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BRIEF COMMUNICATION

Differences in chemical composition of *Alysicarpus vaginalis* (L.) DC. growing in saline and non-saline habitats

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Abstract

In *Alysicarpus vaginalis* (L.) DC. nitrogen, ascorbic acid, proline and epicuticular wax (ECW) contents were higher in the plants growing in the coastal region whereas the protein, soluble sugars and starch contents were lower. The higher contents of proline, nitrogen and ascorbic acid recorded in the plants of the saline habitat are a physiological adaptation to overcome the salt stress. The higher ECW content in the plants of the saline habitat specially in the summer months seems to be an adaptation in these plants to survive in the saline habitat.

Plants which are able to grow under saline conditions show certain intrinsic and extrinsic changes to adapt themselves to salinity. Salinity in the medium generally alters a wide array of metabolic processes leading to decline in yeilds (Ehrler 1960, Reddy and Vora 1986). One of the approaches to understand the ability of the plants to tolerate the environmental stresses is to identify the stress induced changes in the levels of some important compounds like protein, proline, saccharides *etc.* Though there are reports on the changes in the levels of these compounds in crop plants, so far no work has been carried out on wild leguminous plants growing in the coastal regions which play a significant role in fixing the atmospheric nitrogen.

The leguminous plant *Alysicarpus vaginalis* (L.) DC. is important ecologically as well as a fodder crop and a cover crop in plantations. The present report includes the important differences between *A. vaginalis* growing in coastal and interior regions.

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The plants growing in the coastal region of Someshwar near Mangalore and in the University Campus area, about 12 km away from the coast were used for the study. Leaf samples of same age were collected every month from January to June 1991 from both the habitats. Simultaneously, soil samples from the same region were collected to determine the soil salinity.

Soil salinity was estimated in filtered water extracts volumetrically using $AgNO_3$ and a potassium chromate indicator.

Protein content was estimated in water extracts from acetone powder (prepared according to Harborne 1973) using the method of Lowry *et al.* (1951). Nitrogen was estimated in acetone powder obtained by macerating the tissue using the microKjeldhal method (Jayaraman 1981). Starch content was determined in a residue after dry tissue treatment with boiling ethanol. The residue was digested with 36 % perchloric acid at room temperature for 2 h (Clegg 1956) and in the diluted filtrate starch was estimated by the phenol-sulphuric acid method (Kochert 1973). Soluble sugar content was estimated in the filtrate after boiling ethanol extraction using lead acetate precipitation. For the estimation of soluble sugars the phenol-sulphufic acid method (Kochert 1973) was used. Ascorbic acid content was determined after trichloroacetic acid treatment of the tissue using a phenyl hydrazine reagent (Jayaraman 1981). Proline was extracted in 3 % sulfosalycylic acid and estimated following Bates *et al.* (1973). Epicuticular wax (ECW) was estimated according to Ebercon *et al.* (1977). In all the above experiments, the data expressed are for the average of 3 samples.

Higher salinity values were recorded for saline soils in all the months compared to the non-saline soils (Fig. 1A). The highest salinities were recorded in March to May for both saline and non-saline soils. Protein content in *A. vaginalis* was higher in plants of non-saline habitat in January, February, March and April, but the differences were not statistically significant (Fig. 1B). The nitrogen content was higher in plants of saline habitat than those of non-saline habitats (Table 1). Except in May and June, significant differences were observed at 1 % level between non-saline and saline plants.

Table 1. Nitrogen and starch contents in the leaves of *A. vaginalis* [g kg^{-1}(acetone powder)]. Values in parentheses indicate SEM.

	Treatments	Months					
		January	February	March	April	May	June
Nitrogen	non-saline	25.90	16.83	18.03	25.20	28.53	29.40
		(0)	(0.66)	(2.77)	(3.63)	(1.74)	(0.90)
	saline	30.87	23.80	26.60	37.33	28.93	31.47
		(0.66)	(0.66)	(0.66)	(1.66)	(0.76).	(0.74)
Starch	non-saline	98.33	88.16	141.60	125.78	150.55	133.44
		(1.11)	(0.18)	(1.95)	(5.18)	(3.06)	(2.37)
	saline	72.26	88.02	87.29	151.27	147.36	107.08
		(7.50)	(0.77)	(1.85)	(14.50)	(1.47)	(1.77)

The amount of soluble sugars and starch were higher in the non-saline habitats than in the plants of the saline habitat (Fig. 1C, Table 1) in all the months. An exception was found for sugars in June. For starch the difference was not significant in February and May. The ascorbic acid content was higher in the plants of saline habitat (Fig. 1D) but the difference was not statistically significant. A higher proline content was recorded in the leaves of plants growing in the saline habitat (Fig. 1F). The ECW content was higher in the plants of the saline habitat (Fig. 1E). There was a decrease in ECW content from March to June.

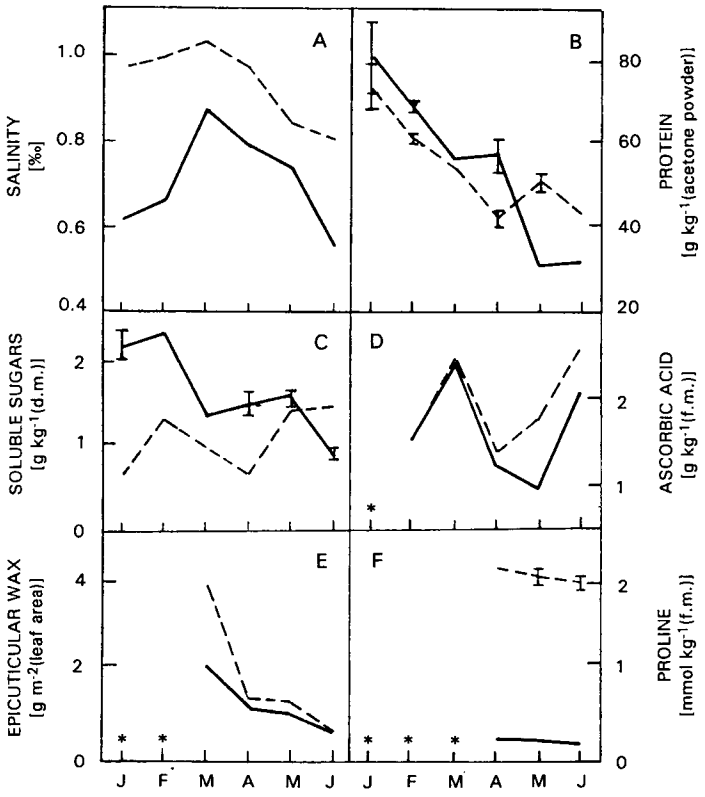


Fig. 1. Salinity of the soils (*A*), and protein (*B*), soluble sugars (*C*), ascorbic acid (*D*), epicuticular wax (*E*), proline (*F*) in the leaves of *A. vaginalis* growing in the saline (*dashed line*) and non-saline (*full line*) habitats. * Data not obtained.

The normal balance between soluble amino acids and proteins changes when the plants grow under saline conditions (Strogonov 1962). Pessarakali *et al.* (1989) found in *Zea mays* L. a higher content of nitrogen in NaCl-treated plants. According to Krishnamurthy *et al.* (1987a), the protein and total nitrogen content in the salt tolerant rice cultivar CO 43 was higher than in the salt sensitive cultivar. In the present study the total nitrogen content in *A. vaginalis* was higher under the saline habitat, whereas the protein content was lower.

Rathert (1983) found in rice cultivars higher contents of sugars and starch under salinity. An enhancement in the amount of reducing sugars in a succeptible cultivar of *Cajanus cajan* L. treated with NaCl was reported by Sagar *et al.* (1989). In wheat plants treated with NaCl and Na_2CO_3 a decline in the sugar content at the seedling stage as well as in mature plants was found by Bharadwaj (1959); this agrees with our results, which are also similar to the cultivars of soybean (Rathert 1985) and horse gram, *Dolichos biflorus* L. (Sudhakar *et al.* 1987). Rathert (1985) concluded that the reduced leaf starch content under salt stress may be due to the increased amylase activity.

A decrease in ascorbic acid content in response to salinity was reported by Kim (1958) in cabbage and radish, and in groundnut by Latha *et al.* (1989). In the present study, opposite results were found. Krishnamurthy *et al.* (1987b) found a higher level of ascorbic acid in the salt tolerant cultivar of rice than the salt sensitive ones and connected the increased amount of this compound with salt tolerance. There are only a few reports on the changes in the chemical composition of ECW under salinity. Rao *et al.* (1981) found in peanut plants a higher ECW on the leaf surfaces of the plants grown under salinity which agrees with our results for *A. vaginalis*. The accumulation of ECW resulting in reduced transpiration may enable the survival of plants in the saline habitat. The decrease of ECW content observed in our experiments under both saline and non-saline conditions in the months of May and June may be due to the onset of rains, decreased temperature and irradiance (Ebercon *et al.* 1977, Rao and Reddy 1980).

Strogonov (1962) explained the accumulation of free amino acids in plants grown under salinity by the hydrolysis of storage proteins. The increased proline content in the plants grown under salinity observed by Greenway and Munns (1980), Krishnamurthy *et al.* (1987b) and Sudhakar *et al.* (1987). This is in agreement with our results. According to Stewart and Lee (1974) the increased proline content in the plants may be an adaption to overcome stress. According to Sagar *et al.* (1989) proline supplies energy to the growing plants and the increase in its quantity in the sensitive cultivar of *Cajanus cajan* L. is an osmoprotective device under salt stress. Bal (1975) states that the proline accumulated under salinity supplies energy for growth and survival and thereby induces a salinity resistance in rice cultivars. The present results suggest that NaCl induced synthesis of proline and its accumulation associated with stress may serve as a compatible solute in order to maintain the osmotic balance between the cytoplasm and the vacuole and thereby play an important role in developing resistance to salinity.

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