

CALCIUM OXALATE CRYSTALS AS AN IMPORTANT CHARACTER OF PERICARP IN COMPOSITAE- A SHORT COMMUNICATION

*Bidyut Kumar Jana and Sobhan Kr. Mukherjee

*Taxonomy and Biosystematics Laboratory, Department of Botany, University of Kalyani,
Kalyani-741235, Nadia, West Bengal, India.*

*Email: *janabidyutkumar@yahoo.com, sobhankumar@yahoo.com*

Abstract: Calcium oxalate is a chemical compound, which produce crystal in plants and is known as raphides. The chemical formula of calcium oxalate crystal is CaC_2O_4 or $\text{Ca}(\text{COO})_2$. They are not universally present in all parts of the plant organ, but instead they are confined to specific parts and certain plant tissues in some restricted taxa only. Accumulation of calcium oxalate crystal is found to be reported in approximately 1000 different genera of plants (Franceschi and Nakata, 2005). So, presence of this crystal is very important in taxonomic view points, as it is not universally present in all parts of the plant organ and is restricted in certain plant parts. These crystals are usually of the common rectangular type but seldom druses (from cross sectional view of the cypselar wall). Within the family Compositae, calcium oxalate crystal is present in the pericarp and testal region of mature fruit (Cypsela) and it act as a taxonomic marker. Within the cypsela, the distribution of crystals is also very specific. In some cases, they are distributed in the epicarpic zone of cypselas (*Aster thomsonii*, *Brachycome heterodonta*, *Carpesium cernuum*, *Carpesium nepalense*, *Inula ensifolia*, *Bupthalmum speciosissimum*) and in such cases, they are also visible in dry condition from the scanning electron photographs of cypselas. In some another cases, they are only observable from histological structure. In *Anthemis tinctoria*, *Arctium lappa*, *Bothriocline laxa*, *Brachycome campylocarpum*, *Catananche caerulea*, *Elephantopus scaber* and *Tanacetum macrophyllum* crystals are found in different parts of the mesocarpic zone of pericarp. So, the distribution pattern of Calcium oxalate crystals in the cypsela is variable. According to the observation of Martin, Matteo, Daniel, Jakob, Guillaume, Michel, Daniel, Eric and Pila (2012), Calcium oxalate crystal is associated to the detoxification of Calcium in the plant. It is a poisonous substance, which can produce sores and numbing on ingestion and could be fatal. Calcium oxalate crystals may be antagonistic to the formation of phytomelanin pigment in cypsela (Mukherjee and Nordenstam, 2010). Many authors {Hanausek, 1911; Metcalfe & Chalk 1950, 1983; Dormer, 1961; Gochu (1973); Robinson & King (1977); Mukherjee and Nordenstam, (2010) etc.} have been contributed, regarding the distributional pattern of Calcium oxalate crystals in Compositae.

Keywords: Calcium oxalate, Compositae, Plant tissues

INTRODUCTION

The presence of calcium oxalate crystals in flowering plants is appears to be more or less widespread in different plant parts, such as leaves, stems, roots, floral parts, fruits and seeds. These crystals may be of two types, extracellular and intracellular. The former type is reported initially in about 160 angiospermic families, but most prevalently in the Amaranthaceae, Rubiaceae and Solanaceae (Metcalfe & Chalk 1950, 1983), and the later is reported from 215 families including

Compositae (Franceschi & Nakata 2005). Most of the crystals look like a hexagonal prism, rectangular type, some times, look like a pointed picket form (Fig-1). Though, hexagonal form of crystal is usually very common type in the cypsela, than other type. According to Dormer (1961), the distribution and shape of such crystals appear to be genetically controlled and hence taxonomically significant. Robinson & King (1977) stated that calcium oxalate crystals are absent in the achene walls within the tribe Eupatorieae.

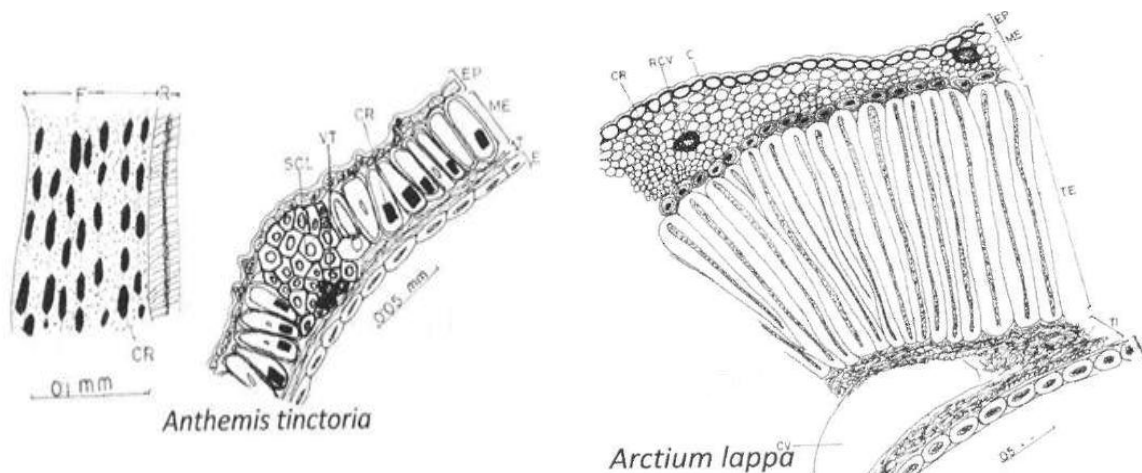


Fig.1. Showing the shape and distribution of crystals in the surface and pericarpic region of cypselas.

Although, the general morphology and mode of distributional pattern of calcium oxalate crystals are now somewhat known, their functional aspects are not clearly known or understood till now.

There are various opinions regarding the possible functions of oxalate crystals, which are as follows:

- i) Help in the regulation of the calcium levels in plant cells and tissues (Franceschi & Nakata 2005).
- ii) Help in the enhancement of the strength of the plant tissue or tissues (Franceschi & Horner 1980).
- iii) Help in the protection of the animals especially herbivores (Molano-Flores 2001).
- iv) Act as a storage tissue of calcium and oxalic acid (Franceschi & Horner 1980, Prychid & Rudall 1999).
- v) Help in the detoxification of heavy metals (Nakata 2003).
- vi) Help in the precipitation of calcium salt in same specific environmental condition (White & Broadley 2003).
- vii) To remove the toxic substances (Borchert 1984).
- viii) Help to overcome the salt stress and homeostasis (Hurkman & Tanaka 1996).
- ix) Help in the regulation of light intensity in plant tissues (Franceschi & Horner 1980).
- x) Provide mechanical support to the plant tissues (Nakata 2003).
- xi) Participate in the transformation of light energy to the chloroplast of the parenchyma cells of leaves during photosynthetic process (Kuo-Huang et al. 2007).
- xii) Facilitate the pollination, by providing a visual signal or a scent interesting to insect (Chase & Peacor 1987, Darcy et al. 1996).

Not only the above mention function, this crystal is very important in bulk calcium regulation.

Although crystal formation is gene controlled, various external factors such as -temperature, air pressure, light intensity, pH of soil and other environmental factors may affect the formation of calcium oxalate crystals (Franceschi & Horner 1980, Garty et al. 2002, Kuo-Huang et al. 2007, Meric 2008, 2009). Ilarslan et al. (1997, 2001) have also suggested that deposition of these crystals serves as a storage source for calcium and it is assumed that both the mitosis and cytokinesis are regulated by calcium ions (Hepler & Wayne 1985). The climatic condition of an area is associated with the phenology controls of the formation of calcium oxalate crystals in the cambial zone of *Citharexylum* (Verbenaceae), which has been observed by Marcati & Veronica (2005). They have indicated that an abundance of crystals was observed during water deficit condition, whereas during flowering time associated with rainy season, crystals were rarely observed. Therefore, further detailed critical studies regarding the distribution of calcium oxalate crystals in mature cypselar walls of Compositae will help to improve the classification of the family Compositae.

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