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Effects of water stress on pearl millet

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Introduction

Soil water deficit limits the yield of crops in many regions of the world. In crop species the problem concerns not simply with the ability of the crop to survive periods of water shortage but also to produce a harvestable yield (this contrasts with the definition of drought resistance in ecological terms, viz. the ability of a plant to stay alive during periods of low water supply).

It is well documented that crops have different sensitivity to water deficits at different growth stage, as measured by grain yield losses [1]. In rainfed crops, drought can occur at any time during crop growth and the crop susceptibility to drought stress is a continuously variable function rather than a discrete function [2].

Pearl millet (*Pennisetum americanum* [L.] Leeke) is known to grow in the droughty areas of the world where there is low annual rainfall amount and its distribution is highly variable from year to year. In semi-arid tropics of Africa and Asia, rainfed farming of pearl millet constitutes the main pattern of land use and about 95 % of the world's millet is grown in these regions [3]. These areas are generally characterized by short rainy seasons, high mean temperatures, high potential evapotranspiration rate and sandy soils. Periods of water deficits in such environment vary in timing, duration and intensity. In pearl millet drought stress occuring early in crop growth has little effect on grain yield [4] and the susceptibility to stress increases at and after flowering [5].

Millet crop is adaptive to both variable and low amounts of rainfall; however, the specific mechanisms of its drought resistance are not yet clearly known. There is evidence that millet possesses some physiological adaptation mechanisms that permit it to resist drought stress [3].

Field experiments on water stress carried out in semi-arid zones, characterized by a rainy season, are affected by many difficulties: during the rainy season the timing and the duration of water stress period are unforeseeable and uncontrollable; staggered plantings, in order to obtain water stress period corresponding to different phases of the growing cycle, are subjected to strong insect damages; crops grown during the dry season, with artificial water supply, are subjected to higher air temperature, higher evapotranspiration demand and different photoperiod lenght.

The subject of this paper is to study water deficit effects both in vegetative phase and in post-flowering on growth and yield of millet plants grown in a controlled environment.

Materials and methods

The experiments were conducted during the period between February and June in 1990 and in 1991 at the Institute of Environmental Analysis and Remote Sensing for Agriculture, Florence (Italy).

Pearl millet (*Pennisetum americanum* (L.) Leeke) seeds of cv. 3/4 H.K., obtained from the INRAN center in Niger, were sown in a 50-l prewatered pots of fine sandy soil at about 3 cm depth in a glasshouse. During planting, 10 to 15 seeds were put on each pot and 20 Days After Sowing (DAS), plants were thinned to four per pot. Subsequent weekly harvests were made until one plant per pot in 1990's experiment and two plants per pot in 1991's experiment were achieved.

Temperature of the glasshouse was uniformily high during growth and the temperature was 34 °C during the day and 24 °C during the night. Photoperiod throughout the growing period was 12 h/12 h day/night.

Plant fertilizer was added to irrigation water at regular intervals before the stress period.