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SERUM GLUTAMIC PYRUVATE TRANSAMINASE AND SERUM GLUTAMIC OXALOACETIC TRANSAMINASE LEVELS OF THE FRESHWATER CATFISH, *CLARIAS BATRACHUS*, INDUCED BY EXPERIMENTAL *PROCAMALLANUS* INFECTION.

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ABSTRACT

Serum glutamic pyruvate transaminase (SGPT) level of control *Clarias batrachus* fluctuated between 1.28±0.26 and 1.96±0.12 µg/l while that of serum glutamic oxaloacetic transaminase (SGOT) level ranged between 1.28±0.27 and 1.80±0.23 µg/l. Experimental *Procamallanus* infection induced a significant increase in the level of both the enzymes of the catfish on day 15, 30 and 60. The SGPT values of the infected catfish were 2.69±0.37, 2.46±0.18, 1.75±0.61 and 4.08±0.48 µg/l, respectively on day 15, 30, 45 and 60 whereas SGOT values were 2.45±0.10, 2.93±0.32, 1.34±0.15 and 2.17±0.15 µg/l, respectively on the corresponding days. The observed increase in level of both the enzymes may probably be due to the damage to various tissues and/or release of toxins (endotoxins/exotoxins) by the nematode parasites harbouring intestine of the catfish.

Key words : Procamallanus infection, SGPT, SGOT, Clarias batrachus.

The usefulness of fishes as a cheap source of animal protein in the diet has been emphasized during the recent years (Pandian, 2001; Anon, 2006). *Procamallanus* are the common nematode parasites inhabiting stomach and intestine of a number of fishes (Moravec *et al.*, 1993; Chandra, 1994; Chandra and Modak, 1995; Martens and Moens, 1995; Bijukumar, 1996; Roberts, 2001; Gonzalez-Solis *et al.*, 2002). Heavy infestations of *Procamallanus* have been recorded in *Heteropneustes fossilis* and *Clarias batrachus* (Furtado and Low, 1973; Bashirullah and Hafizuddin, 1974; Sinha, 1988; Zaman and Leong, 1988; Chandra, 1994). Though life-history, distribution and parasitic infection of *Procamallanus* have been described by several workers, alterations in the various biochemical parameters of fish due to the gastrointestinal parasitic infestations has not yet been clearly defined (Roberts, 2001). Therefore, an attempt has been made to record the effects of experimental *Procamallanus* infection on serum glutamaic pyruvate transaminase (SGPT) and serum glutamic oxaloacetic transaminase (SGOT) levels of the commercially important freshwater catfish, *Clarias batrachus*.

MATERIALS AND METHODS

The adult catfish, *Clarias batrachus* (both sexes; average body weight 88.6±5.86 g) used in the present study were procured from local freshwater ponds as well as markets of Meerut and adjoining districts of western Uttar Pradesh, India. They were acclimatized to the laboratory conditions for a week before initiating the experiment. The females *Procamallanus*, collected from the longitudinally cut intestine of the catfish, were kept in watch glass filled with saline solution for natural egg laying at 24-27°C. The eggs were kept in Lock-Lewis solution for healthy embryonation. The solution was changed periodically from the watch glass and 0.1% of formalin added to the culture medium to protect the eggs from fungal contamination. Only one dose of 500 embryonated eggs was given for induced infection (De and Maity, 2000). For biochemical estimation, blood samples were taken from the caudal vein and centrifuged at 3000 rpm. The sera were separated for the estima-

tion of serum glutamaic pyruvate transaminase (SGPT; also known as aspartate aminotransferase, AST) and serum glutamic oxaloacetic transaminase (SGOT; also known as alanine aminotransferasae, ALT) using standard kits. The data were evaluated for statistical significance between the control and experimental groups using Students 't" test.

RESULTSAND DISCUSSION

Responses of serum glutamaic pyruvate transaminase (SGPT) and and serum glutamic oxaloacetic transaminase (SGOT) of *Clarias batrachus* to the experimental *Procamallanus* infection has been summarized in Table 1, 2. The SGPT level of control catfish were found to be 1.28±0.26, 1.30±0.05, 1.59±0.07 and 1.96±0.12 µg/l, respectively on day 15, 30, 45 and 60 whereas values of the infected fish were 2.69±0.37, 2.46±0.18, 1.75±0.61and 4.08±0.48 µg/l, respectively on the corresponding days (Table 1). The SGOT level of control *Clarias batrachus* were 1.80±0.23, 1.28±0.27, 1.79±0.47 and 1.49±0.21 µg/l, respectively on day 15, 30, 45 and 60 while the respective values of *Catfish* infected with *Procamallanus* were 2.45±0.10, 2.93±0.32, 1.34±0.15 and 2.17±0.15 µg/l on the corresponding days (Table 2).

Serum glutamic pyruvate transaminase (SGPT) and serum glutamic oxaloacetic transaminase (SGOT) are the enzymes that are normally present in liver, heart cells, kidney, muscle and pancreas and released into blood circulation when there organs are getting damaged. In present study, significant increase in SGPT and SGOT levels were observed in *Clarias batrachus* due to experimental *Procamallanus* infection on day 15, 30 and 60. Elevation of both the enzymes has also been recorded in animals infected with helminth parasites. Gray (1963) reported increased SGPT levels in the cattle and sheep infected with *Trypano soma vivax*. Adah *et al.* (1992) also observed increase in level of both the transaminases in goats experimentally infected with *Trypanosoma congolense*. Taiwo *et al.* (2003) reported increase in the SGPT level in sheep infected with *T. congolense* and *T. brucei*.

In fish, Joshi (1979) recorded biochemical changes in the liver and blood of *Rita rita* infected with *Opisthorchis pedicellata*. Zsigmond *et al.* (2002) observed increase in the activity of transaminases

Table 1 : Effect of *Procamallanus* infection on serum SGPT (µg/l) of *Clarias batrachus*.

	15 days	30 days	45 days	60 days
Control	1.28±0.26	1.30±0.05	1.59±0.07	1.96±0.12
Infection	2.69±0.37*	2.46 ±0.18*	1.75±0.61	4.08±0.48*

Values are mean ± S.E. of 5 specimens. *Significant response P < 0.001.

Table 2 : Effect of *Procamallanus* infection on serum SGOT (µg/l) of *Clarias batrachus*.

	15 days	30 days	45 days	60 days
Control	1.80±0.23	1.28±0.27	1.79±0.47	1.49±0.21
Infection	2.45±0.10**	2.93±0.31**	1.34±0.15	2.17±0.15*

Values are mean ± S.E. of 5 specimens. Significant responses : *P < 0.01, **P < 0.001.

(SGOT and SGPT) in infected fish suggesting the pathological processes induced by penetrating cer cariae. The observed elevation in SGPT and SGOT levels of *Clarias batrachus* due to *Procamallanus* infection may probably be due to the tissue break down (necrosis) and inflammation in the host, particularly of liver, heart, muscle, intestine and kidney as varying degress of degenerative changes were noticed in liver, kidney and intestine of the catfish at diiferent time intervals due to the nematode infection (Ruhela *et al*., 2006, 2007a, b). Another possibility of the increase in the serum enzyme levels of *Clarias batrachus* caused by *Procamallanus* infection might be due to the various toxic substances (exotoxins/endotoxins) secreted/excreted by the parasites harbouring intestine of the host (Roberts, 2001).

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VARIATION IN SOIL ENZYME ACTIVITIES AND MICROBIAL BIOMASS CONTENT AT VARIOUS ALTITUDES IN BUFFER ZONE OF NANDA DEVI BIOSPHERE RESERVE.

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ABSTRACT

The present study aims to analysis the variations in soil quality at various altitudes with emphasis on its physiochemical properties and microbial characteristics determining soil fertility status thus supporting plant and animal biodiversity in Nanda Devi Biosphere Reserve (NDBR) India. The experimental results revealed that physico-chemical characteristics (viz., moisture content, organic carbon, available nitrogen, phosphorus and potassium) of soil were maximum in high altitude alpine meadows and minimum in bottom pine forest. The microbial analysis measured in terms of total viable count (TVC) exhibited altitudinal variation being maximum population of bacteria followed by fungi and actinomycetes. The soil microbial population was positively correlated with soil respiration, dehydrogenase activity, acid phosphatase and microbial biomass, which exhibited uneven trend with altitude. Soil from high altitude alpine meadow showed highest microbial count and enzyme activities whilst bottom pine forest showed lowest microbial count and enzyme activities. Similar trends were also observed for microbial biomass carbon and microbial biomass nitrogen as well. This study has clearly proved that variation exists in the enzyme activities and microbial biomass carbon at varying altitude within buffer zone of Nanda Devi Biosphere Reserve.

Key words : *Altitude, microbial population, enzyme activities and soil respiration.*

Soil microorganisms catalyze soil organic matter transformation and are also *perse* the labile constituent of the organic matter. These microbes are the living agent for transformation of both added and native organic matter that act as a labile reservoir of available N, P, and K for plants (Jenkinson and Ladd, 1981). Soil microbial biomass encompassing bacteria, fungi and other microbes are the major organisms responsible for nutrient cycling and for controlling the amount of nutrient available to plants. Soil microbial biomass is a source and sink of nutrients and any change in the microbial biomass can be used to predict the effects of ecosystem perturbation (Hernot and Robertson, 1994). Estimation of microbial count and biomass are essential to gain a better understanding of the soil productivity.

The assay of the functional soil enzymes will give an accurate estimate of the biological activity of the soil. Among the various soil enzymes the dehydrogenase and the phosphates are useful indicators of the biological activity due to their multifarious roles in the soil. The dehydrogenase activity would be an ideal parameter to measure the biological activity of soil and serves as an index of the soil health quality (Pascual et al., 1999).Posphates are a group of enzymes that are involved in the phosphorous trasformation in the soil. The two broad classes of Phasphates viz. acid and alkaline phosphates are active in the acid and alkaline ranges respectively. While only the soil microbes contribute to the acid phosphate activity (Dick et.al.2000).

In buffer zone of NDBR litter decomposition play very important role in organic matter content of soil (Singh 2003). Various studies have been conducted on the pine needle decomposition in the forest floor (Kurz et.al 2000;Parfitt and Newman 2000) and grasses decomposition in alpine meadows (Singh and Rai 2005) but the role of the altitudinal variation on the decomposition pattern and soil biological activity

still remains unclear. Hence the paper aims the study the altitudinal variation in the soil enzymes activity and microbial biomass at various altitudes in buffer zone of NDBR.

MATERIALS AND METHODS

The experimental sites chosen for study was buffer zone of Nanda Devi Biosphere of district Pithoragarh in Central Himalaya (30°20' to 30°41'N and 79°40' to 80°E) of India. Three sites (Alpine meadows, Top pine forest and bottom pine forest) at different altitudes were selected for present study. Details of study site was given in Table 1.

The soil samples collected in May 2003 and 2004 in air tight polythene bags from each study plots in the two layers i.e., surface (0-10 cm) and subsurface (10-20 cm) were brought to the laboratory and stored at 4°C until used for analysis. The soil was handpicked to remove large pieces of plant materials and sieved through a 2 mm mesh screen. Soil moisture was determined gravimetrically by oven-drying 10 g fresh soil for 24 h at 105°C. pH was determined by an electric digital pH meter. Soil organic carbon and available nitrogen were determined; using rapid titration and micro Kjeldhal digestion and distillation procedures in air-dried and finally ground soil samples following Anderson and Ingram (1993). Available phosphorus was analyzed by Bray and Kurtz method (Bary and Kurtz, 1945) and potassium by flame photometeric methods. All soil microbial analyses were performed by using dilution plate technique (Seeley et.al. 1991), where Nutrient Agar media was used for bacteria, Potato Dextrose Agar for fungi and Starch Casein Agar medium for actinomycetes. Soil respiration was measured by alkali absorption method (Singh and Gupta, 1977). Dehydrogenase activity was determined according to the modified method of Casida (1977) whilst, phosphatase activity was analyzed by the procedure of Tabatabai and Bremner (1969). Microbial biomass carbon (MBC) using the chloroform-fumigation incubation technique of Jenkinsen and Powson (1976), whilst Microbial biomass nitrogen by Brooks et al. (1985). As the data did not vary much due to year, for a given parameter the same was pooled and represented as mean.

RESULTS

In general, the values of soil characteristics were maximum in high altitude alpine meadow, followed by top pine forest and bottom pine forest. PH was maximum (6.4) in subsurface layer soil of bottom pine forest and minimum (5.8) in surface layer of alpine meadow soil. The value of moisture, organic carbon and available nitrogen were minimum in sub surface layer of bottom pine forest soil and maximum in surface layer of high altitude of alpine meadow soil. Available soil phosphorus was maximum (12.9Kg/h) in alpine meadow soil and minimum (9.2 Kg/h) in bottom pine forest subsurface soil. The Similar trend was obtained for potassium as well (Table 2).

Microbial population, soil respiration and enzyme activities of all the three sites are presented in Table 3. The changes are observed in the total number of bacteria, fungi and actinomycetes. Over all, maximum microbial population was recorded in alpine meadow soil followed by top pine forest and bottom pine forest. The subsurface layer of soil showed low number of microbial population in comparison to the surface layer. The trend of microbial population in studied meadows were: Bacteria> Fungi >actinomycetes.

Soil respiration did not vary significantly between high altitude alpine meadow and top pine forest forest, whereas it is significantly decreased in bottom pine forest (Table 3). Among the study sites, maximum (0.73 mg CO_2 g^{-1} dm/day) rate of soil respiration was observed in high altitude alpine meadow soil. Soil of alpine meadow exhibited maximum (83.7 µg T PFg^{-1} dm $16h^{-1}$) dehydrogenase activity and minimum (37.2 µg T PFg^{-1} dm $16h^{-1}$) was recorded in bottom pine forest. Similar trend was obtained in phosphate (including acid and alkaline) activity as well.

Significant changes were observed in microbial biomass carbon and nitrogen in all the three studied sites. Maximum microbial biomass carbon and nitrogen (503.4& 65.1 µg/g) were obtained in alpine meadow and minimum (150.3 & 39.1µg/g) in bottom pine forest. Microbial biomass carbon and nitro-

gen were more in surface layer than subsurface layer of the soil.

DISCUSSION

Reduction in organic carbon, available nitrogen and phosphorus in the bottom pine forest soil is probably due to decreased decomposition of soil organic matter caused by soil disturbance including erosion of top layer (Nye and Greenland, 1964). Soil pH and moisture content increased with depth that supports the earlier observation of Sanchez *et al.*, (1999). Young (1996) suggested that due to increased activity of microbes, most of the litter get decomposed into simple organic matter and thus increase the organic carbon, available N & P of the soil. Further, reduced organic carbon, available nitrogen and phosphorus with depth might have resulted in smaller microbial population in subsurface layer (Cheshire and Griffiths, 1999). Campbell and Biederbeck (1982) also report the sharp reduction in microbial populations with depth. This is probably due to combined effect of decreased amount of organic substrate and insufficient aeration especially in the grassland and forest, which often experiences trampling, wood cutting, looping but no ploughing. Myrold (1987) reported that soil respiration was directly related to soil microbial population and plant roots. Therefore decrease microbial population in bottom pine forest soil might have resulted into reduced soil respiration.

Dehydrogenase activity was more or less in accordance with the pattern of bacterial and fungal propagules and soil organic carbon .In alpine meadow greater amount of litter was produced to ultimately enrich the soil (Maithoni *et al.* 1998), thus improving the soil nutrient pool to support more and more microbes. As like the observation of Shukla *et al.* (1989) that dehydrogenase activity regulated by both microbial population and soil organic carbon, seems to be observed in present study as well. Further, the trend of phosphatase activities i.e. acid and alkaline has been shown to altitude dependent and related to soil organic matter and moisture as has been reported by Bonmati *et al.* (1991) and Harrision (1983). More activities were recorded in surface layer than the subsurface layer may be due to more organic matter and microbial population at surface layer. Similar observation was made by Singh and Rai (2004) while studying the enzyme activities of forest soil.

The values of microbial biomass carbon were well within the reported range (102-2073 µg/g) for various temperate and tropical forest soils (Hernot and Robertson, 1994). Relatively dense growth of plants and greater accumulation of litter in the meadows (Arunachalam *et al.*, 1996a), seem to have favoured the growth of the microbial population and accumulation of microbial biomass Carbon. Similar observations were reported by Arunachalam *et al.* (1996 b) while comparing undisturbed 22 year-old subtropical pine forests undestroyed with gaps and tree-out plots. Microbial biomass Carbon and nitrogen were directly related to organic carbon and available nitrogen of soil (Brooks et.al.1989). This shows conformity with the observation of present study as well. The soil microbial biomass C/N ratio observed in present study is well within the range reported, so for, temperate region.

From the above study it is clear that altitudinal variation is seen in the soil characteristics and enzyme activities at the surface and the subsurface layers.

Table 1: Detail of the Experimental sites.

Sl. No.	Parameter	Sites		
		Alpine meadows	Top pine forest	Bottom pine forest
1.	Altitude (m AMSL)	>3000	1800	1100
2.	Distance from road (Km)	45	5	2
3.	Slope	N-E	N	S-W
4.	Slope angle	25-30	20-25	25-30

Table 2: Physico-chemical characteristics (mean ± SE) of the surface layer soil (T) and subsurface layer (B) soil at different altitudes

	3000 m AMSL Alpine meadow		1800 m AMSL Top pine forest		1100 m AMSL Bottom pine forest	
Site/Soil Parameters	T	B	T	B	T	B
pH	5.8±0.2	6.1±0.1	6.3±0.1	6.5±0.2	6.2±0.1	6.4±0.2
Organic C (%)	2.1±0.3	1.9±0.1	1.5±0.1	1.3±0.3	1.1±0.2	0.9±0.1
Avail N (Kg/h)	136.4±5.3	125.3±3.1	112.7±7.1	105.2±6.5	101.8±5.1	86.1±5.1
Avail P (Kg/h)	12.9±1.1	11.1±0.5	10.8±1.3	9.6±1.1	10.3±1.5	9.2±1.1
Avail K (Kg/h)	482±10.2	430±7.0	450±11.2	410±8.1	420±11.5	390±7.1
Moisture (%)	26.1±5.1	32.8±2.1	21.4±.5.1	28.3±5.1	20.1±1.5	25.2±1.1

Table 3: Microbial population and their enzyme activities (mean ± SE) of the surface (T) and subsurface (B) soil at different altitude.

	3000 m AMSL Alpine meadow		1800 m AMSL Top pine forest		1100 m AMSL Bottom pine forest	
Site/Soil Parameters	T	B	T	B	T	B
Total bacteria ($X10^6$)	4.2±0.1	3.5±0.2	3.6±0.5	2.5±0.1	3.1±0.2	2.1±0.1
Fungi ($X 10^4$)	3.9±0.2	2.8±0.2	3.4±0.1	2.5±0.2	2.9±0.1	2.2±0.3
Actinomycetes ($X 10^3$)	1.4±0.2	0.9±0.01	1.0±0.2	0.8±0.03	0.8±0.01	0.6±0.02
Soil respiration ($mgCO_2g^{-1}dmday^{-1}$)	0.73±0.01	0.66±0.02	0.62±0.05	0.49±0.01	0.47±0.02	0.42±0.03
Dehydrogenase ($\mu gT\ PFg^{-1}\ dm\ 16h^{-1}$)	83.7±5.3	69.3±5.8	65.2±7.5	57.5±8.3	49.1±7.8	37.2±6.5
Acid phosphatase ($\mu gPNPg^{-1}\ h^{-1}$)	72.5±5.5	58.3±4.3	53.1±8.8	49.5±75	48.2±9.5	41.5±4.2
Alkaline phosphatase ($\mu gPNPg^{-1}\ h^{-1}$)	198.1±8.4	149.5±2.5	153.2±8.4	110.1±8.4	124.2±4.2	86.3±9.5

Table: 4 Microbial biomass carbon (mean ± SE) and microbial biomass nitrogen (mean ± SE) of the surface (T) and subsurface (B) soil at different altitude.

	3000 m AMSL Alpine meadow		1800 m AMSL Top pine forest		1100 m AMSL Bottom pine forest	
Site/Soil Parameters	T	B	T	B	T	B
Microbial biomass C (µg/g)	503.4±9.2	451.6±7.1	318.3±9.1	250.5±7.2	215.2±9.1	193.4±0.2
Microbial biomass N (µg/g)	65.1±3.3	54.9±4.1	51.5±8.1	43.3±4.3	45.1±7.2	39.1±5.1
C/N ratio	7.73	8.22	6.18	5.78	4.77	4.95

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LENGTH - WEIGHT RELATIONSHIP OF *LABEO CALBASU* (HAM.) FROM THE GANGA RIVER SYSTEM AT ALLAHABAD

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ABSTRACT

***Labeo Calbasu* is an important commercial fish in Allahabad region. For the study of Length-weight relationship 261 fishes in the size range of 11.7 to 75.6 cm. (Total length) were used. A high degree of correlation was observed between the lengths and weights of fishes and increase of length was highly significant for the increase in the weight of the fish. The regression equation for the pooled data was expressed by log w=3.2367 log L-2.1792. The value of exponent 'n' was recorded 3.2367, indicating suitability of abiotic environment. The K_n values were higher during winter months due to intense feeding activity. The mature fishes had high relative condition during breeding season which sharply declined after spawning.**

Key words : *Labeo calbasu, condition factor, regression equation fishery biology, correlation coefficient.*

Study of length-weight relationship is considered important in fishery biology. The increase in the weight of fishes is accompanied by increase in length but the degree of relationship may vary in different fish species. Allen (1938) reported that an ideal fish which maintains the same shape, length-weight relationship follows the cube law ($w=cl^3$). Le Cren (1951) reviewed the cubic parabola ($w=cl^3$) with a clear exposition into general parabola $w=al^n$, where 'w' and 'l' represent the weight and length of fish respectively; a is constant (equivalent to c of cube law) and the value of the exponent 'n' is to be obtained from the data. The formula facilitates the conversion of one measurement into another and may also give indications to taxonomic differences and events in the life history like metamorphosis and the beginning and onset of maturity. As fishes normally do not retain the same shape or body contour throughout their life span. The changes in the power function (b values) is influenced by a number of factors *viz.* gonadal development, nutritive conditions of the environment, physiological conditions of the fish at the time of collection, sex *etc.*

Length-weight relationship study in fishes is important in setting up yield equations (Ricker, 1958), in estimating the number of fish landed and in comparing population in time and space (Chanchal *et. al.*, 1978). Generally it is expected that the weight of fish would vary as the cube of length (Shekhran, 1968; Pandey *et. al.*, 1974 Pathak, 1975 and Dasgupta, 1988) but the actual relationship may depart significantly (Le Cren, 1951). Martin (1949) considered that an exponent 'n' in the general parabolic formula ($w=al^n$) usually varies from 2.5 to 4.0 as fishes change their shape with growth. As the specific gravity and shape or body outline of the fish is subjected to changes, the cube law need not always hold good (Rounsefell and Everhart, 1953).

The coefficient of condition, which is a measure of the variation from the expected weight for a particular length of an individual fish, provides information like suitability of environment, differential growth of different ages, breeding behaviour, spawning, relative fatness and well being, *etc.* K-value appears to increase steadily in most fish species up to a certain size, after which there is a reduction in the rate of increase in length but the weight increases. It is important for the comparative studies to estimate the condition factor in the prespawning period, since the gonad weight adds to the fish weight to a large extent (the post spawning K-values are lower in fishes). The high value of K-factor may be an evi-

dence of breeding season. Das and Pathani (1978) explained the high condition factor during breeding season.

Length-weight relationship in *L. calbasu* have been studied from the Bhavanisgar (Natrajan, 1971), Nagrjunsagar (Vinci and Sugunan, 1981) and Tilaiya (Khan, 1988) reservoirs, but the reports from the riverine environment is scanty, hence an attempt was made to study length-weight relationship of *L.calbasu* from Ganga at Allahabad.

MATERIALS AND METHODS

For the study of length-weight relationship 261 fishes in the size range of 11.7 to 75.6 cm. (Total length) were analysed. After removing the moisture, freshly caught specimens were measured for recording the length and weight of fish in centimeters and grams respectively. Lengths and weights were then converted into logarithmic form. The equation for the length-weight relationships was computed by using formulae:

$W=aL^n$ (Le Cren, 1951)

and $\text{Log } W = \text{Long } a + n \log L$,

where W = weight of fish, L = Length of fish, and a and n are constants.

The parabolic relationship was expressed graphically by plotting the numerical values of observed length and weight and logarithmic relationship was expressed by plotting the calculated log weight against log length.

Based on the data collected and computed for the length - weight relationship, monthly condition factor was recorded and represented graphically.

$Kn=W/w$

where Kn = relative condition factor

W = observed weight and w =calculated weight

RESULTS

The length-weight data were statistically analysed and the regression equation for different seasons were computed as follows;

Pooled: $\log w = 3.2367 \log l - 2.1792$
$(r=0.9662)\ w= 0.0066 l^{3.2367}$

Summer $\log w = 3.3844 \log l - 2.3975$
$(r=0.9718)\ w = 0.0040 l^{3.3844}$

Monsoon $\log w= 3.4873 \log l-2.5909$
$(r=0.9651)\ w=0.0026\ l^{3.4873}$

Winter $\log w= 3.0388 \log l-1.8875$
$(r = 0.9567)\ w=0.0130\ l^{3.0388}$

The sex-wise regression equation was obtained for mature fishes as below:

Male: $\log w=3.1972 \log l - 2.4137$
$(r=0.9672)\ w=0.0039 l^{3.1972}$

Female: $\log w = 3.1702 \log l - 2.3623$
$(r=0.9597)\ w = 0.0043\ l^{3.1702}$

The regression equations and the values of correlation coefficient (r) indicated that length of fish was highly correlated with the weight. Analysis of variance (Tab. 1) revealed that per unit increase in the total length was significant for the per gram gain in the weight of fish. The numerical values of weight against the length, when plotted, gave a parabolic curve (Fig. 1), which showed an increase in the length with the gradual increase in weight of the fish. A straight line was observed with logarithmic values of lengths and weights.

RELATIVE CONDITION FACTOR (K_n)

The relative condition for the pooled data were recorded (Tab. 2) and plotted graphically (Fig. 2). The K_n values were recorded higher during winter months which was due to increased feeding intensity. The analysis of K_n values of mature fishes (Tab. 3 and Fig. 3) showed that the fishes have higher values during breeding season due to heavy growth of gonads which sharply declined after spawning in the month of September.

DISCUSSION

Study of length-weight relationship is helpful in understanding the condition cycle of fish and in conversion of one parameter into another.

Sarojini (1957) on the basis of length-weight relationship study in *Mugil persia* reported that therewas no sexual dimorphism and this relationship did not change during the growth of the fish. Tandon (1962) and Lal and Dwivedi (1969) observed the homogeneity in different populations of *Selarioides leptolepis* and *Rita rita* respectively. Mishra (1982)

Table 1: Analysis of variance - Length and weight of *Labeo calbasu*

Source	df	SS	MS	F
Regression	1	52.5837	52.5837	3004.7981
Residual	214	3.7457	0.0175	
Total	215	56.3294		

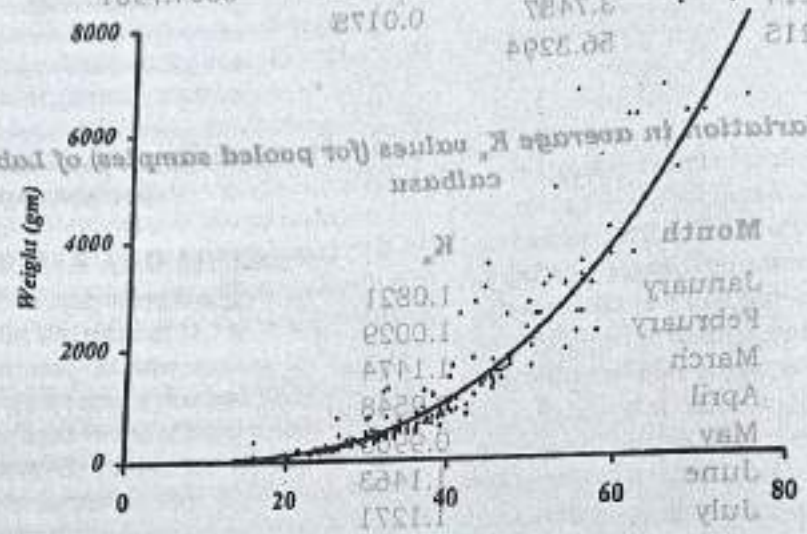
Table 2: Variation in average K_n values (for pooled samples) of Labeo calbasu

Month	K_n
January	1.0821
February	1.0029
March	1.1474
April	0.9548
May	0.9903
June	1.1463
July	1.1271
August	1.0232
September	0.9972
October	0.9368
November	0.9295
December	1.0712

Table 3: Sex-wise monthly variation in average K_n values of mature Labeo calbasu

Month	Male	Female
January	0.9876	0.9432
February	0.9832	0.9535
March	0.9976	0.9326
April	0.9783	1.0028
May	0.9988	1.1043
June	1.0672	1.4637
July	1.1132	1.1138
August	1.1024	1.0679
September	0.9423	0.9474
October	0.9284	0.9276
November	0.9897	0.9987
December	0.9345	0.9862

Fig.: 1: Length - weight relationship of Labeo calbasu (Ham.)



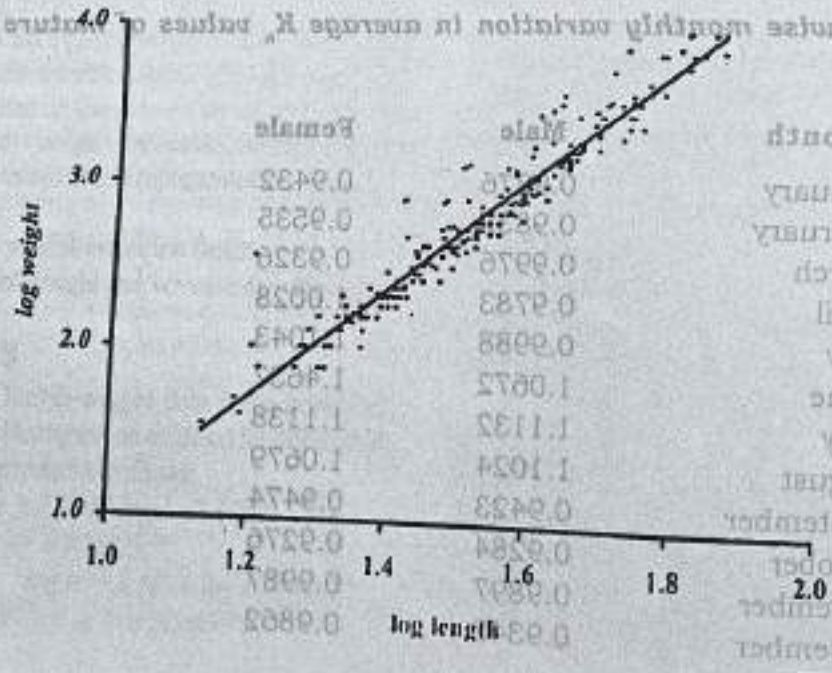


Fig. 2: Average Kn values (for pooled samples) of Labeo calbasu

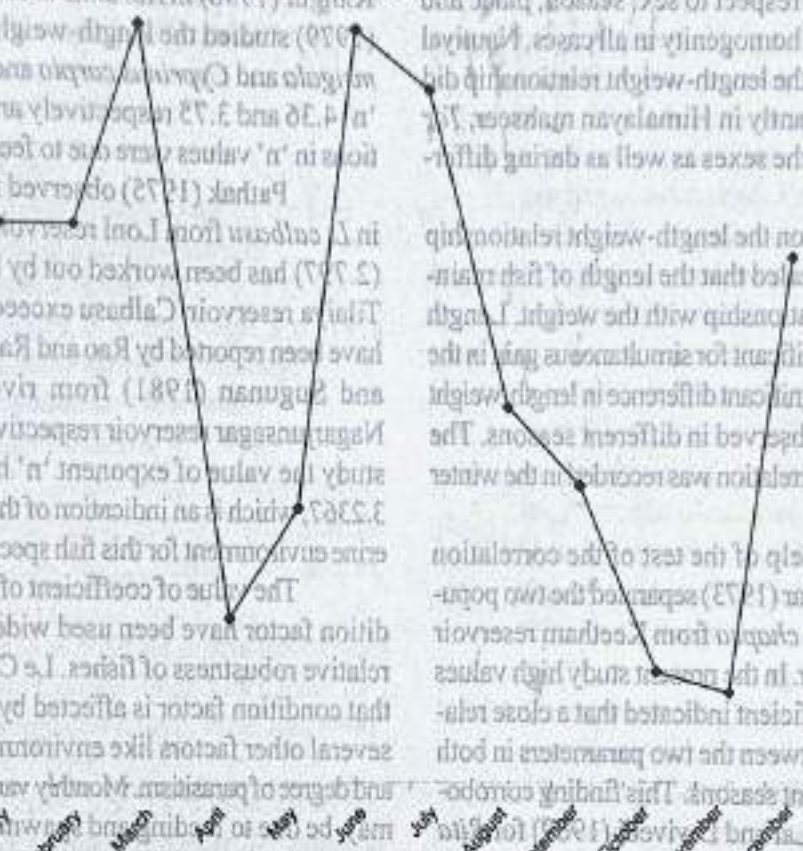
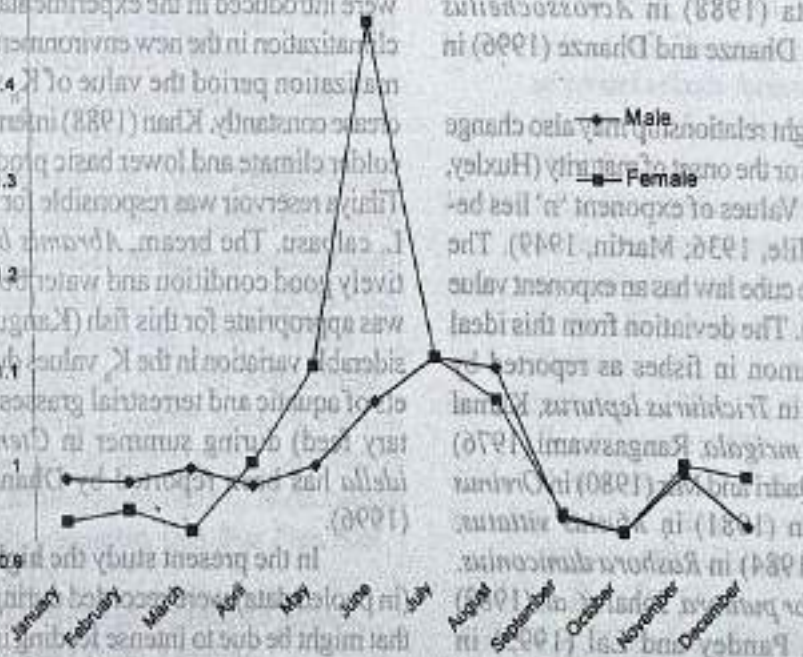


Fig. 3: Sex-wise average Kn values for mature Labeo calbasu



studied the length-weight relationship of *Schizothorax richardsonii* with respect to sex, season, place and year and observed homogenity in all cases. Nautiyal (1985) found that the length-weight relationship did not differ significantly in Himalayan mahseer, *Tor putitora* between the sexes as well as during different seasons.

The study on the length-weight relationship on *L. calbasu* revealed that the length of fish maintained a steady relationship with the weight. Length increment was significant for simultaneous gain in the weight of fish. A significant difference in length-weight relationship was observed in different seasons. The lowest degree of correlation was recorded in the winter season.

With the help of the test of the correlation coefficients Chondar (1973) separated the two populations of *Gadusia chapra* from Keetham reservoir and the Ganga river. In the present study high values of correlation coefficient indicated that a close relationship existed between the two parameters in both sexes and in different seasons. This finding corroborates the views of Lal and Dwivedi (1969) for *Rita rita*, Chondar (1972) in *Labeo gonius*, Rita Kumari and Nair (1978) in *Noemacheilus traingularis* and *Lepidocephalus thermalis*, Lal and Mishra (1980) in *Schizothorax richardsonii*, Nautiyal (1985) in *Tor putitora*, Dasgupta (1988) in *Acrossocheilus hexagonolepis* and Dhanze and Dhanze (1996) in exotic carps.

Length-weight relationship may also change with metamorphosis or the onset of maturity (Huxley, 1932; Frost, 1945). Values of exponent 'n' lies between 2.5 to 4.0 (Hile, 1936; Martin, 1949). The ideal fish obeying the cube law has an exponent value of 3.0 (Allen, 1938). The deviation from this ideal value (n=3) is common in fishes as reported by Narsimham 91970) in *Trichiurus lepturus*, Kamal (1971) in *Cirrhinus mrigala*, Rangaswami (1976) in *Mugil cephalus*, Qadri and Mir (1980) in *Oreinus plagostomus*, Sultan (1981) in *Mystus vittatus*, Thakre and Bapat (1984) in *Rasbora daniconius*, Nautiyal (1985) in *Tor putitora*, Johal *et. al.* (1989) in *Colisa fasciata*, Pandey and Lal (1995) in *Naemacheilus mantanus* and *N. multifasciatus* and Kangur (1996) in *Abramis brama*. Soni and Kathal (1979) studied the length-weight relationship in *C. mrigala* and *Cyprinus carpio* and found the value of 'n' 4.36 and 3.75 respectively and stated that variations in 'n' values were due to feeding habit of fish.

Pathak (1975) observed the value of 'n' 3.0 in *L. calbasu* from Loni reservoir. Value less than 3 (2.797) has been worked out by Khan (1988) from Tilaiya reservoir. Calbasu exceeding the value, 3.0 have been reported by Rao and Rao (1972) and Vinci and Sugunan (1981) from river Godavari and Nagarjunsagar reservoir respectively. In the present study the value of exponent 'n' has been recorded 3.2367, which is an indication of the suitability of riverine environment for this fish species.

The value of coefficient of condition or condition factor have been used widely to express the relative robustness of fishes. Le Cren (1951) found that condition factor is affected by length as well as several other factors like environment, food supply and degree of parasitism. Monthly variation in K_n values may be due to feeding and spawning acts of fishes. Le Cren (1951) and Pillay (1958) stated that spawning season exert a considerable influence on the condition factor of the fish. Srivastava and Pandey (1981) reported low condition factor in major carps after fish were introduced in the experimental pond due to acclimatization in the new environment, and after acclimatization period the value of K_n was found to increase constantly. Khan (1988) inferred that relatively colder climate and lower basic productivity level of Tilaiya reservoir was responsible for low condition of L. calbasu. The bream, *Abramis brama*, has relatively good condition and water body (lake Peipsi) was appropriate for this fish (Kangur, 1996). A considerable variation in the K_n values due to feeding levels of aquatic and terrestrial grasses (as supplementary feed) during summer in *Ctenopharyngodon idella* has been reported by Dhanze and Dhanze (1996).

In the present study the higher values of K_n (in pooled data) were recorded during winter months that might be due to intense feeding in fishes. Mature

fishes showed high K_n values during breeding season due to great increase of gonads. A sharp decline in K_n was noticed in the month of September due to spawning.

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DETECTION OF *PEA SEED-BORNE MOSAIC VIRUS* IN PEA BY ENZYME-LINKED IMMUNOSORBENT ASSAY

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ABSTRACT

Thirty two seed samples of pea belonging to 32 varieties collected from different states viz., Arunanchal Pradesh, Assam, Haryana, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Tripura, Uttar Pradesh, Uttaranchal were subjected to "Grow-out-test" to know whether the viral disease is transmitted through seeds or not. Seeds were sown in 15 inch plastic pots containing mixture of sterilized soil, sand and farmyard manure (2:1:1) under controlled glass house conditions. The intensity of the disease was observed after 12 days and 20 days of germination. The seed-transmission percentage was calculated and out of 32 samples, in 27 the viral disease was transmitted through seeds. In experiments aimed at testing a range of varieties for determining seed transmission frequency, samples were further investigated by ELISA. The test plants were back-indexed to host plants by means of infectivity assay.

Key Words: *Pisum sativum, pea seed-borne mosaic virus, grow-out test, infectivity assay, enzyme-linked immunosorbent assay.*

Pea (*Pisum sativum L.*) is cultivated both as vegetables and pulse crop in India. One of the major constraints in achieving the potential yield of pea is the attack of various diseases and pests of which, those of viral origin assume special importance. Pea seed-borne mosaic virus (PSbMV) reported from different parts of the country has been identified to be one of the major biotic constaints in pea production (Anand *et al.*, 2006). The characteristic symptoms induced by PSbMV include downward leaf rolling with or without leaf mosaic of well-defined dark and light green areas. The symptoms may be mild or even symptomless in the infected plants (Hampton and Braverman,1979). Symptoms appeared late in growth cycle and disappeared soon after infection (Brunt et al., 1996). Such a large variation in symptom expression is due to significant influence of temprature (Maury and Khetarpal, 1992). The study was undertaken to develop a simple and rapid test for determining precisely the frequency of virus transmission through seeds in pea by ELISA. In these experiments aimed at testing a range of varieties for determining seed transmission frequency, samples were further investigated by infectivity assay.

Preliminary test were conducted to compare the biological and serological tests for detection of PSbMV to develop a simple and rapid test for determining precisely the frequency of seed transmission in pea. In test conducted on transmission through pea seed, correlation between PSbMV presence in seed and grow-out test was established.

MATERIALS AND METHODS

Seed collection: A total of 32 varieties of pea from various sources viz., National Seeds Corporation (NSC) Ltd., State Agricultural Universities (SAUs), Central State Farms (CSF), ICAR institutes, local market and farmer's fields belonging to the states of Arunachal Pradesh, Assam, Haryana, Madhya Pradesh (MP), Maharashtra, Manipur, Meghalaya, Mizorum, Tripura, Uttar Pradesh (UP) and Uttranchal were procured and used in the study.

Grow-out test: Pea seeds were grown in a glasshouse at 25-30°C in 15-inch plastic pots containing mixture of sterile soil, sand and farmyard manure (2:1:1). The plants were watered with tap water. Each pot contained a maximum of 25 seeds. Pea plants were scored for viral symptoms such as mosaic and downward leaf rolling on young leaves after 12 and 20 days of germination.

ELISA: For each sample, 150 seeds were kept for germination on paper towel. After 15 days of germination, from each sample, group of 10 seedlings were prepared. The individual samples were further tested in case of groups that were found positive. The double antibody sandwich form of ELISA (DAS-ELISA) was employed (Masmoudi *et al*., 1994). Immunoglobulin concentration (BIORAD Laboratories) for coating the plates was diluted (1:100) in carbonate buffer, pH 9.6 (Na_2CO_3: 1.59 g; $NaHCO_3$: 2.93 g; NaN_3 0.2 g; Distilled water: 1000 ml); seedlings were ground in a mortar and pestle at a ratio of 1:10 (wt: vol) in antigen extraction buffer, pH 7.4 (NaCl: 8.0 g; KH_2PO_4: 0.2 g; $NaHPO_4$. 12 H_2O: 2.9 g; KCl: 0.2 g; NaN_3: 0.2 g; Polyvinyl pyrrolidone: 20 g; Tween-20: 0.5 ml; Distilled water: 1000 ml). IgGs conjugated with alkaline phosphatase were used at a dilution of 1:100. Results were recorded after 15 min., 30 min., 1 h and 2 h of substrate reaction time at 405 nm in ELISA Reader of TECAN (Austria) make. Readings were considered positive if its OD value was more than twice to the mean of negative controls.

Infectivity assay: Plant extracts were prepared in 0.2 M Phosphate buffer, pH 7.2 (KH_2PO_4: 2.7 g; Na_2HPO_4 $2H_2O$: 8.3 g; Distilled water: 1000 ml). Leaves of *Chenopodium amaranticolor* and *C. quinoa* were inoculated manually with plant extracts. PSbMV causes local lesions on inoculated leaves.

RESULTS AND DISCUSSION

In general, the control measures against viral diseases aim at either eliminating the primary source of infection or minimizing the secondary spread of virus. The varieties compared in this paper were identified to be infected by PSbMV on the basis of symptomatology, serology and their common high rate of seed transmissibility.

Correlation between grow-out test, ELISA and infectivity assay: In experiments aimed at testing a range of varieties for determining seed transmission frequency, samples were investigated under grow-out test, which were further confirmed by ELISA.

In tests with 32 pea varieties, with the exception of a few seeds that have low germination rate, each seed those were supposed to contained virus by visual inspection of seed gave positive results in grow-out tests, as confirmed by the presence of typical viral symptoms after 12-20 days of germination. Symptoms include downward rolling of leaflets in some varieties (Swati, DDR-23, JP-885, IM-9101, Lincon-C) and mosaic symptoms were observed in HUDP-16, Hawai chin mubi, Jayanti and PI-36. Variety, Swati showed maximum seed transmission rate of 80.00% and varieties (DDR-27, DDR-33, KPMR-400, Assam Local, Pant P-5) showed no seed transmission. In some severely affected plants, pod formation took place but there was no seed formation and some infected at seedling stage did not produce flowers or had only few distorted flowers and pods.

In varieties, Assam local, Pant P-5 and KPMR-400 the seed-transmission percentage was nil by grow-out test as there was no PSbMV symptoms observed but the presence of virus was recorded by performing ELISA of same seedlings. This can be explained by means of latent infection of virus as found by Munro, 1978, that symptom less infection of pea are common. Some pea cultivars never express symptoms (Khetarpal and Maury, 1987). The virus may be present without inducing symptoms in 5 to 10% of the plants from infected seed lots. Such a large variation in symptom expression is due to the existence of different strains and also to significant influence of temperature. The symptoms may be mild or even absent and expressed late in the growth cycle, even though the plants may be indexed as serologically positive to PSbMV (Brunt *et al*., 1996). However, under ideal

Table 1. Correlation between enzyme-linked immunosorbent assays (ELISA) and grow-out tests for detection of *pea seed-borne mosaic virus*, thereby determining seed transmission frequency.

S. No.	Variety	No. of groups* tested by ELISA	No. of groups* positive by ELISA	ELISA Percentage (%)	Mean values of OD at 405 nm	Negative Control	Seed-Transmission (%)
1	Alankar	10	10	100	1.129	0.210	5.26
2	Aparna	10	10	100	2.245	0.204	2.12
3	Arkel (U.P)	2	2	100	1.218	0.220	2.77
4	Arkel (M.P)	7	7	100	1.623	0.260	12.37
5	DDR-23	2	2	100	0.741	0.220	60.22
6	DDR-27	2	0	0	0.344	0.220	0.00
7	DDR-33	2	0	0	0.208	0.220	0.00
8	DDR-39	2	2	100	0.733	0.220	3.15
9	DDR-53	2	2	100	0.993	0.220	8.08
10	DDR-55	8	4	50	0.430	0.183	1.07
11	Hawai Chin Mubi	2	2	100	1.315	0.220	31.35
12	HFP-4	2	2	100	1.321	0.220	4.08
13	HUDP-15	8	6	75	0.613	0.448	13.92
14	HUDP-16	10	10	100	1.351	0.368	13.79
15	IM-9101	2	2	100	1.096	0.220	72.91
16	Jayanti	10	10	100	1.206	0.368	41.02
17	JP-885	10	10	100	1.097	0.210	32.58
18	KFP-103	2	2	100	1.430	0.220	2.22
19	KPMR-400	10	5	50	0.520	0.183	0.00
20	Kyongton Local	4	3	75	0.747	0.448	28.12
21	Lincon-C	10	10	100	1.420	0.680	50.00
22	Assam Local	5	5	100	1.539	0.183	0.00
23	Arunachal Pradesh Local	2	2	100	2.405	0.220	16.66
24	Green pea South Mizoram	8	8	100	2.570	0.162	10.22
25	Yellow pea South Mizoram	6	6	100	0.935	0.368	7.14
26	South Tripura Local	2	2	100	1.923	0.220	35.71
27	West Tripura Local	3	1	33.33	1.201	0.660	31.03
28	Manipur Local	2	2	100	1.327	0.220	14.28
29	Pant P-5	2	2	100	1.408	0.220	0.00
30	PI-36	2	1	50	0.547	0.220	47.05
31	Sapna	7	1	14.28	0.507	0.448	2.17
32	Swati	8	8	100	0.737	0.448	80.00

* 10 seedlings per group.

conditions, characteristic symptoms of PSbMV are apparent both in field and glass house. The degree of leaf rolling symptom observed varied from variety to variety. The variability in symptoms is often due to variability of host and sensitivity of virus strain involved (Maury and Khetarpal, 1992).

By means of infectivity assay test plants were back-indexed to *Chenopodium amaranticolor and C. quinoa*. Virus presence in grow-out tests was confirmed for some of the varieties (Swati, DDR-23, IM-9101, Lincon-C, PI-36) tested by infectivity assays. The plants were under regular observation for the symptom expression and after 12-15 days of inoculation local lesions were observed on indicator plant. The technique was based on inoculation of sap of infected leaves on healthy pea and indicator host. Although Mink and Parson (1978) developed the procedure for detecting PSbMV in pea seeds called as direct assay i.e by indexing pea on *Chenopodium amaranticolor* and pea cultivars. Fletcher, 1993 observed pea crops over 2 seasons for virus infection using infectivity assay and ELISA to estimate disease incidence.

A perfect correlation was observed between grow-out test and the ELISA tests of the seedlings. The ELISA procedure described is reliable to detect seed transmission frequency of PSbMV in pea and absence of PSbMV was also confirmed by random testing of leaf samples by ELISA. Frequency of seed transmission was determined on the basis of positive reaction in ELISA tests conducted. Results were recorded after 15 min., 30 min., 1 h and 2 h of substrate reaction time at 405 nm in ELISA Reader. Readings were considered positive if its OD value was more than twice to the mean of negative controls.

A majority of varieties tested by grow-out test showing typical PSbMV symptoms were also confirmed positive by ELISA test. Zidan *et al.*, (1997) in Libya detected PSbMV using ELISA along with other viruses *Faba bean necrotic yellows virus*, *Bean yellow mosaic virus*, *Broad bean stain virus*, *Pea seed-borne mosaic virus*, *Beet western yellows virus* and *Alfalfa mosaic virus* in diseased plants showing symptoms of mosaic, yellowing, vein clearing, leaf rolling, stunting, mottling and necrosis. Various virus-like symptoms were recorded on field-grown pea during 1989-90 and found to be positive by ELISA (Dahal and Albrechtsen, 1996).

Varieties, DDR-27 and DDR-33 were showing no symptoms of downward leaf rolling and mosaic during growing-on test and were also ELISA negative. The detection of the virus in leaves by ELISA was found to be more effective in single leaf samples then in bulked samples of four or five plants, from older plants rather than young seedlings in case of latent infection (Anand *et al.*, 2006). It could be explain that in seedlings, with growth the concentration of virus increases with favourable climatic conditions. Virus can also occur in low concentration in certain pea varieties, and in such cases detection by standard ELISA was impossible. To minimize this limitation of ELISA detectability a polyclonal globulin is used (Maury and Khetarpal, 1992). ELISA is uniquely advantageous in screening seedlots and should be useful for plants quarantine and other agencies in screening seedlots for the presence of seed borne viruses.

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THE FOOD AND FEEDING HABITS OF *CIRRHINUS REBA* (Ham.) FROM GANGA RIVER SYSTEM

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ABSTRACT

***Cirrhinus reba* (Ham.) commonly known as Reba is a medium sized carp. Because of its fast growth and taste the fish is commercially important. Food and feeding habit studies were undertaken as a component of detailed biological study. In all, 1294 fish samples collected from Ganga river system and examined during three years period. Index of preponderance, method was used for in-depth analysis.**

The fish samples were classified in three different size-groups on the basis of food preferences. The study inferred that the reba fish is a phytophagus in nature initially the fish consumed plankton but gradually it switched to decayed organic food in adult stage. However, in the intermediate stage (Second group) it preferred diatoms, decayed food, green and blue green algae. Feeding habit was irregular with rate of digestion being very high. Feeding behaviour was further confirmed by Gastro - somatic index of the fish.

***Key Words:** Reba, food and feeding habit phytophagus.*

Cirrhinus reba (Hamilton) a medium sized carp is an important fish because of its abundance and taste. The fish is commonly known as Reba or often as bata, since it is sold in heterogeneous mixture of several cyprinoids, Viz., *Cirrhinus reba*, young ones of *C. mrigala, Labeo calbasu, L. bata* etc. in the market. As the prices of major carps are becoming exhorbitant, these bata fishes have become second preferences for retailers as well as consumers. Job (1944) has recommended for stocking in ponds due to its quality of quick growth during initial period. Job et. al (1955) reported that the fish is being used for stocking in ponds and tanks in Tamil Nadu. Besides, the commercial consideration, the fish has nutritive value and therefore can play a significant role in captive as well as culture sectors.

In view of these scanty but valuable observations, a detailed study was undertaken to understand the biotic potential of *Cirrhinus reba*. The present communication, here on the food and feeding habit of the fish is a part of the detailed study of the cyprinoid, from Ganga river system in and around Allahabad.

MATERIALS AND METHODS

The material for the investigation was obtained from commercial catches landed at two landing centers. Viz., Sadiapur and Daraganj on rivers Jamuna and Ganga respectivel. Mostly specimens were collected from these centers but, occasionally specimens were also collected directly from fishermen's catches at the fishing sites in deep villages. For the present study, the fish guts of the fresh specimens were removed and preserved in 5% formaldehyde for subsequent analysis. Degrees of distention of intestinal bulb (Rogick, 1931) were recorded and classified as full, ¾ full, ½ full, ¼ full and empty. The food constituents, were identified upto genera level in almost all cases, except where it was impossible due to the digestion level. For qualitative analyses, the volumetric and frequency occurrence method was used. The frequency of occurrence of each food component was determined by dividing the number of intestinal bulb containing that food by total number of bulbs examined during three years period. In all, 1294 guts were examined during the detailed investigation. For assessing, the relative importance of various food items in the gut contents, their "Index of Preponderence" was calculated following the method

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of Natarajan and Jhingran (1961).

$$Ii = \frac{100\ Vi\ Oi}{\Sigma\ Vi \times Oi}$$

(Ii = Index of preponderance, Vi=Volume percentage of i:Oi = Occurrence percentage of i)

Body length / Gut length ratio as well as gastro-somatic index (G.S.I.), a ratio between intestinal bulb weight and total body weight was also calculated for knowing the feeding habit and monthly fluctuation in feeding intensity.

RESULTS

Published information on the food and feeding habits of *C. reba* is megre. Mookerjee et. al (1946) classified it as omnivorous as they found crustaceans in the gut contents. Mookerjee and Sengupta (1946) and Das and Moitra (1956) have correlated the length of the gut with its food habit. Das and Moitra (1963) grouped this fish along with other herbivorous group. Earlier, Alikunhi (1957) studying feeding habits of reba, delineated three size groups for the fish. The present author has also classified the fish into three size groups on the basis of food preferences.

1.Composition of gut contents of 1st size group (25-50mm. size)

The gut content analysis of this size group indicate monthly variations in the diet contents. Volume percentage of cladocerans was more in July (56.39%) and August (51.16%) months. In September and October the preference was shifted to rotifers 37.09% and 36.42% respectively, making cladocerans a second preferred food. Diatoms ranked third in all the four months period and intake volume increased gradually with the increase in size. Decayed food, consisting of green plant matter and green algae, was seen only in later months September and October. Copepods were negligible 3.29% in occurrence in this group. (Table-1).

Protozoans with index of preponderance of 0.68 was present only in the month of October. Item wise indices and grades aregiven in the above table. Occurrence of sand and mud ranging in volume between 1.16% and 7.08% is accidental inclusion as the water of these two rivers during monsoon months (July-October) is highly turbid.

2. Size group-II (51-100 mm size)

In all 198 specimens were examined for detailed feeding habit analyses. This group was characterized by the dominance of diatoms (I= 46.99) and not by cladocerans. Rotifers volumetric percentage also showed gradual decline (12.84%) in August and 2.75% in December). Protozoa which was present only in August-September and October months samples was totally absent in November and December. Diet composition in this group is totally different

Table-1 Pooled percentage of different food items encountered in Ist size group during July-October

S. No.	Food Item	Vol. %	Occ. %	Vi Oi	I	Grade
1.	Protozon	0.71	1.33	0.9443	0.03	VII
2.	Rotifers	36.19	34.26	1239.5075	44.65	II
3.	Cladocerans	41.76	30.51	1274.0976	45.90	I
4.	Copepods	3.29	8.93	29.3797	1.05	IV
5.	Diatoms	12.73	15.85	201.7705	7.27	III
6.	Decayed Food	1.28	2.41	3.0848	0.11	VI
7.	Sand & Mud	4.04	6.71	27.1084	0.98	V

* Guts examined 118 Size range 25-50mm.

\## The detailed analysis was done on every months collection for three years period but has been pooled in the communication for convenience.

from earlier group, by the presence of blue green algae and green algal forms. Green algae occurrence was very high with 13.57 index value ranking third in order of preponderance. Plant matter which was absent in first group was subsequently present in all the five months with maximum 10.51 in December.

Diatoms contributed maximum 46.99 to the total food, their indix ranging between 33.73 to 53.16. Decayed food comprising of un-identifiable semi-digestive green matter in order of preference (pooled average Ii value 23.25.

Sand and mud particles ranging between 7.15 to 9.0 percent by volume were present due to the feeding of decayed food deposited at the bottom.

3. Adult Group-III (100 mm and above)

In the adult group, initially sexwise diet composition was recorded since the differentiation of sex was possible but as there was no difference in feeding habit of males and females reba, the data was merged. A total of 508 specimens were studied. The order of preference for food in adult group was diatoms and decayed food. Dependence of phytoplankton and

Table-2 Pooled Vol. percentage and Occurrence percentage and their corresponding index of preponderance in Group-II based on 5 months analysis

Guts examined 198 Size range 51-100mm

S. No.	Food Item	Vol. %	Occ.%	Vi Oi	I	Grade
1.	Protozoans	0.64	1.28	0.8192	0.05	X
2.	Rotifers	7.75	9.33	72.3075	4.45	V
3.	Cladocerans	4.61	5.39	24.8479	1.53	VII
4.	Copepods	1.16	2.43	2.8188	0.17	IX
5.	Diatoms	37.16	20.55	763.6380	46.99	I
6.	Blue green algae	1.78	3.39	6.0342	0.37	VIII
7.	Green algae	13.64	16.17	220.5588	13.57	III
8.	Decayed Food	19.29	19.58	377.6982	23.25	II
9.	Plant Matter	5.88	9.39	55.2132	3.40	VI
10.	Sand & Mud	08.09	12.49	101.0441	6.22	IV

Table-3: Pooled index of preponderance of different food items for adult *C. reba*

Specimens Examined: 508 Size range 100 mm and above

S. No.	Food Item	Vol. %	Occ. %	Vi Oi	I	Grade
1.	Diatoms	24.52	21.63	530.3676	32.04	I
2.	Blue green algae	5.75	7.12	40.94	2.48	VII
3.	Green algae	15.09	15.35	231.6315	13.99	III
4.	Zooplankton	6.82	11.71	79.8622	4.82	VI
5.	Decayed org .matter	27.43	18.76	514.5868	31.08	II
6.	Plant Matter	10.40	10.17	105.7680	6.38	V
7.	Sand & Mud	9.99	15.26	152.4474	9.21	IV

Different food items and their seasonal fluctuations in different groups.

green vegetable matter increased in this size group and the percentage improved at the cost of zooplankton. (Table-3).

1.Diatoms

Members of Baciallariophyceae occurred in all the three groups. The average index value was found to be more in second size group (46.99) than in first or adult group. The highest value of diatoms were encountered in the month of September (18.48) in post larval group. In adults, diatoms occurred in all the months but its value went down considerably ranging between 2.17 (October) to 59.71. (March).

2. Blue green Algae

It was absent in first group but started appearing in the second group (I=0.37) and reached maximum (I=2.48) in adults. Volumetric percentages of blue green algae in third group ranged from 3.75% (Dec.) to 16.52% (April). However it was completely absent in gut analyses of September and October months.

3.Green Algae

Forming 13.64 and 15.09 percent by volume of the food injested in the second and third groups respectively, the chlorophycease was totally absent in the first size group. In both groups green algae is third prepared food with volumetric percentage was 6.25% in January to 29.44% in May.

4.Zooplankton

In the first and second age groups, all the groups of zooplankton are well represented, therefore they were segregated into Protozoa, Rotifera, Copepoda, etc. In the adult group, however, they were meagre in quantity and therefore grouped together.

5.Decayed Organic Food

It comprises of decayed vegetable matter of the river bed. It occurred as dirty greenish mass in all the groups. Decayed organic food with index of preponderance was 0.11 in the first group, but increased to 23.54 and 31.08 in second and third groups becoming second preferred group. In the post level group, this item appeared in September but became highest in October 7.14%. In the third group, decayed organic food showed wide fluctuation and did not show any trend. (Fig.1.).

6.Plant Matter

Plant matter component constituted as portion of leaves and aquatic plant roots. Its percentage of volume is 5.88% in the second group, 10.44% in adult group but was absent in first group. It was present in the guts examined in all months in different proportion in both groups.

7.Sand and Mud

Sand and mud contributes 4.04%, 8.09% and 9.99% of the total contents in first, second and third groups respectively. Large percentage of this item in rectum confirms that they are not food particles but accidental inclusion along with injested food particles.

Presence of sand and mud particles along with high percentage of decayed food also confirms bottom feeding habit of the fish at that age. Apart from above food articles mucous was also present in considerable proportion in all the samples examined. On an average it contributed 6.20%, 22.50% and 30.0% in the three groups respectively Mucous percentage was found to be inversely proportional to the feeding intensity.

Feeding Intensity

Feeding intensity of both male and female specimens was arrived through gastro somatic indices (GSI). It indicated different variability. In male, the feeding intensity gradually drops down from March onwards reaching minimum in June (0.2072). Feeding improves from July attaining maximum in October (1.2557). In female, however, though the value go down gradually (Min. in June), the rise is abrupt in August. In female reba, the subdued feeding extends upto July (Fig.2).

It can be inferred that the fish resorts to subdued feeding with the approach of breeding season and it improves only after spawning is over. Similar observations were also made by Menon (1950), Karerkar and Bal (1958), Desai (1970) and Pathak

(1973) to name a few.

This phenomenon can be explained as non-availability of enough space in abdominal cavity for intestinal bulb to expand due to larger space occupied by gonads.

Gut length-Body length relationship

The adaptations of digestive system of fishes to their feeding habit are evident amongst others in relative-length of the gut. Das and Nath (1965) was of the view that the constant ratio exists between gut length and body length. Gut length body length ratio was calculated after pooling the*C. reba* specimens in 10 mm class interval. The study indicated no mark difference with the increase in size or with the change of season. The ratio in adult fishes ranged from 5.46 to 6.97 with a mean value of 5.95.

DISCUSSION

Elton (1927) suggested that the size of the food is one of the main reasons underlying the existence of food chain. According to him, the great variability of fish growth must result in fish consuming food within rather a wide range of growth. Diverse opinions have been expressed about the food and feeding habit of *C. reba*. Mookerjee et.al (1946) classified the fish as omnivore. Das and Moitra (1963) grouped reba alongwith carp fishes and called them herbivorous fishes.

The present work also indicate this fish as plankton feeding fish with definite learning towards decayed and plant matter. It also finds that the increase in size of fish was directly related to the intake of plant matter with seasonal fluctuations occurring with seasons. The feeding of reba is irregular, continuous and rate of digestion is very high.

Phytophagus habit of fish is also confirmed by total length/body length ratio (5.94) i.e. more than unity. The large gut length provides larger surface for absorption of food which is so in the case of *Cirrhinus reba*.

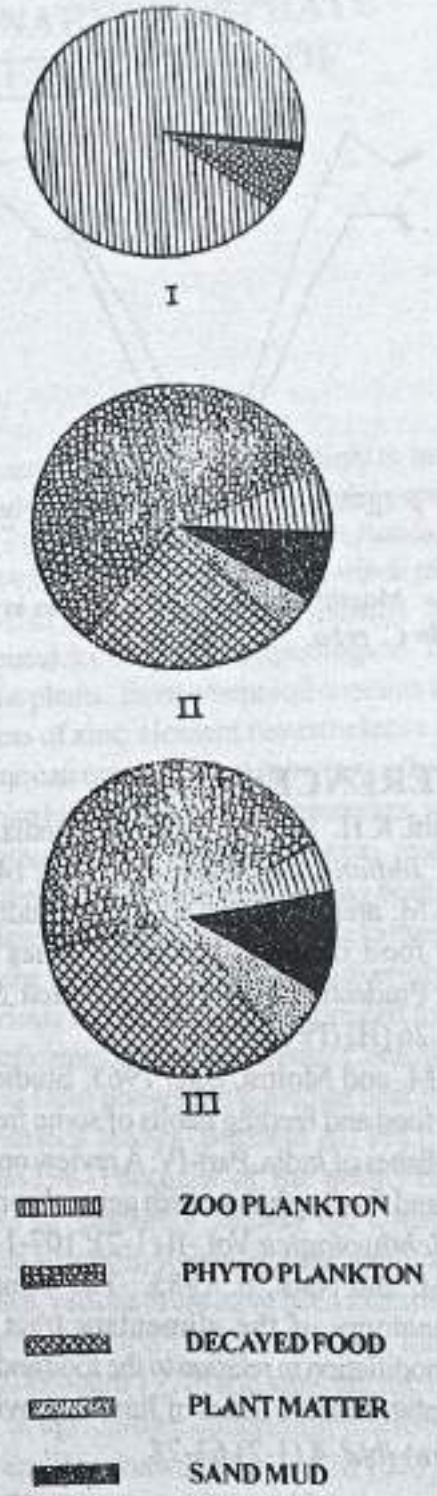

Fig.1. Pie-diagrams showing variations in the food composition with increase in size of *C. reba*.

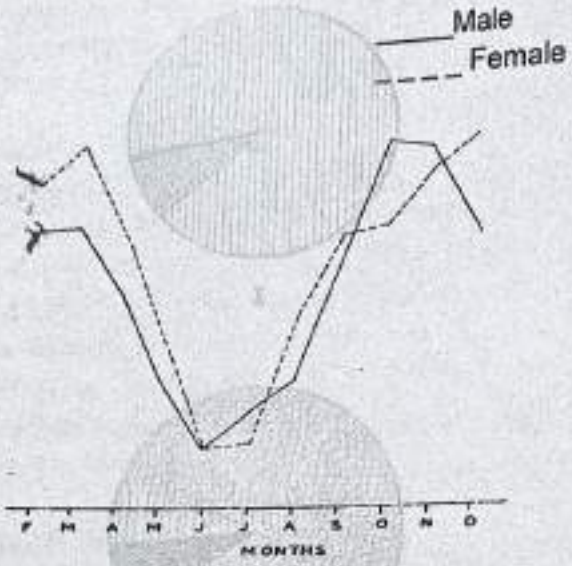

Fig.2. Monthly gastro somatic indices in male and Female *C. reba.*

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LEACHABILITY OF ZINC IONS FROM TERNARY PHOSPHATE GLASSES CONTAINING DIFFERENT CONCENTRATIONS OF K_2O, MgO and B_2O_3

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ABSTRACT

With a view to using glasses as a source of zinc, which is one of the micronutrients required by plants, a systematic study on leachability of zinc ions from ternary phosphate glasses having molar composition (65-X)ZnO.XRO.35 P_2O_5 (where X=5 to 15 mole% and RO=K_2O,MgO and B_2O_3) was carried out. Leaching of zinc ions has been studied as a function of pH and the results show that leaching increases with increasing pH of the solutions. The concentration of zinc ions in the leachate decreases with increasing bond strength between non - bridging oxygen ions and the cations in glasses. The leaching of zinc ions increase with increase in leaching time.

Key Words : *Micronutrients phosphate, glass, concentration, leachibility.*

It is well known that 13 elements – nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, chlorine, boron, copper, iron, manganese, zinc and molybdenum are essential for the growth of plants. The first six are required in comparatively large amounts and hence are called 'major' or macronutrients. But the elements such as zinc, manganese, boron, copper, molybdenum, iron and chorine are required in very small amounts and are known as 'minor' elements or micronutrients. These nutrients are taken up by the plants as anions or cations from the soil or the water in which they grow.

One of the most troublesome and widespread problems of agriculture in India is that of zinc deficiency ,caused either by bright sunlight to heavy soils or to sandy soils containing peat , slightly acid or neutral. Soil . (Takkar and Randhawa 1980, Randhawa and Nayyar 1982). The action of zinc towards plants is similar to that of vitamins in a human body and is essential for the proper physiological functioning of the plants. Even where soil contains sufficient amounts of zinc element nevertheless a deficiency of zinc can occur in plant growing in that soil due to chemical and physiological processes, which render it unavailable to the plants or make it inactive in the physiological functioning within the plants. Deficiency of zinc causes disease to the plants and affects the yield and quality, both adversely.

The various ways have been suggested to overcome the deficiency of micronutrients. Controlled release of ions from phosphate glass has become the subject of various studies (Burrie *et. al.*, 1981, Burrie and Gilcrist 1983) because of the ability of phosphate glass to gradually release the constituents in aqueous solution. Regarding the application of these glasses, various areas have been identified such as bioceramics (Binod 1985), herbicides, fungicides (Drake and Groham 1976) and slow release of plants nutrients in agriculture containing micronutrients (Kanwar and Randhawa 1972, David 1973, Gordan 1975, 1976, Dipali and Roy 1988, Rai and Tyagi 1988, Pyare *et. al.*, 1996, Sumuneva *et. al.*, 2000, Pyare 2003). Leaching characteristic of glasses containing macro nutrient elements has been studied (Mishra *et.al.*, 1985) using blast furnace slag.

The release of zinc ions depends upon the soil

conditions and the particle size of the glass. For controlled release of zinc ions suitable for various soil conditions different concentrations of K_2O, MgO and B_2O_3 have been introuduce in binary zinc phosphate glasses having molar composition (65-X)ZnO.XRO.35 P_2O_5 (where X=5to 15 mole%).In the present investigation the leacability of zinc ions from ternary phosphate glasses has been studies using various concentrations of K_2O, MgO and B_2O_3. The study is expected to provide sufficient information for agricultural applications suitable for different soil conditions in India which may be helpful in increasing the yield of paddy, wheat etc. which are needed for the large population suffering from food deficiencies.

MATERIALS AND METHODS

Preparation of glasses: Analytical and reagent grade chemicals were used to prepare ternary phosphate glasses. Zinc was introduced as Analytical reagent grade ZnO Glass batches of 100g were melted in alumina crucibles of 100 ml capacity in an electric furnace at 900± 5°C. They were melted for two hours. The melts were quenched by pouring the glasses into cold water. The glass was dried and ground in a mortar so that the glass powder passed through a 500 μm sieve but was retained by a 355 μm sieve . These were washed separately with acetone, dried at 110 °C and stored in a desiccator.

Determination of leachability: The buffer solutions of pH 5.5 to 8.5 were prepared by taking 2.5% v/v glacial acetic acid in water and by adding concentrated ammonia solution until the desired pH value was reached . The pH of the solution was measured using a digital pH meter (Type DPH-500). 0.2 g each of the glasses were taken in one litreErlenmeyer flasks and shaken with 250 ml of ammonia –acetate buffer solution of different pH from 5.5 to 8.5 for different time periods at a constant temperature of 20±2°C.

Since the micronutrients are used in the small quantities in the field, higher volumes (250 ml) were taken to minimize the error and also to be more applicable to actual use. After the desired time period between 2 to 24 hours, the content was filtered through Whatman 41 filter paper.

Determination of ZnO (Kundu *et. al.*, 1985): 20ml of leachate was taken in a 250 ml conical flask. pH of the solution was adjusted to value of 5.3 by dropwise addition of NH_4OH (1:1) and 20 ml of buffer solution of pH 5.3. The solution was then titrated with standard ethylene diamine tetra acetic acid(EDTA) solution using xylenol orange as indicator.

RESULTS

(1) Effect of concentration of K_2O, MgO and B_2O_3 on the leachability: The effect of concentration of K_2O, MgO and B_2O_3 on the leachability of ZnO from ternary phosphate glasses in the buffer solutions of 5.5, 7.0, 8.0 and 8.5 pH are presented in table 1. This table shows that the concentration of ZnO increases with increase the concentration of K_2O and decreases with increase the concentration of MgO and B_2O_3.

(2) Effect of pH of the leaching solution: The leachabilities of ZnO are reported at four different values of pH 5.5, 7.0, 8.0 and 8.5 and the results are summarized in table 1. This table shows that the leachabilities of ZnO are increased with an increase in pH of the buffer solution.

(3) Effect of shaking time on the leachability: The glass samples were shaken with buffer solutions of different pH for various time periods from 2 to 24 hours at a constant temperature of 20±2°C. The results are shown in table. 1. This table shows that the leachabilities of ZnO increase with increase in shaking time. It was observed that fast leaching takes place in the beginning and becomes slower with prolong shaking time.

DISCUSSION

The results shown in table 1 can be explained by considering the following three factors:

1. The structure of phosphate glass.
2. The ion exchange properties of the glass, and
3. The glass/Solution interphase and kinetic of phosphate hydrolysis.

The basic structural unit of phosphate glass is the PO_4^{3-} group, which can be attached to a maximum of three neighbouring groups as in P_2O_5 because one of the oxygen atoms in each tetrahedron has to be linked through a double bond. The number of cross links in the polymer is defined as the number of PO_4 groups attached to three others through bridging oxygen. The addition of modifying cations to the glass result in the cleavage of P-O-P linkages and the creation of nonbridging oxygen in the glass. The cross link density[16] for such glasses, ranging from pure P_2O_5 to those containing 50 mole % P_2O_5, is given by:

$$Z=(2Y-1)/Y$$

Where Z the cross-link density and Y is the mole fraction of P_2O_5. The cross link density of pure anhydrous glass decreases when the mole percent of P_2O_5 decreases from 100 to 50%. Pure P_2O_5 glass, as reported in the literature (Bunker *et. al.*, 1984) has the maximum cross link density i.e. oxygen ions are bridged between PO_4^{3-} units. As P_2O_5 contains decrease or concentration of control agent in the glass increases, the no. of nonbridging oxygen increases.

Glasses with the ratio O/P =2.5 are known as vitreous phosphates and those with O/P ratios between 2.5 and 3.0 are known as ultraphosphates. Metaphosphates form when O/P=3.0 and the structure of the glass becomes a collection of tetrahedral chains or rings. The glasses formed in the region between O/P =3.0 and 3.5 are technically polyphosphates and glasses with O/P =3.5 are known as pyrophosphates (Brow 2000). The length of the chains decreases as the O/P ratio increases. Continuous addition of modifiers to the glass and adjustment of the ratio O/P = 3.5 will result in pyrophosphate structure.

The basic building blocks of crystalline and amorphous phosphates are the p-tetrahedra that result from the formation of sp^3 hybrid orbitals by the P outer electorns($3s^23p^3$). The fifth electorn is promoted to a 3d orbital where strong π- bonding molecular orbitals are formed with oxygen 2p electorns (Cruickshank and Corbridge 1961, Doremus 1984). These tetrahedral link through covalent bridging oxygens to form various phosphate anions. The tetrahedral are classified using the Q^i terminology (Kiebau 1981) where 'i' represents the number of bridging oxygens per tetrahedron. Q^3 groups represents a PO_4 tetrahedrin with three bridging and one terminal oxygen (vitreous P_2O_5). Similerly Q^2 groups are PO_4 tetrahedra with two bridging and two non bridging oxygens (meta phosphate structure). Q^1 groups are PO_4 tetrahedra with one bridging and three non bridging oxygens (pyrophosphate structure) and Q^0 groups represents isolated PO_4 tetrahedra with four non bridging oxygens (orthophosphate). These are based on O/P ratio as set by glass composition (Mogis, *et. al.*, 1998).

Phosphate glasses are made up of long chain polymeric phosphate anions , which are connected to one another by ionic bonds to the modifying cations. For such a structure, it is observed that other cations can serve as ionic cross-links between the non-bridging oxygen of the two different chains. Van-Wazer and Componell 1950) suggested that such a cross linkage could take the form of the metal chelate structure. For phosphate glasses containing 50 mol % P_2O_5 or less the number of mean chain length is given by Stevels equation (Volf 1984).

$\bar{n}=2/\Psi-1$ where $\Psi=\Sigma nM/P$

where $\bar{n}$= number of structural units in mean chain length

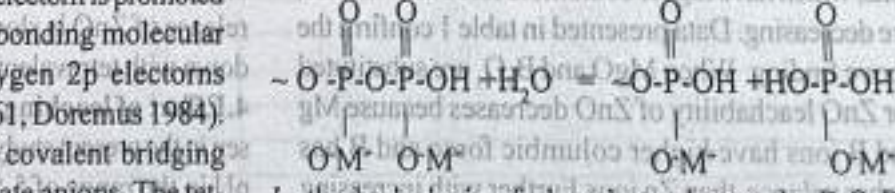
n=oxidation state of the cations in the glass

M=mole fraction of cations in the glass

P=mole fraction of phosphorus in the glass

It has been observed that as the mean chain length decreases, the leachabilites of micronutrient elements decreases (Pyare *et. al.*, 1996. Pyare 2003).

In the determination of dissolution mechanisms,it is important to outline the types of reaction that may take place between water and phosphate glasses. The release of ZnO, P_2O_5 and others constituents from phosphate glasses in aqueous solution is due to the hydrolysis reaction as given below:



In the hydrolysis of phosphate glasses the P-O-P

bonds are broken, which may lead to ultimate destruction of the polymeric phosphate network and may produce orthophosphate. The route and rate of hydrolysis are characteristic of the particular cation and the conditions employed. The following main factors influencing the rate of hydrolysis of the polymeric phosphate network are discussed below:

1)Nature of cations present: The leachabilities of ZnO decrease with increasing coulombic force between non-bridging oxygen and cations. In ternary phosphate glasses of the present series having the molar compositions (65-X)ZnO.XRO.35P_2O_5(where RO= K_2O,MgO and B_2O_3) the following types of bonds are present

$$\rightarrow P - O - P \leftarrow \quad (i)$$
$$\rightarrow P - O Zn^{++} O - P \leftarrow \quad (ii)$$
$$(\rightarrow P - O^-)_n R^{n+} \quad (iii)$$

(where n is the valence state of cation R)

Bonds of the type (i) and (ii) are common in all the glasses of the present series and their number also remains approximately constant. However, on replacement of one cation by another on a molar basis , the bond between cation and non-bridging oxygen ions presented in (iii) changes with the nature and size of the cation. As the coulombic force between the non-bridging oxygen and the cation increases ,the bond strength is expected to increase resulting in a greater chemical barrier to ZnO. It can be observed that the quantities of ZnO in the leachate decreases as the bond strength between non-bridging oxygen and cations increases.

2. Concentration of cation present: When K_2O is substituted for ZnO leachability of ZnO increases because K ions have lower coulombic force and valence than Zn ions which have higher coulombic force and valence. Further, with increasing concentration of alkali ions leachability of ZnO increases since Zn ions, which have higher coulombic force and valence, are decreasing. Data presented in table 1 confirm the above finding. When MgO and B_2O_3 are substituted for ZnO leachability of ZnO decreases because Mg and B ions have higher columbic force and B has higher velence than Zn ions.Further with increasing concentration of MgO and B_2O_3 leachability of ZnO decreases . Data presented in Table 1. confirm the above finding.

3.Effect of pH of the solution : The effect of pH on the leachability of ZnO for ternary phosphate glasses was studied and the results presented in Table 3 show that the leachabilities of ZnO in the solutions increases with increasing pH of the solution. The buffer of pH 5.5, 7.0, 8.0 and 8.5 contain a constant (2.5 % w/v) amount of acetate ions and H^+ ions but contain increasing amounts of ammonium ions and OH^- ions . These hydroxyl (OH^-) ions break the P-O-P bond increasingly fast as the pH of the solution increases and cause the increase in the concentration of ZnO in the leachate. Leaching of ZnO is controlled by the pH value and depends critically on the nature and concentration of the buffering base (Beni and Ott 1981, Kundu and Roy 1988, Pyare *et al.*, 1996).

In order to model the experimental data the zinc phosphate glasses have been treated as a two component system (Beni and Ott 1981)(i) glass forming oxide (glass former) and (ii) metal oxide (glass modifier). Hydroxyl ions are more active in the buffer solutions and cause hydrolysis both of the network former and of the modifier.

Coulombic forces/ bond strength in ternary phosphate glasses with monovalent cations is the lowest. It increases when the monovalent cation is replaced by a divalent, trivalent or tetravalent cation . It is greatest with a tetravalent cation. Thus formation of $R_2(OH)_n$ e.g. LiOH, NaOH or KOH is energetically favoured and in glasses with monovalent cations as control agents release of ZnO is energetically favoured (Gray and Klein 1982 and 1983, Rajaram and Day, 1987). Release of these nutrients from glasses containing divalent cations as control agent is slower than those containing monovalent cations. Formation of $R_2(OH)_n$ from glasses containing trivalent control agent is a slower process as compared to above two and the release of ZnO is slowed down. It is further slowed down with tetravalent control agents in the glasses.

4.Effect of leaching time : Phosphate glasses chosen in the present study dissolve in solution of different pH in the range of 5.5 - 8.5. The result presented in

Table 1- Leachability of wt% ZnO of total ZnO in glass from ternary phosphate glasses at different pH values (Temperature: 20±2°C, Particlesize:-500+355µm)

Glass Conposition	Bond strength	Time in (hrs)	Leaching of wt% ZnO of total ZnO in glass at different pH values.			
			5.5	7.0	8.0	8.5
$60ZnO.5K_2O.35P_2O_5$	0.134	2	5.71	8.62	12.11	16.51
		4	11.32	13.68	18.50	28.10
		6	16.55	19.65	28.08	40.22
		12	21.82	28.61	37.11	57.22
		24	27.51	36.45	47.3	72.69
$55ZnO.10K_2O.35P_2O_5$	0.134	2	6.84	10.18	15.64	20.71
		4	12.21	16.22	21.51	32.51
		6	18.12	23.41	28.84	42.51
		12	26.61	30.88	40.21	57.54
		24	31.61	40.21	51.21	76.42
$50ZnO.15K_2O.35P_2O_5$	0.134	2	8.60	13.56	19.21	25.26
		4	13.53	17.55	24.62	35.64
		6	20.21	25.51	31.51	45.65
		12	27.54	34.91	44.5	60.23
		24	35.61	44.365	53.91	81.02
$60ZnO.5MgO.35P_2O_5$	0.476	2	3.41	4.01	4.99	6.16
		4	7.06	9.36	13.23	18.25
		6	12.11	14.62	16.25	26.2
		12	17.32	20.15	23.22	33.45
		24	21.65	26.45	31.56	42.59
$55ZnO.10MgO.35P_2O_5$	0.476	2	2.51	3.52	4.02	5.12
		4	6.11	7.26	11.22	16.68
		6	10.56	12.22	14.62	24.12
		12	15.12	16.12	20.32	31.52
		24	18.25	21.13	27.41	40.32
$50ZnO.15MgO.35P_2O_5$	0.476	2	2.02	3.05	3.07	3.85
		4	4.91	6.74	9.46	14.23
		6	8.74	9.25	13.62	22.21
		12	11.42	12.61	18.11	30.41
		24	15.24	17.8	24.9	38.6
$60ZnO.5B_2O_3.35P_2O_5$	1.17	2	2.42	3.09	8.08	5.11
		4	4.11	5.61	6.57	8.53
		6	5.62	7.49	9.08	10.49
		12	7.51	9.61	11.52	16.58
		24	10.12	12.14	15.57	27.53
$55ZnO.10B_2O_3.35P_2O_5$	1.17	2	1.42	1.98	2.34	3.42
		4	3.12	4.21	5.51	7.65
		6	4.33	6.32	8.12	10.31
		12	6.31	8.71	10.51	14.52
		24	9.23	11.05	14.26	18.72
$50ZnO.15B_2O_3.35P_2O_5$	1.17	2	1.45	1.57	1.72	2.20
		4	2.89	3.82	4.63	6.50
		6	73.47	5.02	6.72	8.32
		12	5.51	7.25	8.51	13.24
		24	8.32	10.52	12.53	16.50

Table 1 indicates that quantity of ZnO leached increases with increase in leaching time. The leachiblity of ZnO from ternary phosphate glasses as shown in table 1 can explained by an empirical equation of the following form.

$Q=avt+bt$

Where t is leaching time and a and b are empirical constant. The equation shows that quantity of ZnO leached increase with sqare root of time for short leaching time and increase lineary with time for prolonged leaching.

5. Effect of shaking: The shaking which was utilized induced liquid flow relevant to the condition prevailing in the soil where the micronutrient is used for the growth of the plant. Agitation or vigorous stirring was not employed because of the deviation from the real problems of agriculture. However, leaching of ZnO are expected to increase at higher agitation level.

The results of the present work clearly indicate that leachability of ZnO from ternary (65-X) ZnO.XRO. 35 P_2O_5 glasses can be controlled for agricultural use by incorporating different concentration of K_2O, MgO and B_2O_3. Application of this knowledge would increase the yield production of major crops and improve Indias position in agriculture.

The coulombic forces (bond strength) were calculated using the formula $zz^1/(r+r_0)^2$ where z, z^1 are the electrostatic charge on the cations and non-bridging oxygen ions, and r and r_0 represent their ionic radii, respectively.

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ECONOMIC ANALYSIS OF MILK PRODUCTION FROM COMMERCIAL DAIRY FARMS IN MAHARAJGANJ DISTRICT OF UTTAR PRADESH

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ABSTRACT

The present investigation was undertaken to reveal the nature and extent of investment of the dairy inputs required for milk production and problems faced in milk production in socio-economic backgrounds of newly constituted Maharajganj district of Uttar Pradesh. Results indicated that milch animals were mainly reared for milk production during and calves were treated as byproducts. Total milk production showed an increasing tendency with the size of commercial dairy farm. A average dairy farm produced around 180.87 quintals of milk, 20.65 tones of dung and around 5 calves (both male and female) in a year. Male calves were valued very low compared to female calves and there was higher mortality in the male calves. General market price of milk was Rs.12 per litre and dung Rs. 150 per ton. An average farmer's gross receipt from the dairy farm stood at Rs.2,26,783.00. The owners categories of first, second and third size group earned a gross income upto Rs.154,295, Rs. 248,528 and Rs.3,16,741, respectively. An average sample dairy farmer received Rs.32,316.90 per animal in an year from all accounts. The gross receipt on per cow basis varied from Rs.28, Rs.122.53 andRs.36,626.18, respectively showing an indirect relationship with the farm size.

Key Words : *Economic analysis, commercial dairy farms, milk production.*

Milk is nature's ideal and nearly perfect single food for new human beings. Milk provides nearly all the nutrients in balanced proportion for growth and development of mammals. There is no substitute for milk. India is an agriculture based country, having largest bovine population in world. According to recent estimates (2003) India holds 220 million cattle and 94 million buffaloes . The total bovine population in India is about one fifth of the world bovine population but it is painstaking to note that milk production in India is hardly 14% of world total milk production which is in indicative of the poor productivity of our animals. This low level of production has been result of the effects of many factors such as poor socio-economic conditions, hereditary characteristics of non-descript poor yielding animals and poor feeding and management practices adopted by dairy farmers. Most dairy farmers in India are illiterate doing subsistence farming, economically weak and tradition bound, following old and primitive practices of feeding, breeding and management. Farmers usually lack in technical know how and managerial skill and therefore they find difficult to make dairy enterprise an economically viable unit (Acharya 1973). Presently there is an increased demand for milk and milk products due to continually increasing human population and recognition of milk as an important component of human diet. Thus, there is more emphasis to increase milk production in rural areas by encouraging farmers and landless labourers to undertake dairy as subsidiary occupation and supplement their income (Kumar and Raut 1972). It necessitates to work on the cost of milk production to decide the economic level and profitability of milch animals considering the resources supplied by the farm family. Since agro-climatic and economic conditions vary from region to region, region specific (micro-level) study was carried out to

help at producers' level in rural settings of Maharajganj district for studying the invest pattern, cost of milk production, net returns from milk production and break even level of milk production of different sized commercial dairy farms.

MATERIALS AND METHODS

The study was based on collection of data from both the primary and the secondary sources in the capital down of newly constituted Maharajganj district of Uttar Pradesh. The secondary source constituted official purifications of Maharajganj district of Uttar Pradesh, for the socio-economic features of the area under study. Investigators collected full informations on various inputs such as feeds and fodder, medicines, breeds of cows and buffaloes, machines, tools and infrastructural support with the dairy units in the area. The sample design for present study comprised stratified random sampling technique for selection of the respondent private dairy farmers. A list of all the commercial dairy farmers of the Maharajganj was obtained from the dairy survey report Maharajganj – 2000. The 155 commercial dairy units had been grouped into three categories based on their size viz. category I (5 cows), category II (6-10 cows) and category III (more than 10 cows). Numbers of cows indicated the number of adult milch cows in the productive age. A sample of 60 dairy units from these categories had been selected for distribution as 25 units in category I, 20 in category II and 15 in category III. The primary data pertained to the year 2000-01 while the secondary data included time series of different time spans in different cases. The main focus of the study was to examine the resource structure, resource use, its productivity and the resource use efficiency in commercial dairy units of different categories. Data were analyzed using tabular method. This technique of analysis was intensively used for its inherent quality of purporating the true picture of an economy in simplest form. Relatively simple statistical techniques as percentages and average were also employed to analyse the data. (Snedecor and Cochran 1967). Moreover break-even level of milk production was also calculated.

RESULTS AND DISCUSSION

The socio-economic status of the sample farmers and logical interpretation of the analysis milk production on sample commercial dairy farms Maharajganj district of Uttar Pradesh is based on sults furnished in table 1 to 7.

Demographic distribution of dairy farm fa ily exhibits. Sex and age-wise distribution of fam members are given in table 1. The family in first, se ond and third category units consisted 6.04, 5.55 a 5.20 members in each category, respectively and t sample average stood at 5.67 members. Proporti of male and female though depicted a very slight vari tion between the categories, but the common featu was that it was almost equal. Study depicts the domi nating proportion of males over females in genera On these dairy units in general and on smaller siz units in particular it was observed that both the male and females are engaged in dairy works revealed du that 61.73 per cent of the total family members we in the group of adult 28.92 per cent in children an 9.35 per cent in old age group.

Literacy provides ability for measuring im proved life style and standard of living and directly influence the attitude and skill. Table 2 indicates tha there are 63.88 per cent literate persons in the family and average 39.74 per cent males are literate. Male literacy was higher than female literacy on all the ca egory of sample dairy units. 30 per cent of the family members were illiterate.

Table 3 shows the investment pattern on dif ferent categories of dairy units as there stands a direct relationship between farm size and capital investment The investment on cattle shed and equipments was Rs.72,748, Rs. 116,225 and Rs. 1,91,066 in first second and third category, average investment during the year was Rs.1,30,748, Rs.2,40,225 and Rs.3,65,066 respectively, This includes the purchase price (current market) of the dairy animals too. On the whole the magnitude of fixed investment increases as the size of dairy farm increases. Total cost of run ning dairy units includes cost of feeding, labour charges interest and depreciation etc. The cost of milk pro duction for cows in milking, stage is quite difficult

Table 1: Sex and age-wise distribution of members of dairy farmers' in three different categories.

Particulars	Category I	Category II	Category III	Average
Average size of family	6.04 (100)	5.55 (100)	5.20 (100)	5.67 (100)
Male	2.91 (48.17)	3.20 (57.65)	2.80 (53.85)	2.98 (52.56)
Female	3.13 (51.52)	2.35 (42.35)	2.40 (46.15)	2.69 (47.44)
Children (below 14 years)	2.20 (36.42)	1.30 (23.42)	1.14 (21.42	1.64 (28.92)
Adult (15-50 years)	3.20 (52.96)	3.90 (70.27)	3.46 (66.54)	3.50 (61.73)
Old age (above 60 years)	0.64 (10.60)	0.35 (6.30)	0.60 (11.54)	0.53\ (9.35)

Table 2: Literate and illiterate members in different dairy units.

Size of group	Family size	Literate			Illiterate		
		Male	Female	Total	Male	Female	Total
Category I	6.04 (100)	1.902 (31.79)	1.02 (16.89)	2.94 (48.68)	0.99 (16.39)	2.11 (34.93)	31.10 (51.32)
Category II	5.55 (100)	3.00 (54.05)	1.75 (31.53)	4.75 (85.53)	0.20 (3.60)	0.60 (10.81)	0.80 (14.41)
Category III	5.20 (100)	2.40 (43.24)	1.80 (34.62)	4.20 (80.77)	0.40 (7.69)	0.60 (11.54)	1.00 (19.23)
Sample average	5.67 (100)	2.40 (39.74)	1.45 (24.14)	3.85 (63.88)	0.58 (9.60)	1.23 (20.37)	1.8 (29.97)

Table 3: Investment pattern in different categories of dairy farm.

Particulars	Category I	Category II	Category III	Average
Total investment (Rs.)	130748 (100)	240225 (100)	365066 (100)	235679 (100)
a. Cattle shed and equipments	72748 (55.64)	116225 (48.38)	191066 (52.34)	126679 (53.75)
b. Purchase of dairy animal	58000 (44.36)	124000 (51.62)	124000 (47.66)	109000 (46.25)

Note: Figures in parentheses are percentage to total family members.

Table 4: Cost of milk production per animal in different categories of dairy farms.

	Particulars	Category I (Rs.)	Category II (Rs.)	Category III (Rs.)	Average (Rs.)
1.	Feed cost	14545.70	13904.11	14516.02	14311.28
2.	Labour charges				
i)	Hired	660.38	1278.63	2145.08	1470.78
II)	Family	3425.70	2630.96	1661.49	2441.89
3.	Veterinary expenses	463.21	427.40	372.67	414.45
4.	Miscellaneous expenses	224.06	195.21	167.26	191.25
5.	Interest on working capital (@ 12 per cent per annum)	794.67	790.27	835.87	819.39
6.	Depreciation:				
i)	On animals	889.38	859.93	428.26	694.06
ii)	On cattle shed and equipment	1715.75	1592.12	1695.35	1664.68
7.	Interest on fixed resources	3700.42	3948.90	3887.13	3861.54
	Total cost	26,419.28	25,627.53	25,109.13	25,859.32

Table 5: Value of milk, dung and calves in different categories of dairy farms.

Products	Total Quantity and value of products Category I	Category II	Category III	Average
Milk (litre)	12410	19929	25093	18087.08
Dung (Tonnes)	14.50	21.70	29.50	20.65
Male calves	1.20	1.45	2.40	1.28
Female calves	2.40	3.60	6.80	3.90
Milk (Rs.)	148920	239148	301116	217045
Dung (Rs.)	2175	3255	4425	3098
Calves (Rs.)	4200	6125	11400	6640
Total (Rs.)	154295	248528	316941	226783

Table 6: Average annual profits and cost benefit ratio in different categories of dairy farms.

Products	Category I	Category II	Category III	Average
Gross income (Rs.)	154295	248528	316941	226783
Net income (Rs.)	43277.25	90274.02	66619.12	64056.79
Benefit cost (BC) ratio	1.37	1.33	1.27	1.32

Table 7: Dairy farm category-wise break even point of milk production.

Products	Category I	Category II	Category III	Sa... av...
Average annual fixed cost (Rs.)	6,305.55	6,400.55	6,010.74	62.2
Average annual variable cost (Rs.)	20,113.73	19,227.03	19,098.39	19,8
Variable cost per litre milk (Rs.)	6.87	7.04	8.58	
Total cost (Rs. per litre milk)	9.03	9.39	11.55	
Price of milk (Rs.per litre)	12.00	12.00	12.00	
Break even point (Rs.)	1,220.15	1,290.51	1,757.53	1,4

segregate from the total cost as there are some unproductive animals like male calves and old animals who share the feed and infrastructure of the dairy farms. (Parthosarthy, 1975). That is why the whole costs by heads of expenditure had been divided by the number of cows in milking stage to work out the cost of milk production per animal per year and the results are given in table 4. It showed that an average dairy farmer in Maharajganj district spends Rs.25,859.32 as total cost of milk production per animal for the year against the total variable and fixed costs. The category-wise break up showed that the cost of running dairy farm if apportioned for one animal goes on decreasing as the size of the farm increases.

Milch animals are mainly reared for milk production and besides it the dung and calves are treated as byproducts. Table 5 gives the physical position of dund and calves total value of the milk. Total milk production showed an increasing tendency with the farm size. An average dairy farmer produce around 180.87 quintals of milk, 20.65 tons of dung and around 5 calves (both male and female). Male calves are valued low compared to female calves and there was higher degree of mortality in them. General market price of milk was Rs.12 per litre and dung @ Rs.150 per ton was used to compute the value of products. An average farmer's gross receipts from the dairy farm stood at Rs.226783. The category-wise breakup showed that the owners of first, second and third size group earned gross income uptoRs.154,295, Rs. 248528 and Rs.316941, respectively. An average sample dairy farmer received Rs.32316.90 per animal in an year from all accounts and the gross receipt on per cow basis varied from Rs.28,122.53 to Rs.36,626.18 showing an indirect relationshi... the farm size.

Table 6 reveals the magnitudes of gr... come, net income, farm income, family labour i... and benefit cost ratio which vary from farm t... but are not comparable because of variation... farm size. However benefit cost ratio can be... pared . The benefit cost ratio on an average s... stood at 1.32 revealing an average Rs.1.32 fo... one rupee of investment/expenditure on it.

Table 7 gives the measure of break even... of milk production. Break even analysis of mil... duction is the production which covers total c... milk production below which dairy owner wil... loss. On the basis of above analysis that it m... concluded as the milk production is economica... able and profitable enterprise in Maharajganj d... of Uttar Pradesh which can be gainful for em... ment of the rural and urban people.

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COMPARATIVE PRE AND POST HATCHING DEVELOPMENTAL STUDY OF THE *SCHIZOTHORAX PLAGIOSTOMUS* (HECKEL) IN RELATION TO DIFFERENT ENVIRONMENTAL (NATURAL AND CONFINED WATER) CONDITIONS.

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ABSTRACT

The purpose of present study is to describe the pre and post hatching developmental stages of *S. plagiostomus* in the natural as well as laboratory rearing conditions, for successful breeding experiment. *S. Plagiostomus* shows a long spawning season and their breeding was observed at a peak from September–October (2003-05). Suitable temperature, high concentration of dissolve oxygen and relatively low pH are necessary for the spawning of this species. During the course of present study it was observed that the formation of germinal disc or blastodisc was started after 20-30 min of fertilization, first cleavage after 2 hrs, morula stage after 10-12 hrs, yolk plug stage after 13-16 hrs, pre- cephalic movement by "pea shaped" embryos in the periviteline fluid, started by 56-65 hrs in laboratory and by 70-74 hrs in natural condition. Hatching takes place after 108-115hrs of fertilization in laboratory condition when water temperature ranged from 21-23°C while it was 120-135 hrs in natural (running river water) condition where water temperature was recorded 17-19°C. In laboratory condition, the percentage of fertilization and hatching ranged from 70-75% and 60-65% respectively while it was higher 90-95% and 80-85% respectively in natural conditions. Proper development or growth rate was also observed in natural running water condition while it was slow and improper in laboratory-confined water.

Key Words: *Embryonic and larval development, himalayan snow trout, Schizothorax plagiostomus, pre flexion and post flexion stages.*

Schizothorax plagiostomus is one of the most important food fish among the Snowfed Rivers of northern India, including river Alaknanda of Uttaranchal Garhwal region. *Schizothorax species* have a good prospect to become a commercial culturable food fish (Sumner, 1903; Nicholas, 1927; Misra, 1982; Raina et.al.1985a; Sunder, 1992; Bahuguna et.al. 1998 etc). It is only possible when we may develop a good quality of seed by using good indigenous scientific technique for commercial purpose. Before that, it is essential to know the proper development of the different developing stages of embryos for healthy seed production (Sumner, 1903; Nicholas, 1927; Bahuguna, 2000). Although artificial breeding and rearing experiment in various species of fishes including *Schizothorax*, from different habitat has been carried out by many workers (Raina, 1977; Raina et. al., 1985 b; Rajyalakshmi et. al., 1991; Joshi and Sunder, 1995 etc) while in case of *Schizothorax plagiostomus*, excepting some work conducted by Bahuguna et. al. (1998), Bahuguna (2000, 2006), Bahuguna and Rayal (2006), Rayal (2006) etc, this work is usually neglected in Garhwal region.

So, further an attempt has been made to know the pre and post hatching development of the natural as well as laboratory reared *S. plagiostomus* larvae.

MATERIALS AND METHODS

Both eggs and milt was obtained by stripping the mature brooders; the fish was held firmly in one hand while gentle pressure is applied to its abdomen with the thumb and fore finger of other hand. As the

finger drown toward the anus of the fish, the pressure forces out the gametes. The eggs and milt were striped into clean enameled tray, which has been moistened with fresh river water. The eggs and milt were mixed with the help of bird feather for 5-10 min, than excess of the milt was removed by adding and changing the water. There after fertilized eggs were placed in the hatching trays and kept on small stream of river. This was done to ensure the proper and natural development in natural environment among the fertilized eggs (Bahuguna et.al., 1998, 2000). Some of the fertilized eggs were brought to the laboratory in plastic bucket and kept in glass jar hatchery and in hatching tub. The process of development in different sets, at both (natural and laboratory) sites were examined and till post flexion stages at 2-4 hrs (before hatching) and 8-12 hrs intervals (after hatching) some samples were fixed in different fixatives viz. 4% formalin, 70% alcohol, etc., for further study.

Methods for observation:

To remove the sticky outer jelly layer, the eggs were rolled. This procedure was followed daily for stock culture in order to prevent clumping the eggs. For experimental work it was essential to obtain development as nearly normal as possible. The eggs were usually examined either of the following methods (1). The eggs were placed with water on special culture slide having a depression slightly less than the diameter of eggs; than it was possible to roll the egg to desire position by moving cover slip. (2). The eggs were placed with a drop of water on ordinary glass slide and covered with a very thin, flexible sheet of mica, so that it become possible to rotate the eggs as the previous method (3). In those conditions when both above methods were not possible the eggs were placed with a water drop on ordinary glass slide and hair loop was used to rotate the eggs to desired position. Observations of the embryonic developmental stages were noted down and the figures of different developmental stages were drown with the help of Camera Lucida.

For morphological developmental study after hatching, the larvae were examined under the dissecting microscope and observations were noted down. For the study of growth rate (length-weight relationship) method was followed as given by [illegible] (1957) with some modification was applied.

RESULTS AND DISCUSSION

1. Pre hatching morphological develop[illegible] (table-1):

The unfertilized egg: The eggs stripped from a mature female fish into enameled tray re[illegible] the morphological characteristics of freshly extru[illegible] eggs, including thin and delicate outer egg membra[illegible] large size perivitellne space on upper side of the body and yolk sac with germinal disc etc. eggs w[illegible] small, soft and pulpy when they were released.

Fertilization and cleavage:

Eggs swell up considerably (measuring -1.8 mm.) within 10 – 20 min., and there was a gra[illegible] accommodation of egg protoplasm at the animal after 20-30 minute of fertilization. These eggs w[illegible] highly adhesive and get enabled to attach due to osmotic pressure. Eggs were loaded with yellow[illegible] yolk, which was more rounds in shape during the[illegible] development and gradually becomes oval as dev[illegible] opment proceeds. Along with development the bryo, constriction appeared in the yolk and yolk ther gets elongated to form tube shape and ultima[illegible] acquire the shape of a posteriorly elongated yolk (Plate-I. a). A groove on the surface of blastu[illegible] occurs after two hrs of fertilization. The cleavage tinue for a considerable period without much cha[illegible] in the over form, from that of the original blastom[illegible]

Later stages of development:

The periblast appears 16–24 hrs after fer[illegible] zation. In this duration (16-24 hrs) major changes ing place are: 1). the uncleaved protoplasm appe[illegible] around the margin of the group of blstomers and neath the blastodisc. 2). The nuclei of marginal of cells gradually become free of cell outlines, c[illegible] tinue their divisions and migrate into the marginal blast, converting it into a nucleated but non-cel[illegible] structure. 3). Subsequent to the nucleation of periblast the blastoderm changes in size and shape margin of blastodisc thickens due to both a peri[illegible] increase in cells and to a thinning central part of

disc. 4). During few next hrs the germ ring grows completely over the surface of yolk mass, so that the uncovered portion of the egg is finally covered. As the blastoderm spread over the surface of yolk, the embryo grows rapidly in length and become segmented; this segmentation is confined to the mesoderm (Plate-I.e.).

2. Post hatching macro-morphological observations:

In laboratory site:

Just after hatching; the snow trout *S. plagiostomus* larvae measured 9.00 mm and 0.11mg in mean length and weight respectively (table-2). At this stage they were transparent, lacking in pigmentation and irregular in shape. Yolk sac was lobe shaped and yellow-orange in colour. Eyes were without pigmentation, striopore (future anus) and auditory capsule were not clearly visible (Plate-II.a). On 2nd dph pectoral fin was clearly visible and two chambered heart and yellow colored blood circulating in body was clearly visible (Plate-II.c). On 3rd-4th day rudimentary gills appears, myotomes visible, eyes pigmentation commences and pectoral fin slightly increased in size, jaws comparatively more defined, dorsal fin fold commence to develop and opercular region was demarcated (Plate-II.e).

On 5th day yolk sac becomes tubular, ventral fin fold elongated toward anterior side, gill arches and gill filaments were clearly visible. Colour of blood turn yellow to reddish and body become pigmented. Anal area was distinct. On 6th day caudal fin was more defined and functional, yolk sac was reduced. By 7th day flexion of notochord begins. Yolk sac mostly absorbed, jaws and operculum well developed (Plate-II.g). On 8th inflated swim bladder was appeared externally by necked eyes. On 9th-10th day caudal fin was more defined and functional with rudimentary fin rays, jaws well developed and functional, having well movement, pectoral fin elongated and dorsal fin was developed (Plate-II.i).

In natural site:

The newly hatched larvae were 10.5 mm and 0.10 mg in length and weight respectively (table-2). They were transparent, and actively swimming near the bottom. Eyes were pigmented and yolk sac was club shaped with good amount of yolk (Plate-II.b). On 1st day (upto 24 hrs of hatching) yellow blood circulation was clearly visible & mouth was not opened. A depression or striopore was also noticed where yolk sac ended.

On 2nd day, pectoral fin was at rudimentary stage. On 3rd day rudimentary gills appeared, body become pigmented, myotomes and pectoral fin clearly visible, rudimentary jaws (Plate-II.d) and dorsal fin start to develop. On 4th day; opercular area was well demarcated, gill filaments visible and yellowish blood turn to reddish in colour.

On 5th day ventral fin fold and dorsal fin start to develop and anal area become distinct. On 6-7th day flexion of notochord begins, jaws and operculum were well developed and functional, larvae were actively swimming (Plate-II.f) and rudimentary swim bladder was visible.

On 8th day well-inflated swim bladder and some fin rays on caudal fin was clearly visible (Plate-II.h). On 9th-10th day, caudal fin was more developed and started to become bilobed (Plate-II.j). Jaws with lip pad were developed and functional; having well movement. Pectoral fin elongated and functional. Dorsal fin was comparatively large.

In order to follow all the pre- cleavage changes, it is important to record the exact time of insemination and transfer of the eggs immediately to a slide for observation. During the artificial breeding experiment, it was noticed that just after fertilization eggs swell up due to the absorption of water through their vetelline membrane. These eggs were highly adhesive and get enabled to attach due to the osmotic pressure. The uncleaved protoplasm around the margin of the group of blstomers called the marginal periblast, while that beneath the blastodisc is the central periblast.

It was also observed that the incubation period of *S. plagiostomus* is 110–120 hrs in laboratory condition, in the month of Sept. – October when water temperature ranged from 21°C– 23°C but it is higher (120–130 hrs.) in natural water pools where temperature was recorded 18°C – 19°C. These re-

Time schedule of development:

Table.1. The following schedule is based on observation made at the laboratory (confined water) as well as natural (running water) condition when water temperature ranged from 21°C – 23°C and 18-19°C respectively.

S.N.	TIME (After Fertilization)	DEDEVELOPMENT
1.	20 –30 minute.	Blastodisc formation starts (Plate-I.a).
2.	2 hrs.	First cleavage (Plate-I.b-d).
3.	4 hrs.	Four cell stage (Plate-I.e).
4.	6 – 6.5 hrs.	Eight cell stage (Plate-I.f).
5.	9 hrs.	Sixteen cell stage (Plate-I.g).
6.	9.5 - 10 hrs.	Sixty- four cell stage.
7.	10 – 12 hrs.	Morula stage (Plate-I. h).
8.	13 - 16 hrs.	Yolk plug stage (Plate-I.i).
9.	17 - 24 hrs.	Closing of blastopore.
10.	56 -65hrs (in laboratory) and 70-74 hrs (in natural site).	Embryo appeared as circular tubular fold in yolk. Formation of cephalic end started and pre- cephalic movement by "pea shaped" embryo in the perivitelline fluid (Plate-I. j-k).
11.	82 hrs.	Embryo beings to elongate over the yolk and formation of head and tail (Plate-I.l).
12.	90 hrs.	Embryo movement very clear and twitching movement sideways so that the tail almost touching the head. Rudimentary brain visible. Laterally evident optic evagination. Optic capsule present behind the eyes. Notochord extending from optic vesicles, break into tail with myotomes. Embryonic fin fold continue to increase in size (Plate-I.m).
13.	98 hrs.	Embryo becomes active and showing twitching movement freely in the perivitelline space. Both cephalic and caudal portion free from yolk mass. Myotomes on notochord 18 – 28 in number, V shaped and present up to the tail end. Rudiment of lens appears in optic capsule. Heart beat rapid, blood clear but no hemoglobin. Black vesicle visible in the optic vesicle (Plate-I.n).
14.	106 hrs.	Embryos further elongate and gradually differentiate, make vigorous twitching movement and changes position frequently. Further elongate and gradually differentiate. Number of myotomes further increased (Plate-I.o-p).
15.	114 hrs.	Embryo fully differentiated and ready for hatching.
16.	108-115 hrs (in laboratory) and 120-135 hrs (in natural site).	Hatching take place by the leashing movement of tail leading to rupture of egg membrane, tail comes out first from the eggshell.

Table. 2. Growth study of the *S. plagiostomus* larvae inhibiting in laboratory as well as natural environment.

S.N.	Age of larvae (in days)	Larvae in habiting in confined water condition (in laboratory)		Larvae in habiting in natural water condition (in river)	
		Length (in mm)	Weight (in gm.)	Length (in mm)	Weight (in gm.)
1.	1	9.00	0.011	10.5	0.010
2.	2	9.50	0.011	11.00	0.010
3.	3	10.0	0.010	11.50	0.010
4.	4	11.50	0.012	12.00	0.010
5.	5	12.00	0.014	12.50	0.010
6.	6	12.50	0.014	13.50	0.011
7.	7	13.00	0.014	14.50	0.013
8.	8	13.50	0.015	15.00	0.017
9.	9	14.50	0.016	15.50	0.019
10.	10	15.00	0.017	16.00	0.021

Graph-1: Length-weight relationship in the larvae of *S. plagiostomus* reared in laboratory as well as natural environment.

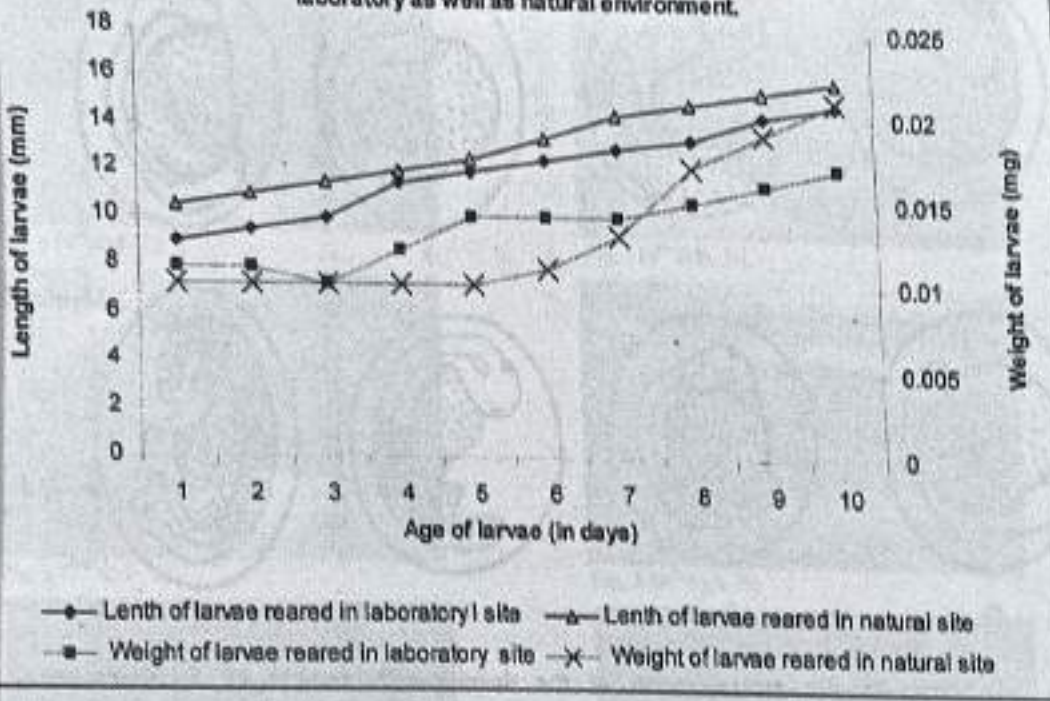

PLATE- I

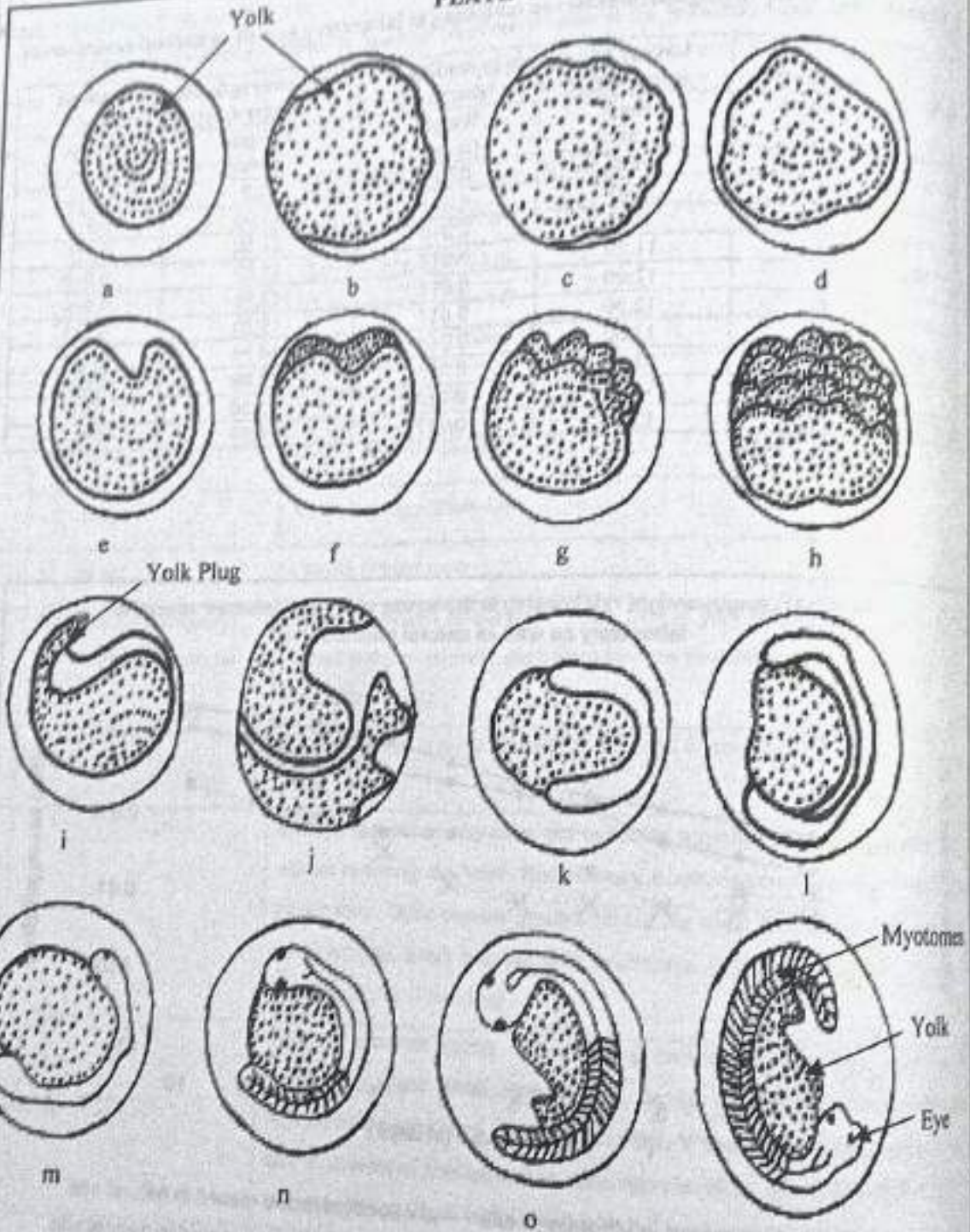

Fig. a-p: Diagrammatic representation of the developmental stages of *S. plagiostomus* (fertilization to hatching). (a) Fertilization; (b-d) Blastodisc formation; (e) 2-celled stage; (f) 4-celled stage; (g) 8- celled stage; (h) Morula stage; (i) Yolk plug stage; (j-k) 56-74 hrs old embryo; (l) 82 hrs old embryo; (m) 90 hrs old embryo; (n) 98 hrs old embryo; (o-p) 106 hrs old embryo.

PLATE- II

Fig. a (1st dph. L)

Fig. b (1st dph. N)

Fig. c (2nd dph. L)

Fig. d (3rd dph. N)

Fig. e (4th dph. L)

Fig. f (6th dph. N)

Fig. g (7th dph. L)

Fig. h (8th dph. N)

Fig. i (10th dph. L)

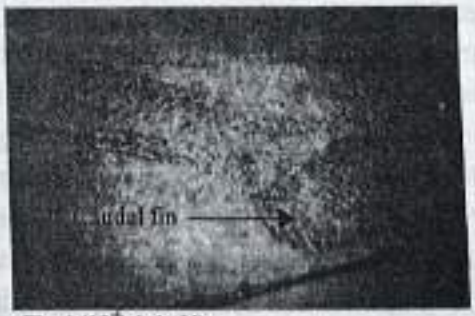

Fig. j (10th dph. N)

Dph= day post hatching; L= laboratory site larvae; N= natural site larvae

sults are in well accordance of the investigation of other workers. In various allied species of *Schizothorax* from various habitat incubation periods is reported by many Workers (Raina et al., 1985a; Raina et. al., 1985 b; Gupta and Subla, 1985; Raizoda, 1985; Joshi and Sunder, 1995 etc). In *Schizothorax micropogon*, *Schizothorax curvifron*, *Schizothorax esocinous* and *Schizothorax richardsoni* it is noticed 190-360 hrs at 9°C-18°C water temperatures from Srinagar (Raina et. al., 1985 a; Raina et. al., 1985 b), 196 hrs in *Schizothorax richardsoni* at 14.5° C-19° C water temperature, from Kumaun lake (Joshi and Sunder, 1995) and 108 hrs in *Schizothorax curvifrons* at 15°C-20°C water temperatures in laboratory condition (Gupta and Subla, 1985).

In present study it is observed that all the embryonic developmental process, excepting the minor difference in time schedule, are similar to the finding of other workers in *Schizothorax curvifrons* from the river Jhelum (Gupta and Subla, 1985) and in *Schizothorax plagiostomus* from Himanchal Pradesh (Raizoda, 1985) and Kumaun lake (Joshi and Sunder, 1995).

The difference in the time schedule for development of various organs inside the eggs, including hatching time may be due to the difference in physicochemical condition of surrounding environment of *Schizothorax plagiostomus* inhibiting in different habitat. In species of *Schizothorax* inhibiting in same habitat it may be due to genetic variations. In the comparison of natural condition/site, rapid yolk absorption and high mortality was also observed (just after yolk absorption) among the larvae reared in laboratory tank which may be due to the rise in water temperature and due to the deficiency of nutritive food component, so that larvae exclusively depends on exogenous food for nutrition which results in rapid absorption or consumption of yolk sac for energy production. Food quality is one of the most important factors for proper growth or development (Brown, 1957); is supporting our findings where growth rate was less or improper in confined laboratory water in comparison of natural water. Less movement area is another factor for the slow growth rate in laboratory conditions.

Relative growth rate as given in table (2) graph (1) showing that natural site larvae are having systematic straight line graph in length and weight in laboratory site these values are slightly up and down. Therefore, the growth or proper development is directly related to the straight line in *Schizothorax* larvae while if there is any health problem they have developed zigzag or up and down graph line. This may be correlated with morpho-ecological as well as nutritional problem.

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IMPACT OF FEEDING *ARGEMONE MEXICANA* SEED ON THE PERFORMANCE OF ALBINO RATS

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ABSTRACT

Forty-two albino rats, at one week of age, having average body weight of 53.33 g were randomly divided into 7 groups of 6 each. Rats were maintained on the rations blended with A. mexicana seed @ 0.00% (T_1), 0.01% (T_2), 0.02% (T_3), 0.05% (T_4), 0.10% (T_5), 0.5% (T_6), and 1.0% (T_7), for a period of 42 days. The intake of DM, CP, CF, Ca and phosphorus were significantly (P<0.01) higher in all the groups fed with A. mexicana than the control, except groups T_3 and T_5. The lowest gain in body weight (P<0.1) and highest (P<0.1) feed efficiency ratio were recorded in control than other groups. The differences in the levels of SGOT, SGPT and serum alkaline phosphate enzymes between the groups were not significant. The weight of heart, liver, kidney and spleen were significantly (P<0.01) lower in T_1 than other treatment groups.

Key words : *A. mexicana, albinorats, performance.*

Mexican poppy or Satyanashi (*Argimone mexicana*) is a globally distributed wild rabi season plant. The whole plant extract has some beneficial properties like insecticidal (Mote & Jadhav, 1993 and Singh and Sharma, 1999), weedicidal (Thakur et al., 1995 and Dushyant et al., 2002) and microbial anti growth regulators (Singh & Sharma, 1999 and Siddhique et al., 2002). Plant is not edible to animals. *A. mexicana* seed and oil both are resemble to mustard seed and oil. The feeding of *A. mexicana* oil may create dropsy (Sharma et al., 2000) which is a fatal disease for human beings. Looking the above facts this experiment was planned to see the impact of feeding *A. mexicana* seed on the performance of rats.

MATERIALS AND METHODS

Forty two albino rats (21 males and 21 females) with an average body weight of 53.33 g were selected at one week of age and randomly divided into 7 groups of 6 each. Care was taken that 3 males and 3 females should be present in each group A. mexicana seed was added @ 0.00% (T_1), 0.01 (T_2), 0.02% (T_3), 0.05% (T_4), 0.10% (T_5), 0.5% (T_6) and 1.00% (T_7) in the normal food of rats.

The feed samples for proximate principles were analysed as per procedure given A.O.A.C. (1985). Calcium and phosphorus (Talapatra el. al., 1940). ADF (Van Soest, 1963) and NDF (Van Saest and Wine, 1967) were analysed as following the standard procedures.

At 42 days of age, the rats were kept hunger for 24 hours. Before one hour of slaughter, 0.5 ml the blood sample from each rat was collected from jugular vein. Blood serum was separated by slanting the test tube and thus serum obtained was stored at – 20°C for the analysis of serum glutamate oxaloacetate (SGOT), serum glutamate piruvate transeaminase (SGPT) and serum alkaline phosphate in blood. These three matabolic enzymes were tested with chemikit SGPT and SGOT adopting 2, 4 – DNPH procedure (Roltman and Franket, 1957).

After slaughter, abdominal cavity was opened and heart, spleen, liver and kidney were removed from the body of rats. The weight of each organ was recorded separately. The data were statistically analysed as per technique suggested by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

A. mexicana seed contained higher crude fat (26.58%), ADF (36.51%), lignin (20.30%) and cellulose (16.20%) than the values found in control feed (Table 1).

The dry matter intake by rats were significantly (P<0.01) increased in the groups fed with 0.01% (17.85 g), 0.05% (18.10g), 0.50% (17.52 g) and 1.00% (18.05 g) *A. mexicana* fed groups than the control (Table 2). Groups T_3 and T_5 showed significantly (P<0.05) lower dry matter intake than the value found in the control. The feed intake by control group was at par with the dry matter intake claimed in MONA Laboratory manual (2003), published by a manufacturer of the rat feed. The reduction in dry matter intake with increased levels of A. mexicana plant extract has been reported by Chitra et. al., (1996) in Spodotoptera litura. The levels of seed did not show any relation with intake of feed in the present study. Fletcher et. al., (1993) found reduction in feed intake at 1% level of this seed in the diet, which was not true in the present study. The presence of dihydroalkaloids in A. mexicana seed rapidly decreased on exposure of sun-light (Fletcher et. al., 1993). The seed used in the present investigation may have less alkaloids as they were collected in the extreme summer (mid-June). This might be the reason behind no bad impact on feed intake upto 1% level of seed present in the diet.

The dry matter, crude protein, crude fat, calcium and phosphorus intake were significantly (P<0.01) higher in groups T_2, T_4, T_6 and T_7 than the values found in groups T_3 and T_5 including control (Table 2).

The average body weight gain in groups T_3 (2.39) and T_5 (2.37 g) were parallel at lower (P<0.01) nutrients intake levels than the gain recorded in groups T_2, T_4, T_6 and T_7 (Table 2). The body weight gain significantly (P<0.01) increased in A. mexicana fed groups than the control. Takken et. al. (1993) reported reduction in the weight when A. mexicana seed was added in the pig diet. This findings did not corroborate with the present results. The feed efficiency ratio was significantly (P<0.01) higher in T_1 (than the value found in other groups. The diff in the value among *A. mexicana* seed fed gro not show statistical significance. Chitra et. al (found lower feed efficiency conversation *mexicana* fed groups than the control, which opposite to the present finding.

The level of SGPT enzyme was higher (I.U./L) in groups T_5, T_6 and T_7 and lower value I.U./L) in groups T_2, T_3 and T_4 but the differe two values were not significant (Table 3). The of variations in the levels of SGPT enzyme in all *mexicana* seed groups were within the range as in control group.

The average value and range of variation SGOT enzymes were maximum in *A. mexicana* groups than the control (Table 3). The average enzyme was 26.25, 30.00, 30.00, 48.75, 48.75 and 41.25 IU/L in groups T_1, T_2, T_3, T_4, T_5, and T_7 respectively. The differences in the value not show statistical significance.

Average serum alkaline decreased in *mexicana* seed fed groups than control (Table except group T_6 which showed the highest (132.23 IU/L). Owing to much differences in the els of serum alkaline phosphate in the blood sam did not observed significant variations betwee groups.

The average weight of heart increased fro 11.7% to 19.6% in A. mexicana fed groups than average value observed in group T_1 (Table 3). Th heart weight was significantly (P<0.01) lower (0.52 g) than rest of the groups. The level of *mexicana* did not show statistical significance with weight of heart.

The average weight of liver significant (P<0.01) increased in *A. mexicana* fed groups the value found in control (Table 3). The liver weig was the highest in group T_7 (6.25 g), followed by (6.20 g) and the lowest in group (4.22 g). The average liver weight found in groups T_3 were significantly (P<0.05) higher than the val recorded in groups T_2 (5.40 g).

The average weight of kidney showed similar trend of variations in all the groups as the variations were recorded in the average weight of liver (Table 3). The average weight of kidney was 1.09, 1.26, 1.47, 1.43, 1.33, 1.43 and 1.48 g in groups T_1, T_2, T_3, T_4, T_5, T_6 and T_7 respectively.

The average spleen weight of rats significantly ($P<0.01$) increased when *A. mexicana* seed was added in the feed, irrespective of its levels, than the value observed in control (Table 3). The average spleen weight was minimum in group T_1 (0.33 g) and the maximum in T_7 (0.46 g).

Table 1 : Per cent chemical composition of feeds (dry matter basis)

Constituents	*Argiomne mexicana* seed	Rat feed
Dry matter	90.50	89.95
Crude protein	18.84	20.50
Nitrogen	3.01	3.28
Crude fat	26.58	3.84
N.D.F.	38.21	40.38
A.D.F.	36.51	26.92
Lignin	20.30	12.84
Cellulose	16.20	14.08
Total ash	5.50	7.82
Acid insoluble ash	1.88	2.27
Calcium	1.30	1.65
Phosphorus	0.33	0.56

Table 2 : Impact of feeding *A. mexicana* seed on intake of dry matter nutrients, body weight grain and efficiency ratio in rats

Treatments	Average intake/rat/day (g)					Daily gain in body wt./rat (g)	Feed efficiency ratio
	Dry Matter	Crude Protein	Crude fat	Ca	P		
T_1	16.31	3.06	4.34	0.21	0.05	1.62	10.06
T_2	17.85	3.35	4.75	0.23	0.06	2.42	7.37
T_3	15.55	2.92	4.14	0.20	0.05	2.39	6.50
T_4	18.10	3.40	4.81	0.23	0.06	2.46	6.32
T_5	15.27	2.87	4.06	0.19	0.05	2.37	6.44
T_6	17.52	3.29	4.66	0.22	0.06	2.43	7.20
T_7	18.05	3.39	4.80	0.23	0.06	2.82	6.40
CD at 5%	0.87	0.16	0.23	0.013	0.003	0.53	1.53
CD at 1%	1.17	0.22	0.31	0.017	0.004	0.72	1.71

Table 3 : Impact of feeding *Argemone mexicana* seed on some enzyme levels of blood (LU/L) and organs of rats

Treatments	Enzymes (IU/L)			Weight (g)			
	SGPT	SGOT	Serum alkaline phosphate	Heart	Liver	Kidney	Spleen
T_1	18.00 (14-28)	26.25 (15-30)	126.35 (96.8-199.9)	0.52 (0.45-0.56)	4.22 (3.12-5.06)	1.09 (1.00-1.34)	0.33 (0.22-0.39)
T_2	15.00 (14-16)	30.00 (15-45)	73.23 (44.3-100.4)	0.59 (0.51-0.66)	5.40 (4.27-6.65)	1.26 (1.01-1.51)	0.42 (0.35-0.49)
T_3	15.50 (14-16)	30.00 (15-45)	100.98 (43.0-154.0)	0.62 (0.57-0.68)	6.20 (5.77-6.74)	1.47 (1.41-1.55)	0.46 (0.41-0.50)
T_4	15.50 (14-18)	48.75 (45-60)	94.73 (71.4-128.4)	0.61 (0.55-0.67)	5.84 (5.06-6.77)	1.43 (1.34-1.54)	0.44 (0.38-0.51)
T_5	21.50 (14-28)	30.00 (15-45)	82.55 (73.3-96.8)	0.58 (0.54-0.69)	5.61 (4.31-6.82)	1.33 (1.02-1.54)	0.42 (0.35-0.49)
T_6	21.50 (14-28)	48.75 (30-75)	132.23 (92.1-200.8)	0.59 (0.55-0.67)	5.92 (5.09-6.61)	1.43 (1.34-1.52)	0.43 (0.40-4.48)
T_7	21.50 (14-42)	41.25 (30-45)	84.73 (62.4-94.9)	0.62 (0.55-0.68)	6.25 (5.82-6.68)	1.48 (1.41-1.55)	0.46 (0.41-0.51)
CD at 5%	NS	NS	NS	0.047	0.70	0.170	0.061
CD at 1%	NS	NS	NS	0.065	0.95	0.235	0.044

In parenthesis range values are given

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STUDIES ON THE SEX RATIO, SEX STRUCTURE AND EXPLOITATION PATTERN OF *LABEO CALBASU* (HAMILTON) IN THE GHAGHARA RIVER.

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ABSTRACT

The fish samples was obtained at random during the months of December 2003 to November 2004. The specimens of *Labeo calbasu* varying between the 1+ to 6+ age groups. The sex ratio of male was high than female in 3+ and 6+ age groups, while female was higher than male in 2+, 4+ and 5+ age groups. In 1+ age group male and female both equal. In the stock , sex ratio of male and female was 1:1.08. The structure of male was 50.00%, 46.87%, 52.94%, 40.00%, 40.00% and 66.67% in 1+, 2, 3, 4, 5 and 6 age groups, respectively. In the stock, structure of male and female 48.04% and 51.95%. The maximum exploitation was recorded in 1+ age group (35.75%) and minimum in 6+ age group (1.67%). The abrupt decline was recorded from the age group 2+ to 3+. Overall lower and middle age groups were maximum exploited.

Keywords: Ghaghara, sex ratio, sex structure, exploitation pattern and age groups.

From the fisheries point of view, the Ganga river system occupies an important position. The Ghaghara river is also part of the Ganga river system, which originate from the Nepal Himalaya and drains into Ganga River near Gazipur. Apart from being natural habitat of the most prized carps, viz *Labeo rohita*, *L. calbasu*, *Catla catla* and *Cirrhinus mrigala*, this forms the backbone of the Indian aquaculture. It also sustains fisheries of many other commercially valued species like siluroids, clupeids, murrels, featherbacks, mullets, many small sized catfishes and less economically important miscellaneous group of fishes.

The wide natural distribution of *L. calbasu* is in throughout India (Chondar 1999), Bangladesh (Alam *et. al.*, 2000, Haroon *et. al.*, 2001, 2002), Pakishtan, Burma, Nepal and Thailand (Jayaram 1999). Day (1878) recorded its distribution in Punjab, Sind, Deccan, Southern India and Malabar, from the Krishna through Orissa, Bengal and Burma. It is commercially important species in the Ganga river (Singh 1999), the Yamuna river Mishra and Moza (2001) and the Ghaghara river (Dwivedi *et. al.*, 2004). It is a short seasonal breeding species. Normally it breeds in the nature system, once in a year. in lacustrine habitat during rainy season, which coinciding the south-west monsoon (Qasim and Qayyum 1962, Natarajan 1971, Singh 1999). The concept of 1:1 sex ratio was confirmed by Jhingran (1968) in *Catla catla*, Pathani (1978) in *Tor tor*, Jhingran and Khan (1979) in *Cirrhinus mrigala*, Singh (1999) in *L.calbasu* Nautiyal and Dwivedi (2006) in *L. rohita*, *Tor tor* and *L. calbasu*.

The main objective of the present study is to determine the sex ratio, sex structure and exploitation pattern of *L. calbasu* in the Ghaghara river. This contributes to the application of a management strategy that gurantees the sustainable used of the sock resources and making of future policies.

MATERIALS AND METHODS

The fish sampling were made from the Guptrarghat, a major landing center at Faizabad (Utter Pradesh). The samples of *L. calbasu* was collected during the period December 2003 to Novem-

ber 2004 from the fish landing center and fish markets. The key scales (scales above lateral line and below dorsal fin region) were used for determination of the age of *L. calbasu*. Prior to age determination, establishment of the fact that the annual increment in length of the scales maintain a constant ratio with increase in length of the fish and that too throughout the years, is of great importance. Hence, the relationship of scale and fish growth was assumed. The finding of key scales was to be linear (Bagenal and Tesch 1978, Nautiyal 1990). The male female fishes are segregated by visual (microscope) of sex organ.

The fish samples were segregated on the basis of their sex (male and female). The percentage of males and females and their sex ratio was computed and tested for significance by chi-square test (Sokal and Roalf, 1973). Sex structure was determined on the basis of percentage frequency of male and female in same age group. The exploitation was determined the number of pooled samples, which converted in the percentage.

RESULTS

The sex ratio of male and female was 1:1, 1:1.13, 1:0.89, 1:1.50, 1:1.50 and 1:0.05 in 1+, 2+, 3+, 4+, 5+ and 6+ age groups. The Chi-square values were 0.24, 0.12, 0.80, 1.0 and 1.0 in 2+, 3+, 4+, 5+ and 6+ age groups. The difference was non-significant in all age groups except 1+ age group. In 1+ age group male and female both was equal. In the stock, sex ratio male and female was 1:1.08 (Table 1). The chi-square value was 0.28 and difference was not significant. The sex structure of male was 50.00%, 46.87%, 52.94%, and 40.00%, in 1+, 2+, 3+ and 4+, age groups, respectively and female 50.00%, 53.12%, 47.06 and 60.00 in 1+, 2+, 3+ and 4+, age groups, respectively (Table 2). In the stock, sex structure of female was higher than male .The maximum and minimum exploited population was observed to be 2+ and 6+ age groups, respectively. Other age groups 1+, 3+ and 4+ accounted for 26.81%, 18.99% and 11.17%, respectively (Table 2). In the overall population, lower and middle age groups were highly exploited. The higher age groups (5+ and 6+) contributed only small proportion (7.26%). The ploitation declined abruptly in 3+ age group, whe in 4+, 5+ and 6+ age groups it declined continuo in a regular fashion. The present exploitation pa was good indicator for recruitment except in 3+ group.

DISCUSSION

Sex ratio varies considerably from specie species, but in the majority of species it is clos one (Holick *et. al.*, 1988). Anupama *et. al.*, (20 observed that sex ratio of female was more than m in *Schizothorax plagiostomus* from the Ri Alaknanda in all size groups (14.1-42.0 cm) and the stock sex ratio of male and female 1:6.11, wh was significantly higher. Sex ratio of *T. putitora* vealed that the males were predominant in the low size and age classes and in the most of the mon while females in the higher size classes (Bhatt *et. a* 1998, 2004). The sex structure is very important the reproduction of a population, and consequent there are mechanisms for adjusting this structure any changes, and especially to changes in food su ply. The last is itself dependent on the population de sity, so that the sex ratio naturally reflects the densi (Nikolskii 1980). Sex structure of *T. putitora* w reported that male was continuously higher in 10- cm size group and in the remaining size groups fema was higher except in 34-37, 43-46 and 49-52 c (Bhatt *et. al.*, 2004).

Fish population was exploited for their eco nomic value, as a source of food or of raw material The biomass or weight of the exploited stock is in creased both by recruitment of new individuals an the growth of new tissue (Beeby 1993). Kamal (196 reported that the lower and middle age groups o *Cirrhinus mrigala* was highly exploited in the Yamun river and Jhingran (1959) in the Ganga river. Accord ing to Seth and Katiha (2001) the lower and middl size groups of *Aorichthys seenghala* was highly ex ploited in the Ganga and Yamuna rivers at Allahabad

In the present study, sex ratio and sex struc ture was systematic but exploitation was declining abruptly in some age groups. It is important to moni

Tabble 1. Sex ratio of *Labeo calbasu* in different age groups from the Ghaghara River.

Age groups	Male	Female	Pooled	Sex ratio	Chi-square	Remarks
1+	24	24	48	1:1.0	-	-
2+	30	34	64	1:1.13	0.24	NS
3+	18	16	34	1:0.89	0.12	NS
4+	8	12	20	1:1.50	0.80	NS
5+	4	6	10	1:1.50	1.0	NS
6+	2	1	3	1:0.5	1.0	NS
Stock	86	93	179	1:1.08	0.28	NS

NS= Non-significant

Tabble 2. Exploitation pattern and sex structure of *Labeo calbasu* in different age groups from the Ghaghara River.

S. No.	Age groups	Exploitation pattern (%)	Male		Female	
			No.	%	No.	%
1	1+	26.81	24	50.00	24	50.00
2	2+	35.75	30	46.87	34	53.12
3	3+	18.99	18	52.94	16	47.06
4	4+	11.17	8	40.00	12	60.00
5	5+	5.59	4	40.00	6	60.00
6	6+	1.67	2	66.67	1	33.33
7	**Stock**		86	48.04	93	51.95

toring especially the exploitation of middle age groups. The present sex structure was indicator for heavy recruitment.

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PHYSIOLOGICAL AND MORPHOLOGICAL CHANGES IN DAUCUS CARROTA BY SOMATIC EMBRYOGENESIS.

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ABSTRACT

Every plant part has the property of growth if they are provided with the required amount of nutrients (macro and micro) and other essential component by the help of somatic embryogenesis.

Key Words : Somatic embryogenesis, zygote, auxin.

It is the process of a single cell or a group of cell initiating the developmental pathway leads to reproducible regeneration of non – zygotic embryos capable of germinating to form complete plant is known as Somatic embryogenesis. According to Sharp *et.al.*, (1980) somatic embryogenesis is initiated either by Pre embryonic determined cell's (PEDC) or by Induced embryonic determined cell's (IEDC). In PEDC, the cells waits for the synthesis of an inducer (removal of an inhibitor)such cells are found in embryogenic tissues. In IEDC's require redetermination to the embryogenic stages by exposure to specific growth regulator such as 2,4, D. These are differentiated in microscope culture and callus culture.

Sometimes individual cells or cells from the group escape and give rise to either embryoid or nodular embryogenic callus consist of proembryoid. Plant regeneration of somatic embryogenesis from cultured cells was originally observed eith carrot. The embryo develop, they process through the distinct structural stages of globular, torpedo, cotyledonary and mature stages. somatic embryogenesis in carrot is initiated in the same manner as the production of callus.

Introduction of somatic embryogenesis in most species require a higher concentration of auxin usually 2,4 D in the culture media. Vasil, (1990). Cytokinin is usually required in induction of somatic embryogenesis important requirements in certain monocot species. A harmone free medium is often used in development of globular stage somatic embryo into plantlets. In contrast to organogenesis require two different hormonal signals to induce first a shoot organ then the root organ.

Considerable effords have been done in the past by many workers on somatic embryogenesis viz. Abeson (1984), Bajaj (1991), Edington (1992), Hall and Rose (1988), Reinert and Yeomann (1977), Street (1973). Keeping this in view the present study was undertaken to morphological changes in Daucus Carrota by Somatic embryogenesis.

MATERIALS AND METHODS

The experiment was conducted at the Plant Tissue Lab in Department of Biotechnology, MIMT, Kota (Rajasthan) during 2005-2006. For the initial experiment *Daucus carrota* seeds has taken after the proper sterilization (.01 mg $Hgcl_2$ for 15min three times) the growth they are transferred to double distilled water filter paper bridge and also kept in MS Agar media both 50% each amount of test tubes are kept in dark and light in 25°C (Overall as shown in Table 1) About 1cm long segments of root /nodes all excised from a week old seedling and the individual culture on semi solid medium and containing salt of MS medium, organic constituents of white's medium (100 mg L^{-1} myonositol and 1mg L^{-1} 2,4,D) 2% sucrose and 1% Agar incubate in darkness. Explant is taken for embryo initiation and multiplied on a rich in auxin (2,4 D 0.5 mg L^{-1}) induces differentiated of localized group of meristematic cells called embryogenic clumps, Levin, (1988). The initial culture is made of embryonic clumps in a very low medium (0.01 – 0.1mg L^{-1}) or sub cultured in different percentage of hormones for 2-5 weeks should be maintained this is known to be the proliferation medium maintained in light at 25 °C (As

shown in Table 2) Evans and Sharp, (1986).

RESULTS AND DISCUSSION

During the experiment it has been found that for getting result, a larger number of quantity have to be placed then only the lower percentage of result will come. Therefore it has been mentioned that practically it takes 2 or 2 .5 months to be completed and by somatic embryogenesis method we can propagate those plant, which are endangered. Bhojwani, *et.al.*, (1983). The use of auxin is not done in initial culture because it favours the callus formation. Therefore no auxin percentage is used in this phase. Similarly, the last phase take the longest time duration where the callus transformation to plantlet is taking place. If required the other mineral or other supplements [illegible] be added with the whites or MS media in suspension culture or in the Agar medium. While, transformation of callus to plantlet success depend upon the initial culture result and here it has been seen that the conversion of plantlet was very less but it was a successful one (mentioned in Table 3). It has been found that the property of growth has been physiologically and morphologically affected it is due to the change in the auxin hormone percentage for regeneration. This type of transforming into plantlet rather than in callus was also done by Reinert, (1977). Therefore more than 30 plant families are known so for where somatic embryogenesis have been introduced. Raghvan (1976), Ammies *et.al.*, (1983).

TABLE 1.Growth variation under light and dark in various test tubes.

Test Tube	No Growth	Lower Growth	Higher Growth
1			++
2		+	
3			++
4	-		
5		+	
6			++
7	-		
8		+	
9		+	
10	-		
11			++
12			++
13	-		
14	-		
15			++
16		+	
17	-		
18	-		
19		+	
20	-		

\- = Found no growth in seed.
\+ = Lower percentage of growth found in seed.
++ = Higher percentage of growth found in seed.

TABLE 2. Different step involved and there day by day outcomes.

Phase I:

Day 1st	Seed Sterlization Preparation of Agar medium without any hormone. Preparation of Filter Paper Bridge		
Day 2nd–19th	Inoculation of seeds and kept under observation in which 20 test tubes are kept under light and 20 test tubes are kept under dark for growth.	Day 17th Growth of plantlet observed.	Day 12th Growth of Plantlet found in distilled water (filter paper bridge)

Phase II

Day 20th	Explant is taken of each part and grown on media with higher percentage of Auxin 2,4 D i.e. 0.5 mg L^{-1} is used.

Node	Root		Leaves	
Agar Medium	Suspension Medium	Agar Medium	Suspension Medium	Agar Medium
Callus observed	Callus observed	Callus observed (Very much less)	Callus observed (Very much less)	Callus observed (Very much less)
Day 27th	**Day 26th**	**Day 31st**	**Day 32nd**	**Day 33rd**

Phase III

Day 34th	Callus obtained is taken and placed on suspension culture i.e. M S Media without or low amount of 2,4,D (0.01mg/L) is used.

After initial culture the following important stages are found

Torpedo stage	Heart stage	Globular stage	Cotyledonary stage
Day61st	**Day58th**	**Day55th**	**Day63rd**

Day64	Kept on suspension medium and found that plantlet regenerate within ten days. There may be alternation in the composition of media.

Table 3. Overall estimation of the input applied and their outcome.

Days	No. of Test Tube (T) or Petriplates(P)	Result obtained in Test Tube(T) or Petriplate
1st -19th	T20 & P20	T19 & P18
20th - 33rd (In All)	T25 & P25	T10 & P12
34th - 63rd (In All)	T20 & P20	T8& P7
64th - 76th (In All)	T10 & P10	T3 & P2

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INCIDENCE AND SEED DAMAGE BY MOLE CRICKET, *GRYLLOTALPA GRYLLOTALPA* ON THREE AGRICULTURAL CROPS

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ABSTRACT

During survey in fields of Ghaziabad and Villages of Chandauli, (U.P.) were visited during July-October and found that mole cricket infestation was maximum in *kharif* crops (soybean, maize, rice, cowpea and sugar cane). The maximum number of mole cricket was encountered from maize and cowpea fields showing spectacular symptom of yellowing and drying of growing seedlings. The population of mole cricket was quite high (2-4 crickets/m^2) were found in moist area near irrigation channel. In Delhi, IARI fields were heavily infested with mole cricket (3-5 numbers/m^2).

Laboratory studies were undertaken on the degree of infestation on seed/seedling damage in three agricultural crops like soybean, cowpea and maize by mole cricket, *Gryllotalpa gryllotalpa*. Mole cricket prefers light, soils with high organic matter contents, where food is available and tunnels can be excavated easily. The cricket causes considerable damage by feeding on the roots and shoots. They also damage the germinating buds. Some seeds were completely eaten or some were partially eaten by mole crickets. It is therefore, confirmed that when the seeds of either cereals, pulses and oils seeds, were sown in mole cricket infected fields germination and plant stand were badly affected.

Key words: *Mole cricket, seed damage*

Gryllotalpa gryllotalpa (L.) is a subterranean destructive insect and is injurious to a wide variety of plants, since it lives in the soil, feeds on underground plant parts that disturbs the soils by its burrowing nature. It becomes active in spring and rainy season. Mole crickets were damaged the seeds and seedlings of the crops. Seeds were chewed to varying extent. Some seeds were completely eaten. There are reports by Singh and Chander (2003) that the mole cricket, *Gryllotalpa* sp., damages completely soils-sown seeds of mustard, sorghum, and gram on priority. The seeds of wheat, sorghum, maize, lathyrus and gram were partially eaten.

A faunistic survey was therefore undertaken during rainy season (July-September) for the collection of population of mole cricket. At three different locations i.e. fields of IARI, New Delhi, fields of Ghaziabad and Chandauli, (U.P.) Villages. The fields were visited several times to know the presence of mole cricket with special symptoms of some raised field surface and sometimes soil was deposited at the end of tunnel.

MATERIALS AND METHODS

Pathogenicity test was carried out in 16 x 10 cm circular jars with 25 cm height were taken, filled with 2 kg field-soil. Thirty seeds of soybean, cowpea and maize were put in each glass jar, in equi distance, replicated 3 times. The mole cricket population was released in a serial number such as 1, 2, 3 and 4 individual per glass jar. Care was taken to provide enough moisture for easy movements and seeds for feeding of the mole cricket. Observation on seed/seedling damage were recorded after 3, 5 and 7 days of insect release. Subsequently, photograph of damaged seeds/seedlings were also taken. Each jar was covered with muslin-cloth with the help of rubber-band, to avoid any escape of mole cricket. After 3, 5 and 7 days number of dead cricket in each jar was counted and seeds from jars were recorded by transferring the soil with seeds from jar. While washing the seeds, care was taken to ensure that seeds were not damaged

Table 1 **Seed Damage in Soybean by Mole Cricket**

After 3 days				After 5 days				After 7 days			
No. of seeds exposed to insect damage	Total No. of insects	Completely eaten seeds	Not eaten seeds	No. of seeds exposed to insect damage	Total No. of insects	Completely eaten seeds	Not eaten seeds	No. of seeds exposed to insect damage	Total No. of insects	Completely eaten seeds	Not eaten seeds
30	1	10 (48.0%)	16	30	1	15 (50.0%)	0	30	1	15 (50.0%)	0
30	2	14 (63.3%)	11	30	2	4 (80.0%)	6	30	2	21 (80.0%)	6
30	3	15 (63.2%)	11	30	3	6 (60.0%)	12	30	3	15 (75.0%)	10
30	4	11 (50.0%)	15	30	4	19 (80.0%)	6	30	4	24 (86.6%)	1

Table 2 Seed Damage in Cowpea by Mole Cricket

After 3 days				After 5 days				After 7 days			
No. of seeds exposed to insect damage	Total No. of insects	Completely eaten seeds	Not eaten seeds	No. of seeds exposed to insect damage	Total No. of insects	Completely eaten seeds	Not eaten seeds	No. of seeds exposed to insect damage	Total No. of insects	Completely eaten seeds	Not eaten seeds
30	1	4 (30.3%)	20	30	1	14 (60.0%)	12	30	1	12 (60.0%)	12
30	2	7 (50.5%)	15	30	2	16 (73.3%)	08	30	2	18 (80.0%)	04
30	3	14 (63.3%)	11	30	3	20 (93.3%)	02	30	3	15 (63.3%)	05
30	4	16 (83.3%)	10	30	4	15 (80.0%)	04	30	4	16 (83.3%)	05

Table 3 **Seed Damage in Maize by Mole Cricket**

After 3 days				After 5 days				After 7 days			
No. of seeds exposed to insect damage	Total No. of insects	Completely eaten seeds	Not eaten seeds	No. of seeds exposed to insect damage	Total No. of insects	Completely eaten seeds	Not eaten seeds	No. of seeds exposed to insect damage	Total No. of insects	Completely eaten seeds	Not eaten seeds
30	1	10 (40.0%)	18	30	1	12 (56.6%)	13	30	1	11 (53.3%)	4
30	2	15 (50.5%)	11	30	2	14 (60.0%)	12	30	2	16 (76.6%)	07
30	3	13 (62.1%)	11	30	3	15 (73.3%)	08	30	3	14 (74.6%)	07
30	4	14 (73.3%)	08	30	4	13 (63.3%)	11	30	4	13 (70.0%)	09

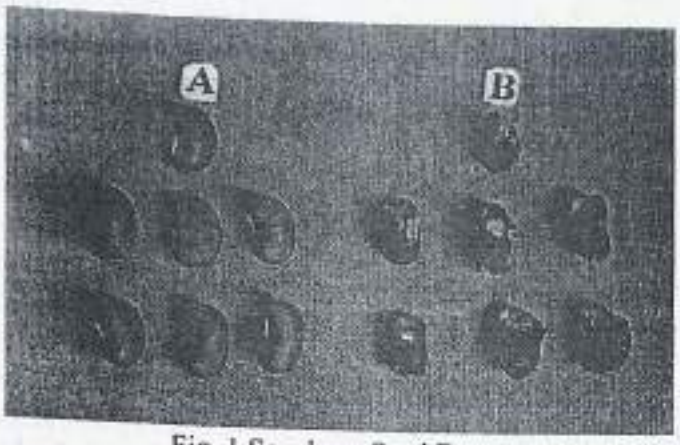

Fig. 1 Soyabean Seed Damage

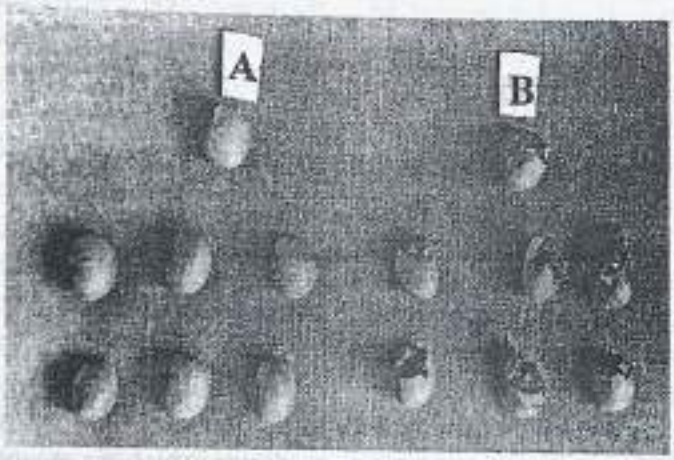

Fig. 2 Cowpea Seed Damage

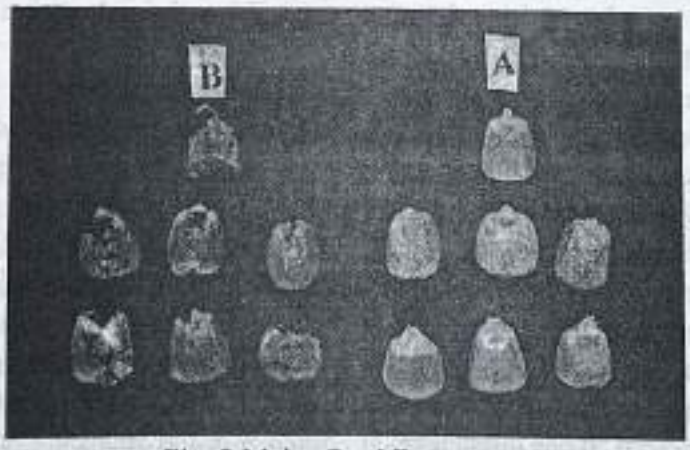

Fig. 3 Maize Seed Damage

seeds/seedlings were also taken. Each jar were covered with the help of rubber band to avoid any escape of mole cricket. After 3, 5 and 7 days number of dead cricket in each jar was counted and seeds from jar were recorded by transferring the soil with seeds from jar. While washing the seed care was taken to ensure that seeds were not damaged. Recovered seeds were observed for cricket damage and categorized as completely eaten, partially eaten and not eaten. The results were summarized in table 1, 2 and 3.

RESULTS AND DISCUSSION

The observation on seed damage was found to be time of exposures to mole cricket, some of the seeds were completely eaten, whereas some were partially eaten. Seeds were either cut from the sides or notched. at the corner. The damage done to various crops grown under field conditions and also in laboratory conditions showed a spectacular loss to the seeds.

In case of soybean seeds, it clearly indicated that after 3 days of release of mole cricket, it started feeding on the seeds of soybean, which accounted for 63.3% seeds eaten and 32.7% uneaten seeds under laboratory conditions. Rest of the seeds were partially eaten by insects. In one insect level, only 50% soybean seeds were taken by the mole crickets, whereas in 2, 3 and 4 insect levels, the seed damage were 80.0, 75.0 and 86.6% respectively. As the number of insect/jar increased there were positive increase in damage of the seeds of soybean (Fig. 1).

The damage of seedlings under laboratory conditions came off easily when pulled. First visible symptom of damage was then wilting of younger seedlings, which later become yellow. Completely drying of seedlings after sometimes resulted in gaps. Sometimes, they remained attached to the roots by a few lateral roots, which formed in older seedlings.

In case of cowpea seed, at one insect level, the % damage was 30.3%, while at 2nd and 3rd insect levels; the seed damage was 50.0 and 63.3%, respectively. Maximum number of seeds were eaten up to 4 insects level, similar results were shown 5 and 7 days of insect released. Ramachandra Singh (1996) reported 43.67% damage in seeds (Fig. 2).

Visual observations indicated that seeds were preferred by the mole crickets, in nating seeds the emerging rootlets were damaged by the mole cricket, whereas in stances the damages was to the parts of It was interesting to note that in some of lings, the mole cricket ate plumules.

In case of maize seed, it clearly indicate as the number of insect/jar increased, the the mole cricket to maize seed also increased observed to be 40.0, 63.3 and 73.3%, irrespe The damage of maize seed was number of pendent. The maize seed was leas prefere mole cricket because of the hard seed-coat. results were showed after 5 and 7 days of mai released (Fig. 3). Sometime the germinating maize seed were eaten by the mole cricket, ultimately failed to germinate. In some of the the germinating seedlings showed the damage roots and plumules emerging out from the seed the mole cricket has showed greater damage seedlings, which are escaped damage. Lal reported 10-30% damage of the young plan tato in Tripura by mole cricket (*Gryllotalpa*

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PHYSICO-CHEMICAL CHARACTERISTICS OF RIVER GANGA AT VARANASI.

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ABSTRACT

A water quality survey of river Ganga at Varanasi was conducted to assess the water quality fluctuations in terms of important physico-chemical characterstics during the years 2004 -05. The pollution load on the river was investigated at seven sampling sites. In the present study, the variations in water quality are discussed with regard to the several water quality variables. The results indicate deterioration in water quality towards the downstream side due to additional discharge of sewage at successive downstream points and bathing ghats all along the river. With an increasing awareness in the field of water pollution control and the desire to maintain rivers at their highest quality levels, it is expected that the approach described in this paper will prove a useful tool in evaluating the quality of the river to be utilized for various beneficial uses.

***Key words:** Physico-chemical, characteristics, Ganga, pollution.*

Varanasi lies at 25018'N latitude and 8301' E longitude in the middle of the Gangetic plain at an average height of about 76.19 meter above the sea level with even topography. The climate of this area is typically monosoonic. Due to marked variation in temperature and rainfall, the year has been divided into three distinct seasons viz. rainy (July to October), winter (November to February) and Summer (March to June). Rainy season is humid and warm. It is characterized by high rainfall (about 80-90 %) of the total annual precipitation, high relative humidity (70-80 %) and relatively dry with occasional rains in the months of January. In morning hours the relative humidity remains around 60 %, diurnal temperature ranges between 20-28°C. During summer season temperature gradually increases from March till May. Strong westerly wind during the day is a characteristic feature of this season. Relative humidity ranges from 30-40%.

This is considered the holiest of all the rivers of India. It has its source at the Gangotri glacier, where it flows from the cave Goumukh as Bhagirathi, which then joins the river Alaknanda as it flows towards Devprayag.

Most cities along the river do not have sewage treatment plants. Millions of tons of untreated sewage are dumped daily into the river from the cities that lie along its banks. Bathing and washing also contribute to the pollution as most of the soap that is used is made from chemical substances. The river is also polluted by human and animal faeces. X Industrial units that lie along the banks of the river discharge all the waste into the river and only few of them have proper treatment facilities. The river is now sick with the pollution of human and industrial waste, and water-borne illness is a terrible factor of Indian life.

SURVEY OF WATER QUALITY

The river Ganga at Varanasi lies at 30°10'N latitude and 83°1'E longitudes in the middle of the Gangetic plain region. River Ganga has always been associated with the evolution of culture and civilization of the very society living in and around Varanasi city. But now-a-days, due to unplanned industrialization and enormous growth of population, the river is under heavy pollution stresse and is struggling for its very existence. The main sources of pollution at Varanasi city are industrial effluents, domestic sewage and dead body cremation. For the present study,

6 sampling stations (ghats) were perennial and they discharge huge amount of sewage into the river.

MATERIALS AND METHODS

Samples of the sewage and river water were collected at monthly intervals in the first week of each month from March 2004 to February 2005. Five replicates, each of two litre were at a time in bottles between 8 a.m. to 10 a.m. from each of the sampling sites. The samples of the river water were collected using standard methods, brought to the laboratory and analysed for pH, acidity, alkalinity, Chemical Oxygen Demand (COD), electrical conductance (ECe), Temperature and pH were also recorded on the spot, at the time of sampling collection. Sample analysis for the different physico-chemical parameters was done as per standard methods for the examination of Water and Waste Water (APHA, 1985).

RESULTS AND DISCUSSION

The physico-chemical characterstics of Ganga water for the year 2004-05 is shown in graphs.

Hydrogen Ion Concentration (pH)

The values of pH at all the sites were usually lower than that at control site except in the month of August and September when it was slightly higher at Rajendra Prasad ghat.(Graph 1)

Acidity

Higher value were obtained in the rainy season months at control site and Assi ghat during which at all other sites the lower values were obtained. (Graph 2)

Alkalinity

At all the sites the values of alkalinity were usually higher than that of the control site. The values were lower during rainy season months increased gradually during wiinter attaining the peak in January at most of the sites. (Graph 3)

Chemical Owygen Demand (COD)

At all the sites COD valtues were higher than that of the control site. A sharp decrease in August and September months at all the sites except ... trol site was also observed. The control site ... increased gradually in summer but peak value ... obtain during August. (Graph 4)

Electrical Conductance (ECe at 25°C)

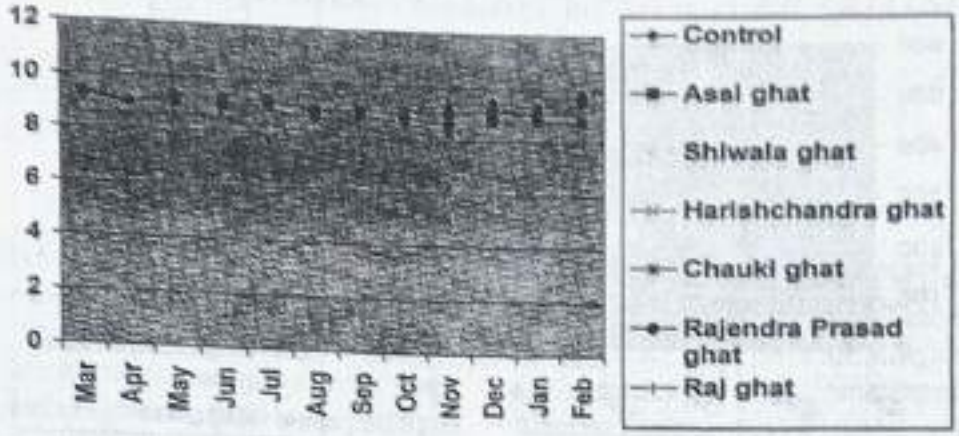
Usually at all the sites the values of EC... higher than that of the control site. The maximum ... ues were recorded at Rajghat. The values of EC... usually low during rainy season, increased gra... in winter attaining the peak in April. (Graph 5)

Present investigation reveals that the ... water at Varanasi is slightly alkaline. The ... stretches of the Ganga river can be identified ... purpose of quality improvements with respect ... various beneficial uses. Upstream ghats were ... the least polluted and were excellent for all ... eficial uses. Thus a general progressive decline ... quality of river water along the downstream ... an increase in pollution pressure due to addition ... charge of sewage and bathing activities at succe... sampling sites. The poorer water quality at Ass... was due to discharge of untreated wastewater ... the nearby Assi nala. Sharma *et al.*, 1981, I.S.I. ...

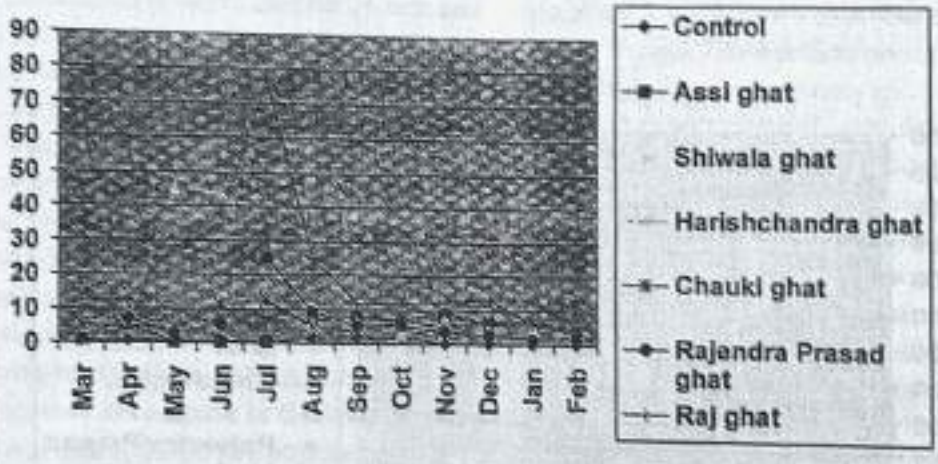
The Harish Chandra - Rajendra Prasad ... is critical because of the cremation of animal ... man carcasses at Harish Chandra ghat with ... dead bodies being thrown into the river and Raj... Prasad being the major bathing ghat specially ... religious occasions. The situation, therefore, p... serious threat to public health and warrants ver... gent pollution control measures in this stretch ... river. Since the greatest degradation of the river ... place at Rajghat where the bulk of the city sew... discharged, efforts should mainly concentrate ... proving the quality of the river. Bhargava, ... Dwivedi, 1991.

It is therefore necessary that the discha... untreated sewage at this sampling site should ... jected to immediate appropriate treatment emp... the latest technologies, before final disposal into ...

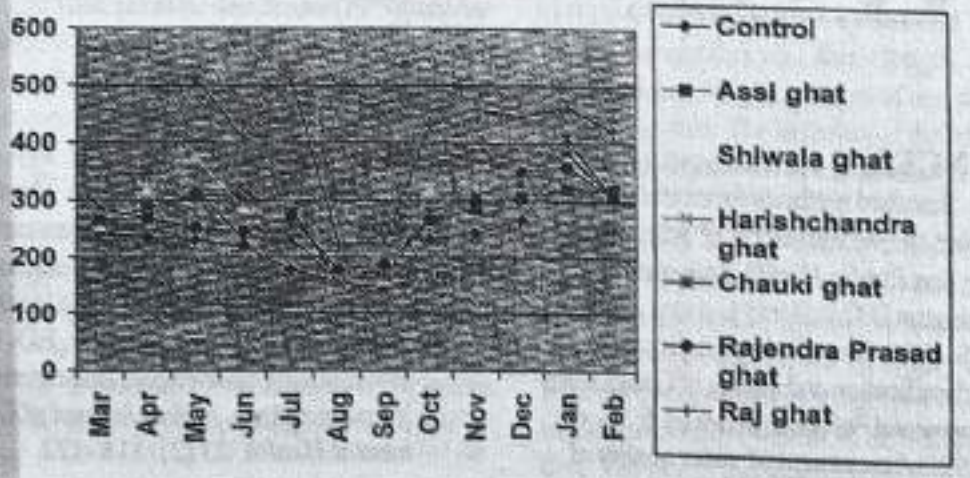
Graph 1



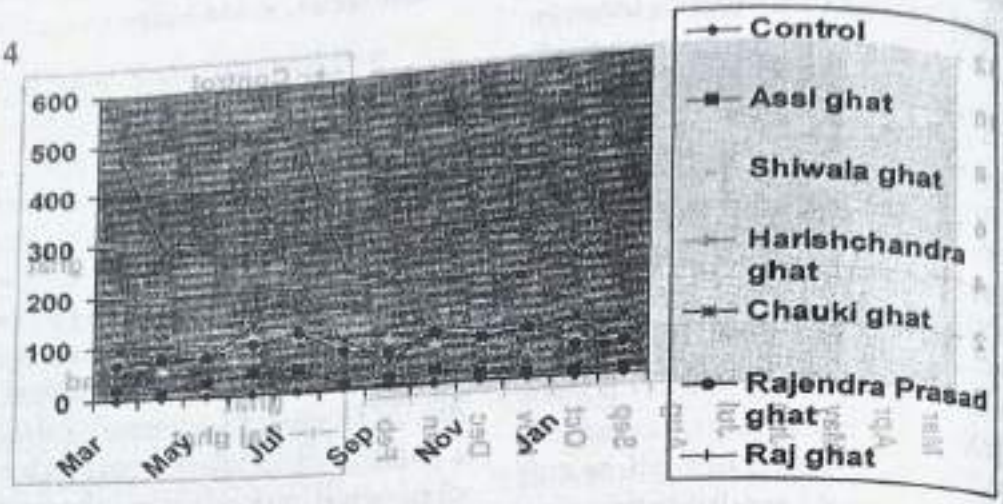
Graph 2



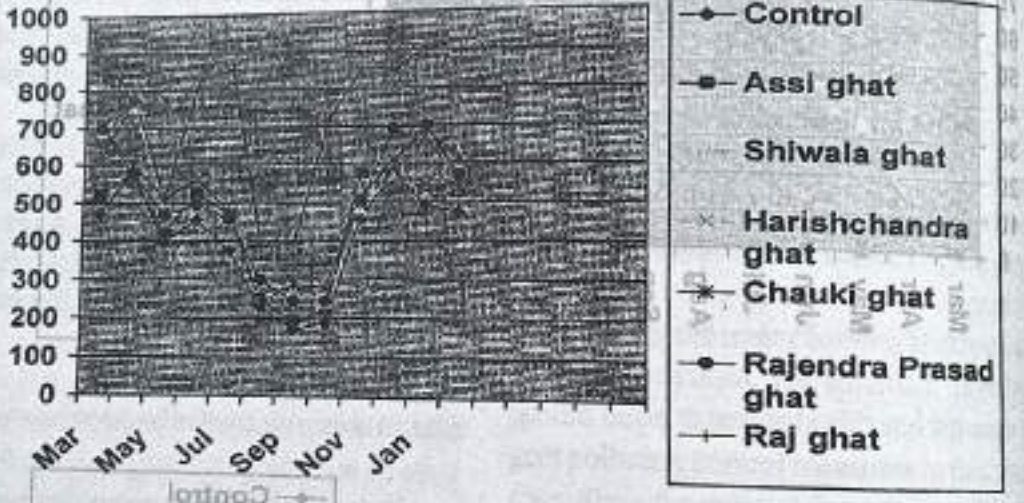
Graph 3



Graph 4



Graph 5



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INTERACTION OF *MELOIDOGYNE INCOGNITA* AND *RHIZOCTONIA BATATICOLA* IN CHICKPEA *(CICER ARITINUM L.)*.

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ABSTRACT

An experiment was conducted during 2004-06 under laboratory condition to determine association between root knot nematode, *Meloidogyne incognita* and soil borne pathogen, *Rhizoctonia bataticola* causing dry root rot disease in chickpea . Observations recorded for the growth parameters revealed that the growth and nodules formation of chickpea significantly reduced by fungus, *R. bataticola* and the nematode, *M. incognita.* Maximum reduction in shoot length was exhibited with nematode alone (10.20cm) followed by nematode inoculated 7 day prior to fungus (11.75) and simultaneously (12.21cm). Reduction in fresh root weight was more pronounced in nematode inoculated plant than *R. bataticola.* Symptoms of dry root rot were more prominent when both pathogens were mixed together as compare to the fungus alone. Fungus was also reduced gall population.

Key words: *Meloidogyne incognita, Rhizoctonia bataticola, Chickpea, Dry root rot.*

The plant parasitic nematodes (PPNs) are one of the biotic factors that adversely affect productivity of pulses in India. They are often associated in various disease complex in which their synergistic effect and damage is much more pronounced (Atkinson 1892). Apart from itself adversely effect, provide, a venue for entry to other pathogens. Besides being initiator or aggravator in disease complexes nematode it self may also be affected adversely by the other partner as well. An experiment has been conducted to study the interaction of *Meloidogyne incognita* and *Rhizoctonia bataticola* on dry root rot of chickpea.

MATERIALS AND METHODS

Chickpea was sown in sterilized earthen pots having 500-cm³ autoc1aved soil using surface sterilized seeds treated with 1000ppm mercuric chlorides. When the seedling of chickpea attained 7-days age, they were inoculated with test fungus and nematode simultaneously as fallows: 1. Nematode alone, 2. Fungus alone, 3. Nematode 7 days prior to fungus, 4.

Fungus 7 days prior to nematode, 5. Fungus and nematode simultaneously and 6. Control. One thousand freshly hatched juveniles were surface disinfested with 1000ppm dihydrogen streptomycin sulphate for one minute and then inoculate 5g sorghum grains colonized with *R. bataticola* near the root zone of chickpea as pathogenic inoculum. Nematode and test fungus were inoculated prior to each other, the nematode and pathogenic inoculum were inoculated separately around the root zone by pulling out the glass tube already embedded in the soil at the time of sowing of seed. Dispensing the fungus - nematode as above, carried simultaneous inoculation of the nematode and fungus.

Observations were recorded for the plant growth parameters *viz.*, shoot length, fresh and dry shoot and root weight, number of nodules and nematode gall in root. The isolation of the test fungus was carried out from roots of inoculated plants.

RESULTS AND DISCUSSION

The plant was resulted in stunting, reduction of lamina size and yellowing on cotyledon leaves 40 days after inoculation due to injury of nematode, whereas concomitant inoculation showed yellowing of trifoliate leaves within 30 days from the inoculation. The plants inoculated with *R. bataticola* alone

resulted in distinct lesions on collar region extending downwards on the tap root and then to lateral roots and rootlets. Significant reduction in shoot length was exhibited with nematode alone or in combination with *R. bataticola*. Reduction in fresh root weight appeared more pronounced in nematode inoculated plants than *R. bataticola*. Development of nematode galls was adversely affected when nematode was associated with *R. bataticola* (Table-I). Maximum reduction in plant height was observed with inoculation of *M incognita* alone. Stunting effect remained less pronounced when inoculations were carried out simultaneously with *M. incognita* and *R. bataticola*. On concomitant inoculations with *M. incognita* and *R. bataticola* slight pallor remained evident throughout the experiment. Both the pathogen suppressed nodulation significantly. Nematode infection and its development were adversely affected when the plants were colonized by *R. bataticola*. The association of *R. bataticola* has thus suggested its antagonistic affect on gall development. Inoculation of *R. bata* decreased nematode multiplication and root-g while root rotting increased in the combined in tion of *M. phaseolina* and *M. incognita*, Bhag and Goswami (2000), Powell (1971). Golde Vangundy (1975), observed equal damage in growth when inoculated with *M. incognita* a *bataticola*, singly but two pathogens together c more damage than the sum of total damage c by both pathogens individually. Inoculation of p gens prior to *Fusarium oxysporum* f. sp. *ciceri* sulted in more damage than 10 days prior to p gens or simultaneous inoculation of *Fusa oxysporum* f. sp. *ciceri* Pandey *et al.* (2006). *M. phaseolina* and *Fusarium oxysporum* f. sp. had an adverse effect on nematode multiplicati gall formation Devi and Goswami. (1992). Sin Singh and Goswami (2001) were found Both n tode and fungus also had an adverse effect on lation.

Table-1. Effect of interaction of *M.incognita* and *R.bataticola* on development of chickpea

Treatments	Plant growth parameters						
	Shoot (cm)	Fresh Shoot (g)	Dry shoot (g)	Fresh root(g)	Dry root (g)	No. of Nodules	No.
Nematode alone	10.20	4.71	2.24	6.34	1.97	25.00 (30.00)	8 (5
Fungus alone	14.59	6.43	2.71	8.13	2.39	40.00 (39.23)	8.00
Nematode 7 days prior to fungus	11.75	5.47	2.37	6.99	2.07	12.00 (20.27)	1 (1
Fungus 7 days prior to Nematode	13.44	6.19	2.57	7.27	2.73	6.00 (14. 18)	20.00
Fungus + Nematode simultaneously	12.21	5.82	2.44	7.00	2.10	16.00 (23.58)	21.0
Check	16.66	7.10	2.89	9.23	2.97	46.00 (42.71)	0.0
CD (P=0.05)	1.64	0.77	0.36	0.86	0.19	4.10	

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EFFECT OF ORGANIC AMENDMENTS ON ROOT-KNOT NEMATODE WITH ITS DEVELOPMENT OF EGG SAC, EGG, JUVENILE, MALE AND FEMALE IN CHICKPEA (*CICER ARIETINUM* L.)

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ABSTRACT

Four oil cakes and three organic matters viz. neem cake, mustard cake, linseed cake, mahua Cake, gobar gas product, compost, saw dust were amended in the microplots. Maximum reduction of root-knot was found in neem cake followed by saw dust. Neem cake caused maximum reduction in egg sac, egg, juvenile, male and female. All treatments were showed significantly effect on number of root-knot, egg sac, egg, female except juvenile and male.
Key words: *Meloidogyne incognita, organic amendment, chickpea.*

Root-knot nematode survive in the form of egg and second stage juveniles in soil. *Meloidogyne incognita* infective juveniles penetrated the root of chickpea seedlings within 12-14 hours after inoculation. Penetration through root tip and lateral root was common, the former causing profuse branching. *M. incognita* feed directly with against cell contents by stylet. The life cycle of *M. incognita* in root of chickpea was completed within 38-40 days (Sarna, 1984). The larvae associated with giant cells shortened, broadened and *underwent* third moult and young females were seen in 28 days after inoculation. The female rapidly increased in size causing lysis of host cells and form cavity in which it was housed. Although studies on organic amendments in order to management of root-knot disease of chickpea plants have been made by several workers Pandey (1988), Pandey and Singh (1990), Khan et al. (1974).

Little is known about development of root-knot nematode of plant. In view of this study on the effect of organic amendments on root-knot nematode and its development of chickpea was undertaken.

MATERIALS AND METHODS

Microplots of 1 x 1 m size were prepared and amended with organic matters and oil cakes at the recommended doses (5q/h oil cakes and 25q/h organic matters). Fifteen days after application seeds of chickpea cv. type-3 were sown at spacing of 30 x 5 cm. Each plant were inoculated with 3500 juveniles of *Meloidogyne incognita*. Observation on the number of root-knot, egg sac, egg, Juvenile, male and female were also recorded. Immediately after root-knots were sampled plants knots were grineded and nematodes were extracted from the suspension of nematodes extracted from each plants separately 1 ml suspension was taken into counting disc. Number of egg sac, egg, Juveniles, male and female nematodes were counted with the help of stereoscopic binocular dissection microscope. Each treatment replicated four times. Data were computed as per analysis of variance test for randomized block design.

RESULTS AND DISCUSSION

Maximum reduction of root-knot was observed in neem cake followed by saw dust, compost, mustard cake, gobar gas product, mahua cake, linseed cake. The values were 14.25,186.50, 228.25, 250.25, 275.50, 314.00 and 318.00 respectively (Table 1, Fig. 1). All treatment showed significant decrease as compared to control. Reduction in the root-knot population may be ascribed to direct toxicity as well as secretion of the toxic chemicals viz.

Effect of different organic amendment on root-knot, egg, sac, egg. Juvenile, male and female nematode in chickpea

Treatment	Root-knot No/Plant	Egg. Sac No/Plant	Egg No/Plant	Juvenile No/Plant	Male No/Plant	Female No/Plant
Neem Cake	14.25	0.00	750	675	0.00	75
Mustard Cake	250.25	9.00	25875	3300	0.00	1050
Linseed Cake	318.00	18.75	23875	10950	150.00	2025
Mahua Cake	314.00	1350.00	50250	17250	300.00	1650
Gobargas slant	275.50	1350.00	23000	7125	450.00	2100
Compost	228.25	1350.00	24300	10350	750.00	2250
Saw dust	186.50	750.00	16650	9250	600.00	1200
Control	418.25	1875.00	64050	12200	525.00	2260
F. Test (P=0.05)	S	S	S	NS	NS	S
L.S.D. (P=0.05)	85.13	824.70	28322.40	--	--	1262.70

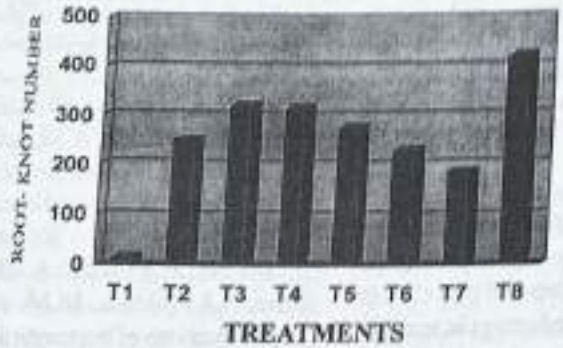

Fig. 1 Effect of Different Organic Amendments on Root-Knot in Chickpea

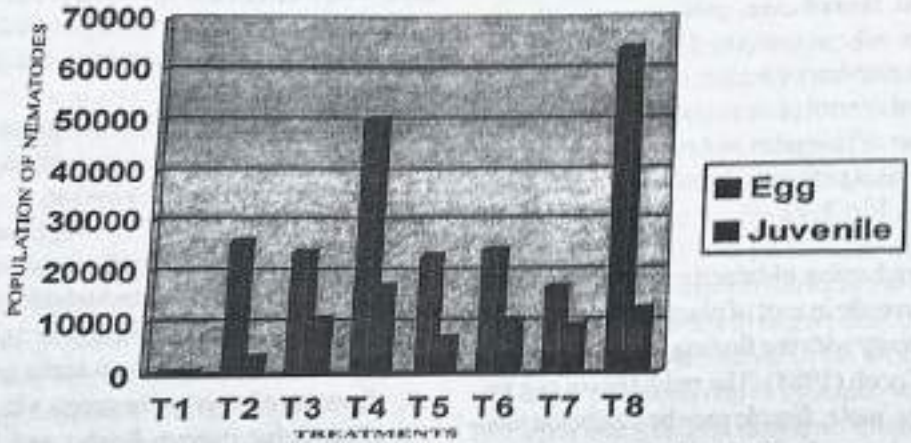

Fig. 2 Effect of Different Organic Amendments on Egg and Juveniles Nematodes in Chickpea

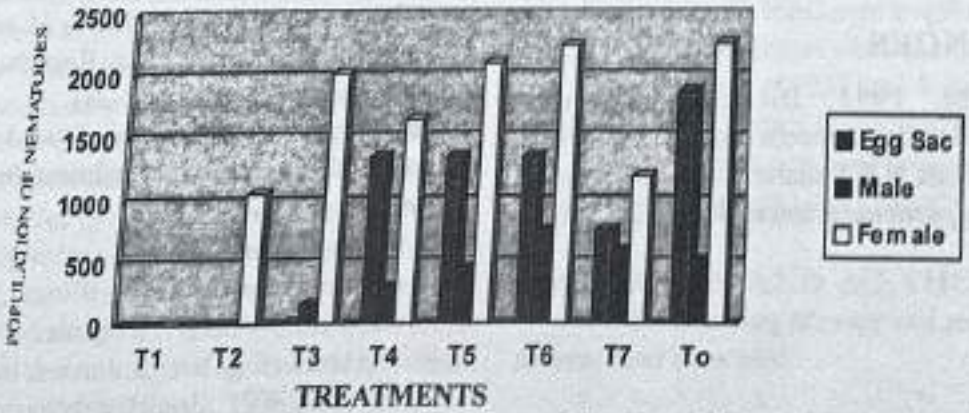

Fig. 3 Effect of Different Organic Amendments on Egg Sac, Male and Female Nematodes in Chickpea

azadirachtin, nimbin, nimbidic acid, kaempferol, quercetin, nimbidin, thionemone, limonoide and organic substrates during decomposition in soil. Similar observation were made by Pandey and Singh (1990), Muller and Cooch (1982), Pandey (1988), Alam *et al.*, (1978), Khan *et al.*, (1974).

All the treatments showed significant effect on the number of egg sac, egg, female nematodes except juveniles and male nematodes. There was no eggsac observed in neem cake amended plot closely followed by mustard cake. The reduction in number of egg sac was found to be significant in mustard cake linseed cake and saw dust as compared to control. The significant decrease in egg was found in mustard cake, compost, linseed cake, gobar gas product, saw dust and neem cake as compared to control. The difference in the number of female nematode between neem cake and control plots was statistically comparable. Number of juveniles and male data indicated that there was no significant difference between the treatments (Table1, Fig. 2,3).

The reduction obtained egg sac, egg, male, female and juvenile in root of plant grow in amended in soil conformity with the finding of Pandey (1988), Muller and Cooch (1984). The reduction of egg sac, egg, Juveniles, male, female may be attributed to direct toxicity, release of toxic chemicals during decomposition and there derivatives has also impaired to egg hatchability in *M. incognita*.

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SPATIAL ANALYSIS OF NATURAL/ PHYSICAL ENVIRONMENT AND AGRICULTURAL LAND QUALITY USING GEO-INFORMATICS

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ABSTRACT

The existing research paper an attempt has been made to analyse the natural / physical environment and there influence on agricultural land quality in Mirzapur district. Both quantitative and qualitative methods of data interpretation have been used in the study. The delineation of agricultural land quality zones was carried out on the basis of visual interpretation of satellite imagery - IRS -IB, LISS - I and II, FCC - 2, 3 and 4 at scale 1: 250000. The major agricultural land quality zones identified and delineated were (i) extremely good, (ii) very good, (iii) good, (iv) moderate, (y) poor and (vi) very poor categories.

Key Words: *Spatial analysis, environment, agricultural land, geo informatics*

Natural/physical environment put forward a direct control and varying choices for both cropland-uses and animal husbandry. Initially, agricultural systems are imposed by physical conditions till the latter are modified. In a long-settled area, the physical environment and man made environment cannot isolate from each other. It is a universal fact that many of the present characteristics of agricultural land-use are the products of past human activities and the varying degrees of modification of physical conditions by man (Singh, 1976). Despite technological advancement and conquest over nature, the agricultural patterns are closely controlled by natural / physical factors. In fact, terrain, topography, slope, altitude, climate (temperature, rainfall, humidity, fog, frost, winds, sunshine etc.), soils, surface drainage and underground water table are quite vital determinants of agricultural activities and cropping patterns (Husain, 1996).

In view of the above facts, various aspects of physical environment in Mirzapur district such as geology, geomorphic features, relief, drainage, ground water characteristics, climate, soil and natural vegetation have been given due emphasis in the present paper. The analysis of these aspects of agricultural relevance has proved to be very fruitful to explain the spatial-temporal variations in various attributes of agricultural development especially in influence on agricultural land quality.

The district of Mirzapur lies between 24°34' N and 25°16' N latitude and 82°05' E and 83°11' E longitudes (NATMO, 1998). The district is situated extreme south-eastern part of the state of Uttar Pradesh, comes partly under the Middle Ganga Plain and partly under the Vindhyachal-Baghelkhand region (Singh, 1971). The district Varanasi lies to its north-east and east, Sonbhadra district lies to its south-east, Bhadohi (Sant Ravidash nagar) district in the north-west and district Allahabad in the west and the state of Madhya Pradesh lies to its south-west direction. Mirzapur was a largest district of Uttar Pradesh, but on 1st April 1989 a new district named Sonbhadra has been carved out from it. At present the district consist of four tahsils and twelve development blocks. The district, with the maximum length (east-west) of 144.2 km and a maximum width (north-south) of 84 km, covered an area of 4952 km^2. It is characterized mostly by rugged terrain, frequent flood (north part) and drought hazards and is an economically backward district of eastern Uttar Pradesh.

MATERIALS AND METHODS

The following primary and secondary data sources have been used:

(i) Survey of India (SOI) topographical sheet No. 63 K, 63 L, 63 O and 63 P on the scale

1: 250,000.

(ii) IRS-IB, LISS-I, FCC (B- 2, 3 and 4) on Scale 1: 250,000.

(iii) IRS-IB, LISS-II, FCC (B- 2, 3 and 4) on Scale 1: 50,000.

(iv) Ground water data from Ground Water Department, Govt. of U.P

(v) Statistical Magazine, Mirzapur district, 1976, 1987, 1997.

(vi) Weather data from Weather Department and D. M. Office, Mirzapur.

Both quantitative and qualitative methods of data interpretation have been used in the study. Remote sensing technique has been largely applied for mapping and analysis of quality of agricultural land, and geomorphic features. GIS and other computer-based techniques are applied in the mapping and analysis of spatial and non-spatial data. Suitable statistical methods have been applied to work out fruitful results.

Remote sensing technique is recognized as a very powerful tool of modern science world. Visual technique of image analysis has been applied taking into consideration the three elements: (i) Photo elements (tone, texture, shape, size, location, association etc.), (ii) Geo-technical elements (geology, geomorphology, drainage, soil, land use / land cover, vegetation etc.) and (iii) Convergence of evidence. The base map was prepared with the help of Survey of India (SOI) topographical sheets. The satellite data (imagery) was interpreted in the lab and the details were transferred on base map and checked in the field at selected sites. Geographical information system is used for efficient storage, analysis and presentation of geographic data. These efforts have apparently been the result of increasing demands by users for data and information of a spatial nature.

RESULTS AND DISCUSSION

GEOLOGY

Geology is a prominent factor which in ciation with landforms, hydrological condition and status plays a vital role in the agricultural develop of a region. Mirzapur district represents a geolo complex, which is exemplified by the rock expo of the Pre-cambrian to tertiary periods. These e sures are well defined in parallel belts, generally t ing in an east-west direction.

Geologically the area under study may di in two parts: (A) Gangetic Alluvium, and (B) Vindh System. The Gangetic Alluvium can be divided two sub groups: (i) Newer Alluvium, and (ii) O Alluvium. Vindhyan formation may also be divided two groups (Auden, 1933) as: (i) the Upper Vindh and (ii) the Lower Vindhyan. The Gangetic Alluv and Vindhyan System in the study area are separ by 100m. contour (Fig. 1).

(A) Gangetic Alluvium

The one fifth (20.58 %) of the district co under this category. It has been observed in the nor ern part mainly in three blocks (Kon, Majhwa, Sikr and partially in Chanwey, City, Pahari, Narainpur Jamalpur blocks. The deposition alluvium in th blocks is considered to occur during quaternary This geological unit is designed by the river Ga and its tributaries, which originate from the Vindh plateau and descend the scarp to meet the main r from right hand side. It is composed of unconsolid sand, clay, silt and their mixture in varying proport The older alluvium of Ganga valley was formed d ing the middle to upper Pleistocene age (Krishnan Swaminathan 1959) and lies above high flood level the rivers. The newer alluvium generally occupies lower elevated land surface and restricted to the flo zones. Table I shows the stratigraphic sequence Gangatic alluvium.

Table 1: Genetic Alluvium Stratigraphy in Mirzapur District

Group	System	Series	Lithology	Water Bearing properties
Quaternary	Upper Pleistocene to Recent	Newer Alluvium	Sand in different grades, silt and clay	Coarse sediments yield moderate to abundant
	Middle to Lower Pleistocene	Older Alluvium	Clay, clay with Kankar silt, fine, medium and coarse-grained sand	
			Unconformity	

Table 2 Vindhyan Stratigraphy in Mirzapur District

Present Classification			Auden,1933		
Group	Formation	Member Beds	Sub-stage	Stage	Series
Kaimur	Mangesar	Dhandraul quartzite	Dhandraul quartzite scarp, sandstone	Upper Kaimur	
	Vijaygarh Shales	Block shale, Sandy shale and dark sandy shale	Vijaygarh Shales		Kaimur
	Gurma	Upper quartzite Sushnai Braccia Silicified shale Lower quartzite	Upper quartzite Silicified shale Lower quartzite Semri Group	Lower Kaimur	

(After Prakash, 1966 and Mathur, 1976).

(B) Vindhyan System

Vindhyan System covers major part (79.42 %) of the district. This formation is exposed in the extreme south of the district covering partial extant of Chhanway, City, Pahari, Jamalpur and Narayanpur blocks and complete Lalganj, Haliya, Marihan and Rajgarh blocks. Vindhyan formation is presented by Kaimur series comprising variegated sandstone, quartzite, inter-bedded shale with or without marginal alluvium cover. The geological succession of the rock formation and their lithological characteristics in the study area are given in the table 2.

The term Vindhyan was adopted by Oldham (1876) on the name of Vindhyan Mountain. The Vindhyan sedimentologic sequence has been divided into two lithostratigraphic group viz. the Lower Vindhyan and Upper Vindhyan separated by a well marked unconformity which tends to disappear from east to west. The Upper group consists of inter bedded sandstone and shale. Massive thick bedded sandstone from the large open plateau, being separated by shale beds which from the intervening sloping areas. This formation appears to be deposited in the vast flood plain deltas. This groups mainly erinaceous and argillaceous. As the two original divisions give very unequal thickness of the formations, Auden (1933) suggested a four fold division of the Vindhyan system such as the Semari, Kaimur, Rewa and Bhander series, from below upwards.

The rock-out crops in the area under study belong mainly to the Dhandraul quartzite which is formed in the most member of the Kaimur group of Upper Vindhyan Super Group. The rocks of this group are more or less horizontally bedded and characterized with deep gorges.

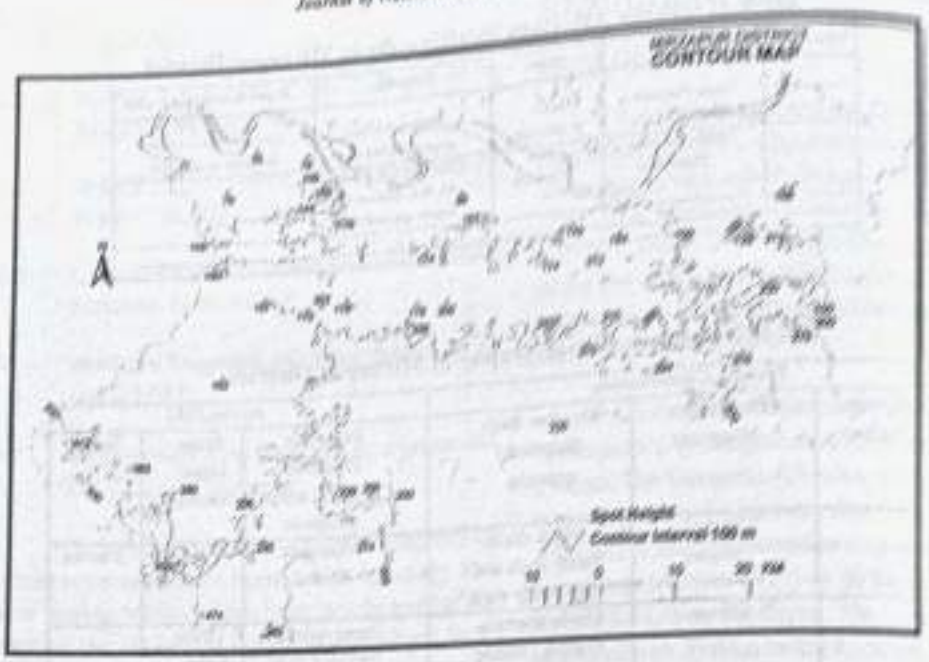
CONTOUR MAP
Spot Height
Contour Interval 100 m

FIG. 1

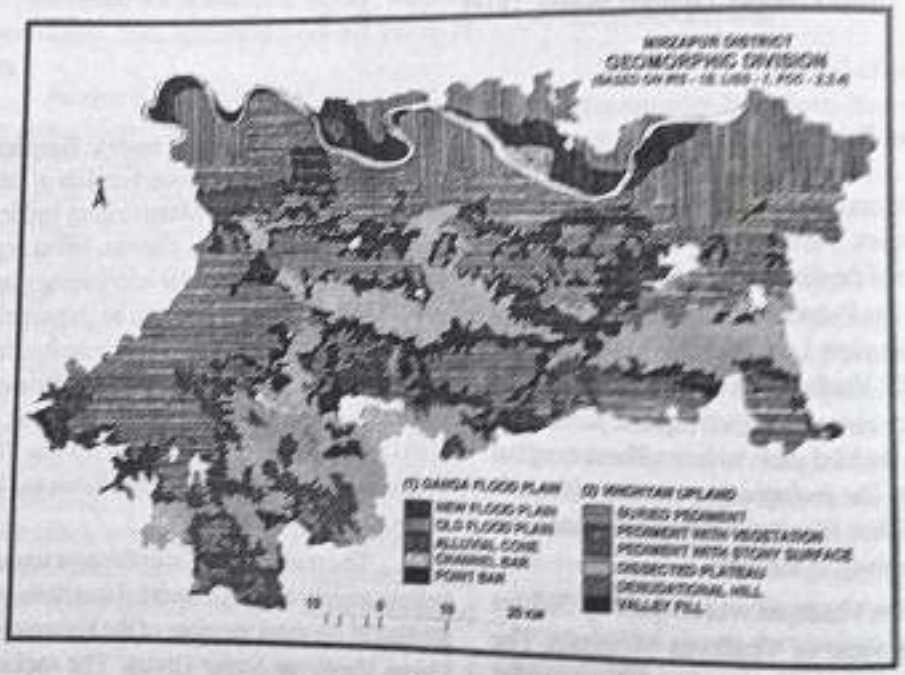
GEOMORPHIC DIVISION
(I) GANGA FLOOD PLAIN
NEW FLOOD PLAIN
OLD FLOOD PLAIN
ALLUVIAL FANS
CHANNEL BAR
POINT BAR
(2) VINDHYAN UPLAND
BURIED PEDIMENT
PEDIMENT WITH VEGETATION
PEDIMENT WITH STONY SURFACE
DISSECTED PLATEAU
DENUDATIONAL HILL
VALLEY FILL

FIG. 2

GEOMORPHOLOGY

Geomorphology is so dominant factor in the human environment that influence on the pattern and destiny of agriculture in Mirzapur district is immense. This is true on macro as well as micro regional scales. The agriculture in mountains, plateaus and plains differs greatly. Similarly, scarps, pediments, valleys, flanks, flood plains, ridges and basins are characterized by different types of agriculture. Micro regional landforms such as paleo channels, sand bars, flood plain deposits natural levees etc. are marked by different mode of agriculture. The geomorphology sets the foundation and background of agriculture, which can be adopted or can be feasible in a particular area. Geomorphology affects the availability of soil moisture, depth, structure and texture of soil, the amount of solar radiation, the feasibility of terracing, field pattern, agricultural transport, possibilities of irrigation, size of distribution of holdings, continuity of cultivation and the most important aspect of agriculture, i.e. the crops, their nature, yield and out-turn (Ahmad, 1992).

The varying geomorphological investigation in the Mirzapur district is largely based on remotely sensed data (IRS-IB, LISS-1, FCC-B2, 3 and 4) hard copy print on scale 1:250,000. Different geomorphic features of the area have been identified and mapped through visual interpretation taking into account (i) photo elements (colors, tone, texture, shape, size, association, pattern etc.) (ii) geotechnical elements (landforms, geology, soil, vegetation, land use, drainage pattern, etc.) and (iii) convergence of evidence. Remote sensing and its geomorphologic application have been well explained by Varstappen (1963, 66, 69, 77), Sabins (1987), Barrett and Curtis (1976), Way (1978), Townshend (1981), Curran (1985), Lillesend and Kiefer (1987), Mishra (1993), Pandey (1998), Mishra and Choubey (1999).

The study area may broadly be divided into two geomorphological units: (A) Ganga flood plain and (B) Vindhyan upland. The landform features under Ganga flood plain can be enlisted as: (i) New flood plain, (ii) Old flood plain, (iii) Paleo channel, (iv) Channel bar, and (v) Point bar, and under Vindhyan upland as: (i) Buried pediment, (ii) Pediment with vegetation, (iii) Pediment with stony surface, (iv) Dissected plateau, (v) Denudational hill, and (vi) Valley fill (Fig. 2, Table 3).

(A) GANGA FLOOD PLAIN

New Flood Plain

New flood plain known as 'Khader' or newer alluvium is confined to the proximity of Ganga River. It is inundated by flood water annually and received sediment deposition during each flood. On the imagery, this geomorphic unit is chavacterized by dark red tone, smooth texture, and irregular shape (Table 3).

Old Flood Plain

The vast alluvium tract of the northern part of the area consists of the old or outer flood plain features locally known as 'Bangar' or older alluvium. This geomorphic unit is most important for agricultural part of view and excellence for ground water exploration. It has generally been observed on satellite imagery by light to medium red tone,

Point Bar, Channel Bar, and Paleochannels

Point bar are formed on the convex side of meanders and grow by individual increments outward into the meander curve (Thornbury, 1969). These point bars have been formed due to the deposition of sediments, carried out river Ganga. The channel bars are formed by the deposition if huge amount of sand in between the channels (Mishra, 1999) while paleochannels are formed due to the shifting of courses of river Ganga mostly in the left side (north). Such features (filled with fertile soils) provide very higher yield of crops. The underground water prospect is also very good in these zones.

(B) VINDHYAN UPLAND

Buried Pediment

Buried pediment are those flat surface of the plateau area which have thin to thick cover of unconsolidated materials mainly gravel, soil (alluvium/colluvium) or weathered rocks. The buried pediments are very clearly marked on imagery by red to dark red tones. The buried pediments are marked with good cultivation most suited to rice farming.

Table3: Image Characteristics of Geomorphic Features and their Relation with Agriculture and Ground Water (Based on IRS-1B, LISS-I, FCC)

Geomorphic Feature	Tone	Texture	Shape	Size	Land Use	Ag. Land Quality	Ground Water Potential
GANGA FLOOD PLAIN							
New Flood Plain	Dark Red	Smooth	Irregular	Large	Very good cultivation	Very good	Very good
Old Flood Plain	Light to moderate red	Smooth	Irregular	Large	Very good to good cultivation	Good to very good	Good to very good
Alluvial Cone	Medium gray	Coarse	Regular	Small	Moderate cultivation sandy patches	Good	Very good
Channel Bar	Very light	Coarse	Elongated	Small	Sandy Patches	–	Very good
Point Bar	Very light	Coarse	Crescentic	Small	None of dry cultivation	–	Very good
VINDHYAN UPLAND							
Buried Pediment	Dark	Coarse	Irregular	Large	Good to very good cultivation plantation	Good to very good	Moderate to good
Pediment with Vegetation	Light to moderate gray	Coarse	Irregular	Large	Open forest, groves, etc.	Poor	Poor
Pediment with Stony Surface	Light	Coarse	Irregular	Large	Stony west	Very good	Very Poor
Dissected Plateau	Gray to medium gray	Uneven mottled	Irregular	Large	Forest	Moderate	Poor
Denudational Hill	Light gray to whitish	Uneven	Irregular	Small	Forest	Moderate	Poor
Valley Fill	Red	Fine	Crescentic	Small	Good cultivation plantation	Good	Poor

Table 4: Climatic Characteristics of Mirzapur District - 1996

Month	Temperature (°C)			Rainfall (mm) 1996	Avg. Rain fall (mm) 1986-96	Relative Humidity	Air Pressure (mb)
	Maximum	Minimum	Average				
January	23.77	11.00	17.38	23	22.00	79	1007.2
February	32.57	14.50	23.53	10	20.58	71	1003.4
March	33.00	14.56	23.78	15	18.32	59	999.9
April	40.33	25.55	31.94	04	5.66	49	996.0
May	42.00	27.25	34.50	09	14.47	48	991.3
June	43.57	28.20	35.89	114	112.88	62	988.7
July	36.25	26.10	31.18	313	248.68	82	987.6
August	34.00	25.50	29.75	354	267.30	84	990.6
September	32.57	24.90	28.73	220	230.18	84	996.3
October	34.57	21.45	28.16	40	21.94	77	1001.1
November	30.45	15.75	23.10	04	10.63	76	1004.3
December	25.40	11.25	18.32	03	17.60	80	1002.7
Average	34.06	20.33	29.83				997.1

Source: Regional Metrological Department, New Delhi and D.M. Office, Mirzapur.

Pediment

The term pediment is used to designate the open rock surface. Although the processes of pediment formation are complex and naturally involve weathering, rill wash, stream erosion, mass wasting, sheet wash, sheet flood etc. (Ahmad, 1985) but King (1967) considers running water as the chef agent for its formation. These features are mostly surface of flat to very low slop and sometimes, attached with denuded hills. The term pediment has generally been used for the land forms of arid and semi arid areas to the transitional lands between hills and plain with gently sloping at angles between 1° and 7° (Mishra, 1993). The pediments in the area under study may be subdivided into two categories: (i) pediments with sparse vegetation', and (ii) pediments having bare rock surfaces. The features under first category are generally visualized by light to moderate gray tones and second by light to very light tones on the imagery.

Dissected Plateau

The plateau region criss-crossed by various streams is named as dissected plateau. Different features like gorges, valleys, scarp lands etc. are prominent which create undulated topography. This unit is marked on imagery by light to dark gray tones depending on the vegetation covers.

Denudational Hill

The denudational hills having their flat top surface are found in a chain in the northern flank and south-west part of the plateau. These hills are generally enclosed with barren land or rocky surfaces partly buried by debris.

Valley Fill

The valley fill is the fundamental landform produced by lateral erosion (Tiwari, 1992). This is ed rock erosional surface remains generally nidentified due to being commonly veneered with luvium.

RAINAGE SYSTEM

Drainage system plays a greater role in shaping logical preview as well as the socio-cultural life of man. It is influenced by certain physical factors like climate, relief, geology, structure, natural vegetation etc. and socio-cultural factors such as agriculture, land use and other anthropogenic features. Drainage mainly serves to remove the surplus water from an area. The under study is drained by the Ganga and its sub-tributaries including Belan (Fig. 3).

(i) Ganga Drainage System

The Ganga, flowing eastward in a meandering course for a total distance of 132.5 km, drains in the northern part of the district. Its main tributaries from the right hand (south) are the Jirgo, the Garain, the Chattar, the Khajuri and Ojhala, all descending from the Vindhyan upland. Some of the waterfalls may be observed at places, e. g. Tanda fall on the Ojhla river. However, the total drainage area by this system may be accounted 55.5% (approximate) of the district.

(ii) Belan Drainage System

The river Belan flow westward direction that is opposite to the Ganga. 11 originate from a 'Tal' (Sonbhadra district) and flowing through the study area it finally merges Tons river (Allahabad district), a tributary of Ganga. Its main tributaries are Sikara, Ghori and Nakahar on the left bank and Adwa, Scoti, Susurawa, Kehenjua and Magarda on the right bank.

CLIMATE

Climate reflects the average conditions of weather's elements like temperature, rainfall, humidity, light (sunshine), wind, air pressure, fog, frost, snow and hailstorms. All these elements, individually and collectively determine the agricultural pattern of a region (Husain, 1996).

Temperature

Temperature is a measurement of the degree of hotness. The agricultural operations and agricultural patterns are closely influence by the prevailing temperature condition of the region. Plant growth and metabolism are profoundly affected by temperature. Various periodic phenomena of plants like seed germination, vegetation growth, reproduction, etc. are also regulated by temperature.

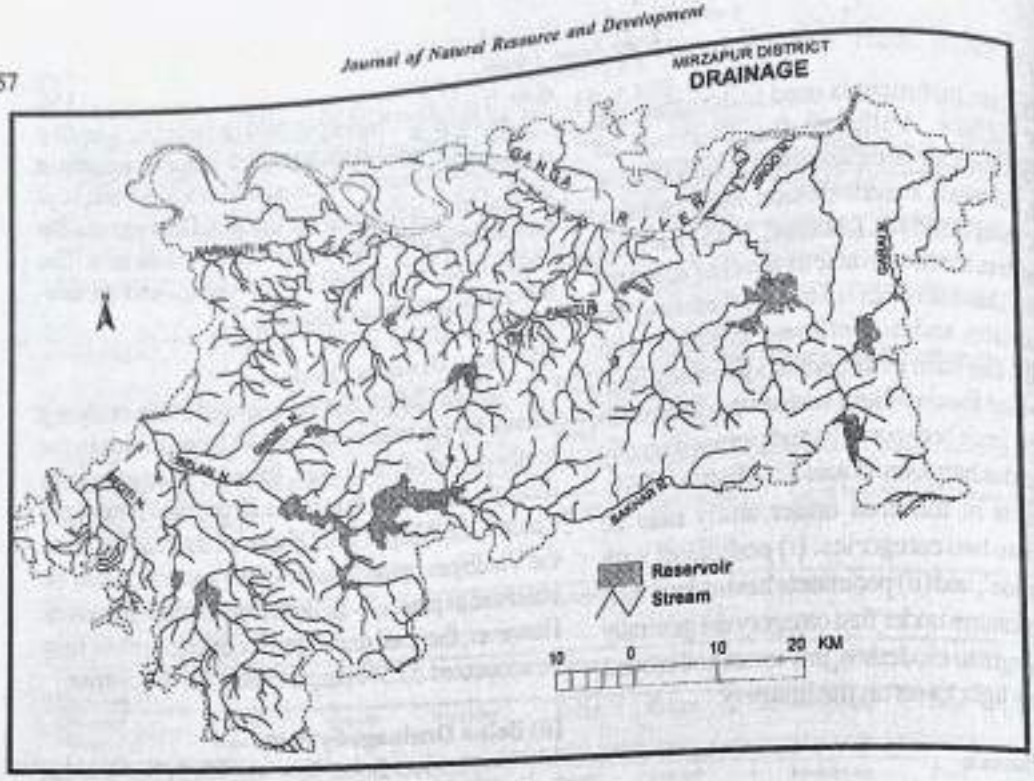
MIRZAPUR DISTRICT
DRAINAGE
GANGA RIVER
KARAMNASA N.
BELAN N.
GARAI N.
BARNAR N.
CHANDAUK
Reservoir
Stream
10 0 10 20 KM

FIG. 3


MIRZAPUR DISTRICT
LOCATION OF HYDROGRAPH STATION AND
PRE AND POST MONSOON WATER LAVEL DEPTH
1995-96
Hilly Tract Boundary
Post - Monsoon Water Contour
Pre - Monsoon Water Contour
Hydrograph Station
10 0 10 20 KM

FIG. 4

The study area has recorded 29.83°C average annual temperature with 34.06°C maximum and 20.33°C minimum in 1996. The highest monthly maximum temperature was recorded in June (43.54°C) and lowest in January (11.0°C (table 4).

Rainfall

Rainfall or precipitation is the cheapest ultimate source of water for plants. The quantity, duration and intensity of rainfall is recorded maximum in August (354 mm) and lowest in December (3 mm) in 1996 and the highest average rainfall is also recorded in August (267.30 mm) and lowest in April (5.660mm) during 1986 to 1996 (table 4). There exists variation in spatial distribution of rainfall and some times district comes under the condition of drought which affects the crop yield.

Relative Humidity

The relative humidity is the quantity of moisture as a percentage of the maximum quantity that the air can hold at the prevailing temperature. The humidity influence plant life by regulating the rate of water loss in the form of evaporation and transpiration. The highest relative humidity is registered in August and September (84%) and lowest in May (48%) in 1996 (Table 4).

Air Pressure

Air pressure influences the wind circulation, evaporation and transpiration. The highest air pressure was recorded in January (1007.15 mb) and lowest in July (987.6 mb) (Table 4).

Winds

Winds are generally light throughout the year strengthen a bit during the afternoon. During The non-monsoon months the winds blow predominantly from directions between south-west and north-west. In the month of May the winds blow from directions between north-west to south-east. During the monsoon season winds blow west or south-west direction for some days (District Gazetteer).

Special Weather Phenomena

Some of the monsoon depression formed in the Bay of Bengal, particularly during the early part of the season, move across the country and affect the district causing widespread heavy rain. Dust-storms and thunderstorms occur during in the hot season, sometimes accompanied with squalls. Thunderstorm also occurs during the cold season in association with passing western disturbances. Rain during the monsoon season is often associated with thunder. Fog occurs occasionally during the cold season which largely affects the productivity of Ravi crops especially pulses and vegetables.

GROUNDWATER

Water is a very important ecological factor which regulates the plant environment. The ground water provides a strong and stable resource base as irrigation for agriculture. Water table is a physical surface defining the upper limit of the zone of saturation. Its position is indicated by the static levels of well tapping free ground water and may register fluctuation due to addition or withdrawals from ground water storage.

Water Table and its Characteristics/ Condition

The depth of water table exhibits a marked spatial variation in Mirzapur district depending upon the geology, lithology, relief, drainage, geomorphic conditions. The analysis of water tables and their characteristic features have been attempted for the year 1996 through the data of observation wells received from U.P. Ground Water Division, Lucknow. The water table contour maps at 5 m. (b. g. l.) interval are prepared for both pre-monsoon and post-monsoon periods. The contour could not be drawn in the southern part of the district because of rocky formation, uneven topography and uncertain water table (Fig. 4, Table 5).

Pre Monsoon Period

As regards the depth of water tables during pre monsoon period, it ranges from 3.22 m (Kolana, Garai Basin) to 17.7 m (Majhwa) in flood plain zones

and from 3.31 m (Kothari, Lower Belan Basin) to 20.04 m (Marihan Bazar) on Vindhyan plateau. There are three water level contours (5 m, 10 m, and 15m) mostly parallel to the river showing higher values towards stream channel (Ganga) and lower towards plateau.

Post Monsoon Period

The Ganga flood plain accounts minimum depth of water table (b. g. l.) at Kaurian Kala (0. 40 m) and maximum at Majhwa (15.25 m). On Vindhyan plateau, the minimum water level depth can be observed at Katahari (0.91 m) and maximum at Sirsa (12.24 m). Water table contour obviously show variation in their nature. The position of water contour is shifted towards channel (Ganga) as compared to their location on the map of pre monsoon period. The highest contour (15 m) values occur only in limited area having small coverage.

Recharge, Discharge and Water Balance

The ground water recharge occurs mainly by local rainfall, ground water inflow and surface irrigation source like canals, reservoirs, bandhies etc. The ground water discharge occurs mainly by tube wells / wells. It is characterized by outcropping of the water table or the capillary fringe through which water is lost to the atmosphere by evapotranspiration or to stream as base flow (Karath, 1989, Pandey, 1998).

The ground water balance has been worked out by deducting net annual draft from the net annual recharge. The general categorization of ground water balance is made according to the stage of development such as (i) white (up to 65%), (ii) gray (65% to 85%), and (iii) dark (above 85%). 'White' category shows enough balance of ground water, where further development is possible. The 'grey' categories indicate moderate balance where further development of ground water structures may be allowed as per need. The 'dark' category reveals that the ground water is not enough for utilization and further development of ground water structure is prohibited.

There are 11 blocks (except Majhwa) of the district under white category, i. e., suitable stage where further ground water development may be allowed. The block Majhwa comes in 'gre category but it is near to 'dark' (above 85%) h further ground water development may be allow strictly as per requirements (Table 6).

SOILS

Soil is the medium in which roots grow, anch the plants and from which the plants derive water a nutrients. The soil is defined as the weathered broken particles) surface of the earth's crust which mixed with organic material and in which mic organism live and plant grows. Soil consists of th inorganic materials derived from parent rocks, th organic materials derived from dead organism, the and water occupying the pores between the so particles which are loosely packed, small organism like bacteria, fungi, nematodes etc., and the highe plants live in it. The soils of Mrzapur district may b grouped in 11 categories (Singh, 1968) according t their texture characteristics, as explained below (Fig 5)

(1) Belan Valley Clay Soil

It is light brown in colour, rich in organic matte and non-calcareous in nature. It has 49.0% clay and 21.5% silt. It situated mostly in Belan valley.

(2) Clay Loam Soil

Clay loam soil is found in Narayanpur and Jamalpur block. It is highly productive for agricultural part of view and is most suited to paddy cultivation.

(3) Gangapar Sandy Loam

This type of soil can be observed in south of the Ganga. It is brownish gray in colour and non-calcareous. It has also good moisture retaining capacity and favorable for plant growth.

(4) Ganga Plain Sandy Loam

It covers whole of blocks Kon, Majhwa and Sikhar which are situated north in the Ganga. It is mostly on the higher or bangar land which is generally out of reach of flood waters. The nature of soil is highly suitable for cultivation.

Table 5: Pre and Post Monsoon Water Level of Plateau Upland

Observation Well	Depth of Water Level (in m)		Observation Well	Depth. of Water Level (in m)	
	Pre-monsoon	Post- mansoon		Pre- monsoon	Post-monsoon
Pankauli	D	4.05	Majhyar	4.20	1.35
Samogara	8.74	3.29	Patchara	6.86	1.86
Lahangpur	7.81	3.71	Kamalpur	D	2.95
Lalganj	7.23	3.33	Marihan Block	10.74	1.59
Babura	6.75	3.00	Marihan Bazar	20.04	6.09
Tilav	4.80	2.00	Rajohan	8.87	2.35
Baraudha	D	1.42	Kotwan	5.60	1.00
Dubarkalan	3.61	1.11	Kalwari	17.69	3.19
Amoli	8.71	2.63	Pachokhara	D	2.48
Sirsi	D	12.24	Rajgarh Block	18.84	2.65
Kathari	3.31	0.91	Saktesbgarh	D	1.97
Durjanipur	5.77	1.47	Madhupur	8.65	3.10
Nadini	10.40	7.90	Sukrit	D	2.94
Rateh	7.44	2.84	Ramrasahi	2.82	0.76
Bhisor	11.17	6.07	Dhaurahara	15.06	11.61
Halia	6.94	4.24	Paduri	14.02	12.08
Adawa	7.10	3.20	Jaihind Pahari	7.19	2.09

Note: D-Dry

Source: Ground Water Department, Govt. of U.P.

Table 6: Ground Water Status in Mirzapur District (31.03.1996)

Block	Net Recharge (ham)	Net Draft (ham)	Ground Water Balance(ham)	Stage of development as on 31.03.96	Stage of development after 5 years (%)	Category
Chhanway	4890.91	1960.05	2930.86	40	50	White
City	4161.77	1680.92	2480.85	40	50	White
Haliya	10944.52	158.08	10786.44	01	11	White
Jamalpur	7461.62	1292.81	6168.81	17	27	White
Kon	1874.74	749.42	1125.32	40	50	White
Lalganj	6585.83	176.71	6408.72	03	13	White
Majhwa	2626.83	1684.25	942.58	64	74	Grey
Marihan	7465.81	191.57	7274.24	03	13	White
Narayanpur	8146.80	119 7.85	6948.95	15	25	White
Pahari	5338.97	782.74	4556.23	15	25	White
Rajgarh	11927.80	1062.56	10865.24	09	19	White
Sikhar	2966.47	1095.95	1870.52	37	47	White
Total District	74391.67	12032.91	62358.76	16	26	White

Source: Ground Water Department, Lucknow.

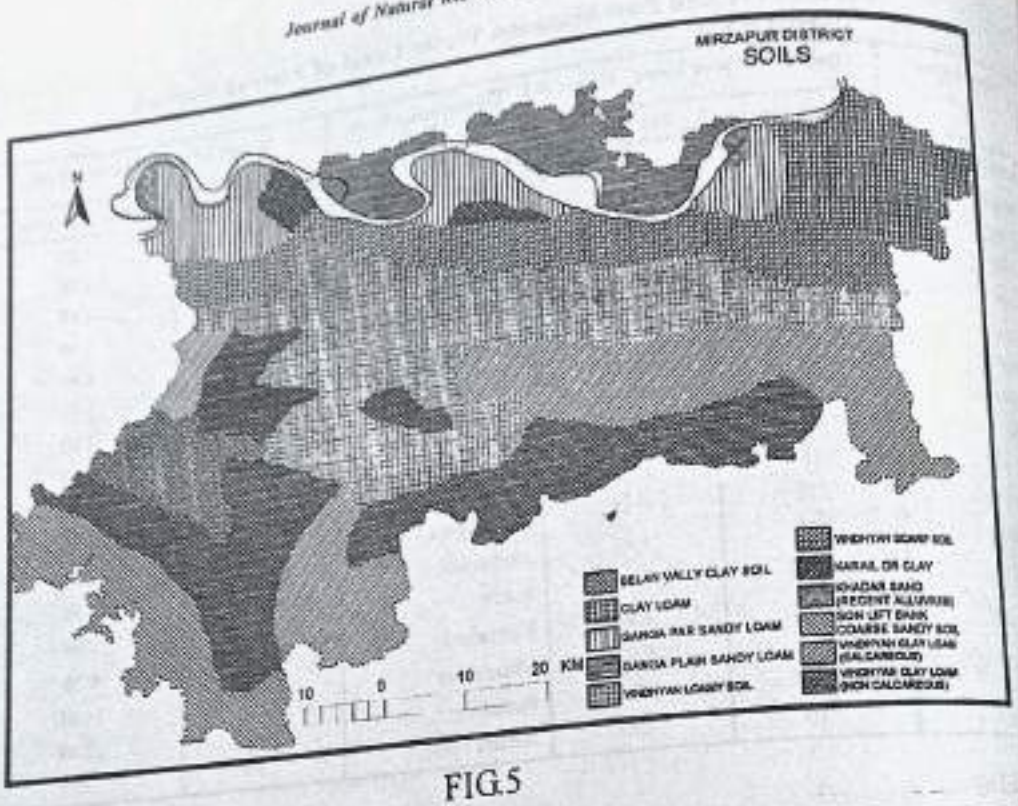
MIRZAPUR DISTRICT
SOILS
N
BELAN VALLY CLAY SOIL
CLAY LOAM
DANDIA RAR SANDY LOAM
DANDIA PLAIN SANDY LOAM
VINDHYAN LOAMY SOIL
KHADAR SAND
(RECENT ALLUVIUM)
SON LEFT BANK
COARSE SANDY SOIL
VINDHYAN CLAY LOAM
(NON CALCAREOUS)
10 0 10 20 KM

FIG.5

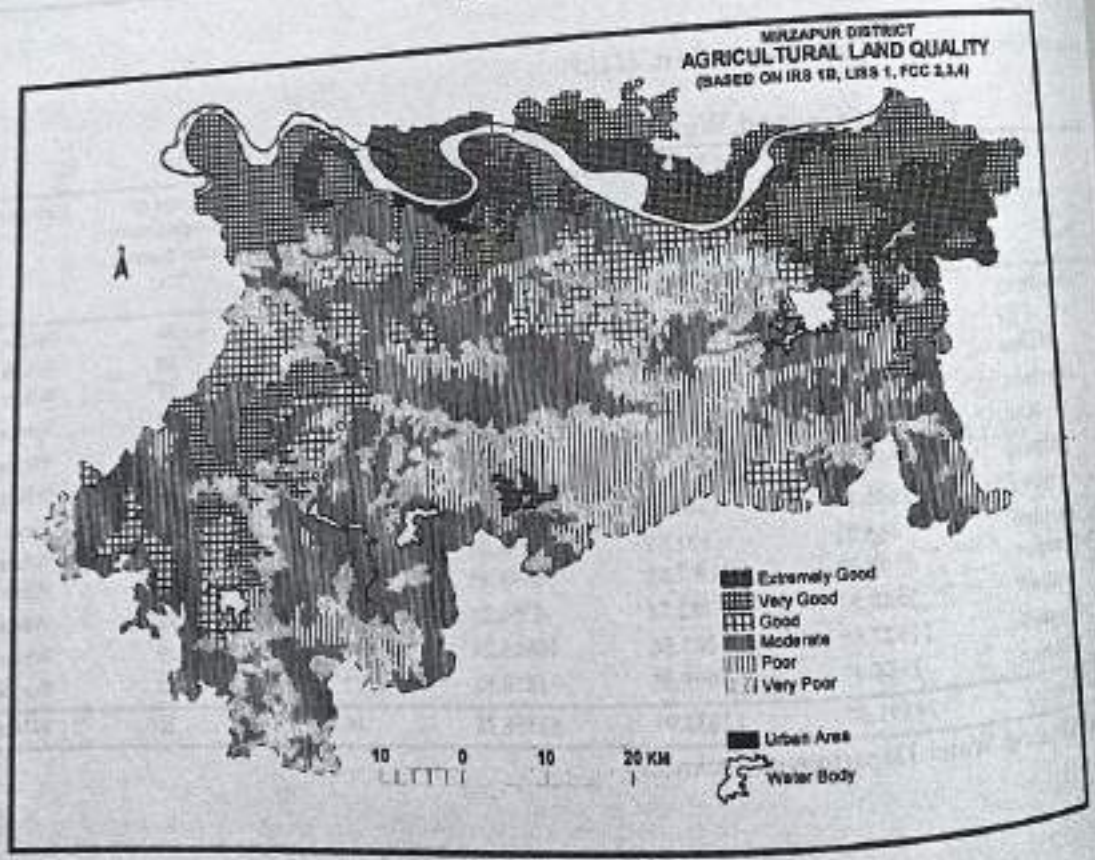
MIRZAPUR DISTRICT
AGRICULTURAL LAND QUALITY
(BASED ON IRS 1B, LISS 1, FCC 2,3,4)
N
Extremely Good
Very Good
Good
Moderate
Poor
Very Poor
Urban Area
Water Body
10 0 10 20 KM

FIG. 6

(5) Vindhyan Loam Soil

It has been developed on the undulating Vindhyan upland and situated in middle part of the area. It consist of high sand content (more than 60%), followed by 19% clay and 18.25% silt. Its colour is red to dark and slightly acidic in reaction.

(6) Vindhya Scarp Soil

It has marked in a narrow belt along the foot of the plateau scarpment zone where the streams descend from the upland. It has higher proportion of coarser materials.

(7) Karail or Clay

Its colour is dark and having higher content of clay (50.08%) with 18.97% of silt. It is also found to be highly fertile.

(8) Khadar Sand (Recent Alluvium)

It occurs in the Ganga flood plain in the Khadar land. The soil colour is gray and constitutes about 80% sand with slight alkaline. The soil profile is not developed due to frequent deposition of fresh alleviation during flood.

(9) Son Left Bank Coarse Sandy Soil

It is developed in narrow belt along the left of Son River (south part of the district) from lower Vindhyan limestone and shale. It has 13.07% silt and 16.0% clay and characterized by yellowish gray colour with neutral reaction. It is locally known as 'balui'.

(10) Vindhyan Clay Loam

It has been developed in the basin of river Belan with 25.75% silt and 33.88% clay in the upper horizon. It is characterized by dark gray colour and slightly alkaline in nature with cloddy and indurated.

(11) Vindhyan Clay Loam (Non-Calcareous)

It is locally known as 'Gurmota'. It is situated mostly on the undulating southern Vindhyan upland in the margin of Belan valley. It is generally gray in colour with varying degree of darkness with 20-25% silt and 23-26% clay in the upper layer.

NATURAL VEGETATION

The spatial distributions of natural vegetation of the area under study are largely controlled by the geomorphic and geologic factors along with the soil, water and moisture conditions. The natural vegetation can broadly be grouped as: (i) Ganga plain vegetations, and (ii) Upland vegetations. Bomboos, guavas, plums, mangoes, are found as orchards while species like Banyan (Ficus indica), Jamun (Syvgium cumin), Mahua (Madhuca logofolia), Neem (Malia azadira), Pipal (Ficus religious), etc. are prominent in riverine areas of Ganga plain. The vegetations in upland area (Vindhyan plateau) includes the forests, bushes and grasses depending on the topography of the region, for example, the forest can be observed on dissected plateau region, hill slops, hill tops etc. The bushes and grasses are prominent on pediment zone.

The forest type in Mirzapur district can be classified in (i) moist peninsula valley sal, (ii) tropical river side's forest, and (iii) southern / northern dry mixed deciduous forest (Champion and Seth, 1968). The moist peninsula valley sals are largely found in the valleys of major river and their tributaries. The construction of dams especially at Meja and Sirsi damaged this type of forest and now the sal trees are confined only in a short belt.

The tropical river side forests are found in strips along rivers and nalas in which prominent species are Jamun, Gular, Tendu, Ajawai, Karaunda. The southern / northern dry mixed deciduous forest are found on the major portion of the study area especially on Kaimur hills and Vindhyan plateau. The common species in this area are Asna (Tarmmalia tomentosa), Dhao (Angeissus pendula), Khair (Acacia catechu), Tendu (Diospyres tomentosa), Jinga (Cannea caromandalica), Piyar (Buchanania lazz on), Mahua (Madhuca logofolia), Aonla (Ennblica afticinalis), Kakor (Liziphus glabarrime), Palas (Butea monosperma), etc. The main characters of the trees of such forests are to fall their leaves after March due to poor moisture conten t in the soils along with very thin depth of soils and become green during rainy season.

Table 7: Land Quality in Mirzapur District (GIS Analysis Based on IRS-IB, LISS-1, FCC-B-2, 3 & 4) (In percent)

Block	Land Quality					
	Extremely Good (V1)	Very Good (V2)	Good (G)	Moderate (M)	Poor (P)	Very Poor (VP)
Chhanway	11.43	64.73	0.80	9.63	1.15	12.23
Kon	100.00	0.00	0.00	0.00	0.00	0.00
Majhwa	32.43	67.57	0.00	0.00	0.00	0.00
City	19.93	24.59	4.33	35.40	4.42	11.32
Pahari	4.63	7.79	24.72	24.42	12.41	26.04
Lalganj	0.00	11.79	27.58	31.38	5.66	23.59
Haliya	0.00	8.74	11.07	52.37	6.46	21.37
Marihan	2.70	0.00	1.03	43.71	23.35	29.21
Rajgarh	2.12	3.65	5.50	31.67	34.86	22.00
Sikhar	89.97	10.83	0.00	0.00	0.00	0.00
Narayanpur	27.93	53.39	7.16	0.00	5.74	5.51
Jamalpur	41.43	39.98	0.00	9.18	6.92	2.49
Total District	**11.49**	**16.98**	**8.52**	**30.98**	**13.51**	**18.53**

NATURAL VEGETATION

The spatial distributions of natural vegetation of the area under study are largely controlled by the geomorphic and geologic factors along with the soil, water and moisture conditions. The natural vegetation can broadly be grouped as: (i) Ganga plain vegetations, and (ii) Upland vegetations. Bomboos, guavas, plums, mangoes, are found as orchards while species like Banyan (Ficus indica), Jamun (Syvgium cumin), Mahua (Madhuca logofolia), Neem (Malia azadira), Pipal (Ficus religious), etc. are prominent in riverine areas of Ganga plain. The vegetations in upland area (Vindhyan plateau) includes the forests, bushes and grasses depending on the topography of the region, for example, the forest can be observed on dissected plateau region, hill slops, hill tops etc. The bushes and grasses are prominent on pediment zone.

The forest type in Mirzapur district can be classified in (i) moist peninsula valley sal, (ii) tropical river side's forest, and (iii) southern / northern dry mixed deciduous forest (Champion and Seth, 1968). The moist peninsula valley sals are largely found in the valleys of major river and their tributaries. The construction of dams especially at Meja and Sirsi damaged this type of forest and now the sal trees are confined only in a short belt.

The tropical river side forests are found in strips along rivers and nalas in which prominent species are Jamun, Gular, Tendu, Ajawai, Karaunda. The southern / northern dry mixed deciduous forest are found on the major portion of the study area especially on Kaimur hills and Vindhyan plateau. The common species in this area are Asna (Tarmmalia tomentosa), Dhao (Angeissus pendula), Khair (Acacia catechu), Tendu (Diospyres tomentosa), Jinga (Cannea caromandalica), Piyar (Buchanania lazz on), Mahua (Madhuca logofolia), Aonla (Ennblica afticinalis), Kakor (Liziphus glabarrime), Palas (Butea monosperma), etc. The main characters of the trees of such forests are to fall their leaves after March due to poor moisture conten t in the soils along with very thin depth of soils and become green during rainy season.

Spatial Distribution of Agricultural Land Quality Zones

The extremely good and good qualities of agricultural land are characterized with the intensive cultivation and very good harvesting efficiency. It can be identified on satellite imagery by very dark red tone and smooth texture. The extremely good quality of agricultural land is registered maximum in Kon (100 percent) block. The very good quality of agricultural land have been identified by light red and fine to moderate texture and occupy highest rank in Lalganj block (27.58 percent). The moderate category of agricultural land quality is characterized with gray to red mixed tone because of reflectance variation caused by mixed objects (such as cultivation, settlement, trees etc.) and moderate to coarse texture. It has occupied highest area extent in Haliya block (52.37 percent). The poor quality of agricultural land is recorded highest in Rajgarh (34.86 percent) whereas very poor quality of agricultural land is found to be highest in Marihan (29.21 percent).

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ROLE OF GIS (GEOGRAPHICAL INFORMATION SYSTEM) AND EXPERT SYSTEM IN NATURAL RESOURCE MANAGEMENT

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ABSTRACT

The goal of information systems is to convert data into information. Data are considered to be the input to a process where information is created. Geographic Information Systems (GIS) and expert system is a rapidly advancing technology that enables people to develop, analyze, and display spatially explicit information. After incorporating the coordinates of landscape features into a computer, users can manipulate map information from any source and visualize the landscape at any scale and with any combination of features. By creating computerized maps of project areas, the GIS database can identify. GIS has significant potential value to natural resource managers in such fields as biological inventory and monitoring, land use planning, and ecological research. The purpose of study is to integrate geographic information systems (GIS) with expert systems to develop a technical method and tool for sustainable land development, based on the physical productivity of the soil. The main objectives for the GIS/Expert System development are to apply this integrated system to the natural resource management.

Key Words : *GIS, expert system, natural resource.*

Many countries are already using Geographic Information Systems (GIS) to plan and implement programs to promote sustainable socio-economic and environmental development. The technology, often called mapping software, can be used for a variety of purposes, including resource management, development planning, cartography, and route planning.

GIS (Geographical Information Systems) are commonly used as planning and analysis tools in developing countries, while parallel work has been investigating sustainable development and the future of cities. GIS-P (GIS-Participation) combines GIS and other methodologies of social and environmental assessment in a new set of techniques that meet the aims of sustainability.

GIS Participation combines GIS and other methodologies to give local government the most effective basis for policy formulation in partnership with stakeholders (*John Forrester of the Stockholm Environment Institute and colleagues Howard Cambridge and Steve Cinderby.)* GIS-P is a means for the inclusion of subjective non-expert data into both qualitative and quantitative expert planning processes and models. This enhances effective communication and understanding, facilitates greater stakeholder involvement in decision-making, and assists in monitoring the impacts of management policies. The techniques include the incorporation within a GIS of individuals' or groups' mental maps of the local environment and data about how they interact with that environment. GIS-P also allows for comparisons between factors and identification of sites of special concern or areas of potential conflict, which need to be flagged as requiring possible arbitration. GIS-P can therefore help to promote bottom-up policy development by incorporating local concerns and knowledge, all stored within a single database in a similar way to conventional spatial databases

Influence and Importance of GIS

The role of Natural Resource GIS is to provide internal and external coordination and leadership on Natural Resource and Inventory and Monitoring GIS and information management issues. GIS-P can help to promote bottom-up policy development by incorporating local concerns and knowledge, all stored

within a single database in a similar way to conventional spatial databases.

GIS-P is a means for the inclusion of subjective non-expert data into both qualitative and quantitative expert planning processes and models. GIS-P allows for correlations between maps of different data to be investigated; it also permits analysis of relationships between mapped data and other inputs from citizen groups; in other words, not only the physical environment but the social environment as well can be recorded, thus revealing new information or criteria which could influence possible management patterns for assessing the sustainability of urban environments under various development scenarios. The GIS database provides a structure for storing, interrogating and analyzing other data sets thus enhancing their use and value. The potential to combine different perceptions allows for the investigation of "multiple realities". GIS-P can therefore help to promote bottom-up policy development by incorporating local concerns and knowledge, all stored within a single database in a similar way to conventional spatial databases.

To be effective, the use of information technology must be supported by policies and practices that view data and information as a long-term asset, requiring dedicated management and coordination, to produce increased efficiency and effectiveness in natural resource operation operations. A powerful GIS successfully combines leadership, people, computer hardware and software, applications, and data into a framework or infrastructure that ensures the appropriate tools and rules that are in place to maintain data and turn them into useful information products to support operations and decision-making. A GIS help to provide integrated solution. An integrated solution ensures that good data are accessible and that the appropriate applications are in the hands of the people who need them. An integrated solution also provides opportunities to do new things, and to improve the way current activities are done, in ways currently not foreseen or possible. GIS-P applies novel methodologies for the integration, comparison and utilization of local environmental knowledge. This approach builds on insights from the input of citizen panels into environmental and land use assessment. The GIS-P methodology has already been shown to be a successful vehicle for presentation of lay and public perceptions around land use, the methodology thus provides a model for the integration of public insights not only into the policy process around urban management and development issues but also into computer simulation scenarios. This benefits both local people and local government and brings about improvements in the dissemination of information from local government and governmental agencies to the wider community.

Remote Sensing, Geographical Information System (GIS), Global Positioning System (GPS) and the information technology together provide the requisite support for policy makers to take appropriate, precise and faster decisions about natural resource management. Based on Object oriented approach Gahanna, Worbys have developed system for geographical information manipulation and decision-making. Most of the current object oriented GIS designs emphasis processing of geometric data models and data structures. However, the concept based object oriented GIS by Leung provides a spatial conceptual model which comprises spatial semantics, fundamental to spatial analysis, and an object oriented data model which provides an appropriate and effective representation of the spatial conceptual model for better database management. The remotely sensed data require their analysis, interpretation and preparation of databases at various levels of use and application in different decision-making systems.GIS use remotely sensed data of natural resources along with various ancillary information such as map data, statistical data, meteorological data etc. In such applications AI is again needed to interpret ancillary data for GIS and to provide natural language interface to GIS. Aribib (1995), Gahned and Robot (1998).

Impact and Importance of expert system

The modern era of science and technology is the era of expert skill. Everywhere in every domain relevant expertise is needed. The major problems in accessing a human expert in a particular field are unavailability and scarcity of real experts and if the hu-

man expert is available then there may be problem for common people in making contact with him. Consultation may be very expensive and human expert may feel the repetitive job uninteresting. This in turn may affect expert's efficiency. The other major problems that are being faced by the human expert are the limitation of his memory and processing inability of all the essential knowledge required in the process of decision-making. As a result of researches and developments, day by day, new knowledge in enormous amount is being added in every discipline and thus more relevant and accurate advice can be taken from a human expert if his own knowledge is updated which is not an easy task. Human experts are bounded by limitations and it is quite difficult for a human expert to consider all the essential factors while taking decision. To update his knowledge and get help in decision making process, some tool or assistance is needed even for an expert. The availability of powerful tools to develop expert system has made possible creation of large number of expert systems in different domains. Today the most important applications of expert systems are those in which expert systems access databases used for other purpose or linked to other types of software and systems.

The economic growth of a region depends upon the proper exploitation of its natural resources. The resources like land; water, minerals, forests, fisheries and livestock are the natural gift and are transformable into tangible wealth on exploitation to produce agricultural, industrial and energy outputs. The economic planning for a region or state or nation needs detail information of various items of natural resources. The set of activities related to data management on natural resources, such as data generation, data collection, compilation, storage, retrieval and processing are mutually interacting and inter-dependent which naturally open option for management as a system. In this connection the Department of Science and Technology, Govt. of India has launched the pilot project called as the Natural Resource Database Management System (NRDMS) [4], with following objectives:

1. To evolve appropriate methodology for collection, collation, storage and processing of data on natural resources in a given region in totality.
2. To evolve standardized format in which natural resources and socio-economic data could be presented in an integrated manner to establish linkage among various hierarchical units.
3. To make assessment of natural resources of the areas under study.
4. To make utilization of the information for the purpose of planning and development.

National Remote Sensing Agency (NARSA), Bangalore has developed an expert system in PROLOG, to access the databases of acquired/processed remote sensing data. This expert system provides access to databases by making queries relevant to type of data needed for a particular application. NARSA has also developed expert systems for interpretation of remote sensing data / images emulating the experiences and logical reasoning process used by human experts to derive information from remote sensing data/ images. Such expert systems have been developed for interpretation in the area of soil studies, land use, land capability, geology etc.

The significant developments in the field of electronics, computer science, artificial intelligence, communication, space-technology, availability of variety of sensors and platforms, remote sensing techniques and data processing techniques enable collection, analysis and interpretation of data with multi-objective approach at highly minimized cost. The advancements in the information technology have made the area of natural resources management information rich. Information is coming in volumes and can be obtained by various means such as maps in conventional and digital form, aerial photographs surveys or experimental data, remotely sensed images and other forms of transmitted signal. The application of knowledge and expertise related to natural resources is essential and will be helpful in streamlining, analyzing, managing, digesting, visualizing and integrating information in an efficient and affective manner. The role of knowledge and information is complementary in

the intelligent decision-making.

In recently years the of remote sensing is used in data collection of natural resources management. The technique of remote sensing has been applied in almost every aspect such as atmosphere, geosphere, biosphere, hydrosphere, and cryosphere together with environmental application and data collection systems etc. of natural resources management. Remotely sensed data/images are used to obtain necessary information on land under various crops, crop rotation and agricultural practices adopted, soil types, problems of land degradation, availability of water bodies (both surface and ground water) etc., which are very useful for agricultural development. The remotely sensed data/images can be taken even of inaccessible land and identification of unused land, waste land, degraded land etc. Satellite remote sensing data are useful in carrying out integrated sustainable development planning at manageable units. The remote sensing data can be used for the preparation of a set of resource maps such as surface water bodies, ground water potential zones, ground water recharge site, type of soil, existing land use patterns etc. and the combination of these data with other information like meteorological data, socio-economic factors etc. can be used to identify the priority areas for various land use to meet the needs of the people without disturbing the ecology. Rao (1991).

The knowledge representation scheme of natural languages is the most sophisticated and this very act of knowledge representation have been captured by logic, and different formal methods such as propositional logic, predicate logic, fuzzy logic, semantic networks, frames etc. and related techniques have been developed to represent various types of knowledge that can be used by expert systems in decision making and reasoning. In the recent years the asymbolic approach for intelligence modeling has evolved in which neural networks, modelled after human brain, are connected to represent knowledge and to make inferences. In such systems the knowledge is encoded by connection strength and acquired through learning process. In geographical analysis, decision-making system like intelligent spatial decision support systems have been developed to reason with structured or loosely structured knowledge. Here, again the expert system shell play core role in directing control flows and information flows. It provides facilities to represent and store domain specific knowledge acquired form experts or learning examples.

The object oriented programming approach has been found to be very effective approach in developing systems for the natural resources management. The object-oriented approach provides the way for user to perceive reality. It provides an effective user interface, enhances data reusability, maintainability, and extensibility through data encapsulation and inheritance. Obviously, Expert systems have large impact and scope for the application of remote sensing techniques in the monitoring and management of natural resources. Thus seeing the potentials of field large effort are required to be made to develop expert systems for natural resources management. We can also develop an expert system for natural resource management in basis of object identification, modeling and optimization module. Deekshatulu (1991).

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