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Effect of herbicide (basalin EC) on pollen germination and tube growth of twelve hours stored pollen of five cultivars of Apocynaceae: Further evidence of a criticism of Banerji and Gangulee (1937), Sudhakaran (1967-Ph.D.Thesis), Dharurkar (1971 - Ph.D. Thesis), Berg (1973), Brandt (1974), Vick and Bevan (1976), Rasmussan (1977), Navara, Horvath and Kaleta (1978), Mhatre (1980-Ph.D. Thesis), Mhatre, Chaphekar, Ramani Rao, Patil, Haldar (1980), Shetye (1982-Ph.D. Thesis) and Giridhar (1984 -Ph.D. Thesis) – A Critical Review

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Abstract

All the concentrations (10^{-17}-10^{-2}-10^{-3}, 1, 5, 10, 20-20-100 mg/ml) of basalin EC tried suppressed the germination of pollen of F-72 series of pink-flowered cultivar of *Catharanthus roseus*. Basalin EC stimulated the germination of pollen and tube growth in either sets in all the 5 cultivars of the Apocynaceae. Stored pollen shows the decrease in the germinability of pollen as well as tube growth in control and treated sets in all the 5 cultivars of the Apocynaceae.

Key Words : *Palynology, Toxicology, Environmental Sciences.*

Running Title : Effect of basalin EC on stored pollen of Apocynaceae

Introduction

The use of vegetation as biological indicator of environmental quality has a long history dating back to the miners canary, to the recognition about 100 years ago. Recent studies have shown the feasibility of using natural vegetation for monitoring pollution (Berg, 1973; Brandt, 1974; Rasmussan, 1977; Navara, Horvath and Kaleta, 1978).

Materials and Methods

Pollen of successive flowers (*viz.* F, F-24, F-48, F-72 series *i.e.* open flowers and the flower buds which require 24, 48, 72 hours to open respectively.) of 5 cultivars of the Apocynaceae *e.g.* red-, pink- and white-flowered cultivars of *Nerium odorum* Soland. and pink- and white-flowered cultivars of *Catharanthus roseus* (L.) G. Don. were collected at the stage of the dehiscence of anthers in the open flowers and stored at room temperature (21-31°C) having RH 59% and in diffuse laboratory light at the department of botany, Govt. Institute of Science, Mumbai. Pollen viability was tested by using 2,3,5-triphenyl tetrazolium chloride (Hauser and Morrison, 1964). Germination of stored pollen grains of successive flowers was made with 2 hours intervals for the first 12 hours in the optimum concentrations of sucrose as well as in the optimum concentrations of sucrose supplemented with the optimum concentrations of basalin EC (Table 1). However, the present investigation is restricted only with the pollen stored 12 hours at the room temperature (Table 1). Observations were recorded 24 hours after incubation. For each experiment a random count of

200 grains was made to determine the percentage of pollen viability and germination. For measurement of length of pollen tubes 50 tubes were selected randomly and measured at a magnification of 100x.

Results and Discussion

Pollen viability is a subject that has a great deal of practical as well as theoretical interest. In the present investigation even the different cultivars of the same species show the variations in the percentage of their pollen viability (Table 1). Reduced pollen viability has been interpreted as an indication of suspected hybridity in wild populations. Nevertheless, variations in pollen viability may affect the breeding systems of the species concerned, and if the pollen viability can be altered by the environment, then the breeding system itself may be under some degree of environmental control.

Potentiality of the germinability of pollen is noted only in F series of pink- and white-flowered cultivars of *Nerium odorum*. Both of them are single-flowered cultivars (Salgare, 1983) Potentiality of the germinability of pollen was recorded in F and F-24 series of *Physalis minima* and *Solanum xanthocarpum* (Ram Indar, 1981), in red-flowered (double-flowered) cultivar of *Nerium odorum* and in white-flowered cultivar of *Catharanthus roseus* (Salgare, 1983), in all the 5 cultivars of *Petunia grandiflora* (Sharma, 1984), in all the 5 cultivars of *Solanum melongena* (Singh, 1985) and in all the 5 cultivars (light-violet-, pink- violet- and white-violet-flowered cultivars) of *Petunia axillaris* except for white-flowered cultivar (Salgare, 1986a). Pollen germination *in vitro* culture of sucrose was noted in F, F-24 and F-48 series of *Brunfelsia americana* and in violet-flowered form of *Datura fastuosa* (Ram Indar, 1981), in all the 3 cascades (Sharma, 1984) and in white-flowered cultivar of *P. axillaris* (Salgare, 1986a). However, it was the pollen of white-flowered form of *D. fastuosa* (Ram Indar, 1981) and pink-flowered cultivar of *C. roseus* (Salgare, 1983) showed their germination *in vitro* culture of sucrose in all the 4 series (F, F-24, F-48, F-72 series) investigated. Potentiality of the germinability of pollen in all the 4 series investigated was also noted by Salgare (1986g) in 3 Leguminous crops *viz. Cyamopsis tetragonoloba* Var. Pusa Navbahar – gawar, *Phaseolus aureus* Var. J-781- mung and *Phaseolus mungo* Var. T-9- urid. Theresa Sebastian (1987) observed the germination of pollen of one of the Leguminous crops *i.e. Vigna mungo* Type 9, of Uttar Pradesh in all the 4 series investigated *in vitro* culture of sucrose. Suwarna Gawde (1988) noted the germinability of pollen of 2 Leguminous crops *viz. Vigna unguiculata* Var. Pusa Barsati – cowpea and *Vigna radiata*. Var. Pusa Baisakhi of Delhi in all the 4 series investigated. Johri and Chowdhury (1957) stated that in *Citrullus colocynthis*, where pollen grains 'mostly remained attached in tetrads', satisfactory germination is observed.

Salgare (1983) observed the germination of pollen of F-72 series of pink-flowered cultivar of *Catharanthus roseus invitro* culture of sucrose. However, Trisa Palathingal (1990) failed to germinate the pollen of F-72 series of pink-flowered cultivar of *C. roseus* in Brewbaker and Kwack's, (1963) culture medium. This proves that the culture medium is also having the bearing on the germination of pollen. This also points out that Brewbaker and Kwack's, (1963) culture medium is not ideal for pollen culture.

As a rule the percentage of pollen germination is always less than the pollen viability. However, Banerji and Gangulee, (1937) and Dharurkar, (1971) reported higher percentage of pollen germination than the pollen viability in *Eichhornia crassipes*. The claim of Banerji and Gangulee, (1937) and Dharurkar, (1971) is challenged by Salgare, (1986c, 95, 2000b, 6d) who stated that the observations of Banerji and Gangulee, (1937) and Dharurkar, (1971) are exaggerating.

All the concentrations (10^{-17}-10^{-2}-10^{-3}, 1, 5, 10, 20-20-100 mg/ml) of basalin EC tried suppressed the germination of pollen of F-72 series of pink-flowered cultivar of *C. roseus* (Table 1). Pollen of F series of duet, F-24 series of white cascade, duet and sonata and F-48 series of all the 3 cascades did not germinate when treated with 10^{-17} mg/ml of basalin EC. All of them are the cultivars of *Petunia grandiflora* (Sharma, 1984). Even the lowest concentration (10^{-17} mg/ml) of basalin EC tried suppressed the germinability of pollen of F-24 series of light-violet- and violet-flowered cultivars of *Petunia axillaris* (Salgare, 1986a). This proves that the pollen of the said series are highly sensitive and acts as an ideal indicators of pollution. Thus it is confirmed that the pollen development and activity are more sensitive indicators of adverse factors in the botanical environment and the use of an entire vascular plant (Berg, 1973; Brandt, 1974; Vick and Bevan, 1976; Rasmussan, 1977; Navara, *et al.*, 1978; Mhatre, 1980; Mhatre, *et al.* 1980; Shetye, 1982 and Giridhar, 1984) as an indicator of pollution is a very crude method and rather a wrong choice. There is no evidence of any entire vascular plant exhibiting this much degree of sensitivity. This is confirmed in the present critical review. This was already proved earlier by Salgare (1983, 84, 85a-c, 86a, d-g, 2000a, 01a-b, 05a-c, 06b, f), Salgare and Theresa Sebastian (1986), Salgare and Phunguskar (2002), Salgare and Singh (2002, 06a-b) and Salgare and Sanchita Pathak (2005) and his Research Group (Ram Indar, 1981; Sharma, 1984; Singh, 1985; Theresa Sebastian, 1987; Suwarna Gawde, 1988 and Trisa Palathingal, 1990) in their extensive work.

Basalin EC stimulated the germination of pollen and tube growth in either sets in all the 5 cultivars of the Apocynaceae. Stored pollen caused decrease in the germinability of pollen and tube growth in control as well as treated sets in all the 5 cultivars of the Apocynaceae (Table 1). Stored pollen of F series of all the 3 cultivars and F-24 series of red-flowered cultivar of *Nerium odorum* and F-24 and F-48 series of pink-flowered cultivar of *Catharanthus roseus* failed to germinated *in vitro* culture of sucrose after 10 hours of their sowing. However, they were found germinated *in vitro* culture of sucrose supplemented by basalin EC (Table 1). This proves that the herbicide extended the longevity of the stored pollen.

In many instances due to hyper- or hypo-nutrition the percentage of germination and length of the tube are considerably reduced. Bursting of pollen also increases and occasionally the pollen tubes were observed to eject their content. In addition to this various pollen tube deformities *viz.* 'bloating' or 'bulla' formation resulting in the swelling of the tip of the pollen tube were also observed. In the pollen tubes that grew in the coiled or *zig-zag* manner the wall was not straight. *Catharanthus roseus* though characterized by the presence of monosiphonous condition at a low frequency bisiphonous and trisiphonous condition was also recorded in the present investigation along with the branched pollen tubes. In this connection it should be pointed out that Sudhakaran (1967) stated that in *Vinca rosea* L. [*Catharanthus roseus* (L.) G. Don.] besides pollen grains which produced single pollen tube, it has also been noticed that tetraploid grains frequently produce more than one pollen tube. Pollen tubes are branched quite frequently. Aberrations of this type in the pollen tube development are not observed in diploid pollen tubes, but quite frequently met with the pollen grains of irradiated plants. Salgare (1983) made it very clear that Sudhakaran (1967) had failed to trace out the branched pollen tubes and polysiphonous condition which is fairly common even in diploid pollen grains. Apart from this Sudhakaran (1967) was not able to report the various types of pollen tube deformities either with diploid or tetraploid grains. Present investigation as well as the extensive work of Salgare (1983, 86b, 2006a, c, e, g) proved that the observations of Sudhakaran (1967) are superficial and misleading.

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Table 1. Effect of basalin EC on pollen germination and tube growth of twelve Hours stored pollen of five cultivars Apocynaceae.

			pgtgsaps							pgtg 12 haps				
			C			T				HC	C	T	C	T
Species	Series	PV	SC	G	µm	HC	G	HC	µm	HC	G	G	µm	µm
N.odorum pink-flowered	F	80	50	35	1485	10^{-15}	38	10^{-17}	1490	10^{-15}	Ng_1	25	Ng_1	0386
N.odorum red-flowered	F	74	20	20	1250	10^{-15}	30	10^{-17}	1450	10^{-15}	Ng_1	28	Ng_1	0640
N.odorum white-flowered	F	62	50	20	0675	10^{-15}	30	10^{-17}	1000	10^{-15}	Ng_1	29	Ng_1	0516
C.roseus pink-flowered	F	90	20	60	1575	10^{-15}	78	10^{-17}	1867	10^{-15}	45	78	967	1256
C.roseus white-flowered	F	88	20	40	1256	10^{-15}	76	10^{-17}	1280	10^{-15}	28	70	110	0483
N.odorum red-flowered	F-24	74	20	06	0485	10^{-15}	23	10^{-17}	0490	10^{-15}	Ng_1	20	Ng_1	0320
C.roseus pink-flowered	F-24	90	50	28	0240	10^{-15}	70	10^{-17}	1025	10^{-15}	Ng_1	16	Ng_1	0600
C.roseus white-flowered	F-24	88	50	16	0248	10^{-15}	76	10^{-17}	0407	10^{-15}	06	40	80	0272
C.roseus pink-flowered	F-48	90	50	14	0095	10^{-15}	60	10^{-17}	0390	10^{-15}	Ng_1	Ng_1	Ng_1	Ng_1
C.roseus pink-flowered	F-72	90	80	10	0065	Ng_2	Ng_2	Ng_2	Ng_2	Ng_2	01	Ng_2	015	Ng

C, in control sets pollen germination and tube growth; G, germination of pollen in %; HC, optimum concentrations of herbicid in mg/ml; Ng_1 and Ng_2, no germination of pollen after 12 and 24 hours of sowing respectively; pgtgsaps, Pollen germination an tube growth in the sets, sets soon after pollen storage; pgt12 haps, Pollen germination and tube growth in the sets, sets 12 Hou after pollen storage at room temperature; SC, optimum concentrations of sucrose in %, PV, pollen viability in %, T, in treate sets pollen germination and tube growth; µm, pollen tube length in µm.

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Monitoring of herbicide (MH) toxicity by using pollen as indicators - Pollen of five cultivars of *Petunlia axillaris* BSP.: Further evidence of a criticism of Banerji and Gangulee (1937), Dharurkar (1971 - Ph.D. Thesis), Berg (1973), Brandt (1974), Vick and Bevan (1976), Rasmussan (1977), Navara, Horvath and Kaleta (1978), Mhatre (1980 - Ph.D. Thesis), Mhatre, Chaphekar, Ramani Rao, Patil, Haldar (1980), Shetye (1982 - Ph.D. Thesis) and Giridhar (1984 - Ph.D. Thesis) - A Critical Review

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Abstract

Germination of pollen of F series of white-flowered and white-violet-flowered and F-24 series of white-violet-flowered cultivars of *Petunia axillaris* was noted even in 100 mg/ml MH.

Key words : *Physiology of Pollen, Palylnology, Toxicology, Environmental Sciences,*

Running Title: Monitoring of MH toxicity by using pollen of *Petunlia axillaris*

Introduction

Extensive use of herbicides leaves behind residues which contaminate our environment. It is primarily needed to work out some simple system for the evaluation of the toxicity of herbicides.

Materials and Methods

Pollen of successive flowers (*viz.* F, F-24, F-48, F-72 series *i.e.* open flowers and the flower buds which require 24, 48, 72 hours to open respectively) of 5 cultivars of *Petunia axillaris* BSP. *e.g.* light-violet-, pink-, violet-, white- and white-violet-flowered cultivars were collected at the stage of the dehiscence of anthers in the open flowers. Germination of pollen grains of successive flowers was studied by standing-drop technique in the optimum concentrations of sucrose (acts as control) as well as in the optimum concentrations of sucrose supplemented by the different concentrations (10^{-17}-10^{-2}-10^{-3}, 1, 5, 10, 20-20-100 mg/ml) of Maleic Hydrazide (MH) (1,2-dihydropyridazine, 3-6-dione) (Table 1). The cultures were then transferred to a moist filter chamber, stored at room temperature (21.9-32.2°C) having RH 58% and in diffuse laboratory light. Observations were recorded 24 hours after incubation. For each experiment a random count of 200 grains was made to determine the percentage of pollen germination. For measurement of length of pollen tubes, 50 tubes were selected randomly and measured at a magnification of 100x.

Results and Discussion

Potentiality of pollen germinability was noted in F and F-24 series of all the 5 cultivars of *Petunia axillaris* and in F-48 series of white-flowered cultivar of *P. axillaris*. Thus the potentiality of pollen germinability in

P. axillaris was recorded in 11 out of 20 series investigated (Table 1). Potentiality of the germinability of pollen is noted only in F series of pink- and white-flowered cultivars of *Nerium odorum*. Both of them are single-flowered cultivars (Salgare, 1983). Potentiality of the germinability of pollen was recorded in F and F-24 series of *Physalis minima* and *Solanum xanthocarpum* (Ram Indar, 1981), in red-flowered (double-flowered) cultivar of *N. odorum* and in white-flowered cultivar of *Catharanthus roseus* (Salgare, 1983) and in all the cultivars (light-violet-, pink-, violet- and white-violet-flowered cultivars) of *Petunia axillaris* except for white-flowered cultivar (Salgare, 1986a). Pollen germination *in vitro* culture of sucrose was noted in F, F-24 and F-48 series of *Brunfelsia americana* and in violet-flowered form of *Datura fastuosa* (Ram Indar, 1981) and in white-flowered cultivar of *P. axillaris* (Salgare, 1986a). However, it was the pollen of white-flowered form of *D. fastuosa* (Ram Indar, 1981) and pink-flowered cultivar of *C. roseus* (Salgare, 1983) showed their germination *in vitro* culture of sucrose in all the 4 series (F, F-24, F-48, F-72 series) investigated. Potentiality of the germinability of pollen in all the 4 series investigated was also noted by Salgare (1986d) in 3 Leguminous crops *viz. Cyamopsis tetragonoloba* Taub. var. Pusa Navbahar – gawar, *Phaseolus aureus* Roxb. var. J-781- mung and *Phaseolus mungo* Roxb. var. T-9- urid. Theresa Sebastian (1987) observed the germination of pollen of one of the Leguminous crops *i.e. Vigna mungo* (L.) Hepper Type 9, of Uttar Pradesh in all the 4 series investigated *in vitro* culture of sucrose. Suwarna Gawde (1988) noted the germinability of pollen of 2 Leguminous crops *viz. Vigna unguiculata* (L.) Walp. var. Pusa Barsati – cowpea and *Vigna radiata* (L.) Wilczek. var. Pusa Baisakhi of Delhi in all the 4 series investigated. Johri and Chhaya Roy Chowdhury (1957) stated that in *Citrullus colocynthis,* where pollen grains 'mostly remained attached in tetrads', satisfactory germination is observed.

Salgare (1983) observed the germination of pollen of F-72 series of pink-flowered cultivar of *Catharanthus roseus in vitro* culture of sucrose. Trisa Palathingal (1990) stated that the pollen of F-72 series of pink-flowered cultivar of *Catharanthus roseus* did not germinate in Brewbaker and Kwack's (1963) culture medium. This proves that the culture medium is also having the bearing on the germination of pollen. This points out that Brewbaker and Kwack's (1963) culture medium is not ideal for the pollen culture.

Even the lowest concentration (10^{-17} mg/ml) of MH tried suppressed the germinability of pollen of F-24 series of red-flowered cultivar of *Nerium odorum* and F-48 and F-72 series of pink-flowered cultivar of *Catharanthus roseus* (Salgare, 1983). Singh (1985) stated that the germinability of pollen of F series of brinjal round and F-24 series of brinjal long, muktakeshi and round was prevented even by the lowest concentration (10^{-17} mg/ml) of MH. All of them are the cultivars of *Solanum melongena*. This proves that the pollen of the said series are highly sensitive and acts as an ideal indicators of pollution. Thus it is confirmed that the pollen development and activity are more sensitive indicators of adverse factors in the botanical environment and the use of an entire vascular plant (Berg,1973; Brandt, 1974; Vick and Bevan, 1976; Rasmussan, 1977; Navara, Horvath and Kaleta, 1978; Mhatre, 1980; Mhatre, *et al.*,1980; Shetye, 1982 and Giridhar, 1984) as an indicator of pollution is a very crude method and rather a wrong choice. There is no evidence of any entire vascular plant exhibiting this much degree of sensitivity. This is confirmed in the present critical review (Table 1) and was also proved earlier by Salgare (1983, 84, 85a-c, 86a-d, 2000, 1a-b, 05a- c, 06), Salgare and Theresa Sebastian (1986), Salgare and Phunguskar (2002), Salgare and Sanju Singh (2002) and Salgare and Sanchita Pathak (2005) and Salgare's Research Group (Ram Indar, 1981; Sharma, 1984; Singh, 1985; Theresa Sebastian, 1987; Suwarna Gawde, 1988 and Trisa Palathingal, 1990) also supports the present findings.

Inhibition in the germination of pollen was caused by MH in 13, 7, 4, 6, 11 series of Solanaceae (Ram Indar,

1981), Apocynaceae (Salgare, 1983), *Petunia grandiflora* (Sharma, 1984), *Solanum melongena* (Singh, 1985) and *Petunia axillaris* (Table 1) respectively.

The widest range of concentrations of MH found to be 10^{-17}- 10, 10^{-5}-100, 10^{-17}-40, 10^{-17}-100 mg/ml which inhibited the germination of pollen of *Petunia axillaris* (in F-24 series of violet-flowered cultivar) (Salgare, 1986a-Table 1), Apocynaceae (in F series of pink-flowered cultivar of *Catharanthus roseus* (Salgare, 1983), *Petunia grandiflora* (in F series of pink and white cascades) (Sharma, 1984) and brinjal (in F series of all the five cultivars of brinjal except for brinjal round) (Singh, 1985) respectively.

Sub-toxic concentration of MH caused as high as 96.67%, 98.59, 75.00, 96.77, 96.00% inhibition in the pollen germination of *P. axillaris* (in F series of pink-flowered cultivar) (Table 1), Solanaceae (in F series of violet-flowered form of *Datura fastuosa* (Ram Indar, 1981), Apocynaceae (in F series of white-flowered cultivar of *Nerium odorum* and F-24 series of white-flowered cultivar of *C. roseus* (Salgare, 1983), *P. grandiflora* (in F series of pink cascade) (Sharma, 1984) and brinjal (in F-24 series of brinjal small) (Singh, 1985) respectively.

Ratio between the series and inhibition caused by MH (in sub-toxic concentration) in the germination of pollen is as (Inhibition is represented in the form of percentage):

F:F-24:F-48:F-72 = 92.70:84.53:80.00:00.00 in *Petunia axillaris* (Table 1-Salgare, 1986a)

F:F-24:F-48:F-72 = 89.70:93.84:81.74:70.58 in Solanaceae (Ram Indar, 1981)

F:F-24:F-48:F-72 = 75.00:75.00:00.00:00.00 in Apocynaceae (Salgare, 1983)

F:F-24:F-48:F-72 = 94.28:96.77:00.00:00.00 in *Petunia grandiflora* (Sharma, 1984)

F:F-24:F-48:F-72 = 00.77:78±4.56:00.00:00.00 in brinjal (Singh, 1985)

This shows that MH caused maximum inhibition in the germination of pollen of F series of *Petunia axillaris* (Table 1), F-24 series of Solanaceae (Ram Indr, 1981), F and F-24 series of Apocynaceae (Salgare, 1983), F-24 series of *Petunia grandiflora* (Sharma, 1984) and of F-24 series of brinjal (Singh, 1985).

MH inhibited the pollen tube growth in 13, 7, 4, 6, 11 series of Solanaceae (Ram Indar, 1981), Apocynaceae (Salgare, 1983), *Petunia grandiflora* (Sharma, 1984), *Solanum melongena* (Singh, 1985) and *Petunia axillaris* (Table 1) respectively.

The widest range of the concentrations of MH tried, found to be 10^{-17}- 100, 10^{-17}-100, 10^{-17}-100, 10^{-17}- 40, 10^{-17}-100 mg/ml which inhibited the pollen tube growth of *Petunia axillaris* (in F and F-24 series of white-violet-flowered cultivar) (Salgare, 1986a-Table 1), Solanaceae (in white-flowered form of *Datura fastuosa*) (Ram Indar, 1981), Apocynaceae (in F series of pink- and red-flowered cultivars of *Nerium odorum* and pink-flowered cultivar of *Catharanthus roseus* and F-24 series of red-flowered cultivar of *N. odorum*)(Salgare, 1983), *Petunia grandiflora* (in F series of pink and white cascades) (Sharma, 1984) and brinjal (in F series of all the cultivars of *Solanum melongena* except for brinjal round) (Singh, 1985) respectively.

Sub-toxic concentration of MH caused as high as 80.00% inhibition in the pollen tube growth of *Petunia axillaris* (in F-24 series of light-violet-flowered cultivar) (Salgare, 1986a-Table 1). However, the maximum inhibition in the pollen tube growth *viz.* 96.14, 77.78, 94.59, 78.72%) was reported by Ram Indar (1981) in

Solanaceae (in F series of *Brunfelsia americana*), Salgare (1983) in Apocynaceae (in white-flowered cultivar of *Nerium odorum*), Sharma (1984) in *Petunia grandiflora* (in F series of red cascade) and Singh (1985) in *Solanum melongena* (in F-24 series of brinjal small) respectively

Ratio between the series and inhibition caused by MH (in sub-toxic concentration) in the pollen tube growth is as (Inhibition is represented in the form of percentage):

F:F-24:F-48:F-72 = 69.45:67.86:77.78:00.00 in *Petunia axillaris* (Table 1-Salgare, 1986a)

F:F-24:F-48:F-72 = 89.70:93.84:81.74:70.58 in Solanaceae (Ram Indar, 1981)

F:F-24:F-48:F-72 = 75.00:75.00:00.00:00.00 in Apocynaceae (Salgare, 1983)

F:F-24:F-48:F-72 = 94.28:96.77:00.00:00.00 in *Petunia grandiflora* (Sharma, 1984)

F:F-24:F-48:F-72 = 00.77:78±4.56:00.00:00.00 in brinjal (Singh, 1985)

This shows that MH caused maximum inhibition in the pollen tube growth of F-48 series of *Petunia axillaris* (Table 1), F-24 series of Solanaceae (Ram Indar, 1981), F and F-24 series of Apocynaceae (Salgare, 1983), F-24 series of *Petunia grandiflora* (Sharma, 1984) and F-24 series of brinjal (Singh, 1985).

Tube length *in vitro* culture (sucrose + MH) of MH (in sub-toxic concentration) is 0.03% (in F series of light-violet-, pink-, and violet-flowered and F-24 series of light-violet- and pink-flowered cultivars of *Petunia axillaris*) in *P. axillaris* of the tube length found *in vivo* is the longest of all the cultivars investigated (Table 1).

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Table 1. Inhibitory effect of MH on pollen germination and tube growth of successive flowers of five cultivars of *Petunia axillaris* BSP.

			iocs				rchi		pgtgstch				
Cultivars	Series	PV	SC	PG	TG	V/O	RCPG	RCTG	HC	PG	TG	V/O	TC
Light-violet-	F	76	50	32	030	0.09	10^{-17}-40	10^{-17}-40	40	88.57	66.67	0.03	40
Pink-	F	93	50	28	035	0.11	10^{-17}-40	10^{-17}-40	40	96.67	75.00	0.03	60
Violet-	F	80	50	25	038	0.11	5-60	10^{-17}-60	60	92.86	66.67	0.03	80
White-	F	95	30	34	080	0.24	10^{-7}-100	60-100	NWO	NWO	NWO	NWO	NWO
White-violet-	F	90	30	30	325	0.88	5-100	10^{-17}-100	NWO	NWO	NWO	NWO	NWO
Light-violet-	F-24	76	30	25	045	0.14	10^{-5}-60	10^{-17}-60	60	89.29	80.00	0.03	80
Pink-	F-24	93	10	16	030	0.09	10^{-13}-40	10^{-17}-40	40	92.86	60.00	0.03	60
Violet-	F-24	80	60	25	030	0.09	10^{-17}-10^{-13}	10^{-7}-60	60	64.29	60.00	0.29	80
White-	F-24	95	10	26	030	0.09	10^{-3}-20	10^{-17}-20	20	91.67	71.43	0.29	40
White-violet-	F-24	90	30	30	210	0.57	10^{-17}-100	10^{-17}-100	NWO	NWO	NWO	NWO	NWO
White-	F-48	95	10	13	40	0.12	10^{-7}-60	10^{-17}-60	60	80.00	77.78	0.29	80

HC, concentrations of herbicide in mg/ml; iocs, in optimum concentrations of sucrose germination of pollen and tube growth; Ng, no germination; NOW, not worked out; PG, pollen germination in %; pgtgstch, pollen germination and tube growth in sub-toxic concentrations of herbicide; PV, pollen viability in %; rchi, range of concentrations of herbicide for inhibition of pollen germination and tube growth; rcpg, range of concentrations of herbicide for inhibition of pollen germination; rctg, range of concentrations of herbicide for inhibition of pollen tube growth; SC, optimum concentrations of sucrose in %; TG, pollen tube growth in µm; V/O, *in vitro* tube length in compare to *in vivo* in%.

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Pond and riverine algae of Khargone, Madhya Pradesh

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Abstract

Algae were collected from temporary and permanent water accumulations and banks of river Kunda at Khargone during 2005. In all 68 algal taxa were recorded, out of these 34 taxa belong to ponds and 18 to the river Kunda while remaining 16 algal taxa are common to both Pond and river.

Keywords: *Phycology, Lentic and Lotic Systems.*

Introduction

In past few decades various workers have reported a large number of algae from different parts of India. Phycological studies of Khargone and its neighbourhood areas have earlier been done by Seerwani (1963) and Mahajan (1987, 1988, 2004 and 2005) but a detailed comparative study of Ponds and riverine algae is still lacking. In the Present investigation an attempt has been made to study the distributional pattern of algal flora of Khargone in lentic and lotic water bodies.

Khargone ($27^0$45' N, $75^0$30' E and 250.38 m above MSL) is the district headquarter of West Nimar of M.P. It is 89 Km from Khandwa Central Railway Station. The average rainfall is 709.20 mm. The algal flora of West Nimar is very rich and there is much scope for algalogical studies in future.

Material and Methods

For the present study two different types of water bodies i.e. settling tank, Adampur dam, temporary and permanent water accumulations of Khargone representing the lentic system and Sarkari Ghat, Navgrah Ghat and Meldera Ghat of river Kunda representing the lotic system, were selected. All the sites are situated in different parts of Khargone city.

The algal samples were collected at monthly intervals during the period January to December 2005. Identification of algal forms was done with the help of relevant literature and monographs (Desikachary, 1959; Randhawa, 1959; Phillipose, 1967; Ahmed, 1967 and Venkateswarlu, 1970).

Enumeration of algal flora

A. Only in Pond :

Cyanophyceae

Anabaena ambigua Rao forma,
Arthrospira martinii,
Cylindrospermum spirale kg.,
Gloeocapsa stegophila (Itz,) Rabenh.,
Gloeotrichia raciboraskii Wolosz. forma.,
Lyngbya dendrobia Bruhl et. Biswas.,

Microcystis aeruginosa Kutz.,
Nostoc linckia (Roth.) Born et. Flah forma.,
Oscillatoria sancta Kutz.,
Rivularia bacearíana (De Not) Born et. Flah.,
Spirulina major Kutz.,
S. mahajanii Mahajan.,

Bacillariophyceae

Cymbella cistula (Hempr.) Grwn.,
Navicula viridis Kutz.,

Chlorophyceae

Chara zeylanica Wild,
Chlorella vulgaris Beyernick,
Cladophora glomerata (Linn.) kutz.,
Closterium monoliferum (Bory.) Ehrenb.,
Coleochaete orbicularis Pring.,
Cosmarium granatum Breb.,
Desmidium swartzii Ag.,
Edorina elegans Ehrenb.,
Hydrodictyon reticulatum (L.) Lagerh (Planktonic).
Mougeotia affinis Kg.,
Oedocladium indicum Singh,
Oedogonium sylvaticum Halles forma.,
Pandorina morum (Muell.) Bory.,
Pleurococcus naegelii (Cohdat.),
Sirogonium indicum Singh.,
Spirogyra elongata Kg.,
S. neglecta (Hass.) Kutz.,
Vaucheria terrestris Lyng. em. Walz.,
Stigeolonium tenue Kutz. (Ag.) and *Englena viridis* Ehrenb.

Euglenophyceae

Euglena uiridis Ehrenb (Planktonic).

B. Only in river

Cyanophyceae

Anabaena variabilis Kuetz.ex Born.et Flah. (Periphytic)
Lyngbya lutea (Agar.) Gom. (Planktonic)

Oscillatoria formosa Bory ex Gom. (Planktonic)

O. ornata Kuetz. var. crassa Rao, C.B. (Planktonic)

O. princeps Vauch. ex Gom. (Planktonic)

Bacillariophyceae

Cymbella tumida (Breb.) Gandhi (Planktonic)

Gomphonema lanceolatum var. affine (Kuetz.) A. Cl. (Planktonic)

Navicula constans Hust var, symmetrica Hust . (Periphytic)

N. minuta (Cleve) A.Cl. (Benthic)

Nitzschia kittonii Smith (Plankotonic)

N. microcephala Grun. var. elengantula Grun. (Periphytic)

Pinnularia balatonis (Pant.) Gandhi (Planktonic)

Synedra ulna var.subaequalis Grun (Planktonic)

Chlorophyceae

Closterium tumidum john. (Planktonic)

Euastrum spinulosum Delp. var. inermius Nordst. Benthic

Scenedesmus armatus Chod. var. *bicaudatus* (Gugi-Printz.) Chodat (Planktonic).

Spirogyra setiformis (Roth.) Kuetz. (Periphytic)

Euglenophyceae

Euglena polymorpha Dong (Planktonic)

C. **Common in Pond and river**

Cyanophyceae

Merismopedia punctata Meyen (Planktonic)

Nostoc calcicola Breb. ex Born. et Flah. (Planktonic)

Bacillariophyceae

Achnanthes exigua Grun. (Planktonic)

Cymbella cymbiformis (Kutez.) V.H. var. *Jimboii* (Pant.) A. Cl. (Planktonic)

Gomphonema constrictum Ehr. var *capitata* (Ehr.) Cl. (Planktonic)

Navicula inflata Donk (Planktonic)

Nitzschia umbilicata Hust. (Planktonic)

Chlorophyceae

Coelastrum microporum Naeg. (Planktonic)

Cosmarium auriculatum Reinsch (Planktonic)

Euastrum binale (Turb.) Ehr. var. *juvae* croas. (Benthic)

Pediastrum tetras (Ehr.) Ralfs .var. *excisum* (Rabenh.) Hans. (Planktonic)

Scenedesmus acuminatu (Lager) Chod. (Periphytic)

S. quadricauda (Trup.) Breb. (Planktonic)

S. quadricauda var. *bicaudatus* Hans. (Periphytic)

Spirogyra elliptica Jao (Benthic)

Euglenophyceae

Euglena acus Ehr. (Planktonic)

Results and discussion

The present study revealed that out of 68 algal taxa ,19 taxa belong to Cyanophyceae , 15 to Bacillariophyceae, 31 to Chlorophyceae and only 3 taxa to Euglenopyceae. Thus green algae are in maximum number followed by blue green and Diatoms. The representation of euglenophyceae is least in this survey.The taxa mentioned in section' C' indicate that they able to tolerate water pollution condition to some extent.

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Whether optimum pollen germination and tube length attained in the same growth medium (sucrose + basalin EC) by five cultivars of *Petunia axillaris* BSP.: Further evidence of a criticism of Banerji and Gangulee (1937), Sudhakaran (1967-Ph.D.Thesis), Dharurkar (1971 - Ph.D. Thesis), Nair, Nambudiri and Thomas (1973), Berg (1973), Brandt (1974), Vick and Bevan (1976), Rasmussan (1977), Navara, Horvath and Kaleta (1978), Mhatre (1980 - Ph.D. Thesis), Mhatre, Chaphekar, Ramani Rao, Patil, Haldar (1980), Shetye (1982 - Ph.D. Thesis) and Giridhar (1984 - Ph.D. Thesis) - A Critical Review

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Abstract

The widest range of concentration of basalin EC was proved to be 10^{-17}-10^{-11} mg/ml which stimulated the germination of pollen of *Petunia axillaris* BSP., while 10^{-17}-10^{-15} mg/ml was confirmed as the widest range of concentration which stimulated the tube growth. Pollen of F-24 series of pink-flowered cultivar showed the highest stimulation (142.86%) in the germination of pollen. Basalin EC produced maximum stimulation (66.67%) in the pollen tube growth of *P. axillaris* (in F series of violet-flowered cultivar).

Key Words : *Physiology of Pollen, Palylnology, Toxicology, Environmental Sciences*

Running Title : Effect of basalin EC on pollen germination and tube growth of *Petunia axillaris*

Introduction

The residual matter of the herbicides left over in the soil, may, further, proves to be an important factor in the growth of the subsequent crops.

Materials and Methods

Pollen of successive flowers (*viz.* F, F-24, F-48, F-72 series *i.e.* open flowers and the flower buds which require 24, 48, 72 hours to open respectively) of 5 cultivars (light-violet-, pink-, violet-, white- and white-violet-flowered) of *Petunia axillaris* BSP were collected soon after the dehiscence of anthers in the open flowers. Germination of pollen grains was studied by standing-drop technique in the optimum concentrations of sucrose which acts as control as well as in the optimum concentrations of sucrose supplemented with the wide range of concentrations (10^{-17}-10^{-2}-10^{-3}, 1, 5, 10, 20-20-100 mg/ml) of basalin EC. Pollen grains were incubated soon after the dehiscence of anthers. The cultures then transferred to a moist filter chamber, stored at room temperature (29.3-32.5°C) having RH 64% and in diffuse laboratory light. The experiments were run in triplicate and average results were recorded. Observations on the germination of pollen and tube growth were recorded 24 hours after incubation. For each experiment a random count of 200 grains was made to determine the percentage of pollen germination. For measurement of length of pollen tubes, 50 tubes were selected randomly and measured at a magnification of 100x.

Results and Discussion

Potentiality of the germinability of pollen was noted only in F series of pink- and white-flowered cultivars of *Nerium odorum*. Both of them are single-flowered cultivars (Salgare, 1983). Potentiality of the germinability of pollen was recorded in F and F-24 series of *Physalis minima* and *Solanum xanthocarpum* (Ram Indar, 1981), in red-flowered (double-flowered) cultivar of *Nerium odorum* and in white-flowered cultivar of *Catharanthus roseus* (Salgare, 1983) and in all the five cultivars (pink, red and white cascades, duet and sonata) of *Petunia grandiflora* (Sharma, 1984) in all the cultivars (light-violet-, pink-, violet- and white-violet-flowered cultivars) of *Petunia axillaris* except for white-flowered cultivar (Salgare, 1986a). Pollen germination *in vitro* culture of sucrose was noted in F, F-24 and F-48 series of *Brunfelsia americana* and in violet-flowered form of *Datura fastuosa* (Ram Indar, 1981), in all 3 cascades (Sharma, 1984) and in white-flowered cultivar of *P. axillaris* (Table 1). However, it was the pollen of white-flowered form of *D. fastuosa* (Ram Indar, 1981) and pink-flowered cultivar of *C. roseus* (Salgare, 1983) showed their germination *in vitro* culture of sucrose in all the 4 series (F, F-24, F-48, F-72 series) investigated. Potentiality of the germinability of pollen in all the 4 series investigated was also noted by Salgare (1986f) in 3 Leguminous crops *viz. Cyamopsis tetragonoloba* Taub. Var. Pusa Navbahar – gawar, *Phaseolus aureus* Roxb. Var. J-781- mung and *Phaseolus mungo* Roxb. Var. T-9- urid. Theresa Sebastian (1987-Ph.D.Thesis) observed the germination of pollen of one of the Leguminous crops *i.e. Vigna mungo* (L.) Hepper Type 9, of Uttar Pradesh in all the 4 series investigated *in vitro* culture of sucrose. Suwarna Gawde (1988) noted the germinability of pollen of 2 Leguminous crops *viz. Vigna unguiculata* (L.) Walp. Var. Pusa Barsati – cowpea and *Vigna radiata* (L.) Wilczek. Var. Pusa Baisakhi of Delhi in all the 4 series investigated. Johri and Chhaya Roy Chowdhury (1957) stated that in *Citrullus colocynthis,* where pollen grains 'mostly remained attached in tetrads', satisfactory germination is observed.

Salgare (1983) observed the germination of pollen of F-72 series of pink-flowered cultivar of *Catharanthus roseus in vitro* culture of sucrose. Trisa Palathingal (1990) stated that the pollen of F-72 series of pink-flowered cultivar of *C. roseus* did not germinate in Brewbaker and Kwack's (1963) culture medium. This confirms that Brewbaker and Kwack's (1963) culture medium is not perfect. This also proves that the culture medium is also having the bearing on the germination of pollen. This pointed out that Brewbaker and Kwack's (1963) culture medium is not ideal for pollen culture of successive flowers.

Even the lowest concentration (10^{-17} mg/ml) of basalin EC tried found to be toxic for the germination of F-24 series of light-violet- and violet-flowered cultivars of *Petunia axillaris* (Table 1), F-72 series of pink-flowered cultivar of *Catharanthus roseus* (Salgare, 1983) and F series of duet, all the 3 cultivars of cascades of F-48 series and except for pink and red cascades all the cultivars investigated of F-24 series of *Petunia grandiflora* (Sharma, 1984). This proves that the pollen of the said series are highly sensitive and acts as an ideal indicator of pollution. Thus it is confirmed that the pollen development and activity are more sensitive indicators of adverse factors in the botanical environment and the use of an entire vascular plant (Berg,1973; Brandt, 1974; Vick and Bevan, 1976; Rasmussan, 1977; Navara, Horvath and Kaleta, 1978; Mhatre, 1980; Mhatre, Chaphekar, Ramani Rao, Patil, Haldar, 1980; Shetye, 1982 and Giridhar, 1984) as an indicator of pollution is a very crude method and rather a wrong choice. There is no evidence of any entire vascular plant exhibiting this much degree of sensitivity. This is also confirmed in the present critical review (Table 1). This was already proved earlier by the extensive work of Salgare (1983, 84, 85a-c, 86a, c-e, 2000, 1a-b, 05b, d-e, 06a), Salgare and Theresa Sebastian (1986), Salgare and Phunguskar (2002), Salgare and Sanju Singh (2002) and Salgare and Sanchita Pathak (2005) and Salgare's Research Group (Ram Indar,

1981; Sharma, 1984; Singh, 1985; Theresa Sebastian, 1987; Suwarna Gawde, 1988 and Trisa Palathingal, 1990) also supports the present findings.

It was the only pollen of F series of pink-flowered cultivar of *Petunia axillaris* showed their germination even in 100 mg/ml basalin EC (Table 1). This proves that the pollen of the said series are very resistant.

The widest range of concentration of basalin EC was proved to be 10^{-17}-10^{-15} mg/ml which stimulated the germination of pollen of *Petunia axillaris* (Table 1), while Salgare (1983) and Sharma (1984) confirmed 10^{-17}-100 and 10^{-17}-10^{-11} mg/ml basalin EC as the widest ranges of concentrations for Apocynaceae (in F-24 and F-48 series of white- and pink- flowered cultivars of *Catharanthus roseus* respectively) (Salgare, 1983) and in *P. grandiflora* (in F series of red cascade) (Sharma, 1984) respectively.

Basalin EC stimulated the germination of pollen of 1, 8, 2 series of *Petunia axillaris* (Table 1) (Salgare, 1986a), Apocynaceae (Salgare, 1983) and *P.grandiflora* (Sharmal, 1984) respectively.

Ratio between the series and stimulation produced by basalin EC (in an optimum concentration) in the germination of pollen in the number of series is as:

F:F-24:F-48:F-72 = 0:1:0:0 in *Petunia axillaris* (Table 1-Salgare, 1986a)

F:F-24:F-48:F-72 = 4:3:1:0 in Apocynaceae (Salgare, 1983)

F:F-24:F-48:F-72 = 1:1:0:0 in *Petunia grandiflora* (Sharma, 1984)

This shows that basalin EC stimulated the germination of pollen in maximum number of series of F and F-24 series of Apocynaceae (Salgare, 1983) and *P. axillaris* (Table 1) (Salgare, 1986a) respectively, while in an equal number of series of F and F-24 series of *P. grandiflora* (Sharma, 1984).

An optimum concentration of basalin EC produced 142.86% stimulation in the germination of pollen of F-24 series of pink-flowered cultivar of *Petunia axillaris* (Table 1) (Salgare, 1986a), while as high as 375.00% and 75.00% in Apocynaceae (in F-24 series of white-flowered cultivar of *Catharanthus roseus*) (Salgare, 1983) and in *Petunia grandiflora* (in F series of red cascade) (Sharma, 1984) respectively.

Ratio between the series and stimulation produced by basalin EC (in an optimum concentration) in the germination of pollen is as (Stimulation is represented in the form of percentage):

F:F-24:F-48:F-72 = 00.00142.86:00.00:00.00 in *Petunia axillaris* (Table 1-Salgare, 1986a)

F:F-24:F-48:F-72 = 55.00:269.44:328.57:00.00 in Apocynaceae (Salgare, 1983)

F:F-24:F-48:F-72 = 75.00:25.00:00.00:00.00 in *Petunia grandiflora* (Sharma, 1984)

This shows that basalin EC produced maximum stimulation in the germination of pollen of F, F-25 and F-48 series of *Petunia grandiflora* (Sharma, 1984), *P. axillaris* (Table 1) (Salgare, 1986a) and Apocynaceae (Salgare, 1983) respectively.

Basalin EC stimulated the pollen tube growth of *Petunia axillaris* (Table 1) (Salgare, 1986a), Apocynaceae (Salgare, 1983) and *P. grandiflora* (Sharma, 1984) in 2, 6, 1 series respectively.

Ratio between the series and stimulation produced by basalin EC (in an optimum concentration) in the

pollen tube growth in the number of series is as:

F:F-24:F-48:F-72 = 2:0:0:0 in *Petunia axillaris* (Table 1-Salgare, 1986a)

F:F-24:F-48:F-72 = 3:2:1:0 in Apocynaceae (Salgare, 1983)

F:F-24:F-48:F-72 = 1:0:0:0 in *Petunia grandiflora* (Sharma, 1984)

This shows that basalin EC stimulated the pollen tube growth in maximum number of series of F series of all cases investigated.

The widest range of concentration of basalin EC was proved to be 10^{-17}-10^{-13} and 10^{-17}-80 mg/ml which stimulated the pollen tube growth of *P. axillaris* (in F series of light-violet-flowered cultivar) (Table 1) (Salgare, 1986a) and Apocynaceae (F-48 series of pink-flowered cultivar of *Catharanthus roseus*) (Salgare, 1983) respectively. The pollen tube length of F series of red cascade was stimulated by basalin EC in the range of 10^{-17}-10^{-7} mg/ml basalin EC (Sharma, 1984).

An optimum concentration of basalin EC produced as high as 66.67% and 327.08% stimulation in the pollen tube growth of *Petunia axillaris* (in F series of violet-flowered cultivar) (Salgare, 1986a) and Apocynaceae (in F-24 series of pink-flowered cultivar of *Catharanthus roseus*) (Salgare, 1983) respectively. An optimum concentration of basalin EC produced maximum stimulation (158.78%) in the pollen tube growth of *Petunia grandiflora* (in F series of red cascade) (Sharma, 1984).

Ratio between the series and stimulation produced by basalin EC (in an optimum concentration) in the pollen tube growth is as (Stimulation is represented in the form of percentage):

F:F-24:F-48:F-72 = 58.34:00.00:00.00:00.00 in *Petunia axillaris* (Table 1-Salgare, 1986a)

F:F-24:F-48:F-72 = 27.58:242.04:310.53:00.00 in Apocynaceae (Salgare, 1983)

F:F-24:F-48:F-72 = 158.78:00.00:00.00:00.00 in *Petunia grandiflora* (Sharma, 1984)

This shows that basalin EC produced maximum stimulation in the pollen tube growth of F series of both the species of *Petunia* (Salgare, 1986a and Sharma, 1984) and F-48 series Apocynaceae (Salgare, 1983).

Tube length *in vitro* culture (sucrose + basalin EC) of basalin EC (in an optimum concentration) is 0.14, 13.18, 1.99% in *Petunia axillaris* (in F series of light-violet- and violet-flowered cultivars) (Table 1) (Salgare, 1986a), in Apocynaceae (in F series of red-flowered cultivar of *Nerium odorum*) (Salgare, 1983) and *P. grandiflora* (in F series of red cascade) (Sharma, 1984) respectively of the tube length found *in vivo* is the longest of all the cultivars investigated.

However, 10^{-17}-10^{-13} mg/ml basalin EC proved to be the widest range of concentrations which stimulated the tube growth of *P. axillaris*. It was the pollen of F-24 series of pink-flowered cultivar of *P. axillaris* which showed the highest stimulation in the germination of pollen. Basalin EC produced as high as142.86% stimulation in the germination of pollen of successive flowers of *P. axillaris*. However, 66.67% stimulation proved to be the highest produced by the herbicide in the pollen tube growth of successive flowers of *P. axillaris* (Table 1) (Salgare, 1986a). It should be pointed out that horticulturists and plant breeders often failed to get the fertile seeds in spite of all the care taken during artificial pollination. Unless sterility is the main cause, failure of seed setting may be due to slow growth of the pollen tube or its early degeneration

in the style. As a rule, the length of the pollen tube obtained *in vitro* is significantly shorter than that *in vivo*. Consequently, one of the main problems is to obtain *in vitro* germination and tube length comparable to that *in vivo*. Tube length *in vitro* (in an optimum concentration of sucrose supplemented by an optimum concentration of basalin EC) is 0.14% in F series of light-white- and violet-flowered cultivars of *P. axillaris* of the tube length found *in vivo* is the longest of all the cultivars investigated of *P. axillaris* (Table 1) (Salgare, 1986a). Tube length *in vitro* is 13.18% in F series of red-flowered cultivar of *Nerium odorum* of the tube length found *in vivo* is the longest of all the cultivars investigated of Apocynaceae (Salgare, 1983). This proves that though basalin EC stimulated the pollen tube growth, however, it can not be produced as long as that found *in vivo*. However, the use of the herbicide as the growth substance is very economical.

It should be pointed out that in a few cases the length of the tubes in cultures does equal that in nature (Knight, 1917; Schoch-Bodmer, 1921; Brink, 1924; Branscheidt, 1929, 30; Ehlers, 1951; Vasil, 1960).

Pollen germination and tube elongation are two distinct processes differing in their sensitivity to different concentrations of the herbicide was also confirmed with the present work (Table 1) (Salgare, 1986a). However, Nair, *et al.*, (1973) stated that it has been significant that the optimum percentage of germination and tube length were attained in the same growth medium. However, with the present work (Table 1) as well as previous extensive work of Salgare (1979, 83, 86a-b, e, 2004, 05a, c, 06b-c), Salgare and Bindu (2002, 05) and Salgare and Tessy Mol Antony (2005a, b) it could be concluded that the observations of Nair, Nambudiri and Thomas (1973) are superficial and misleading.

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Table 1. Stimulatory effect of basalin EC on pollen germination and tube growth of successive flowers of five cultivars of *Petunia axillaris* BSP.

Table 1. Inhibitory effect of MH on pollen germination and tube growth of successive flowers of five cultivars of *Petunia axillaris* BSP.

			iocs				rchi		pgtgstch				
Cultivars	Series	PV	SC	PG	TG	V/O	RCPG	RCTG	HC	PG	TG	V/O	TC
Light-violet-	F	76	50	32	030	0.09	10^{-17}-40	10^{-17}-40	40	88.57	66.67	0.03	40
Pink-	F	93	50	28	035	0.11	10^{-17}-40	10^{-17}-40	40	96.67	75.00	0.03	60
Violet-	F	80	50	25	038	0.11	5-60	10^{-17}-60	60	92.86	66.67	0.03	80
White-	F	95	30	34	080	0.24	10^{-7}-100	60-100	NWO	NWO	NWO	NWO	NWO
White-violet-	F	90	30	30	325	0.88	5-100	10^{-17}-100	NWO	NWO	NWO	NWO	NWO
Light-violet-	F-24	76	30	25	045	0.14	10^{-5}-60	10^{-17}-60	60	89.29	80.00	0.03	80
Pink-	F-24	93	10	16	030	0.09	10^{-13}-40	10^{-17}-40	40	92.86	60.00	0.03	60
Violet-	F-24	80	60	25	030	0.09	10^{-17}-10^{-13}	10^{-7}-60	60	64.29	60.00	0.29	80
White-	F-24	95	10	26	030	0.09	10^{-3}-20	10^{-17}-20	20	91.67	71.43	0.29	40
White-violet-	F-24	90	30	30	210	0.57	10^{-17}-100	10^{-17}-100	NWO	NWO	NWO	NWO	NWO
White-	F-48	95	10	13	40	0.12	10^{-7}-60	10^{-17}-60	60	80.00	77.78	0.29	80

HC, concentration of herbicide in mg/ml; iocs, in optimum concentrations of sucrose germination of pollen and tube growth; germination; NOW, not worked out; PG, pollen germination in %; pgtgstch, pollen germination and tube growth in su concentrations of herbicide; PV, pollen viability in %; rchi, range of concentrations of herbicide for inhibition of pollen germ and tube growth; rcpg, range of concentrations of herbicide for inhibition of pollen germination; rctg, range of concentrat herbicide for inhibition of pollen tube growth; SC, optimum concentrations of sucrose in %; TG, pollen tube growth in µm; *vitro* tube length in compare to *in vivo* in%.

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Impact of stored effluents of slaughter houses on ground water quality of hand pumps situated nearby slaughter house at Khurja town, District- Bulandshahar (U.P.) India

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Abstract

Khurja is a tehsil of district Bulandshahar (U.P.) India which is famous for manufacturing of crockery products. There is a large scale slaughter house at Mundakhera road which discharges its blood red effluents in nearby ponds having area more than 5 acre. The city Khurja is situated on G.T. road between Aligarh and Bulandshahar cities and approximately 75 km away from Delhi towards south. This paper presents a case study of water quality of hand pumps situated around the ponds which receives more than 80% blood red effluents of slaughter house. The study reveals that the ground water quality of hand pumps selected within range of 2 km. from slaughter house is not suitable for drinking purpose with respect to colour, odour, pH, TDS, conductivity, hardness, DO, BOD and chloride at sampling points 1-3 while at sampling point 4 and 5 the parameter colour, odour, pH, hardness, BOD and chloride were found within limit of drinking purpose where as TDS, conductivity, and DO were observed beyond the limit.

Keywords: *Conductivity, TDS, Hardness, DO and BOD.*

Introduction

Khurja is a tehsil of district Bulandshahar (U.P.) India which is famous for crockery manufacturing industries. This town is situated on G.T. road between Bulandshahar-Aligarh and approximately 75 km away from Delhi. It has more than 2 lakh population of different communities. There is a big slaughter house between Mundakhera road and Bulandshahar road from where a large quantity of blood red effluents are discharge into near by ponds. The pond covers an area of 5-6 acres. More than 2 thousand animals are slaughtered in open area everyday and red effluents as well as their wastes are discharged into this pond. This pond is named as, Khooni Talaab by the people. This slaughter house comes under the Jurisdiction of Nagar palika but it seems that Government has never looked into the matter.

Inhabitants of the vicinity of the slaughter house are facing many problems due to highly polluted pond causing pungent, untolerable, bad smell and also ground water of hand pumps situated around this slaughter house. Therefore, it was proposed to assess the impact of stored effluents of slaughter house on ground water quality of hand pumps situated in the vicinity of slaughter house in respect of physico-chemical characteristics.

Several researchers/ workers have carried out studies on water of different sources in respect of physico-chemical parameters (Vaishya and Agarawal 1993, Abbasi *et al.* 1999, Soren and Julian 1977, Pande and Hasan 1979, Singh *et. al.* 1988, 1989, 1991, 1993 and 1994 and Khanna *et al.* 2003). So far it is reviewed that no such rype of investigations have been conducted to assess the impact of stored effluents of slaughter house on ground water quality of hand pumps situated near slaughter house. Hence, a study has been

carried out to assess the water quality of hand pumps selected in the vicinity of slaughter house in terms of physico- chemical characteristics and to forecast impact of such polluted water on human beings. Study has been made in the month of August-2005.

Material and Methods

The ground water samples were collected in a neat clean two liter capacity white plastic Jericanes for general parameters and samples for DO were taken in 300 ml capacity borosil glass bottles and DO was fixed by using $MnSO_4$ and alkaline azide reagents. Methods of analysis, sampling and preservation of samples were adopted as per standard methods of APHA-AWWA-WPCF, (1992), Trivedi and Goel, (1984), Kotiah and Kumaraswamy, (1994).

Parameters studies were colour, odour, pH, conductivity, dissolved solids, DO, BOD, total hardness, calcium hardness, magnesium hardness and chloride.

Slaughter house situated on Mundakhera road and its pond of stored effluents also touches the main GT road Khurja- Bulandshahar, Hand pumps were selected to collect the samples of ground water situated within the range of 2 Km. at diferent locations and distances from the slaughter house. Sampling sites were selected as per following points and map (fig.-1).

1. Hand pump situated adjacent to Slaughter house at plot of Mr.Padmi, Mundakhera road Khurja, district- Bulandshahar (U.P.). This sampling point is represented as -A.

2. Hand pump situated at 100 metre away from slaughter house at Khurja-Bulandshahar (U.P.) This sampling point is represented as -B.

3. Hand pump situated 1.0 Km. away near house of Mr. Mahendra Singh, Murari nagar from Khooni Talab (redish pond of slaughter house), Mundakhera road, Khurja, district Bulandshahar (U.P.) This sampling point is represented as -D

4. Hand pump situated 2.0 km. away at Khurja- Bulandshahar road from Khooni Talab Mundakhera road, Khurja, district- Bulandshahar (U.P.). This sampling point is represented as-E. All above hand pumps have been installed at depth of 30-45 feet approximately.

Results and Discussion

During the study period, five samples were collected from selected sites of hand pumps and analysed the parameters. The data obtained are shown in Table-1 and prescribed limit of BIS-(1991) and CPCB- (1997) have been given in Table-2 to compare the results of studies characteristics with respect to drinking purpose.

As it is clear from the results that the values of studied parameters ranged as pH 7.2-9.04, conductivity 1.08-2.95 μmhos/cm, DO 1.9-5.8 mg/I, BOD 0.0 - 3.9 mg/I, Total hardness 263-710 mg/I, Calcium hardness 170-420 mg/I, Magnesium hardness 88-356 mg/I, Chloride 134-679 mg/I, and Total Dissolved Solids 689-2913 mg/I, within the study area. Minimum values of these parameters obtained at sampling point-E except DO and Magnesium hardness where as maximum values of the characteristics were observed at sampling point -A except DO, and Total hardness. Minimum value of DO and Mangesium hardness were found at sampling point-A and while maximum value of DO and Total hardness observed at sampling point- E and

C (Table 1.) The parameters of colour, odour, pH conductivity, DO, BOD, Total Hardness, Calcium Hardness, Magnesium Hardness and Total Dissolved solids were not found as per prescribed standard of drinking purpose at sampling points-A, B and C as compared to other points but values of conductivity, DO and Total Dissolved Solids were also observed beyond the prescribed limit of drinking purpose BIS-(1991) and CPCB (1997) at all sampling points which may be due to contamination of ground water quality through percolation of stored effluents of slaughter house. However, the ground water quality of sampling points-D and E is far better than other sampling points with respect to colour, odour, pH, BOD, Total hardness and chloride which may be due to no much contamination of ground water quality percolation of stored effuents of slaughter house. Second reason may be distance factors of situated hand pumps location. It is evident from the Table-1 that as distance of the sampling points increases from the slaughter house, the values of the studied parameters also decreases besides DO. While an enhancement in DO is obtained. However it is not found as per standards limit. Therefore, ground water quality of selected hand pumps is alkaline in respect of pH and most contaminated ground quality was found at sampling points-A,B and C which may be due to seepaging of stored effluents of slaughter house. Ground water rich in carbonic acid and dissolved oxygen usually possesses a high solubilizing potential towards soil or rocks that contain appreciable amount of minerals calcite, gypsum and dolomite and consequently hardness level may increased

Table -1

Results of physico-chemical characteristics of ground water quality of hand pumps situated near slaughter in Khurja Town, District- Bulandshahar (U.P.) India.

Parameters	Date of sample collection	Sampling point (A)	Sampling point (B)	Sampling point (C)	Sampling point (D)	Sampling point (E)
Colour	17.8.2005	Straw	Straw	Light straw	Colourless	Colourless
Odour	17.8.2005	Untolerable	Untolerable	Unpleasant	No specific	Odourless
pH	17.8.2005	9.04	8.91	8.80	7.4	7.2
Conductivity µmhos/cm)	17.8.2005	2.95	2.62	2.01	1.68	1.08
TDS (mg/l)	17.8.2005	2913	2604	2438	910	689
DO (mg/l)	17.8.2005	1.9	2.4	2.3	5.4	5.8
BOD (mg/l)	17.8.2005	3.9	3.5	3.5	0.8	00
Total Hardness (mg/l)	17.8.2005	710	681	744	286	263
Calcium Hardness (mg/l)	17.8.2005	420	390	388	198	170
Magnesium Hardness (mg/l)	17.8.2005	290	291	256	88	93
Chloride (mg/l)	17.8.2005	679	312	366	143	134

(WHO 1984). That's why the values of conductivity, TDS and DO were observed beyond the limit of drinking purpose (Table-2) at all sampling points. Hence, the ground water quality of selected hand pumps situated within 500 metre range from slaughter house are not at all suitable for drinking purpose. Ground water quality of selected hand pumps situated beyond is 500 metre- 2 Km range i.e. Sampling points-D and E from slaughter house is better than other points because BOD values obtained at these points are found negligible. It is necessary to protect such contaminations which are polluting ground water quality.

Table - 2: Standards of water quality for drinking purpose in terms of physico- Chemical characteristics (BIS-1991 and CPCB-1997)

Parameters	Standard limits
Colour	Colourless
Odour	Odourless
pH	6.5-8.5
TDS (mg/l)	500.0
Conductivity (mmhos/cm)	1.0
DO (mg/l)	>6.0
BOD (mg/l)	2.0
Total hardness (mg/l)	300.0
Calcium hardness (mg/l)	200.0
Magnesium hardness (mg/l)	100.0
Chloride (mg/l)	250.0

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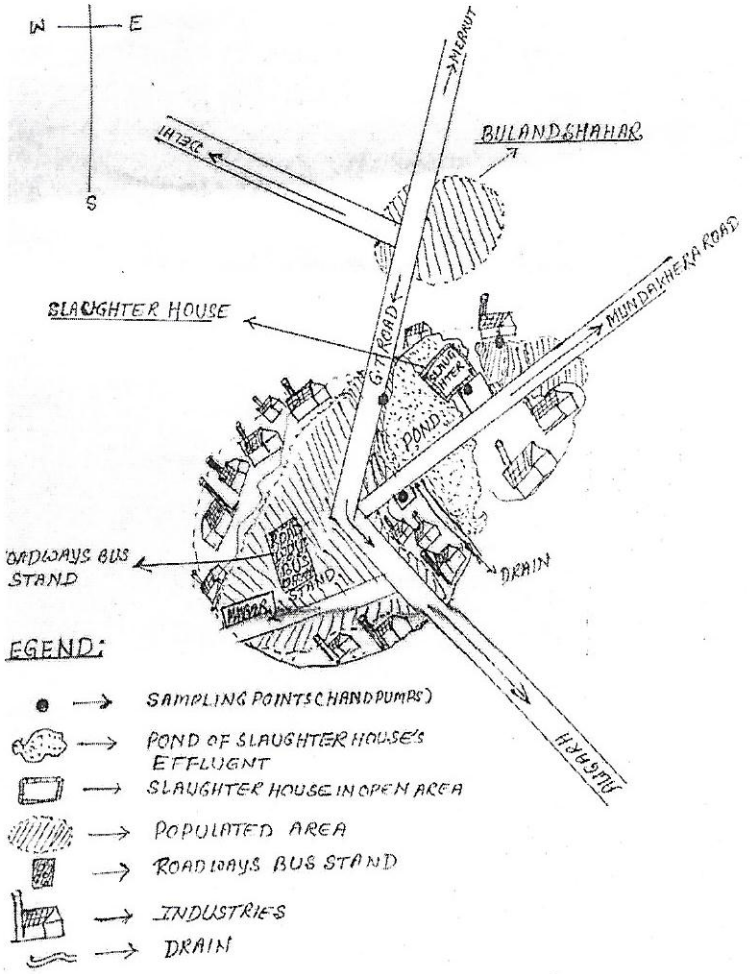
Fig. 1:-Map Showing Situation of sampling points (Handpumps) in the Vicinity of Slaughter House at Khurja, District-Bulandshahar (U.P.)



Legend :-

Sampling Points (handpumps)

Pond of Slaughter House's effluent

Slaughter House in open area

Populated Area

Road ways Bus stand

Industries

Drain

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Fecundity and sex ratio in *puntius conchonius* (pisces cyprinidae) from Garhwal Himalaya

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Abstract

The paper deals with the analysis of reproductive capacity of *Puntius conchonius* (Ham.-Buch.), an important ornamental fish inhabiting the river Mandal in Garhwal Himalaya. Study is based on 73 mature female specimens in a length ranging from 53 to 79 mm were collected from river Mandal. The absolute fecundity ranged from 523.0 ± 100.3 (fish length 54.2 ± 1.1 mm, fish weight 2782.5 ± 84.6 mg, ovary length 17.5 ± 1.2 mm and ovary weight 250.1 ± 12.7 mg) to 1366± 282 (fish length 77.4±1.4 mm, fish weight 8408 ± 861 mg, ovary length 26.2 ± 2.2 mm and ovary weight 584.7 ± 112.7 mg). Four linear relationships were observed between fecundity and different body parameters calculated by the method of least squares. Sex ratio of fish in nature was also studied monthly, which varied from 1:1 (April) to 1:1.8 (July) with an annual average 1:1.17 (male: female, X^2 = 0.013 which is insignificant) .Overall it was found very close to the natural one.

Introduction

The knowledge of fecundity, its mathematical relationship, with the body parameters and sex-ratio is considered very useful in fishery science 'as it provides prior information regarding number of eggs that are likely to be received for hatching process and further management of nursery etc. Sex- ratio is an indication of abundance of any sex at a particular time or whether the population is in natural ratio or not.

Significant contribution to the estimation of reproductive capacity of hill-stream fish have been made by Joshi and Khanna (1980), Pathani (1981), Nautiyal (1984), Nautiyal and Lal (1985), Dobriyal (1986,88, 2005), Dobriyal and Singh (1987,89,93), Agrawal, *et al.* (1988), Dobriyal, *et. al* (2000, 2003), Negi (1998), Rautela (1999), Thapliyal (2002) and Uniyal (2003). Present communication deals with the fecundity of an important ornamental fish *P. conchonius* (Ham.-Buch) from river Mandal of Garhwal Himalaya.

Material and Methods

The fish for present study were sampled during the years 2003-05 from river Mandal of Garhwal Himalaya, which flows close to the border of Garhwal and Kumaun region. After recording the morphometric data of the fish, it was preserved in 5 % formalin and brought to the laboratory for further analysis. Measurements of ovary were made just before the estimation of fecundity. Gravimetric method was used for fecundity count and its relationships were traced by the method of least squares. Sex ratio was noted for entire period of study and its significance was tested by Chi square test.

Observations

The information regarding reproductive capacity and body parameters is presented in Table 1. The fish were in a range of 52 to 79 mm length and 2620 to 9403 mg in body weight. The minimum fecundity was calculated for a fish measuring 52 mm and weighing 2620 mg whereas the maximum fecundity was 1727 in the fish measuring 79 mm and weighing 9403 mg. The relationships of fecundity with different independent

body parameters were observed straight and presented in Figs 1 to 4. The equations obtained were as follows:

1.	F	=	- 737.892	+	27.0161	FL	(r = 0.4053)
2.	F	=	307.701	+	00.1309	FW	(r = 0.5334)
3.	F	=	- 279.155	+	60.8235	OL	(r = 0.4958)
4.	F	=	116.619	+	2.3303	OW	(r = 0.8163)

Where F = fecundity, FL = fish length, FW = fish weight, OL = ovary length, OW = ovary weight and r = coefficient of correlation.

The sex ratio and its significance test is presented in Table 2. It shows that the population was normal round the year as the *Chi*-square was always insignificant at the level of 5 % significance.

Discussion

Puntius conchonius (Ham.-Buch), an ornamental fish has good fecundity considering its body size. It is definitely conducive if developed as an aquarium fish. The hill-stream fishes show a great variation in their reproductive capacity. It mostly depends on the habitat ecology of the fish. *Schizothorax* species forms the major fishery in Garhwal hillstreams. It has two major species in Garhwal region, the *richardsonii* and the *plageostomus*. The fecundity of *S. plageostomus* has been reported in a range from 3474 to 13016 in the fish ranging from 30.1 to 55 cm and ovary weight from 132 to 19.7g by Agrawal, *et al.* (1988). The biology of *Schizothorax richardsonii* (Gray) was studied by Misra (1982) who reported its fecundity 3832 to 10.351 in the fish range.of 35- 53 cm. Mahseer is another important fishery of Garhwal region, which is next to the *schizothoracids* in its productivity magnitude. Nautiyal and Lal (1985) reported the fecundity range of *Tor putitora* from 26,998 to 98,583 in the fish weighing from 3.5 to 23 Kg. Dobriyal (2005) have reported low fecundity of *Tor putitora.* (5600-31438 in the fish measuring 50-78 cm and ovary weighing from 21.6 to 136.8 g) from Song river.

Tor chilinoides (McClelland) is a very important game and food fish for the rural folk in Garhwal Himalaya. Its fecundity has been reported as 1265- 9284 in the fish measuring 11-24 cm and ovary weighing 1- 15.6 g from the spring-fed river Western Nayar (Uniyal, 2003). *Garra* and *Crossocheilus* species are next in the queue of important fishery of the region. Dhasmana (1990) reported high fecundity of *Garra gotyla gotyla* (Gray) from 1.05,900 to 1,94349 in the fish measuring from 15.2 to 19.2 em. in river Alaknanda. Rautela (1999) reported low fecundity (4930-55553) for Glama from Khoh stream. The fecundity of *Crossocheilus latius latius* (Ham.) was reported 20,660- 79630 from river Mandakini in the fish measuring 16.0-26.3 cm by Dobriyal *et al.* (2003).

Glyptothorax and Pseudecheneis are the two important catfish genera inhabiting the Garhwal hillstreams. The fecundity of *G. pectinopterus* was reported as 1600- 8050 (Dobriyal and Singh, 1989) in the fish measuring 12 to 16 cm and ovary weighing from 1.15 to 9.17g. The fecundity of *Pseudecheneis sulcatus* was reported from river Alaknanda in a range of 1299 to 6435 (Thapliyal, 2002) in the fish measuring 12.2 to 20 cm and ovary weighing from 0.72 to 2.42 g. The size of ova was 1.7 mm. *Barilius* and *Noemacheilus* are two most common genera available in all the small stream and brooks in Garhwal region. The fecundity of *B. bendelisis* was reported from 900- 5048 in the fish measuring 7.5- 11.5 cm and ovary weighing from 700

mg to 2.42g (Dobriyal and Singh, 1987). *Noemacheilus botia* (Ham.) was studied by Singh (2004) in the Khoh stream who reported its fecundity from 447- 1631 in the fish measuring just 51 to 80 mm.

Four linear relationships were observed for *P. conchonius* in the present study, which had a low correlation coefficient value. The fecundity was observed to be more dependent on ovary weight than any other body parameter. It is evident that the ecological conditions of streams play vital role in the development, maturation and fecundity of fish. The fecundity of coldwater fishes is generally low due to lower temperature range and less availability of food in nature. The fecundity of *C. latius latius* and *G. gotyla gotyla* is generally higher in relation to other species because these two species have been designated as eurythermal species, which can bear a wide temperature range. Our observations support the views of Nikolski (1961) who stated that the food consumed by fish determines not only the fecundity but also the quality of sexual product.

The sex ratio analysis has been considered of immense importance in the fisheries investigations. It was observed that the sex ratio was quite natural one in *P. conchonius.*

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Table 1 Data on the reproductive capity of *Puntius conchonius* (Ham Buch).

S.No	Size Group	Fish Length	Fish Weight	Ovary Length	Ovary Weight	Fecundity
1	46 - 55	52 - 55*	2620 - 2920	16 - 19	230 - 272	360 - 635
		54.25 ± 1.16	2782.5 ± 84.64	17.5 ± 1.19	250.12 ± 12.71	523.75 ± 103.61
2	56 - 65	57 - 65	3100 - 5907	17 - 23	324 - 550	540 - 1560
		61.18 ± 2.48	4513.54 ± 915.52	19.73 ± 1.55	379.45 ± 149.69	1155.50 ± 379.84
3	66 - 75	66 - 75	4800 - 8110	19 - 28	205 - 621	390 - 1723
		70.35 ± 2.37	6687.97 ± 860.58	23.77 ± 2.60	432.07 ± 139.63	1243.02 ± 404.89
4	76 - 85	76 - 79	7400 - 9403	24 - 29	463 - 751	1018 - 1727
		77.43 ± 1.40	8404.85 ± 816.62	26.25 ± 2.25	584.75 ± 112.70	1366.00 ± 282.99

Min - Max*

Average ± SD

Table 2 : Sex ratio in *Puntius conchonius* (Ham-Buch) during July 2003 to June 2005 from Mandal river.

Month	No. of Specimen	Male	Female	% of male	% of female	Sex ratio		Chi square (X^2)	Remarks
						Male	Female		
Jul	42	15	27	37.714	64.285	1.00	1.80	0.228	NS
Aug	28	12	16	42.875	57.142	1.00	1.33	0.046	NS
Sep	28	12	16	42.875	57.142	1.00	1.33	0.046	NS
Oct	43	21	22	48.837	51.162	1.00	1.05	0.001	NS
Nov	31	16	15	51.612	48.387	1.07	1.00	0.002	NS
Dec	34	15	19	44.117	55.882	1.00	1.26	0.029	NS
Jan	39	19	20	48.717	51.282	1.00	1.05	0.001	NS
Feb	28	15	13	53.571	46.428	1.15	1.00	0.010	NS
Mar	29	16	13	55.172	44.827	1.23	1.00	0.237	NS
Apr	48	24	24	50.000	50.000	1.00	1.00	0.000	NS
May	46	20	26	43.478	56.521	1.00	1.30	0.039	NS
Jun	39	15	24	38.461	61.538	1.00	1.60	0.138	NS
Total	435	200	235	45.597	54.022	1.00	1.17	0.013	NS

NS = Non Significant ($X^2_{0.1} = 2.705$)

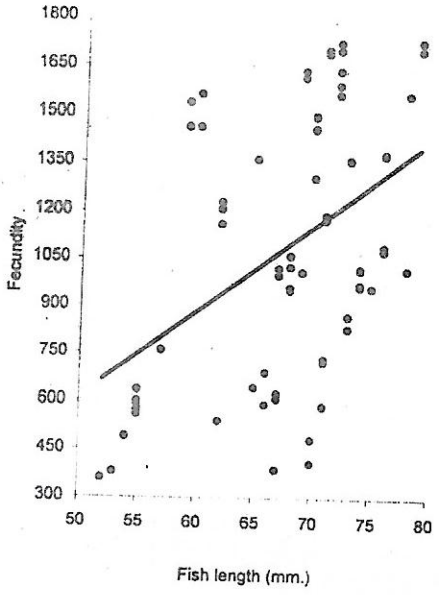

Fig:1 Regression between fecundity and fish length of *P. conchonius*

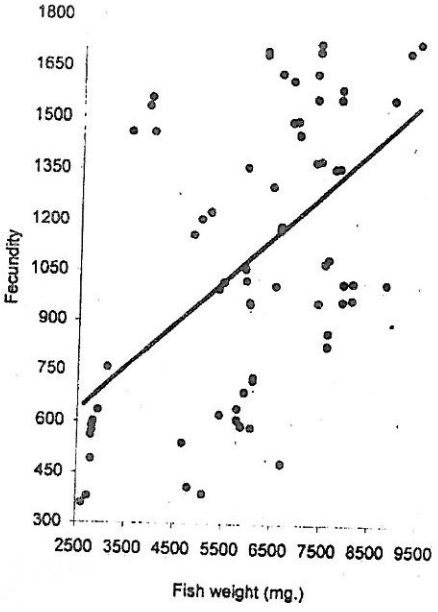

Fig:2 Regression between fecundity and fish weight of *P. conchonius*

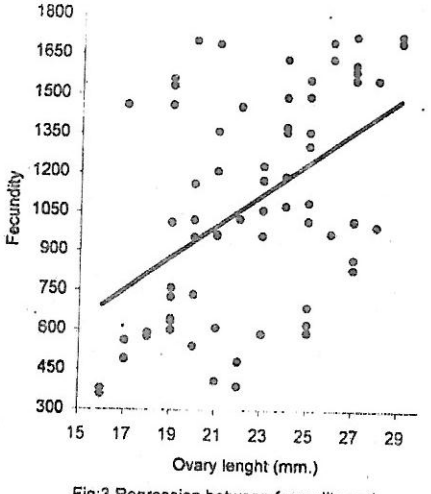

Fig:3 Regression between fecundity and ovary length of *P. conchonius*

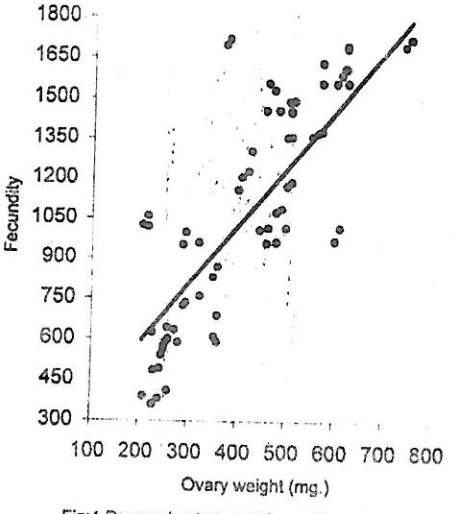

Fig:4 Regression between fecundity and ovary weight of *P. conchonius*

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Ecology of plankton in some paddy fields, near Nagri bus stand, Kathua (J&K state)

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Abstract

Physico-chemical characteristics of water and plankton were analysed from four paddy fields, irrigated by a tributary of the river Ravi, near Nagri bus stand, Kathua, J&K, during July, 2005 to September, 2005 have been described. Phytoplankton has shown the presence of Chlorophyceae (14 genera), Bacillariophyceae (9 genera) and Cyanophyceae (6 genera). The order of qualitative dominance of zooplankton is observed as Protozoa (10 genera and 31 species) > Rotifera (8 genera and 9 species) > Arthropoda (8 genera, 8 species and 3 larvae) > Annelida (1 genus and 1 species) and> Nematoda. Planktonic diversity and density remained low during first two observations (preparation of fields and seedlings transplantation). Coefficient of correlation (r) of phytoplankton and zooplankton, with the various parameters of water, is insignificant.

Key words: *Planktonic Ecology, Paddy fields, Nagri bus stand, Kathua.*

Introduction

Paddy fields, which support a diversified aquatic biota, have received the scientific attention of Goyal *et al.* (1984), Rather and Mir (1987), Pandoh (1998) and Dutta *et al.* (2002 a,b; 2004; 2005 and 2006 a,b,c) from J&K state. However, there is no record of any work for seasonal wetlands from Kathua district. The present planktonic study from paddy fields, irrigated by a tributary of the river Ravi, near Nagri bus stand, was undertaken to add to the existing knowledge of biotic characteristics of seasonal wetlands from Jammu region of J&K state.

Topography of the area

Kathua district, of Jammu region,situated at 32°17' to 32°55' North Latitude and 75°70' to 76°16' East Longitude has an area of 2651 Km^2. The District is surrounded by Punjab in the S-E , Himachal Pradesh in N-E, Doda and Udhampur in North and N-W, Jammu in the West and Pakistan in S-W. (Fig. 1). The main drainage of the area is by the river Ravi. The area being plain is suitable for agriculture. The texture of the soil is soft and loamy. Annualy two crops viz. wheat during winter and paddy during summer- monsoon season are cultivated. Three varieties of paddy viz. China, Ratna and local basmati are cultivated in the area. For the present study, four paddy fields (about 1 acre), near Nagri bus stand, were selected. In these fields, local basmati is cultivated. Irrigation of fields in the area is done through a tributary of the river Ravi called as Kathua canal or Kashmir canal.

Materials and methods

Sampling of Water

Water samples, from four selected paddy fields, were collected during preparation of fields for seedlings transplantation, during seedlings transplantation and weekly thereafter, during paddy growing season viz. July to September (2005) in plastic containers and analysed for various abiotic characteristics by standard

methods (Indian Standard Method, 1973; Trivedy *et al.* 1987 and APHA, 1998). Depth was recorded by using a meter rod and temperature by mercury bulb (^{0}C) thermometer.

Sampling and Analysis of Plankton

Planktonic samples from each paddy field were collected by filtering two litres of water through a planktonic net (No. 25) and analysed in the laboratory (Smith, 1950; Nair *et al.* 1971; Kant, 1977; Kant and Anand, 1978; Dutta, 1983; Adoni, 1985; Kudo, 1986; Battish,1992; Edmondson, 1992 and Biswas and Raut, 2000) and counted by drop count method. The results are expressed as number per litre (n/1).

Coefficient of correlation (r) of phytoplankton and zooplankton, with various abiotic parameters of water, was calculated by the formula:

$$\text{Coefficient of correlation}(r) = \frac{\sum xy - \overline{X}\sum y}{\sqrt{\left(\sum x^2 - \overline{X}\sum x\right)\left(\sum y^2 - \overline{Y}\sum y\right)}}$$

Where, x = Total no. of phytoplankton or zooplankton species.

y = Total no. of physico-chemical parameters.

$\overline{X}$ = Mean of phytoplankton or zooplankton.

$\overline{Y}$ = Mean of physico-chemical parameters.

Results and discussion

Physico-chemical Parameters of Water

The results of various physico-chemical parameters of water are summarized in Table 1 and depicted in Figs. 2a to 2h. Water temperature (22.17^{0}C, 1st observation and 29.22°C, 4th observation), due to shallowness and lentic conditions, closely followed by the air temperature, and varied between (25°C, 1st observation and 34°C, 4th observation) and is in accordance with the findings of Dutta *et al.* (2004 and 2006 a,b,c). Heavy rains and irrigation of fields with large quantities of water, during preparation of fields, may explain the lowest record of water temperature noticed on 1 st observation. Maximum record of water temperature during 4th observation coincided with the highest observation of air temperature. Depth in these paddy fields varied between 2.87 and 11.92 cm (Table1 ;Fig.2b) and observed its maximum value during 1st observation, when large amount of water is available for field preparation, before seedlings transplantation, and is in agreement with the findings of Dutta *et al.* (2004 and 2006 a,b,c).

pH varied between 6.38 and 8.18. Its wide variation coincided with the presence or absence of free CO_2 and CO_3. Direct relationship of pH with CO_3 may explain highest record of pH (8.18) during 4th observation, when carbonate was present in two fields. Similarly, an inverse relationship of pH with free CO_2 may explain the low record of pH during 2nd observation, with free CO_2 was comparatively high. An inverse relationship of pH with free CO_2 and direct with CO_3 is already on record (Welch, 1952; Reid and Wood,1976; Goldman and Horne, 1983; Jhingran, 1991 and Wetzel, 2000). Dissolved oxygen fluctuated between 2.49mg/l to 7.15 mg/l. Irrigation of fields with large quantities of water and agitation of water during preparation of fields, before seedlings transplantation, may account for rise in DO during 1st observation. Free CO_2 recorded its

highest (17.44 mg/l) and lowest (6.93mg/l) value during 9th and 4th observation, respectively. Presence of water in pools and records of decaying dead organic matter may explain highest record of free CO_2 during 9th observation. Carbonate is seen only once during 4th observation (21.3 mg/l), in two paddy fields. Bicarbonate showed its minimum (67.05 mg/l) record during 12th observation and maximum (151.85 mg/l) during 11th observation. Highest (17.43 mg/l) and lowest (9.19 mg/l) value of chloride is noticed during 10th and 5th observation, respectively. Calcium, magnesium and total hardness varied between 16.80 to 33.22 mg/I, 1.57 to 11.36 mg/I and 65.60 to 130.83 mg/l, respectively. Highest record of calcium, magnesium and total hardness during 9th observation coincided with decomposition of algae and some macrophytes and maximum value of free carbon dioxide during this observation. Chemical oxygen demand showed its lowest (23 mg/l) and highest (105.4 mg/l) record during 11th and 5th observation, respectively.

Sulphate recorded its highest (80.62 mg/l) value during 1st and lowest (9.25 mg/l) during 6th observation. Mixing of sediments, crop residues and dead organic matter (cowdung) during field preparation, before seedlings transplantation, may explain highest record of sulphate during 1st observation. Silicate varied between 0.65' mg/l (7th observation) and 15.4 mg/l (1st observation). Irrigation of fields by large quantities of water and mixing of sediments during field preparation may explain the maximum record of silicate seen during 1st observation. Nitrate showed its highest (2.5 mg/l) value during 10th observation and lowest (0.125 mg/l) during 6th observation. Decomposition of algae and macrophytes in the pools of water in these paddy fields may account for nitrate enrichment during 10th observation.

Maximum (0.292 µMhos/cm) and minimum value (0.090 µMhos/cm) of electrical conductivity is noticed on10th and 7th observation, respectively. Low record of various salts like bicarbonate, chloride, calcium, magnesium and total hardness may explain lowest record of conductivity during 7th observation.

Planktonic Analysis

The results of phytoplanktonic analysis are shown in Table 2 and depicted in Figs. 3a to 3i. Phytoplankton, qualitatively, comprising of 29 genera has shown the dominance of Chlorophyceae (14 genera) followed by Bacillariophyceae (9 genera) and Cyanophyceae (6 genera) and is in accordance to the findings of Dutta *et al.* (2006b) for paddy fields in Maralia Morh, Jammu. Qualitatively, various phytoplanktonic genera showed their irregular presence. Among the various genera of *Chlorophyceae*, *Spirogyra* made its appeareance 10 times; *Chlorococcum* and *Volvox* nine times; *Cosmarium*, *Eudorina* and *Closterium* seven times, each; *Pediastrum* five times; *Lepocynclis* and *Pandorina* four times; *PIeodorina*, *Euastrum*, *Spirotenia* and *Dictyospherium* thrice and *Gonium* twice (Table 2).

Among various genera of Bacillariophyceae, *Navicula* is noticed nine times; *Caloneis* and *Fragillaria* six times; *Gyrosigma*, *Cymbella* and *Mastogloea* five times, each and *Surirella* and *Pinnularia* four times (Table 2).

Various Cyanophycean genera like *Oscillatoria, Nostoc, Spirulina, Anabaena, Microcystis* and *Anacystis* showed their presence nine times, six times, five times, four times, thrice and only once, respectively. (Table 2).

Maximum phytoplanktonic diversity in these paddy fields is seen during 8th observation minimum during 1st and 2nd observation. Quantitatively, total phytoplankton varied between 0 to 1650 n/l and recorded a bimodal increase viz. during 4th and 8th observation. The order of quantitative dominance of various

phytoplanktonic groups is recorded as Chlorophyceae (0 to 751 n/l), Bacillariophyceae (0 to704 n/l) and Cyanophyceae (0 to 481 n/l).

Analysis of coefficient of correlation (r) of total phytoplankton, Chlorophyceae, Bacillariophyceae and Cyanophyceae, with various physico-chemical characteristics of water, has shown mostly insignificant results (Table 4). This indicates that no single factor is a strong determinant for phytoplanktonic abundance in these paddy fields.

A total of 28 genera of zooplankton, seen in these paddy fields (Table3 and Figs 4a to 4m), have shown the qualtitative dominance of Protozoa (10 genera), followed by Rotifera (8 genera), Arthropoda (8 genera), Annelida (1 genus) and Nematoda. Protozoan dominance as seen during the present analysis is in agreement with the findings of Dutta *et al.* (2002 a,b; 2004; 2005 and 2006 a,b and c). Protozoa, the most dominant zooplanktonic group in these paddy fields, is represented by three classes viz. Sarcodina (6 genera and. 24 spp.) Mastigophora (2 genera and 5 spp.) and Ciliata' (2 genera and 2 spp.).

Qualitatively, Sarcodina is seen during all the twelve observations. Among its various genera, *Centropyxis* is observed during all the twelve observations; *Difflugia* and *Arcella* eleven times; *Lesqueresia* seven times; *Nebela* five times and *Cucurbitella* four times (Table 3). Along ciliates, *Chilodonella* and *Paramecium* are seen five and four times, respectively. *Euglena* and *Phacus*, among mastigophores, showed their presence nine and five times, respectively. Protozoans recorded maximum diversity during 8th and minimum during 1st observation.

Total protozoans, quantitatively, varied between 37 to 443 n/l. Among protozoans, the order of quantitative dominance is seen as Sarcodina (37 to 345 n/l) > Mastigophora (0 to 166 n/l) and> Ciliata (0 to 73 n/l). An overall analysis has shown a trimodal increase of Protozoa viz. during 2nd, 5th and 8th observation (Table 3). Resistance of Testacean rhizopods to the environmental' conditions viz. wide fluctuations in water level, drying of fields after paddy harvest and other abiotic characteristics, due to the presence of test/ shell may account for their presence during 1st observation.

Rotifers are noticed during nine times, out of twelve observations, in the planktonic samples collected from these four paddy fields. These showed maximum diversity during 4th and minimum during 10th observation. Among the various genera of class Monogononta, of Rotifera, *Monostyla, Platyias*, *Colurella* and *Brachionus* showed their presence four times, each; *Lecane* and *Philodina*, thrice, each; *Lepadella* twice and *Asplanchna* only once (5th observation) in the planktonic samples collected from four paddy fields in Kathua District. Rotifers, quantitatively, varied between 0 to 102 n/l and showed maximum diversity during 4th and minimum during 10th observation. These recorded a trimodal increase viz. during 4th, 7th and 12th observation, respectively. Arthropods in these paddy fields have shown the presence of two classes viz. Crustacea and Insecta. Crustaceans are represented by three orders viz. Copepoda, Cladocera and Ostracoda. Among copepods, *Mesocyclops hyalinus* and *Cyclops* are seen only twice. *Nauplius* and *Metanauplius larva* of Copepoda are noticed eight and five times, respectively. An overall Copepod analysis has shown their eight times presence. Among *Cladocerans*, *Ceriodaphnia* recorded its five times presence; *Alonella*, *Daphnia* and *Moina* twice, each, and *Alona* only once. An overall Cladoceran analysis has shown their six times presence. Ostracoda, another order of class Crustacea, is represented by genus *Cypris* and is seen during four observations only. An overall analysis of Crustaceans (Table 3), belonging to Phylum Arthropoda, has shown their nine times presence. Class Insecta, of Arthropoda, is qualitatively represented by *Chironomous* larva and is noticed presence thrice.

An observation of the Table 3 reveals nine times presence of arthropods in the planktonic samples collected from four paddy fields of Kathua district. Maximum and minimum diversity of arthropods is noticed on 10th and 12th observation, respectively.

Quantitatively, arthropods varied between 0 to 218 n/l (Table 3).These recorded a trimodal increase viz, during 5th, 7th and 10th observation. Annelida, represented by *Nais* spp. is seen only once (12th observation) during the present study. Water nematodes and eggs showed their four times presence in the present study area.

Total zooplankton recorded maximum, qualitative diversity during 8th and minimum during 1st observation.Total zooplankton quantitatively, varied between 37 to 684 n/l and observed a trimodal increase. Zooplanktonic first rise is seen during 2nd, 2nd during 5th and 3rd during 8th observation. Maximum and minimum quantitative count of zooplankton is seen during 8th and 1st observation, respectively. An overall study has indicated mostly insignificant correlation(r) of protozoans, rotifers, arthropods, nematodes and total zooplankton with various physico-chemical parameters of water (Table 5).

Insignificant results of coefficient of correlation of phytoplankton and zooplankton (Tables 4 and 5), with various physicochemical parameters of water, indicate that any of the physicochemical water parameter alone does not appear to be a strong determinant factor for the planktonic abundance in these four paddy fields of Kathua District, J & K. A similar type of conclusion has been drawn by Dutta *et al.* (2002 a, b; 2004; 2005 and 2006 a, b and c). Present analysis has indicated that the range of various physico-chemical parameters of water viz. temperature, depth, pH, free CO_2, bicarbonate, chloride, calcium, magnesium, total hardness, COD, silicate, sulphate, nitrate and electrical conductivity, in four paddy fields, near Nagri bus stand, Kathua, J & K, are within the optimum limits for fish culture. Biotic analysis has shown that there is sufficient planktonic food in these paddy fields that can be utilized by the fish. However, for the exploitation of these paddy - fields for aquaculture practices, depth above 15 cm has to, be maintained during the paddy growing period through regular irrigation. Fish larvae of some fishes, however, can be reared in these shallow paddy fields through regular irrigation. These may be released in these fields during seedlings transplantation and allowed to grow before drying of fields for harvesting. Young fishes, after collection, may be transferred into stocking ponds for their further growth. Some fishes like common carps, through depth management, are known to reach marketable size during this paddy growing period of three months (Nath and Dey, 1990).

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Table 1:- Mean observations of various physico-chemical characteristics of water, in four paddy fields, near Nagri bus stand, Kathua.

(6th July 2005 to 26th Sep. 2005)

	1	2	3	4	5	6	7	8	9	10	11	12
WATER PARAMETERS	**06.07.05**	**08.07.05**	**18.07.05**	**25.07.05**	**02.08.05**	**09.08.05**	**17.08.05**	**22.08.05**	**29.08.05**	**12.09.05**	**19.09.05**	**26.09.05**
Air temperature(°c)	25	28	30	34	31	29.5	27	28	29	30	30.5	29.5
Water temperature(°c)	22.17	26.55	28.2	29.22	28.75	27.42	26	23.5	25.97	25.95	25.72	25.47
Depth (cm.)	11.92	7.9	6	7.72	4.97	4.85	4.86	5.9	4.67	2.87	3.42	3.95
pH	6.69	6.38	7.71	8.18	7.43	7.39	7.69	7.99	7.67	7.66	8.06	7.52
DO(mg/l)	7.15	4.37	4.95	3.74	6.16	3.26	5.63	6.34	6.3	2.73	2.49	6.67
Free CO_2(mg/l)	11.98	7.27	12.47	4.56	16.2	6.93	12.65	9.08	17.44	14.84	11.01	8.46
CO_3^-(mg/l)	-	-	-	21.3	-	-	-	-	-	-	-	-
HCO_3^-(mg/l)	133.3	106.09	84.16	117.08	104.78	107.9	93.4	131.93	99.5	142.56	151.85	67.05
Cl^-(mg/l)	16.63	12.45	8.85	9.33	9.19	12.15	11.74	11.84	11.87	17.43	15.63	13.5
Ca^{++}(mg/l)	22.43	17.65	25.66	23.76	27.5	31.23	23.36	24.97	33.22	30.5	28.1	16.8
Mg^{++}(mg/l)	5.57	5.35	6.97	4.83	1.57	5.79	5.87	9.93	11.36	8.69	10.96	6.8
Total hardness(mg/l)	74.77	65.6	92.67	79.12	75.01	101.57	69.27	103.14	130.83	107.88	115.12	69.53
COD (mg/l)	73.73	64.24	74.52	39.8	105.4	30.94	101.66	47.52	50.83	80.77	28.92	23
SO_4^-(mg/l)	80.62	27.12	14.92	23.5	14.87	9.25	8.44	14.4	39.3	14.62	10.85	14.82
SiO_3^-(mg/l)	15.4	9.82	3.82	1.21	6.12	0.94	0.65	7.43	1.56	2.5	4.02	1.62
NO_3^-(mg/l)	0.79	1.5	0.125	1.125	2.04	0.57	1.57	0.405	0.725	2.5	0.85	1.89
Electrical conductivity(mMho/cm.)	0.104	0.203	0.131	0.152	0.129	0.122	0.09	0.158	0.189	0.292	0.256	0.146

Table 2:- Mean phytoplanktonic variations (n/l), in four paddy fields, near Nagri bus stand, Kathua.

(6th July 2005 to 26th Sep.2005)

Observations / Phytoplankton	1	2	3	4	5	6	7	8	9	10	11	12
	06.07.05	08.07.05	18.07.05	25.07.05	02.08.05	09.08.05	17.08.05	22.08.05	29.08.05	12.09.05	19.09.05	26.09.05
CHLOROPHYCEAE												
Gonium Muller	-	-	-	-	18	27	-	-	-	-	-	-
Volvox Linnaeus	-	-	-	93	27	56	56	37	75	93	18	9
Pleodorina Shaw	-	-	-	-	-	-	-	-	19	18	-	18
Pandorina Bory	-	-	-	9	-	-	37	-	9	10	-	-
Eudorina Ehren	-	-	-	9	6	-	19	9	9	18	-	22
Lepocynclis Perty	-	-	-	-	17	-	-	-	9	28	-	31
Clorococcum Fries	-	-	-	9	15	38	46	44	76	29	18	21
Dictyospherium pulchellum Wood	-	-	-	-	-	18	-	-	-	10	9	-
Closterium leibleini Kutzing	-	-	-	27	-	9	9	65	15	-	55	9
Spirotenia anglica Brebisson	-	-	-	9	-	46	19	-	-	-	-	-
Euastrum gemmatum Ehren	-	-	-	-	-	18	-	-	9	19	-	-
Pediastrum Meyer	-	-	-	-	-	-	-	9	19	19	19	4
Cosmarium Corda	-	-	-	119	67	-	36	37	28	-	53	38
C.pachydermum West	-	-	-	-	-	-	19	9	-	-	-	-
C.pseudobroomei Wolle	-	-	-	-	15	-	-	-	-	-	-	-
C.monomazum Lundell	-	-	-	18	9	-	-	18	-	-	18	-
C.granatum Brebisson	-	-	-	-	18	-	-	9	-	-	-	-
Total *Cosmarium*	-	-	-	**137**	**109**	-	**55**	**73**	**28**	-	71	**38**
Spirogyra Link	-	-	18	458	9	129	94	219	268	104	27	19
Zygote	-	-	-	-	-	9	9	9	-	-	-	-
Total Cholorophyceae	-	-	**18**	**751**	**201**	**350**	**344**	**465**	**530**	**348**	**217**	**171**
BACILLARIOPHYCEAE												
Caloneis Bory	-	-	-	-	9	-	9	-	9	10	19	9
Gyrosigma (Grun.)	-	-	-	-	8	-	47	36	28	9	-	-
Cymbella (Hemp. & Ehren)	-	-	-	28	-	-	28	18	-	10	-	13
Fragillaria Desmazieres	-	-	-	-	38	9	18	54	9	9	-	-
Surirella Turpin	-	-	-	-	17	-	-	28	19	10	-	-

Observations / Phytoplankton	1	2	3	4	5	6	7	8	9	10	11	12
	06.07.05	08.07.05	18.07.05	25.07.05	02.08.05	09.08.05	17.08.05	22.08.05	29.08.05	12.09.05	19.09.05	26.09.05
Navicula Kutz	-	-	-	74	159	111	84	531	233	114	63	49
Nitzschia Nitzsch	-	-	-	-	-	18	-	-	9	18	-	-
Pinnularia Ehren	-	-	-	9	-	-	-	-	19	-	9	9
Mastogloea Thwaites	-	-	-	-	-	9	37	37	-	19	9	-
Total Bacillariophyceae	-	-	-	111	231	147	223	704	326	199	100	80
CYANOPHYCEAE												
Oscillatoria Vaucher	-	-	-	18	34	18	102	436	187	116	73	4
Spirulina Turpin	-	-	-	28	-	27	28	-	-	29	-	13
Anabaena Bory	-	-	-	-	9	18	-	-	-	47	-	22
Microcystis Kutzing	-	-	-	-	6	-	-	-	28	-	-	4
Anacystis Meneghini	-	-	-	-	-	-	9	-	-	-	-	-
Nostoc Vaucher	-	-	-	18	-	54	-	45	9	-	28	9
Total Cyanophyceae	-	-	-	64	49	117	139	481	224	192	101	52
TOTAL PHYTOPLANKTON	-	-	18	926	481	614	706	1650	1080	739	418	303

Table 3:- Mean zooplanktonic variations (n/l), in four paddy fields, near Nagri bus stand, Kathua.
(6th July 2005 to 26th Sep. 2005)

Observations / Zooplankton	1	2	3	4	5	6	7	8	9	10	11	12
	06.07.05	08.07.05	18.07.05	25.07.05	02.08.05	09.08.05	17.08.05	22.08.05	29.08.05	12.09.05	19.09.05	26.09.05
PHYLUM-PROTOZOA												
CLASS-SARCODINA												
SUBCLASS-RHIZOPODA												
Order-Testacida												
Difflugia lebes Penard	-	38	9	55	94	37	65	129	66	66	63	63
D.urceolata Carter	-	-	-	-	-	-	-	-	-	10	-	-
D.pyriformis Perty	-	-	9	18	-	28	-	-	28	29	-	-
D.tuberculata Wallich	-	-	-	-	9	9	-	-	-	19	-	-
D.rubescens Penard	-	-	-	-	9	27	-	-	9	9	-	-
D.acuminata Ehren.	-	-	-	-	18	-	9	-	9	-	-	9
D.corona Wallich	-	-	-	9	-	-	9	-	18	-	-	-
D.oblonga Ehren.	-	-	9	-	-	-	46	27	28	10	9	8
D.lobostoma Leidy	-	-	-	-	-	-	-	-	-	-	9	9
Total *Difflugia*	**-**	**38**	**27**	**82**	**130**	**101**	**129**	**156**	**158**	**133**	**91**	**89**
Centropyxis aculeata (Ehren.)	-	-	-	-	27	-	-	-	19	18	-	-
C.arcelloides Penard	-	-	-	18	-	-	18	9	-	-	-	-
C.constricta (Ehren.)	-	9	-	-	9	18	19	19	9	-	9	8
C.ecornis (Ehren.)	9	-	9	9	32	-	-	18	18	-	-	8
C.aerophila Deflandu	-	-	-	-	-	27	-	-	19	9	9	8
C.stellata Wailes	-	-	-	-	-	-	-	-	-	9	-	9
Total *Centropyxis*	**-**	**9**	**9**	**27**	**68**	**45**	**37**	**46**	**65**	**36**	**18**	**33**
Arcella discoides Ehren.	-	-	-	-	-	9	18	37	19	9	9	21
A.vulgaris Ehren.	28	9	9	-	37	9	18	56	38	37	18	-
A.polypora Penard	-	9	-	-	-	19	-	-	-	-	10	9
A.dentata Ehren.	-	-	-	-	-	-	9	-	-	-	9	4
A.megastoma Penard	-	-	-	-	-	9	-	-	9	-	9	-
Total *Arcella*	28	18	9	-	37	46	45	93	66	46	55	34
Cucurbitella Penard	-	-	9	-	-	9	-	-	9	10	-	-
Lesquaresia modesta Rhumbler	-	-	-	-	35	18	19	9	19	-	9	8
L.spiralis Ehren.	-	-	-	-	-	9	9	-	28	-	-	4

Observations / Zooplankton	1	2	3	4	5	6	7	8	9	10	11	12
	06.07.05	08.07.05	18.07.05	25.07.05	02.08.05	09.08.05	17.08.05	22.08.05	29.08.05	12.09.05	19.09.05	26.09.05
Total *Lesuqueresia*	-	-	-	-	35	27	28	9	47	-	9	12
Nebela Leidy	-	-	-	-	15	-	19	32	-	-	19	37
TOTAL-SARCODINA	37	65	54	109	285	228	258	336	345	225	192	205
CLASS-CILIATA												
Chilodonella (Ehren.)	-	-	-	-	-	-	19	19	-	9	9	9
Paramecium Ehren.	-	-	-	66	-	-	-	54	-	-	19	9
TOTAL CILIATA	-	-	-	66	-	-	19	73	-	9	28	18
CLASS-MASTIGOPHORA												
Order-Euglenoidida												
Euglena acus (Ehren.)	-	-	-	-	9	19	129	-	9	37	9	-
E.gracilis Klebs	-	-	-	9	-	-	-	18	9	-	-	8
E.viridis Ehren.	-	-	-	46	30	36	28	38	47	9	63	-
E.spirogyra (Ehren.)	-	-	-	-	-	9	-	9	-	-	-	-
Total *Euglena*	-	-	-	55	39	64	157	65	65	46	72	8
Phacus Dujardin	-	-	-	9	-	-	9	18	-	29	-	8
TOTAL MASTIGOPHORA	-	-	-	64	39	64	166	83	65	75	72	16
TOTAL PROTOZOA	37	65	54	239	324	292	443	492	410	309	292	239
PHYLUM-ROTIFERA												
CLASS-MONOGONONTA												
Order-Ploima												
Lecane luna Muller	-	-	-	-	-	-	28	18	-	-	-	31
Lepadella ovalis Muller	-	-	-	-	18	-	-	-	9	-	-	-
Monostyla bulla Ehren	-	-	-	9	-	9	-	18	-	-	9	-
Platyias platulus Harring	-	-	-	66	-	9	9	-	-	-	9	-
Colurella Bory	-	-	-	-	9	9	-	-	19	-	-	9
Brachionus quadridentata Pallas	-	-	-	9	9	-	-	-	-	10	-	-
B.bidentata Pallas	-	-	-	9	-	-	28	-	-	-	-	-
Total *Brachionus*	-	-	-	18	9	-	28	-	-	10	-	-
Asplanchna priodonta Gosse	-	-	-	-	-	-	-	19	19	9	27	18
Total Ploima	-	-	-	93	36	27	65	55	47	19	45	58
Order-Bdelloida												
Philodina roseola Ehren.	-	-	-	9	-	18	-	-	-	-	9	-

TOTAL ROTIFERA	-	-	-	102	36	45	65	55	47	19	54	58
Observations / Zooplankton	1	2	3	4	5	6	7	8	9	10	11	12
	06.07.05	08.07.05	18.07.05	25.07.05	02.08.05	09.08.05	17.08.05	22.08.05	29.08.05	12.09.05	19.09.05	26.09.05
PHYLUM-ARTHROPODA												
CLASS-CRUSTACEA												
Order-Copepoda												
Cyclops Muller	-	-	-	-	-	-	19	-	-	9	-	-
Mesocyclops hyalinus Rehberg	-	-	-	-	-	-	-	-	37	19	-	-
Nauplius larva	-	-	-	9	16	-	18	27	27	133	45	8
Metanauplius larva	-	-	-	9	15	-	-	-	9	29	-	9
Total Copepoda	-	-	-	18	31	-	37	27	73	190	45	17
Order-Cladocera												
Alona Sars	-	-	-	-	-	-	-	-	-	-	9	-
Alonella Sars	-	-	-	-	-	29	-	-	-	-	18	-
Moina Baird	-	-	-	9	26	-	-	-	-	-	-	-
Ceriodaphnia Dana	-	-	-	9	7	9	9	-	-	-	9	-
Daphnia Claus	-	-	-	9	-	-	-	-	-	9	-	-
Total Cladocera	-	-	-	27	33	38	9	-	-	9	36	-
Order-Ostracoda												
Cypris Muller	-	-	-	-	-	-	9	9	-	19	18	-
Total Crustacea	-	-	-	45	64	38	55	36	73	218	99	17
CLASS-INSECTA												
Order-Diptera												
Chironomous larva Meigen	-	-	-	-	-	-	9	-	19	-	-	18
TOTAL ARTHROPODA	-	-	-	45	64	38	64	36	92	218	99	35
PHYLUM-ANNELIDA												
CLASS-OLIGOCHAETA												
Nais Muller	-	-	-	-	-	-	-	-	-	-	-	9
PHYLUM-NEMATODA	-	-	-	-	-	9	-	92	47	-	19	-
Eggs	-	-	-	-	-	-	28	9	-	19	18	-
TOTAL ZOOPLANKTON	37	65	54	386	424	384	600	684	596	565	482	341

Table No.:- 4 Co-efficient of correlation (r) between phytoplankton and physico-chemical parameters of water in four paddy fields, near Nagri bus stand, Kathua.

Water paramters → / Phyto-planktonic Groups ↓	Water Temperature	Depth	pH	DO	Free CO_2	HCO_3^-	Cl^-	Ca^{++}	Mg^{++}	Total Hardness	COD	SO_4^{--}	SiO_3^{--}	NO_3^-	Electrical Conductivity
Chlorophyceae	0.017	0.46	0.492	-0.08	-0.3	0.304	-0.075	0.181	0.11	0.172	-0.22	0.506	-0.25	-0.04	0.056
Bacillariophyceae	-0.59	0.24	0.191	0.456	0.16	0.215	-0.164	0.129	0.33	0.283	0.142	0.14	0.66	-0.41	-0.086
Cyanophyceae	-0.73	0.1	0.281	0.245	0.08	0.35	0.109	0.191	0.33	0.453	-0.02	0.119	0.52	-0.46	0.125
TOTAL PHYTOPLANKTON	**-0.5**	**0.26**	**0.387**	**0.205**	**-0.1**	**0.406**	0.048	**0.205**	**0.35**	**0.327**	**-0.1**	**0.337**	**0.26**	**-0.15**	**0.081**

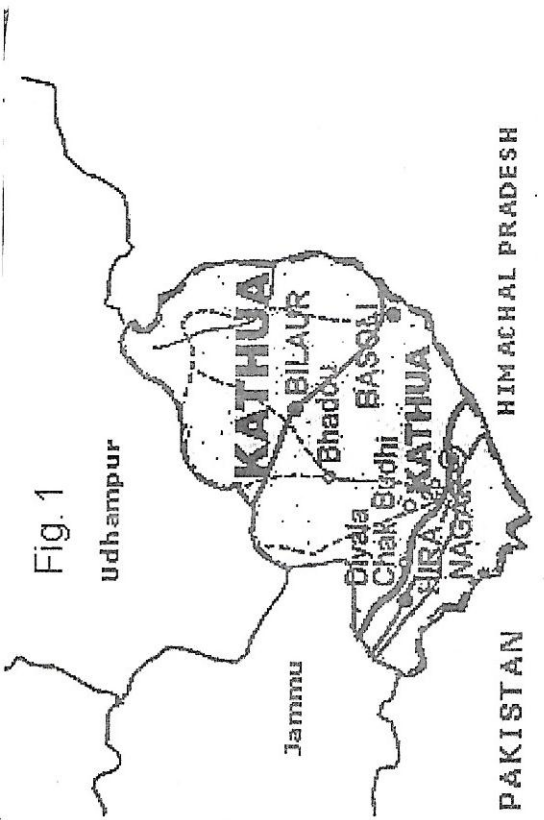
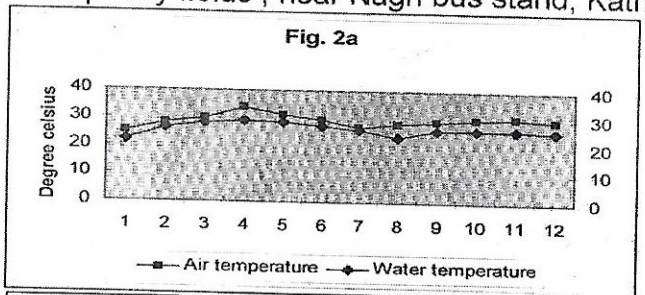
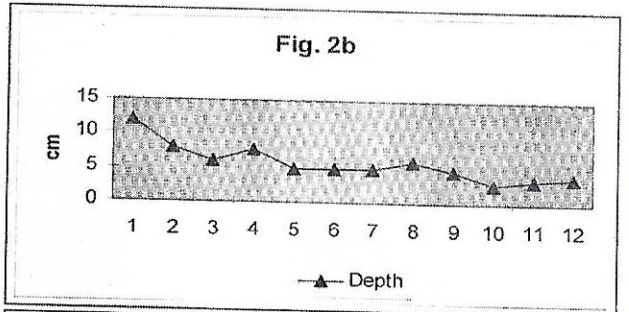
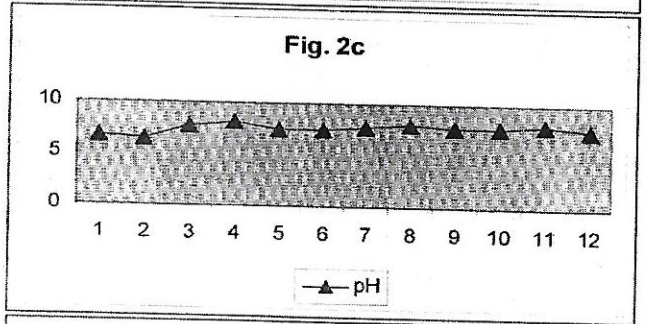

Udhampur
KATHUA
BILAUR
Bhadoli
BASOLI
Diyala
Chak Bidhi
KATHUA
JIRA
NAGAR
Jammu
HIMACHAL PRADESH
PAKISTAN

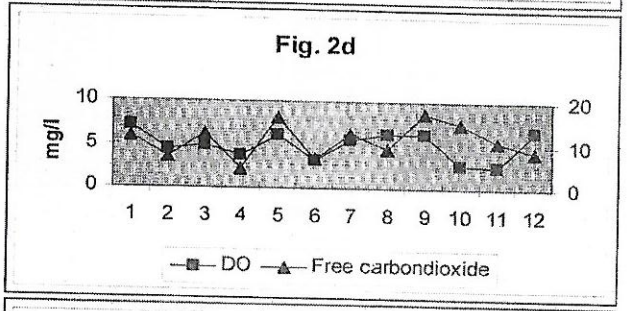
Fig. 1

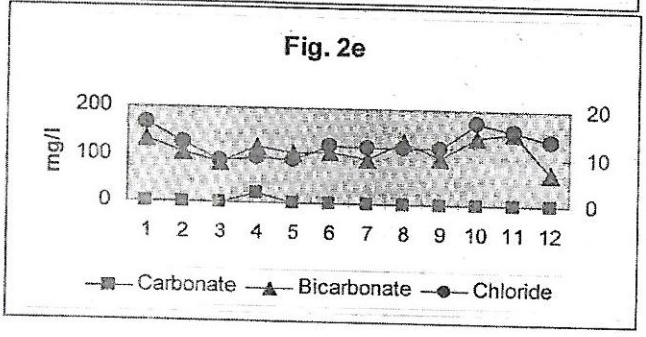
Figs. 2a to 2h showing mean graphical variations in various physico- chemical paramters of water, in four paddy fields , near Nagri bus stand, Kathua.

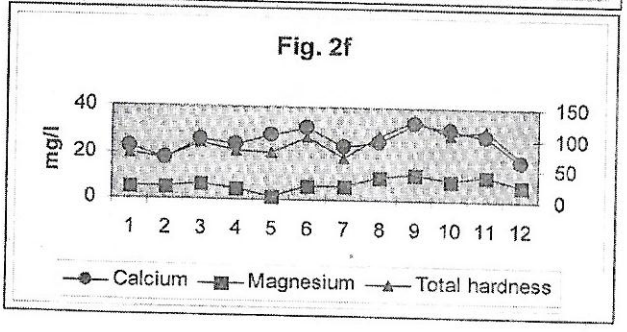












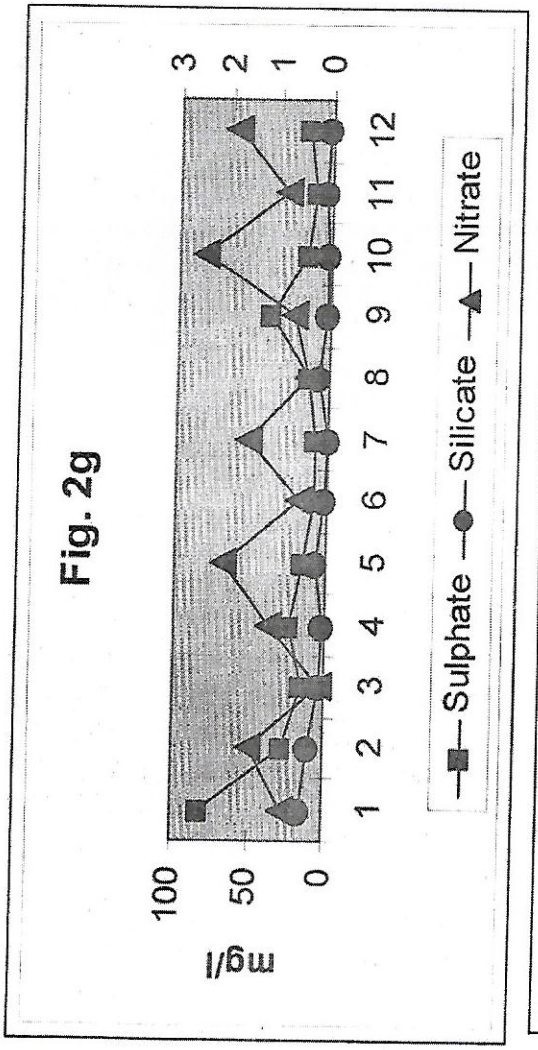


Fig. 2g
mg/l
100
50
0
3
2
1
0
1 2 3 4 5 6 7 8 9 10 11 12
Sulphate
Silicate
Nitrate

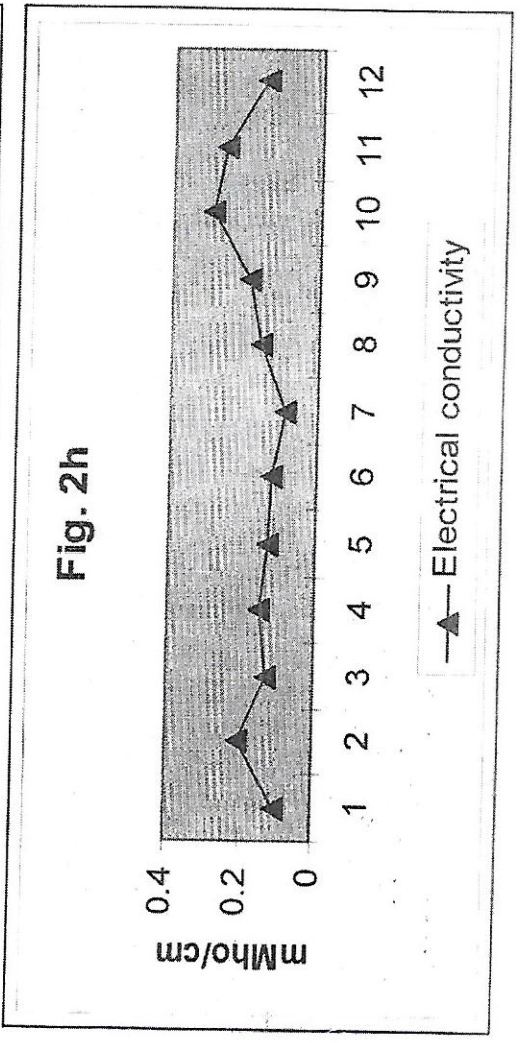
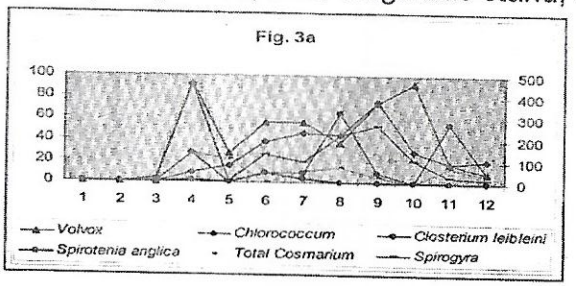
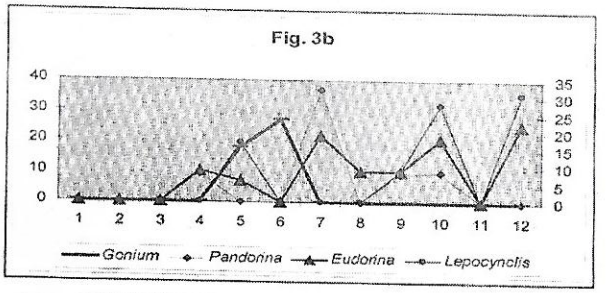
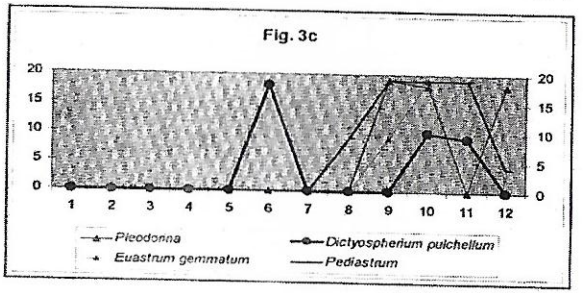


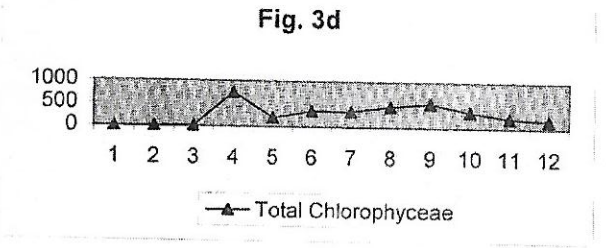
Fig. 2h
mMho/cm
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12
Electrical conductivity

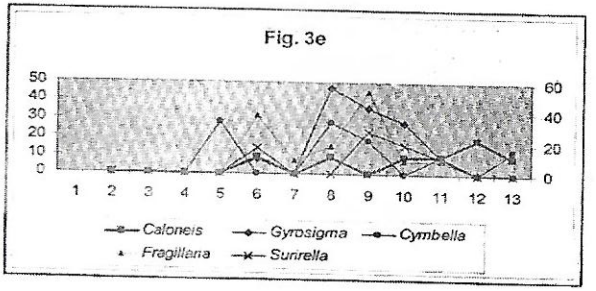
Figs. 3a to 3i and 4m showing mean graphical variations of various phytoplanktonic genera in four paddy fields, near Nagri bus stand, Kathua.

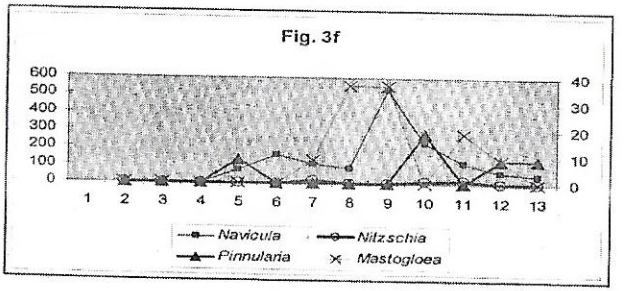












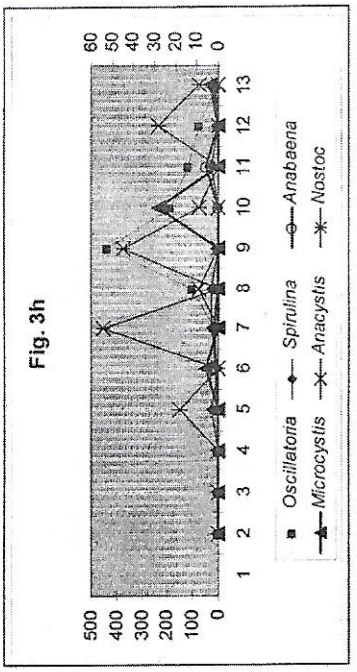


Fig. 3h
500
400
300
200
100
0
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13
Oscillatoria
Spirulina
Anabaena
Microcystis
Anacystis
Nostoc

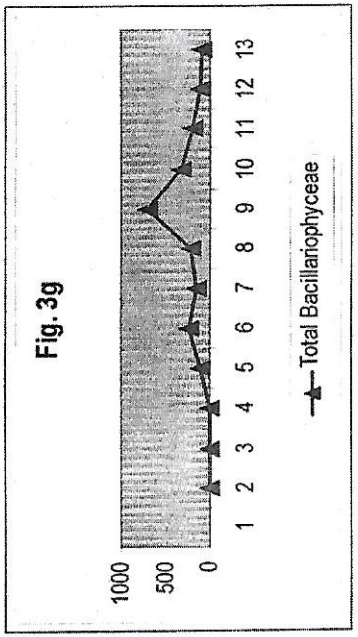


Fig. 3g
1000
500
0
1 2 3 4 5 6 7 8 9 10 11 12 13
Total Bacillariophyceae

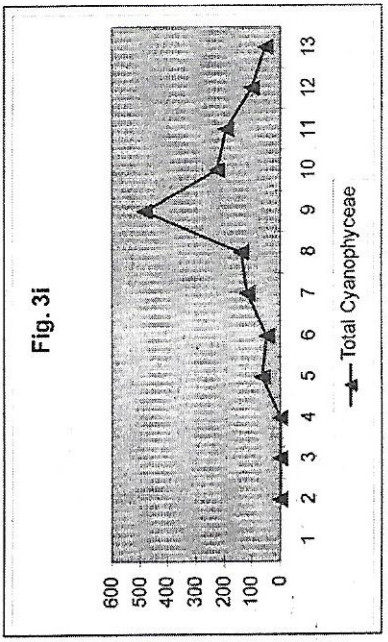
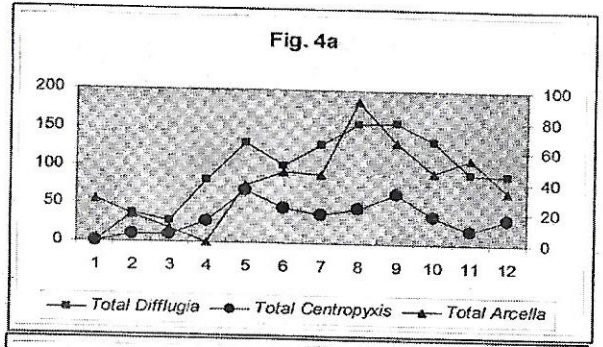
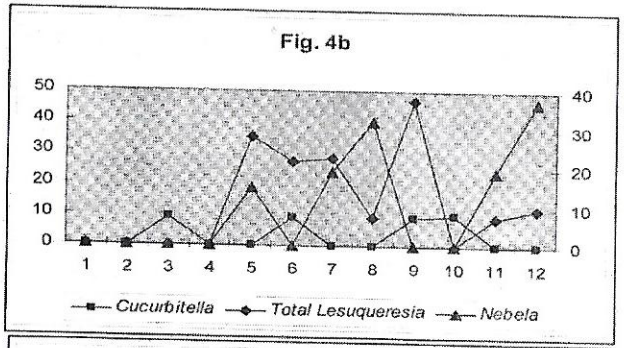
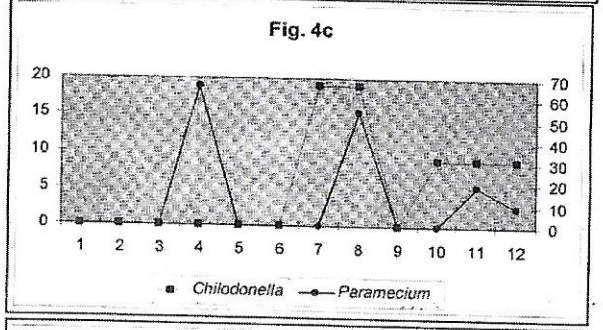


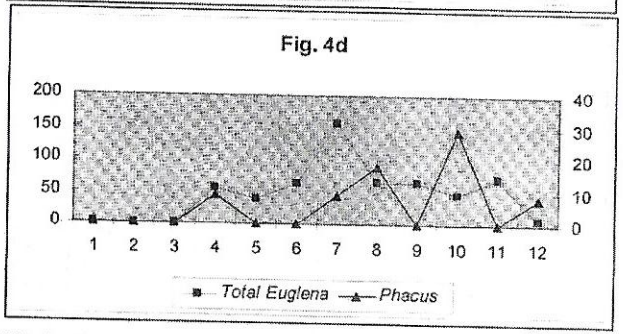
Fig. 3i
600
500
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12 13
Total Cyanophyceae

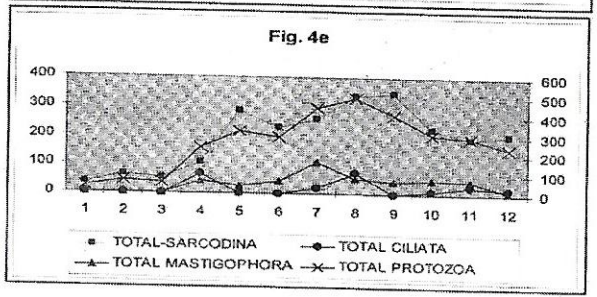
Figs. 4a to 4m showing mean graphical variations of various zooplanktonic genera in four paddy fields, near Nagri bus stand, Kathua.

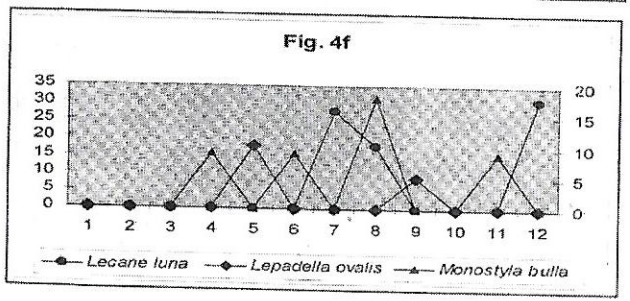












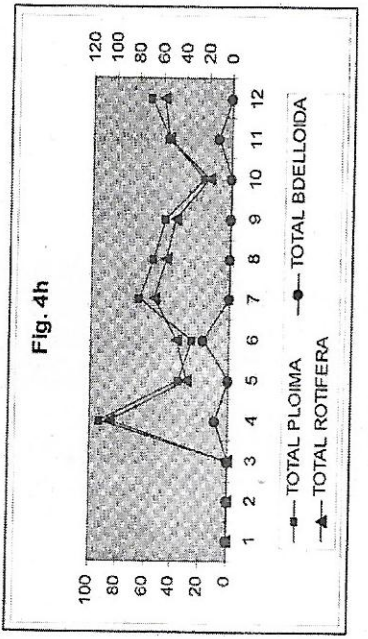


Fig. 4h
TOTAL PLOIMA
TOTAL BDELLOIDA
TOTAL ROTIFERA

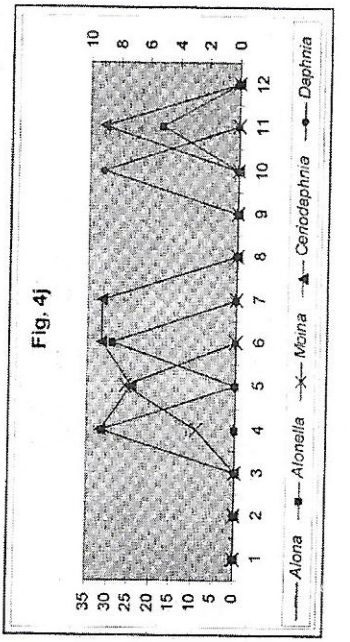


Fig. 4j
Alona
Alonella
Moina
Ceriodaphnia
Daphnia

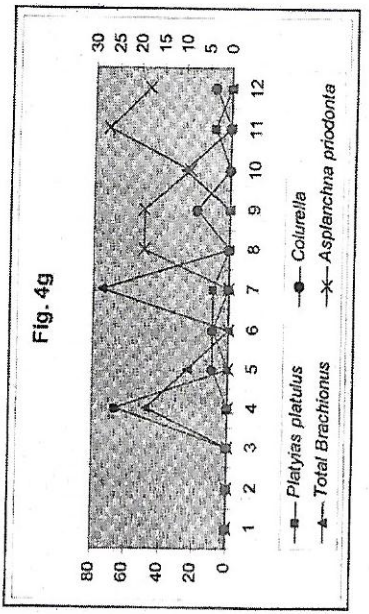


Fig. 4g
Platyias platulus
Colurella
Total Brachionus
Asplanchna priodonta

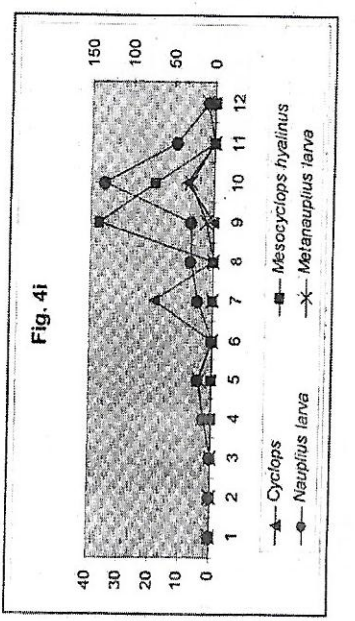


Fig. 4i
Cyclops
Mesocyclops hyalinus
Nauplius larva
Metanauplius larva

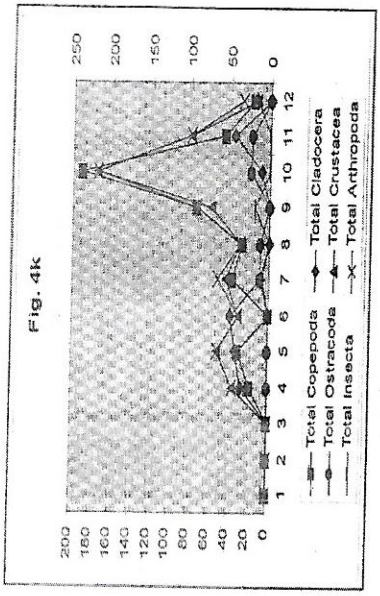


Fig. 4k
Total Copepoda
Total Cladocera
Total Ostracoda
Total Crustacea
Total Insecta
Total Arthropoda

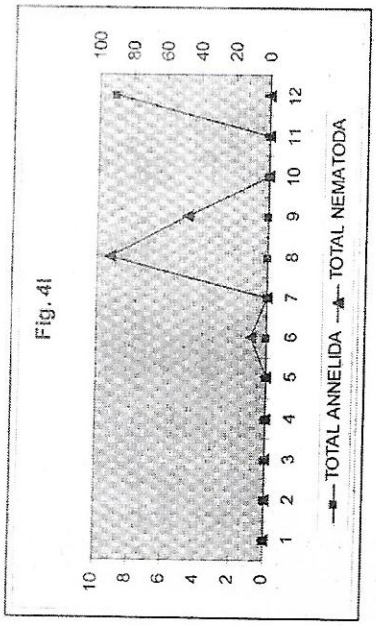


Fig. 4l
TOTAL ANNELIDA
TOTAL NEMATODA

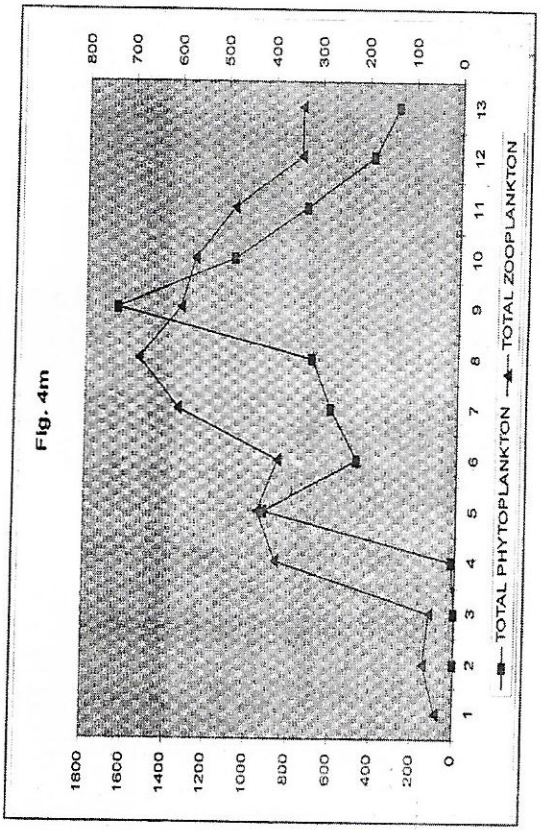


Fig. 4m
TOTAL PHYTOPLANKTON
TOTAL ZOOPLANKTON

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Abiotic status of Song river and its relations to zoo and phytoplankton at Nepali farm (Dehradun)

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Abstract

Water sample were collected from Song River during pre-autumn to post-autumn seasons 2006. This study indicates the direct relationship among various physico-chemical parameters like water temperature, free carbon di oxide, Transparency, DO, BOD, COD, Hardness and Phosphate, an inverse relationship was found between, DO and BOD, DO and COD during course of the study.

Introduction

In the lotic system, the significance of physico-chemical and biological data for the assessment of water quality has been recognized. The studies consider water quality usually involve physico-chemical and biological variables.

The song River is a tributary of River Ganga. It is a spring fed River. It originates from near Dehradun.The river ultimately mixed in to Ganga near Raiwala. The present investigation was carried out to study the abiotic characteristics in relation with Planktonic diversity.

Number of workers have carried out their work on aquatic quality of different River. Khanna (1993), Khanna (2003) of River Ganga and Badola and Singh (1982), studied about the abiotic and biotic factors of River Alakhnanda. Where as the study about the Song River is seanty therefore the study will be helpful for other workers.

Methodology

Water sample were collected fortnightly during paddy in different season (Pre-autumn , post-autumn) in plastic containers and analyzed for abiotic characteristics by standard methods (APHA, 1998).Plankton were collected by filtering the water through a planktonic net and identified with the help of Jhingran (1975), and Khanna (1993) .

Results and discussion

The physico-chemical parameter and planktonic fluctuation obtained during the study period are tabulated in table 1 to 3. The temperature showed a negative relationship with the dissolved oxygen. Water is often attributed to the fact that the oxygen is dissolved more during the period of active photosynthesis. Hutchinson (1957) concluded that cold water has greater capacity for holding dissolved gases. The maximum dissolved oxygen was recorded (9.13 mg/l±0.12) in pre-autumn and minimum (8.68 mg/l± 0.30) in post-autumn. It was also reported by Badola and Singh (1982). The maximum total solids was observed (210 mg/l pre-autumn 10) in post-autumn and minimum(155 mg/l±5) in pre-autumn. The value of the total solids is increased from pre-autumn to post-autumn as also reported by David (1956) in Bhadra River (Mysore) .

The maximum value of pH was observed (8.33 mg/l ± 0.16) in pre-autumn and minimum (7.91 mg/l ± 0.01) in post-autumn . Maximum value of pH in winter might be due to increase in algal population in the river. pH and DO showed a positive relationship to one another as also found by Ali *et al.* (1988) in a eutrophic lake.

The minimum value of free carbon di oxide was found (1.33 mg/l ± 0.16) in pre-autumn and maximum(1.50 mg/l ± 0.14) in post-autumn. Free carbon di oxide and DO showed a negative relationship to one another. The maximum value of alkalinity was (168.33 mg/l ± 6.66) in pre-autumn and minimum (140.83 g/lm ± 9.16) in post-autumn. It was also observed by Venkateswarlu and Jayanti (1968) in the River Sabarmati.

The lowest chloride value was observed (16.68 mg/l ± 0.12) in pre-autumn and highest in post-autumn (17.80 mg/l ± 1.47). It showed the positive relationship with temperature also studied by Mohanty 1981 in Bhubaneswar.

The sulphate value was minimum (1.07 mg/l ± 0.07) in pre-autumn and maximum (1.20 mg/l ± 0.02) in post-autumn are also observed by Singh 1988. The maximum value of biochemical oxygen demand was recorded (3.33 mg/l ± 0.37) in post-autumn and minimum (2.15 mg/l ± 0.35) in pre-autumn. Biochemical oxygen demand and DO showed negative relationship which is in agreement to Verma *et al.* (1984) as reported in eastern Kalinadi .

The COD was highest (3.45 mg/l ± 0.5) in post-autumn and lowest (2.15 mg/l ± 0.17) in pre-autumn. Biochemical oxygen demand and COD showed a positive relationship with one another also observed by Chopra and Patrick (1994) in the river Ganga at Rishikesh. COD showed a negative relationship with DO as reported by Verma *et al.*(1984) in eastern Kalinadi. The total planktonic concentration was maximum (977.50 mg/liter ± 96.77) in pre-autumn and minimum(787 mg/liter ± 19.76) in post-autumn. There was a inverse co-relation in the temperature and the phytoplankton and zooplankton production. Whereas increase in temperature causes reduction in plankton production. Badola and Singh (1982) reported high value of plankton during pre-autumn in the River Ganga of Garhwal Himalaya.

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Table-1 Seasonal Variations in Physico-Chemical Parameters of Song River

Parameters	Seasons			
	Pre-autumn	Autumn	Post-autumn	Average
Temperature (°C)	19.0 ± 0.57	19.9 ± 0.16	22.0 ± 0.50	20.3 ± 1.70
Total solid (mg/l)	155.0 ± 5.0	185.0 ± 15.0	210.0 ± 10.0	183.3 ± 22.4
pH	8.33 ± 0.16	8.10 ± 0.10	7.91 ± 0.01	8.11 ± 0.12
Free CO_2	1.33 ± 0.16	1.39 ± 0.07	1.50 ± 0.14	1.40 ± 0.07
Dissolved Oxygen (mg/l)	9.13 ± 0.12	8.72 ± 0.22	8.80 ± 0.30	8.88 ± 0.30
Alkalinity (mg/l)	168.33 ± 0.66	142.50 ± 8.30	140.81 ± 9.16	150.55 ± 12.58
Chloride (ppm)	16.68 ± 0.12	17.33 ± 1.41	17.80 ± 1.47	17.27 ± 0.45
Sulphate (mg/l)	1.07 ± 0.01	1.26 ± 0.02	1.29 ± 0.02	1.20 ± 0.09
BOD (mg/l)	2.15 ± 0.35	2.13 ± 0.25	3.33 ± 0.37	2.53 ± 0.56
COD (mg/l)	2.15 ± 0.17	2.54 ± 0.27	3.45 ± 0.05	2.71 ± 0.54

Table-2 Seasonal Quantitative Analysis of the Plankton of the River Song

Seasons	Plankton		
	Phytoplankton (u/l)	Zooplankton (u/l)	Total Plankton (u/l)
Pre-autumn	929.5 ± 61.50	98.0 ± 6.32	977.5 ± 96.17
Autumn	832.5 ± 53.5	83.5 ± 2.5	916.0 ± 56.0
Post-autumn	719.5 ± 27.5	67.5 ± 2.5	787.0 ± 19.7
Average	827.1 ± 85.81	83.0 ±12.45	827.1± 85.81

Table-3 Number of different groups among Phytoplankton of the River Song during different Seasons

Seasons	Phytoplankton		
	Bacillariophyceae(u/l)	Chlorophyceae(u/l)	Myxophyceae (u/l)
Pre-autumn	598.0 ± 42	226.5 ± 18.5	105.0 ± 1.0
Autumn	528.0 ± 42	204.5 ± 10.5	100.0 ±1.0
Post-autumn	437.5 ± 21.5	186.0 ± 4.0	96.0 ± 1.4
Average	521.16 ± 6.80	205.66±16.55	100.33 ±6.37

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Impact of treated and untreated distillery effluent on *Momordica charantia* L. var. Jaunpuri super special

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Abstract

The present study has been made to evaluate the impact of treated and untreated distillery effluent from M/s Devans Modern Breweries Ltd. Talab Tillo, Bohri, Jammu on seed germination, growth parameters and yield of Bitter Gourd (*Momordica charantia* L. var. Jaunpuri Super Special). From the analysis of data and the impact of distillery effluent on various quantitative morphological features of *Momordica charantia*, it can be concluded that the Untreated Distillery Effluent is detrimental for the growth of plants whereas Treated Distillery Effluent without dilution is also harmful for agriculture.

Introduction

Industrial activity has expanded so much all over the world today that it has become a matter of great concern of the deteriorating environment. With the rapid growth of industries in the country, the pollution of environment by industrial waste has increased tremendously. However, the wastewater from industries can act as a useful resource in agriculture thus preventing environmental hazard. Use of wastewater in agriculture is gaining importance now days, because of its value as a potential irrigant and a nutrient donor. Use of waste water for irrigation makes it possible to conserve the limited water resources for crop production and also prevent pollution of water bodies, as soil is a very good sink. Also, application of some effluents to agricultural land may promote the growth of crops and conserve water and nutrients. A large number of waste viz. dairy waste, food processing waste, tannery waste, pulp and paper mill waste etc. have been successfully used for irrigation of crops. In addition to providing large quantity of water, some effluents contain considerable amounts of nutrients, which may prove beneficial for plants.

Distillery waste is amongst the worst pollutants produced by industries both in magnitude and in strength. Although distillery effluent contain many constituents, which are phytotoxic at higher concentrations, many of these constituents are, however essential for the growth and development of plants.

The effect of distillery effluent on different plant communities has been investigated by various workers (Sahai and Srinivatava, 1986; Banerjee *et al.*, 2004; Chandra *et al.*, 2004).

In the present study, attempt has been made to assess the impact of treated and untreated distillery effluent from M/s Devans Modern Breweries Ltd. Talab Tillo, Bohri, Jammu on seed germination, growth parameters and yield of Bitter Gourd (*Momordica charantia* L. var. Jaunpuri Super Special).

Material and Method

To carry out these investigations, 13 experimental sets each comprising of 10 polythene bags were prepared – one control set (without any treatment to seed as well as soil); four seed treatment sets (i.e. one set each having seeds soaked in 100% treated distillery effluent for 24 hrs. and 48 hrs. and one set each having seeds soaked in 100% untreated distillery effluent for 24 hrs. and 48 hrs.); eight soil treatment sets- i.e. four soil treatment sets having treatment with treated distillery effluent at 25%, 50%, 75% and 100% concentra-

tion and four sets having treatment with untreated distillery effluent at 25%, 50%, 75% and 100%. Each of the eight soil treatment set was given respective concentration of respective effluent at interval of 5 days during first month, at interval of 10 days during second month, at interval of 15 days during third month. In impact study, the seed germination, root and shoot length, number of leaves per plant, number of tendrils per plant, wet weight of root and shoot, dry weight of root and shoot, number of flowers, number of fruits and quantitative morphology of fruits (dry weight of fruit, dry weight of seed and number of seeds per fruit) were studied at regular intervals. Physico-chemical characteristics like pH, electrical conductivity, BOD, COD, TDS, TSS and volatile solids of effluents were also studied.

Observation and Discussion

The physico-chemical parameters of untreated distillery effluent and treated distillery effluent are represented in table1. The comparison of physico-chemical analysis of treated and untreated distillery effluent is supported by the work of Chandra *et al.* (2004) i.e. They also observed acidic nature of raw effluent and higher values of BOD, COD, TDS and TSS of raw effluent as compared with that of treated effluent. BOD value (25mg/l) of the treated distillery effluent was found to be less than the bod value of 30mg/l which is prescribed as minimum national standard for surface water disposal of liquid effluents from fermentation industry (Table II).

The seed treatment with treated distillery effluent for 24 hours had a stimulatory effect on percentage seed germination (96%) as compared with that of the control set (88-92%) whereas seed treatment with treated distillery effluent for 48 hours and with untreated distillery effluent for 24 hours as well as 48 hours inhibited percentage seed germination (i.e. 81%, 79% and 70% respectively) as compared with that of the Control Set (Table III). This observation partly finds support from the work of Sahai and Srinivastava (1986), Dayama (1987), Rajendrababu (1987), Sahai and Srivastava (1988) and Gupta (1991) on different crops using different types of industrial effluents. They observed that industrial effluent has affected the seed germination more severely when effluent treatment was given to seeds and less severely when effluent treatment was given to soil.

The analysis of the data further revealed that seed treatment with Treated Distillery Effluent for 24 hrs (Set II) and 48 hrs (Set III) inhibited the average root length (31.3 cm and 31.8 cm. respectively), whereas the seed treatment with Untreated Distillery Effluent for 24 hrs (Set VIII) and 48 hrs (Set IX) increased the average root length (32.6 cm and 33.0 cm respectively) as compared with that (32.4 cm) of the Control Set at 60 days after thinning. The soil treatment with Treated Distillery Effluent was observed to exhibit stimulatory effect on average root length with increasing concentration from 25% to 75%, but it had inhibitory effect at 100% concentration. The soil treatment with Untreated Distillery Effluent exhibited stimulatory effect on average root length at 25% concentration (Set X) and then it exhibited inhibitory effect on average root length with increasing concentration from 50% to 100% (Table III). Patel, *et al.* (1990) also observed that root length of mustard plant increased with pharmaceutical factory effluent up to 40% and higher concentrations had inhibitory effect. Kumar *et al.* (1990) and Gupta and Nathawat (1992) also observed decrease in root length of various plants with increasing concentration of different industrial effluents.

The analysis of the data further revealed that seed treatment with 100% treated distillery effluent and soil treatment with 25%, 50% and 75% treated distillery effluent had a stimulatory effect on the average shoot

length, whereas soil treatment with 100% treated distillery effluent had a inhibitory effect on the shoot length as compared with shoot length of the control set. The seed treatment with 100% untreated distillery effluent as well as soil treatment with 25% untreated distillery effluent was also observed to exhibit stimulatory effect on the shoot length whereas soil treatment with 50%, 75% and 100% untreated distillery effluent exhibited inhibitory effect on the shoot length of *Momordica charantia* as compared with that of the control set (Table III).

The study further revealed that treated distillery effluent treatment to seeds in sets –II (soaked for 24 hrs) and III (soaked for 48 hrs); untreated distillery effluent treatment to seeds in sets –VIII (soaked for 24 hrs) and IX (soaked for 48 hrs) as well as the soil treatment with treated distillery effluent up to 75% and the 25% untreated distillery effluent treatment to soil exhibited stimulatory effect on average number of leaves as well as tendrils per plant as compared with those of the control set, whereas soil treatment with 100% treated distillery effluent and untreated distillery effluent above 25% exhibited inhibitory effect on average number of leaves as well as tendrils per plant as compared with those of the Control Set (Table III). Banerjee *et al.* (2004) also observed increased growth rate of *Casurina equisetifolia* with distillery effluent up to 60%.

The analysis of data regarding dry weight of root revealed that seed treatment with treated as well as untreated distillery effluent and soil treatment with treated distillery effluent at 100% as well as untreated distillery effluent at all concentrations inhibited the average dry weight of root. But soil treatment with treated distillery effluent stimulated dry weight with corresponding increase in effluent concentration from 25% to 75% as compared with that of the Control Set (Table III). Ramana *et al.* (2002) have reported a similar pattern of increase in dry weight with application of distillery effluent.

The critical analysis of data further revealed that seed treatment with treated as well as untreated distillery effluent and the soil treatment with treated distillery effluent from 25% to 75% and untreated distillery effluent at 25% exhibited stimulatory effect on dry weight of shoot as compared with that of the control set. But the soil treatment with 100% treated distillery effluent and untreated distillery effluent at 50%, 75% and 100% concentration had inhibitory effect on dry weight of shoot as compared with that of the Control Set (Table III). Dayama (1987), Patel *et al.* (1990) and Sundaramoorthy and Kunjithapatham (2000) also observed decrease in average dry weight with increase in effluent concentration while working on different plants using different industrial effluents.

The cumulative number of flowers per set in seed treatment sets of treated distillery effluent –II (soaked for 24 hrs) and III (soaked for 48 hrs) and the soil treatment sets of treated distillery effluent exhibited an increase in cumulative number of flowers at 25%, 50% and 75%, but in all the untreated distillery effluent sets and treated distillery effluent at 100%, these exhibited low value as compared with that of the Control Set (Table III).

Seed treatment Sets- III (having seeds soaked in 100% treated effluent for 48 hrs), VIII (having seeds soaked in 100% untreated effluent for 24 hrs) and IX (having seeds soaked in 100% untreated effluent for 48 hrs) exhibited no fruit formation. The cumulative number of fruits in soil treatment sets of treated distillery effluent exhibited a random pattern thereby showing no relation with the effluent concentration i.e. the cumulative number of fruits was observed to be 5, 2, 7, and 2 in Sets – IV (25%), V (50%), VI (75%) and VII (100%) respectively (Table III).

The untreated distillery effluent sets- X (25%), XI (50%) and XII (75%) exhibited one fruit each whereas no fruit formation was observed in Set XIII (100%). The average dry weight of fruit was observed to be more (4831.8 mg) in seed treatment set II (having seeds soaked in 100% treated effluent for 24 hrs) than that (4766.6 mg) of the control set. The average dry weight of fruit in soil treatment sets of treated distillery effluent exhibited no relation with increasing effluent concentration but exhibited higher values of 5178.8 mg at 25%, 5082.6 mg at 50%, 5985.9 mg at 75% and lower value of 4295.5 mg at 100% as compared with that (4766.7 mg) of the Control Set (Table III).

The average dry weight of fruit in untreated distillery effluent sets recorded lower value with increase in the effluent concentration i.e. of 4081.3 mg at 25%, 3511.3 mg at 50% and 3013.6 mg at 75%. The average dry weight of seed exhibited a higher value of 98.0 mg in Seed Treatment Set II (having seeds soaked in 100% treated effluent for 24 hrs) as compared with that (87.5 mg) of the Control Set. The average dry weight of seed in soil treatment sets of treated distillery effluent exhibited higher values of 131.6 mg at 25%, 110.1 mg at 50%, 160.3 mg at 75% and lower value of 79.2 mg at 100% whereas in untreated distillery effluent Sets, the average dry weight of seed exhibited lower value of 71.3 mg at 25%, 46.5 mg at 50% and 31.6 mg at 75% (Table III). The average number of seeds per fruit in the seed treatment set II (having seeds soaked in 100% treated effluent for 24 hrs) remained same (16.33) as that of the control set.

The average number of seeds in soil treatment sets of treated distillery effluent exhibited higher value of 17.14 at 25%, 16.8 at 50% and 18.0 at 75% and lower value of 16.5 at 100% and untreated distillery effluent sets exhibited lower value of 16.0 at 25%, 15.5 at 50% and 15.0 at 75% (Table III).

Conclusion

From the above analysis, it can be concluded that Treated Distillery Effluent is better in physico-chemical characteristics as compared with Untreated Distillery Effluent i.e. BOD value of Treated Distillery Effluent was observed to be 25 mg/l which is less than 30 mg/l as prescribed in Minimum National Standards for surface water disposal of liquid effluents from fermentation industry. From the analysis of data on the impact of distillery effluent on various quantitative morphological features of *Momordica charantia*, it can be concluded that the Untreated Distillery Effluent is detrimental for the growth of plants whereas Treated Distillery Effluent without dilution is also harmful for agriculture.

But the Treated Distillery Effluent at 25%-75% concentration was observed to have stimulatory effect on the growth of plants. Therefore, it can be recommended that Treated Distillery Effluent after diluting to 25% i.e. 75% concentration can be used for irrigation of agricultural land. Rampal and Dorjey (2001) also concluded that 50% concentration of untreated foam industry effluent favoured growth and yield of *Lens esculenta*. Chandra *et al.* (2004) also made similar conclusion while working on the impact of treated and untreated distillery effluent irrigation on soil micro flora, growth, total chlorophyll and protein contents of *Phaseolus aureus* L.

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Table I:- Physico- Chemical Parameters of Distillery Effluent

Parameter	*Untreated Effluent*	*Treated Effluent*
Colour	*Brown*	*Colourless*
Odour	*Unpleasant*	*Odourless*
Temperature (^{0}C)	*75*	*40*
pH	*6.97*	*8.26*
Electrical Conductivity (μMho)	*2.78*	*2.09*
BOD (mg/l)	*2300*	*25*
COD (mg/l)	*4200*	*80*
Total Dissolved Solids (mg/l)	*1450*	*769*
Total Suspended Solids (mg/l)	*575*	*230*
Volatile Solids (mg/l)	*415*	*280*

Table II: Minimum National Standards for Liquid Effluents from Fermentation Industry

Parameters	**Concentration not to exceed mg/l**
Maltry	
BOD, 5 days, 20°C:	30
Suspended Solids:	100
Brewery	
BOD, 5 days, 20°C:	30
Suspended Solids:	100
Distillery:	100 for land disposal, 30 for surface water disposal
BOD, 5 days, 20° C:	

Babu and Chakrabarti (2002)

Table III: Impact of Treated and Untreated Distillery Effluent on Seed Germination and Quantitative Morphological Features of *Momordica charantia* L. var. Jaunpuri Super Special

PARAMETERS	NAME OF EXPERIMENTAL SET												
	CONTROL SET	TREATED DISTILLERY EFFLUENT SETS						UNTREATED DISTILLERY EFFLUENT SETS					
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
%age of seed germination	90	96	81	92	91	66	89	79	70	90	92	88	89
Avg. root length (cm)	32.4±6.08	31.3±5.61	31.8±5.55	33.3±5.01	39.1±4.10	42.6±9.83	20.4±8.47	32.6±4.52	33.0±5.15	33.1±5.80	19.9±2.25	19.3±1.36	16.7±0.53
Avg. shoot length (cm)	99.1±52.77	105.3±28.98	107.0±26.85	115.2±24.42	128.5±10.55	151.4±33.65	87.5±13.44	106.7±30.12	100.5±32.41	100.8±32.66	80.2±21.80	70.6±16.86	65.9±15.12
Avg. no of leaves /plant	39.6±4.72	43.3±5.13	44.0±4.58	42.6±8.14	46.3±14.01	63.0±19.92	39.3±2.52	44.6±6.02	40.6±6.43	41.3±5.86	34.6±5.51	33.3±6.03	31.0±4.58
Avg. no of tendrils /plant	24.0±7.21	28.0±8.72	29.0±3.05	26.3±3.05	31.3±6.66	40.3±12.88	23.3±6.11	30.0±6.93	25.6±8.14	26.0±7.94	21.6±3.05	21.0±3.00	20.6±2.52
Avg. dry wt. of root (gm)	0.83±0.04	0.77±0.05	0.86±0.04	0.92±0.01	1.20±0.47	1.47±0.42	0.83±0.04	0.87±0.06	0.87±0.05	0.86±0.03	0.78±0.11	0.72±0.10	0.66±0.01
Avg. dry wt. of shoot (gm)	3.72±1.27	4.13±1.59	4.24±1.56	4.01±1.33	4.46±1.42	4.88±0.80	3.17±0.87	4.35±1.66	3.76±1.11	3.99±1.27	2.51±0.99	1.79±0.55	1.11±0.01
Cumulative no. of flowers per set	93(75)	87(78)	84(78)	86(75)	93(82)	105(98)	75(68)	82(79)	76(71)	65(57)	59(53)	56(49)	47(45)
Cumulative no. of fruits per set	3	3	–	5	2	7	2	–	–	1	1	1	–
Avg. dry wt. of fruit (mg)	4766.7	4331.8	–	5178.8	5082.6	5995.9	4256.5	–	–	4081.3	3511.3	3013.6	–
Avg. dry wt. of seed (mg)	87.5	98.0	–	131.6	110.1	160.3	79.2	–	–	71.3	46.5	31.6	–
Avg. no. of seeds /fruit	16.33	16.33	–	17.14	16.8	18.0	16.5	–	–	16.0	15.5	15.0	–

Set I: Control Set (Without any treatment to soil and seed)

Set II: Seeds soaked in 100% Treated Effluent for 24hrs before sowing.

Set III: Seeds soaked in 100% Treated Effluent for 48hrs before sowing.

Set IV: 25% Treated Effluent Treatment to soil.

Set V: 50% Treated Effluent Treatment to soil.

Set VI: 75% Treated Effluent Treatment to soil.

Set VII:100% Treated Effluent Treatment to soil.

Set VIII: Seeds soaked in 100% Untreated Effluent for 24hrs before sowing.

Set IX: Seeds soaked in 100% Untreated Effluent for 48hrs before sowing.

Set X: 25% Untreated Effluent Treatment to soil.

Set XI: 50% Untreated Effluent Treatment to soil.

Set XII: 75% Untreated Effluent Treatment to soil.

Set XIII: 100% Untreated Effluent Treatment to soil.

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Hydrobiological studies in the upstream of river Kunda at Khargone, Madhya Pradesh

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Abstract

The present paper deals with the hydrobiological observation on the upstream water of river Kunda at Khargone, M.P. The data revealed that 4 major groups of algae i.e. Chlorophyceae, Bacillariophyceae, Cyanophyceae and Euglenophyceae are persent in the upstream of Kunda river.

Key words: *Phycology, fresh water biology, algal taxonomy, limnology, water analysis.*

Introduction

Algae plays an important role in all types of water bodies. Polluted water harbour characteristic types of algal taxa. Algae in general and blue green algae in particular cause additional problems in water supplying. Kunda river, a tributory of Narmada is sufficiently rich in various types of algae. Earlier works on the algal flora of M.P. by Desikachary and Mall (1955), Agarkar and Agarkar (1962), and others reveal that our knowledge regarding the algal flora of M.P. is scanty. Seerwani (1963) and Mahajan (1987 & 1991) have published some research papers on the algae of Khargone. Recently physico-chemical and biological characterization of the river Kunda at downstream of Khargone has been reported (Mahajan *et al.*, 2002 and Mahajan, 2005) but till now no such type of work has been done on the upstream of this river. Therefore the present investigation has been taken up.

Material and Methods

Water samples were collected during 2005-06 from the Dargah site of the river Kunda near water filteration and purification plant of Khargone city. This place is only 3 Km away from the city. Algal taxa were identified after consulting the standard literature and monographs (Desikachary, 1959; Randhawa, 1959; Prescott, 1964 and Phillipose, 1967) and every attempt has been made to bring the nomenclature up-to-date. Enumeration of algal members of different classes is shown in Table 1. Physico-chemical characteristics of water samples were determined following Golterman and Clymo, 1969; Trivedi and Goel (1986) and APHA (1989) and the data are shown in Table 2.

Results and Discussion

It is revealed from Table 1 that altogether 21 algal taxa are reported, out of which 10 taxa belong to Chlorophyceae, 5 to Bacillariophyceae, 4 to Cyanophyceae and 2 to Euglenophyceae. Important members reported are *Zygnema* and *Scenedesmus*. Occurrence of Anacystis and *Schizomeris* is significant because these taxa are new records for West Nimar district. Fertile stages of *Zygnema* and *Spirogyra* were also reported. Apart from this, 3 members of zooplankton are also reported i.e. *Daphnia*, *Cyclops* and *Rhabditis*. From Table-2 the water analysis shows that pH of water is alkaline (7.7), DO is maximum in winter months while minimum during monsoon months. The values of Conductivity, Total alkalinity, Hardness, Magnesium, Calcium and Chlorides are maximum in summer while minimum in winter months.

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Table 1. Algal taxa reported in the upstream water of river Kunda at Khargone, M.P.

Chlorophyceae

1. *Chlorella sp.*
2. *Cosmarium sp.*
3. *Mougeotia abnormis*
4. *Scenedesmus armatus*
5. *S.brasiliensis*
6. *Schizomeris sp.*

7. *Spirogyra condensata*
8. *S. sinensis*
9. *Staurastrum sp.*
10. *Zygnema himalayansis*

Bacillariophyceae

1. *Fragillaria rumpens*
2. *G. sphaeroperum*
3. *Navicula cuspidata*
4. *N.pupula*
5. *Nitzschia*

Cyanophyceae

1. *Anacystis nidulens*
2. *Gomphosphaeria sp.*
3. *Oscillatoria princeps*
4. *O. sancta*

Euglenophyceae

1. *Euglena*
2. *Phacus*

Table 2. Physico-chemical parameters of upstream water of river Kunda at Khargone, M.P.

Parameters	Upstream
Physical -	
Air temperature (°C)	28.4
Water temperature (°C)	23.5
Turbidity (NTU)	17.5
Conductivity (mhos)	125
pH	
	7.9
Chemical -	
Dissolved oxygen (mg/l)	15
B.O.D. (mg/l)	1.5
Total Solids (mg/l)	51
Total Hardness (mg/l)	180
Chlorides (mg/L.)	128
Calcium (mg/L.)	26.05
Magnesium (mg/L.)	7.62
Total Alkalinity (mg/l)	85

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Moss bag technique for monitoring of metal precipitation

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Abstract

Moss *Barbula vinealis* and *Rhodobryum roseum* used as biomonitor of metal precipitation at Nainital during 2004 - 2005 to examine deposition of Zn, Cu, Cd, Pb at Nainital area, around point sources in all the four directions. Moss bags were transplanted at 8 sites for fixed exposure time in sampling seasons (summer, monsoon and winter) and were harvested periodically after 4 months of exposure. An increase in amount of metals in 2004 - 2005 reflects an increase in metals in air. High metallic load was observed in locations in proximity of higher traffic density. From the result, it is concluded that local sources in Nainital, especially due to enhanced tourism during summer, contributes to elevated metal deposition in comparison to winter and monsoon season. Active monitoring by 4 months of exposure of mosses gives reliable results on metal contamination. Study also aim at assessing the suitability of both mosses as a biomonitor for metal deposition. Study confirms that in Nainital, where due to higher vehicular traffic, wear and tear of vehicular parts and beside it increasing tourist activity, high level of Zn, Pb was measured in moss transplant bags.Bioaccumulation ability in these two mosses was evaluated statistically using Dunkun's Multiple Range Test and was presented on contour maps obtained from SURFER program.

Key Words: *Element concentration, Barbula vinealis, Rhodobryum roseum, biomonitoring*

Introduction

Activities of man and the uncontrolled development of large and small cities and urbanization during the recent past and especially on hills resulted in the contamination of ecosystem. Combustion of fuel, increasing tourist activity and heavy traffic load contribute a considerable amount of pollutants to air. In recent decades the number and intensity of anthropogenic sources, such as waste burning, fertilizers, vehicle emissions, agricultural and sewage sludge, have increased the overall environmental element concentration (Bargagli, 1998). This fact seems to be true for the city of Nainital where there are large numbers of vehicles and other human activities increased with time. Therefore, monitoring of air contaminants of study area is necessary to determine impact upon ecosystem and control measure requires for abatement of their sources in investigated region.

Bryophytes have been used as terrestrial biomonitors and bioindicators of air pollution worldwide as well as by this laboratory and are recognized as more sensitive to pollution than other plants (Fernandez *et al.*, 2000). Among them mosses have tremendous ability to absorb metal as dry fallout from the atmosphere (Saxena, 2001). They have capability to receive and accumulate chemical substances predominantly from surrounding atmosphere (Fernandez *et al.*, 2004). Due to this accumulation potential they have been preferred in present study.

In present work, active monitoring (moss bags) has been used to determine total level of atmospheric deposition of heavy metals in Nainital city. This technique is very useful especially in such polluted areas where wild growing mosses are lacking (Makholm and Miadenoff, 2005).

Study is an attempt to use moss *Barbula vinealis* and *Rhodobryum roseum* to investigate the spatial distribution of the metals (Cu, Zn, Pb and Cd) contamination in Nainital city during Monsoon, summer and winter seasons with the help of moss bag (transplant) technique during different seasons of 2004 to 2005.

Material and Methods

Study area

Nainital is located at an altitude of 5900 ft. on Kumaon hills and connected by road only. It is situated in area of 11.7 Sq. Km. and surrounded by hills from all sides except east, which has only entry in the city (fig.1). The climate was quite cold between October - April and mild warm through May - June followed by monsoon rain till September. The average rainfall measured 80" and relative humidity range from 85 to 90% in the months of July and August. The maximum and minimum temperatures were recorded 27°C to 10°C in summer and 15°C to 3°C in winter respectively.

Sampling

Moss *Barbula vinealis* and *Rhodobryum roseum* were collected from the forest cover of Mukteshwar (unpolluted area), situated at an altitude of 2300 meters. A complete green patch of moss was transplanted in nylon bags at 8 study sites of investigated areas and sufficient amount of the same moss was taken for digestion to determine the baseline concentration of each season. Each moss bag was suspended 6 feets above the ground in triplicate. These moss bags were transplanted cross section wise in all the four directions at the distance of 100m and 300m and were harvested after an exposure period of four months i.e. first week of November (for monsoon monitoring), March (for winter monitoring) and July (for summer monitoring).

Metal analysis

Upon return to the laboratory, harvested moss samples were oven dried at 40°C for 24 hours. Prior to analysis, adhering substrate and litter was removed by hand, great care being taken to avoid metal contamination. Triplicate samples were digested with concentrated HNO_3 and $HClO_4$ in ratio of 5:2 v/v on a hot plate. The digestion was completed after all organic material had disappeared. The extract obtained was filtered and the filtrate was made up to a final volume of 50 ml and fraction was quantitatively analyzed by atomic absorption spectrophotometer. Suitable blank were used to check for possible contamination during extraction.

Data analysis

Samples were collected in triplicate to conduct the statistical analysis. Value represented as mean $\pm$ standard error (Snedecor and Cochran, 1967). ANOVA revealed significant differences in the metal concentration at different distances and seasons (for $p \leq 0.01$, $p \leq 0.05$) utilizing Dunkun's Multiple Range test (Karmer, 1956). Catographic representation of the results was performed with the program package Surfer (Golden Software Inc., U. S. A.).

Results

Mean concentration (mg g^{-1} dry wt.) of metal ions were detected in *Rhodobryum roseum* and *Barbula vinealis* exposed during 2004-2005 transplant period at 8 monitoring stations of Nainital city (tables: 1 and 2). From analysis of moss transplant, it appears that different concentration of metal accumulation was observed which was related to different pollution sources, its level in the study sites and seasonal variations. A positive correlation was observed in all four metals in each season.

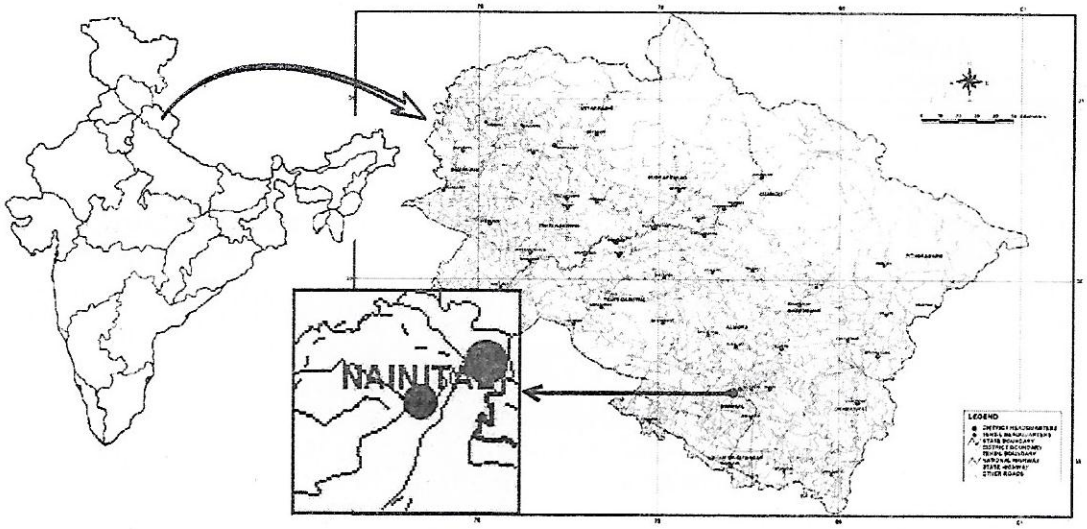

Fig 1. Map of monitoring sites (Nainital) of Kumoan hills, India.

Rhodobryum roseum

In view of seasonal affect maximum concentration of Zn, Pb, Cu and Cd were measured 2.056, 1.585, 0.785 and 0.064 mg g^{-1} dry wt. respectively at 100 m in south direction. However, minimum concentration was measured in west direction of Nainital at 300 m for Zn (0.709 mg g^{-1} dry wt.), Pb (0.477 mg g^{-1} dry wt.), Cd (0.008 mg g^{-1} dry wt.), whereas, in Cu (0.325 mg g^{-1} dry wt.) was lowest in north (300 m). Results were highly significant different for values ($p \leq 0.05$) of Zn, Pb and Cu in each site and for all metals undertaken, while, Cd value was non-significant at north direction between winter and summer season. An identical trend was observed in both transplant belongs to west direction (monsoon and winter season).

Barbula vinealis

The maximum concentration of Zinc was measured as 2.055 mg g^{-1} dry wt. at 100m (south) and minimum as 1.408 mg g^{-1} dry wt.at 300m (west), whereas, in case of lead, higher value was analyzed 1.846 mg g^{-1} dry wt. at 300m (east) and lowest at 0.753 mg g^{-1} dry wt. at 300m (west). In copper concentration was as high as 1.229 mg g^{-1} dry wt. in south direction (100m) and decline up to 0.416 mg g^{-1} dry wt. in west (300m). Cadmium was detected quite low in all samples, the maximum and minimum values were measured as 0.070 mg g^{-1} dry wt. at 300m (south) and 0.013 mg g^{-1} dry wt. at 100 m in north direction respectively.

After calculating ANOVA Zn, Pb and Cu show almost significant different values in different seasons. Cd shows almost non-significant results. However, results of eight study sites show significant different values for other metals Zn, Pb and Cu in all three seasons in comparison to control.

Metal distribution pattern

The distribution mapping pattern of undertaken metals (Cu, Zn, Cd, Pb) show maximum concentration in south and south east direction, whereas, minimum concentration was observed in west direction of transplant sites (in most of the cases)at Nainital during different seasons in both the mosses (figs: 2-25).

The reason could be due to higher vehicular load as bus station and petrol pump is located in south side of Nainital city. In addition, at some places samples get direct exposure while in other areas not. We cannot ignore even meteorological factor and direction of prevailing wind, which may be the other cause for variation in distribution pattern.

Discussion

The metal concentration of the analyzed samples varied greatly, depending on the environmental precipitation and correlated well with the distribution of emission sources. In different seasons, metal precipitation was not constant and recorded maximum during summer followed by winter and lowest in monsoon season. The more significant seasonal trend is reflected by the fact that consumption of gasoline peaks during summer due to many fold increased in tourist activity and also due to decrease in growth during dry summer period (Gerdol *et al.*, 2002). However, in monsoon tourist activity decreases and pollutants leach out. Further more, increase in growth and biomass occurs more rapidly during rains and thus reduces the metal percentage in leaves in proportion to biomass. Present observation are ample documented by tables 1 and 2 confirm that statistically only Pb, Zn and Cu showed any degree of positive correlation for the whole data set.

The study confirms that there are different levels of contaminants accumulation in the transplants. It is evident from analytical parameters that high amount of metals (Pb, Cu, Cd and Zn) was detected in south direction in moss *Rhodobryum roseum* and *Barbula vinealis* due to the reason that site is near bus station and petrol pump, dry deposition of metals spewed out from automobile (Imperato *et al.*, 2003), the only source of transportation connecting the foot hill (Haldwani) to Nainital. On the contrary, Pb was measured maximum at 100m (north) in *Barbula vinealis* may be due to traffic density, proximity to other roads, precipitation, meteorological factors, and finally by direction of prevailing wind. The lowest ratios of metal were found in the transplants, west direction along with north site during monsoon season. This reveals that mosses exposed to traffic are relatively high (south) compared with those having low traffic volume and human interference (west).

This is further confirmed for Pb and Zn both elements were found high in concentration. This may be due to busy roads, motorways, traffic density, use of fertilizers for growth of crops and orchards (Saxena and Saxena, 2000). Besides, it is an integral constituent of lead as steel and automobile industries. The likeliest source of the Zn from vehicles is engine and particularly tires wear, along with very little from exhaust emission (Pearson *et al.*, 2000). The main source of Pb is vehicular emission. It is also found associated with anthropogenic variables of the environment. Since, Cu is an integral part of discarded metallic waste and used in fertilizers etc.On the contrary it is also used as fungicides and pesticides, practices in agriculture (Gerdol *et al.*, 2000; Otvos *et al.*, 2003). Higher values in domestic waste were reported due to their improper dispersal in atmosphere. In addition, higher concentration of Cd was due to automobile exhausts (Stefano and Bononi, 2000). The contamination may also come from use of metallic or plastic pipes, sewage sludge, abrasion of automobile tires and from domestic wastes in urban areas (Grodzinska and Szarek-Lukaszewska, 2001).

Study successfully demonstrated the regional gradients of metals. Mosses *Rhodobryum roseum* and *Barbula vinealis* were very common in urban areas and were often the only species near busy main road, an indication of their general tolerance to atmospheric pollution in Nainital.

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Table 1: Metals concentration (mg g-1 dry wt.) in transplants of *Rhodobryum roseum* at different sites of Nainital city during monsoon, winter and summer season (2004-2005).

Rhodobryum roseum												
Sites	Monsoon 2004				Winter 2005				Summer 2005			
	Zn	Pb	Cu	Cd	Zn	Pb	Cu	Cd	Zn	Pb	Cu	Cd
Control	0.408± .004	0.268±0.005	0.207±0.004	$0.005\pm0.002^{ABC*}$	0.582±0.001	0.399±0.006	$0.312\pm0.006^{DEF*}$	$0.024\pm0.052^{GHIJa*}$	0.758±0.052	0.488±0.046	0.403±0.002	0.026 ± 0.035^{KLa}
South,100m	1.030±0.008	0.668±0.004	0.412±0.006	0.026 ± 0.005^{AB}	1.205±0.003	0.776±0.003	0.525±0.013	0.034±0.026	2.056±0.018	1.585±0.003	0.785±0.003	0.064±0.003
South,300m	1.354±0.002	0.925±0.014	0.456±0.003	0.023±0.002	1.575±0.006	1.125±0.014	0.577±0.004	0.044±0.029	1.659±0.005	0.954±0.023	0.762±0.015	0.054±0.001
North,100m	1.183±0.007	0.844±0.012	0.378±0.004	0.009 ± 0.006^{b}	1.277±0.009	0.958±0.004	0.484 ± 0.006^{D}	0.024 ± 0.027^{Gb}	1.728±0.045	1.286±0.035	0.623±0.024	0.027 ± 0.013^{Kb}
North,300m	0.880±0.002	0.723±0.013	0.325±0.009	0.022±0.002	1.010±0.008	0.804±0.027	0.454 ± 0.002^{E}	0.039 ± 0.043^{c}	1.277±0.038	1.023±0.002	0.529±0.004	0.055 ± 0.021^{c}
East,100m	0.980±0.003	0.771±0.002	0.453±0.008	0.020 ± 0.003^{a}	1.134±0.003	0.950±0.014	0.604±0.002	0.034 ± 0.021^{a}	1.428±0.026	1.123±0.021	0.756±0.035	0.046 ± 0.033^{a}
East,300m	1.207±0.004	0.903±0.026	0.449±0.011	0.009 ± 0.001^{b}	1.476±0.009	1.003±0.002	0.506 ± 0.003^{a}	0.029 ± 0.038^{Hf}	1.627±0.002	1.295±0.026	0.668±0.041	0.030 ± 0.036^{Jf}
West,100m	0.876±0.011	0.706±0.003	0.348±0.004	0.017 ± 0.021^{g}	1.156±0.004	0.837±0.064	0.518±0.011	0.026 ± 0.032^{gi}	1.390±0.003	1.125±0.003	0.556±0.015	0.046±0.031
West,300m	0.709±0.005	0.477±0.004	0.404 ± 0.003^{de}	0.008 ± 0.001^{b}	0.828±0.046	0.704±0.004	$0.221\pm0.166^{Fd*}$	$0.033\pm0.038^{Jh*}$	1.228±0.004	1.025±0.024	$0.678\pm0.047^{e*}$	0.050±0.055*

- * p≤ 0.05
- Values are represented as mean ± standard error.
- With in vertical columns of different seasons, values superscripted with same small alphabets are not significantly different at P<0.01.
- With in horizontal rows, values with same Capital alphabets are not significantly different at P<0.01 in comparison to control.

Table 2: Metals concentration (mg g-1 dry wt.) in transplants of *Barbula vinealis* at different sites of Nainital city during monsoon, winter and summer season (2004-2005).

Barbula vinealis												
Sites	Monsoon 2004				Winter 2005				Summer 2005			
	Zn	Pb	Cu	Cd	Zn	Pb	Cu	Cd	Zn	Pb	Cu	Cd
Control	0.479±0.023	0.370±0.020	0.275±0.002	ND	0.675±0.014	0.470±0.012	0.395±0.003	$0.005\pm0.014^{a*}$	0.775±0.005	0.576±0.010	0.435±0.012	$0.015\pm0.012^{aAB*}$
South,100m	1.355 ± 0.102^{b}	0.954 ± 0.023^{cd}	0.505±0.003	0.018 ± 0.052^{fg}	1.531 ± 0.009^{b}	1.417 ± 0.241^{ce}	0.666±0.015	0.038 ± 0.005^{m}	2.055 ± 0.012	1.481 ± 0.052^{de}	1.229 ± 0.011	0.064 ± 0.018^{gh}
South,300m	1.333±0.017	1.030±0.087	0.704±0.023	0.025 ± 0.046^{ik}	1.653±0.007	1.346±0.021	0.884±0.006	0.047 ± 0.011^{lij}	1.805±0.029	1.630±0.008	0.931±0.016	0.070 ± 0.011^{jk}
North,100m	1.226±0.006	0.896±0.017	0.457±0.006	0.013 ± 0.072^{kl}	1.378±0.121	1.052±0.016	0.585±0.072	0.025 ± 0.002^{km}	1.714±0.008	1.421±0.011	0.829±0.058	0.032 ± 0.007^{lmA}
North,300m	1.151±0.027	0.792±0.001	0.429±0.012	$0.025\pm0.002^{ik*}$	1.278±0.052	0.977±0.012	0.766±0.013	0.040 ± 0.011^{no}	1.501±0.007	1.204±0.002	0.955±0.104	$0.062\pm0.069^{gh*}$
East,100m	1.300±0.028	0.846±0.035	0.568±0.179	0.017 ± 0.069^{jk}	1.578±0.012	1.260±0.017	0.636±0.023	$0.030\pm0.005^{Pq*}$	1.774±0.013	1.519±0.058	0.746±0.010	0.060 ± 0.077^{q}
East,300m	1.380±0.011	1.076±0.029	0.517±0.007	0.030 ± 0.087^{rs}	1.704±0.023	1.430±0.008	0.629±0.011	0.045 ± 0.011^{rt}	2.004±0.023	1.846±0.098	0.795±0.002	0.058 ± 0.052^{st}
West,100m	1.178±0.005	0.876±0.005	0.526±0.010	0.018 ± 0.005^{k}	1.379±0.011	1.093±0.001	0.723±0.013	0.033 ± 0.006^{tx}	1.618±0.052	1.307±0.024	0.954±0.053	0.053 ± 0.053^{x}
West,300m	1.048±0.003	0.753±0.075	0.466±0.015	0.014 ± 0.055^{uv}	1.254±0.013	0.994±0.003	0.676±0.009	0.029 ± 0.005^{uu}	1.453±0.075	1.126±0.041	0.873±0.088	0.036 ± 0.075^{uuB}

- * p≤ 0.05
- Values are represented as mean ± standard error.
- With in vertical columns of different seasons, values superscripted with same small alphabets are not significantly different at P<0.01.
- With in horizontal rows, values with same Capital alphabets are not significantly different at P<0.01 in comparison to control.

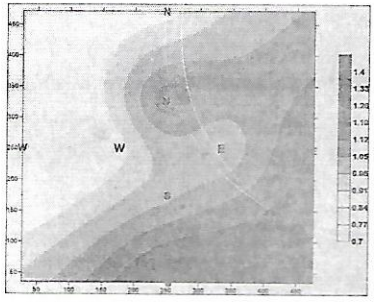

Fig.2.Distribution map of Zn content *R. roseum* (mg g^{-1}) in monsoon at Nainital

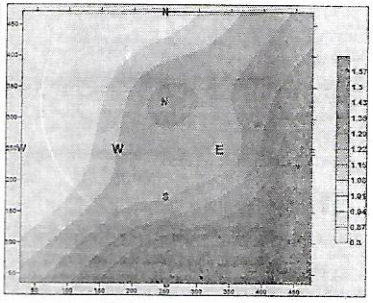

Fig.3.Distribution map of Zn content *R. roseum* (mg g^{-1}) in winter at Nainital

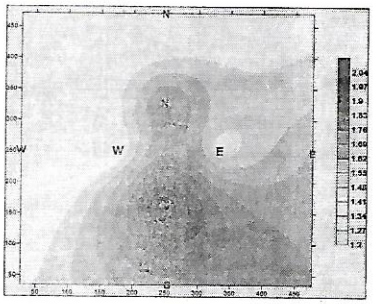

Fig.4.Distribution map of Zn content *R. roseum* (mg g^{-1}) in summer at Nainital

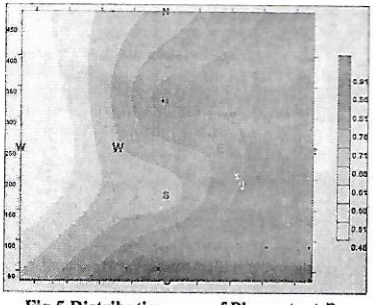

Fig.5.Distribution map of Pb content *R. roseum* (mg g^{-1}) in monsoon at Nainital

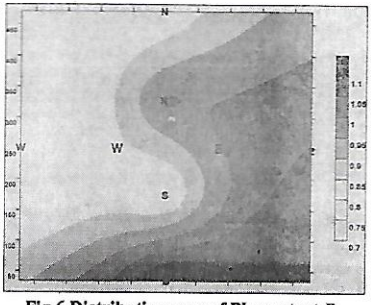

Fig.6.Distribution map of Pb content *R. roseum* (mg g^{-1}) in winter at Nainital

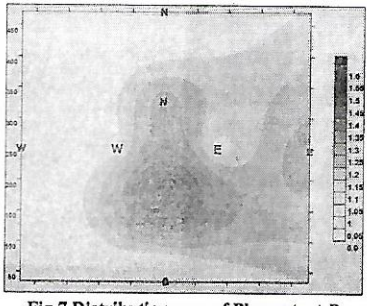

Fig.7.Distribution map of Pb content *R. roseum* (mg g^{-1}) in summer at Nainital

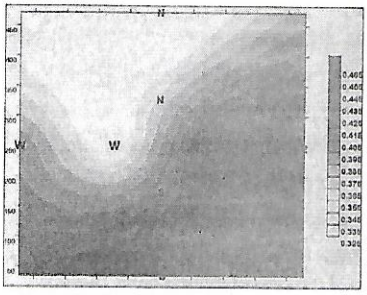

Fig.8.Distribution map of Cu content *R. roseum* (mg g^{-1}) in monsoon at Nainital

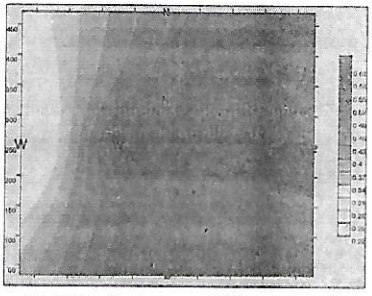

Fig.9.Distribution map of Cu content *R. roseum* (mg g^{-1}) in winter at Nainital

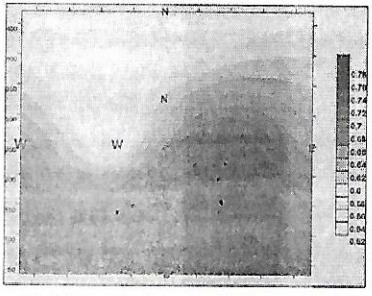

Fig.10.Distribution map of Cu content *R. roseum* (mg g^{-1}) in summer at Nainital

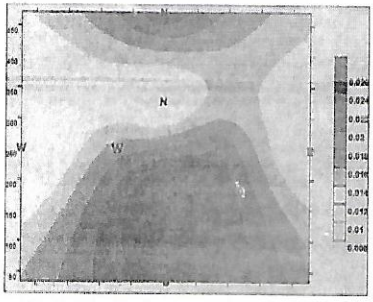

Fig.11.Distribution map of Cd content R. roseum (mg g^{-1}) in monsoon at Nainital

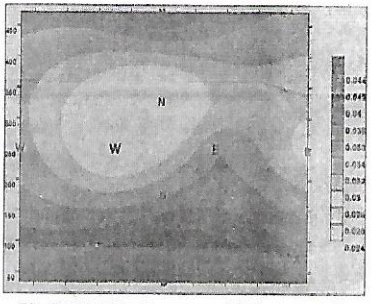

Fig.12.Distribution map of Cd content *R. roseum* (mg g^{-1}) in winter at Nainital

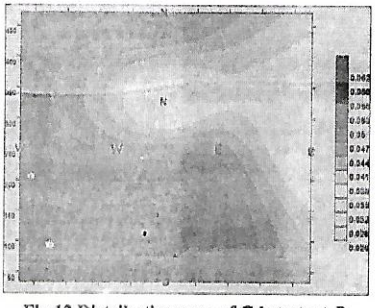

Fig.13.Distribution map of Cd content *R. roseum* (mg g^{-1}) in summer at Nainital

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Heavy metal contamination in vegetables by flash torch & battery manufacturing industry

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Abstract

Pollution of the biosphere with heavy metal has accelerated dramatically during the last century. Unlike organic pollutants heavy metal are persistant environmental contaminant, which can not be chemically or biologically destroyed. In low concentration, several heavy metals such as Fe, Mn , Zn, Cu,Ni and Mo are essential micronutrients for plants. Elevated concentration of heavy metals in the soil surface cause a variety of environmental problems, including toxicity to plants, animal and humans. The objective of this study was to evaluate the level of heavy metal contamination in a field irrigated with flash torch & battery manufacturing industry effluent and accumulation, distribution of heavy metals in vegetables grown in contaminated fields .An attempt has also been made to evaluate the exposure risk of heavy metals to human beings. Cabbage were found to have translocation index more than 100 i.e 103.06 for Fe, While Cauliflower has translocation index 110.77 for Cu. These plant species can be suggested, as hyper accumulator species for Fe and Cu, but these plant species are edible plant hence can not be suggested to grow on metal contaminated site. The exposure risk levels of the exposed population groups to heavy metals, it is quite clear from the results that except Cu (1.08) none of the metal were found to exceed the RQ value more than 1.0.While in case of Fe the RQ value were found 0.935 which is nearer to 1.0.

Keywords: *Heavy metals, Vegetables, Risk Quotient, Translocation index*

Introduction

The problem of environmental pollution on account of essential industrial growth is in practical terms, the problem of disposal of industrial waste, whether solid or gaseous. All three forms of pollution have the potentiality for taking ultimately the form of water pollution, soluble gases and solids adding to the pollution caused by liquid industrial effluents, directly affects not only soil in exclusively industrial areas but also agricultural fields as well as the beds of rivers, channels and barrage reservoirs, creating secondary sources of chronic pollution. Industrial effluents from paper factories, the automobiles industry, textile factories, and the food industry have adverse effects on soil properties, seed germination, and seedling growth (Somashekar *et al.,* 1984). The effluents from all these factories were alkaline and contaminated with variable amounts of plant nutrients such as Ca, Mg, B, Fe, and Cu, other toxic metals and minerals such as Na, K and nitrate were also present in varying concentrations. The raw effluent altered the physico-chemical properties of the treated soil and were responsible for a reduction in the rate of seed germination. Diluted effluents, however, showed favorable effects on seedling growth.

Pollution of the biosphere with heavy metal has accelerated dramatically during the last century. Unlike organic pollutants heavy metal are persistant environmental contaminant, which can not be chemically or biologically destroyed (Wade *et al.* 1993).

In low concentration, several heavy metals such as Fe, Mn , Zn, Cu,Ni and Mo are essential micronutrients for plants (Taiz and Zeiger 1988) .Elevated concentration of heavy metals in the soil surface cause a

variety of environmental problems, including toxicity to plants, animal and humans.

The objective of this study was to evaluate the level of heavy metal contamination in a field irrigated with flash torch and battery manufacturing industry effluent and accumulation, distribution of heavy metals in vegetables grown in contaminated fields .An attempt has also been made to evaluate the exposure risk of heavy metals to human beings.

Material and Methods

A flash torch and battery manufacturing industry located in out skirt of Lucknow, Uttar Pradesh, India.Manufacturing process in this industry is based on electroplating. Effluent of this industry passes long distance through open channel and ultimately falls in to the nearest river Gomti. Local people also uses this effluent for cultivation of crop and vegetables as irrigation water as per requirements.

Soil and Vegetable samples were collected from a field irrigated with this effluent, the name of vegetables are given in table 1. For each plant sample 10 to 15 plants of the same species were collected randomly from each of the locations in the area from where soil samples were drawn. It was ensured that the different samples of each plant species had the same physiological age and identical appearance. The plant samples were washed first with running tap water to remove extraneous matter and then with distilled water. After washing, the plant material was blotted dry, finely chopped and oven dried at 65 °C. The dry plant material was pulverised and stored in kraft paper bags till needed for analysis, prior to analysis.

Soil collection has been made at depth ranging from 0 to ~30 cm during Dec. 2000 to Nov. 2001. The samples were freed from extraneous matter (stones, pebbles etc) and air-dried. After air-drying, the samples were ground and sieved through 2 mm sieve to ensure uniform particle size. The potentially toxic elements- Fe, Cu, Pb, Cr and of Cd were analysed in soil and plant samples by atomic absorption spectrophotometer (Perkin Elmer 5000) Digestion of plant and soil sample were carried out according to the method of Piper (1942). All determinations were carried out in triplicate and the data were analyzed statistically for standard deviation of each value (Panse, 1954).

Results and Discussion

The concentration of Fe was found higher in cabbage (88.17 µg/g) while lower in Capsicum (30.45 µg/g). In case of Cu it was higher in Cabbage (80.32 µg/g) and lower in cauliflower (24.77 µg/g). The concentration of Cr was higher in Cabbage (137.96 µg/g) and lower in Cauliflower (5.37 µg/g). In case of Pb & Cd it was higher in Cabbage i.e 7.65 ìg/g & 1.60 ìg/g respectively while lower in Capsicum i.e 0.88 µg/g & 0.93 µg/g respectively.

The heavy metal concentration in soil were higher than the plant species in most of the cases, it means the presence of heavy metal in growing media i.e. soil or water is not an important factor for metal uptake by plant from their respective soil, similar results were shown by Kisku *et al.*, in 2000.

The different heavy metal levels in plants grown on un polluted soil are Fe=140, Cu=4-15, Zn=8, Ni=1, Cr=0.2-10, Pb=0.1-10, Cd=0.2-0.8 µg/g dry weight as suggested by Allaway (1968).

Except Fe & Pb all metals exceed the normal limits suggested by Allaway (1968).

The concentration of heavy metals in different plant parts is presented in Table 2.The concentration of

metals in edible parts of different vegetables especially Cr, Pb and Cd are much higher in Cabbage & Cauliflower (table 2) and may exceed the average normal concentration reported by others and are beyond human consumption level. This may create health problems in the long run. The average normal concentration of Cd is 0.05 µg/g (Elinder 1988), Pb is 0.01 to 1.0 µg/g (Warren and Delavault, 1962) , Cr is 60 µg/day (WHO, 1994).

Accumulation of metals in root from soil and subsequent translocation to other parts of plant like stem, leaves and fruits is important for the selection of plant specially crops & vegetables. Plant accumulating least quantity of metals in the edible parts with the concentration within the permissible limit then the variety or species can be selected for the cultivation on field having high level of metal concentration (Barman *et.al* 2000).

Translocation index of different heavy metals in different plants were computed using the Eq. (1)

$$\text{Translocation index (T.I)} = \frac{\text{Average heavy metal in soil samples}}{\text{Average heavy metal in plant samples}} \times 100 \qquad (1)$$

Translocation index may be an important parameter for selection of plant species that can grow on a contaminated site of heavy metals. The plants that has translocation index more than 100 can be suggested as hyper accumulator plant species for particular metal.

Cabbage were found to have translocation index more than 100 i.e 103.06 for Fe, While Cauliflower has translocation index 110.77 for Cu (table3). These plant species can be suggested as hyper accumulator species for Fe and Cu, but these plant species are edible plant hence can not be suggested to grow on metal contaminated site.

The environmental exposure risk to the populations from these elevated levels of metals in vegetables in area receiving wastewater has been evaluated by first computing the mean estimated total daily intake (TDI) of each of these metals using Eq. (2)

$$\text{TDI (mg/day)} = \text{S C.D} \qquad (2)$$

Where C is the mean concentration of individual metal in the vegetables and D is the mean daily intake of the same media by a person. The major intake routes considered are drinking water (2.5 l/d) , food grains (600 g/d) , vegetables (300 g/d) and milk (200 g/d). The computed TDI (mg/d) values for each metal are then compared with their respective acceptable daily intake (ADI) values (mg/d). Worked out from their individual ADIs (mg/d) as available in literature for a person of 60 kg body weight.

The risk quotient (RQ) for each metal was computed using Eq. (3)

$$\text{RQ} = \text{TDI} / \text{ADI} \qquad (3)$$

The computed results for the metals only for which ADI values are available are presented in table (4).

As a general principle, the population exposed to toxic metals will be at risk with respect to metals, if the value of the respective risk quotient (RQ) is above 1.0. (Singh *et al.* 2004). However if we compare the two population groups for their relative risk with respect to some common heavy metals to which these are exposed, their respective RQs may give an assessment of their relative risk level for that particular metal.

The exposure risk levels of the exposed population groups to heavy metals are given in table (4).It is quite clear from table (4) that except Cu(1.08) none of the metal were found to exceed the RQ value more than 1.0.While in case of Fe the RQ value were found 0.935 which is nearer to 1.0. Thus it can be concluded that these two metals were at higher exposure risk and will pose threat to human health in the exposed area receiving wastewater.

Table: 1 Average concentration of heavy metals in the different plant and soils collected from the field irrigated with the industrial effluent.

Name of the plant	Fe	Cu	Cr	Pb	Cd
Brinjal	42.40	39.43	14.45	0.98	0.95
	± 1.92	±15.27	±0.64	±0.18	±0.05
Soil	46.53	42.12	16.35	5.32	4.32
	±2.90	±2.65	±0.76	±0.67	±0.15
Capsicum	30.45	28.38	6.87	0.88	0.93
	±2.88	±0.95	±2.12	±0.08	±0.05
Soil	55.08	29.90	18.55	3.72	4.43
	±3.00	±0.92	±0.85	±0.20	±0.72
Cauliflower	53.08	24.77	5.37	2.27	1.05
	±1.61	±0.72	±0.17	±0.21	±0.20
Soil	84.50	22.36	12.73	3.03	4.30
	±0.50	±0.46	±0.54	±0.15	±0.26
Cabbage	88.17	69.26	137.96	7.65	1.60
	±1.46	±19.16	±39.64	±1.17	±0.13
Soil	85.55	80.32	207.68	10.89	4.58
	±2.00	±0.85	±2.07	±0.33	±0.41

± = Standard Deviation
All values are in µg/g

Table 2: Concentration of metals in different parts of plants.

Plants	Fe	Cu	Cr	Pb	Cd
Brinjal	L>S>R>E.P	L>S>R>E.P	L>S>R>E.P	R>L>S>E.P	R>L>S>E.P
	(46.25)(44.92)(34.25)(20.12)	(41.3)(34.7)(28.35)(18.23)	(15.65)(12.0)(11.45)(10.45)	(1.2)(0.68))(0.54)(0.52)	(1.0)(0.59)(0.54)(0.52)
Capsicum	L>S>R>E.P	L>S>R>E.P	S>R>L>E.P	L> <R>S>E.P	R>L>S>E.P
	(35.45)(32.14)(29.32)(19.25)	(28.25)(22.75)(18.25)(14.52)	(16.25)(15.25)(12.12)(11.35)	(2.0)(2.0)(1.6)(0.68)	(1.1)(0.88)(0.76)(0.62)
Cauliflower	L>R>S>E.P	L>R>S>E.P	R>S>L>E.P	R> <L> <S>E.P	R>L>S>E.P
	(66.5)(54.56)(45.75)(35.26)	(55.6)(42.5)(30.4)(28.25)	(18.25)(17.25)(15.6)(12.45)	(2.5)()(2.5)(2.5)(2.1)	(1.2)(1.0)(0.99)(0.95)
Cabbage	R>S>E.P	R>S>E.P	R>S>E.P	R>S>E.P	R>S>E.P
	(84.8)(52.8)(45.23)	(82.3)(42.8)(41.25)	(16.2)(15.26)(14.25)	(3.0)(2.5)(2.1)	(1.2)(0.96)(0.92)

L= Leaves, R = Root, S = Stem, E.P=Edible part

Table: 3 Translocation index of different heavy metals in different plant

Plants	Fe	Cu	Cr	Pb	Cd
Brinjal	91.12	93.61	88.37	18.42	21.99
Capsicum	55.28	94.91	37.03	23.65	20.99
Cauliflower	62.81	**110.77**	42.18	74.91	37.20
Cabbage	**103.06**	86.23	66.42	70.24	22.92

Table: 4 Exposure risk of metals in area contaminated with flash torch and battery manufacturing industry

Metal	Metal concentration Vegetable (Edible part) µg/g	Intake per day Vegetable µg/d (300g)	TDI mg/d	ADI mg/kg b.w	TDI mg/d b.w=60 k.g	Risk Quotient TDI/ ADI
Fe	29.96	8988	44.88	0.8	48	0.935
Cu	25.56	7668	32.66	0.5	30	1.08
Cr	12.13	3639	7.35	-----	---	-----
Pb	1.35	405	0.091	0.05	3	.030
Cd	0.75	225	0.028	0.007	0.42	.066

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Rajnigandha a new host of *Fusarium* sp. from Bahraich-A New Report

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Abstract

Polianthes tuberosa **L.(Rajigandha) is an important medicinal plant possessing diuretic emetic and antigonorrhoeic properties.Plants of *P.tuberosa* growing in pots were found suffering from a leaf spot disease.Oval to elongated spots were produced throughout the leaf blade.The spots remained broader in the center and pointed at the ends.Light brown spots are surrounded by dark brown spots. Spots may also coalesce to form large irregular spots.Isolation from the disease tissue yield a species of *Fusarium*.Pathogenicity test was proved to be positive when carried out by spray inoculation on healthy potted plants of *P. tuberosa*, positive. On the bases of cultural characters and morphology of vegetative and reproductive bodies,the isolated species from *P.tuberosa* was identified as *Fusarium solani*.Search of the available literature revealed that *P. tuberose* is a new host for *F. solani* which is being first reported from Bahraich district (U.P.)**

Introduction

Rajnigandha (*Polianthes tuberosa* L.,Eng. -Tuberosa;Hindi –Rajnigandha,Gulshaba,Family-Agavaceae) is a herb native to Mexico grown as an ornamental for its white ,fragment flowers.It is an important ethnomedicinal plant possessing diuretic emetic and antigonorrhoeic properties.The plant is grown in pots in family gardens,parks,nurseries and government gardens.In Nov.2006 during our routine gardening activities in morning we observed that some plants were suffering from some foliar spots.The no. of spots and size per leaf was gradually increasing significantly.The observation resulted a curiosity to know about the microbe responsible for the leaf spot.The disease on Rajnigandha was a foliar spot disease so it generate a curiosity as the leaves are known for suitable habitat which provide ample surface area and nutritional supply to the fungal pathogen for its overall growth.Keeping this view in our mind,authors surveyed the gardens of housing colonies,parks,nurseries and government gardens and infected specimens were collected and gone through for the detailed study for the disease symptom.

Material and Methods

The collected specimens were pressed and dried by routine herbarium technique as described by Jain and Rao(1978).The fresh infected leaves were collected ,hand cut section and scrap mount were prepared of infected parts in lactophenol and cotton blue as described by Kamal *et.al.*(2003).

For pathogenicity test the isolated fungus was cultured on PDA and its pathogenicity test was done on healthy potted plants by spray inoculation of sporulating mass in aqueous solution as described by McCallum and Tekauz (2002).

Results and Discussion

The infected plants showed oval to elongated spots produced throughout the leaf blade.The spots were remained broader in the centre and pointed at the ends.Light brown spots are surrounded by dark border.Spots merge to form a large irregular patch.The microscopic examination of slides prepared showed that the causal organism of the leaf spot is a fungus having microconidia 2.5-5 micron;macroconidia 5-14 micron in size.The consultation of monographs showed that the tested fungus is *Fusarium*

solani(Mart.)Sacc. The pathogenicity test by spray method was positive.Latter the fungus was confirmed by Prof.Kamal,Emeretus Professor in Botany,D.D.U. Univ. of Gorakhpur,Gorakhpur(U.P.)

During pathogenicity test the first spot appeared after 10 days of spray which latter covered about 60% area of leaf blade within 15 days in form of irregular patches.This system is latter followed by infection on leaf sheath and spike.

The severity of spot causes defoliation.Leaf spots are numerous,large and irregular which cause a considerable reduction in the photosynthetic area of leaf.The inhabiting fungi interfere with the physiology of the host and host as well as pathogen produces toxins which may degrade the ethnomedicinal quality of the plant.The fungal pathogen reduces the productivity of host. Ahir *et.al.*(2006) has also reported *F.solani* on Rajnigandha leaf blades only causing less damage.

So some important strategies must be adopted for the conservation of *Polianthes tuberosa* from plant pathogen considering its importance in garden as well as its use in green herbal medicine system.The plants are still under observation and further study will be done to save the plant from loss.

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Synergistic effect of *Pongamia pinnata* bark and *Tamarindus indica* fruit extract against aflatoxin producing fungi i.e. *Aspergillus flavus*

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Abstract

Aflatoxin is the most toxic of many naturally occuring toxins produced by fungi. *Aspergillus flavus* and *Aspergillus parasiticus* are the major casual organisms. These co-exist and grow on almost all crops. *Pongamia pinnata* (Karanj) and *Tamarindus indica* (Imli) and other tree species producing non edible oil were screened for their possible antifungal activity. Methanolic fraction were assayed to control the fungi and significant reduction in fungus growth was observed when applied synergistically than the individual plant extract.It was found that Combination of both extract were more effective than the individual extract when tested alone i.e 62% inhibition of fungal growth as comapared to *Pongamia* bark alone (33.20%) and *Tamarindus indica* alone (34.12%).

Keyword: Aflatoxin, *Tamarindus indica*, *Pongamia pinnata*.

Introduction

Aflatoxin are the secondary metabolite i.e. the metabolite not required during the growth of microorganism and it was mainly produced by the fungi *Aspergillus flavus* and *Aspergillus parasiticus* and in some cases by *Aspergillus nomius*. The most important group of toxigenic Aspergilli are the Aflatoxigenic molds, *A. flavus* , *A. parasiticus* and the recently described but much less common species *A. nomius* all of which are classified in *Aspergillus* section Flavi (Gams *et al.*, 1985). Although these three species are closely related and shares many similarities a number of characteristics may be used in their differentiation. *A. flavus* is widely distributed in nature but *A. parasiticus* is less wide spread, the actual extent of its occurrence being complicated by the tendency for both species to be reported indiscriminately as *A. flavus*. In a wide ranging survey of the mycoflora of commodities in Thailand. *A. flavus* was the most common species in the peanut and second most common (after *Fusarium moniliforme*) in corn. *A. nomius* was reported from both commodities. Soyabeans, mung bean, sorghum and other commodities also contained considerable population of *A. flavus* but *A. parasiticus*.

A. flavus and *A. parasiticus* have strong affinity with nuts and oil seeds, corn, peanuts and cotton seed are the most important crops invaded by these mold and in many instances, invasion takes place before harvest not during storage. Peanuts are invaded while still in the ground if the crops suffer drought stress or related factor (Cole *et al.*, 1982; Pitt *et al.*, 1991; Sanders *et al.*, 1981). In corn insect damage to developing kernels allow entry of Aflatoxigenic molds but invasion can also occur through the silks of developing

ears (Lilehoj *et al.*, 1980) cotton seeds invaded through nectaries. (Klich *et al*, 1984). Cereals and spices are common substrate for *A. flavus* (Pitt *et al*, 1991), but aflatoxin production in these commodities is almost always a result of poor drying, handling or storage and aflatoxin levels are rarely significant .

Significant amount of aflatoxin can occur in peanuts, corn and other nuts and oil seeds particularly in some tropical countries where crops may be grown under marginal condition and where drying and storage facilities are limited.

A. flavus can produce Aflatoxin B_1, B_2 and cyclopiazonic acid, but only a proportion of isolates are toxigenic. *A. parasiticus* produces Aflatoxin B_1, B_2, G_1 and G_2 but not cyclopiazonic acid, and almost all the isolate are toxigenic. *A. nomius* is morphologically similar to *A. flavus*, but like *A. parasiticus* produces B and G aflatoxin without cyclopiazonic acid. Because these species appear to uncommon, it has been little studied , so the potential toxigenicity of isolates is not known and practical importance of this species is hard to access.

There is an immense potential of active fractions from many biodiversity resources available in the country. The proposed study focuses on a systematic study with respect to antifungal potential of bioactive compounds of these resources in relation to fungal infestation and aflatoxin production in high risk groundnut, its oil and cake. *Pongamia pinnata Pierre* (Leguminosae) is commonly known as Karanja. It is distributed throughout Western Ghats and chiefly found in tidal forests of India (Krishnamurthi, 1969). Different parts of the plant have been used in traditional medicines for bronchitis, whooping cough, rheumatic joints and to quench dipsia in diabetes (Kirtikar *et al.*, 1995). Previous phytochemical examination of this plant indicated the presence of furanoavones, furanoavonols, chromenoavones, avones, and furanodiketones (Talapatra *et al.*, 1980,1982; Murty *et al.*, 1944; Rangaswami *et al.*, 1942; Sharma *et al.*, 1973; Pathak *et al.*, 1983; Toshiyuki *et al.*,1992). In the present communication, we describe the isolation and characterization of three new furano-.avonoid glucosides, pongamosides A-C (1–3), and anew .avonol glucoside pongamoside D (4). Tamarind (*Tamarindus indica L.*) belongs to the family Leguminaceae and grows naturally in many tropical and sub-tropical regions. In Thailand, two types of Tamarind are found in abundance, the so-called sweet and sour varieties. Tamarind is an important food resource for the Thai population. The flower and leaf are eaten as vegetables, while the germ obtained from the seed is used for manufacturing Tamarind gum, which is well known as a component of jelly (Phakruschaphan, 1982). Tamarind seeds are also reported to contain phenolic antioxidants, such as 2-hydroxy-30, 40-dihydroxyacetophenone,methyl 3,4-dihydroxybenzoate, 3,4-dihydroxyphenyl acetate and epicatechin (Tsuda *et al.*,1994). Extracts exhibit antioxidant potential by reducing lipid peroxidation *in vitro* (Tsuda *et al.*, 1993, 1994) and anti-microbial activity (De *et al.*, 1999). Pumthong (1999) described the antioxidant activity of extracts of Tamarind pericarp, and reported the presence of mainly polymeric tannins and oligomeric procyanidins but these were not identified or quantitated. From this stand point it was of interest to compare the polyphenolic content in methanolic extracts of Tamarind pericarp and seeds, utilizing the methods of Owen *et al.* (2000a, 2003b).

Material and Methods

Collection and extraction of plant materials

Pongamia bark were collected from the campus of Banthara Research Station of National Botanical Research Institute (CSIR), Lucknow and Fruits of *Tamarindus* were purchased from the local market of

Lucknow. Pongamia bark were then air dried to a uniform moisture level. Fruits of *T. indica* obtained were extracted in methanol using Polytron homogenizer (PT 6100 KINEMETICA). Methanolic extracts collected by filtration (Whatman No. 1) were concentrated under vacuum at low temperature using Rotary Evaporator of Heidolph, Switzerland. The residue then dissolved in 15% ethyl alcohol to get the desired concentration for the activities.

Maintenance of fungal strains

The strain of *Aspergillus flavus* MTCC2799 were obtained from Microbial Type Culture Collection from IMTECH, Chandigarh. The culture was maintained at 4 ± 1°C on Slants of Potato Dextrose Agar (PDA)

Antifungal assay

Antifungal activity of *P.pinnata* and *T. indica* was tested against aflatoxin producing fungal strains of *A. flavus* obtained from IMTECH, Chandigarh, India.

Preparation of Inoculum

The spore suspension was prepared as described by Fan & Chen (1999). *A. flavus* was grown on PDA (HiMedia) slant for 5 - 7 days at 25 ± 3°C and the spore were harvested by adding 10 ml of sterile water and aseptically dislodging the spore with a sterile inoculating loop. This was diluted to obtain desired concentration of spore suspension.

Agar Well Diffusion Method

The Potato Dextrose Agar media (HiMedia) was cooled down up to 40-45 °C after autoclaving and added desired amount or concentration of plant extract. Shaked it very well and poured the media in Petriplates. After solidifying the media, three wells of 8mm diameter were made in each Petriplates. Without addition of plant extract were used as controls. 40 µL of spore suspension contained 18 x 10^4 spores mL^{-1} of *A. flavus* were added to each wells and incubated at 28°C for 5 days. Fungal growth of both the treated and untreated control plates was measured at every 24 hrs for 5 days (Perea *et al.*, 1990).

The percentage of inhibition was calculated using the following formula (Rasooli *et al.*, 2004)

$$I = C - T / C * 100$$

Where **I** = percentage inhibition

C = radial growth in control

T = radial growth in treatment

Result and Discussion

Production of toxin are linked to fungal growth and the environment in which the grains/ cereals are stored (especially Relative Humidity and Temperature). Fungal growth and subsequent mycotoxin product in stored grain can be inhibited by physical method (aeration, modified atmosphere, etc.) or by fungistatic of which is propionic acid, acetic acid and sorbic acid are the most common used (Paster *et al.*, 1988). Report by several authors (Monzumi, 1978; Azzouz and Bullerman, 1982; Bahk and Marth, 1983; Bullerman *et al.*, 1980; Yin & Cheng, 1998; Hitokoto *et al.*, 1980) supports the fact that the extract of certain spices and herbs

of medicinal importance exhibit antifungal property. These natural antifungal agents can be potential exploited in controlling the growth of fungi consequently inhibiting aflatoxin formation (Yin and Cheng, 1998; Grayer & Harborne, 1994).

*M*ethanolic extract of *Pongamia* bark were tested for their antifungal activity against aflatoxin producing fungi. Fungal growth was significantly reduced in all the treatments as compared to that of control. Antifungal activity varied significantly among different treatments (Table 1). Methanolic extract of bark inhibited fungal growth from 26.44% to 33.20%.

Different concentrations i.e 500ppm, 1000ppm, 1500ppm and 2000ppm of methanolic extract of tamarind fruits were tested for their efficacy against aflatoxin producing fungi. All the concentrations tested were found to decrease fungal growth as compared to that of control. Percentage inhibition of fungal growth ranged from 11.60 to 34.12% at 500ppm and 2000ppm concentration, respectively (Table2). Another experiment was also set to study the synergistic effect of both extract. Percentage inhibition of fungal growth ranged from 39.75 to 62.72% at 500ppm and 2000ppm concentration, respectively it was found that at 2000 ppm i.e percentage inhibition increased approximately 50 times higher than individual extract.

Table 1. Efficacy of bark of *P. pinnata* against aflatoxin producing fungal strain *A. flavus*

Plant parts used	Concentration (in ppm)	Radial dia in mm after 72 hrs	Percentage inhibition in %
Bark	Control	30.21 ± 1.436	--
	500	22.22 ± 0.780	26.44
	1000	21.78 ± 1.080	27.9
	1500	20.35 ± 0.800	32.6
	2000	20.18 ± 0.980	33.20

Table 2. Efficacy of polar fraction of *Tamarindus indica* against *A. flavus*.

Plant parts used	Concentration (ppm)	Radial dia in mm after 72 hrs	Percentage inhibition
Fruit	Control	30.21± 1.436	0
	500	26.70 ± 0.025	11.6
	1000	25.03 ± 0.095	17
	1500	23.13 ± 0.145	23.4
	2000	19.9 ± 0.295	34.12

Table.3 Combined effect of methanolic extract *Tamarindus* Fruit and *Pongamia* bark against aflatoxin producing *A. flavus*.

Plant parts used	Concentration (ppm)	Radial dia in mm after 72 hrs	Percentage inhibition in %
Fruit + Bark	Control	30.21± 1.436	0
	500	18.20 ± 0.010	39.75
	1000	16.13 ± 0.085	46.6
	1500	12.45 ± 1.055	58.78
	2000	9.75 ± 0.470	62.72

In conclusion, the present study reports the antifungal properties of *P. pinnata* and *T.indica* extracts, which can be commercially exploited and applied to foodsystems. Further studies are needed on the isolation and characterization of individual compounds to elucidate their different antifungal components.

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Biodiversity of fish fauna of Kishanpura lake, Indore (M.P.)

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Abstract

The water quality of Kishanpura lake is assessed in order to estimate its potency for fish culture. The present study deals with fish species diversity. During the study period 23 species of fishes were recorded, which belong to five orders, nine families and 17 genera. The present study was carried out at Kishanpura lake during a Apr 2005- Jan 2006.

Introduction

Indian fishes constitutes an important sectors of national economy for various reasons. India vast potential for development of inland fisheries. The fish population of our aquatic eco system plays a significant role in the human economy. Approximately 21, 723 fishes are known to science of which 40% live in fresh water, that too majority of them in tropics. Potentiality of inland resources of India are the richest in the world. Fishes of Inland water of the Indian subcontinent have been studies since a century (Hamilton-Buchaan (1822), Day (1878), Hora (1920-59), Dutta (1970), Jayram (1991), Jhingran(1982), Nanda and Tiwari(2001). State of Madhya Pradesh is neglected in this record even through gross work of this aspect were made by Dubey and Mehra (1959), Gupta and Rao (1978), Rao *et al.,* (1988, 1991, 1993) and Sharma and Mudgal (2003).

No attempts has been made on Kishanpura lake in this regard, so far the first limnological studies in this lake has been conducted and details of fish biodiversity were recorded which will helpful in the development, management and conservation of fish species diversity in the lake. In our present study an attempt is made to document the fish fauna in the Kishanpura lake during May 2005-Jan2006. There is no earlier study on fish species diversity of this lake.

Material and methods

Sampling of fish has been made for every month through out the study period ,collection of fish was made directly from the fisher men during the time of fishing .Two types of fish nets were used like Gillnet, Cost net. The fish were brought to the laboratory and preserved in 5% formaldehyde solution, after noting the coloures and general pigmentation of fishes. The identification of the fishes was done with the help of standard keys and books (Jayaram 1994, Shrivastava 1998, Jhingran 1991 and Day 1958).

Description of Study Area

The Kishanpura lake is situated at near Chhota Betma on Indore -Dhar road at 22 KM. from Indore. The lake is located at Latitude 22°-40'-30" and Longitude 75°-39'-00". The neighboring areas of the lake are agricultural fields the main source of water of this lake is rainy water. Suitability of water body for fish culture depends upon its Physico-Chemical characteristics, hence the important physico-chemical characters of water from the lake were analyzed (Table no.01).

Results and Discussion

The result of our study confirms the occurrence of 23 species belonging to the five orders, out of the five orders Cypriniformes was dominate with 13 species followed by Siluriformeis with four species, Order Perciformes with three species and order osteoglossiformes, Mastacembelidae and Beloniformes represented by one species. The change in the composition of fish assemblage often indicated a variation in the water quality parameters such as pH, temperature, dissolve oxygen, hardness etc.

Table: 1:Physico-chemical Parameters of Kishanpura Lake Indore.

Parameters	**Results**
Temperature	27°C
pH	6.89
Transparency	68 cm.
Dissolved Oxygen	7.06 mg/l
Total Alkalinity	2.56 mg/l
Hardness	120 mg/l
Chloride 0.0031 mg/ltr.	Calcium 4.49 mg/l
Phosphate	0.49 mg/l

Table:2 -Fish Species diversity of Kishanpura lake Indore.

Order - Cypriniformes	
Family - Cyprinidae	
Genus and species -	*1 Puntus ticto*
	2 Punctus sarana
	3 Catla catla
	4 C rrhinus mrigala
	5 Labeo rohita
	6 Labeo calbasu
	7 Labeo gonia
	8 Cyprius carpio
	9 Danio malavaricus
	10 Rasboradanicolius
Family - Cobitinae	
Genus and species -	*1 Noemachilius aureus*
	2 Lepidocephalus guntea
Family - Siluridae	
Genus and species -	*1 Wallago attu*
Order - Osteoglossiformes	
Family - Notopteridae	

Genus and species - *1 Notopterus notopterus*
Order - Siluriformes
Family - Bagridae
Genus and species - *1 Mystus seengnala*
2 Mystus bleekeri
Family - Claridae
Genus and species - *1 Clarias botrachus*
Family - Hetropneustidae
Genus and species - *1 Hetropeneustes fossilus*
Order - Perciformes
Family - Chammidae
Genus and species - *1 Chamma punctus*
2 Chamma striatus
3 Chamma gachua
Family - Mastacenbelidae
Genus and species - *1 Mastacembalus armatus.*

Table No.3 : Fish Species diversity of Kishanpura lake Indore.

S.No.	Sientific name of fish	Local name or Varnacular name	Status
1.	*Rasbora daniconius*	Ajara	++
2.	*Puntius ticto*	Puthf	+++
3.	*Puntius sarana*	Sherni	++
4.	*Catla catla*	Catla	+++
5.	*Cirrhinus mrigala*	Mrigal	+++
6.	*Labeo rohita*	Rohu	+++
7.	*Labeo calbasu*	Kalot	+++
8.	*Labeo gonius*	Sarsi	++
9.	*Cyprinus carpio*	Kangi	+
10.	*Danio malabanicus*	-	+
11.	*Notopterus notopterus*	Patola	++
12.	*Mystus seenghala*	Singhara	+++
13.	*Mystus bleekeri*	-	++
14.	*Heteropneustes fossillis*	Singhi	+++
15.	*Clarias botrachus*	Mangur	++
16.	*Channa punctatus*	Kabra	++
17.	*Channa striatus*	Girai	++
18.	*Channa gachua*	Giral	+
19.	*Mastacembalus armatus*	Bam	+
20.	*Noemachilus aureus*	-	+
21.	*Leidocephalus guntea*	-	+
22.	*Wallago attu*	Padhni	++
23.	*Xenentodon cancila*	Sooja	+

V Order - Beloniformes
Family - Belonidae
Genus and species - *1 Xenentodon cancila*

The Change in the composition of a fish assemblage often indicate a variation in the water quality parameters. Such as pH. Temp., DO and Nutrient (Jhingran, 1982; Vijay, K. and R. Paul, 1990). Due to more fecundity of major crop and suitable environmental condition these exists a relatively higher No. of cypriniforimes. Such type of observation was reported by Talwar and Jhingran (1991) and Das and Chand (2003) Patnak and Mudgal (2005) Indian fishes.

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Studies on the natural infection of mosaic disease of Brinjal (*Solanum melongena* L.) in tarai region of Eastern U.P.

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Abstract

Brinjal crops were surveyed for the incidence of mosaic disease in Devipatan mandal of Tarai region, U.P. On the basis of symptoms, host range, physical properties, sap transmission, insects transmission different hosts and seed transmissions, three different virus isolates were characterized as PVY, TRSV and TMV.

Key words- *Disease incidence, brinjal, mosaic disease.*

Introduction

Brinjal or eggplant (*Solanum melongena* L.) is one of the most commonly cultivated vegetable crops in India, especially in eastern Uttar Pradesh and is presently affected by a number of viral diseases. During routine survey of Brinjal growing fields various types of Mosaic and ring spot symptoms were noticed viral disease characterized by chlorotic, vein banding, oak leaf pattern, yellow blotches, slight puckering and stunting were frequently observed in crop (var. Pusa Purple long and Pusa Purple round) around Balrampur district of Devipatan mandal. One isolates among these was transmitted by aphids readily. The identification of various mosaic diseases of brinjal is an objective of the present study. This communication deals with the results of the studies pertaining to the identification of various diseases, conducted at post Graduate Department of Botany, Balrampur, U.P.

Materials and Methods

The cultures of these diseases were maintained on the brinjal var. Pusa Purple long and Pusa Purple round in glass house conditions. Based on the symptoms they were grouped into three categories and labeled as virus A, B and C. The infected leaves with chlorotic rings and oak patterns with yellow patches, virus C infected leaves exhibited mild mosaic symptoms with necrotic spots on stem and leaves. The mechanical sap transmission studies of these three viruses were conducted by macerating the infected leaf material in phosphate buffer pH-7 (0.05M) and inoculated to the test plants *Solanum melongena* L.

Aphid transmission studies were conducted by using *Aphis gossypii* Glov and *Myzus peersicae* Sulz. During the transmission studies the aphids were given two hour fasting followed by 30 min. each acquisitation and inoculation periods and brinjal was used as a test plant. Seed transmission tests were also conducted by collecting the seeds from the fruits of infected plants and were raised in the glass house.

Results and discussion

Based on the host range and physical properties, aphid and seed transmission viruses A,B and C were identified as potato Y(PVY), tobacco ring spot (TRSV) and tobacco mosaic virus (TMV). For quick identifications of these three viruses, a key having a set of four differential hosts (*Physalis floridana* Rydb., *Cucumis sativus* L., *Phaseolus vulgaris* var. Pinto and *Vigna unguiculata* (Linn.) Walp sub. Sp. *Cylindrica* van-Eseltine) was developed and their reaction are given (Table-I). Only virus A was transmitted by both

the aphids and the transmission was 70%. The results indicated that only viruses B and C were transmitted and the percentage of transmission was 12 and 41 respectively.

From India, Sastry *et al.* (1974) reported a strain of PVY which had thermal in activation point between 55-60°C, dilution and end point between 1/1000 to 1/10000, and ageing in vitro for 24 hours. The present PVY isolate is different with this isolate in physical properties (Table 2). Tobacco ring spot virus under study differs with the report of Sastry and Nayudu (1976) and also Sastry (1982) both in host range and physical properties. Hence, it is new strain TRSV occurring on brinjal, which is not reported earlier in Eastern U.P. The third virus C, TMV differs with the report of Naqvi & Mahmood (1976, 1978) in having higher thermal inactivation point & also in host range and this being different reported from Tarai region of eastern U.P.

In the present study, *Physalis floridana* Rydb., *Cucumis sativus* L., *Phaseolus vulgaris* var. and *Vigna unguiculata* (Linn) Walp sub. Sp. *Cylindrica* van-Eseltine were found to be good differential hosts for PVY, TRSV and TMV strains infecting brinjal. *Physalis floridana* produced necrotic local lesions only with PVY. *Cucumis sativus* L., and *Vigna unguiculata* (Linn) reacted to TRSV and produced mosaic mottling followed by chlorotic rings and reddish brown necrotic local lesions respectively. *Phaseolus vulgaris* var. Pinto produced mosaic mottling and severe mosaic mottling with TRSV and TMV on inoculation. With the help of these four differential hosts, the three viruses under study can easily be identified during the germplasm screening in the breeding programme.

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Table -1
Host range of viruses infecting Brinjal

Host Range	Reaction		
	Virus-A	Virus-B	Virus-C
Solanum melongena L.	SMM	Ch.R.	MM
Capsicum annum L.	MM	Ch.R., NLL	MM
Physalis floridana Rydb.	NLL		-
Datura stramonium L.	-	NLL,Ch.R.	MM
Datura metel L.	MM	-	MM
Phaseolus vulgaris var. pinto	SMM	MM	MM
Lablab niger L.	-	NLL	NLL
Nicotiana tabacum var WB(L.)	MM,VN	NLL	MM
Nicotiana glutinosa L.	MM	NLL,Ch.R.	NLL
Cucumis sativus L.		NLL,Ch.R.	MM
Vigna unguiculata(Linn.) Walp. sub. sp. *Cylindrica* van - Eseltine		NLL	Ch.R.
Chenopodium amaranticolor Coste and Reyn.	NLL	NLL	NLL

Note - SMM = severe mosaic mottling, Ch.R. = chlorotic ring, MM = mosaic mottling, NLL = necrotic local leisons, VN = veinal necrosis, - = no reactions.

Table -2
Physical Properties of infecting Brinjal

Physical properties	Virus-A	Virus-B	Virus-C
Thermal inactivation Point	60-65°C	65-70°C	90-95°C
Dilution end point	1/1000	1/1000	1/10,0000
	10000	1/10000	1/10,00,000
Ageing in vitro	5days	10days	95days

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Bioevaluation of *Cascabela thevatica* plant extract

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Abstract

The *In vitro* antibacterial activity of *Cascabela thevatica* plant extract has been investigated against *Escherichia coli*, *Staphylococcus aureus*, *Salmonella typhi* and *Klebsiella pneumoniae* using the agar disc diffusion method. The alcoholic extract was found effective against *Escherichia coli*, *Staphylococcus aureus* and *Salmonella typhi* but does't show any activity against *Klebsiella pneumoniae*. The antibacterial activity is attributed to the presence of alkaloids, which was confirmed by gas liquid chromatography (GLC) and positive alkaloid test. The minimum inhibitory concentration (MIC) was determined by paper disc diffusion method and the results were compared with reference antibiotic tetracycline (one unit solution).

Keywords : *Antibacterial, Cascabela thevatica, plant extract, disc diffusion method, MIC.*

Introduction

The increasing prevalence of multi drug resistant strains with reduced susceptibility to antibiotics raises the specter of untreatable microbial infections and adds urgency to the search for new infection fighting strategies. The use of plant extracts with known antimicrobial properties can be of great significance in therapeutic treatments.The evaluation of plant extract for their antibacterial activity has known for more than seventy years.(Machat and Kankel, 1920).Evaluation of plant extract for their antimicrobial activity has been done by several workers. Chakraborty (1999), studied antibacterial steroid alkaloids from the stem bark of *Holarrhena pubescens.* Kaushik and Kishore (1991) studied effect of alcoholic extract of *Pholidota articulata* Lind. against *Bacillus subtilis, Staphylococcus aureus* and *Klebsiella pneumoniae.* Antimicrobial activity of various plant parts of *Aerva persica* has been tested against human pathogenic bacterial strains and pathogenic fungal species (Gehlot and Bohra, 1998). Antifungal activity of *Cassia fistula* leaf extract has been tested against *Candida albicans* (Singh and Karnwal, 2006).

The microorganisms have developed resistance to many antibiotics. This has created immense clinical problems in the treatment of disease; therefore, there is a need to develop an alternative to these drugs for the treatment of disease. The medicinal herbs represent a rich source of antibacterial activity. (Dhar *et. al.*, 1968).

Material and methods

The plant material of *Cascabela thevatica* was collected from B.H.E.L, Hardwar and the bacterial strains viz *Escherichia coli* (MTCC- 739), *Staphylococcus aureus* (MTCC-737), *Salmonella typhi* (MTCC- 531), *Klebsiella pneumoniae*(MTCC-432) were self purchased from IMTECH, Chandi garh.

For the preparation of plant extract, plant material were first washed with 2-3 times with tap water and then again with sterilized distilled water. Finally the surface sterilization was done with 90% absolute ethyl

alcohol. 100gms of plant material were crushed in ware blender resulting in the formation of a paste which was mixed in 250 ml of absolute ethyl alcohol. Alcoholic extract so prepared was allowed to evaporate at room temp. until 80ml of this was left. This extract was squeezed through double layer muslin cloth and filtered through Whatman filter paper no.42 and was centrifuged at 5000 rpm for 20 minutes and was then sterilized by passing through 0.2 micron disposable filters.For primary screening of antibacterial testing procedure 100%, 50% and 20% dilutions of extract were taken. In 100% dilution, no distilled water was added, in 50% extract dilution 50% part of distilled water and in 20% dilution 80% part of distilled water was mixed.

For antibacterial screening and minimum inhibitory concentration (MIC), agar disc diffusion method was used (Kirby and Bauer,1966).In this method nutrient agar medium was prepared and autoclaved and then cooled up to 42-45°C. To each 100ml of nutrient agar medium 1.0ml of 24h old bacterial culture of *E.coli*, *S.aureus, S.typhi* and *K.pneunioniae* was added from nutrient broth and than shaken properly to ensure complete distribution of microorganisms in the medium.

The culture medium which was already inoculated with bacterial suspension was poured in Petri dishes and when it was in solid phase, Whatman's filter paper no 42 discs, which were already dipped in different dilutions of the plant extract, were placed on nutrient agar surface. Distilled water and absolute alcohol served as negative control and the standard antibiotic tetracycline (one unit solution) as positive control. After inoculation plates were kept at 37° for 24 hrs in incubator. The antibacterial activity was evaluated by measuring the diameter of the inhibition zones in mm.

The alcoholic extract was tested for the presence of alkaloid by Dragondroff's test, also followed by Stahl(1969) and gas liquid chromatography (GLC). which was carried under university science instrumentation center, Indian Institute of Technology (IIT), Roorkee. In GLC HP-5 column & FID detector was used for analysis at 250°C temp. This column detected alkaloids from extract and solvent was ethyl alcohol.

Results and discussion

Results of present investigation clearly indicates that the alcoholic extract of *Cascabela thevatica* is effective against *E.coli, S.aureus* and *S.typhi,* and was found non effective against *K.pneumoniae.*The size of effective zone of inhibition of undiluted(100%) plant extract of *Cascabela thevalica* against *E.coli* measured 9.5mm, *S.aureus* 12.7mm and *S.typhi* 11.7mm (Table-1). The MIC of *Cascabela thevatica* extract against *E.coli* was 33.3% concentration, against *S.aureus* measured 11.3% and *S.typhi* measured against 18.3% concentration (Table-2) *S.aureus* was only bacterium, which was the most sensitive to undiluted (100%) alcoholic extract of *C.thevatica*. In reference to antibiotic the zone of inhibition against *E.coli* were 15mm, against *S.aureus* 16 mm and against *S.typhi* 13mm which was nearly comparable to that at plant extract.

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Table -1 : Determination of the antibacterial activity of *C.thevatica* plant extract and reference antibiotic by disc diffusion method.

Test Organism	*Effective Inhibition zone in mm					
	Antibiotic Zone	Extract Zone			Control Alcohol	Distilled water control
		100%	50%	20%		
Escherichia coli	15	9.5	6.7	-	Nil	Nil
Staphylococcus aureus	16	12.7	10.0	6.0	Nil	Nil
Salmonolla typhi	13	11.7	9.7	6.5	Nil	Nil
Klebsiella Pneumoniae	15	-	-	-	Nil	Nil

*Effective zone of inhibition = Total zone of inhibition – Diameter of the disc(5mm)

Table -2 : Minimum Inhibitory Concentration (MIC) of *C.thevatica.*

Extract	**Name of Organisms**		
Alcoholic Plant Extract	*Escherchia coli*	*Staphylococcus aureus*	*Salmonella typhi*
MIC (in %)	33.3%	11.3%	18.3%

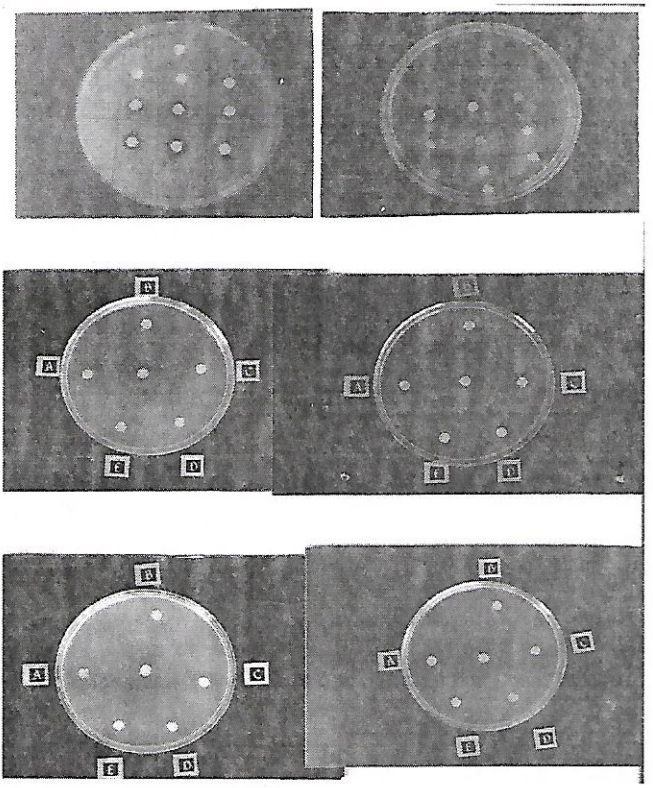

Figure- Showing MIC against *E.coli* and *S.typhi* (Upper)
Showing Zone of Inhibition against *E.coli* (Middle)
Showing Zone of Inhibition against *S.typhi* (Lower)

Here A = Showing 100 % Extract Potency
B = Showing 50 % Extract Potency
C = Showing 20 % Extract Potency
And Center Disc of Antibiotic Potency

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Deviation in nitrogen metabolism of Ridge gourd (*Luffa acutangula.* Roxb.) infected with three strains of water melon mosaic virus

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Abstract

The effect of three strains of Watermelon mosaic virus (WMV) infection on the nitrogen metabolism of *Luffa acutangula* leaves were studied and found that the infected levels of total nitrogen, total protein, nitrate and nitrate nitrogen and some of free amino acids (aspartic, proline, serine & cysteine) were higher in comparison to healthy plants, but ammonical nitrogen, threonine, alanine and lysine were low.

Key Words : *Ridge gourd, nitrogen metabolism, WMV.*

Introduction

A virus disease found to be most prevalent in eastern U.P. on *Luffa actangula* Roxb. was characterized by severe mosaic and reduction in leaf size, distortion and chlorotic spotting and considerable loss in the yield of crop. The causal agent was earlier reported to be a strain of watermelon mosaic virus (Shukla *et al.* 2004) Physiological disturbances which are induced by the viral infection have been reviewed by many workers (Bawden, 1959; Diener, 1963; Yarwood, 1967). In India, work on physiology of virus infected plants is studied for a very few diseases (Sadashivan.1963). The present investigation was therefore, undertaken to study the deviation in nitrogen metabolism of *Luffa acutangula* leaves infected by watermelon mosaic virus.

Materials and methods

Luffa acutangula (Roxb.) plants were used as host and three strains of Watermelon mosaic virus (WMV) viz., WMVVB, WMVMM and WMVC were used as pathogen. Five day old plants were taken into four groups, each containing fifteen seedlings. Seedlings of the first, second and third groups were inoculated mechanically by usual method with all three strains of Watermelon mosaic virus, while seedling of the fourth group served as healthy control. A random method of composite samplings was used for estimation and extraction were obtained from fifty days old healthy and diseased plants of uniform size. Three replicates were taken for each estimation and the average of same is reported in the results. Total nitrogen was determined in day samples by ash analysis method of Snell & Snell (1949.) Protein nitrogen and non-protein nitrogen by method of Pregal (1945). Nitrate nitrogen and nitrite nitrogen by Humphries (1956), ammocical nitrogen by Stronganov (1964) and free amino acid was determined according to Draper (1963).

Results and discussion

It is evident from the result given in Tables 1 and 2 that total nitrogen and protein were higher in diseased leaves, maximum in WMVVB followed by WMVMM and WMVC strain. The level of nitrate nitrogen was lower in the diseased leaves. Nitrite nitrogen was higher in diseased leaves but ammonical nitrogen was lower, in diseased samples. whereas protein nitrogen was higher in diseased leaves. Non-protein nitrogen was reduced in diseased leaves. Among free amino acids, aspartic serine, glutamic acid, cystine and proline were higher, but threonine, alanine, glycine and lysine were lower in diseased leaves.

It is now almost generally agreed the host viral infection of plants should be regarded as change in the nitrogen metabolism of the host (Bawden 1959). The increased levels of different nitrogenous fractions in virus infected plants is in accordance with previous observations (Diener, 1963, Harman *et.al.* 1970) Ammonical nitrogen decreased in virus infected leaves. Similar observations were found by Commoner & Dietz. (1952). Nambiar (1966) reported that the increased activity of nitrate reductase may be one of the reasons for increased nitrite nitrogen, as developed here due to viral infection.

Luffa acutangula Roxb. leaves infected with three strains of Watermelon mosaic virus reveals pronounced changes in the free amino acid pool. Infected leaves in comparison to healthy leaves contain higher levels of some amino acids (aspartic, glutamic, serine, praline & cystine) and lower levels of others (threonine, alanine, glycine and lysine). Similar results have been reported by Mohanty & Sridhar (1982) in RTV-infected rice plants.

Selman *et al.* (1961) observed that increased nitrogenous fractions may be due to check of growth and normal protein synthesis. Goodman *et al.* (1967) and Commoner and Dietz. (1953) reported the active utilization of non-protein complex for the synthesis of virus during nitrogen deficient conditions results in the decrease of some amino acids.

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Table 1. Influence of three strains of Watermelon mosaic virus infection on nitrogenous fractions (µg/100 µg dry wt.) of *Luffa acutangula Roxb. leaves.*

Nitrogen fraction	Healthy	Diseased			S.D.
		WMVVB	WMVVB	WMVC	
Total N_2	3.50	4.08	3.95	3.85	0.219
Protein	11.20	13.90	13.50	13.24	1.112
Nitrate N	0.128	0.142	0.138	0.133	0.005
Nitrite N	15.44	16.82	16.52	16.26	0.613
Ammonical N	0.142	0.126	0.122	0.119	0.011
Protein N	5.60	6.41	5.81	5.63	0.429
Non-proteinN	2.85	3.95	3.77	3.64	0.537

Table 2. Influence of three strains of Watermelon mosaic virus infection on nitrogenous fractions (µg/100 µg dry wt.) of *Luffa acutangula Roxb. leaves.*

Amino acids	Healthy	Diseased			S.D.
		WMVVB	WMVVB	WMVC	
Aspartic	20.8	292.5	286.7	281.5	102.615
Glutamic	19.6	228.4	216.3	211.8	97.81
Threonine	46.1	16.2	15.2	14.8	14.422
Serine	11.8	32.4	31.7	31.5	9.304
Alanine	72.4	23.9	22.8	21.8	26.75
Glycine	26.3	18.5	17.5	16.3	4.418
Proline	11.1	14.5	14.0	13.8	1.705
Cysteine	50.8	60.6	61.4	60.8	5.132
Lysine	30.9	24.8	23.5	22.6	3.628