INTRODUCTION

Life evolved in the medium of water and hence water-life association is very significant and anything that causes depletion of the water, upsets this association. In the unicellular organisms, the water deficit may completely arrest physical and physiological activity, however, in higher plants where there are millions of cells, many groups or tissues are organised in a close coordination, water has a profound role in coordinating the colloidal system of the protoplasm. Any lack of water causing water stress in plants results into dehydration of the cells and tissues. Plants have to adjust to such adverse conditions.

A large portion of the earth is remaining unproductive on account of the unavailability of water rendering these areas in arid and semi-arid conditions. Water is not available to the plant because either the rains are scanty, or the rainfall throughout the monsoon is unevenly spread. Sometimes the rains are scattered; these factors contribute to the aridity of the lands. Another factor which is equally responsible for the causes of aridity is the quality of water, which is either too alkaline or too saline, and thus render water unavailable to the plants. These situations prevail over the larger portion of the land on earth. Water deficit is, therefore, everyone's concern and has attracted
many workers. The problem of the drought resistance of crop plants assumes the great importance throughout the dry regions of the world.

A seed is a ripened ovule containing the dormant embryo, its coat and the food storage tissues - the endosperm or cotyledons. With the imbibition and absorption of water by seeds, the dormant embryo awakes, this is described as germination. Germination of seed is conditioned by an optimum supply of water in the medium, optimum temperature and presence of oxygen in balance proportion in atmosphere. The establishment of seedlings and successful germination in any case, depends upon the absorbed water and this accounts to a several fold increase in water content, (Kramer and Kozlowski, 1960).

When a seed absorbs water the protoplasm gets hydrated and a number of metabolic processes are activated. The food reserves from cotyledons or endosperms are hydrolysed and mobilized to the growing embryo axis. Water thus has a paramount role in continuing and maintaining the germination processes.

Water is the major constituent of living tissues. In addition, it is a solvent in protoplasm in which dissolved salts etc. move from cell to cell. Water is also a reagent of the photosynthesis and is required for hydrolytic processes, such as starch digestion. Thus, in living system
water is required for a number of different physiological processes.

Deficit of water may hamper any of the above physiological processes. Water deficit may be of two nature in the case of plants. Water in the soil and water from the atmosphere. The soil water deficit has a greater importance in the case of the crop plants. It may be to extent that the plants may permanently wilt, and even addition of water to soil will not cause any revival of the plants. On the contrary, due to the atmospheric dryness caused by high temperature, high wind velocity and high light intensity as well as low humidity, plants suffer from only temporary wilting.

The drought resistance as considered by Maximov (1929, 1941) is a disturbance in the water balance of plants. The maximum drought resistance is seen in a dry seed, Chinoy et al. (1969) and Parker (1972). Drought resistance gradually decreases with the age of the plants. According to Chinoy et al. (1969) drought resistance is a dynamic process, which changes with difference phases. Some phases are more critical than others, and critical phases are for different for different plants, and the same plants in different environments.

The usual method of creating the water deficit has been to withhold water supply below field capacity in
various percentage to seedlings or plants and subjecting them to repeated soil drying cycles; by desiccating them in desiccators using desiccants by CaCl₂, H₂SO₄, etc., Kaufmann (1968).

The behavior of seedlings or plants changes depending upon the metabolic changes under water stress. There are variations in metabolic activities of a plant under drought conditions which depend on methods used to simulate water deficit. To the germinating seedlings water deficit can be simulated by germinating seeds under low water supply or using various osmotica such as NaCl, mannitol, sucrose and other sugars as well as the high molecular weight, carbowax-polyethylene glycol (PEG). The addition of various osmotica mentioned is very useful and has received considerable attention in the literature (Janes, 1966; Lawler, 1970).

This method in addition to conventional method of simulating water deficit should prove to be useful in evaluating the drought. It is known that under a water deficit condition the rate of germination is lower, there is delayed germination and arrested seedling growth (Collis-Georges and Sands, 1959, 1962; Williams and Shaykewich, 1971; Pawloski and Shaykewich, 1972).

Parmar and Moore (1968) used polyethylene glycol (PEG), NaCl and mannitol and observed that all the solutions had a
detrimental effect on germination of corn, being greatest in PEG and least in NaCl. They suggested that PEG may simulate the soil closely in terms of the effects of water deficit on germination. According to Kaufmann and Eckard (1972), PEG of high molecular weight, when added to a nutrient medium causes changes in plant water relations similar to those observed under drying soil. Uhvits (1946) used NaCl and mannitol as osmotica to study their effects on germination of alfalfa. He found a more reduction in germination in NaCl than in mannitol. The effect of such osmotica is thus mimic to that of low or restricted moisture levels, i.e. reduction, retardation and slow rate of germination, decreased uptake of water and consequently retardation in the fresh weights.

The metabolic changes in water stressed seedlings, although showing an apparent reduction in germination and retarded growth, show different responses depending upon the nature and methods used to create water deficit (Vora et al. 1974). Thus low moisture supply, use of osmotica and desiccation treatment may not cause the same metabolic alterations.

Behavior of seedlings and associated biochemical changes when germinating under stress have been investigated either by using a single osmoticum or by desiccating the seedlings or by low moisture level. A few isolated studies
have been undertaken to investigate the effect of various osmotica on metabolism, although the germinating behavior has been extensively studied (Parmar and Moore, 1968; Kaufmann and Ross, 1970). Greenway and co-workers (1967, 1968, 1972) investigated the effect of low water potential using mannitol on metabolism of *Chlorella pyrenoida*. Salts and carbowax were employed by Frisco and O'leary (1970) to investigate the protein synthesing capacity in embryo axis of *Phaseolus vulgaris* seeds. Nitrogen and soluble sugar contents were examined from brown sarson seeds during germination in carbowax by Pandya et al. (1972, 1973).

But these isolate studies or investigations have been undertaken to study the behaviour of seedlings and various metabolic changes of such seedlings germinated under different water stressed condition by employing osmotica. A perusal of review of literature indicates that effects of water deficit caused by different methods as well as their comparative effects are less studied. Low temperature treatments of seedlings in which the available water is frozen and therefore is not available to the seedlings may also be considered as a water stress, (Alden and Hermann, 1971). Further, protoplasmic water may be iced in such seedlings, thereby causing a water stress. Low temperature influences the physiological and biochemical processes, Alden and Hermann (1971).
Considering thus the various ways viz. desiccation, osmotica and low temperature, an attempt has been made to investigate the behaviour of seedlings under different osmotic stresses using osmotica and desiccation treatment and low temperature and the associated biochemical changes of seeds of two different diverse to food reserves. Oat—a starchy seed and Guar—a proteinaceous seed.

It has been also established that pretreatment of seeds by various chemicals and growth hormones induce drought and desiccation resistance, Chinoy et al. (1969), Genkel (1946, 1961).

It is thus evident from foregoing introduction of the subject that much remains to be done to understand the mechanism of action of various osmotica, effects of desiccation on pretreated seeds and low temperature on seed germination as well as the associated metabolism with this view.

The following experiments were carried out.

I Effect of different osmotica on biological changes during germination of Oat and Guar.

II Effect of desiccation on biochemical changes during germination of Guar and pretreated seeds of Oat.

III Effect of low temperature on biochemical changes during germination of Oat and Guar.