mosaic virus, but Calotropis mosaic virus does not produce inclusion bodies in infected plants which are characteristic of TEV and these two viruses also differ in their host range. The properties of Datura enation mosaic virus (DEMV) are similar to those of Calotropis mosaic virus though the host range is different. Calotropis mosaic virus does not infect *Datura metel* and *Solanum nigrum* whereas DEMV produces characteristic symptoms on both the hosts. A perusal of literature reveals that there is no record of any virus disease on *Calotropis procera* L. The Calotropis mosaic virus is therefore a new virus with some properties in common with DEMV and TEV. This report therefore constitutes the first record of a virus disease on *Calotropis* from India. Further investigations on this virus are in progress. The cryptogram of the virus is (x x:x x:x x:S AP).

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## LEVELS OF ENZYMES OF $C_4$ ACID METABOLISM IN DEVELOPING MAIZE SILKS

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THE angiospermic pistil is tripartite: the stigma, which is meant for pollen reception and germination; the style through which the pollen tubes grow; and the ovary enclosing one or more ovules, each containing an embryo sac, the female gametophyte. Pistils show characteristic periods of development[1] and may undergo substantial elongation as in the case of the maize silk. If not pollinated, the silk continues to grow and may reach several centimeters in length beyond the husk. When fertilization is accomplished, elongation quickly ceases, the silk shrivels up and turns brown. The information on the underlying physiological and biochemical changes resulting in the prodigious elongation of maize silks is scarcely available. In other plant systems, the enzyme activities of non-photosynthetic $C_4$ dicarboxylic acid metabolism have been shown to be related with the metabolic requirements of cell elongation[2,3]. It is, therefore, of interest to investigate this relationship in maize silks and the present communication is the first report on the enzyme profiles of $C_4$ carbon metabolism during their development.

Silks from the field-grown maize (*Zea mays* L cv J 1034) were collected at four developmental stages designated as I to IV with average lengths of Ca. 5.6, 14.9, 20.3 and 19.3 cm respectively. At stage I the silks were enclosed in the husks which extended out at the rest of the stages. Stage IV represented the senescing stage of silks and their shrivelling led to a slight reduction in length. Five hundred mg of silks were collected at each stage and the enzyme extracts prepared as described previously[3]. Enzyme activities were determined spectrophotometrically at 340 nm following the oxidation of NADH or reduction of NAD(P)$^+$. The activities of enzymes of $C_4$ metabolism viz PEP carboxylase (EC 4.1.1.31), NAD-malate dehydrogenase (EC 1.1.1.37), NADP-malic enzyme (EC 1.1.1.82) and glutamate-oxaloacetate transaminase (EC 2.6.1.1) were determined by following the assay methods as reported earlier[3]. All the enzymes from each replicate were assayed in duplicate. The variations in replicate values were within 2%. Hence, the average values are given in figures.

The enzymes of $C_4$ carbon metabolism and changes in their activities were detectable in developing maize silks (figures 1 and 2). Since the maize silks are non-chlorophyllous, a $C_4$ photo-

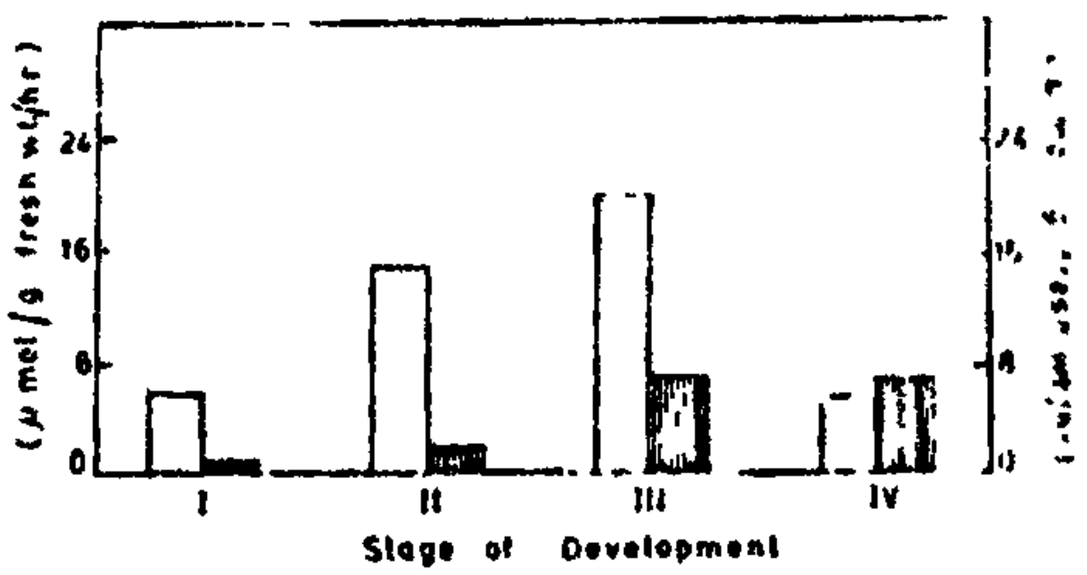


**Figure 1.** Activities of PEP carboxylase and glutamate-oxaloacetate transaminase in the maize silks at four phases of development. [□, PEP carboxylase; ■, Glutamate-oxaloacetate transaminase.]

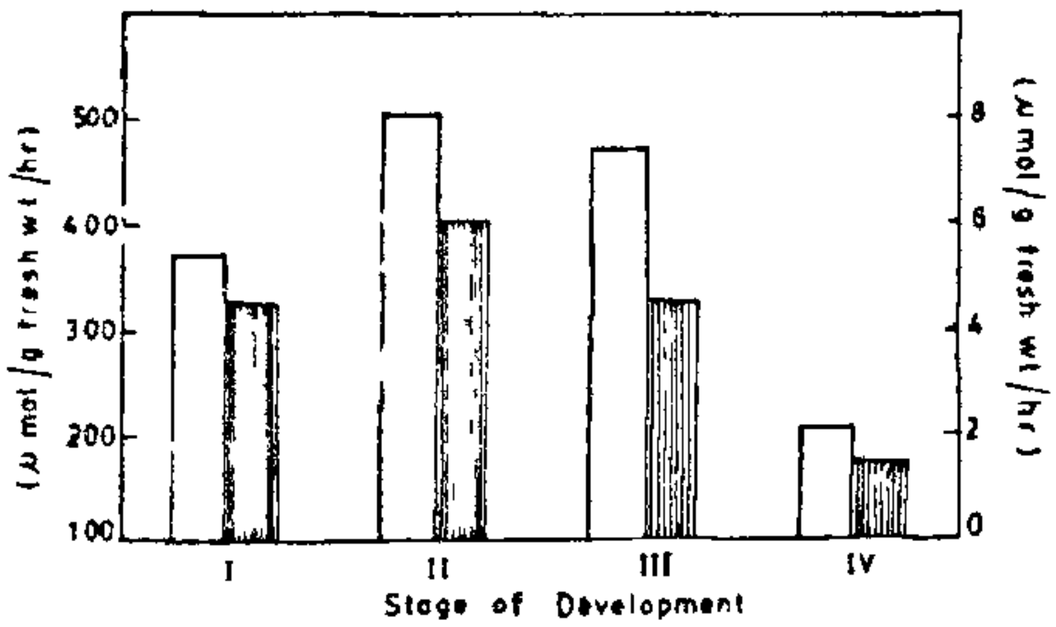


**Figure 2.** Activities of NAD-malate dehydrogenase and NADP-malic enzyme in the maize silks at four phases of development. [□. NAD-malate dehydrogenase; ▨. NADP-malic enzyme.]

synthetic carbon metabolism is hardly expected and a $C_4$ non-photosynthetic function seems to be required for their development.

In comparison to stage I, the activity of PEP carboxylase increased markedly through stages II and III and declined steeply at stage IV (figure 1). Thus, the increase in enzyme activity corresponded to the period of active elongation of developing silks. The developmental profiles of NAD-malate dehydrogenase matched with those of PEP carboxylase except that the activities were manifold higher and the decline at stage IV was much greater (figure 2). Glutamate-oxaloacetate transaminase activity showed a rising trend of activity during the silk development (figure 1). The above observations may be interpreted to mean that oxaloacetate, the product of PEP carboxylase activity, is very rapidly reduced to malate by quite high activities of NAD-malate dehydrogenase and a small amount may be used by glutamate-oxaloacetate transaminase to form aspartate. Thus, the predominant $C_4$ acid formed in elongating maize silks seems to be malate rather than aspartate.

The malate can subsequently be decarboxylated by NAD- and NADP-malic enzymes. Reasonable levels of NADP-malic enzyme were found in the maize silks but the values at each developmental stage investigated were lower compared with the other three enzymes (figures 1 and 2). Therefore, the decarboxylation of malate by NADP-malic enzyme in the cytosol to provide pyruvate and NADPH can only be of minor quantitative importance. It is quite likely that the malate formed may get accumulated in the vacuoles to achieve necessary turgor changes and as well as be a source of carbon for the anaplerotic operation of TCA cycle upon oxidation in the mitochondria.

Overall, it is deduced that there may be a necessity in the formation of $C_4$ acids for anaplerotic metabolism (biosynthesis) and for making available the osmoticum for the development of maize silks.

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## A NEW STEM GALL ON *GNETUM SCANDENS* ROXB

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The insect-induced foliar gall on *Gnetum ula* seems to be of common occurrence. Swamy and Krishnamurthy[1] described 4 morphologically different leaf galls on this host plant which were presumably caused by different insects. As far as the author is aware, the present report of stem gall on *Gnetum*, induced by a midge (Cecidomyiidae) is the first record for this taxon.

The galls were collected near Nagercoil (Tamilnadu) where *Gnetum scandens* Roxb occurs as a shrubby liane in shady habitats. The midge larva infests young shoot axis and the gall develops in such severe form that the liane becomes defoliated totally and eventually dies. Galling was noticed from the ground level of the shoot up to several feet above. The galls are subglobose or hemispherical, solid, hard unilocular, indehiscent dark brown cortical swellings of the tender branches. They are either solitary or crowded in large numbers close to each other and often agglomerated into complex masses or multilocular and irregularly knotted structures (figure 1). The surface of the gall has remnants of distorted epidermal layer. Fairly wide circular holes seen on the galls represent the exit holes of the insects.

The gall-free normal stem (figure 2) has a thin zone of periderm followed by fairly broad parenchy-