WATER DEFICIT EFFECTS ON MAIZE YIELD IN SOUTHERN BRAZIL

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ABSTRACT: The objective of this experiment was to evaluate the water deficit effects on maize yield and yield components. The maize hybrid Pioneer 30F33 was submitted to five irrigation water management treatments. Irrigation management was based on crop maximum evapotranspiration (ETm). Irrigations were applied when cumulative ETm reached values of 14, 22, 30, 38 and 46 mm. The experiment was conducted on a set of 20 drainage lysimeters under a mobile rain shelter. Leaf area index and plant height were measured twice a weak in each treatment from 29 days after emergency to harvest. Soil moisture were measure in each soil layer (0-20; 20-40; 40-53; 53-66 and 66-100 cm), twice a weak. Results of leaf area and plant height were similar during crop growing season for all irrigation strategies, and aboveground biomass accumulation at harvest was also similar for all treatments. Maximum technical maize yield was obtained applying irrigation when cumulative ETm reached value of the 34 mm. Total irrigation depth applied was 264, 281, 278, 279, and 282 mm using the irrigation management of 14, 22, 30, 38 e 46 mm of cumulative ETm. The use of irrigation application based on cumulative ETm values in Southern Brazil results in a easier practice to increase water use efficiency, increase maize yield and reduce application cost.

Keywords: irrigation management, evapotranspiration, maize

INTRODUCTION: The climate in Southern Brazil usually presents drier than rainier year (BERLATO, 1982). During the Summer months the high evaporative demand due to high solar radiation and temperature causes water deficit for many crops because the total amount of precipitation is commonly low. One important

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aspect the relationship between water consumption and crop yield is the water supply to the plants to satisfy water requirements. The amount of plant water required is governed by the crop and stage of growth, soil moisture holding capacity, the extent of root development and the meteorological climatic conditions in interaction with plant canopy (CARLESSO, 1995). Irrigation management based on maximum crop evapotranspiration offers vantages to attend crop water requirements, reducing the occurrence of water deficit and minimizing cost production and irrigation operation (BRAUNWORTH & MACK, 1987). Frequency and intensity of water deficits are the main factors that cause reduction yield or lower harvest quality (LAMM et al., 1995; CARLESSO & SANTOS, 1999; AL-JAMAL et al., 2001; FABEIRO et al., 2001). Thus, the objective of this experiment was to evaluate the water deficit effects on maize yield and yield components.

MATERIAL AND METHODS: The experiment was conducted during the 2000/2001 growing season in the experimental field of the Agricultural Engineering Department of the Federal University of Santa Maria, RS-BRAZIL. A set of 24 drainage lysimeters was used. The experimental site was protected against rainfall by a mobile arch rain-shelter. Maize plants were submitted to five irrigated treatments. Irrigations were applied when cumulative daily maximum crop evapotranspiration (ETma), estimated by the Penman-Monteith equation, reached values of 14, 22, 30, 38 and 46 mm. All treatments were irrigated to reach upper limit of soil plant available water when cumulative crop maximum evapotranspiration reached 55 mm. The first period of irrigation management was from 26 to 42 DAE, the second from 45 to 59 DAE, the third from 61 to 73 DAE and the forth from 75 to 102 DAE. A completely randomized design was used with four replications. All plants from each lysimeters were evaluated to determined crop yield and yield components.

Data collected were analyzed using ANOVA by SAS procedure (SAS Institute, Inc. 1990).

RESULTS AND DISCUSSIONS: Total amount of water irrigation applyied and numbers of irrigations is presented in table 1. During the crop growing season (26 DAE to 102 DAE) the irrigation depth applicated was 264, 281, 278, 279 e 282 mm for the water management of 14, 22, 30, 38 e 46 mm of ETma, respectively (Figure 1).

Table 1. Total amount of irrigation depth applicated and numbers of irrigations on each period of maize irrigation management. Santa Maria-RS, 2002.

	Water irrigation management (mm)									
	14		22		30		38		46	
	L	N°	L	N°	L	N°	L	N°	L	N°
	Irrigation Management Period (DAE)									
26-42	56	12	51	11	46	10	38	9	26	7
45-59	49	11	50	10	44	8	35	6	26	5
61-73	45	9	38	7	30	5	19	5	11	2
75-102	41	10	42	10	34	8	26	6	20	5
	14		22		30		38		46	
	L	N°	L	N°	L	N°	L	N°	L	N°
	Irrigation to raise soil water content to upper limit									
43	20	1	26	1	30	1	39	1	52	1
60	20	1	26	1	32	1	40	1	50	1
74	19	1	26	1	32	1	42	1	52	1
103	14	1	22	1	30	1	40	1	46	1
Total	264	46	281	42	278	35	279	30	283	23

L =Irrigation amount (mm); N° = number of irrigation applied; DAE = days after emergence

The Kernel weight, stem mass, ear mass and leaf mass were similar for all irrigation managements tested. Similar results were found for FERREIRA et al. (1992). A maximum technical maize yield efficiency was verified applying irrigation when cumulative ETma reached 34 mm (Figure 2). CARLESSO et al. (2000) working with different irrigation depth for maize obtained maximum technical efficiency for grain yield and biomass accumulative applying 21 mm e 24 mm, respectively.

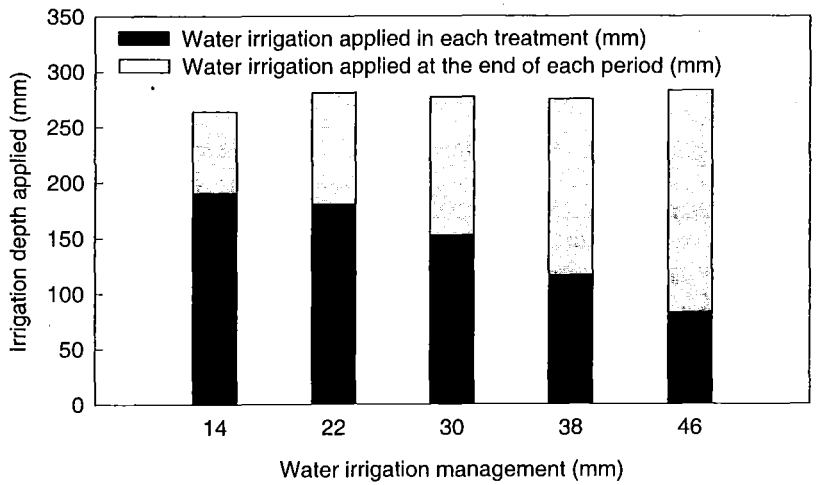

Figure 1. Total amount of irrigation depth applicated to maize crop during the growing season and irrigation applicated to raise soil water content to the upper limit. Santa Maria-RS, 2002.

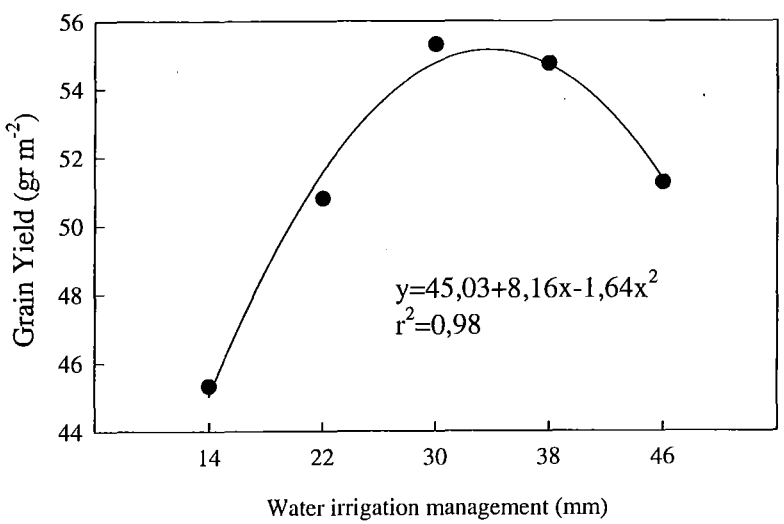

Figure 2. Maize grain yield of the five irrigation managements. Santa Maria-RS, 2002.

CONCLUSIONS: The best irrigation management for maize plants in Southern Brazil is obtained using the value of 34 mm of cumulative crop maximum evapotranspiration as irrigation trigger.

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