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Seasonal Variations in Sugar and Protein Contents of Halophytes in Indian Desert

Sher Mohammed and David N Sen
Plant Ecology Laboratory, Department of Botany, Jai Narain Vyas University, Jodhpur 342 001, India

Abstract Seasonal changes in sugar and protein contents of some important halophytes in Indian desert have been studied and presented here. Plants at Jodhpur (site-II), which is non-saline, showed maximum sugar during summer season. Plant species at Pachpadra (site-I), which is extremely saline, indicated higher sugar during rains, when soil salinity is reduced. Crude protein declined under drought or saline stress at both sites. Plant species at site-II exhibited higher crude protein as compared to those at site-I.

Key words halophytes, sugar, protein, arid zone

In Indian desert, salinity and water stress are the most important factors responsible for plant metabolic activity. The effect of salinity as specific and dominant factor in a saline environment determines to a great extent the ability of halophytes to reproduce and perpetuate. High concentration of salts, which accumulate in cell sap, can affect water relations and metabolism of plants. Salt accumulation seems to reduce activity of certain enzymes resulting in a decreased metabolic rate. The present study was aimed to obtain a better understanding in seasonal variations in sugar and protein contents of halophytes in Indian desert.

Materials and Methods

For the present study plants were collected every month from two different sites, *viz.,* Pachpadra salt basin (site-I), 100 km west of Jodhpur town and Botanical Garden of JNV University, Jodhpur (site-II) during 1985-1988. Out of eight plant species, four *viz., Suaeda fruticosa* (Linn.) Forsk., *Salsola baryosma* (Roem. et Schult.) Dandy, *Sesuvium sesuvioides* (Fenzl.) Verdc. and *Trianthema triquetra* Rottler ex. Willd were common at both the sites. *Aeluropus lagopoides* (Linn.) Trin. ex. Thw. Enum, *Sporobolus helvolus* (Trin.) Th. Dur. et Schinz, *Cressa cretica* Linn. and *Zygophyllum simplex* Linn. (red strain) were observed only at site-I. Fresh leaf samples were collected and dried in oven at 80°C for 24 h. Sugars were estimated in the dried leaves using Anthrone reagent (Plummer 1971) and crude protein by micro-kjeldahl method (Peach & Tracey 1955). The osmotic potential of fresh leaves was measured as per the method of Janardhan *et al.* (1975).

The data, mean of the study period, were statistically analysed after Gomez & Gomez (1984). All estimations, were done in triplicate and repeated twice for confirmation.

Results and Discussion

Metabolism of carbohydrates in plants is affected with increase in salinity, as well as by types of ions present. The plant species of site-II, which is non-saline (EC ranges from 0.18-2.1 dSm^{-1} in 1:5 soil-water extract), showed maximum sugar content during summer season (Table 1) when plant water stress was higher than in winter or rainy seasons (Table 2; Sen & Mohammed 1992). The plant species of site-I, which is extreme saline (EC : 3.2-13.0 dSm^{-1}) indicated higher sugar content during rainy followed by winter and least in the summer season. These varying observations in sugar content may be due to the higher salinities at site-I, because the level of soluble sugars decreased with increase in salinity levels, as observed by Gill & Singh (1985) in different varieties of paddy (*Oryza sativa*) at germination stage when samples were collected upto 72 h after salt treatments. Chavan & Karadge (1986) also observed in *Sesbania grandiflora* an

Table 1 *Seasonal variations in total sugar and crude portein contents in halophytes growing at sites-I & II*

Species	Site-I				Site-II			
	R	W	S	CD 5%	R	W	S	CD 5%
				Total sugar (mg g^{-1})				
A. lagopoides	34.1	–	–	a	–	–	–	–
C. cretica	39.1	11.4	17.5	9.4	–	–	–	–
S. baryosma	33.2	16.3	18.4	7.9	5.3	10.2	18.5	9.1
S. sesuvioides	21.6	8.7	–	a	16.2	16.6	–	a
S. helvolus	29.5	7.9	14.1	10.2	–	–	–	–
S. frutieosa	39.1	35.2	18.5	17.2	4.6	14.2	24.7	19.2
T. triquetra	10.0	4.3	–	a	5.0	14.8	19.5	9.3
Z. simplex	18.3	25.4	–	a	–	–	–	–
				Crude protein (%, d.w.)				
A. lagopoides	12.2	–	–	a	–	–	–	–
C. cretica	21.3	18.7	17.2	5.1	–	–	–	–
S. baryosma	19.9	15.6	15.1	7.2	36.1	16.0	21.9	12.1
S. sesuvioides	20.2	15.9	–	a	19.1	9.2	–	a
S. helvolus	17.8	12.1	7.8	9.1	–	–	–	–
S. fruticosa	29.8	24.9	21.3	9.0	28.1	24.7	17.3	12.1
T. triquetra	19.4	17.5	–	a	21.4	15.3	12.5	8.4
Z. simplex	18.0	17.2	–	a	–	–	–	–

R = rainy; W = winter; S = summer; – = plant not available; a = data insufficient for analysis;

increase in the level of soluble sugar in the leaves at certain level of salt stress, then it decreased under higher salinity. Thus, the maximum sugar content at site-I during rainy season may be due to comparatively low salinity because of leaching of salts in the soil profile due to rain. However, at site-II sugar content was maximum during summer season because the leaves of plants subjected to water stress often showed decrease in starch content which is usually accompanied by an increase in sugar contents (Levitt 1956; Sen & Mohammed 1987). Comparatively, more sugar content was noted in plants at site-I than at site-II (Table 1), because each species has its own ecophysiological strategies towards different environmental conditions.

The results of the present study reveal that protein contents of plants at both sites were maximum during rainy season when plant water status was higher than winter or summer season. Plants at site-II exhibited more protein as compared to site-I. Among all plant species studied, the values of sugar and crude protein in *S. fruticosa* were maximum at site-I (Table 1). The nutritive patterns of plants are very important when fodder values and productivity are taken into account. Nutritive values are mainly concerned with protein content. Changes in ion content of plant cells induced changes in activity of certain metabolic system. Such changes may have serious consequence for membrane proteins, under extreme conditions of salinity, proteins are precipitated. Protein content of various plant tissues declined under drought or salt stress, because of increased proteolysis & decreased protein synthesis (Vaadia & Waisel 1967).

Different plant species respond differently towards different ions because the nature and quantity of ionic composition of soil differ at two different sites (Mohammed 1988). Thus, it can be concluded that salinity is known to effect almost all the aspects of the plant metabolism.

Table 2 *Seasonal variations in osmotic potentials (-bars) of halophytes growing at sites-I & II*

Species	Site-I			CD 5%	Site-II			CD 5%
	R	W	S		R	W	S	
A. lagopoides	33.55	–	–	a	–	–	–	–
C. cretica	43.88	70.00	85.00	5.10	–	–	–	–
S. baryosma	61.00	107.40	105.00	5.92	70.00	120.01	88.95	41.96
S. sesuvioides	19.59	32.65	–	a	42.00	44.00	–	a
S. helvolus	21.90	54.43	41.03	13.38	–	–	–	–
S. fruticosa	59.69	81.52	89.50	15.59	55.0	78.82	76.91	66.77
T. triquetra	32.57	69.47	–	a	52.09	58.34	55.00	0.92
Z. simplex	41.03	69.08	–	a	–	–	–	–

'a' = data insufficient for analysis; – plants not seen;

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