1. Introduction

Development of living organisms follows a highly coordinated expression of genetic information to give rise its characteristic phenotype. While each individual species has its characteristics phenotype, species share several characters among themselves, which allows them to be classified into genus, family and so on. Such grouping of species means that in spite of differences in their development program, they have common elements, which allows them to be grouped. The genetic basis of this commonness is yet to be understood completely. One good example, which shows common feature in a range of plants, is the presence of two cotyledons in the seedlings, which forms the basis of classification of angiosperms into two classes, dicotyledons and monocotyledons. While these two groups can also be distinguished on the basis of several other features, such as the numbers of flower parts, the leaf venation, the arrangement of the vascular bundles and the existence of secondary growth, the cotyledon number is the most prominent feature.

During the course of evolution there has been reduction in the cotyledon numbers. The gymnosperms have many cotyledons, which are reduced to two in dicots, and one in monocots. In fact, Burger (1996) suggested that the cotyledons of the monocots and the dicots are not homologous, since in the monocots the cotyledon is apparently a modified leaf. In dicots the cotyledons are the first differentiated organs of the embryo, which, consists of five main segments: the hypocotyl, which is the lower primitive stem; the shoot apical meristem, small dome of undifferentiated cells which give rise to all the above ground portion of the plant; the radicle or primitive root; root apical meristem; two seed leaves or cotyledons, which are symmetrically positioned across the body axis.

The main function of cotyledon in dicots is to help the young seedling after germination to acquire phototrophy. To achieve this function the cotyledon may serve as
repository of nutrients, and in case of epigeally germinating plants also carry out photosynthesis, till the leaves can appear and begin photosynthesis. The mature seeds of dicot can be classified as endospermic (with endosperm) or non-endospermic. Many dicots seeds remain endospermic but, some (e.g. Pea) absorb the endosperm during development redistributing the reserves within the cotyledons. In such non-endospermic seeds, the cotyledons are storage organs of all the nutrients needed for germinating seeds, therefore these cotyledon loose their leaf-like characteristics. Whereas, in the endospermic seeds the cotyledons have proteins and lipids bodies, in addition to their role in mobilization of nutrients from the endosperm in early stages of seed germination. In epigeal species where cotyledons come out of soil on germination and become photosynthetic, the cotyledons also play important role during initial seedling growth by carrying photosynthesis.

Cotyledons are often erroneously described as embryonic leaves. However, both ontogenically and morphologically cotyledons are different from true leaves. Firstly, the leaves arise as primordia on SAM, whereas, the cotyledons can form in the mutants, whose embryos lack SAM, showing independence of cotyledon origin. Secondly, the cotyledons contain embryo specific characters such as the presence of protein and lipids bodies. In comparison to leaf, the cotyledons have simple morphology, less number of cells, uniform size, fixed number and less influenced by the environment.

The genetic regulation of the cotyledon formation and differentiation is currently being investigated in Arabidopsis. Since cotyledon forms during embryo development, the study of embryo development has provided a wealth of information about the regulation of cotyledon development. The genetic dissection of embryo development in Arabidopsis has provided information about the genes controlling cotyledon number,
expansion, differentiation and cotyledon relationship with the shoot apical meristem. But, above knowledge is still incomplete and has to be expanded for other plants too.

I have used tomato as a model system to initiate a program on genetic regulation of cotyledon development and differentiation. As a part of this study I have isolated and characterized a polycotyledon and a narrow petioleless cotyledon mutants of tomato. Such mutants though have been reported earlier in few dicot species the detailed genetic, morphological and physiological studies have not been carried out. Even in Arabidopsis, where several mutants have been reported for the occurrence of the polycotyledony, the mutation has low penetrance, with only 30-40% seedlings showing multiple-cotyledon phenotype. Since tomato is a crop species, the understanding of the mechanism and factors controlling the cotyledon number and differentiation, would add and complement the information currently obtained in Arabidopsis. In this study isolation and characterization of two cotyledon mutants in an alternative system, the tomato is presented.