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Short Communication

Crassulacean acid metabolism (CAM) in leaves of a common weed *Commelina nudiflora* L.

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Survey of weed flora of Baramati region has revealed that *Commelina nudiflora* L. is a dominant weed among common weeds in croplands and fallow lands. In order to ascertain the survival potential of *C. nudiflora* some photosynthetic parameters along with water relations of this plant were investigated. Baramati region is a drought prone hot semi-arid area in Pune, Maharashtra. *C. nudiflora*, belonging to the family Commelinaceae is a typical succulent plant and this was confirmed further by water relation studies like moisture content, osmotic potential, leaf water content and succulent index. Besides above mesophyll succulence, surface expansion and succulence index values were within the range of a typical crassulacean acid metabolism (CAM) plant. Further studies on diurnal fluctuations in pH status, stomatal behaviour and acidity status also confirmed its CAM mode of photosynthetic behaviour. All these findings led to the conclusion that CAM is in an operation in this weed.

Key words: Crassulacean acid metabolism (CAM), *Commelina nudiflora* L., weeds.

INTRODUCTION

Baramati is a drought prone hot semi-arid region of Pune, Maharashtra, India is severely affected by rain shadow effect of Western Ghat (Blatter and Hallberg, 1984). The study area lies in between 18° 3'N latitude and 74° 13'-74° 40'E longitude having a total geographic area of 1, 38 and 247 ha, receiving 530.2 mm of average rainfall. Maximum and minimum temperatures are 43 and 19°C respectively, with mean daily temperature of above 22°C (Bhagat et al., 2008).

Preliminary study revealed that *C. nudiflora* grows well even under unfavourable conditions like extreme hot summer as a dominant weed in crop fields and fallow lands (Murumkar and Magdum, 1991). Morphotypical and physiotypical plasticity of crassulacean acid metabolism (CAM) phenotypes allows wide ecophysiological amplitude of niche occupation in the tropics (John, 2001). But physiological and biochemical plasticity appears more responsive than do morphological adaptations. This makes CAM plants particularly fit for the multi-factor stressor networks of tropical forests (Luttge, 2012).

Plants which have acclimatised to a certain habitat always show morphological, reproductive, phenological and physiological adaptations for successful survival. In the present work we studied the relationship in between survival potential and water relations, mode of photosynthesis in *C. nudiflora* plants.

MATERIALS AND METHODS

Plant populations of *C. nudiflora* in an open field were selected for studies.

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Table 1. Some leaf characteristics of *Commelina nudiflora* L.

Parameter	Value
Leaf thickness (mm)	1.68 ± 0.012
Moisture content (%)	85.3 ± 3.18
Succulence index (SI) ($g.g^{-1}$)	11.02
Mesophyll succulence (Sm) $Kg.g^{-1}$chl.	5.88
Surface expansion ($m^2.kg^{-1}$)	1.76

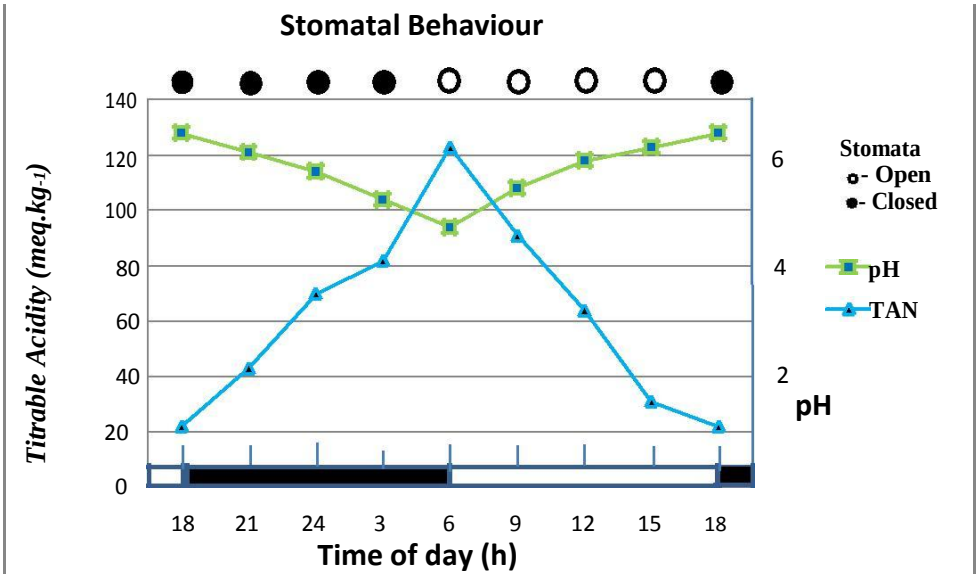

Figure 1. Diurnal Variation in Titrable Acidity status pH of leaf tissues and stomatal behaviour (Black bar indicates the night? Day light absent time).

The investigation was conducted during October to November and April to May months. Plant population of same age growing in an open field with a daily average temperature of 38.5/20.0 ± 2°C, relative humidity (34.7 ± 5%), rate of evapotranspiration (6.18 mm/h) with a natural photoperiod of about 13 h/day length was selected for this study. Healthy fully grown two month old plants were sorted out and the leaves of these plants were subjected to study various leaf parameters like moisture content, succulence index, mesophyll succulence, surface expansion values using standard protocols. Moisture content of leaves was calculated by measuring the difference in weight before and after oven drying for 10 days at 80°C. Succulence was calculated as the ratio of fresh and dry matter, mesophyll succulence and surface expansion (Klug and Ting, 1978).

Study of biochemical and physiological parameters

Diurnal behaviour of titrable acidity status, pH values and stomatal behaviour of the leaves of *C. nudiflora* was studied for successive days using standard protocols. Every three hours fresh leaves were homoginised using glass distilled water and filtrate was used for pH determination using Elico digital Li 120 pH meter. Thomas and Beevers' (1949) method was used to determine titrable acidity for every three hours. Stomatal behaviour was studied every three hours using thin peels of leaf epidermis at 10 x 45X of compound microscope. Leaf extracts in 85% acetone was estimated for chlorophyll contents at 645 and 663nm using SPECTRONIC 20 spectrophotometer (Arnon, 1949). Standard statistical procedures were followed for analysis of results and values represented means of at least five replicates.

RESULTS

C. nudiflora is a herbaceous annual plant with stem thick, green and creeping while leaves are thick, linear, lanceolate, pubescent with hairy outgrowth and highly succulent. Some characteristic features of the leaves were presented in Table 1. Leaf had an average thickness of 1.68 mm with 85.31% moisture contents, succulence index was 11.02 $g.g^{-1}$, mesophyll succulence was 5.88 $Kg.g^{-1}$ Chl., with surface expansion of 1.76 $m^2.Kg^{-1}$. From the Table 1 it showed that leaf and its succulence para-meters were within the range for CAM plants (Klug and Ting, 1978).

Parameters of photosynthetic behaviour are showed in Figure 1. Titrable acidity number (TAN) clearly indicates titrable acidity status in leaf tissues and a typical diurnal fluctuation of about 6 fold increase in TAN values. This was further supported by stomatal behaviour which showed characteristic nocturnal opening of stomata. The CAM

pathway is characterized by the temporal separation of carbon fixation between nocturnal CO_2 fixation by phosphoenolpyruvate carboxylase in the cytosol and daytime decarboxylation of organic acids to release CO_2 which is then refixed by Rubisco in the chloroplast (Ting, 1985). All these findings strongly advocated that CAM is mode of photosynthesis in this plant.

DISCUSSION

In the present study, we noticed that there is nocturnal CO_2 uptake through open stomata at night. Under the dominance of high irradiance and hot temperatures and low availability of water, CAM provides plants to operate photosynthetically with closed stomata (Luttge 2004). Paper chromatography confirmed 4 fold increase in malic acid contents at night. There was also significant diurnal fluctuation in TAN values, pH and osmotic potential in photosynthetic mature leaf tissue. CAM is a taxonomi-cally widespread photosynthetic pathway that has evolved in plants having CO_2 and water-limited environments, including tropical forest canopies with intermittent or sea-sonal water availability, hot semiarid regions, and some aquatic environments (Katia et al., 2009).

These findings clearly indicated that CAM is also a mode of photosynthesis in this species. In previous studies CAM behaviour was reported in *Thlaspi arvense* of Brassicaceae (Murumkar et al., 1991) and *Aristolochia bracteata* of Aristolochiaceae (Deshmukh and Murumkar, 1996). Thus in present findings, the occurrence of CAM in *C. nudiflora* clearly designated a strong positive func-tion between acidity and CAM mode of photosynthesis in plants growing under extreme drought conditions.

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