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Effects of Drought on Morphological Characters of Sugarcane

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ABSTRACT

A pot experiment was conducted to study the effects of drought on morphological characters of three sugarcane varieties viz. Isd-16, Isd-2/54 and Isd-20. Higher plant height, number, volume, fresh and dry weight of roots were obtained in the tolerant variety Isd-20. However, the highest base diameter was obtained in the intolerant variety Isd-16. Leaf production was affected by drought imposition in all varieties. Plant height, number, fresh and dry weight of roots might be used for screening of sugarcane against drought tolerance. The yield was also higher in the tolerant variety Isd-20 followed by Isd-16 and Isd-2/54.

INTRODUCTION

In Bangladesh sugarcane is an important food-cum-industrial crop and principal cash crop of low rainfall belts. Bangladesh has great potentiality to grow sugarcane to meet national requirements of sugar and gur. But yield of sugarcane is very poor due to various reasons such as vulnerability of sugarcane to drought, water-logging, flood and salinity (Miah, *et al.*, 1993). The sugarcane faces drought during germination, establishment and early tillering phases resulting poor yields. Sugarcane varieties differ markedly in their tolerance to drought stress. Some varieties wilted and showed reduced yield early in drought, while others remained turgid and showed optimum growth for a longer period (Humbert, 1968).

Many workers reported that plants tolerant to water stress posses some distinet morphological and physiological characters that enable them to adopt and overcome the deleterious effects of water stress (Pathasarathy, 1972; Hook and Scholtens, 1978; Rahman, 1983; Malik, 1992). Therefore, morphological and physiological characters for selection of sugarcane varieties with built-in potential to grow under drought stress deserve due attention and as such to examine the effects of drought on morphological and physiological characters, the present investigation was undertaken.

MATERIALS AND METHODS

The present investigation was conducted in pots during 1988-89 cropping season at the Bangladesh Sugarcane Research Institute (BSRI), Ishurdi, Pabna. Three commercial sugarcane varieties viz. Isd-16, Isd-2/54 and Isd-20 having different degree of tolerance to water stress were used as test crops. Single-budded polybag settlings were raised and the settlings of 45 d old were transplanted in plastic pots of height 35 cm, top diameter 33 cm and base diameter 27 cm following the method of Ali *et al.*, 1989.

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The variety Isd-16 is a high yielding high sugar containing thick-tall cane intolerant to water stress, variety Isd-2/54 is a moderately high yielding relatively thin-dwarf cane tolerant to water stress (both drought and water-logging) and variety Isd-20 is a high yielding high sugar containing thick-tall cane highly tolerant to water stress (both drought and water-logging).

The top soil of BSRI farm was collected and thoroughly mixed with rotton pressmud at a ratio 3:2. Each pot was fertilized at the rate of 4-3-3-2 g Urea-TSP-MP-Gypsum respectively. Full TSP, MP, Gypsum and half of Urea were applied in each pot as basal dose at transplanting and the rest of Urea was applied as top dressing in two equal splits at 45 and 75 d after transplanting. In each pot one settling having three pruned leaves (including spindle leaf) was transplanted. Intercultural operations and plant protection measures were taken as per requirement. Each plant including three tillers were allowed to grow in each pot. Each treatment was replicated seven times (one pot represent one replication). After transplanting, all pots (42 pots) were irrigated to bring approximately field condition in the net house and allowed to grow for a period of 125 d.

Artificial drought stress was created in 21 pots (7 pots of each variety). The plants were allowed to grow in the net house till permanent wilting. A polythylene shed was made at the corner of net house to keep away the plants from rain water. The remaining 21 pots (7 pots of each variety) were left out as control providing normal water supply. Irrigation was done to control pots as and when required.

A. The following growth data were recorded fortnightly:

a) Plant height (cm).
b) Base diameter of plants (cm).
c) Number of leaves per plant.

B. The following data were recorded at harvest:

a) Number of roots per plant.
b) Volume of roots per pot (ml).
c) Fresh weight of roots per por (g).
d) Dry weight of roots per pot (g).
e) Fresh weight of cane per pot (g).

RESULTS AND DISCUSSION

Results of the experiment have been presented in the Figures 1-8. The highest plant height was recorded during the treatment period in the variety Isd-20 followed by Isd-16 and Isd-2/54 (Figure 1). The adverse effects were more prominent in the variety Isd-2/54 than Isd-16 and Isd-20. The variety Isd-20 showed similar vegetative growth as control throughout the period of stress. Malik (1992) reported varietal differences in growth and survival behaviours during moisture stess. He studied that drought tolerant varieties of CP-43-33 and BF-162 maintain near optimum growth for longer period of time and show lesser yield reduction under moisture stress condition. The base diameter increased during drought stress in Isd-16 and Isd-20. The highest base diameter obtained in the variety Isd-16 followed by varieties Isd-2/54 and Isd-20 (Figure 2). The increased base diameter under drought condition was also reported by Joshi, *et al.* (1994). The lowest base diameter and higher plant height were obtained in variety Isd-20 (Figures 1 & 2). In this variety base diameter showed negative relationship with plant

height. Great fluctuations in base diameter were recorded at different growth stages of sugarcane. The findings agree with the results of Dillewijn (1952). Leaf production increased gradually upto 15 d of drought stress imposition in varieties Isd-16 and Isd-2/54 while leaf production was increased upto 30 d in variety Isd-20 and then gradually decreased (Figure 3). Leaf production reduced in all varieties due to drought imposition resulting higher leaf production in control plants during treatment period. Results agree with the findings of Clements (1980). He reported inhibition of leaf production in sugarcane due to drought stress.

Root production was significantly affected in Isd-16 due to water stress. Lower valume and number of roots and fresh and dry weight of roots were obtained in stress affected plants compared to control plants of Isd-16. However, drought effects were found insignificant in varieties Isd-2/54 and Isd-20 and in respect to root production. Malik (1992) reported that drought resistant varieties were characterized by better development of buttress roots and rope type roots than lateral roots.

The highest cane yield was obtained in variety Isd-20 followed by Isd-16 and Isd-2/54 (Figure 8). Irrespective to varieties adverse effects of drought were found significant compared to control. Figure 8 shows much less yield of cane in drought stressed plants compared to control since stressed plants were found completely dried up at harvest. Clements (1948) reported that growth of sugarcane was checked before the soil moisture reached to wilting point. Venkatraman and Naidu (1989) evaluated 10 cultivars under normal irrigation and water stressed condition and found 19.2% reduction in cane fresh weight of water stressed plants. Fresh weight of cane in variety Isd-20 was found to be less affected due to drought stress than other varieties perhaps because of water stress tolerant characteristics of this variety. Results agree with the findings of Malik (1992).

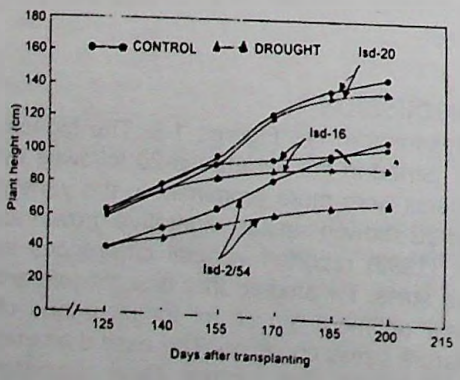

Figure 1. Effects of drought on plant height of sugarcane.

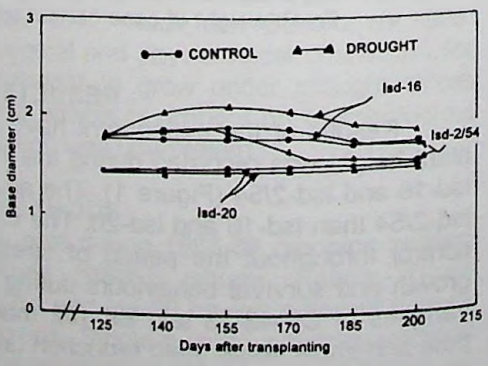

Figure 2. Effects of drought on base diameter of sugarcane.

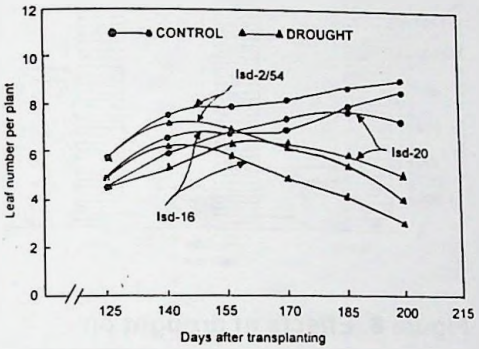

Figure 3. Effects of drought on leaf production in sugarcane.

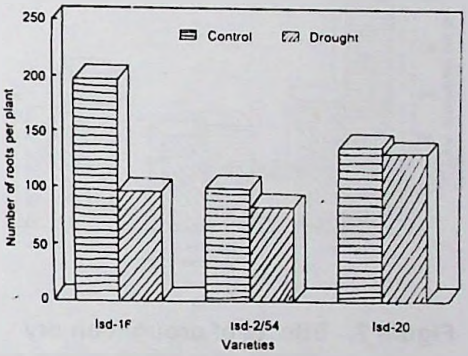

Figure 4. Effects of drought on root number in sugarcane.

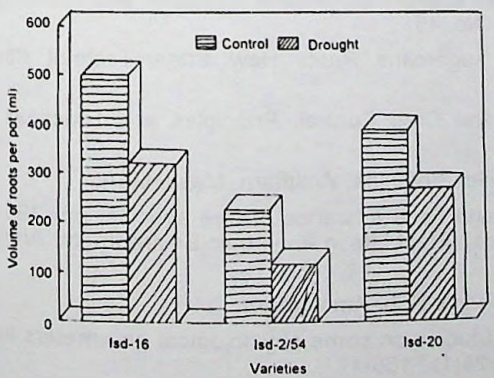

Figure 5. Effects of drought on volume of roots in sugarcane.

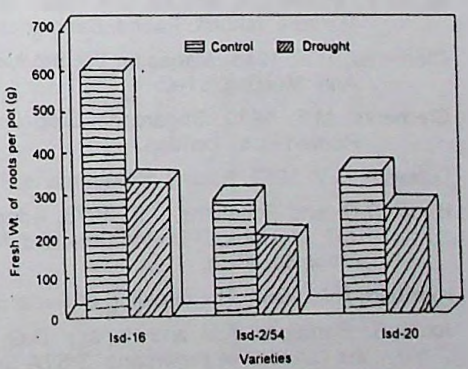

Figure 6. Effects of drought on fresh weight of roots in sugarcane.

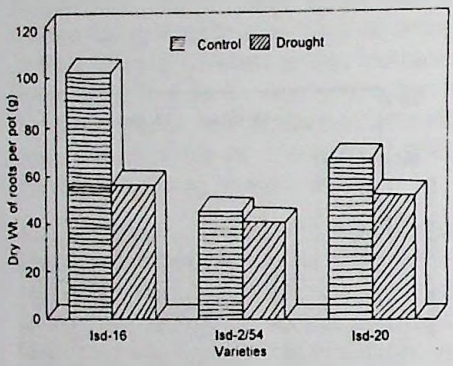

Figure 7. Effects of drought on dry weight of roots in sugarcane.

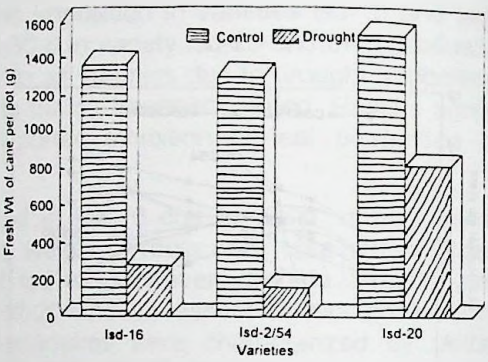

Figure 8. Effects of drought on fresh weight of sugarcane.

It may be concluded that drought tolerant varieties had less adverse effects on morphological parameters compared to moderately tolerant and intolerant varieties and drought tolerant varieties had greater potentiality to produce roots to combate drought ettects.

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