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INFLUENCE OF PHYSICO-CHEMICAL FACTORS ON THE DRY WEIGHT OF PLANKTONIC BIOMASS IN A COMMERCIAL FISH FARM

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The main objective of this study was to establish correlation between physico-chemical factors and dry weight of planktonic biomass. Among the physical factors significant ($P < 0.05$) interaction between dry weight of planktonic biomass and light penetration was observed. The coefficient of determination $(R)^2$ of physical factors on biomass was observed to be .389. The correlation of biomass with total alkalinity, total hardness, potassium and nitrates was significant ($P < 0.05$). The calculated R^2 of chemical factors on dry weight of planktonic biomass was .753. The overall contribution of physico-chemical factors towards dry weight of planktonic biomass was 83.31%.

INTRODUCTION

Fish culture is considered today as one of the most promising sources of animal proteins for the future. Of late, the potential and verstality of fish culture has been increasingly realised all over the world and much more attention is being directed towards its adoption and promotion. Pakistan has extensive fresh water fisheries resources which at present are not being adequately utilised due to lack of research and other technical inputs. Studies on limnological aspects of water bodies are of great significance in intensive fish farming. The biological production of freshwater provides basic food for the growth of fish which in turn depends upon the ecological and physico-chemical conditions of water body. Ecologically,

the productivity is measured in terms of the standing crop or biomass which represents instantaneous quantity of organisms. Changes in the dry weight of planktonic biomass depend upon the physico-chemical environment of water body (Boyd,1982 and Mahboob et al , 1988). The phytoplankton population showed a direct relationship with light penetration, pH, dissolved oxygen, total alkalinity and hardness of water (Vasisht and Jindal, 1980 and Saleem, 1986). Levasseur et al. (1984) provided information about the influence of light penetration on the phytoplankton production. They described that the phytoplankton production period was short (June-September) and was characterised by the occurrence of 3 distinct peaks. This paper primarily provides information about the influence of physico-chemical factors on the dry weight of planktonic biomass in a commercial fish farm near Faisalabad.

MATERIAL AND METHODS

Ajmal Fish Farm is located at about 19km from Faisalabad. The farm is rectangular in shape (144m x 38m) and its depth varies from 1.0 to 2.5 m. It is surrounded by small trees from three sides and is exclusively served with tube-well water. Major Carps viz. Catla catla, Labeo rohita and Cirrhina mirgala were cultured with a total density of 3000 fishes/acre. The pond was treated with poultry droppings at the rate of 1200 kg/acre.

Water samples were collected fortnightly in plastic bottles. Air and water temperature was recorded with the help of an alcohol thermometer. Secchis' disc was used for determining light penetration, while pH and electrical conductivity of water samples were determined in laboratory. Dissolved oxygen, total alkalinity, carbonates, bicarbonates, total hardness, Ca^{++}, Mg^{+}, nitrates, phosphates, total solids and total dissolved solids and dry weight of planktonic biomass were estimated according to Boyd (1981). Sodium and potassium concentrations were assessed by flame photometer. The data thus obtained were analysed by M Stat Programme (Power,1986) by using IBM-PC.

RESULTS AND DISCUSSION

The results of the correlation between physical factors and dry weight of planktonic biomass revealed significant ($P < 0.05$) interaction between dry weight of biomass and light penetration (Table 1), which showed the interdependence of phytoplanktonic life on the penetration of light. The results of the present study are supported by Saleem (1986).

Table 1. *Simple correlation between physical factors and dry weight of biomass*

	Light penetration	pH	Electrical conductivity	Dissolved oxygen	Dry weight of biomass
Water temperature	$.650^{**}$	$-.034^{NS}$	$.720^{**}$	$-.434^{*}$	$-.166^{NS}$
Light penetration		$.193^{NS}$	$.604^{**}$	$.297^{NS}$	$-.425^{*}$
pH			$-.421^{*}$	$.300^{NS}$	$-.021^{NS}$
Electrical conductivity				$-.219^{NS}$	$-.201^{NS}$
Dissolved oxygen					$.277^{NS}$

* = ($P < 0.05$); ** = ($P < 0.01$); NS = Non-significant.

The correlation between water temperature, light penetration, electrical conductivity and dissolved oxygen was signigicant ($P < 0.05$). showing that water temperature highly significantly affected the light penetration through the abundance of phytoplanktons, which increased the dissolved oxygen. The interaction between pH and electrical conductivity was also significant ($P < 0.05$), The coefficient of determination (R^2) of biomass on physical factors was observed to be .389. The R^2 indicated that there was 38.9% contribution of these factors on the dry weight of planktonic biomass (Table 2).

Table 2. *Regression coefficient of physical factors on dry weight of planktonic biomass*

Variables	Regression coefficient	Standard error	Student t-value
Water temperature	10.880	12.487	.871
Light penetration	-61.597	24.183	-2.547
pH	17.1052	193.802	.088
Electrical conductivity	-54.588	264.617	-.206
Diasolved oxygen	40.168	18.221	2.204
Constant	1337.895		
Coefficient of determination (R^2)	.389		

The correlation between chemical factors i.e. carbonates,bicarbonates, total alkalinity, total hardness, calcium, magnesiumm, chloride, sodium, potassium, nitrates, phosphates and dry weight of planktonic biomass was found to be variable (Table 3). The correlation of biomass with total alkalinity, total hardness, potassium and nitrates was significant ($P < 0.05$), indicating that these chemical factors and dry weight of planktonic biomass were interdependent upon each other, agreeing thereby with the results obtained by Vasisht and Jindal (1980) and Saleem (1986). However, the correlation between biomass and carbonates, bicarbonates, and phosphates was non-significant.

The calculated R^2 showed that the effect of chemical factors on dry weight of planktonic biomass wass 75.% (Table 4).

Table 3. *Simple correlation between chemical factors and dry weight of biomass*

Variables	Bicarbonates	Total alkalinity	Total hardness	Ca^{++}	Mg^{+}	Chloride	Sodium	Potassium	Nitrates	Phosphates	Dry Wt. of biomass
Carbonates	.355 NS	.788 **	.710 **	710 **	-.161 NS	.667 **	.707 **	.652 **	.342 NS	.577 **	-.397 NS
Bicarbonates		.845 **	.036 NS	.063 NS	.240 NS	-.085 NS	.213 NS	.391 NS	.290 NS	.268 NS	-.313 NS
Total alkalinity			.457 **	.373 NS	.071 NS	.306 NS	.252 NS	.617 **	.397 NS	.492 *	-.429 *
Total hardness				.685 NS	.137 **	.482 *	.587 **	.550 **	.295 NS	.420 *	-.429 *
Calcium					-.361 NS	.620 **	.714 **	.323 NS	.536 **	.637 **	-.185 NS
Magnesium						-.459 *	-.436 *	.007 NS	-.197 NS	-.058 NS	.218 NS
Chloride							.877 **	.420 *	.253 NS	.659 **	-.291 NS
Sodium								.520 **	.141 NS	.520 **	-.349 NS
Potassium									-.032 NS	.391 NS	.431 *
Nitrates										.549 **	.419 *
Phosphates											-.324 NS

* ($P < 0.05$); ** ($P < 0.01$); NS = Non-significant.

Table 4: *Regression coefficient of chemical factors on dry weight of planktonic biomass*

Variables	Regression coefficient	Standard error	Student t-value
Carbonates	24.575	12.722	1.932
Bicarbonates	28.843	15.007	1.922
Total alkalinity	-29.306	13.945	-2.102
Total hardness	7.242	3.256	2.224
Calcium	- 3.277	3.814	- .859
Magnesium	- 7.364	10.198	- .722
Chloride	- .528	2.770	- .191
Sodium	.852	1.689	- .505
Potassium	-33.513	31.341	-1.069
Nitrates	34.053	23.321	1.460
Phosphates	-4564.012	9957.493	-.456

Constant = -83.847

Coefficient of determination(R^2) = .573

The overall coefficient of determination (R^2) was .833, indicating a mutual interaction between physical and chemical factors (Table 5).

Table 5. *Regression coefficient of physico-chemical factors on dry weight of planktonic biomass*

Variables	Regression coefficient	Standared error	Student t-value
Water temperature	16.979	23.966	.708
Light penetration	-79.832	60.007	-1.330
pH	-24.258	274.760	- .008
Electrical conductivity	527.942	451.718	1.169
Dissolved oxygen	- 3.427	34.083	- .101
Carbonates	14.202	16.943	.838
Bicarbonates	17.058	20.035	.851
Total alkalinity	-18.790	18.613	- .009
Total hardness	- 1.160	5.275	- .220
Calcium	9.712	7.061	1.375
Magnesium	13.448	14.538	.925
Chloride	2.820	4.787	.589
Sodium	- 1.847	2.453	- .753
Potassium	- 5.753	62.821	- .092
Nitrates	44.009	35.797	-1.229
Phosphates	-166462.633	16332.574	-1.008

Constant = -1479.989

Coefficent of determination (R^2) = .883

The stepwise multiple regression analysis indicated that the effect of water temperature,carbonate, total hardness and potassium on biomass was 7.06%, 15.06%, 11.80% and 22.71% respectively. It was indicated that that there was 56.63% effect of these four factors on biomass while the effect of the remaining factors was negligible.

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