INTRODUCTION

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Water is the earth's most abundant compound and yet on a worldwide scale a deficit of water is the single most important factor limiting plant life. Water is major constituent of plant tissue, a reagent in photosynthetic and hydrolytic processes, the solvent for and mode of translocation for metabolites and minerals within plants, and is essential for cell enlargement and growth. Water deficit occurs in the plant, whenever transpiration exceeds water absorption; this may be due to excessive water loss, reduced absorption or both. Drought has generally been accepted as a deficiency of available soil moisture which produces water deficits in plants sufficient to cause a reduction in growth. The problem of drought is particularly serious and severe in the desert areas which are found in different regions of the world. It is observed that even under these extremes of environment, some plant species can successfully grow and complete their life cycle. The most prominent among these species are the succulents.

The classification of a plant as succulent is based exclusively on morphological criteria and does not implicate a special taxonomic status, because we can find succulent members in several families of higher plants as well as in ferns and gymnosperms. The single morphological criterion which classifies a plant as succulent is the possession of voluminous water-storing tissues resulting in an increase in volume relative to surface area. In succulents, all basic organs of the plant can function as water reservoirs. Thus, a thick, fleshy, juicy habitus results which is envisaged as "succulence" and which results in a form tending towards a spherical shape rather than disc shape typical for most leaves. Hence, succulents are generally characterised by their ability to store relatively large amounts of water. Thus the succulents are able to maintain favourable water balance even under the conditions of severe drought by means of several anatomical and physiological adaptations related to control of transpiration. Besides this, succulents are able to maintain a positive carbon balance or at least to prevent a negative carbon balance even during extended periods of drought. This is achieved with the help of Crassulacean Acid Metabolism (CAM).

The acid metabolism of certain succulent plants, now known as CAM has fascinated plant physiologists and biochemists for the last one and a half centuries. It is now very well realised that CAM is characterised by two segmental major metabolic sequences separated in time, one occurring in the night and the other during the day (Kluge and Ting, 1978). During dark period the stomata in CAM plants remain open and the CO_2 fixation takes place through the activity of a carboxylating enzyme PEP-carboxylase coupled with malic dehydrogenase (MDH). As a result of this process large amount of malic acid is synthesized and it is stored in the vacuoles during night hours. During day time the stomata remain mostly closed and the stored malic acid enters the metabolic compartment and it undergoes decarboxylation through the activity of malic enzyme. The CO_2 thus liberated is refixed by the action of RuBP-carboxylase and through the subsequent operation of Calvin cycle. Major part of pyruvic acid produced during malate decarboxylation is converted into carbohydrates by reversal of glycolysis and some pyruvate enters the TCA cycle. Thus in CAM plants a typical stomatal behaviour can be easily noticed. Similarly the diurnal fluctuations in organic acids (especially malate) with a definite rhythmycity are also evident in these plants. This is further accompanied by diurnal fluctuations in storage carbohydrates, the fluctuations occurring in exactly a reverse phase. The physiological investigations on succulents in last fifty years have been mainly concentrated on the biochemistry and control of CAM and it is now very well established that CAM has got a marked ecological significance. However, not much attention has been paid on the other aspects of physiology of succulents such as mineral nutrition or secondary metabolism.

Among the succulents we can find only few species which have got some economic importance and they have been exploited on a limited basis. Among these species Agave is the most prominent because it is one of the very important fibre crops in the world. There have been few attempts to understand ecological adaptations and physiological processes (particularly CAM) in some Agave species such as A. americana, A. deserti, A. lechuguilla, A. fourcroydes, A. salmiana, A. veracruz, etc., but there is hardly any major work on A. cantala which is one of the very prominent and promising Agave species in India (Chakravarty and Biswas, 1986). Hence we thought it worthwhile to understand physiological studies in A. cantala. In Shivaji University laboratory considerable attention has been paid to the physiology of succulents in last twenty five years. Thus the carbon metabolism and the enzymology of CAM in succulents like Bryophyllum pinnatum, Aloe barbadensis and Portulaca oleracea have been studied in considerable details (Karmarkar, 1965; Bartakke, 1977; Karadge, 1981). Similarly an attempt was also made to study influence of salinity on CAM behaviour in these plant species. Thus the present work can be regarded as a continuation of above work on succulents. However, the present studies have been performed with rather different angle. In this investigation an attempt is made to study the fate of various mineral elements and organic constituents during the course of different seasons (rainy season, winter and summer) of the year and during the course of leaf senescence. Similarly influence of different seasons on CAM behaviour in *Agave cantala* is also studied.

The dissertation is divided into four chapters. In order to understand basic problems involved in study of *Agave* plant, brief resume of current status of literature on *Agave* is covered in Chapter I. An attempt has been made to take a brief review of distribution, morphology, cytology, cultural practices, physiology and economic importance of various *Agave* species. The second chapter deals with the methodology followed for present investigation. The methodology includes titrametric and spectrophotometric determinations of organic constituents. The flamephotometer and atomic absorption spectrophotometer have been employed for determination of inorganic constituents. The stomatal studies were performed with the help of autoporometer. The third chapter "Results and Discussion" covers the major findings of the present investigation and they have been discussed in the light of available literature. The significant findings have been briefly summarised in the fourth chapter "Summary and Conclusions". The literature cited in the dissertation is properly presented in the "Bibliography" part of the thesis.

The author is fully aware of the limited significance of the present investigation because it is only of preliminary nature. At the same time it should be mentioned that these studies for the first time throw light on various physiological processes (especially CAM) in *Agave cantala* as influenced by different seasons and leaf age. Thus these studies can form a starting point for further detailed investigations on this economically important *Agave* species.

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