INTRODUCTION

Drought is a problem which is faced almost every year in many areas of the world, especially India. Drought reduces both quantity and quality of the plant material produced and is a major factor for preventing the stabilization of agriculture. One way of economically combating this problem is to ensure adequate irrigation whenever required. To predict irrigation scheduling, a suitable indicator of drought stress is required which must, at the same time, be simple and inexpensive. Visual symptoms of water stress, if they occur at all, are not satisfactory as they frequently appear after much photosynthesis activity is lost (Boyer and MacPherson, 1975). Various quantitative parameters of water stress have been described (Boyer, 1969; Kramer, 1969); for instance, water content as a percentage of fresh weight or dry weight, water saturation deficit, relative water content, hydratability, and water potential. However, these parameters merely reflect the water status of the plants whereas the analysis of the crop performance, as related to water supply and use, requires the understanding of the underlying physiological processes. Hence, it is important to develop a parameter which adequately represents the physiological state of the system under drought stress.

The literature indicates that almost any parameter or process of the plant can be changed by a severe and a prolonged
period of water stress. However, the activity of the enzyme, nitrate reductase, is extra sensitive to moisture stress since it responds markedly and rapidly even to small alterations in the water content of the tissue (Lattas and Pauli, 1965; Huffaker, 1970). It is also very sensitive to changes in the environmental temperatures and supra-optimal temperatures can cause rapid decrease in the activity (Younis et al., 1965). Other environmental factors like light and nutrition, also markedly affect the nitrate reductase activity (Beevero et al., 1965; Hageman and Flesher, 1966). These attributes of the enzyme suggest it as a suitable parameter to represent the response of the plant to the changing environmental conditions. Moreover, the key role of nitrate reductase in nitrogen metabolism and the growth and development of plants is also well recognised (Beevero and Hageman, 1969). The requirement of nitrate, for the induction of this enzyme, can enable the plant breeder to assess the response of the crops to nitrogen application. The importance of this enzyme has also been demonstrated in relation to total reduced nitrogen, protein content and yield in some crop plants (Croy and Hageman, 1970; Rilrich and Hageman, 1973). This offers the possibility of evaluating the productivity potential of a crop, by determination of the level of nitrate reductase activity after a period of drought. In view of these characteristics, it
sooms justified to study the effects of moisture stress, as well as of heat stress, in terms of the nitrate reductase activity of the plants.

For the assay of nitrate reductase, the *in vivo* method, developed in the recent years (Ferrari and Varner, 1970; Klepper et al., 1971), offers certain advantages over the *in vitro* assay. The former enables rapid estimations of a large number of field samples to be made simultaneously. Moreover, the technique provides an indication of the availability of the carbohydrate in the leaf (Klepper et al., 1971). Under certain conditions (Radin et al., 1975), it gives the best measure of the rates of nitrate assimilation in the leaf.

Moisture stress can be simulated in the laboratory by placing the plant material in a solution containing an osmotic agent. This constitutes an effective method to establish a predetermined and stable water potential in the tissue (Slatyer, 1961; Jarvis & Jarvis, 1963b; Ruf et al., 1963; Lawlor, 1970). Among the osmotic agents like mannitol, sodium chloride, PEG 6000, the last has been found to be the most suitable since it is not absorbed by plants (Lawlor, 1970; Michel, 1970). The addition of PEG 6000 to the nutrient solution has been shown to result in water relations, similar to those expected in soil of the same
water potential (Kaufmann and Eckard, 1971). However, the plants may not be physiologically similar under these two cases since in the natural conditions, water stress does not develop suddenly; rather it increases gradually, whereas the osmotic stress is established rapidly.

In the present work the emphasis has been to define a convenient and simple system for the study of moisture stress in the laboratory and also to evaluate the usefulness of this system in relation to the actual drought phenomena observed in the field. The in vivo nitrate reductase activity was established as a suitable parameter to study the physiological response to stress. Based on this parameter, it was sought to use the leaf discs, rather than the intact plants, as the experimental system. This is because the former are considered more convenient in terms of the case in handling, multiple sampling and improved accessibility of tissues to the added substrates or inhibitors. However, in view of certain differences in the behaviour of the leaf discs, as noted from a careful survey of the results of previous workers, it was necessary to compare the response with that of the intact plants. Some preliminary investigations were made in this regard.

A study of the possible role of the endogenous proline content in the moisture stressed and heat-stressed
plants was also undertaken. The effects of certain amino acids and hormones on the response of the plants to drought or heat stress were also investigated.

The efficiency of laboratory method was tested by comparing certain responses observed thus, with those observed under natural drought. An attempt was made to understand the combined influence of the environmental factors in determining the response of the plants to natural drought. Finally, the responses of certain physiological parameters were compared with the response of nitrate reductase activity, in relation to drought and to release from it.