported that increase in concentration of SO_2 and NOx decreased microbial content of air whereas maximum value of fungal count was exhibited at Site II *i.e.* Households located in Commercial area this was due to narrow lanes with no exposure to direct sunlight and humid conditions.

A significant correlation was found between SPM and fungi (+0.06 to +0.62) and fungi and relative humidity (+0.10 to +0.60) at all sites of study area

(Table II). Subramanyam *et al*. (1999) also observed positive correlation between fungi and SPM while studying airborne fungi in urban environment.

Table II: Correlation coefficient(r) of SPM and Fungi and Fungi and Relative Humidity in households at different sites of Jammu city

SPM in households at different Sites	SPM and Fungi	Fungi and Relative Humidity
SPM at Site I	+0.09	+0.60
SPM at Site II	+0.11	+0.41
SPM at Site III	+0.20	+0.55
SPM at Site IV	+0.06	+0.14
SPM at Site V	+0.06	+0.10
SPM at Site VI	+0.62	+0.56
SPM at Site VII	+0.38	+0.50

A total of 22 fungal types were found. They are *Aspergillus niger*, *Aspergillus versicolor*, *Aspergillus clavatus*, *Aspergillus glaucus Aspergillus fumigatus*, *Aspergillus flavus*, *Aspergillus* sp., *Trichoderma* sp., *Alternaria* sp., *Alternaria alternata*, *Mucor* sp., *Rhizopus* sp., *Cladosporium* sp., *Geotrichum* sp., *Fusarium oxysporum*, *Fusarium solani*, *Curvularia lunata*, *Bipolaris spicifera*, *Bipolaris* sp., *Penicillium* sp., *Aeurobasidium* sp., *Yeast and Sterile hypha.*

*The o*verall highest prevalence of fungal types was represented by *Aspergillus* followed *by Alternaria* and *Fusarium*. It was in agreement with the findings of Begum and Ahmed (2006) and Begum *et al.* (2001) who found *Aspergillus* to be most dominant in the air.

The present study also revealed that fungal count in indoor air is affected more by indoor sources of pollutants than outdoor sources of pollutants. There was statistically significant correlation between the total number of fungi and the concentration of suspended particulate matter. It is clear that everyday activities may result in significant changes in numbers and types of such air borne moulds (Lehtonen *et al.*, 1993)

Outdoor air used to penetrate into buildings easily through windows and doors (Dingle, 1957) to become a potential source of indoor fungi (Husman, 1996) but at the same time indoor environment, building materials, humidity and insufficient ventilation were suitable habitats for growth of outdoor organisms (Reijula, 1996).

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Seasonal physico-chemical characteristics assessment and primary production in the planktonic community of Godavari River water, Nashik (Maharashtra)

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Abstract

The physico-chemical characteristics influence the planktonic population whereas primary productivity depends upon the photosynthetic activity of phytoplankton. The productivity is nothing but the amount of organic matter produced by phytoplankton under a unit area of water surface thus influenced by physico-chemicals parameters. The present paper deals with seasonal variations (winter, summer, monsoon) of parameters like Temp, Turbidity, pH, Free CO_2, DO, Nitrates, Phosphates, Planktonic community, along with primary production of Godavari river water at Nashik during November 2002 to October 2003. It was observed that the abiotic parameters are in direct correlation with the biota of an aquatic ecosystem. The planktonic community showed direct correlation with primary productivity i.e. maximum in the summer and minimum in the winter.

Keywords: *Godavari river, Physico-chemical, Planktonic community, Primary production*

Introduction

The Godavari river originates near Trimbak in Nashik, Maharashtra. The river is 1465 kms. long and joins the Bay of Bengal in Andhra Pradesh and has a catchment area of 3,12,813 sq. km. of which 69.3 % lies in Maharashtra and is nearly 10% of the total geographical area of the country. The Godavari is the most celebrated largest river of the Peninsular India, inspite of its massive catchment area, the discharge is not very impressive because of moderate annual average rainfall. On account of high concentration of population, industries, towns and cities in the basin, large quantities of domestic and industrial wastes are discharged into the river besides this waste water from agriculture, animal care, domestic and industrial use also reaches the river by leaching; drainage and surface wash off during the monsoon. Numerous aspects of river pollution such as physico-chemical properties of different river water (Mitra, 1982; Raina *et al*., 1984) and changes in biological composition of rivers with respect to impact of pollutants (Bhatt *et al*., 1985; Nandan, 1985; Shukla, 1994) have been reported in India. Some investigation has also been conducted on physico-chemical and biological aspects of river Godavari at different places (Sanap *et al*., 2006, Deshmukh *et al*., 2006). As the quality of Godavari river water is getting deteriorated day by day and there is paucity of data on the pollution status, therefore the present study was undertaken to find out the pollution in terms of various physico-chemical and biological aspects of Godavari river water in and around Nashik area.

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Materials and Method

For physico-chemical analysis of water samples were collected from three different sites (Site 1 – Near Someshwar temple, Site 2 – Ramkund, Site 3 – Tapovan). Water samples were collected once in a month during the period Nov. 2002 – Oct. 2003. Samples were collected in cleaned plastic containers. Temperature and pH were measured in the field itself using digital thermometer and pH meter respectively. While remaining parameters were analyzed in the laboratory following the standard methods given by APHA (1989),Trivedy and Goel (1986). The investigation period was

divided into three seasons i.e. Winter (Nov – Feb), Summer (Mar – June) and Monsoon (July – Oct).

Results and Discussion

The observations recorded during different seasons at different sites 1, 2, 3 during the year Nov. 2002 – Oct. 2003 are shown in Table 1 and Fig.1 respectively. Minimum (20.10^0C) temperature was recorded at Site-1, during the winter season and maximum (28.85^0C) at Site-2 and Site-3 during the summer season. Lower temperature recorded during winter and monsoon may be due to extreme cold and shorter sunshine period. Similar findings were observed by Swarnlatha and Narsing Rao, 1991. Turbidity plays an important role in the energy dynamics of an aquatic ecosystem. Turbidity values were highest in summer (163.25 NTU) followed by monsoon (142.59 NTU) at Site-3 and minimum in winter (95.25 NTU) at Site-1, Mathew *et al.* (1972) observed the same order of turbidity. Maximum pH (7.80) was recorded in summer at site-3 and minimum pH (7.49) recorded in winter at site-1. The observation indicated that water was alkaline throughout the study period. Free carbondioxide may be produced in water through biological oxidation of organic matter, particularly in polluted water. Maximum free CO_2 (7.82 mg/l) was reported at Site 3 in summer and minimum (3.16 mg/l) in summer at Site 1. Higher free CO_2 in water samples in summer reason was due to discharge of domestic waters, inflow of sewage and mostly due to decomposition of organic wastes. Similar observations were observed by Chakraborty and Asthana (1984), Mehta (1999) and Khanna and Bhutiani (2003).

Table 1 : Seasonal variations in physico-chemical characteristic of Godavari river

Parameters	Site-1			Site-2			Site-3		
	Winter	Summer	Monsoon	Winter	Summer	Monsoon	Winter	Summer	Monsoon
Temperature (^{0}C)	20.10	28.65	25.20	20.37	28.85	25.32	20.40	28.85	25.40
Turbidity (NTU)	95.25	143.50	131.75	104.00	149.75	134.50	107.50	163.25	142.50
pH	7.49	7.70	7.58	7.53	7.55	7.50	7.65	7.80	7.75
Free CO_2 (mg/l)	3.16	7.49	5.93	3.31	7.80	6.21	3.47	7.82	6.30
DO (mg/l)	7.48	4.40	4.93	7.20	4.13	4.65	6.93	3.90	4.58
Nitrates (mg/l)	2.55	0.63	1.51	2.73	0.67	1.59	2.87	0.69	1.65
Phosphates (mg/l)	0.83	1.45	0.98	0.88	1.48	1.03	0.89	1.52	1.03
Phytoplankton (unit/l)	326.50	2170.50	1230.25	310.00	2256.00	132.00	424.50	2365.25	1375.75
Zooplankton (unit/l)	203.75	884.00	370.00	214.75	880.75	375.50	222.50	908.25	377.25
GPP	115.74	270.31	129.73	118.36	285.20	132.18	121.63	290.95	134.12
NPP	85.76	214.34	102.14	85.51	227.09	103.47	85.12	231.18	104.20
CR	29.98	55.97	27.58	32.85	58.10	28.71	36.50	59.77	29.91

Dissolved oxygen in an important factor in an aquatic ecosystem which brings about various biochemical changes. Maximum DO (7.48 mg/l) was observed in winter at Site 1 and minimum DO (3.90 mg/l) in summer at Site 3. The low oxygen content during summer may be due to low water, high temperature and decay of macrovegetation. Mishra and Yadav (1978), Adebisi (1981) and Mitra (1982) also discussed seasonal averages and. fluctuations in dissolved oxygen. Nitrate is an important factor for controlling the occurrence and abundance of phytoplankton. Maximum Nitrate (2.87mg/l) observed in winter at Site - 3 and minimum (0.63mg/l) in summer at Site 1 during the study period. The observed maximum values of nitrates are in agreement with Prasad and Saxena (1980); Rana *et al*. (1991), Prasad and Karnawat (1993); Shrivastava and Chaudhary (1997) minimum concentration of nitrates during rainy season is also due to increased volume of water and flooding which dilutes nitrate concentration. Maximum phosphate values ranged

(1.52 mg/l) in summer at Site 3 while it was found minimum (0.83 mg/l) in winter at Site 1 during the study period. Singh *et al.* (1999), Jayaraman *et al.* (2003) observed that maximum phosphates values may be due to concentration effect, agricultural run off and high load of organic matter. Maximum phytoplankton (2365.25 unit/l) were observed during summer at Site - 3 and minimum (132.00 unit/l) during winter at site-1. Similar findings were reported by Trivedy *et al.* (1985), Haque *et al.* (1986, 1989). During the study period maximum zooplankton were found in summer (908.25 unit/l) at Site - 3 and minimum (203.75 unit/l) in winter at Site 1. In winters small growth of plankton may be due to low temperature. In the present investigation phytoplankton are more prominent than zooplankton. Jaya Raju *et al.*, (1994) and Khanna and Bhutiani (2003) reported similar findings. Primary productivity is limited by shortage of nutrients such as nitrogen, sulphur and

Fig. 1 : Graphical Representation of observed parameters

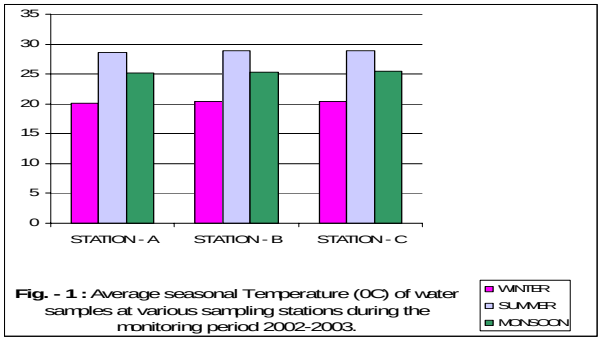

Fig. - 1 : Average seasonal Temperature (0C) of water samples at various sampling stations during the monitoring period 2002-2003.

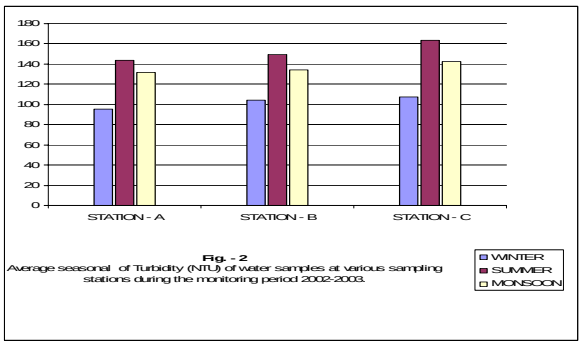

Fig. - 2
Average seasonal of Turbidity (NTU) of water samples at various sampling stations during the monitoring period 2002-2003.

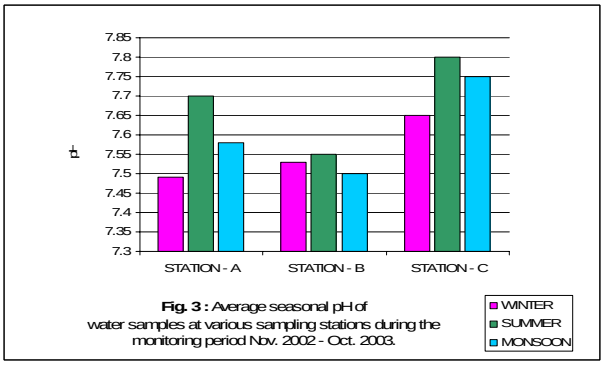

Fig. 3 : Average seasonal pH of water samples at various sampling stations during the monitoring period Nov. 2002 - Oct. 2003.

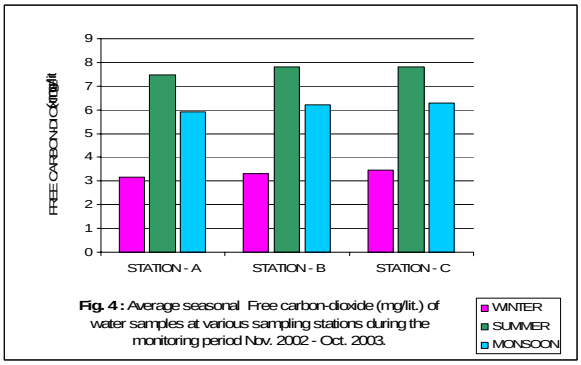

Fig. 4 : Average seasonal Free carbon-dioxide (mg/lit.) of water samples at various sampling stations during the monitoring period Nov. 2002 - Oct. 2003.

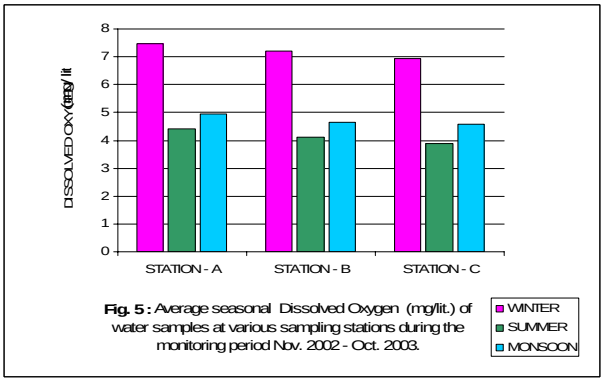

Fig. 5 : Average seasonal Dissolved Oxygen (mg/lit.) of water samples at various sampling stations during the monitoring period Nov. 2002 - Oct. 2003.

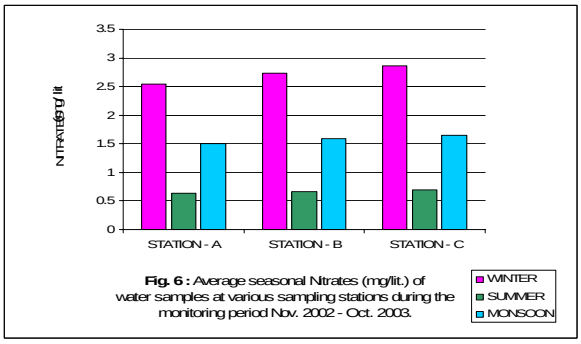

Fig. 6 : Average seasonal Nitrates (mg/lit.) of water samples at various sampling stations during the monitoring period Nov. 2002 - Oct. 2003.

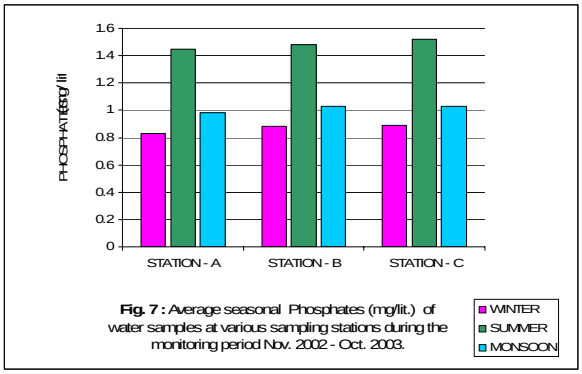

Fig. 7 : Average seasonal Phosphates (mg/lit.) of water samples at various sampling stations during the monitoring period Nov. 2002 - Oct. 2003.

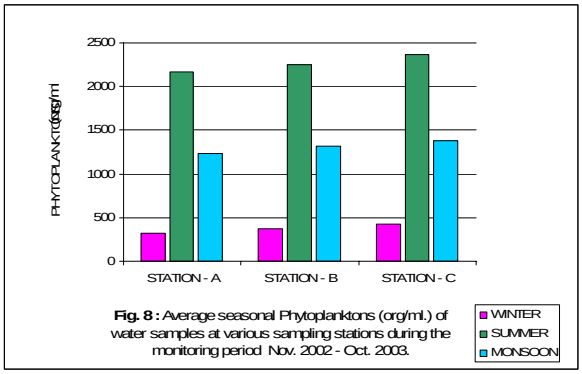

Fig. 8 : Average seasonal Phytoplanktons (org/ml.) of water samples at various sampling stations during the monitoring period Nov. 2002 - Oct. 2003.

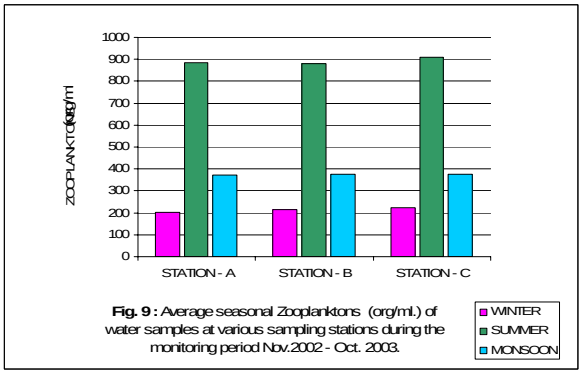

Fig. 9 : Average seasonal Zooplanktons (org/ml.) of water samples at various sampling stations during the monitoring period Nov.2002 - Oct. 2003.

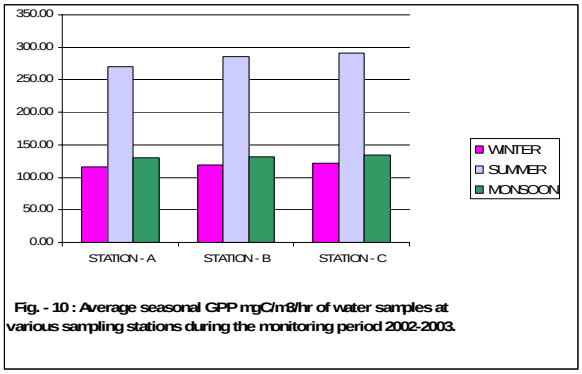

Fig. - 10 : Average seasonal GPP mgC/m3/hr of water samples at various sampling stations during the monitoring period 2002-2003.

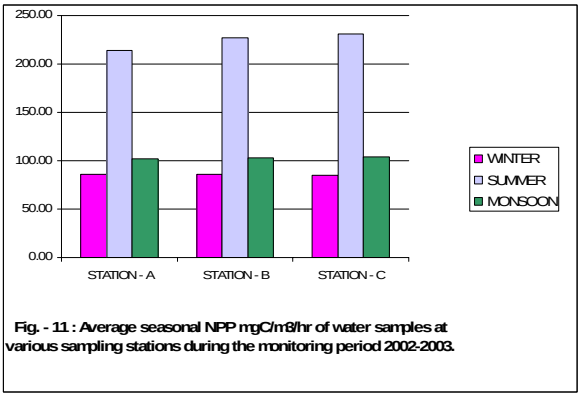

Fig. - 11 : Average seasonal NPP mgC/m3/hr of water samples at various sampling stations during the monitoring period 2002-2003.

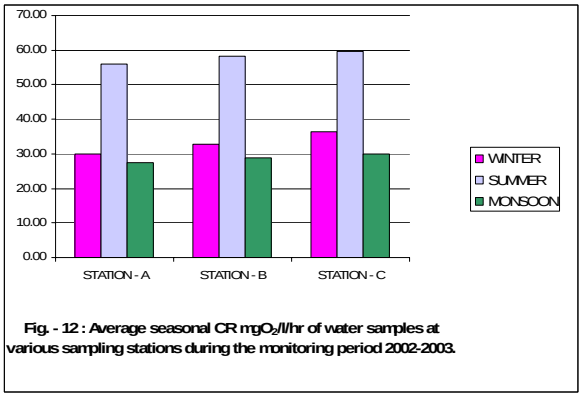

Fig. - 12 : Average seasonal CR mgO_2/l/hr of water samples at various sampling stations during the monitoring period 2002-2003.

other essential trace elements. Maximum GPP, NPP and CR (290.95, 231.18 and 59.77) are observed in summer at Site 3 and minimum GPP (115.74) in winter at site 1, minimum (85.12) NPP in winter at Site 3 and minimum CR (27.58) in monsoon at Site 1.

Conclusion

The overall study of physico-chemical and biological parameters during the three seasons indicate that there is much pollution load at Site 3 it may be due to release of huge quantities of sewage, effluents and more of the man made activities, as holy activities are being carried out thus affecting the quality of water at a faster speed. Thus, water quality is highly deteriorated and therefore stringent action must be taken by the municipal corporation for its cleaning and to prevent further deterioration and to protect the riverine ecosystem.

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Phytoremediation of sewage pollutants through some macrophytes near industrial area of Balrampur

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Abstract

The present study deals with the phytoremediation of aquatic pollutants through macrophytes including *Lemna, Eicchornia* and *Hydrilla*. The study was conducted from June 2009 to September 2009 on Suawn Nala and was observed that application of aquatic plants is the cheapest and ecofriendly method for the removal of pollutant from sewage.

Keywords: *Aquatic plants, Ecofriendly, Macrophytes, Phytoremediation, Sewage*

Introduction

Balrampur is a fast developing industrial city at Indo-Nepal border at eastern Uttar Pradesh and is a famous industrial city and well known for a major sugar industry *i.e.* Balrampur Chini Mill (BCM) Ltd. BCM is the largest sugar industry of India by its production point of view. In spite of this unit several other small scale industries like pulse mill, rice mill, dairy plants etc. are also functional in Balrampur. These units are discharging their wastes and garbage into Suawn Nala, Balrampur (Fig.1). This is the fact that these industries are the backbone of the rural economy of Balrampur. Need has arisen to review and recognize environmental problems associated with them. The enormous quantities of wastes (solid, liquid, and gas) generated by these rural industries has led to problems of air, water, and soil pollution. The problems of water quality and water pollution are solely severe in many industrial areas and are threatening the population residing in adjoining areas. In the recent past, several studies (Manas, 1976; Kundra and Purthy,1979; Handa, 1981; Krupanidhi, 1984) have reported that receiving water bodies are becoming increasingly contaminated due to discharge of domestic and industrial waste waters. The present study deals with the phytoremediation of aquatic pollutants of Suawn Nala by some aquatic macrophytes *viz. Lemna, Eichornia and Hydrilla*. These plants have great potential in treating industrial effluent and to prevent early pollution of water bodies.

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Materials and Method

Phytoremediation of polluted water of Suawn Nala, Balrampur was done by using macrophytes. A fresh plant of *Eichornia, Lemna* and *Hydrilla* having 100 g weight were grown in cemented turf of 60 cm diameter and 20 cm depth, containing polluted water of Suawn Nala for a period of 10 days. The treatment potential of the macrophytes and elimination of pollutants from polluted water of Suawn Nala were assessed on monthly basis by estimating quality of polluted water before and after treatment. The quality was determined by analyzing physico-chemical parameters following the standard methods of APHA (1998) and Khanna and Bhutiani (2008).

Results and Discussion

The result of physico-chemical analysis of polluted water of Suawn Nala, Balrampur City before and after 10 days of culture of *Eichornia*,

Lemna and *Hydrila* are presented in Table 1. Reduction in the temperature was observed after 10 days of culture.The effect of temperature controls the chemical reactions, solubility of the substances, chemical and biological reaction of the organism in water and the growth of nuisance organisms are enhanced by warm water condition and could lead to the unpleasant taste and odour

Fig. 1: Suawn Nala- carrying industrial effluent

(Sacramento, 1963, Mechalas *et al*., 1972). In natural water, pH changes diurnally and seasonally due to variation in photosynthetic activity, which increases the pH value (Bouwer, 1978; Yadav *et al.*, 1987). The pH value was observed around 7.0 before the culture but it increased after culture. The treated sewage showed effective reduction in turbidity. The values were in the range of 22 NTU-37.8 NTU. Electrical conductivity was in the range of 736.2 – 907 µmhos/cm. According to Rao *et al.* (1979), solids in water samples vary with the alkaline nature. Total alkalinity observed before the treatment was in the range of 285 – 327 mg/l which reduced after the treatment and was observed in the range of 254 – 293 mg/l. Free CO_2 was observed highest in the month of August *i.e.* 108 mg/l and was lowest in the month of September i.e. 2.9 mg/l, before and after treatment.

Table 1: Physico-chemical characteristic of sewage water in Balrampur city before and after phytoremediation by *Eichornia, Lemna* and *Hydrila*

Parameters	Unit	June 2009		July 2009		August 2009		September 2009	
		BP	AP	BP	AP	BP	AP	BP	AP
Temperature	(^{0}C)	41.5	38.3	39.6	36.1	37.8	36.3	37.6	34.4
pH	-	6.93	7.10	7.32	7.40	7.23	7.39	7.10	7.46
Turbidity	NTU	47.6	37.8	44.2	35.4	32.0	27.0	29.9	22.0
EC	µmhos/cm	940.0	879.0	902.0	835.0	920.0	907.0	785.0	736.2
TDS	mg/l	609.4	585.2	608.0	560.0	576.0	520.0	382.0	346.0
Total alkalinity	mg/l	317.0	289.0	325.0	278.0	327.0	293.0	285.0	254.0
Free CO_2	mg/l	97.2	64.7	99.9	63.2	108.0	76.0	56.0	22.90
Chloride	mg/l	170.2	152.0	194	167.0	189.0	167.0	163.0	149.0
Dissolved oxygen	mg/l	1.6	5.0	2.6	5.4	2.40	5.20	4.70	6.50
COD	mg/l	293.4	244.8	220.0	179.0	212.0	187.0	133.0	121.0
Total hardness	mg/l	295	246.0	345.0	287.0	349.0	284.0	298.0	270.0
Calcium	mg/l	167.0	136.0	148.0	103.0	142.0	112.0	164.0	107.0
Ammonical-N	mg/l	8.04	5.50	10.8	6.54	24.70	20.90	9.08	7.86
Nitrate-N	mg/l	59.3	48.90	72.5	54.8	63.30	50.10	68.80	52.20
Phosphate	mg/l	0.485	0.378	0.448	0.386	0.452	0.387	0.502	0.298
Organic phosphate	mg/l	0.552	0.532	0.542	0.479	0.486	0.302	0.899	0.577

BP= Before Plantation, AP = After Plantation

Very small changes were reported in chloride content due to non-utilization by the plants. Dissolved oxygen (DO) values were increased in small quantity in sewage water after culture of *Eichornia*, *Lemna* and *Hydrilla which* helped in oxygen transfer in water system by their roots.Chemical oxygen demand (COD) was recorded maximum as 293.4 mg/l in the month of June and minimum was observed as 121.0 mg/l after treatment in the month of September. The reduction in COD after culture was due to more availability of oxygen in water for oxidation of organic matter. The peak value of total hardness (349 mg/l) was observed in the month of August.

Calcium value was always found above 100 mg/l in all the four months of experimentation. Calcium being a useful nutrient absorbed by plant *Eichornia*, *Lemna* and *Hydrila* for their growth and development which fluctuated from 103 to 167 mg/l before and after treatment in different months. Nitrogen content was estimated in the form of ammonical nitrogen. Nitrate nitrogen is the stable product of oxidation, the maximum value of nitrate nitrogen was observed 24.7 mg/l while minimum was observed as 5.50 mg/l before and after treatment. Phosphorus content was estimated as total phosphate. The peak value of phosphate was found as 0.502 mg/l and organic phosphates as 0.899 mg/l in the month of September

Table 2: Monthly variation in NPP (gm^{-2} day^{-1}) of *Eichornia* after 10 days of culture in sewage water during 2009 (initial biomass of *Eichornia* used for culture = 7.2 g dry weight)

Months	Period	Production gm^{-2}	Productivity	N.P.P $g.m^{-2}$ day^{-1}
June	15^{th}-25^{th}	11.20	1.12	1.47
July	15^{th}-25^{th}	6.93	0.69	0.96
August	15^{th}-25^{th}	16.57	1.65	2.10
Sept.	15^{th}-25^{th}	10.44	1.04	1.38
Mean X	___	___	___	1.47

Table 3: Monthly variation in NPP (gm^{-2} day^{-1}) of *Lemna* after 10 days of culture in sewage water during 2009 (initial biomass of *Lemna* used for culture = 2.9 g dry weight)

Months	Period	Production gm^{-2}	Productivity	N.P.P gm^{-2} day^{-1}
June	15^{th}-25^{th}	3.56	0.35	0.47
July	15^{th}-25^{th}	1.20	0.12	0.20
August	15^{th}-25^{th}	4.50	0.45	0.59
Sept.	15^{th}-25^{th}	0.80	0.08	0.15
Mean X	___	___	__	0.35

Table 4: Monthly variation in NPP (gm^{-2} day^{-1}) of *Hydrila* after 10 days of culture in sewage water 2009 (initial biomass of *Hydrila* used for culture = 10.4 g dry weight)

Months	Period	Production gm^{-2}	Productivity	N.P.P gm^{-2} day^{-1}
June	15^{th}-25^{th}	16.58	1.65	2.17
July	15^{th}-25^{th}	8.64	0.86	1.23
August	15^{th}-25^{th}	11.65	1.16	1.59
September	15^{th}-25^{th}	20.11	2.01	2.59
Mean X	___	___	____	1.90

The potential of *Eichornia, Lemna and Hydrila* species for phytoremediation of polluted water of Suawn Nala, Balrampur city was evidence from the result of net primary productivity (NPP), which registered a significant increase in value after 10 days of culture. The higher value of NPP of *Eichornia* was observed 2.10 gm^{-2} day^{-1} in month of August (Table 2) and the higher value of NPP of *Lemna* was observed 0.59 gm^{-2} day^{-1} in month of August (Table 3). Like *Eichornia* and *Lemna*, in *Hydrila* the value of NPP was found maximum as 2.59 gm^{-2} day^{-1} in the month of September (Table 4). The observed NPP value proved that rainy season is the best for phytoremediation of sewage water through *Eichornia, Lemna and Hydrila* species. The result of in vitro culture has proved the application of aquatic plant *Eichornia, Lemna and Hydrila* species for removal of pollutant from sewage water of Balrampur city (Dings, 1978). It is

concluded from the above findings that phyto remediation is the cheapest, ecofriendly and natural method for the removal of pollutant occur in sewage.

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Antimicrobial screening of Trikatu and Sitopladi Churnas

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Abstract

Ayurvedic system of medicine prescribes a number of crude drugs for longevity of life and for curing various ailments. In the present study we have selected two most commonly used ayurvedic formulations i.e. Trikatu and Sitopladi churnas. which are used against respiratory tract infections. The petroleum ether, acetone, methanolic and aqueous extracts of each plant was tested against *Staphylococcus aureus, Streptococcus pyogenes, S. pneumoniae, S. sanguis, S. salivarius, S. mutans, Lactobacillus acidophillus, E.coli, Pseudomonas aeruginosa, Staphylococcus epidermidis, Salmonella typhi, Micrococcus luteus, Bacillus megneterium, Bacillus subtilis, Proteus vulgaris, Candida albicans* and it was found that methanolic extracts exhibited the highest degree of activity. *Zingiber officinales* (tuber) and *Piper longum* (fruits) produced outstanding antibacterial effect with inhibition zone greater than 20 mm against most of the pathogens. Minimum inhibitory concentration of most effective extract (methanolic) was performed against *E. coli, B. subtilis, S. pneumoniae* and *S. pyogenes* whereas *P. longum* showed best results against *E.coli* (0.0391 mg/ml) and *Z. officinales* against *B. subtilis* (0.0391mg/ml).

Keywords: *Minimum inhibitory concentration, Respiratory tract infection concentration, Sitopladi, Trikatu*

Introduction

Medicinal plants are the local heritage with global importance, world is endowed with a rich wealth of medicinal plants. Herbs have always been the principle form of medicine in India and presently they are becoming popular throughout the world, as people strive to stay healthy in the face of chronic stress and pollution and to treat illness with medicines that work in concert with the body's own defense (Chopra *et al*., 1992).

Medicinal plants play an important role in the lives of rural people, particularly in remote parts of developing countries with few health facilities. The ayurvedic system of medicine prescribes a number of crude drugs for longevity of life and for curing various ailments (Holetz *et al*., 2002 and Prabhat *et al*., 2005). These crude drugs are processed in different forms to produce specific therapeutic effect, one of the important forms is churna. The improvement of disease conditions after herbal treatment, without any harmful side effects and the high cost of the other forms of treatment (Ahmad *et al*., 1998) compelled a large population of the world to use medicinal plants. In the present study we have selected two most commonly used ayurvedic formulations i.e. Trikatu and Sitopladi churnas which are known to cure respiratory tract infections.

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Materials and Method

Plant material

The ingredients of both churnas were collected separately from M/s Vijay Herbal Automation, Haridwar and were further confirmed in the Department of Botany, Gurukul Kangri University, Haridwar (Uttarakhand). Trikatu churna was prepared from dry ginger (33.33 gm), long pepper (33.33 gm), black pepper (33.33 gm) in equal quantities while Sitopladi churna comprises of long pepper (12.90 gm), cinnamon (03.23 gm), cardamom (06.45 gm), thorny bamboo (25.81 gm) and Mishri (51.61 gm).

Preparation of extracts

The method of Alade and Irobi (1993) was adopted for the preparation of plant extracts separately. 100 gm of the powdered plant materials and 50 gm of Trikatu and Sitopladi churnas were loaded in Soxhlet assembly and extracted in four different solvents (Petroleum ether, acetone, methanol and aqueous) for 72 hours. After extraction it was passed through filter paper. The filtrate then obtained was concentrated using vacuum-rotator evaporator at 30^0C.

Culture media

Muller Hinton Agar Media No.173 (Hi media Pvt. Ltd., Mumbai, India) was used for screening of antimicrobial activity.

Microorganisms

A total of sixteen different pathogenic microorganisms (12 undesignated and 4 designated) strains or serotypes were isolated from infected patients in Ravi diagnostic laboratory and Aggarwal dental clinic, Haridwar. Out of these *Staphylococcus aureus, Streptococcus mutans, S. salivarius, S. sanguis, S. pneumoniae, S. pyogenes, Lactobacillus acidophillus* were isolated from patients having dental and respiratory tract infection while *E. coli, Micrococcus luteus, Pseudomonas aeruginosa, Candida albicans* and *Salmonella typhii* were isolated from the urinary tract infection (UTI) patients. The isolates were identified according to guidelines given by Burneti *et al.* (1994).The rest of the strains *i.e. Proteus vulgaris* (MTCC-742), *Bacillus subtilis* (MTCC-441), *B. megneterium* (MTCC-428) and *Staphylococcus epidermidis* (MTCC-435) were procured from IMTECH, Chandigarh.

Antimicrobial assay

Antibacterial activity was carried out using Cup-Plate method during the process 0.1 ml of diluted inoculum (10^5 CFU/ml) of test organism was mixed in Muller Hinton Agar media, it was then shaken and poured in sterilized petridishes. Wells of 8 mm diameter were punched into the agar medium and filled with 45 µl of plant extracts. All the solvents were served as negative control. Each extract was assayed in triplicate. The plates were then incubated at 37^0C for 24 hrs. The antibacterial activity was interpreted from the size of the diameter of zone of inhibition measured in millimeters (mm) (Prabhat *et al.*, 2008).

Determination of MIC

The minimum inhibitory concentration of the most effective extract (methanolic) was determined for *B. subtilis*, *E. coli*, *S. pneumoniae* and *S. pyogenes* by using the serial dilution method at a final concentration starting from 10 mg/ml. The extracts were added to sterile Muller Hinton Broth into microtiter plates. Each extract was assayed in triplicate. The turbidity of the wells in the microtiter plate was interpreted as visible growth of the microorganisms. The MIC values were taken as the lowest concentration of the extracts in the wells of the microtiter plate that showed no turbidity after 24 hours of inoculation at 37^0C.

Results and Discussion

The present study was designated to obtain preliminary information on the antimicrobial effect of medicinal plants used in Trikatu and Sitopladi churnas against the disease causing microorganisms. The cup-plate diffusion method was used in this study since it was found to be better than the disc diffusion method (Essawi and Srour, 2000).

A total of six medicinal plants were used for the formulation of Trikatu and Sitopladi churnas, belonging to 4 families of Angiosperms. The petroleum ether, acetone, methanolic and aqueous extracts of each plant at the concentration of 200 mg/ml was tested against the microorganisms (Table 1). Antimicrobial activity was found in all plants and churnas but *Zingiber officinales* (tuber) and *Piper longum* (fruits) produced outstanding antibacterial effect with inhibition zone greater than 20 mm (Table 1). Other plant extracts were found to have moderate antimicrobial activity. Trikatu and Sitoladi churnas showed best antibacterial activity against *B. subtilis* with 15 and 14 mm of zone of inhibition (Table 2). In general methanolic extracts exhibited the highest degree of antimicrobial activity as compared to aqueous, acetone and petroleum ether extracts

Minimum inhibitory concentration of most effective extract (methanolic) was performed against *E. coli, B. subtilis, S. pneumoniae* and *S. pyogenes* (Table 3). *P. longum* showed best results against *E.coli* (0.0391 mg/ml) and *Z. officinales* against *B. subtilis* (0.0391 mg/ml).

Table 1: Antimicrobial activity of plants, Trikatu and Sitopladi churnas

S. No	Family Botanical name	Part used	Fractions Extracts	Antimicrobial activity														
				Sa	Sp	Sp*	Ss	Ss†	Sm	La	Ec	Pa	Se	St	Ml	Bm	Bs	Pv	Ca
1.	Poaceae *Bambusa arundinacea*	Vanslochan	I	9	10	9	-	-	-	-	-	-	-	-	-	11	12	9	8
			II	12	11		-	-	-	-	-	-	12	-	-	-	-	-	-
			III	12	10	10	12	14	16	8	-	-	-	11	12	9	9	11	13
			IV	12	15	13	8	11	9	-	-	-	-	-	-	-	9	10	8
2.	Zingiberaceae *Elettaria cardamomum*	Fruits	I	8	9	8	-	-	-	-	-	-	-	-	-	11	9	8	-
			II	11	12	9	17	9	11	8	12	-	-	-	8	12	-	-	11
			III	10	12	14	8	9	16	13	8	8	10	9	13	17	18	16	13
			IV	9	11	10	8	8	9	-	-	-	-	-	9	17	9	11	12
3.	Lauraceae *Cinnamomum zeylanicum*	Stem Bark	I	9	10	8	9	11	10	8	-	-	11	-	9	8	10	11	-
			II	16	12	16	14	15	9	13	-	-	10	9	14	13	12	14	9
			III	14	17	16	13	17	16	18	10	11	10	9	19	19	20	20	9
			IV	10	9	11	8	9	11	10	-	-	-	11	8	9	-	-	10
4.	Piperaceae *Piper longum*	Fruits ,bark	I	10	9	8	11	8	9	11	10	11	9	12	8	9	11	8	10
			II	9	11	8	12	9	11	8	9	11	9	12	10	10	11	9	8
			III	22	20	21	16	20	11	15	22	14	17	15	16	17	22	22	9
			IV	10	11	9	8	12	9	-	-	-	-	-	-	-	12	9	10
5.	Piperaceae *Piper nigrum*	Fruits	I	9	10	11	8	12	-	-	-	-	-	8	10	12	11	9	8
			II	9	8	11	10	9	10	9	11	8	9	11	9	8	10	9	10
			III	17	20	21	17	18	15	13	21	21	21	20	20	11	10	9	8
			IV	10	17	8	11	17	16	11	9	17	16	9	12	9	10	11	-
6.	Zingiberaceae *Zingber officinale*	Rhizome	I	9	10	11	8	10	11	9	8	11	10	9	8	10	11	9	-
			II	12	9	10	11	9	8	12	9	10	11	8	11	12	8	9	18
			III	22	19	18	13	15	16	17	16	17	15	22	15	21	23	21	16
			IV	13	11	10	-	-	-	-	-	9	11	17	11	9	8	9	12

All values are in mm = millimeter

Sa-*Staphylococcus aureus, Sp-Streptococcus pyogenes, Sp*- S. pneumoniae, Ss- S. sanguis, Ss†- S. salivarius, Sm- S. mutans, La- Lactobacillus acidophillus, Ec- E.coli, Pa-Pseudomonas aeruginosa, Se- Staphylococcus epidermidis, St- Salmonella typhi, Ml- Micrococcus luteus, Bm- Bacillus megneterium, Bs- Bacillus subtilis, Pv- Proteus vulgaris, Ca- Candida albicans I-* Petroleum ether, II-Acetone, III-Methanolic, IV-Aqueous

Table 2: Antimicrobial activity of Churnas (mm) with 100 mg/ml of extracts

S. No	Methanolic extract of Churnas	Antimicrobial activity														
		Sa	Sp	Sp*	Ss	Ss†	Sm	La	Ec	Pa	Se	St	Ml	Bm	Bs	Pv	Ca
1.	Trikatu Churna	15	12	11	11	-	13	-	13	-	-	-	-	-	15	-	-
2.	Sitopladi Churna	12	12	12	11	-	11	-	13	-	-	-	-	-	14	-	-

All values are in mm = millimeters

Sa-*Staphylococcus aureus, Sp-Streptococcus pyogenes, Sp*- S. pneumoniae, Ss- S. sanguis, Ss†- S. salivarius, Sm- S. mutans, La- Lactobacillus acidophillus, Ec- E.coli, Pa-Pseudomonas aeruginosa, Se- Staphylococcus epidermidis, St- Salmonella typhi, Ml- Micrococcus luteus, Bm- Bacillus megneterium, Bs- Bacillus subtilis, Pv- Proteus vulgaris, Ca- Candida albicans* I-Petroleum ether, II-Acetone, III-Methanolic, IV-Aqueous

Table 3:- Showing MIC values against bacteria by two-fold serial dilution method

S. No	Plants (mg/ml)	Bacteria			
		B. subtilis	***E.coli***	***S. pneumoniae***	***S. pyogenes***
1	*P. longum*	0.0781	0.0391	0.0781	0.1593
2	*Z. officinales*	0.0391	0.3125	0.1593	0.1593

All values are in mg/ml

The results of the present study were encouraging and all the six plants and churnas appeared to contain substances that have antimicrobial properties. This correlates with the observations of previous workers made in different parts of the world (El Astal *et al.*, 2005, Ahmad *et al*., 1999, Okemo *et al.*, 2001).

All extracts showed the exhibited inhibitory activity against the pathogens that are not conventially incriminated with the diseases. The methanolic and aqueous extracts showed broad spectrum antimicrobial effects against tested pathogens because more organic components were leached in it. The antibacterial activities of the plants are particularly note worthy, considering the importance of these organisms in dental, respiratory and urinary tract infections. *Staphylococcus aureus* and *Streptococcus pyogenes* are more susceptible to lot of extracts obtained from the studied plants and churnas as also reported by Madamombe and Afotayan, (2003). MIC values of both the extracts showed that *B. subtilis* is the most susceptible bacteria among all tested organisms. Our findings have

validated the use of these medicinal plants and formulations for the treatment of respiratory tract infections as well as dental and urinary tract infections.

Further work is needed to locate the active principle from the various extracts and their phyto-pharmaceutical studies. Research into the effect of local medicinal plants is expected to boost the use of these plants in the therapy against diseases caused by the test microorganisms. It is possible that better therapy for microbial diseases can be found in the fruits, bark, leaves etc. of the plants.

The traditional therapeutic indication of the plant studied appears to have a fairly good degree of correlation with their specific antibacterial activity.

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Adaptive modifications in some hillstream fishes of Betul district

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Abstract

Fishes form the largest group of vertebrates and they serve as best food supplement. It contains protein, fat, vitamins and minerals. District Betul in Madhya Pradesh is situated at the centre of India. It has dense forest and many streams arise from hills. Tapti river and Machna river are originated from this district and Tawa river originated from the neighbouring district Chhindwara enters in Betul district. These rivers are inhabited by many fishes including hill stream fishes. The present study intends to identify the main hill stream fishes of Betul district and to observe their structural modification.

Keywords: *Adaptive modification, Chikhlar stream, Hillstream fishes*

Introduction

A number of fishes of sluggish water have migrated to hill streams and rivers and developed some special permanent modification to live there. Their modifications are integumental and helps in anchoring. Various structural modification found in hill stream fishes have been studied in part of twentieth century by Hora (1922, 1930). Enough literature exists on the hill stream fishes and adaptive modification in fishes of India (Singh *et al.*, 1983), but a few reports are available from central India. Studies on the biology and conservation of hill stream fishes especially Mahseer (Tor) have also been made by Kulkarni (1971), Tripathi (1978), Pathani (1977 and 1982) and Nautiyal (1984). The present paper is intended to report the-presence of some special hill stream fishes in Betul district and hill stream adaptation found in them. The three hill stream collecting centers during the present investigation are located in the Betul district of Madhya Pradesh. This district is situated approximately 21° 22' to 22° 24' N latitude and 77° 04' to 78° 33' E longitude and at an altitude of about 653 m above m.s.l. It has dense forest and many streams arise from hills. Three sampling centers were selected namely Tapti ghat (Tapti river), Chikhlar stream (Machna river) and Satpura dam (Tawa river). All rivers except Tawa originate from this district.

Materials and Method

A survey of hill stream fishes was made in Tapti ghat (Tapti river), Chikhlar stream (machna river) and Satpura dam (Tawa river) of Betul district, during a period of one year from Feb. 2007 to Jan. 2008 (Table 1 and 2). Fishes were collected from these spots and were fixed in 5% formalin and identified according to Day (1978) and Srivastava (1980).

Results and Discussion

In the present study a total of 9 species belonging to 2 families were identified. These include *Barilius bendelisis*, *Garra gotyla gotyla*, *Labeo gonius*, *Tor tor*, *Lepidocephalichthys balgera L. guntea*, *Nemacheilus beavani*, *N. botia and N. denisonii* (Table 2).

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Table 1: Sampling Station

S. No.	Collecting Centre	Rivers
1	Tapti Ghat	Tapti River
2	Chikhlar Stream	Machna River
3	Satpuna Dam	Tawa River

Table 2: Record of fishes collected from different collection centre

Name of Fishes	Name of Collection Centre		
	Tapti Ghat	**Chikhlar Stream**	**Satpura Dam**
Order:- Cypriniformes			
Family:- Cyprinidae			
1. *Barilius bendelisis* (Ham.)	+	-	+
2. *Garra gotyla gotyla* (Gray)	+	+	-
3. *Labeo gonius* (Ham.)	-	-	+
4. *Tor tor* (Ham.)	+	-	+
Family- Cobitidae	+	+	-
5. *Lepidocephalichthys balgara* (Gunther)	+	+	+
6. *L.guntea* (Ham)	-	+	+
7. *Nemacl1eilus beavani* (Gunther)	+	-	-
8. *N. botia* (Ham)			
9. *N.denisonii* (Day)			

All these fishes possess adaptive modifications in their integument. Some hill stream adaptive modification found in these fishes are as follows: -

1. *Barilius bendelisis* and *Labeo gonius*:
Their body shows cylindrical shape with strong muscular tail. They are found in rapidly flowing stream and rivers.

2. *Tor tor* : The body is cylindrical and has a powerful muscular tail. Posterior lip is hypertrophied and it acts as adhesive organ. This species also found in stream and rivers.

3. *Nemacheilus* sp.: In *Nemacheilus beavani, N. botia, N. denisonii,* the body is elongated. The lips are divided in the middle and are swollen, so that they form a ring like sucker and pulled outward. Paired fins are less horizontally placed and they can easily adhere to bottom of torrential streams. *Nemacheilus sp.* is also found in pools and ditches.

4. *Garra gotyla gotyla*: This species possess many adaptive modifications. The highly muscular upper lip is fringed and overhangs the mouth. In the form of a disc behind mouth is found in *Garra gotyla gotyla* and act as adhesive organ. The paired fins are big, muscular and horizontally placed. Their bases are provided with cushion-like thick muscular pads.

5. *Lepidocephalichthys* sp.: In *Lepido-cephalichthys balgara* and *L. guntea* the body is elongated and slightly compressed. Barbels are six

in number. Dorsal fin is short and commencing opposite of the pelvic fin. Caudal fin is truncate.

The fish fauna of India consists of many species. (Singh *et al*, 1983). Most of the hill stream fishes possess modified structural organization of integument. Day (1978) also documented adaptive modification in these fishes. Hora (1922 and 1930) described a large number of hill stream fishes with respect to their adaptive modification and evolutionary point of view.Khanna and Bhutiani (2004) studied the fish and their ecology of River Ganga. In various hill stream fishes like *Garra annandalei*, *Glyptothorax madraspatnum*, *Garra lamta*, *Glyptothorax telchilta*, *G. mullya* and *Pseudecheneis sulcatus* presence of adhesive apparatus has been studied by Rauther (1928), Bhatia (1950) Saxena (1959) and Khanna *et al.* (2009).

To increase the population of these hill stream fishes, it is vital that the availability of water throughout the year in streams should be made and their habitat, community and food chain be preserved. More studies should be carried out to identify the hill stream fishes found in this district.

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Preliminary pharmacognostic and phytochemical investigation of *Ensete superbum* (Roxb.) Cheesman (Musaceae)

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Abstract

A pharmacognostic study of *Ensete superbum* (roxb.) Cheesman was performed on sample collected from dense forests of Sirwel hills, district Khargone (M.P.). Evaluation of the crude drug was conducted according to the World Health Organization (WHO) guidelines for herbal standardization. Microscopic examination of the powdered drug revealed the presence of parenchyma and fiber cells of the medullary ray. The contents of foreign matter, acid-insoluble ash and total ash determined were 0.12%, 3.04% and 15.0% respectively, whereas the ethanol-soluble extractive and water-soluble extractive values were found to be 4.08% and 5.68 %. Preliminary phytochemical screening of *Ensete superbum* (roxb.) Cheesman was also studied. First of all plant was undergone extraction process by using various solvents like Hexane, Benzene, Ethanol, water respectively. After the extraction process phytochemical screening was carried out for identification of various active constituents in which it was found that the Ethanol extract gave more constituents than other which are carbohydrates, alkaloids, phenolic compounds and terpenoids.

Keywords: *Ensete superbum,Ethanol, Hexane, Medullary ray,Parenchyma, WHO*

Introduction

Plants have been used as folk remedies and for centuries, the ethno-botanical literature has described the usage of plant extracts, infusions and powders for diseases now known to be of viral origin. The ethnopharmacology provides an alternative approach for the discovery of antimicrobial agents, namely the study of medicinal plants with a history of traditional use as a potential source of substances with significant pharmacological and biological activities (Ambasta,1992). Herbal preparations are more frequently used to prevent and treat several diseases in world. In developing countries, the World Health Organization (WHO) estimates that about 80% of the population relies on plant based preparations used in their traditional medicinal system and as the basic needs for human primary health care (WHO, 2000). In recent years, there is a need to study the plants having different values in their medicinal properties. Therefore, several medicinal plants have been evaluated for possible activity and potential cure from a variety of ailments (Evans, 1996).

The traditional methods, especially the use of medicinal plants, still play a vital role to cover the basic health needs in the developing countries too and moreover the use of herbal remedies has increased in the developed countries in the last decades. In this connection, plants continue to be a rich source of therapeutic agents. The remarkable contribution of plants to the drug industry was possible because of the large number of phytochemical and biological studies all over the world. The Indian subcontinent is endowed with rich and diverse local health tradition, which is equally matched with rich and diverse plant genetic source. A detailed investigation and documentation of plants used in local health traditions and ethno-pharmacological evaluation to

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verify their efficacy and safety can lead to the development of invaluable herbal drugs or isolation of compounds of therapeutic value.

Materials and Method

Materials: Sample of *Ensete superbum* (Roxb.) Chessmen were collected from forest of Sirwel.

Method: Macroscopic and microscopic properties, and constant numbers due to quality of *Ensete superbum* Roxb. were examined following the standard methods of the WHO (2000).

Macroscopic and microscopic examination-Each sample of *Ensete superbum* Roxb.was identified. For microscopic examination, the powdered sample was inspected under a microscope equipped with a micrometer.

Determination of foreign matter-The sample was spread in a thin layer and the pieces of foreign matter were sorted out by visual inspection. All portions of the foreign matter were weighed.

Determination of total ash-The ground sample was placed in a previously ignited and tared crucible. The sample was ignited by gradually increasing the temperature until white ash was obtained. The ash was then cooled in a desiccator and weighed without delay.

Determination of acid-insoluble ash-To the crucible containing the total ash was added hydrochloric acid. The crucible was then covered with a watch-glass, and the mixture was boiled gently, watch-glass was rinsed with hot water, and this liquid was added into the crucible, insoluble matter was collected on ashless filter-paper, washed and to constant weight. The residue was weighed without delay.

Determination of ethanol-soluble extractive-The ground sample was macerated with absolute ethanol. The filtrate was evaporated to dryness and then dried with heat to constant weight.

Determination of water-soluble extractive- The ground sample was macerated with distilled water in a closed conical flask. The extract was filtered, and the filtrate was evaporated to dryness.

Plant Extract Preparation- The collected plants were dried and powdered. These powders were then subjected to successive extractions by various solvents of gradual increasing polarities.

Preliminary Phytochemical and Pharma cognostical Screening- The preliminary phytochemical studies were carried out following the methods of Raman (2006) and Kokate *et al.* (2003). The plant extracts were screened for the presence of alkaloids, proteins, free amino acids, anthraquinones glycosides, flavonoids, tannins, phenolic compounds, carbohydrates, saponins, phytosterol and triterpenes. The pharma-cognostical investigations were conducted in terms of flourescence analysis. Physico-chemical parameters such as total ash, water-soluble ash, acid insoluble ash and loss on drying were determined.

Results and Discussion

Preliminary Phytochemical Screening- The results of preliminary phytochemical screening of hexane, benzene, ethanol and water extracts of *Ensete superbum* (Roxb.) Chessmen are presented in Table 1. While the results of Preliminary Pharmacognostic studies are shown in Table 2.The pharmacognostic investigations on physico chemical characteristics and fluorescence analysis shows that authentic botanical of this crude drug prevents adulteration, substitution and has a crucial role in standardization of crude drugs. The preliminary phytochemical screening of the leaves of *Ensete superbum* (Roxb.) Chessman indicates the presence of secondary metabolities, having an essential role in medicine. Overall, the present study indicates phytochemical and pharma-cognostical investigation on *Ensete superbum* (Roxb.) Chessman. This study paves the way for further attention/research to identify the active compounds responsible for the plant biological activity.

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Table1: Phytochemical screening of hexane, benzene, ethanol and water extracts of *Ensete superbum* (Roxb.)

Data for Phytochemical Screening																	
	Leaf				Root				Rhizome				Pseudostem				Plant Juice
Constituents	**Hexane**	**Benzene**	**Alcohol**	**Water**	**Hexane**	**Benzene**	**Alcohol**	**Water**	**Hexane**	**Benzene**	**Alcohol**	**Water**	**Hexane**	**Benzene**	**Alcohol**	**Water**	
Alkaloid	+	+	+	+	+	+	+	+	+	+	+	±	+	±	+	-	+
Carbohydrate	-	+	+	+	±	±	+	+	±	-	±	±	-	-	+	+	+
Glycoside	±	±	-	±	±	-	-	-	-	-	-	-	±	±	+	±	±
Saponines	-	+	+	+	+	+	+	+	+	+	-	+	-	-	+	+	+
Proteins	±	+	±	±	±	±	+	±	+	-	±	+	±	±	±	±	±
Amino acid	-	-	+	+	-	-	-	+	-	-	-	+	+	-	+	+	+
Steroid	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Fixed oils & fats	+	+	±	-	±	±	±	±	±	±	-	±	-	±	±	±	-
Phenolic Compounds	-	+	±	±	+	+	+	+	+	-	-	+	+	+	+	-	+
Gum and mucilage	-	-	-	-	+	+	+	+	+	+	-	+	+	-	-	+	-

(±) : Partial presence, (+) : Present, (-) : Absent

Table 2: Data Table for Pharmacognostic study

S. No.	Evaluated Parameter	Yield (%)
1.	Foreign matter	0.12
2.	Total Ash value	15
3.	Acid insoluble ash value	3.04
4.	Alcohol soluble extractive value	4.08
5.	Water soluble extractive value	5.68

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Antifungal and antibacterial activities of crude withanolides extract from the roots of *Withania somnifera* (L.) Dunal (Ashwagandha)

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Abstract

Ashwagandha [*Withania somnifera* (L.) Dunal] is an important medicinal plant and its medicinal properties have been attributed to various classes of withanolide compounds. In the present study, we evaluated antifungal and antibacterial activities of withanolide extracted from roots of ashwagandha, against five pathogenic, fungi and bacteria. The minimal inhibitory concentration (MIC) of withanolides against two fungi, *F. oxysporum* and *A. brassica* were observed to be 4826.25 and 4474.22 ppm respectively. Antibacterial activity of withanolide extract was tested against three bacteria, *E. coli*¸ *Pseudomonas solanacearum* and *Pseudomonas vulgaris*. The maximum zone of inhibition at 4000 ppm of withanolide extract against *E. coli, P. solanacearum* and *P.vulgaris* were observed to be 8.7mm, 12.1mm and 12.5mm respectively. Thus withanolides extract was found to be the inhibitor of pathogenic fungi and bacteria.

Keywords: *Antifungal activity , Antibacterial activity, Ashwagandha, Withanolides*

Introduction

Withania somnifera (L.) Dunal of Solanaceae, is commonly known as Ashwagandha. It is a shrubby bush held in high repute in traditional Indian medicine recommended in Ayurveda (Dash and Junins, 1983).It contains pharmacologically active compounds such as with anolides and alkaloids which attribute to its anti-cancerous, antioxidant, antibacterial, antifungal, aphrodisiac activities (Singh and Kumar, 1998). Withanolides are basically steroidal lactones and various types have been isolated (Kazutoshi and Umehara, 1999). The withanolides are classified according to their structural skeleton (Ray and Gupta, 1994) and the structural variation is responsible for the wide array of pharmacological activities. Withaferin–A, a withanolide, isolated from *Withania somnifera* posses antibiotic activity such as antibacterial activity against acid fast bacilli and gram positive microorganisms (Atta-ur-Rahman and Chaudhary ,1993). Beta epoxywithanolide-I and Beta hydroxywithanolide-K isolated from *Withania coagulance* were found to be active against a number of potential pathogenic fungi (Choudhary *et al.,* 1995). In the present investigation withanolides extracted from the roots of *Withania somnifera* were tested against five pathogenic fungi and bacteria.

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Materials and Method

Pure cultures of various fungi and bacteria were obtained from College of Agriculture and C.B.S.H., G.B.P.U.A.&T., Pantnagar. The cultures were maintained throughout the experiments. The withanolide isolation was based on the method of Gupta *et al.* (1996) with slight modification**.** For bioactivity analysis 100 gm root powder was extracted twice with 500ml methanol. The extract was filtered and evaporated. The extract thus obtained was defatted with n-hexane and then

extracted with 1% sulphuric acid, basified with ammonia. The sulphuric acid insoluble fraction was extracted with diethyl ether. The ether was evaporated and crude withanolide was dissolved in chloroform for checking the bioactivity.To check the bioactivity 10,000 ppm of crude withanolides were prepared. Further dilutions were made from these stock solutions. Poisoned food technique for fungi (Finhold, 1951) and paper disc zone inhibition technique for bacteria (Thornberrry, 1950) were used to screen the withanolide extracts *in vitro*. List of bacteria and fungi used in present experiment are given in Table 1.

For fungi plates were inoculated at the centre by a 5 mm disc of respective fungi, placed with a sterilized needle from the edge of a seven day old fungus culture maintained on PDA medium. For each concentration of withanolide three replicates were taken. Discs were punched out with the help of a 5 mm sterilized steel cork-borer and incubated at 28 ± 0.2^0C and after 7 days diameters of fungal growth were measured from the direction by Vernier Caliper scale. The percent inhibition was determined with the help of mean colony diameter and calculated by using following formulae:

$$\textbf{Percentage inhibition} = \frac{\textbf{X - Y}}{\textbf{X}} \times \textbf{100}$$

Where,

X = Colony diameter in control

Y = Colony diameter in treated medium

For bacteria withanolide extract was suspended in water or suitable organic solvent. Filter paper disc of 10 mm diameter were first dipped in the test liquid and dried in air. The dried disc was then placed on nutrient agar plates. The plates were kept in incubator at 28 ± 0.2^0C. After incubation the inhibition zones about the test organisms were measured.

Results and Discussion

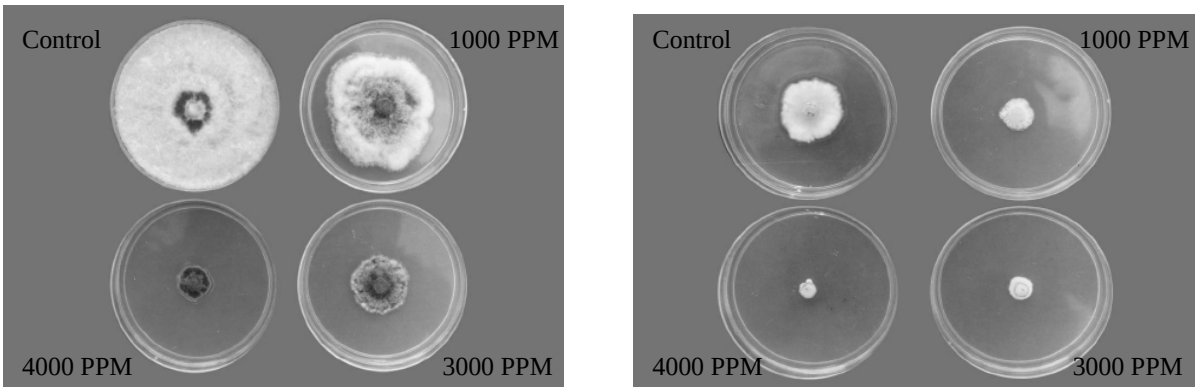
Three concentrations of withanolides, 1000, 3000 and 4000 ppm were used for testing the activity against two pathogenic fungi (Table 2). The minimal inhibitory concentration (MIC) of withanolide against *F. oxysporum* was higher than *A. brassica* with MIC of 4826.25 and 4474.22 ppm respectively. The growth level of both fungi decreased with increase in withanolide concentration. At 4000 ppm of crude withanolide, mean percent inhibition was found to be 95.66 in case of *F. oxysporum* while 86.33 in *A. brassica*. At lowest concentration (1000ppm), withanolides were more effective in *F. oxysporum* with mean percent inhibition of 62.33 as compared to *A brassica* with 20.33 only. At 3000 ppm of withanolides, inhibition was found to be similar in both fungi with mean percent inhibition of 74.66 in case of *F. oxysporum* and 71.33 in *A. brassica* The inhibitory activity was illustrated in Fig.1. The present findings might be supported by the work of Ramteke *et al*. (2003) while studying the antifungal activity of *W. somnifera* root extract against *Fusarium solani*. They found that the extract had higher inhibitory effect on the growth of *F.solani* than clotrimaxole (antifungal).

Table 1: List of Bacteria and Fungi used

S No.	Bacteria & Fungi	Common host	Diseases
1.	*E. coli*	Animals	Diarrhoea
2.	*P. solanacearum*	Potato	Bacterial brown rot of potato
3.	*P. syringae*	Pea, Tomato	Bacterial spot of pea, Bacterial speck of tomato
4.	*A. brassica*	mustard	Alternaria blight of rape seed & mustard
5.	*F. oxysporum*	Tomato, chilli	Damping off of seedlings.

Table 2: Antifungal activity of withanolide extract against pathogenic fungi

Sl. No.	Fungus	Conc. (ppm)	Percent inhibition			Mean %	MIC (ppm)
			R_1	R_2	R_3		
		4000	86	86	87	86.33	
1.	*Alternaria brassica*	3000	72	71	71	71.33	4474.22
		1000	21	20	20	20.33	
		4000	95	96	96	95.66	
2.	*Fusarium oxysporum*	3000	74	75	75	74.66	4826.25
		1000	62	62	63	62.33	



A **B**

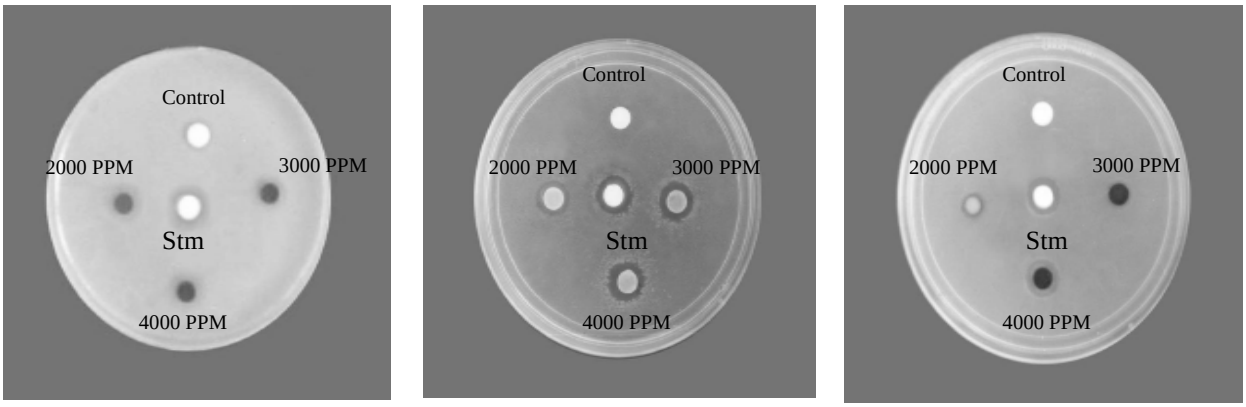
Fig. 1: Antifungal activity of withanolide extract of Ashwagandha against (A) *Alternaria brassica* (B) *Fusarium oxysporum*

Antibacterial activity observed against *P. vulgaris* was found to be maximum among the tested bacteria with zone of inhibition values 8.6, 10.5, 12.5 mm at 2000, 3000 and 4000 ppm of withanolide extract, respectively (Table 3). The maximum zone of inhibition at 4000 ppm of extract in *E. coli*, *P. solanacearum* and *P.vulgaris* were found to be 8.7 mm, 12.1mm and 12.5mm respectively. Withanolides extract was least effective at 2000 ppm in *E. coli* followed by *P. solanacearum* with mean zone of inhibition of 4.8mm and 6.1mm as compared to *P. vulgaris*, 8.6mm. Streptomycin control of 100 ppm was most effective in *P. solanacearum* with zone of inhibition of 12.6 followed by *P. vulgaris* and *E. coli* with 11mm and 8.8mm. In all the tested bacteria zone of inhibition increased with increase in the concentration of crude withanolide extract. The antibacterial activity of withanolides was described in Fig. 2. The present findings are supported by the work of Arora *et al*. (2004) while evaluating the antibacterial/synergistic activity of withanolide extract by agar plate disc-diffusion assay against *S.typhimurium* and *E. coli*. They observed that methanol/hexane extract of roots of Ashwagandha was found to have potent antibacterial activity. Thus, present investigation revealed that withanolide extracts from the roots of *W. somnifera* possess antifungal and anti bacterial activities against pathogenic fungi and bacteria.

Table 3: Antibacterial activity of withanolide extract against various bacteria

S. No.	Bacteria	Conc. (ppm)	Zone of inhibition			Mean
			R_1	R_2	R_3	
1.	*E. coli*	100[C]	9.0	8.5	9.0	8.8
		2000	5.0	5	4.5	4.8
		3000	6.0	5.5	6.0	5.8
		4000	9.0	9.0	8.0	8.7
2.	*P. vulgaris*	100[C]	11.0	11.5	10.5	11.0
		2000	9.0	8.5	8.5	8.6
		3000	11.0	10.0	10.5	10.5
		4000	12.0	12.5	13.0	12.5
3.	*P. solanacearum*	100[C]	13.0	12.5	12.5	12.6
		2000	6.0	6.0	6.5	6.1
		3000	7.0	7.5	7.0	7.2
		4000	12.0	12.0	12.5	12.1

[C] **represent streptomycin (stm) control.**



A **B** **C**

Fig. 2: Antibacterial activity of withanolide extract of Ashwagandha against:
(A) *E. coli*
(B) *P. vulgaris*
(C) *P. solanacearum*

Stm: Streptomycin control

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Histopathological studies on intestine of *Columba livia* Gmellin, 1789 infected with cestode parasites

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Abstract

In the present study an attempt has been made to visualize the histopathological changes that are caused to the intestine of avian host *Columba livia,* Gmellin, 1789 due to infestation of cestode parasite *Cotugnia aurangabadensis* (Shinde,1969) and *Paruterina* sp. Histopathological studies have been made to asses the extent of damage caused by the parasites. It includes destruction and extrusion of intestinal villi, inflammatory fibrosis due to cysts. The scolex of *Cotugnia aurangabadensis* is non-penetrative type while *Paruterina sp*. is penetrative type. It was found that the extent of damage is proportional to the penetration of scolex. Cysts were found encircled with connective tissue sheath deep in the submucosa.

Keywords: *Cotugnia aurangabadensis, Crypts of Lieberkhun, Histopathology*

Introduction

In Cyclophyllidea, many genera like *Dipyllidium canium, Cotugnia bhaleraoi, Raillietina R. tetragona* and *Echinococcus granulossus* are studied for histopathology and host-parasite relationships. Some scolexes of these genera were penetrative type and others were non-penetrative type (Shinde and Mitra, 1980). In penetrative type attachment is very intimate and Crypts of Lieberkhun are invaded while in non-penetrative type it superficially attached to mucosal epithelium of intestinal villi. Important contributions in this direction were made by Tuli *et al*., 1992; Mitra and Shinde, 1981; Lakshma Reddy *et al*., 2006; Banarjee *et al*., 2007.

In the present study an attempt has been made to visualize the histopathological changes that are caused to the intestine of avian host *Columba livia,* Gmellin, 1789 due to infestation of cestode parasite *Cotugnia aurangabadensis* (Shinde, 1969) and *Paruterina* sp.

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Materials and Method

Intestines of host bird *Columba livia* were examined and observed to see the degree of infection. The worms which were attached to the intestine were kept intact and small pieces of intestine were fixed in Bouin's fixative and then it was washed thoroughly. These were then dehydrated through ascending alcohol grades, cleared in xylene and embedded in paraffin wax (M.P. 52°-54°C). The transverse and longitudinal sections were cut on rotary microtome and eosin was used as counter stain.

Results and Discussion

The result of the study is given in Fig. 1- Fig. 6. The changes that occur in the intestine of host are due to mechanical damage and may be due to the release of toxins by the parasites. Intestine is one of the important parts of the alimentary canal concerned with several functions like chemical digestion and absorption of nutrients. The histopathology caused extensive damage to various layers of intestine right from epithelium of mucosa to the muscularis mucosae.The infected intestine of *Columba livia* by *Cotugnia aurangabadensis* showed scolex attached to the intestinal villi through large rostellum (Fig. 2).

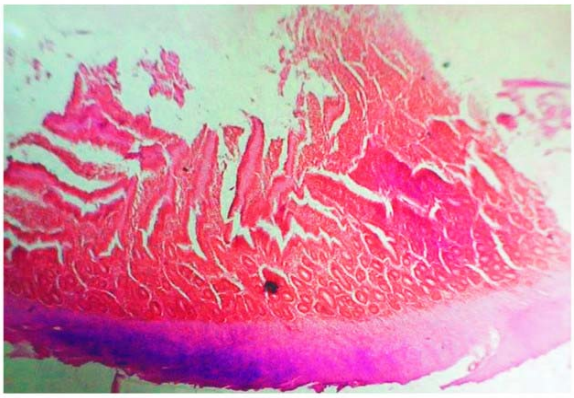

Fig. 1: Non-infected intestine of *Columba livia*

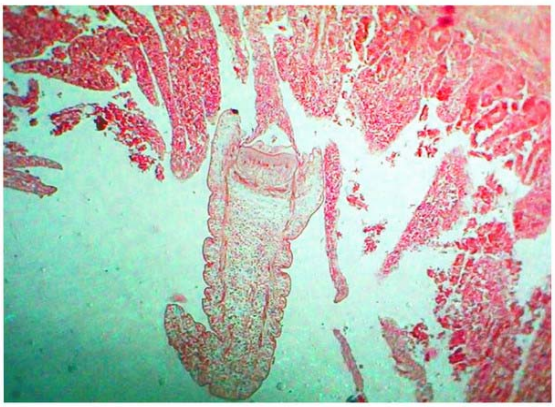

Fig. 2: Scolex of *Cotugnia aurangabadensis* attached to intestinal villi

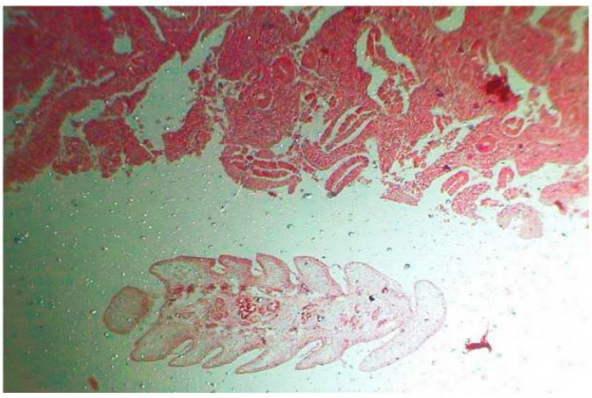

Fig. 3: Mature proglottids of *Cotugnia aurangabadnesis* in lumen of intestine

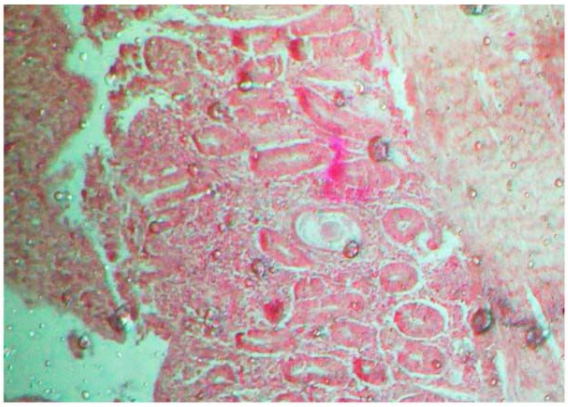

Fig. 4: Cyst of *C. aurangabadensis* in submucosa layer

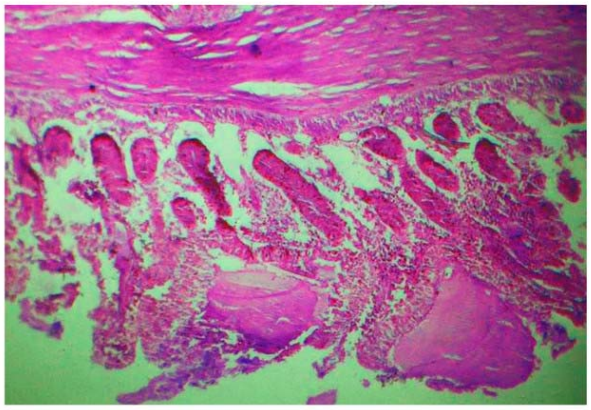

Fig.5: Scolex of *Paruterina shindei* approaching to the crypts of lieberkhun

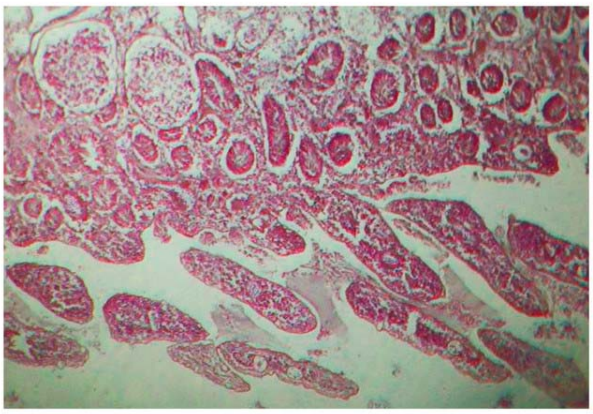

Fig. 6: Cyst of *P.shindei* in submucosa and mature proglottids among intestinal villi of *Columba livia*

It is non-penetrative type of scolex as worm invades only the villi but not the Crypts of Lieberkhun. Mature and gravid proglottids found freely suspended in the lumen of intestine. Cysts found deep in the submucosa, just above the tissue muscularis and encircled with connective sheath.

The infected intestine of blue rock pigeon by *Paruterina* sp. is heavily destroyed, rupturing the villi and reaching deep up to submucosa. It is penetrative type of scolex. Mature proglottids found among the intestinal villi. A pair of cyst shows fibrosis deep in the submucosa. It leads to lesion on the intestine causing pores and bleeding. Gravid segments freely suspended in the lumen of intestine.

Various helminth parasites shows pathological consequences of parasitic effects on birds, cestode parasites influences the avian health, causes morbidity and also mortality which pose a major threat to avian population. However, the extent of damage depends upon depth of penetration of scolex, type and number of cestode parasite and site where they localize in the body of host (Paperna and Zwerner, 1976).

The infected intestines were diseased with swellings blood clot, all along the alimentary canal and bleeding at certain places. The intestine infected with *C. aurangabadensis* is superficial and not invades the Crypts of Lieberkhun, so the worm is non- penetrative type as also described by (Chincholkar and Shinde, 1956; Joshi and Kamalpur, 1971). In the present study tissue reaction and cellular infiltration occurs while according to Mitra and Shinde (1981) it is negligible when parasite attached superficially with non-penetrative type of scolex. It become extreme with extensive granuloma and fibrosis when the scolex is attached to the submucosa or entirely perforates the wall of intestine (McDonough and Gleason 1981).

Histopathology revealed disseminated erosion at the site of attachment, lymphocyte migration and hyperplasia of connective tissue in the submucosa (Ivona, 2006).

Conclusion

Cotugnia aurangabadensis has non-penetrative scolex as attaches superficially to the intestinal villi but causes fibrosis, tissue reaction and cellular infiltration. This interrelation of the parasite with the host results in the survival of the parasite and a slight damage to the host intestine as the parasite is non-penetrative type.

The *Paruterina* sp. are penetrative type and it pierces through crypts of Lieberkhun, mucosa and up to the submucosa layer. It pose a serious threat to the birds. However, the extent of damage or pathogenic conditions depends on number of invasive parasites and the site where they localize in the host body.

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Potential importance of Cyanophytes for sustainable development and exploitation in West Nimar of M.P., India

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Abstract

The present paper deals with aquatic biodiversity of Cyanophytes at Khargone, Madhya Pradesh (India). During the course of study a total of 26 algal taxa belonging to 16 genera are reported in the water samples collected from various ponds and reservoirs.

Keywords: *Blue green algae, Cyanobacteria, Fresh water algae, Myxophyceae*

Introduction

Biodiversity is the variety and variability of organisms present on planet earth. Variation is one of the features in the process of evolution, which is occurring continuously in nature. It is the biodiversity that provides the basic resources for sustaining human race. Today in India, we are loosing our biodiversity at a greater rate, the reasons being the overpopulation, deforestation and pollution. Due to this about 55 percent of Indian fresh water species are threatened. Besides this a large number of plant and animal species are on the way of extinction. India is facing an alarming danger to the loss of aquatic biodiversity. Therefore it becomes essential to conserve these species from extinction and there is no option except to develop research strategies and public policies, which can help us in conserving the aquatic biodiversity.Various workers have contributed valuable information on aquatic biodiversity of India (Pandey and Purushothaman, 2005; Ahmed and Siddiqui,1990; Bilgrami and Munshi, 1979).The present study has been focused upon the algal communities in various ponds and reservoirs situated in and around Khargone.

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Materials and Method

The water samples were collected on monthly basis from Virla reservoir during the year 2007-08. The water samples were then analysed for various physico-chemical parameters following the standard methods as suggested by APHA (1998), Khanna and Bhutiani (2004) and Trivedi and Goel (1986). Identification of blue green algae was done with the help of standard literature (Smith,1950; Desikachary, 1959; Prescott, 1969 and Mahajan, 2005).The algal samples are deposited in the Botany Department of Govt. P.G. College, Khargone for future record.

Results and Discussion

The results of various physico-chemical parameters of Virla reservoir is given in Table 1 while the list of different species of cyanophytes observed during course of study is given in Table 2. From Table 2 it is revealed that 26 members of Cyanophyta (BGA) belonging to 16 genera were reported during course of study. Important taxa are *Anabaena*, *Aphanothece Arthrospira*, *Gloeocapsa*, *Merismopodia*, *Phormidium*, *Oscillatoria*, *Spirulina*, *Lyngbya*, *Microcystis*, *Nostoc*, *Cylindrospermum* and *Rivularia.*

As regards the physico-chemical characteristics of the water samples it has been noted that Blue green algae (BGA) develop in summer (June) due to high temperature as has also been pointed out by Ganapati (1960) and Seenayya (1972). High pH and bicarbonate also favour the blue-green algae. In contrast to this decrease in the concentrations of phosphate and nitrate was observed at the time of gradual disappearance of these groups of algae. The abiotic factors such as temperature, pH, nitrates, phosphates and bicarbonates generally affect the distribution of BGA with the range of chemical tolerance. Hence it can be concluded that chemical status of the water appears to be the most vital factor significantly influencing the general distribution of aquatic flora.

Table 1: Physico-chemical parameters of water sample collected from Virla reservoir of Khargone

S.No.	Parameters	Summer	Monsoon	Winter	Average
I	**Physical:**				
1.	Temperature (^{O}C)	22	20	17	19.66
2.	Turbidity (J.T.U)	200	350	100	216.66
3.	Conductivity(μmhos/cm)	0.41	0.36	0.33	0.36
II	**Chemical:**				
4	pH	8.30	7.50	7.20	7.66
5	Chlorides (mg/l)	39.76	45.00	36.50	40.42
6	Nitrates (mg/l)	0.14	0.33	0.25	0.24
7	Phosphates (mg/l)	0.22	0.35	0.26	0.27
8	Bicarbonates (mg/l)	158.60	150.00	138.00	148.86
9	Total solids (mg/l)	220.00	275.00	175.00	223.33
10	Total hardness (mg/l)	108.00	135.35	112.00	118.45

Table 2: List of different species of Cyanophytes reported from Khargone

S.No.	Name of species	S.No.	Name of species
1	*Anabaena ambigua*	14	*Johanbaptista* sp.
2	*Anabaena subcylindrica*	15	*Lyngbya lutea*
3	*Anacystis nidulens*	16	*Merismopodia punctata*
4	*Aphanocapsa littorale*	17	*Merismopodia convolute*
5	*Arthrospira massertii*	18	*Microcysris aeruginosa*
6	*Aphanothece microscopica*	19	*Microcystis viridis*
7	*Chroococcus limneticus*	20	*Nostoc linckia*
8	*Chroococcus minutus*	21	*Oscillatoria princes*
9	*Cylindrospermum* sp.	22	*Oscillatoria formosa*
10	*Gloeocapsa rupestris*	23	*Phormidium purpurescens*
11	*Gloeocapsa stegophila*	24	*Rivularia bacearіana*
12	*Gloeotrichia raciborkii*	25	*Spirulina mahajanii*
13	*Gomphospaeria* sp.	26	*Spirulina major*

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A note on *Turnicola* sp. (Ischnocera: Phthiraptera: Insecta) infesting *Turnix suscitator* (Turnicidae)

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Abstract

Ischnoceran louse belonging to genus *Turnicola* were collected from *Turnix suscitator* (Turnicidae) in district Rampur. The morphological features of all the three species recorded from Turnices so far have not been adequately described. Difficulties arising in taxonomic categorization of the specimens of *Turnicola* and preparation of key of genus have been discussed in the paper. The specimens collected during present studies resembled to *T. angustissimus*

Keywords: *Biting louse, Insecta, Ischnocera, Phthiraptera, Turnicola, Turnix louse*

Introduction

Giebel (1866) recorded the ischnoceran louse, *Lipeurus angustissimus* from *Turnix nigricollis* and *L. platyclypeatus* from *Turnix suscitator*. Piaget (1885) recorded *L.nigrolineatus* from *Turnix sylvatica*. However, Clay and Minertzhagen (1938) created the genus *Turnicola* and regarded the aforesaid three ischnoceran species, as member of this genus. Thus, a look on the checklist of Price *et al.* (2003) indicates that the genus *Turnicola* includes only three species (*T. angustissimus*, *T. nigrolineatus* and *T. platyclypeatus*), occurring on Turnices. In India Lakshminarayan (1979) recorded only *T. angustissimus* from *T. suscitator*. According to Clay (1938) genus *Turnicola* is characterized by the presence of vertical bar (passing through the centre) in the pre-antennal region of head, distinct clypeal structure (prolonged inwards across the dorsal surface of head as semilunar suture), large clypeal area with internal band curving towards each other anteriorly (and fusing just posterior to the suture dividing the semicircular anterior portion of head). However, a look on the available literature (indicated in Table 1) suggests that morphological features of the *T. angustissimus* have yet not been adequately described by the authors. Several additional features of the louse, including the chaetotaxy deserved further description. Hence, present report provides further information of morphological features of *T. angustissimus.*

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Materials and Method

Lice were collected from two host bird *Turnix suscitator* (in district Rampur, U.P. India during 2007) were subjected to dehydration (ethanol series), clearing (clove oil) and mounting (Canada Balsam) (Palma, 1978) for light microscopy.

Results and Discussion

The specimens collected from *T. suscitator* largely resemble to *Turnicola angustissimus* in morphological characters. However, following addition features observed in the specimens deserve supplementation. Marginal carina laterally thickened but absent medially. Hyaline margin surrounded by thin, prominent anterior rim. The pre-antennal nodi medium sized and not bulbous. Conus well developed post-antennal nodus medium sized, eyes distinct. Antennae monomorphic, long but three flagellomeres not equal sized. Temple margin rounded laterally but

posterior margin of head straight. The median bar present on head merges with arc shaped ridge occurring below the premarginal carina. Mesothoracic spiracle has migrated forward and lies pleurally close to the posterior margin of the prothorax. Size of abdominal segment Ist is slightly smaller than abdominal segment IInd and bulging on the sides. Abdominal segment Ist and IInd completely separate.Tergopleurites fused medially. Vertical sclerotized plates are present in middle from IV to VII segment in females and from IIIrd to Vth in males. In males, the head is

Table 1: Comparative account of morphological features of three species of *Turnicola* (based on available literature)

Characters	*T. platyclypeatus* (Piaget, 1880)	*T. nigrolineatus* (Piaget, 1885)	*T. angustissimus* (Giebel, 1866)
Head	4 fine hair in front	Bare, rounded in front	Elongate, rounded anterior margin
Trabeculae	Short	Short	Small, pointed
Antenna	Last 3 articles equal sized.	Last article longer than 4th.	Filiform, monomorphic
Clypeus	Separated by suture, constricted on sides, flattened into thin colorless stripes	?	clypeal suture prolonged inwards across dorsal surface of head
Occiput	Hardly retractable	Prominent	
Occipetal Stripes	Straight and curved into a hook at the base	Curved backwards	Occipetal bands distinct.
Prothorax	Trapeziform, bare with marginal stripes	Trapezoid	
Mesothorax	Marked by lateral bulge	?	?
Metathorax	pointed on the abdomen. 2 bristles; a marginal stripes curved into hook	Bare, convex on the abdomen, with pointed angles, with a marginal stripes	Pterothorax short and diverging posteriorly.
Abdomen shape	Lanceolate	Oval, elongated	Narrow, elongated
Ist segment	Bulging on sides	Ist broader than IInd, rounded laterally	Ist short
Ist-VIIth	More or less of same length, Bare, except at the last angles; a small median mark in the shape of ossicle; lateral stripes enter fairly far into anterior segments	IInd with a small rounded mark. IIIrd-VIIth with small median mark in form of ossicle. Broadest at IIIrd and IVth, prominent angles	Pleurites narrow, distinct, with re-entrant heads.
VIIIth-IXth	Shorter, a mark taking shape of pincer. Last one bilobate, fringed with fine hairs.	VIIIth colorless. IXth shorter deeply notched with 2 longitudinal marks	9 rounded, bilobed posteriorly.

conical and carries eight setae in front, in which four setae are present infront of anterior part of frons, one between premarginal carina and post marginal carina , one above the pulvinus and two near the margin of postmarginal carina. Besides, one seta occurs near that lingual sclerite. One ocular seta, one sub-ocular seta and one temporal seta also occur on each half. In females, there are five setae in front of frons instead of eight. Prothorax quadrangular and bare. Posterior margin of pterothorax slightly convex with marginal strips and having two distinct setal pairs on postero-lateral margin. Two large setae present between these pair in both sexes. Abdomen lanceolate. Male chaetotaxy, Tergal setae I, 1; II, 1; II, 2; IV, 2; V, 2; VI, 2; VII, 0; IX, 1. Sternal setae II, 1; III, 1; IV, 1; V, 1; VI 1. Pleural setae III, 1; IV, 1; V, 2; VI, 2; VII, 2; VIII, 2. Post spiracular setae present from IInd to VIIth segments. The semi circular terminal segment bears 5+5 setae (Fig. 1)

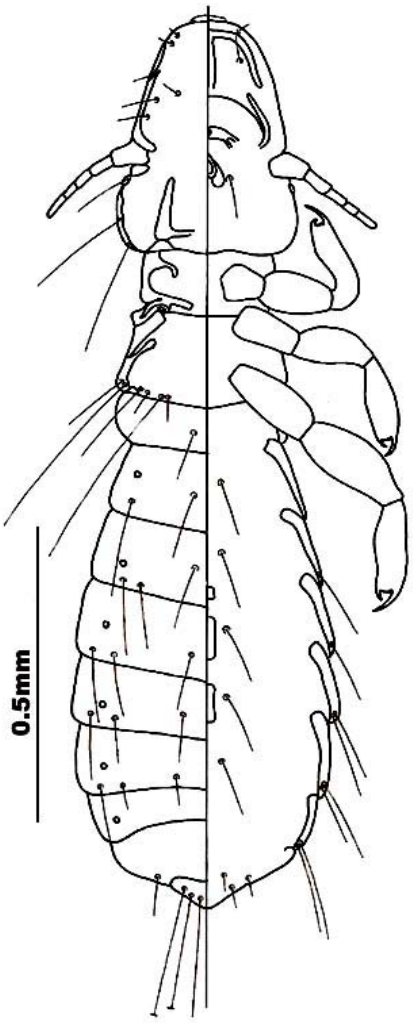

Fig. 1

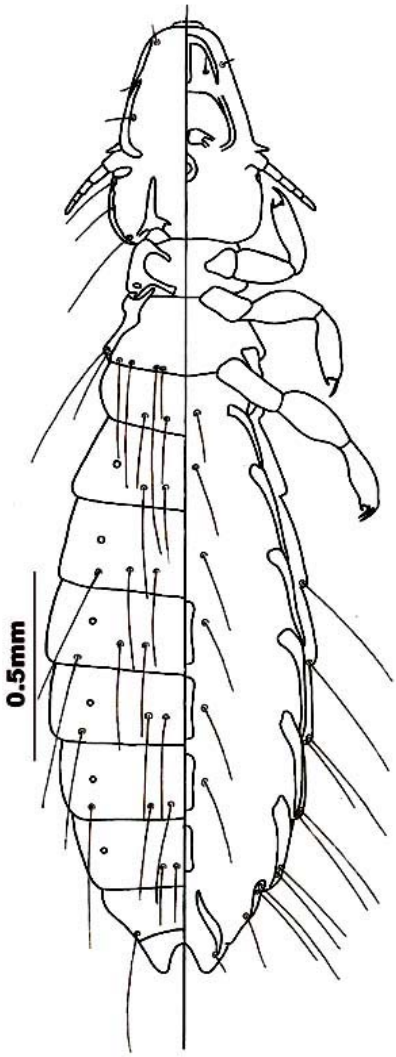

Fig. 2

Fig. 1: ***Turnicola Sp.*** **Adult Male**

Fig. 2: ***Turnicola Sp.*** **Adult Female**

Female chaetotaxy, Tergal setae I, 2; II, 2; III, 2; IV, 2; V, 2; VI, 2; VII, 2; VIII, 1. Sternal setae I, 1; II, 1; III, 1; IV, 1; V, 1; VI, 1; VII, 0; VIII, 0. Pleural setae III, 1; IV, 1; V, 2; VI, 2; VII, 2; VIII, 2. Post spiracular setae present from IIIrd to VIth segments. Terminal segment bilobed, beset with arc shaped chitinized plate. Vulval margin fringed with four fine hair on the posterior side and one on lateral side (Fig. 2). A scrutiny of description of all the three species of *Turnicola* clearly suggested that the authors have given only a brief account of morphological features of respective species. Even the chaetotaxy has not been described in any case. Hence, the available account does not permit comparative study of the three species so as to formulate a key. An examination of the holotype (if available) may indicate that the remaining two species may be synonyms. Nevertheless, the specimens collected during present studies from *T. suscitator* appear to be closely related to *T. angustissimus* and present report provides supplements morphological features of the louse.

Acknowledgement

The authors are thankful to the Principal, Govt. Raza P. G. College, Rampur for laboratory facilities, Dr. Costica Adam for the valuable help in identification of lice. Author's are also thankful to Chief Wild Life Warden of U. P. for permission for catching the birds and to CSIR, New Delhi, India for providing financial support in the form of project No. 37 (1298)/07/EMR II.

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Slow poisoning of Indian reservoirs due to idol immersion: A case study of Laharpur reservoir, Bhopal

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Abstract

Today the developmental activities and the occupancy in the area is exerting pressure on the water body. Surface water contains some degree of contamination and in country like India this increases due to some religious activities. The present study was conducted on Laharpur reservoir, Bhopal to access the pollution load due to such religious activities. During the course of study various parameters like DO, BOD COD, pH, turbidity, alkalinity, Nickel, Manganese, Chromium and Lead were observed during pre-immersion and post immersion of idols. It was found that there is little variation in physico-chemical parameters but the increasing load of heavy metals due to idol immersion is a serious problem for the reservoir.

Keywords: *Biodegradable and non-degradable material, Idol immersion, Siltation, Toxicity, Water contamination*

Introduction

The Laharpur reservoir is at the southwest corner of the Bhopal city (India) and was constructed with an objective to store water for irrigational purposes. At the time of construction it was in the outskirts of Bhopal, but expansion of the township reached beyond the reservoir and now it is well within the settlements. The development activities and the occupancy in the area is exerting pressure on the water body. Surface water almost always contains some degree of contamination and this is also increased by the other religious activities. Added clay results in the siltation of water bodies while addition of biodegradable and non bio-degradable materials contaminate the water quality. Besides polluting the water, they reach humans *via* the food chain, when human consumes these fishes and sea food. In India, festivals like Ganesh Chaturthi, Durga Puja and Diwali are occasions of great joy and celebration and there is tradition of idol immersion on such occasions but unfortunately they also add even greater load to our already overburdened rivers, lakes and seas. Idols are made up of plaster of Paris, lime and cement contain toxic substance, when these are immersed they silt the water bodies. These do not get dissolve or disintegrate fast and on settling on the beds, kills the flora and fauna. Even clay idols are being baked which does not allow it to dissolve in water easily. Moreover, the chemical dyes and colors being used to color them contains poisonous elements like mercury, zinc oxide, chromium and lead which even in low concentration kill aquatic life and have the potential of causing even cancer (Dhote *et al.* 2001). On certain festivals idols were brought at community level and so was less in number. But now each house has one for them. Even at community level, the spirits is more of competitions with one community trying to do another by having bigger and jazzier idols some idols are so big that cranes are required for immersion (Fig. 3). The decoration on the idols has also turned jazzier with our Gods and they are being decorated with non-biodegradable and toxic

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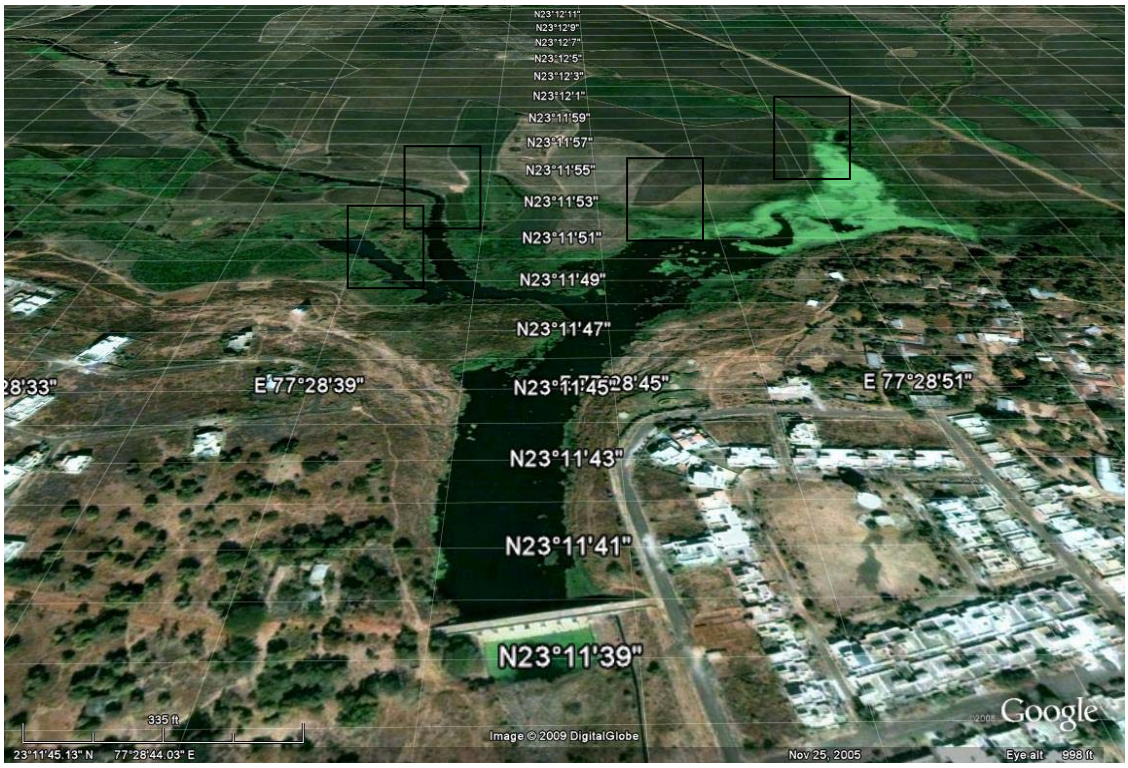
material like thermocol, zari and plastics. Along with the idols we also immerse tones of polybags, flowers, earthen-vessels, clothes, coconuts and other decorations.

All this is adding a greater load to our already overburdened water bodies. Our water is poisoned, killing the innocent aquatic life and affecting our health too. Environmentalist said that materials like plaster of paris do not dissolve easily and reduce the content in the water which in turn results in the death of fishes and other aquatic species Mukherjee (2000) and Mukherjee (2001). Immersion of thousands of idols had added over 5000 liters of paints and hundreds of kilograms of toxic synthetic material into waterbodies. The paint used in idols also contains heavy metals such as Hg, Cr and Pb which contaminate the water further. Information to this effect will go long way in educating people who think that using poisonous and colorful material by such activities they are devoting their emotions to God. Keeping these points in mind the present study is an attempt to know the effect of idol immersion on Laharpur reservoir of Bhopal.



Source: Google Earth

Materials and Method

For the present study the samples were collected from four different places of Laharpur reservoir *i.e.* Anna nagar fed drain, Shahpura fed drain, Barkhera Pathani Nalla and Barkhera Nalla. The samples were collected by automatic sampler and were analyzed for various physico-chemical and heavy metal contents including DO (dissolved oxygen), pH, BOD, COD, turbidity and alkalinity. All the parameters were analyzed following the standard methods of APHA (1998), Khanna and Bhutiani (2004) and Trivedy and Goel (1986).

Results and Discussion

The annual average obtained for various physico-chemical parameters of Laharpur Reservoir are given in Table1 and 2 and Fig. 5 while the annual average for various heavy metals are given in Table 3 and 4 and Fig. 6. Immersion of idols contains toxic substance and silts the water bodies.Added clay results in siltation of water bodies while addition of biodegradable and non-biodegradable material contaminates the water quality (Brown and Ganesh 1991) (Fig.1 and Fig. 2)**.** On immersion of these idols in the reservoir, the water gets contaminated with various heavy

metals present in the paints of idols and a change in chemical load in the water in the water body is expected Dhamji and Jain (1995) and Hosetti *et al.* (1994). Khanna and Bhutiani (2003) observed variations in ecological status of sitapur pond at Haridwar. All this is adding a greater load to our already overburdened water bodies our water is poisoned, killing the innocent aquatic life affecting our health too Khanna and Bhutiani (2005) observed the benthic fauna and its ecology on river Ganga and observed that changes in physico-chemical parameters may result in depletion of benthic fauna.

The immersion practice leads to degradation of water quality and siltation. Parameters like turbidity, BOD and COD became higher on immersion. During course of study the increase in heavy metal concentration is low or we can say that can say that it is tolerable at present, but it is apprehended that continuation of immersion might change this. While the biodegradable materials are the cause of short term deterioration of water quality, the heavy metals are the cause of health hazards in the long run (Agemian and Chau, 1975; Saika *et al.*, 1988; Forstern and Whitman, 1983; APHA, 1998).

Fig.1: Contamination of Laharpur reservoir

Fig.3: Cranes for idol immersion

Fig.2: Small island formed by the wastes

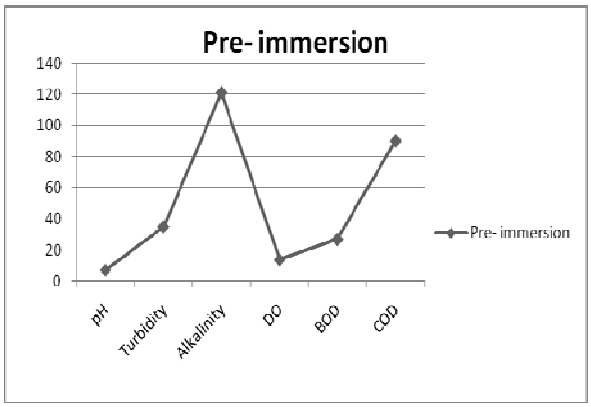
Fig. 4: Idol of 21 feet

Table 1: Impact of Ganesh idol Immersion on water quality of Laharpur Reservoir, Bhopal (India)

Parameters	**Pre- immersion** (average values obtained from surface water and bottom water)	**Post-Immersion**(average values obtained from surface water and bottom water)
pH	7.1-7.3	7.8-8.1
Turbidity (J.T.U.)	30-35	40-45
Alkalinity (mg/l)	89-121	105-136
DO (mg/l)	9-13.9	3.1-12.8
BOD (mg/l)	13.8-26.9	14.1-38.9
COD (mg/l)	25-90	140-200

Table 2: Impact of Durga idol Immersion on water quality Laharpur Reservoir Bhopal (India)

Parameters	**Pre- immersion**	**Post-Immersion**
pH	7.8-8.9	8.1-9.2
Turbidity (J.T.U.)	35-40	28-32
Alkalinity (mg/l)	105-135	98-120
DO (mg/l)	4.6-14.7	3.9-7.6
BOD (mg/l)	13.5-25	13.9-31.9
COD (mg/l)	125-259	196-395



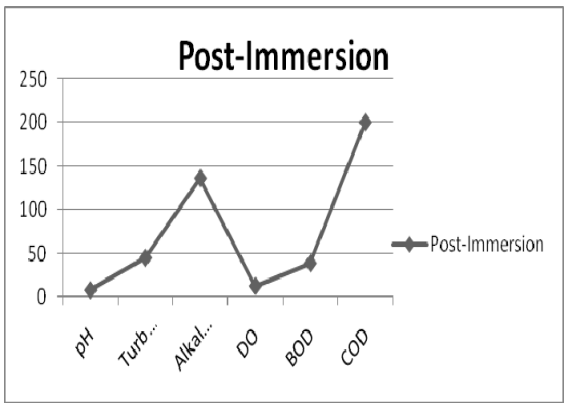


Fig. 5: Graphs showing differences between pre immersion and post immersion in various parameters

Table 3: Heavy metals concentration (µg/l) during Ganesh idol Immersion in Laharpur Reservoir

Heavy metals	**Pre- immersion** (average values obtained from surface water and bottom water)	**Post-Immersion**(average values obtained from surface water and bottom water)
Ni (µg/l)	BDL	3
Mn (µg/l)	115	132
Cr (µg/l)	5	10
Pb (µg/l)	360	504

Table4: Heavy metal concentration (µg/l) during Durga idol Immersion in Laharpur Reservoir

Heavy metals	Pre- immersion	Post-Immersion
Ni (µg/l)	BDL	5
Mn (µg/l)	125	142
Cr (µg/l)	6	9
Pb (µg/l)	310	377

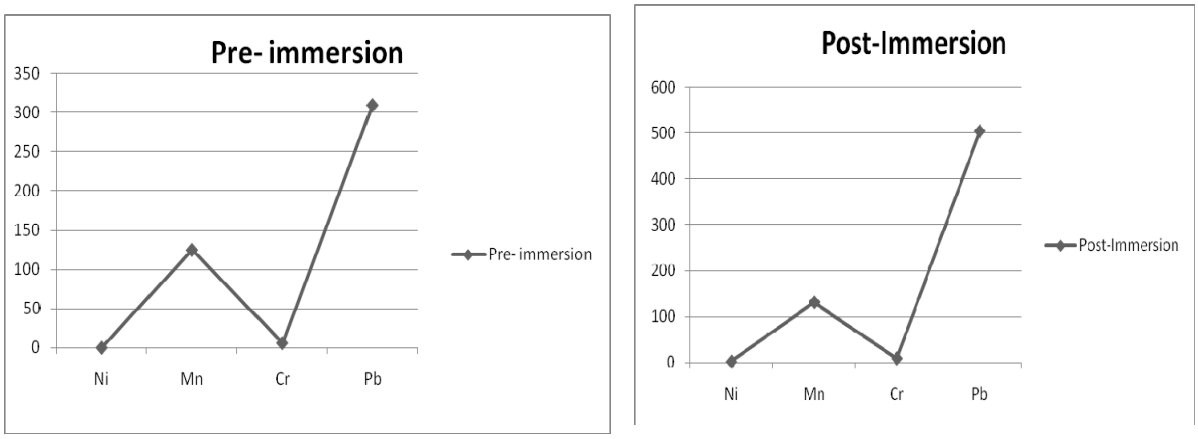


Fig. 6: Graphs showing differences between pre-immersion and post immersion in various heavy metals

Conclusion

Comparison of the results obtained in this study indicates that the average chemical and metallic contamination due to idol immersion activities in the sample collected from the Laharpur reservoir is a major environmental problem. Any alternation in water discharge of pollution would not remain at one location for long time and the contamination what so ever is subsequently is carried away in the flow of water. The immersion practices lead to degradation of water quality and siltation. For other parameters like turbidity, DO, BOD, COD and heavy metals become higher on immersion. Idols have grown in number and size over the year and the urban water bodies are facing on increasing nutrient load. From the above study it may be concluded that there is small variation in physico-chemical parameters of Laharpur reservoir, but the increasing concentration of heavy metals like Cr, Ni, Mn and Pb is an alarming position of slow poisoning of Laharpur reservoir besides this there is also danger to flora and fauna because the idols do not dissolve in water properly. They go to river bed and affect the aquatic life.

Suggestions for proper idol immersion

Going back to traditional festivals

With the help of the following points, we can do lot for our water bodies and can prevent them from being polluted and silted.

1. By making an idol from china clay or mud: Plaster of paris does not dissolve easily in water hence the idol float in water and after some time it settles at the bottom causing siltation of the reservoir. Mixing of plaster of paris in water pollutes the reservoir and can have an adverse effect on the health of living beings. Hence it is appropriate to use an idol made up of mud.

2. Idol should not be huge: Now a days the idols of 11, 21, 51 feet are made which requires iron rods, bamboos etc. to insert them for support which again contributes in polluting the water body. Such a heavy amount of the clay immersion with above supporting substancs (iron rod, bamboo *etc*) also increases the base level of the water body ultimately leads in decreasing the capacity of the reservoir in containing water.

3. Color of the idol: An idol should be made with natural color which looks more appealing than one made with artificial colors.

4. Return to Eco-Visarjan: Certain human friendly suggestions are there as following with which we can celebrate our festivals.

I. If idols have to be immersed, make sure that they are made of unbaked mud or clay.
II. Do not buy idols painted with chemical color or those having non-biodegradable material (thermocol, plastic *etc.*) as decoration.
III. Smaller idols can be immersed in clean water in vessel at home. Leave it for some time and when they mixes with water give it to your plants especially, Tulsi.
IV. Make dough of idol using turmeric powder. Such idols can be colored by using natural colors like haldi, chandan, kesar, kumkum etc.
V. Flowers and other biodegradable materials used in worship may be used for mulching by spreading them on the top of soil around the plant or trees. They can also be composted.

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Effect of varying slopes on soil loss from newly planted tea in North Eastern India

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Abstract

Tea grows on different slopes in North Eastern India. Varying intensity and duration of rainfall result in considerable soil loss, which has not been documented so far. Experiments were conducted during 2009 at the Tocklai Experimental Station of Tea Research Association, Jorhat, Assam (India) to monitor the periodical changes in soil loss from a newly established tea area with different rainfall intensities, duration and amount under varying degrees of slope (0.1, 2, 3 and 6 percent). The study revealed that an increase in the rainfall intensity, amount and duration in general, increased the soil loss in all treatments. An increase in the soil loss was recorded with the increase in slope per cent. The comparative soil loss, however, decreased with the advancement of crop/ increase in number of days after planting. The average soil loss per mm of rainfall under 0, 1, 2, 3 and 6 per cent slopes was found to be 2.65, 17.14, 34.91, 39.89 and 47.26 kg ha^{-1}. The estimated average annual soil loss from these slopes was 5.37, 34.71, 70.70, 80.79 and 95.73 t ha^{-1} year^{-1}, respectively. The trend of soil loss was highly correlated with the soil slope having R^2 value of 0.9

Keywords: *Rainfall , Soil erosion, Soil loss, Tea*

Introduction

Among other components, soil is considered to be one of the most important factors for crop cultivation. Protection of the soil from erosion in the initial years of tea growth is crucial while in mature tea the compact canopy offers fairly satisfactory ground cover. In a tea garden for identical slopes the maximum soil loss is from plots with newly planted tea with inadequate soil cover (Samraj *et al*., 1980). The steeper the grade, the more will be the velocity and discharge for the same cross-sectional area of the drain, but excessive grade produces very high velocities which cause erosion (Singh, 1979). With age and increase in the canopy of the tea bushes, both run-off and resulting soil wash are considerably reduced. Proper catchment planning and various soil conservation measures like contour planting, contour drains, contour bunds, raising green crop, mulching, strip weed control and drop structures etc. are important for erosion prone areas (Bordoloi and Goswami,1996; Chakravartee and Barpujari, 1996). The problem of soil erosion in tea gardens is higher in sloping lands than in plains. The planting of tea on steep slopes, therefore, posses the soil erosion problem of special nature. It is reported that more than 30 cm of valuable fertile top soil has lost through soil erosion by water in Darjeeling tea estates in North Eastern India. This amounts to about 3 to 4 mm of soil wash every year which is a very high figure. There are several hill slopes now without any top soil and, hence the tea plantation has been abandoned in those areas (Singh, 1984). Goswami *et al.* (1997) reported a soil loss of 4 to 58 tonnes/ha and 98 to 172 tonnes/ha from different sites depending on the slope, soil type and the extent of soil cover. The trend of soil loss closely followed the rainfall pattern. Significant quantities of essential nutrients were also lost with the eroded soil. In North East India 70 percent of the total rain is received in the months of May-August and this period receives most of the erodable rain. Keeping this in view a study was carried out with the objective of assessing the soil loss from varying percentage of slopes in a newly planted tea area.

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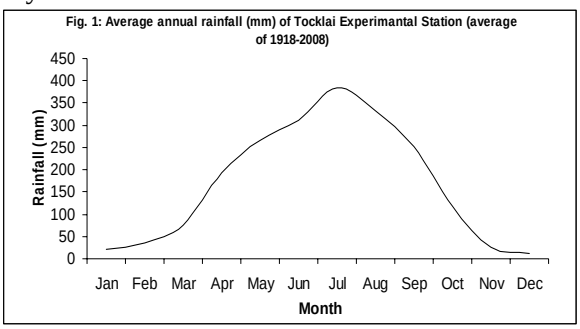
Materials and Method

The experiments were conducted at the Tocklai Experimental Station of Tea Research Association, Jorhat, Assam (India) in the year 2009. The research farm lies at 26^{O} 47' N latitude and 94^{O} 12' E longitude at an elevation of 96.5 m above mean sea level and comes under humid sub tropic zone. Annual average rainfall of the place is 2025.5 mm. The monthly distribution of rainfall for the last 90 years is given in Fig. 1. The monsoon rains start from mid April and withdraw in mid October. About 86 per cent of annual rainfall is received during this period only, whereas post rainfall contributes about 6 per cent. Winter rains are meager and account for only 8 per cent. The soil texture of the experimental site was sandy loam with a bulk density of 1.31 mg m^{-3} and a pH value of 5.50. The experimental plots with five varying slopes having a magnitude of 0, 1, 2, 3, and 6 per cent were constructed artificially to estimate the soil loss. The loss of soil after the occurrence of rainfall event was collected at the entry point of cement concrete tank constructed at the end of the plot. The amount of soil present as suspension in the tank was also accounted for calculating soil loss. The rainfall duration and intensity were calculated from the meteorological data recorded from the met station situated in the experimental area itself. One year old tea saplings, clone TV-23, were planted on June 17, 2009. The tea was grown under natural conditions without any shade.



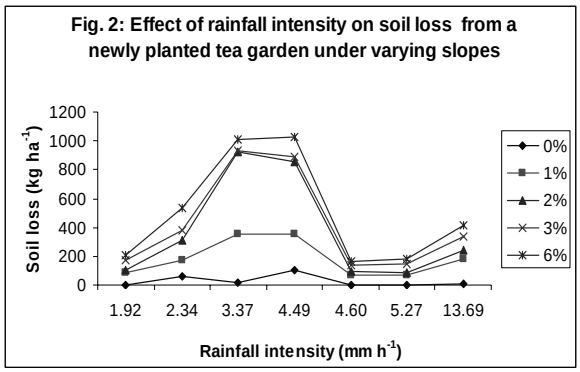
Results and Discussion

A perusal of the data on soil loss indicated that an increase in the rainfall intensity, amount and duration in general, increased the soil loss in all treatments. Also an increase in the soil loss was recorded with the increase in slope percent. The comparative soil loss, however, decreased with the increase in the number of days after planting.

The observations recorded after 58 days of planting revealed that the soil loss decreased as the crop growth advanced and the comparative impact of increasing rainfall intensity and duration, decreased with the increase in the age of plants after this period. This could be attributed to relative establishment of tea roots in the soil, binding of soil particles and stability of the aggregates in the soil over time. The establishment was more pronounced in relatively flat land (0% slope) and decreased with the increase in slope. The crop might have established themselves earlier and better in plots with 0% slope than under higher slopes. This effect could be ascribed to higher velocity of the run off water on the surface of sloping plots than the relatively flat plots. Also, infiltration of water in flat lands is higher as compared to that of plots having higher slope, where water flows over the surface with high velocity as a result of difference in gradient.

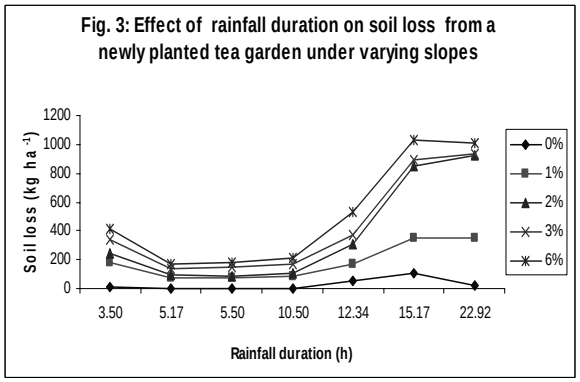
Rainfall intensity *vs.* soil loss

The soil loss under different rainfall intensities (RI) and slopes is given in Fig. 2. Under all the treatments, higher soil loss was observed when the rainfall intensity (RI) was 4.49 mm h^{-1} followed by RI of 3.37 mm h^{-1}. Among different treatments higher soil losses of 851.42, 892.64 and 1025.12 kg ha^{-1} under RI of 4.49 mm h^{-1} and 926.48, 934.73 and 1009.82 kg ha^{-1} under RI of 3.37 mm h^{-1} were observed under 2, 3 and 6 per cent slopes, which was comparatively low (105.48, and 352.83 kg ha^{-1} under RI of 4.49 mm h^{-1} and 19.06 and 350.20 kg ha^{-1} under RI of 3.37 mm/h) under 0 and 1 per cent slope, respectively. The higher soil loss under these two RIs can be attributed to higher corresponding rainfall duration of 22.92 and 15.17 hours, respectively. The higher rainfall duration under these two RIs provided ample time to beating and washing action of falling raindrops on the soil surface which increased with the increase in slope. The soil loss under steeper slopes is also higher because of low water infiltration under increasing slopes especially when the RI is high. Dey (1969) reported that rapid infiltration of rain water was necessary to minimise loss of soils through erosion and can be achieved more easily in flat tea lands or where soil erosion management practices are followed.



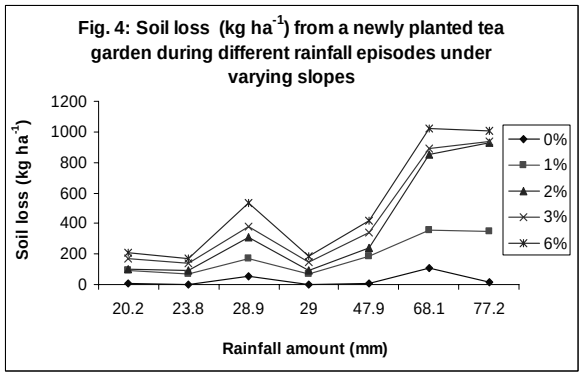
Rainfall duration *vs.* soil loss

The effect of rainfall duration on soil loss under varying slopes shows that in all the treatments, a rainfall of 3.50 hours duration yielded higher soil loss over rainfall episodes of 5.17, 5.50 and 10.5 hours duration (Fig 3). A rainfall event of 3.50 hours duration after 66 DAP with an average RI of 13.69 mm h^{-1} resulted in higher soil loss than a rain of 5.17, 5.50 and 10.5 hours duration having 4.60, 5.27 and 1.92 mm h^{-1} RIs, indicating that the former rainfall duration (3.50 hours with RI of 13.69 mm h^{-1}) was more intense to cause higher soil losses. However, rainfall duration of 15.17 and 22.92 hours duration in the initial stages of crop establishment *i.e.*, 54 and 58 DAP, respectively, caused higher soil loss under 2, 3 and 6 per cent slopes than under 0 and 1 per cent slopes.



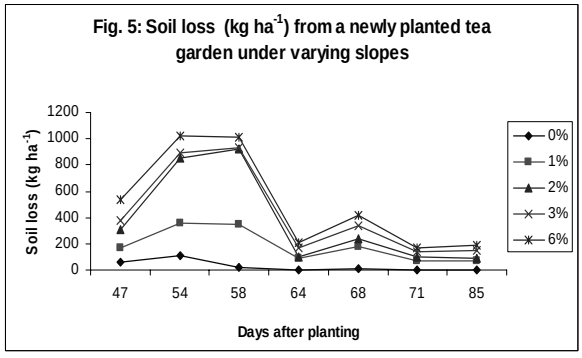
Rainfall amount *vs.* soil loss

The amount of soil loss with the amount of rainfall received showed that under all the treatments, the soil loss increased with the increase in slope at all the quantities of rainfall receipt. In 0 percent slope, rainfall amount of 20.2, and 23.8 mm resulted in lesser soil loss (3.92, 3.57 and kg ha^{-1}), than 47.9, 68.1 and 77.2 mm rainfall where the soil loss was to the tune of 7.23, 105.48 and 19.06 kg ha^{-1}, respectively. The soil loss was much higher under 2, 3 and 6 per cent slopes at rainfall amount of 68.1 and 77.2 mm because of early stage of crop and soil establishment (54 and 58 DAP), wherein under increasing slopes, the soil was more vulnerable to the impact of rainfall. Goswami *et al.*, (1997) also observed that the trend of soil loss closely followed the rainfall pattern from young tea fields on Cachar teelas.



Days after planting *vs.* soil loss

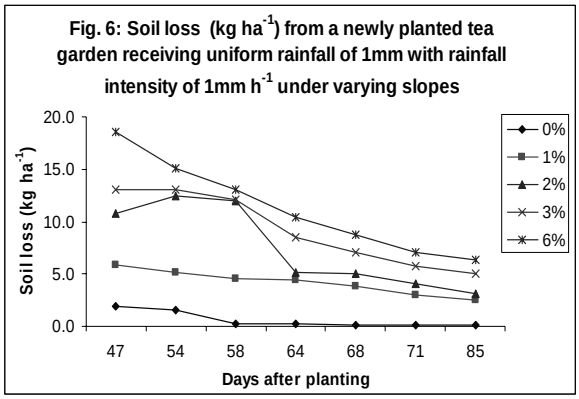
In general, except for 54 and 58 days after planting (DAP) of tea crop, where rain duration was higher to cause higher soil loss, there was a decrease in soil loss under all the treatments, with the advancement of the crop (Fig. 5). However, among different slopes, the soil loss increased with the increase in the degree of slope. The reason for the reduction of soil loss over time is that the binding of soil particles by plant roots over time might have resulted in the lesser soil loss with increased DAP in all the treatments. The results were found to be in confirmation with Samraj *et al.* (1980).The soil loss under different slopes over



time was also calculated under a condition when the soil was receiving a uniform rainfall of 1mm with rainfall intensity of 1mm h^{-1} for one hour (Fig 6). It can be established that with the advancement of crop, the soil loss also decreased under all the treatments.

Average annual soil loss from young tea garden

From the different rainfall episodes it can be 2025.5 mm, that on an average, the soil loss per mm of rainfall receipt under 0, 1, 2, 3 and 6 per calculated for newly established tea garden in Jorhat area, where the average annual rainfall is cent slopes would be 2.65, 17.14, 34.91, 39.89 and 47.26 kg ha^{-1} and average annual soil loss from these slopes would be 5.37, 34.71, 70.70, 80.79 and 95.73 t ha^{-1} $year^{-1}$, respectively (Table 6). The trend of soil loss was highly correlated with the soil slope having R^2 value of 0.95 (Fig. 7).



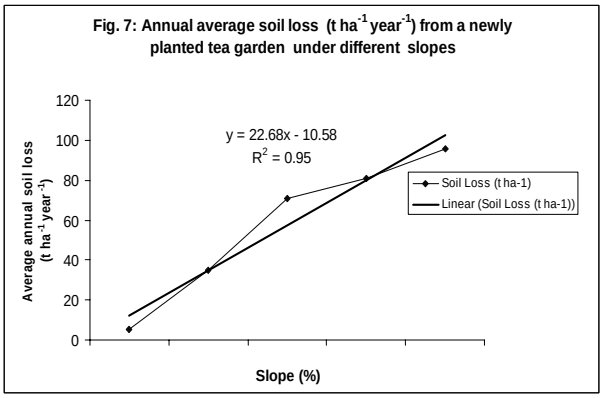


Table 6: Average soil loss (kg ha^{-1}) from a newly planted tea garden under varying slopes

Particulars	Slope (%)				
	0	**1**	**2**	**3**	**6**
Average rainfall (average of seven episodes)received during experimental period: 10.73 mm					
Soil loss (kg ha^{-1}) with 10.73 mm rainfall	28.45	183.87	374.48	427.92	507.03
Average loss (kg ha^{-1}) per mm of rainfall	2.65	17.14	34.91	39.89	47.26
Annual average rainfall of the experimental site: 2025.5 mm					
Average annual loss t/ha^{-1}year^1	**5.37**	**34.71**	**70.70**	**80.79**	**95.73**

Conclusion

Soil loss increased in the early stages of the tea as well as increase in soil slope. The increase in rainfall intensity increased soil loss with the increase in slope. Flat soil with zero slope had the minimum soil loss. The necessary steps should be taken to reduce the soil loss by contouring, bunding, erosion control devices etc. as early as possible in the newly established tea garden. A huge quantity of soil loss, as is evident from the data generated from the current experiment, can be avoided, thus, helping in maintaining the environment sustainability by conserving the soil.

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Influence of primary air pollutants on local biota of Trichy, India

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Abstract

Air pollution is one of the serious problems faced by the people globally, especially in urban areas of developing countries like India. All these in turn lead to an increase in the air pollution levels and have adverse effects on the health of people and plants. In any well planned urban set up, industrial pollution takes a back seat and vehicular emissions take precedence as the major cause of urban air pollution. The unplanned growth of cities in India has led to the problems of increasing slums, vehicular traffic and air pollution. Automobile exhaust, which also consists of all major air pollutants is a significant source of air pollution in the urban context. The present paper deals with the study on concentration of major air pollutants from vehicles and their influence on local biota like plants and human beings in Tiruchirappalli city besides this the impact on plant species and human health has been undertaken.

Keywords: *Ambient air quality, Health disorders, Biota, Trichy*

Introduction

Air pollution caused by automobiles has been described as the "disease of wealth". Around the world, five major types of materials are released directly into the atmosphere in their unmodified forms and in sufficient quantities to pose a health risk. They are carbon monoxide, hydrocarbons, particulates, sulfur dioxide and nitrogen compounds. This group of pollutants is known as primary air pollutants. These materials may interact with one another in the presence of an energy source to form new secondary air pollutants such as ozone and other very reactive materials. Secondary air pollutants also form from reactions with natural chemicals in the atmosphere. Human health is very closely linked to environmental quality, as the Etiology of most of the human diseases being related to the status of the living environment of man. According to statistics, 25% of all preventable illnesses are caused by detrimental environmental factors. In developing countries the air quality crisis in cities often attributes in large measures (40–80%) to vehicular emission. The improved performance of technology is presently insufficient to counteract the growth of vehicles (Anon, 1997a, 1997b).

The Trichy city (10.5°N, 78.43°E, 78.8 MSL), situated at the bank of the river Cauvery and is the fourth largest city in Tamil Nadu. It spread over an area of 146.90 sq. km with total population of above 8, 36,000.Trichy is very rapidly growing in terms of its population and number of vehicles. The 4 major highways NH-45, NH-67, NH-210 and NH-277 passes through the city. The heavy traffic on these highways has been significantly contributed to air pollution in the city

Materials and Method

Ambient air quality was monitored for major air pollutants *viz* Suspended Particulate Matter (SPM), Sulphur dioxide (SO_2) and Oxides of Nitrogen (NO_X). High volume sampler (Envirotech APM-430) is used for sampling. SO_2 and NO_X were absorbed in Sodium tetrachloromercurate and Sodium hydroxide. Analysis of this solution was done according to West and Gaeke (1956). The monitoring was done for 24 hours. This research work was carried out from July 2008 to June 2009. Eight sampling stations were selected to represent different traffic

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volumes and activities which includes Central Bus Stand, Chattram bus stand, Puthur, Palakarai, Srirangam, Main guard gate, TVS toll gate and Old Paalpanne Circle.

Leaf samples were collected from 15 different plants growing commonly in traffic areas of Tiruchirappalli city and their Air pollution tolerance index (APTI) was determined the Polythene bags were used for storing leaf samples during transportation. The leaf samples were refrigerated at about 20^0 C. The samples were estimated for Leaf-extract pH, relative moisture content, total chlorophyll and ascorbic acid following the standard methods of APHA (1977) and Arnon (1949).

APTI was calculated using the formula:

$$APTI = \frac{[A\ (T + P) + R]}{10}$$

Where,

A = ascorbic acid in mg/g
T = total chlorophyll in mg/g
P = pH of leaf sample
R = relative water content in mg/g.

Data related to adverse effects of vehicular pollution on human health in eight different locations of Tiruchirappalli has been collected by the 'Questionnaire method', covering many individuals. A questionnaire was prepared and survey was conducted particularly in case of suspected allergic population by inquiring the recurrence of the type of allergic symptoms and other respiratory diseases. The occasions of this onset was recorded with each individual to assess the allergic status. The secondary data were collected from various health centers, hospitals and clinics which belong to the area under study.

Results and Discussion

Table-1 shows average concentrations of SPM, SO_2 and NO_X at each sampling station. The highest concentration of NO_X, SO_2 is recorded at Palakarai, while the highest SPM concentration was recorded at Chattram bus stand. SPM concentrations ranged from 312.46 to 1401.41µg/m^3. SO_2 concentrations ranged from 13.03 to 30.19 µg/ m^3. NOx concentrations ranged from 120.31 to 171.21µg/ m^3.

The air pollution tolerance index (APTI) value of 15 different plants growing commonly in traffic area of the city is given in Table 2. In the present study the maximum APTI is observed in *Azadirachta indica* (12.95) and minimum in *Enterolobium saman* (7.12) (Table 2). Agarwal and Bhatnagar (1991) studied APTI of some selected plants and described *Mangifera indica* as reliable bioaccumlator plant. Agarwal and Agarwal (1988) also reported high sensitivity of *Mangifera indica*, *Azadirachta indica*, *Psidium guajava*, *Bougainvillea glabra*, *Lagerstroemia indica*, *Morinda tinctoria*, *Hibiscus rosasinensis*, *Ixora coccinea*, *Polyalthia longifolia*, *Achras sapota* and *Cassia fistula* and reported high APTI values and considered them as tolerant plant.

Table 1: Average concentrations of SPM, SO_2, and NO_X (µg/m^3) at different sampling stations

Sampling Station	SPM	SO_2	NO_x
Central Bus Stand	1121.99	21.72	153.17
Chattram Bus Stand	1401.41	19.26	157.55
Puthur	617.32	13.03	156.92
Palakarai	890.03	30.19	171.21
Srirangam	353.17	14.88	132.21
Main Guard Gate	929.27	19.28	164.19
TVS Toll Gate	312.46	17.70	161.13
Old Paalpanne Circle	900.17	18.29	120.31

Total exposure to an individual to a specific pollutant is determined by the concentration of contaminant and the duration of its exposure. Exposure to indoor and outdoor air quality is different because they always change with time and diurnal pattern. Exposure to SPM is also an equally serious risk to health. SPM includes all air-borne particles in the size range of 0.5 μ to 100 μ. The actual health damage caused by dust particles depends upon its nature and composition. The effects attributed to mild eye irritation mortality. The data generated from the survey were analysed to assess the percentage of allergic population and the suspected allergy causing agents. The results are shown in Table 3.The assessment of respiratory disorders (RDs) was obtained from thequestionnaire survey from the doctors. On the basis of the survey of the SPM-related RDs each disease was recorded for indexing the imprint class I to IV (Table 4). The highest imprint score depicts the maximum severity of RDs.

Table 2: APTI of some selected plant species

Name of the plant Species	pH	% of Relative moisture content	Total Chlorophyll mg/g	Ascorbic acid mg/g	APTI
Achras sapota	4.3	88.22	0.97	1.71	9.72
Azadirachta indica	5.9	90.77	0.42	6.14	12.95
Bauhinia purpurea	4.1	87.39	0.40	0.70	9.05
Bougainvillea glabra	5.5	90.56	1.56	2.80	11.03
Cassia fistula	4.2	80.01	0.30	3.23	9.45
Citrus aurantifolia	3.9	79.00	0.24	1.89	8.68
Enterolobium saman	4.9	65.31	0.69	1.07	7.12
Hibiscus rosasinensis	4.2	91.49	0.71	2.40	10.32
Lagerstroemia indica	4.2	84.94	1.60	3.51	10.52
Mangifera indica	6.9	81.43	0.50	5.10	11.91
Morinda tinctoria	4.7	90.93	0.26	2.41	10.28
Polyalthia longifolia	5.2	90.99	0.18	1.43	9.86
Pongamia glabra	4.4	84.30	0.38	0.93	8.87
Psidium guajava	6.6	81.97	0.21	6.64	12.71

Table 3: Estimation of Allergic Symptoms

Complaint	Total no. cases	Condition	No. of person	Percent of incidence
Neck block	20	Allergic	17	85
		Non- Allergic	3	15
Sneezing	35	Allergic	30	86
		Non- Allergic	5	14
Cough	60	Allergic	50	83
		Non- Allergic	10	17
Hyperacidity	29	Allergic	18	62
		Non- Allergic	11	38

Table 4: Imprint classification of respiratory diseases

Imprint score	Symptoms
0.0	No RD: healthy, free from any respiratory disease
2.5	Mild RD: suffering from only upper track respiratory infections (UTRI)
5.0	Moderate RD: suffering from UTRI as well as lowest track respiratory infections
10.0	Severe RD: Suffering from bronchitis, asthma, allergic thintis, fibrosis, asbestosis, pneumoconiosis and non-malignant RDs

Conclusion

Suspended Particulate Matter (SPM) is the main pollutant within the Tiruchirappalli city. In all eight sampling sites, the concentration of SO_2 is well within the CPCB limits. The reason being the growing number of automobiles and poorly and congested road with heavy traffic. This problem

can be overcome by adapting advance ecofriendly transport systems, usage biofuels and widening of roads. The plants with low APTI value like *Bauhinia*, *Pongamia*, *Citrus* and *Enterolobium* were categorize as sensitive and plants with high APTI value like *Azadirachta*, *Psidium*, *Mangifera*, *Bougainvillea*, *Largerstromia*, *Morinda*, *Hibiscus*, *Ixora*, *Polyalthia*, *Achras* and *Cassia* as tolerant. The study reveals that urban air pollutants have adverse effects on human health. In Tiruchirappalli city many individuals residing near by traffic intersections are suffering from respiratory diseases. Proper control measures may tackle this unhealthy problem of urban pollution.

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Macro-benthic diversity in relation to biotic indices in Song river at Dehradun, India

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Abstract

The composition and abundance of benthic animals are commonly used as bio-indicators to determine the impact of pollution on physico-chemical integrity of surface waters and changing pattern of biotic characteristics of lentic and lotic system. The benthos serves as a link between primary producers, decomposers and higher trophic level. Song river is a spring fed hill stream originated from different small rivulets of lesser Himalayan mountainous ranges at Garhwal region of Uttarakhand. The study was carried out from 2006-2008, the water samples were collected from three different sites in a stretch of about ten kilometres from Song river. All taxa were identified to species/genus level with the help of identification keys. The 5 faunal groups and 19 genera were observed at three different stations in the Song river. At all three sites, *Tubifex* was the dominant genera among Oligochaeta. Among polychaeta, *Namalycastic indica, Napthys polybranchia, Napthys oligobrunchia* species were reported at all above three different sites of Song river. Biotic indices indicated moderate pollution in the water quality of upstream and down stream water. The CCME (Canadian Council of Minister of Environment) water quality index (2001) showed marginal range of pollution in the river. The abundance of pollution tolerant organisms indicated the downstream site is receiving nutrient-rich urban runoff containing little or no toxins substances.

Keywords: *Benthic diversity, Biotic indices, Song river, Water quality index*

Introduction

The benthic flora and fauna of fresh water has been the subject of intensive ecological research because they play important role as indicators of water pollution (Mason, 1991). The benthos serves as a link between primary producers, decomposers and higher trophic level in aquatic ecosystem. The biological assessment of aquatic environments has been practiced since the1900s (Hynes 1960, 1994, Cairns and Pratt 1993). It has been evidenced by a number of recent books devoted entirely to the subject interest in distribution of benthos (Abel 1989; Plafkin *et al*., 1989; Loeb and Spacie, 1994). Many methods have assessed stream quality using invertebrates, ranging from assessing physiological and morphological changes of individuals to various measures of community structures (Rosenber and Resh 1993). Biotic indices based on macroinvertibrate community structure are widely used and alternatively biological monitoring offers a relatively affordable means of environmental measurement compared to chemical data for assessing degradation of aquatic habitats and loss of biological diversity induced by anthropogenic disturbances (Karr, 1991 and Hynes, 1994).

Benthic macro-invertebrates are being utilized as a tool to assess surface water quality. Understanding the response of aquatic communities to pollution is vitally important, as it forms the basis of a variety of biological methods for assessing water quality and biological productivity. Now a days, biotic indices are become the most common methods for river biological monitoring (Nerris and Georges, 1993; Norris and Norris, 1995). The present study was conducted to estimate the biotic status and water quality of Song river at Dehradun.

Materials and Method

Geographically, Garhwal has almost central position in the long Himalayan sweep, it is the

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most important part of lesser Himalaya, which lies between latitudes 29˚ 26' to 31˚ 28' N and longitude 77˚ 49' to 80˚ 06' E in Indian subcontinent. Song river is a spring fed river originated with Sahastradhara streams flow downwards towards Doon valley basins and finally it assimilates into river Ganga at Raiwala. Song river is basically the tributary of Ganga. The present study was carried out from 2006-2008, the water samples were collected from three different sites *i.e.* Site-I Upstream point, Site-II Confluence point and Site-III-Downstream point in a riverine stretch of about ten kms .

The collections of macro-zoobenthic organisms were done at time between 8.00 to 10.30 A.M. on monthly basis. All benthic samples were collected with an Ekman's Dredge sampler and sieve having size US No. 60 cms and preserved in 4.0% formalin. In laboratory, the benthic animals were sorted out and identified to genus/species level with the help of identification keys (Edmondson, 1992). An average of three samples of macro-zoobenthic organisms were taken monthly from each sites and mean density value of the three replicates were converted to individual per meter square (ind./m^2) as following formula described by Jhingran *et al*. (1969). Three diversity indices were used, namely:

(1) Shannon-Wieners Index (1949) $H = -\sum \frac{ni}{N} \ln \frac{ni}{N}$

(2) Simpson's Index (1949) $C = 1-\sum \left(\frac{ni}{N}\right)^2$

(3) Margalef's Index (1958) $(D) = \frac{S-1}{\ln(N)}$

Where,

ni = number of individuals of a given family (i)

N = The total number of individuals of all families

S = total species number

ln = $\log_e$ (logarithm to the base)

The CCME Water Quality Index: The CCME-WQI produces a measure of the derivation of water quality from water quality guidelines described in (CCME- WQI, 2001).

Results and Discussion

Macrozoobenthos are important components of the bottom biocoenosis. Invertebrate macrobenthic organisms mainly consisted of sessile or sedentary animals and reflect characteristics of both sediments and water column of aquatic systems. Changes in land use in stream catchments often results in obvious changes in their invertebrate communities (Hall *et al.,* 2001 and Quinn, 2000). The removal of vegetation from the riparian strip along stream banks also affects stream communities, increasing water temperature and decreasing the input of organic matter (LeBlanc *et al.,* 1997 and Quinn, 2000).

The 5 faunal groups and 19 genera were observed at three different stations in the Song river (Table 1). Song river constituted by the different macro-zoobenthos groups mainly Oligochaeta, Polychaeta, Insecta, Pelecypoda and Gastropoda. Oligochaeta was reported as a dominant group among all other groups. In Oligochaeta, the *Tubifex* species was recorded maximum in number. Brinkhurst (1966) suggested that the *Tubifex* species and *Limnodrillus* species were more resistant of all kind of pollution in river. *Limnodrillus hoffmeisteri* and *Branchiora sowerbyii* were reported least in compare to *Tubifex* species. At all three sampling sites, *Tubifex* was the dominant genera among Oligochaeta. Among Polychaeta group the benthic species, *Namalycastic indica*, *Napthys polybranchia*, *Napthys oligobrunchia* were reported at all three different sites of Song river. The *Oligochaetes* are known to exhibit high percentage of the total benthic fauna in polluted water as reported by Howmiller and Beeton (1973) and Kaniewska-prus (1983). Tiwari *et al*., (1988) reported *Tubifex* species as pollution indicator species. Prater *et al.* (1980) stated that the *Branchiora sowerbyii* tolerates moderate organic pollution.Earlier work proves their presence from different stretches of the river Song (Singh *et al*., 1988, Ahmad and Singh, 1989 and Jhingran *et al*., 1986). Insects were poorly reported than Oligochaetes. Wiederholm (1980) suggested that in heavily polluted water, Oligochaetes are more abundant than Insecta. According to Paine and Gaufin (1956) some aquatic insect species were restricted in clear water conditions of riverine ecosystem.

Table 1: **The distribution of Macro-zoobenthic organisms (ind./m^2) at different sampling sites in Song river at Dehradun**

S.No.	Organisms	Site-I	Site-II	Site-III
1.	**OLIGOCHAETA**			
	Tubifex sp.	51-65	205-250	492-516
	Limnodrillus hoffmeisteri	6-7	28-40	89-97
	Branchiora sowerbyii	6-7	8-15	23-26
2.	**POLYCHAETA**			
	Namalycastis indica	79-94	40-46	45-52
	Napthys polybranchia	13-24	6-10	8-14
	Napthys oligobranchia	16-14	5-6	7-10
3.	**INSECTA**			
	Chironomous plumosus	99-125	66-71	9-16
	Strictochironomous sp.	22-31	11-13	10-14
	Culicoides	5-11	5-6	8-12
	Dragonfly *nymph*	12-17	5-6	7-10
4.	**PELECYPODA**			
	Parreysisa favidens	24-36	15-17	6-8
	Parreysia coerulea	32-37	18-23	7-9
	Corbicula striatella	11-17	6-7	2-4
	Noviculina ganetica	14-24	10-15	5-7
5.	**GASTROPODA**			
	Bellumya crassa	15-20	25-33	33-40
	Thiara scrabra	51-61	55-72	33-40
	Thiara granifera	27-30	32-37	61-73
	Thiara tuberculata	62-77	67-76	05-120
	Brotia costula	17-27	28-35	25-31

Maximum Pelecypodas were reported at Site-I followed by Site- II and III these were identified at different species like *Parreysisa favidens*, *P. coerulea*, *Corbicula striatella*, *Noviculina ganetica* which indicates good dissolved oxygen and physico-chemical characteristics associated with least organic pollution load in running water. Depletion in oxygen has shown major stresses in fresh water system by Pelecypodas (Ingram, 1957). Gastropods were found to be more tolerant of organic pollution in river water. These were found maximum at Site- III followed by Site- II and I. The presence of *Bellumya crassa*, *Thiara scrabra*, *Thiara granifera*, *Thiara tuberculata and Brotia costula* indicates that it has a broad tolerance range of organic enrichment. So present status of benthic organisms supports that Gastropods are facultative organism, therefore the Oligochaetes can serve as useful indicator of organic pollution prevailing riverine system of Song river. The response of macroinvertebrates to organic pollution has been well documented in different running water bodies (Hellawell, 1986; Mason, 1991 and Cao, 1996).

Sala *et al.* (1977) studied that polluted water has been showed low diversity indices due to occurrence of many pollution tolerant benthic organism flourished in absence of competition and presence of abundant food supply. The present result has implied that Song river was more affected by nutrients as organic matters added by distillery effluents at upstream of Site- II.

There were significant differences in the species composition and relatively abundance between all three sites of Song river. Diversity indices were calculated on the basis of occurrence of macro-

invertebrate organisms as Shannon Weiner's Diversity Index (H), Simpson's Diversity Index (D) and Margalfes Index (MgI) (Table 2 and 3). At site I (upstream), the Shannon Weiner's index was recorded in the range of 0.629, 0.721, 0.914, 1.32 and 0.466 for Oligochaeta, Polychaeta, Insecta, Pelecypoda and Gastropoda respectively**.** For the same site, Simpson index was calculated as 0.331, 0.403, 0.482, 0.720 and 0.745 for Oligochaeta, Polychaeta, Insecta, Pelecypoda and Gastropoda respectively (Table 2). According to Shannon Weiner's diversity Index, the maximum diversity was found of Pelecypoda (1.32) and minimum diversity found in Gastropoda (0.466) and Simpson's Index showed maximum (0.745) diversity of Gastropods and minimum shown by Oligochaeta (0.331) at Site I. At Site II (Confluence point), the Shannon Weiner's index

Table 2: Macrobenthic Diversity Indices of Song river

		Site I Upstream		**Site II Confluence point**		**Site III Downstream**	
S. No.	**Groups**	**Shannon Weiner's Index (H)**	**Simpson's Index (C)**	**Shannon Weiner Index (H)**	**Simpson's Index (C)**	**Shannon Weiner's Index (H)**	**Simpson's Index (C)**
1.	Oligochaeta	0.629	0.331	0.300	0.135	0.577	0.316
2.	Polychaeta	0.721	0.403	0.723	0.400	0.798	0.447
3.	Insecta	0.914	0.482	0.486	0.425	1.473	0.743
4.	Pelecypoda	1.32	0.720	1.314	0.720	0.602	0.726
5.	Gastropoda	0.466	0.745	1.535	0.768	1.491	0.761

Table 3: Margalef's Index (D) at different sites of river Song

		Site I Upstream	**Site II Confluence point**	**Site III Downstream**
S.No.	**Groups**	**Margalef Index (D)**		
1.	Oligochaeta	2.784	2.723	2.586
2.	Polychaeta			
3.	Insecta			
4.	Pelecypoda			
5.	Gastropoda			

was ranged as 0.300, 0.723, 0.486, 1.314 and 1.535 for Oligochaeta, Polychaeta, Insecta, Pelecypoda and Gastropoda respectively**.** The Simpson index was calculated as 0.135 (Oligochaeta), 0.400 (Polychaeta), 0.425 (Insecta), 0.720 (Pelecypoda), 0.768 (Gastropods). At Site II (Confluence point of Song river), the Shannon Weiner's Index was calculated as maximum (1.535) shown by Gastropods and minimum (0.300) by Oligochaeta. The Simpson's index was recorded maximum (0.768) by Gastropods and minimum (0.135) by Oligochaeta**.** The decreasing trend of declining benthic species richness was also apparent at Site II, It may be correlated with the degrading water quality along with probably reflecting the pollution gradient.

At sampling Site III (Downstream of Song river), the Shannon Weiner's Diversity Index was calculated as 0.577 (Oligochaeta), 0.798 (Polychaeta), 1.473 (Insecta), 0.602 (Pelecypoda), 1.491 (Gastropods). The Simpson index recorded in the range of 0.316 (Oligochaeta), 0.447 (Polychaeta), 0.743 (Insecta), 0.726 (Polecypoda), 0.761 (Gastropoda) and Shannon Weiner's index showed maximum diversity (1.491) in Gastropoda and minimum diversity (0.577) reported in Oligochaeta at sampling Site III. The Simpson's Index was recorded maximum (0.761) by Gastropods and minimum (0.316) by Oligochaeta.

Margalef's Index (1958) was calculated for the simple ratio between total species and total number of individuals, which is used to compare one community with another. The Margalef's Index was calculated at Site I, II and III for Oligochaeta, Polychaeta, Insecta, Pelecypoda and Gastropoda were found as 2.784 (Upstream), 2.723 (Confluence point) and 2.586 (Downstream) respectively. At Site I, Margalef's index was reported maximum (2.784) and minimum reported at Site III (2.586). It showed that benthic community ratio was higher at Site I compared to Site II and III (Table 3). The present results revealed that Song river water quality is moderately polluted and macro invertibrates

diversity also showed moderate variation in distributional pattern of different species occurred at different sampling sites in the river. Ravera (2001) analyzed the similar occurrence of benthic organisms in Ravell stream in North Italy. Kumar and Dobriyal (1993) reported the similar pattern of benthic diversity indices for the Garhwal Himalayan hill streams. It has been proved that higher benthic species diversity is always associated with minimum pollution load in hill stream like Song river.

Table 4: CCMI water quality index of Song river

Sites	WQI value in summer	Quality criteria	WQI value in rainy	Quality criteria	WQI value in winter	Quality criteria	Range
Site I Upstream	52.04	Marginal	42.56	Poor	54.95	Marginal	45-64
Site II Confluence point	23.52	Poor	20.96	Poor	23.56	Poor	0-44
Site III Downstream	48.53	Marginal	53.83	Marginal	49.9	Marginal	45-64

On the basis of CCMI water quality index, the water quality of Song river was categorised as marginal and poor (Table 4). At sampling Site I (Upstream), water quality was recorded almost in the marginal category during winter and summer season. The poor water quality was recorded in the rainy season, it may be due to sudden input of excessive domestic sewage drain and waste dumping into the river. At Site II, poor water quality was recorded during summer, winter and rainy season. It may be due to the discharge of doon distillery effluent. At Site III, the marginal water quality was recorded in all the three seasons that may be due to the self-purification process of water body depending upon the quantitative capacity of water and flowing velocity. Samantray *et al.* (2009) reported the national sanitation foundation water quality index in the Mahanadi and Atharabanki river. Therefore the present investigation revealed that the water quality of Song river is moderately polluted at Site II based on benthic species and their distributional pattern in aquatic ecosystem due to enormous change by polluted organic matter load. It is evident that higher benthic diversity is always associated with minimum pollution stress in running riverine system.

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Status of ambient noise levels in Jaipur city

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Abstract

Transportation sector is one of the major contributors to noise in urban areas. Hence, as a first step towards assessment of noise pollution, measurement was taken up with emphasis on traffic noise. During the course of study ten heavy to medium busy commercial corridors were selected for monitoring of vehicular traffic activities and ambient noise levels as well. Sound Level Meter (SLM) SC-30 with a calibration source was used for measurement of equivalent noise levels.
The results indicates that the noise levels were higher than the limits prescribed by Central Pollution Control Board (CPCB), It directly highlighted the necessity of effective mitigation measures of noise pollution levels in the city.

Keywords: *Ambient noise levels, Interrupted traffic flow, Permissible limits, Road intersection, Traffic congestion*

Introduction

Environmental noise has been defined as one of the unwanted or harmful environmental pollutants which is created by human activities and directly affects the human health (Anomohanran *et al*., 2008). It is a common experience which may interfere with our ability to communicate (Onuu and Menkiti, 1996). Noise is a prominent feature of the environment which comes from transport, industry and neighbour (Padhy and Padhi, 2008). It is recognized as a major problem for the quality of life in urban areas and all over the world (Ozer *et al*., 2009).

Road traffic noise is considered as one of the important source of noise pollution that adversely affects the human health (Pathak *et al*., 2008; Aparicio and Surez, 1993). The Ministry of Environment and Forests, Govt. of India, has given a notification regarding allowable limits of noise. Through the comprehensive 1986 Air Act of the Ministry of Environment and Forests noise pollution has become an offence in India (Singhal, 2005). Permissible limits of noise have been specified for different urban environments. The latest one, the Noise Pollution (Regulation and Control) Rules 2000, released in February 2000, clearly classified our environment in to four different categories and specified the allowable limits of noise separately for day and night time for each category (Table 1).

Jaipur is relatively a large industrial city which has been expanded in all directions, randomly (Agarwal and Swami, 2010). All modes of transportation are always present on roads, responsible for interrupted flow and traffic congestion in the city. The increased socio-economic status of the residents, availability of automobiles, lack of integrated mass transport system and increased demand of transport for daily journeys have resulted in steep growth of vehicle ownership in the city. The growth of registered vehicles in Jaipur city has shown in Fig. 1. It was found that two wheelers had increased at a rapid rate, while cars increased steadily at a slower rate.

The present study is aimed to assess the ambient noise levels at the major ten intersections of the city. Further, a detailed study has been carried out to investigate the increased noise pollution in the city.

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Materials and Method

For this study, ten typical commercial road intersections with comparable geometrical feature, but associated with distinctly different types of traffic movement, were selected for monitoring of noise levels. Details of each selected location are given in Table 2.

As, the important part of the noise assessment is the actual measurement of the noise levels; the equivalent noise levels (Leq) were measured at all the selected locations.

The Sound Level Meter (SLM) (SC- 30; version 1.0-2.1) having digital display was calibrated before taking the measurement according to user manual. The 'A' weighted network was used as it is very closer to a person's hearing sensitivity. It was mounted on a stand at a height of 1.2 m above the ground level and was located at 7.5 m distance from the centre line on the road way during interrupted traffic flow conditions.

Table 1: Ambient noise level standards in Leq applicable in India (CPCB, 1998)

Type of the Area	Environmental Noise Standards (Leq) in dBA	
	Day Time 0600-2200	Night Time 2200-0600
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40

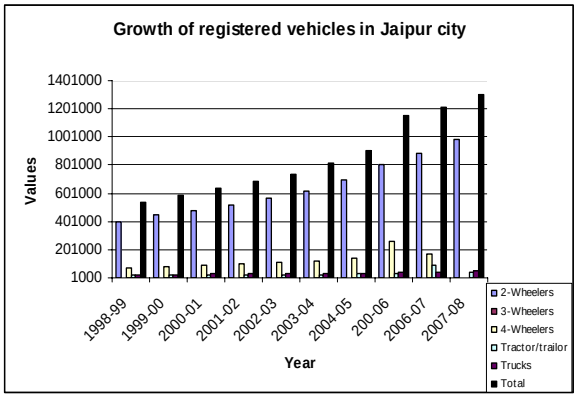

Fig. 1: Total Number of registered vehicles in Jaipur city

Results and Discussion

Since, it is found that all vehicles are the source of noise and measured noise is the resultant of all of them; traffic flow per hour has also been recorded with the ambient noise levels at all the similar locations. Fig. 2 shows the average traffic flow passed in one hour at all the selected locations.

The Fig. 2 shows that the mean hourly traffic flow was very high at all the selected locations. However, it was very higher at JDA circle. The reason could be that this intersection connects the older city to newer city. Therefore, heavy traffic flow is always present on the junction point. Further, the university and different colleges are also present at the end of the one arm of the intersection while, the presence of famous Ganesh temple at another arm also increases the traffic flow on the site.Yoshida *et al*. (1997) found that on densely crowded roads the sound levels for 24h can reach up to 75-80 dB. Increasing number of vehicles and electronic devices has created a serious threat of noise pollution (Tripathi *et al*., 2006; Agarwal *et al*., 2009).

The influence of noise on human health can be due to direct effects upon the auditory system. On non-auditory physiological processes and on purely psychological mechanisms (Sampath *et al*., 2004).

Fig. 3 shows a comparison between observed equivalent noise levels (Leq) Vs. Leq prescribed by CPCB.

Table: 2 Details of Identified Locations

S. No	Name of the Location	No. of Lanes	Nature of Traffic Flow
1.	Bus Station	4	Heavy, Congested
2.	Gopal Pura Mod	4	Heavy, Congested
3.	Government Hostel	6	Heavy, free flow
4.	J.D.A Circle	6	Heavy, free flow
5.	Khasa Kothi Circle	4	Medium, Congested
6.	Pani Paich	4	Medium Congested
7.	Queen's Road	4	Medium, free flow
8.	Railway Station	4	Heavy, Congested
9.	Sodala Circle	4	Medium, Congested
10.	Transport Nagar	6	Heavy, Congested

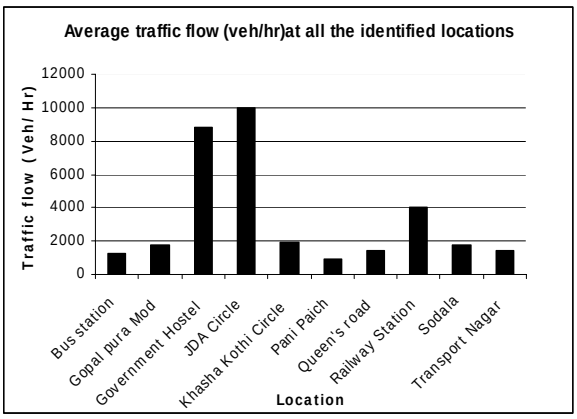

Fig. 2:Average traffic flow at all the selected locations

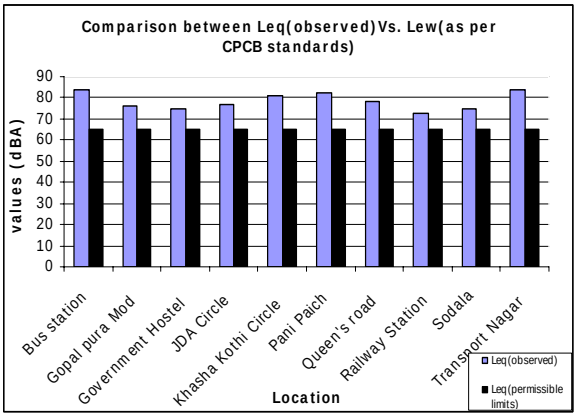

Fig. 3: Comparison between Leq (observed) and Leq (standard)

It was found that the leq values were higher (ranged between 74.7-83.9) as compared to the permissible limits of 65dBA prescribed by CPCB for commercial locations. This may be due to the fact that the public transportation system is inadequate and inefficient which directly develops the tendency of personalized vehicles among people. Besides this, all types of vehicles *i.e*., fast moving vehicles along with slow moving vehicles on the roads which develop honking behaviors among drivers. Further, road are narrow, poorly maintained and are not designed properly for increased traffic flow, resulted in traffic congestion and tendency to blow horn among people.

Conclusion

Noise is comparatively a newly recognized problem from last few decades. It did not get much attention as compared to air or water pollution. The present study has two major objectives. Firstly, to investigate the contemporary traffic flow at all the ten selected locations. And secondly, ambient noise levels have been measured at the similar identified locations. Traffic data were recorded manually.While, Sound Level Meter having digital display was used for monitoring of leq level at all the locations. It was found that the vehicular traffic was very higher at all the locations and showing continuously increment from last ten years. Further, at none of the location, noise levels were less than 65dBA.The difference between observed Leq and standard Leq was ranged between 7.6-18.9. It clearly indicated that the ambient noise levels were very higher as compared to prescribed noise levels. Effective traffic management and continuous noise level monitoring are the tools for mitigation of noise levels in the city.

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Evaluation of microbial contaminants (CFU/g) of certain energy foods at different intervals under controlled 85 laboratory conditions and impact of utilization processes on them

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Abstract

In the present paper, efforts have been made to evaluate microbial contaminants in term of CFU/g of three sealed Bournvita samples (B1, B2, B3) and three sealed Horlicks samples (H1, H2, H3) at interval of one month for 120 days (4 months) under controlled laboratory conditions. Further to find out the effect of consumer's handling on microbial load, these packs after 120 days were distributed to consumer A, B and C respectively and were examined for extended period of 28 days at interval of 7 days. The results revealed that microbial contaminants were present since beginning (when opened) in all the energy food samples. Maximum microbial load in Bournvita sample was recorded in B2, followed by B3 and B1 respectively and in Horlicks, it was maximum in H2 followed by H3 and H1 respectively. In general the microbial contaminants were more in Bournvita than Horlicks. No significant change occurred in their CFU till 120 days but handling process enhanced the contaminants significantly both in their quality and quantity in term of microbial group. Fungi and Actinomycetes were recorded in sampling from the samples of consumers A, B and C. Total CFU enhanced from both energy food and reached in several lakhs. Total Bacterial species isolated and identified were *Staphylococcus aureus, Bacillus cereus, Enterococcus, Escherichia coli*, *and Pseudomonas aeruginosa.* After 2 and half years (Feb 2010) the bacterial count was found 3, 00000 CFU/g of Horlicks and fungal count was 250CFU/g.

Keywords: *Contaminants, Food Sample, Microbial load , Serious effects*

Introduction

Food may be defined as an essential element which is must needed for growth and to keep body system healthy and in proper active state. In the twenty-first century, the demand for food and agricultural products in general reached unprecedented levels. Form and varieties of food has been changed time to time. In the last few decades after independence, a great change in food habits have been recorded in our country due to economic revolution. A significant revolution has been occurred in baby's food also. A number of baby foods for infants are available in the market. Albeit to these, some high energy yielding tinned dry foods are also in common use in society for growing childrens such as Bournvita, Horlicks etc.

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Suitable to human health, safe food is a consumer's basic right. The quality of the baby food is very essential for both in terms of its listed nutrients which should provide requisite elements and energy for growth as well as should be free from any kind of contamination. Assuring safe food is the most difficult task in preparation and distribution units, especially in small and medium-size companies (Baş *et al*., 2005; Ayçiçek *et al.*, 2004; Bermúdez-Millán *et al.*, 2004; Sun and Ockerman, 2004; Walczak and Reuter, 2004; Walker *et al*., 2003; Walker and Jones, 2002; Worsfold, 2001). Albeit in the food processing industry, unwanted and growth of pathogenic microorganism is a key concern. Therefore the production of safe foods is based on the implementation and application of Good Hygienic Practice (GHP) and Good Manufacturing Practice (GMP) (CAC, 1997). Since the infant foods are milk and cereal based and are consumed by most vulnerable group of population, therefore there is

need to exercise great care at every stage of processing and precautions to be taken at consumer level. Several outbreaks regarding energy foods and other infants milk and cereal based food products have been widely reported in the literature. Andreas *et al.* (2004) examined twenty eight milk samples from 18 different countries for Thermophillic bacilli. Of 742 isolates examined, 96.8% were assigned to the same strain of bacilli as previously found in New Zealand powder. Three cases with *Salmonella Tennessee* in infants in Canada and United States have been linked to consumption of contaminated powdered infant formula. Outbreaks of Salmonellosis caused by powdered milk products have been reported in US and else where (Leuschner *et al.* 2004).

The presence of *Enterobacter sakazaki* other than *Salmonella* and other Enterobacteriaceae from powdered infant formula milk and other food products have been widely reported in the literature (Farmer *et al* 1980; Leuschner *et al*., 2004; Iversen *et al*., 2004; Gurtler *et al*., 2005). Infection caused by *Enterobacter sakazaki* are rarely reported. The first outbreak of *Enterobacter sakazaki* from powdered infant formula was reported in 2001 (CDC, 2002; Himelright *et al*., 2002). The bacterium has been implicated most frequently in causing illness in neonates and children from 3 days to 4 years (Iversen and Forysthe, 2003). Therefore, as these foods are directly concerned with human health and may cause serious effects, therefore the main aim of this research paper is to protect the society from unwanted epidemics associated with these energy foods.

Materials and Method

Collection and storage of samples

Bournvita (MFD-07/2007), Horlicks (MFD-07/ 2007), Net weight- 200gms. Test samples/ materials of bournvita of batch number W29T7W2 and horlicks 8903. H were collected randomly from different shops located in Yamuna Nagar, Haryana, India. Samples were stored at room temperature (30 ± 5°C) until required.

Sampling procedure

Three sets of test materials were kept in laboratory and were opened from their purchase date adjoining to their manufacturing date and were sampled under aseptic conditions for quality analysis for a period of 120 days. Samples were evaluated at an interval of 30 days. Precautions were taken to close the pack properly under aseptic conditions after sampling and were kept in dry conditions. After 12 days these samples were given to three consumers (A,B,C) to use as such and samples were taken for evaluation of handling effect on microbial load at interval of 7 days from them for the total period of 28 days. Quantitative enumeration of microorganism was done by serial dilution method and qualitative enumerations of isolated bacteria from the user's samples were examined microscopically and were characterized biochemically.

Test procedure

For the enumeration of microorganism from energy foods, different medias were used each for bacteria, fungi and actinomycetes. Nutrient agar media for bacteria, Czapek-Dox Agar for Fungi and Kenknight's Media for Actinomycetes. All ingredients used for specific medium were weighed properly and mixed in proper volume of distilled water. pH of the media was adjusted and measured by the pH meter and prepared media were sterilized properly and were kept in the laminar flow hood for conducting the experiments. Serial dilution procedures were adopted for isolation of microorganism from selected energy food. Isolated organisms were identified by their morphological, physiological and biochemical characteristics (Cowan and Steel, 1974; Leanor and Carey, 1978).

Results and Discussion

Results obtained during this investigation of microbial load (CFU/g) of test material *i.e.,* Bournvita and Horlicks during different storage period and storage conditions in terms of mode of consumption of consumer A, B and C have been presented in Table 1 below. Results revealed that microbial load in Bournvita sample B1, B2 and B3 had shown only bacterial count and other organism *i.e*. Fungi and Actinomycetes were absent. Maximum bacterial count of 35,000 CFU/g was recorded on zero day in bournvita sample B2 and minimum bacterial load of 32,000 CFU/g was found in Bournvita sample B1. Maximum bacterial load of 34,000 CFU/g was found in sample B2, and minimum 29,000 CFU/g in sample

B1, after four months of storage under clean conditions and fungi and actinomycetes count were not found in any of the sample during four months of storage. In case of Horlicks samples H1, H2 and H3, was found contaminated with heterogenous group of bacterial species however, fungi and actinomycetes were found completely absent even after four months of storage. Maximum bacterial count recorded in sample H2 was found to be 31,000 CFU/g and minimum load of 27,000 CFU/g was found in sample H1. Profound increasing trend of total microbial load (CFU/g) in all three samples of each Bournvita and Horlicks was recorded when these were used by consumers A, B and C. Results showed that till first sampling (7th day) in Bournvita, only bacterial population could be observed constantly. On second sampling *i.e*. on 14 days actinomycetes started to appear and fungi started to appear from 21st day (third sampling). Maximum total microbial load of 9,44,000 CFU/g was recoded on 28th day from the sample given to consumer B followed by consumer A with microbial load of 8,59,000 CFU/g and than consumer C with microbial load of 7,14,000 CFU/g. Similar trend has been recorded in Horlicks. On 7th day (first sampling) only bacterial population was recorded and actinomycetes started to appear on 14th day (second sampling) and Fungi started to appear from 21st day (third sampling). Maximum total microbial load *i.e*. 7,90,000 CFU/g, was recorded on 28th day in consumer B followed by consumer A *i.e.* 7,72,000 CFU/g and consumer C *i.e.* 6,31,000 CFU/g.

Comparative account of total microbial load of both Bournvita and Horlicks on effect of consumer use for extended 28 days period after 120 days has been presented in the Table 2. Data recorded has shown that average value of microbial load was always higher in Bournvita than Horlicks, since 7th day (first sampling) to till 28 days of sampling. Comparative account of microbial load of both Bournvita and Horlicks on storage period of 120 days (four months) has been presented in Table 1. Data recorded showed that the total microbial load in Bournvita is slightly higher than Horlicks under storage conditions for 120 days (four months).The organism identified from different samples of Bournvita (B1, B2 and B3) and Horlicks (H1, H2 and H3) after a storage period of 28 days when given to consumer A, B & C are *Staphylococcus aureus*,*Bacillus cereus*, *Enterococcus*, *Escherichia coli*, *Pseudomonas aeruginosa* (Table 3.)

Table 1: Comparative account of Total Microbial Load (CFU/g) of Bacteria, Fungi and Actinomycetes in Bournvita (B1, B2 and B3) and Horlicks samples (H1, H2 and H3) during a storage period of 120 days.

Storage period (sampling day)	Dilution	Bournvita Total Microbial Load (CFU/g)			Average count	Dilution	Horlicks Total Microbial Load (CFU/g)			Average count
		B1	B2	B3		10^{-3}	H1	H2	H3	
0 day	10^{-3}	32,000	35,000	33,000	33333	10^{-3}	27,000	31,000	29,000	29000
30 days	10^{-3}	30,000	36,000	32,000	32666	10^{-3}	28,000	32,000	30,000	30000
60 days	10^{-3}	30,000	36,000	32,000	32666	10^{-3}	28,000	32,000	31,000	30333
90 days	10^{-3}	30,000	35,000	33,000	32666	10^{-3}	27,000	32,000	31,000	30000
120 days	10^{-3}	29,000	34,000	32,000	31666	10^{-3}	27,000	30,000	31,000	29333

Table 2: Effect of consumers (A, B and C) handling on Microbial Load (CFU/g) of Bacteria, Fungi and Actinomycetes of Bournvita (B1,B2 and B3) and Horlicks (H1,H2 and H3) Samples after 120 days at interval of 07 days interval

S. No	Test Energy Food Under Different Conditions	Sampling Period (days)	Dilution	Effect of Handling on Microbial Load			
				Bacteria	Fungi	Actinomycetes	Total CFU
1.	**Bournvita (Consumers)**						
	B1 (A)	**7**	10^{-3}	2,00,000	--	--	2,00,000
		14	10^{-3}	3,30,000	--	1,10,000	4,40,000
		21	10^{-3}	4,70,000	46,000	1,60,000	6,76,000
		28	10^{-3}	5,70,000	69,000	2,20,000	8,59,000
	B2 (B)	**7**	10^{-3}	1,90,000	--	--	1,90,000
		14	10^{-3}	5,40,000	--	45,000	4,25,000
		21	10^{-3}	6,20,000	12,000	2,70,000	9,02,000
		28	10^{-3}	6,30,000	14,000	3,00,000	9,44,000
	B3 (C)	**7**	10^{-3}	1,70,000	--	--	1,70,000
		14	10^{-3}	3,80,000	--	45,000	4,25,000
		21	10^{-3}	5,30,000	12,000	1,20,000	6,62,000
		28	10^{-3}	5,70,000	14,000	1,30,000	7,14,000
2.	**Horlicks (Consumers)**						
	H1 (A)	**7**	10^{-3}	1,80,000	--	--	1,80,000
		14	10^{-3}	3,90,000	--	1,30,000	5,20,000
		21	10^{-3}	4,50,000	81,000	1,90,000	7,21,000
		28	10^{-3}	4,60,000	82,000	2,30,000	7,72,000
	H2 (B)	**7**	10^{-3}	2,30,000	--	--	-2,30,000
		14	10^{-3}	3,90,000	--	41,000	4,31,000
		21	10^{-3}	5,30,000	71,000	1,10,000	7,11,000
		28	10^{-3}	5,80,000	80,000	1,30,000	7,90,000
	H3 (C)	**7**	10^{-3}	1,40,000	--	--	1,40,000
		14	10^{-3}	2,10,000	--	11,000	2,21,000
		21	10^{-3}	4,50,000	--	45000	4,95,000
		28	10^{-3}	5,10,000	40,000	81,000	6,31,000

Table 3: Bacterial species identified from different samples of Bournvita (B1, B2 and B3) and Horlicks (H1, H2 and H3) after used by consumers (A, B and C)

Consumer	Energy food	Bacteria Identified
A	B1	*Staphylococcus aureus, Bacillus cereus, Enterococcus*
	H1	
B	B2	*Staphylococcus aureus, Bacillus cereus, Enterococcus, Escherichia coli, Pseudomonas aeruginosa*
	H2	
C	B3	*Staphylococcus aureus, Bacillus cereus, Enterococcus*
	H3	

Results obtained from the present investigation revealed that bacteria were present in all the samples of Bournvita and Horlicks while fungi and actinomycetes were completely absent in the samples when container were opened and closed in sterilized conditions under laminar air flow. It is much obvious that microbial load interim of bacterial species was already present in Bournvita and Horlicks since beginning. Although bacterial population could not show any constant pattern of their increase or decrease in CFU/g value but has shown variation in their declined and enhanced value. However, enhanced bacterial count has been recorded in Horlicks sample (Table 1). These findings are in accordance to the other workers who have reported the contaminants in cereal based food as well as raw and dried milk.

Infants food and dried milk harbours the microbial contaminants since their sealed finished product and several reports have been made in this regard. Variation in bacterial count among the different container may be related with manufacturing conditions *i.e.* manpower, industrial cleanliness, and packing container quality. Although opening and closing of sealed pack under strict aseptic conditions could control to minimize the bacterial growth in both energy foods. Speedy enhancement in generic level (fungi and actinomycetes) as well as their quality (in bacterial count) could establish the impact of handling and storing environmental conditions. It is directly related with handling as all consumers (A, B and C) handled routinely as normal and common practice in the society. Besides this, time and temperature may be a major factor for enhancing the bacterial population. Time and temperature, which governs the microbial proliferation in food items changes the color and pH therefore, this can be used for monitoring of food quality (Hariklia *et al.* 2008).

Presence of certain bacterial species *Staphylococcus aureus, E.coli, Enterococcus* and *Bacillus cereus* in both energy foods is a serious problem. Therefore, it is highly needed to improve manufacturing conditions as well as to educate the consumers to follow hygienic conditions in public interest to prevent any outbreak from these energy foods.

Conclusion and Recommendations

On the basis of the results of present investigation, the microbiological quality of energy foods *i.e.* Bournvita and Horlicks are influenced to varying degrees of microbial contamination even in their sealed finished packets. Presence of certain bacterial species such as *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Enterobacter* and *Bacillus* in both energy food is a serious problem and it is directly related with inappropriate production method, production environment handling and packaging material. Moreover high count of harmful microorganism such as *P.aeruginosa*, *S.aureus*, *E.coli* etc may affect the human health and can cause serious health hazards in children and infants. Therefore, there is a necessity of improving the energy food quality and to establish better hygienic conditions in public interest to overcome any serious hazard/ outbreak through such type of energy foods.

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Watershed characteristics of Shiwalik torrents at Sabhawala in Doon Valley

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Abstract

In the foothills of Shiwalik Himalaya, torrents are the prominent seasonal land features and characterized by high sediment ladder flash flow during monsoon period. These torrents have low banks and thus the flow frequently over tops the banks and causes floods in foot hill region to agricultural plain area. In present study, morphological, water and soil characteristics were studied with special references to torrential behavior and flow mechanics of torrent at Sabhawala watershed in Doon Valley of Garhwal Himalaya. The torrent gradient had varied from 1-75 to 2-62 % with flow velocity was 0.30 - 0.95 ms^{-1}, occurred in Sabhawala watershed. Different forms of soil texture of torrent were observed and pH slightly alkaline consisting organic matter (%) as 0.24-0.95 in different zones of torrent The present study will provide resource based data for remedial measurement of torrent in other watersheds of Himalayan region.

Keywords: *Doon valley, Stream order, Torrents, Watershed*

Introduction

The Himalayan region is particularly sensitive to natural land disturbing activities. Steep slopes, high rainfall and weak geology of the Himalayas accentuate the land degradation and soil erosion process at much faster rate than in the plains due to fragile ecosystem (Das, 1986). In the head water reaches the sediment and flushed them with high velocity currents and reached the relatively flat foothills alongwith debris. Sediment starts accumulating on the river bed causing change of river course and flooding its bank. These rivers with flash flows and high sediment loads are known as torrents. This is the most common problem in, Himalayas spread over the northern states of India. In the foothills of Shivalik Himalaya, torrents are the prominent land features. The torrents are seasonal in nature and characterized by high sediment ladder flash flow during monsoon period. These torrents have low banks and thus the flow frequently over tops the banks and cause floods The problem of torrent menace has been rising in Himalayas with the rise in population pressure and related mismanagement of upstream watersheds (Singh *et al.*, 1990). Torrents are causing vast area submergence and damage to life, property and infrastructure almost every year.

Moreover, the torrents have meandering nature *i.e.* they often change their course and cause damage of adjoining land, life and property. Torrent effected states include Uttarakhand, Punjab, Haryana, Jammu & Kashmir, Himachal Pradesh, Assam and the north eastern states (Juyal *et al.*, 2005). To effectively tackle the menace of torrents through appropriate soil and water conservation measures, it is necessary to systematically study the mechanism and behaviour of torrents through geomorphological characterization and analysis of watershed physiographic features. The physio-logical features of a watershed help in inter-comparison of watersheds for the purpose of deciding priority areas in developmental planning and execution. In the present study the torrential behaviour of watersheds originating from outer Himalayas and Shiwalik ranges has been studied and compared through morphometric analysis.

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Materials and Method

Study area

Uttarakhand is a state located in the Northern part of India. It extends from 28º 43' N to 31º 27' N longitude and 77º 34' E to 81º 02' E la borders China (Tibet) on the North, Ne East and the Indian states of Uttar Prad South, Haryana to the West and Himachal Pradesh to the North West. Uttarakhand has a total geographic area of 53,483 km² out of which 93% is mountainous and 64% is covered by forest. Most of the northern parts of the state are part of Greater Himalayan ranges, covered by high Himalayan peaks and glaciers, while the lower foothills are densely forest. Climate in the Shivaliks is hot in summer and cold in winter. The temperature in summer goes more than 45° C and while in winter it goes sometimes below 0° C. Rainfall is quite favorable in this area and is more than 1100 mm per annum. However its main concentration is in monsoon season (about 80% of the total precipitation).

Methodology

A lot of torrential watersheds originating from Shiwalik Himalaya foothill regions have been identified and delineated on the topo sheets received from Survey of India on the scale of 1 :50000. These maps were exploded to the scale of 1:10000 for the purpose of finding out various morphological characteristics and selecting the watersheds only third and fourth order streams were considered for systematic analysis. All the watersheds drain caused natural hazards in forest as well as agricultural plain basin and lastly drained into Asan river, a tributary of Yamuna river. In analytical observations of watersheds, various morphological characteristics of the watersheds such as area, perimeter, and maximum length of flow, average width, form factor, average slope and drainage density and physico-chemical analysis as followed by APHA (1998) and Khanna and Bhutiani (2004). Soil analysis as organic carbon, moisture content, pH and available NPK were determined by Anderson and Ingram (1993), Walkley and Black (1934) and Eno (1960).

Results and Discussion

The characteristics of Sabhawala watershed and geomorphic catchment of the Shiwalik torrent ranges had been characterized by narrow width and high gradient at the upper reaches of its upstream of forest area and wide spreading beds in downstream catchment basin area towards riverine plain region. In the present study, torrent was measured as 200 meter length span. In each zone comprised, the total length was 2.4 km and the total average gradient (%) was recorded 2.19 %. In Zone A and B the torrent width was ranged in 36-75 meter and 21-33 meter having the bank height ranged 1.5 -2.0 meter and 2.5-2.8 meter along with the gradient (%) was 1.75 to 2.62 respectively (Table 1). In water characteristics, the flow velocity (m s^{-1}) was recorded in the range of 0.95, 0.85, 0.65 and 0.30 in Zone A B C and D respectively. The torrent water discharge Q (m^3s^{-1}) was calculated as 18.00, 27.54, 21.06 and 24.00 in the zone A, B, C and D respectively. The turbidity (NTU) was measured in range 3780 to 5200 in torrent water sampling zones (Table 2).The largest component comprising the mixture of particles creating turbidity in rivers is caused by erosion of materials from the contributing watershed. Turbidity may be created from a wide variety of eroded materials, including clay, silt or mineral particles from soils or from natural organic matter created by the decay of vegetation. Particles may capture and hide or mask, other inorganic and organic constituents that are present in the watershed. In the riparian area, there is variation in landform, soil, topography, land use and hydrology (Yadav and Bhushan, 2002). Therefore, these factor influence erodibility of the soil, which is of practical interest in conservation planning. However there are certain limitation (slope and topography) associated with this kind of field study in the riparian areas as against its in-situ determination of soil characteristics.In the physico-chemical characteristics of soil in the torrent area, the soil texture (sil) was recorded common in Zone A, B and C, having the pH range 6.25, 7.40 and 7.50 respectively. The Zone D has sicl soil texture with maximum pH value as 7.80.

Table 1: Morphological characteristics of torrent channel at Sabhawala watershed.

S.No.	Zones	Subzones	Torrent length (m)	Torrent width (m)	Torrent bank height (m)	Torrent gradient (%)
1	**A**	a	200	75	1.5	1.75
		b	200	41	1.7	
		c	200	36	2.0	
2	**B**	a	200	33	2.5	2.62
		b	200	28	2.7	
		c	200	21	2.8	
3	**C**	a	200	5	3.0	1.75
		b	200	5	3.0	
		c	200	100	0.5	
4	**D**	a	200	200	0.25	2.62
		b	200	-	-	
		c	200	-	-	
			Total length= 2.4 km			**Average= 2.19**

Table 2 : Water characteristics of the torrent channel at Sabhawala watershed during rainy season

S. No	Zones	Flow velocity V (m s^{-1})	Hydraulic measures and Discharge Q (m^3 s^{-1})				Turbidity (NTU) Mean value
			W	D	A	Q	
1	A	0.95	50	0.60	30.0	18.00	3780
2	B	0.85	27	1.20	32.4	27.54	4045
3	C	0.65	36	0.90	32.4	21.06	4460
4	D	0.30	200	0.40	80.0	24.00	5200

V= Flow velocity (m s^{-1}), W=width of torrential water, D= depth of water during torrential flow, A=Total area (M3), Q= Discharge (m^3s^{-1}),

Table 3: **Physico-chemical characteristics of soil in the Sabhawala watershed**

S No	Zones	Soil texture	pH	Water holding capacity (%)	Organic matter (%)	Available Nutrient (kg/ha)		
						N	P	K
1	A	Sil	6.25	7.56	0.95	215	32	162
2	B	Sil	7.40	10.66	0.24	70	5	78
3	C	Sil	7.50	17.85	0.27	96	11	88
4	D	Sicl	7.80	20.70	0.32	102	18	154

The water holding capacity (%) was measured in range 7.56 to 20.70. The organic matter (%) was calculated in range of 0.24 to 0.95 with maximum at Zone A. The available nutrients (kg/ha) N, P, K were found maximum as 215, 32 and 162 respectively at zone A. Minimum value of N, P, K as 70, 05 and 78 respectively at zone B (Table 3). Selection of appropriate location for growing sorghum by employing water holding capacity, soil depth and organic carbon in combination with land form was found useful in Maharastra (Sharma *et al.*, 1997). Steep slope and high relative relief in Sabhawala watershed were led to the low availability of agricultural land. Due to the population pressure on cultivated land there has been resulted in large scale encroachment on the forest land for extension of agriculture land and thus deforestation had denuded the forest cover

and caused many steep torrential streams from the upper forest heights. The research data revealed that morphological, water and soil characterstics of torrent in forest, agricultural area and habitation region play vital contribution as base data for engineering and bioengineering treatment measures to rehabilitate the watersheds in Shiwalik as well as in other Himalayan region.

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Water Quality characteristics of River Tons at District-Dehradun, Uttarakhand (India)

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Abstract

In the present research work an approach to assess the water quality status of Tons river at Dehradun (Uttarakhand) has been done during Jan 2008 to June 2008. The Tons is the largest tributary of the Yamuna and flows through Garhwal region in Uttarakhand, touching Himachal Pradesh. Its source lies in the 20,720 ft (6,315 meters) high Bandarpunch mountain, and is one of the most major perennial Indian Himalayan rivers. The parameters studied were temperature, velocity, TS, TDS, TSS, pH, free CO_2, DO, hardness, calcium, magnesium, BOD, COD, chloride and alkalinity. Except DO all the studied parameters showed higher range of values in summer period and lower values in winter period. On the other hand DO showed reversed pattern by reveling maximum values in winter which may be due to higher solubility of oxygen at lower ambient temperature. Water of river Tons is of alkaline in nature so far as pH is concerned. The average values of BOD, TS, hardness and alkalinity were observed beyond the standard limits. The presence of bacteria was clearly shown by the value of BOD which has gone beyond the standard limit that can affect public health by causing fatal diseases.

Keywords: *BOD, Chloride, DO, Hardness, TDS*

Introduction

The Tons is the largest tributary of the Yamuna and flows through Garhwal region in Uttarakhand, touching Himachal Pradesh. Its source lies in the 20,720 ft (6,315 meters) high Bandarpunch mountain, and is one of the most major perennial Indian Himalayan rivers. This river is mainly glacial fed having some tributaries named as Bhitrall river, Kiarkuli river, Nalhota river, Noon river and Nimi river. In fact, it carries more water than the Yamuna itself. On its course, a large stretch of this River passes through the western part of Dehradun which is the capital of Uttrakhand state. Along its stretch in Dehradun there are situated Forest Research Institute Campus, Indian Military Academy Campus, cantonment area, a famous picnic spot named Robber's Cave and famous Tapkeshwer Mahadev temple. The Tons river merges into Yamuna river near Assan Barrage in Dehradun adjacent to the boundary of Uttarakhand and Himachal State. This is an ultimate source of water for drinking and irrigation purpose for the people of near by Town and villages. Very few studies has been conducted to assess the water quality of Tons river till now. Due to the importance of river for the villagers and tourists this study has been conducted.

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Materials and Method

Some of the physico-chemical parameters like TS, TDS, TSS, DO, BOD, COD, chloride, hardness, calcium, magnesium and alkalinity were observed in the laboratory. Temperature, velocity, pH, and free CO_2 were observed at the spot. Grab sampling collection method was adopted through out the study. Sampling preservation and analytical methods were adopted as per APHA (1998), Trivedi and Goel (1986), Khanna and Bhutiani (2004).

Results and Discussion

The average value of observed physico-chemical parameter of samples are given in Table-1 and 2 and shown in Fig. 1-8. The average values of temperature ranged between 11.50 ± 0.28-20.80 ± 0.23. A more or less similar trend has been observed by Khanna and Bhutiani (2003) in the river Ganga at Haridwar and Khanna *et al.* (2008)

in stream Nalhota at Dehradun. The value of velocity was observed between 0.99±0.12-1.51±0.05 m/s. Total solids, total dissolved solids and total suspended solids were found between 583.33±109.71-1050.00±200.23mg/l,186.66 ± 31.83-366.66±28.86 mg/l and 350.00±76.46-650.00±150.17 mg/l respectively. Khanna and Bhutiani (2007) in River Suswa found same thing. pH value fluctuated in between 7.50±0.00-8.16±0.l6. Singh *et al.* (2006) observed the same pattern in the River Ganges at Anupshahar, Bulandhshar.The similar trend has been observed by Khanna *et al.* (2007) in Song. Dissolved oxygen and biochemical oxygen demand ranged between 10.12±0.23-7.01±0.75 mg/l and 2.15 ±0.35-3.77±0.35 mg/l respectively. Kulkarni *et al.* in Khushavati river at Quepem, Goa and Khaiwal *et al.* (2003) reported in the River Yamuna.

Table 1: Average value of physical parameters of Tons River from January 2008 to June 2008

Month / Parameter	January	February	March	April	May	June	Average
Temperature (°C)	11.50 ±0.28	12.60 ±0.20	14.90 ±0.14	17.70 ±0.43	18.90 ±0.14	20.80 ±0.23	16.30 ±4.05
Velocity (m/s)	0.99 ±0.12	1.02 ±0.09	1.16 ±0.07	1.37 ±0.01	1.42 ±0.02	1.51 ±0.05	1.24 ±0.21
Total solid (mg/l)	583.33 ±109.71	650.00 ±100.11	716.66 ±92.90	750.00 ±173.20	786.66 ±131.84	1050.00 ±200.23	756.10 ±161.25
TDS (mg/l)	186.66 ±31.83	233.33 ±33.36	266.66 ±16.68	266.66 ±16.68	283.33 ±33.36	366.66 ±28.86	267.21 ±59.64
TSS (mg/l)	350.00 ±76.46	400.00 ±100.11	446.66 ±92.90	500.00 ±76.46	566.66 ±92.90	650.00 ±150.17	485.55 ±110.48

Table 2: Average value of chemical parameters of Tons river from January 2008 to June 2008

Month / Parameters	January	February	March	April	May	June	Average
pH	7.50±0.00	7.83±0.16	8.00±0.00	8.00±0.00	8.16±0.16	8.16±0.l6	7.94±0.09
Free CO_2 (mg/l)	0.88±0.25	1.00±0.l4	1.17±0.14	1.46±0.l4	1.61±0.25	1.90±0.14	1.33±0.38
DO (mg/l)	10.12±0.23	9.58±0.35	9.30±0.39	8.77±0.95	8.09±0.61	7.01±0.75	8.81±1.12
Hardness (mg/l)	381.33±8.11	385.33±6.75	397.33±4.37	400.00±3.71	406.66±5.03	409.33±2.90	396.66±11.27
Calcium (mg/l)	118.89±2.91	122.24±2.31	126.24±2.00	127.58±4.17	130.29±4.05	132.26±2.31	126.24±4.98
Magnesium (mg/l)	45.00±1.53	46.40±0.69	46.97±0.19	48.02±0.20	48.71±0.l9	48.83±0.10	47.32±1.48
BOD (mg/l)	2.15±0.35	2.83±0.23	2.97±0.35	3.17±0.52	3.47±0.61	3.77±0.35	3.06±0.56
COD (mg/l)	3.36±0.09	3.52±0.09	3.68±0.18	4.16±0.18	4.21±0.l3	4.42±0.10	3.89±0.42
Chloride (mg/l)	30.76±31.71	31.71±0.46	35.66±1.78	37.49±2.15	41.65±1.24	43.54±1.24	36.80±5.15
Alkalinity (mg/l)	220.00±7.64	228.33±6.01	240.00±7.64	241.66±7.27	245.00±8.67	250.00±8.67	237.49±11.19

The sample showed Chemical oxygen demand value in between 3.36±0.09-4.42±0.10 mg/l. Hardness, calcium and magnesium varied between 381.33±8.11-409.33±2.90 mg/l, 118.89 ±2.91-132.26±2.31 and 45.00 ± 1.53 - 48.83 ± 0.10 mg/l respectively. A similar trend has been found by Bhandari and Nayal. (2006) in the River Kosi in Uttarkhand. Free CO_2 ranged between 0.88±0.25-1.90±0.14 mg/l. A similar trend has been found by Khanna *et al.* (2006) in river Suswa and Khanna *et al.* (2008) in stream Nalhota at Dehradun. Chloride was found between 30.76 ± 31.71-43.54±1.24 mg/l. Alkalinity varied between 220.00 ± 7.64 - 250.00 ± 8.67 mg/l.

Khanna and Singh (2000) found similar trend in River Suswa in Raiwala. Except DO all the studied parameters showed higher range of values in summer period and lower values in winter period. On the other hand DO showed reversed pattern by reveling maximum values in winter which may be due to higher solubility of oxygen at lower ambient temperature. Water of river Tons is of alkaline so far as pH is concerned. . The average value of pH, DO, COD and Chloride were obtained with in the prescribed tolerance limits of drinking purpose (BIS-1991) where the average values of BOD, TS, hardness and Alkalinity were observed beyond the standard limits. The presence of bacteria was clearly shown by the value of BOD which has gone beyond the standard limit that can affect public health by causing fatal diseases. Indian standards of drinking water (BIS-1991) are given in table-3.

Table-3: Standard limits of drinking water in terms of physico-chemical parameters

Parameters	Desirable limit
pH	6.5-8.5
TS (mg/I)	500
DO (mg/I)	>6.0
BOD	2.0
Hardness (mg/I)	300.0
Calcium hardness (mg/I)	75.0-200.0
Magnesium hardness (mg/I)	30.0-100.0
Alkalinity (mg/l)	<200.0
Chloride (mg/I)	250.0

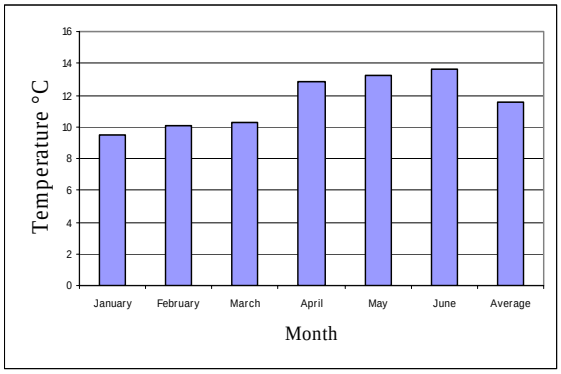

Fig: 1: Monthly fluctuation in Temperature °C

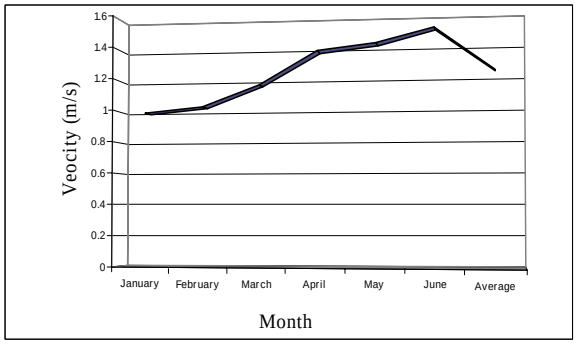

Fig: 2: Monthly fluctuation in Velocity (m/s)

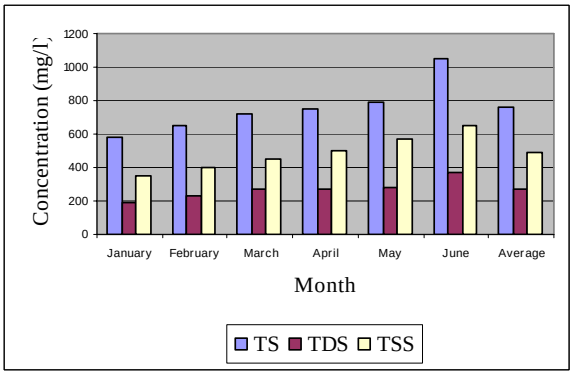

Fig 3: Monthly fluctuation in Total solid, TDS and TSS (mg/l)

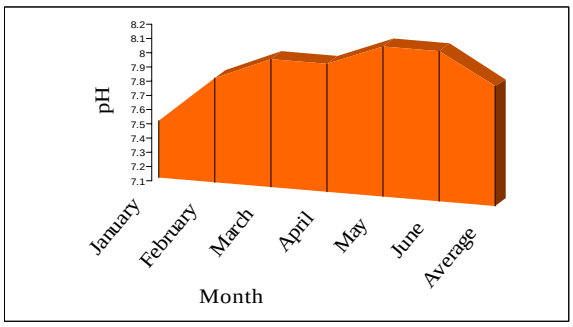

Fig. 4: Monthly fluctuation in pH

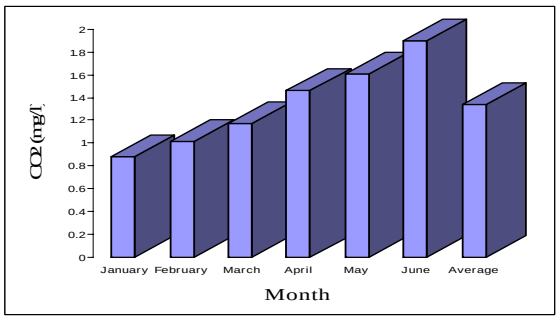

Fig: 5: Monthly fluctuation in Free CO_2 (mg/l)

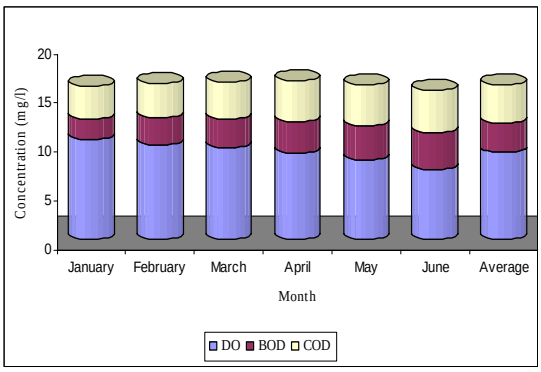

Fig: 6: Monthly fluctuation in DO, BOD and COD (mg/l)

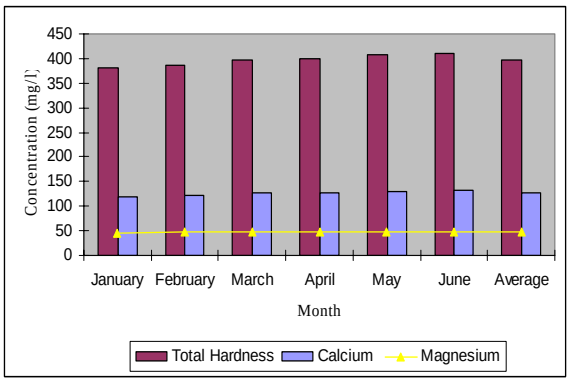

Fig: 7: Monthly fluctuation in Total Hardness, Calcium and Magnesium (mg/l)

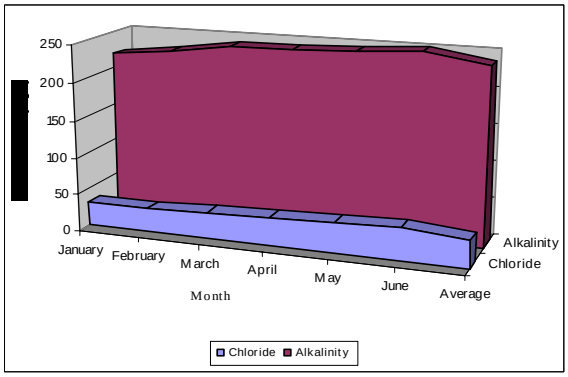

Fig: 8: Monthly fluctuation in Chloride and Alkalinity (mg/l)

The correlation coefficients among the different parameters are presented in Table 4. The analysis show the high degree positive correlation of temperature with other parameters except DO. Besides this the high degree positive correlation was also found between velocity and TSS, velocity and CO2, velocity and hardness, velocity and calcium, velocity and BOD, velocity and COD, velocity and chloride, velocity and alkalinity, TS and TSS, TS and TDS, TS and CO_2, TS and Chloride, TDS and TSS, TDS and CO_2, TDS and hardness, TDS and calcium, TDS and BOD, TDS and chloride, TDS and alkalinity, TSS and CO_2,

Table 4- Correlation coefficient among the different Parameters

	Temperature	Velocity	TS	TDS	TSS	pH	CO_2	DO	Hardness	Calcium	Magnesium	BOD	COD	Chloride	Alkalinity
Temperature	00.00	0.99	0.90	0.92	0.98	0.92	0.99	-0.96	0.99	0.99	0.96	0.95	0.99	0.98	0.98
Velocity		00.00	0.87	0.87	0.96	0.86	0.98	-0.94	0.96	0.96	0.45	0.92	0.99	0.92	0.93
TS			00.00	0.98	0.95	0.77	0.93	-0.96	0.86	0.88	0.82	0.89	0.87	0.90	0.86
TDS				00.00	0.95	0.86	0.93	-0.96	0.90	0.93	0.88	0.94	0.88	0.91	0.92
TSS					00.00	0.88	0.99	-0.99	0.95	0.97	0.44	0.96	0.96	0.92	0.93
pH						00.00	0.86	-0.85	0.94	0.96	0.45	0.96	0.87	0.84	0.96
CO_2							00.00	-0.98	0.95	0.96	0.94	0.94	0.98	0.98	0.93
DO								00.00	-0.92	-0.94	-0.42	-0.94	-0.94	-0.90	-0.90
Hardness									00.00	0.99	0.96	0.94	0.95	0.98	0.98
Calcium										00.00	0.98	0.97	0.95	0.97	0.99
Magnesium											00.00	0.48	0.45	0.71	0.45
BOD												00.0	0.93	0.89	0.96
COD													00.00	0.90	0.92
Chloride														00.00	0.88
Alkalinity															00.00

TSS and hardness, TSS and calcium, TSS and BOD, TSS and COD, TSS and chloride, TSS and alkalinity, pH and hardness, pH and calcium, pH and BOD, pH and alkalinity, Free CO_2 and hardness, Free CO_2 and Calcium, Free CO_2 and magnesium, Free CO_2 and BOD, Free CO_2 and COD, Free CO_2 and chloride, Free CO_2 and

alkalinity, hardness and calcium, hardness and magnesium, hardness and BOD, hardness and COD, hardness and chloride, hardness and alkalinity, calcium and magnesium, calcium and BOD, calcium and COD, calcium and chloride, calcium and alkalinity, BOD and COD, BOD and alkalinity, COD and chloride, COD and alkalinity. The analysis shows the high degree negative correlation of DO with all other parameters. The statistical analysis of present study shows the correlation coefficient among the parameters was negative 14 times and positive 91 times. This study indicated the dominancy of positive correlation.

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