OCCURRENCE OF CRASSULACEAN ACID METABOLISM IN LEAVES OF *ARISTOLOCHIA BRACTEATA* RITZ.

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ABSTRACT

Aristolochia bracteata Ritz. is a common weed of fallowlands of hot, semi-arid region of Baramati area. High succulence index was noticed in leaf tissues along with marked diurnal fluctuations in titratable acidity status, and pH of leaf sap. Stomatal behaviour also followed typical CAM pattern. All these findings conclude that Crassulacean Acid Metabolism is in operation in this species.

KEY WORDS: *Aristolochia bracteata*, Crassulacean Acid Metabolism.

INTRODUCTION

CAM plants are adapted to arid environment and represent well in the flora of saline and brakish habitats. Plants have obviously evolved and adapted in response to selective pressures prevalent in xeric and saline habitats (Laetsch, 1974). In an earlier survey, as many as 3 divisions, 26 families, 159 genera and 612 species have been reported to possess CAM (Szarek, 1979). Many families amongst this belong to tropics and subtropics. CAM cycling is an important adaptation minimising water loss by perennial succulents growing in shallow soil or rock outcrops. Recently, CAM behaviour was reported in a succulent weed *Thlaspi arvense* L. growing in this region (Murumkar et al. 1991). In preliminary survey, it was noticed that *Aristolochia bracteata* Ritz., dominant weed of this hot, semi-arid region persists even in hot summer (Murumkar and Magdum, 1991). This led us to investigate its survival potential. Our findings have formed the basis of the present work.

MATERIAL AND METHODS

Plant population of *Aristolochia bracteata* Ritz. in open field was selected for study. The investigation was conducted in months of April-May. The plants of the same age, were growing in open field with daily Temperatures $38.5/20.0^{\circ}\pm 2^{\circ}\text{C}$, relative humidity $34.70\% \pm 5\%$, rate of evapotranspiration 6.18 mm/h with natural photoperiod of about 13 hours daylength. Healthy, fully-grown plants (about 2 months old) with normal relative growth were sorted out. Fully expanded leaves (6th to 10th leaf number) of these plants were employed for studies of CAM behaviour.

Freshly collected leaves were subjected to moisture content determination by measuring difference in weight after oven-drying for 10 days at 80°C . Succulence was calculated as ratio of fresh and dry matter as well as mesophyll succulence and surface expansion (Walter, 1926; Kluge and Ting, 1978).

Fresh leaves of known weight were ground in homogenizer in glass distilled water and the filtrate was subjected to pH determination (Elico digital Li 120 pH meter) at every three-hour interval of the day. Titratable acidity was determined by using 0.01 N NaOH at every three-hour interval following the method of Thomas and Beevers (1949). Chlorophylls were estimated spectrophotometrically in 85% acetone extractives (Arnon, 1949). Thin peels of leaf epidermis were employed for stomatal studies. Each experiment was performed at least in triplicate.

RESULTS

Aristolochia bracteata Ritz. is a slender, prostrate, perennial with reniform or ovate leaves. It flowers from October to May. Every part of the plant is nauseously bitter. Some characteristics of the leaf are presented in Table 1. Leaf had thickness of about 0.86 mm with high moisture content (82.09%). Leaves showed high succulence index (6.70). Mesophyll succulence value was $4.02 \text{ kg g}^{-1} \text{ chl}$. According to Kluge and Ting (1978) the S_m value provides a resonable index of succulence at the cellular or tissue level; and in CAM species the value ranges from 1.50 to 13.00. Leaves showed surface expansion value of $13.17 \text{ m}^2 \text{ kg}^{-1}$ and this was within the range (9.50 to 13.50) reported for CAM plants by Walter (1926).

We found marked diurnal fluctuations in titratable acidity status as well in pH values (Fig. 1). The preliminary analysis of acids in leaf sap by paper chromatography indicated presence of malic acid predominantly. Organic acid content increased significantly during night while it lowered during

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TABLE 1. Some leaf characteristics of *Aristolochia bracteata* Ritz. ($\pm$ S.E.).

Parameter			
i)	Leaf thickness (mm)	—	0.86 ± 0.012
ii)	Moisture content (%)	—	82.09 ± 3.18
iii)	Succulence index (SI) (g g^{-1})	—	6.70
iv)	Mesophyll succulence (S_m) (Kg g^{-1} chl.)	—	4.02
v)	Surface expansion ($\text{m}^2 \text{kg}^{-1}$)	—	13.47

the subsequent day (Fig. 1). Studies in stomatal behaviour showed that these remained open during night while closed during day time (Fig. 1). All these findings strongly advocated that in *Aristolochia bracteata* Ritz. Crassulacean Acid Metabolism was in operation.

It is now accepted that in nature certain species show an intriguing plasticity in expression of CAM in response to the environment. Martin et al. (1988) working on ecophysiological significance of carbon dioxide recycling via CAM in *Talium calycinum* Engelm. claimed that CAM cycling may be an important adaptation minimising water loss by perennial succulents growing in arid conditions. Present findings indicate that by adapting CAM mode of strategy, *Aristolochia bracteata* Ritz. has become successful survivor of this region. Report on occurrence of this species even in Thar desert of India (Blatter and Hallberg, 1984) is in concurrence with our findings. The biochemical studies of other species of *Aristolochia* will prove rewarding in this respect.

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Fig. 1. Diurnal variation in titratable acidity status and pH of leaf tissue of *Aristolochia bracteata* Ritz. Black bar indicates the night time. Closed symbols (●) represent closed stomata while open symbols (○) open stomata. (Vertical bars represent $\pm$ SE).

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FOTOSYNTeza GRUBOSZOWATYCH W LIŚCIACH *ARISTOLOCHIA BRACTEATA* RITZ.

STRESZCZENIE

Aristolochia Bracteata Ritz. jest pospolitym chwastem rosnącym na gorących półpustynnych ugorach obszarów Baramati. Wysoki wskaźnik sukulencji stwierdzono w tkankach liścia, wraz z wyraźnym wahaniami dobowym pH soku komórkowego. Zachowanie się aparatów szparkowych było typowe dla roślin o fotosyntezie CAM.

SŁOWA KLUCZOWE: *Aristolochia bracteata*, fotosynteza CAM.