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Research Article

OCCURRENCE OF CAM ACTIVITY IN STEM OF *CAPPARIS DECIDUA* (FORSSK) EDG.

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Summary: *Capparis decidua* (Forssk) Edg**.** of family Capparidaceae known as desert bloom is a common wild plant of the dry region of Baramati. It is a versatile plant and it survives well in the harshest conditions like severe frost and draught. In order to access its survival in the dry region, several physiological parameters pertaining water relation and mode of photosynthesis were studied. This study revealed high moisture content, osmotic potential and high succulence index exhibiting its succulent nature. Further studies showed similar diurnal activity of pH and titratable acidity status throughout the day showing diurnal fluctuations in their consistent manner. Stomatal analysis showed similar diurnal activity. Succulence index was in the range characteristic of crassalacean acid metabolism (CAM) plants. These findings reflect CAM activity in this plant.

Keywords: *Capparis decidua* (Forssk) Edg.; CAM; osmotic potential; succulence index.

Abbreviations: CAM – crassalacean acid metabolism; TAN – titratable acid number.

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INTRODUCTION

Crassalacean acid metabolism (CAM) is a natural process of photosynthetic carbon fixation that allows chloroplasts to fix CO_2 at night using phosphoenolpyruvate carboxylase in the cytosol (Cushman, 2001). CAM photosynthesis functions in a large number of vascular plants in arid regions for water conservation and CO_2 concentration. These plants are relatively rare globally as they represent a significant fraction of regulation mechanism in some hot, arid environments. Still so far 328 genera from 33 families have been recorded for their CAM behavior (Winter and Smith, 1996). CAM plants can effectively save metabolic energy and water during harsh environmental conditions (Sen, 1982).

C. decidua (Forssk) Edg. belonging to family Capparidaceae, is a common perennial weed growing in the arid regions of Western Ghats. The plant is a large, leafless, thorny, densely branched, spinous shrub. This has been also

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mentioned in Ayurveda that the bark has an acrid flavor, good in asthma, ulcers and boils, vomiting, piles and in all inflammations (Wealth of India, 1982).

In present investigation the relationship between water relations and mode of photosynthesis in C. *decidua* (Forssk) Edg. under dry conditions was investigated.

MATERIALS AND METHODS

Plant population of *C. decidua* (Forssk) Edg. grown in fallow lands along road sides was selected for the present work. Mature, healthy, fresh stems of this plant were analyzed for CAM metabolism. The investigation was conducted in the period between March to May in Baramati. Baramati (18°,8' N and 75°,7' E) is a distinct semi-arid zone of Pune district in Maharashtra, India because of the rain shadow effect of Western Ghats.

Moisture content was determined by the weight difference method before and after drying for 5 days at 80°C. Succulence index was calculated as the ratio of fresh and dry matter by the method of Klug and Ting (1978). Mesophyll succulence index was also calculated (Walter, 1926). It is obtained by taking the ratio of moisture content to total chlorophylls. Osmotic potential of cell sap from stem tissue was conducted as per Janardan et al. (1915). One gram of filtered homogenized fresh tissue was used to measure electrical conductivity. Dilution factors were also obtained using fresh and dry weight. Osmotic potential was calculated by using electrical conductivity and dilution factor.

Fresh stem tissue of known weight was ground in distilled water and the filtrate was used for pH determination (digital pH meter) at every 3 h interval during the day. The Thomas and Beevers (1949) method was used to determine titratable acidity. Plant material was boiled in distilled water made to a final volume titrated with 0.01N NaOH using indicator. Standardization was done using 0.01 N oxalic acid. Thin stem peels were used for analysis of stomata. Data are means obtained form three individual plants ± SE.

RESULTS

Various parameters of water status in stem tissue of *C. decidua* (Forssk) Edg. are presented in Table 1. Stem tissue showed 75% moisture content and high succulence index (4.00 kg g^{-1}). The mesophyll succulence index value was 2.22 kg g^{-1} chl. and osmotic potential was

Table 1. Parameters of water status in stem tissue of *C. decidua* (Forssk) Edg. Values are means of three replicates.

Sr. No.	Parameter	Means ± SE
1	Moisture content (%)	75.00 ± 0.58
2	Succulence index (g g^{-1})	4.00 ± 0.18
3	Mesophyll succulence index (Sm) (kg g^{-1}Chl)	2.22 ± 0.03
4	Osmotic potential (atm. pressure)	16.66 ± 0.06

16.66 atm. pressure.

TAN values as well as pH values are shown in Figure 1. It is clear from the figure that organic acid content was highest during the night and lowest during the day. This was further supported by nocturnal opening of stomata. These findings strongly advocated that in stem tissue of *C. decidua* (Forssk) Edg. CAM was in operation.

DISCUSSION

CAM pathway enhances water use efficiency and may be evolved from ancestral C_3 pathway playing a role in bifurcating some prominent plant groups because it may have allowed their successful spread into arid and semiarid environments (Quezada, 2011). Klug and Ting (1978) provided a reasonable index of succulence at the cellular level and in CAM species the values range from 1.5 to 13.00. The highest succulence indicates high relative water content and succulence under drought may be due to extensive growth of root showing a tendency to maintain water supply to shoot (Qi et al., 2009). The degree of succulence and range of CAM activity associated with the inhibition of PSII and Rubisco activity during the night was observed by Griffith (2008) in *Kalanchoe* species. Ripley et al. (2013) postulated that increased leaf succulence might be associated with decreased mesophyll conductance and increased dependence on CAM.

The results from the present investigation revealed that in *C. decidua* (Forssk) Edg. CAM mode of photosynthesis was in operation. CAM behavior has been reported in several weeds growing in the semi-arid region of the rain shadow area of Western Ghats like *Thlapsi arvence* L. of Brassicaceae (Murumkar et al., 1991), *Aristolochia bracteolata* Lam. (Aristolochiaceae) and *Commelina nudiflora* L. (Commelinaceae), (Deshmukh and Murumkar, 1996, 2013). Joseph et al. (2007) also observed CAM in the

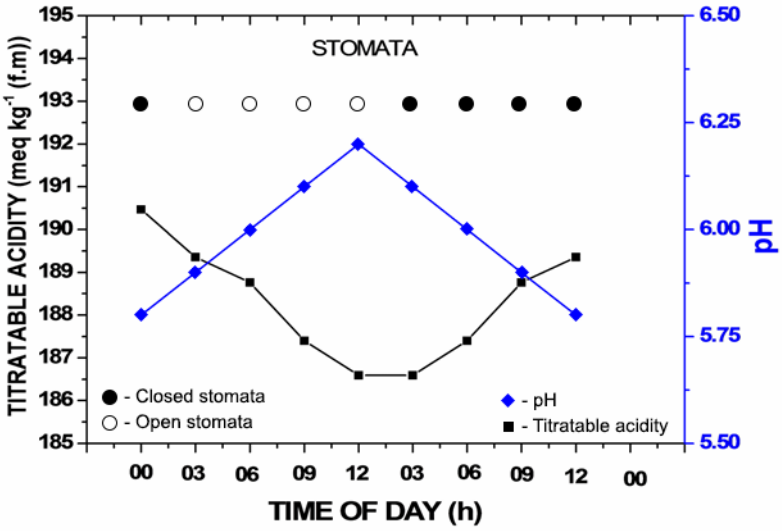

Figure 1. Diurnal variation in titratable acidity status and pH in stem tissue of *Capparis decidua* (Frossk) Edg.

terrestrial aroid *Zamioculcas zamifolia* Schott (Araceae) and concluded that the survival of *Z. zamiifolia* was related to reduced water loss thus maintaining carbon gain during seasonal droughts characteristic of its natural habitat.

In the present study, typical CAM activity was recorded in the perennial plant *C. decidua* (Frossk.) Edg. which can reflect environmental adaptive response under dry arid conditions. The morphological status of the mature plant clearly showed its dry, leafless phyllode nature which indicated its hardy nature. Further physiological studies to pursue its resistant behavior in hot arid conditions are in progress.

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