J. Phytol. Res. 4(2), 1991

ECOLOGY AND PRODUCTIVITY STUDIES ON *SPIRODELA POLYRHIZA* L. SCHL.

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Biomass production of *Spirodela polyrhiza* L. was studied in a slow moving, perennial stream for a period of one year. Bimodal peaks of biomass production was recorded. Daily biomass production (0.079 g/m^2 /day and net annual production (11.511 g/m^2 /year) values recorded were very low. Physico-chemical parameters of water and the bottom sediments exhibited interesting correlationships with biomass production had also been discussed.

Keywords : Ecology; Productivity; *Spirodela polyrhiza.*

Introduction

Region Jammu, the winter capital of J&K state provides a varied climatic ranges, in which exist a number of different types of aquatic habitats like ponds, lakes, rivers and streams. These aquatic habitats conceal a large number of different macrophytic plants which are very important from the point of view aquatic productivity. Very little work has been done on the productivity of macrophytic vegetation of water bodies of Jammu-J&K state (Anand, 1977, 1986). Keeping this in mind, studies were initiated pertaining to the productivity of aquatic macrophytes.

In the present communication, ecology and productivity of *Spirodela polyrhiza* growing in a slow moving stream has been dealt. Investigations were conducted for a period of one year. Since the plant was quite infrequent in the stream, these studies were restricted only at Station-II of the stream where floating mats of *S. polyrhiza* showed a healthy growth (Fig. 1).

Materials and Methods

For analysis of biomass production, five samples were collected at random using m^2 quadrate during every month. Plants were washed thoroughly and dried in an oven at 60°C to a constant weight. Biomass production, standing crop, turn over values and annual increment were calculated after the methods of Misra (1974) and Misra *et al.* (1970)

Dissolved oxygen concentration of water was measured by modified Wink-

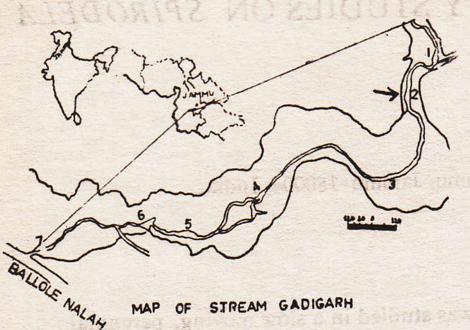

Fig. 1 Location of Station II (arrowed) in the stream.

ler's methods (Lagler, 1970). Maximum and minimum temperature of water and air, bicarbonates, carbonates, chlorides, calcium and magnesium, phosphates were determined after the methods of Schowoerbel, 1970; A.P.H A., 1965 and Lagler, 1970.

Bottom sediments were analysed for particle size distribution, pH, conductivity, bicarbonate, carbonate, organic matter, available phosphates, potassium, total nitrogen and organic carbon after the methods Olsen *et al*, Bremner, Pratt and Walk Blacks (cf. Black, 1965), A.P.H A., Kanwar and Chopra, 1967 and Wilde *et al.*, 1972.

Results and Discussion

Topographic features of Station II — Fig. 1 indicates the location of Station II of the stream which is 79.8 mts long, 1.9 to 9.3 mts wide, and 20–130 cm deep. Depth and the width increases tremendously during the rainy season when the whole stream swells up. Main sources of water either the incessant rains, overflown water from surrounding agricultural fields or the subterranean natural springs. *Typha angustata* and *Ipomea carnea* grow densely along the shore line.

Water — Fig. 2, indicates the physico-chemical properties of the stream water at Station II. The water was alkaline (pH 8.0–8.3); carbonates had never been detected throughout the course of investigations; bicarbonates, calcium, magnesium and phosphates showed distinct variations during certain months of the year.

Bottom sediments — The bottom sediments of the Gadigarh stream was alkaline in nature; mostly yellowish-grey with 5 YR and 10 YR hues being a very common and was alluvial. Table 1 and Fig. 3 reveal the fluctuations shown by bicarbonates, pH, phosphate, organic matter, total nitrogen, available potassium and C:N ratio of the bottom sediments at Station II.

Productivity — The biomass production of *S. polyrhiza* during November, 1974 to October, 1975 at Station II has been tabulated in Tables 2 & 3.

S. polyrhiza appeared during the month of February at the Station II and increased in density in the preceding months. It thrived better and was abundant in shallow regions of the Station II rich with organic matter. The plant formed pure mats or grew in association with *Azolla pinnata*; the mats being held up by *Typha angustata* and *Ipomea carnea.*

The area under investigations experiences three seasons, i.e., winter

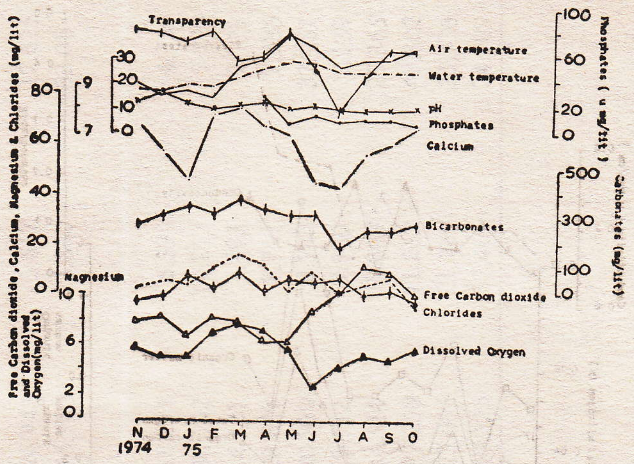

FIG - 2

Fig. 2 Seasonal changes in different physio-chemical parameters of the water at Station-II.

(November to February), summer (March to June) and monsoon (July to September). Table 3; Fig. 4 reveal that the year round biomass production resulted two maxima peaks; one during the winter and other in summer. Floods, caused through the incessant and seasonal rains washed away the vegetation and resulted in a bimodal pattern of biomass production of *S. polyrhiza.* Singh (1982) also recorded a bimodal pattern of biomass production in case of *Lemna minor* L. and *Spirodela polyrhiza* while studying a pond.

Comparing the two maxima peaks recorded in the year, winter maxima as smaller as compared to the summer maxima. Highest value of dry matter biomass production 6.9 g/m^2 was recorded in June. The atmospheric temperature and sunshine hours available during summer (particularly in the month of June) were maximum and congenial for the luxurient growth of *S polyrhiza* in the present stream water. After the cessation of monsoons, the water became calm and station gets stabilized. The amount of biomass production was not as high in winter as during summer (Table 4). It was due to low temperature which slows down the metabolic activities (Tables 2 & 3). But from February onwards, there was a gradual rise in temperature (air and water) and this rise in temperature ran parallel with the increase in dry matter biomass production till a highest value of 6.9 g/m^2 was achieved. This revealed that air and water temperature coupled with the rate of water flow (being higher during rainy season) plays a significant role in the productivity of *S. polyrhiza.* This agrees with Popp (1926), Shirley (1929) and Jha (1968).

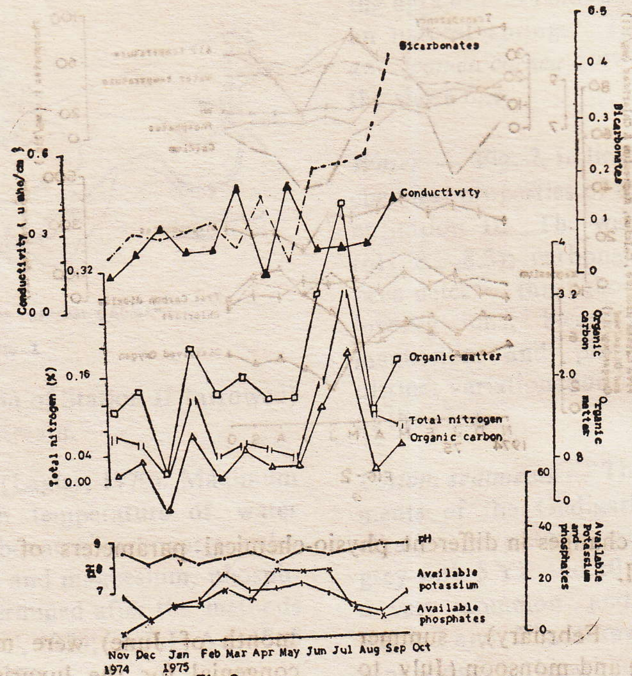

Fig. 3 Seasonal changes in different physico-chemical parameters of the bottom sediments at Station-II.

The daily mean biomass production (0.079 g/m^2/ day) and net annual production (11.511 g/m^2 year) values were very low as compared to the one obtained for the lentic (standing) water bodies (Nasar and Munshi, 1976). The turn over value calculated for *S. polyrhiza* is 0.24 which indicated that 24% of the biomass is being replaced each year (Tables 2 & 3). These values were very low as compared to the one obtained for a pond of Bhagalpur (Nasar and Munshi, 1976), indicating about the different nature of the water bodies (the present being a lotic water body while that worked out by Nasar and Munshi a lentic one). The annual average rate of production (1.92 g/m^2 / day) of *S. polyrhiza* in this stream was within the ranges obtained by other workers for different ecosystems i.e. 1.9 g/m^2 for pond macrophyts, Varanasi (Jha, 1968) and 2.2 g/m^2 for pond macrophytes, Bhagalpur (Nasar and Munshi, 1971).

Low oxygen values were recorded during the months with higher biomass production (Tables 1 & 2). This indicated that the floating mats of *S. polyrhiza* made the oxygen exchange difficult and thus depleted the oxygen concentration. Sucha condition promoted the production of detritus and increased the concentration of free carbondioxide and other gases (Anand, 1977).

Table 1. Monthly values of particle size distribution (sand, silt, clay & loam) and colour of bottom sediments at Station II in Gadigarh stream.

Period	Munshell colour	Texture	Totat sand	Silt	Clay	Loam
1974						
November	5YR 7/1	Sandy–silt	42.303	26.443	13.617	17.635
December	5YR 5/3	Loamy–clay	15.452	15.900	23.880	33.05
1975						
January	10YR 6/2	Sandy–silt	71.039	18.211	5.394	4.756
February	10YR 7/1	Sandy–silt	39.756	38.742	14.213	7.229
March	10YR 7/1	Sandy	81.606	14.121	1.493	2.779
April	10YR 6/2	Sandy–silt	55.568	28.617	8.719	7.636
May	10YR 6/2	Sandy–loam	37.667	20.910	8.742	32.481
June	10YR 6/2	Sandy–silt	68.270	19.712	9.870	2.139
July	5YR 6/3	Silty–sand	33.178	34.514	6.943	25.365
August	5YR 6/3	Loamy–silt	15.336	23.250	11.612	49.802
September	5YR 5/3	Loamy–silt	19.682	23.096	21.786	35.436
October	5YR 6/3	Silty–sand	28.365	30.125	17.401	24.109

Table 2. Monthly net production (gain/loss, g/m²) in biomass of *S. polyrhiza* in Gadigarh stream

Period from November, 1974 to October, 1975 (monthly interval)	Net production (g/m^2)
November — December	+ 0.58
December — January	— 3.98
January — February	+ 2.68
February — March	— 1.607
March — April	+ 3.198
April — May	— 1.17
May — June	+ 3.799
June — July	— 6.9
July — August	+ 0.273
August — September	+ 0.981
September — October	— 1.234

Net annual production = 11.511 g/m^2 /year
Net daily production = 0.079 g/m^2 /day
Turn over value = 0.24

The water and soil of this stream was alkaline (Table 1 & Fig. 3). No clear relationship could be derived between dry matter biomass production and chloride; but magnesium and bicarbonates showed direct relationship (Tables 1 & 3). Carbonates had not been detected from the stream water during the course of presesnt investiga tion.

The average mean values of biomass production of *Spirodela* and that of water of the stream for pH and bicarbonates contents showed a positive correlation; but no such correlation could be possible for the bottom sediment of the stream (Tables 2 & 4 and Figs. 2–4). Thus, for the productivity of floating plants in general and *Spirodela* in partiular of the two media (water and bottom sediments), water is very important. The soils releases the nutrients into the water slowly and gradually from the loose, viscous top layer above the hard bottom. From this nutrient rich water, the floating plants absorb the minerals either through the roots or from the surfaces in contact with the water surface. Seddon (1967) emphasized the importance of water being prime than the bottom sediments in circulation of nutrients in the lacustrine ecosystem and a substrate is the secondary or a modifying factor which varies from place to place. Thus,

Table 3. Biomass production of *S. polyrhiza* in Gadigarh stream.

period	Standing crop	Production
	Dry wt. /g/m² /month	Dry wt. /g/m² /day
1974		
November	3.4	0.113
December	3.98	0.13
1975		
January	—	—
February	2.68	0.10
March	1.073	0.035
April	4.271	0.14
May	3.101	0.1
June	6.9	0.222
July	—	—
August	0.273	0.01
September	2.254	0.08
October	1.02	0.033

Table 4. Seasonal average values of pH, HCO_3 and biomass production at Station II.

	Winter	Summer	Monsoon
pH water	8.05	8.16	8.03
Bottom sediment	8.19	8.17	8.46
HCO_3 water (ppm)	311.86	341.33	231.33
Bottom sediment (%)	6.073	0.1022	0.225
Biomass production	2.51	3.836	0.642

Fig. 4 Seasonal fluctuations in biomass production (g/m^2 /month) in *Spirodela polyrhiza* L. Schl. at Station-II.

the bottom exhibited its own pattern of productivity being influenced by a number of various physico-chemical factors of water and bottom sediments amongst which the rate of water flow and temperature being of prime importance.

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