Study of water use efficiency, yield and quality of two sugar beet varieties in line source sprinkler irrigation

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Abstract

A line-source sprinkler irrigation trial was carried out to study water use efficiency (WUE), photochemical efficiency of photo system II (PEPS II), yield and quality of two different sugar beet varieties (IC1 and 9597*7233) at a site with clay-loamy soil and low rainfall (semi-arid area, about 250 mm rainfall annually) in Kraj-Iran, 2001-02. Irrigation water was applied when 50% of soil available water was used by plants from the soil to a depth of 60 Cm closed to the sprinkler line. 4 irrigation treatments were considered on the basis of water distribution form from sprinkler line between sugar beet rows. Water content in soil was measured by a time domain reflectometer (TDR).

WUE increased significantly with decreasing water consumption but no difference was found between the varieties. Root and shoot weight, sugar content and yield, and PEPS II were varied significantly among irrigation treatments.

Media summary

WUE, sugar yield and photochemical efficiency of photo system II on two different sugar beet varieties were studied in a line source sprinkler irrigation, experiment.

Key Words

Sugar beet, irrigation, water use efficiency, line source, photochemical efficiency of photosystem II

Introduction

Improving WUE of plants is a big challenge in arid and semi-arid areas. Therefore, parallel to plant breeding programs, physiological and technical studies need to be considered as supplementary research studies to improve W.U.E.. Previously, evapotranspiration requirements of 900 to 1200 mm have commonly been reported in sugar beet crop depending on the location and year (Dunham 1993; Hills et al. 1992). On the other hand, some reports have shown that sucrose concentration was increased by deficit water in a line source system (Kaffka et al. 1993). Recently, it has been shown that WUE of sugar beet in furrow irrigation systems is about 500-600 gr/m^{-3}water in Iran (Tohidloo et al. 2000; Taleghani et al. 2000) The line source system (Hanks et al., 1980) can be used to investigate physiological responses and selection of drought tolerant/resistance varieties in semi-arid areas.

Methods

Two different sugar beet varieties ((ICI and 9597*7233) were planted in 0.50 m rows in early April at the SBSI research field experiment, using a single line-source irrigation systems (Hanks et al.. 1980; Kaffka et al. 1994). Rows were parallel to the single sprinkler line and there were 24 on each side of the line source. Every 6 rows with a length of 6 m were considered as one plot on the basis of water distribution from the sprinkler line. Therefore, 4 treatments were considered on both sides along the sprinkler line. Rows and the line source were oriented slightly Northwest to Southwest to parallel the prevailing wind direction. Irrigations were applied when the amount of water in the surface 60 cm was depleted to 50 % of

available water in row 2 (100% ET treatment). Collection cups were placed in the same rows as access tubes to measure water applied. Soil water was measured using time domain reflectometry (TDR). The amount of water applied for each treatment is presented in figure 1. Photochemical efficiency of the varieties was measured in each plot a using Plant Stress Meter. Harvest was carried out in October collecting 6 m^2 from each plot. Fresh and dry weights for roots and leaves plus crowns were determined. Data reported were analyzed using the method by Hanks et al., 1980.

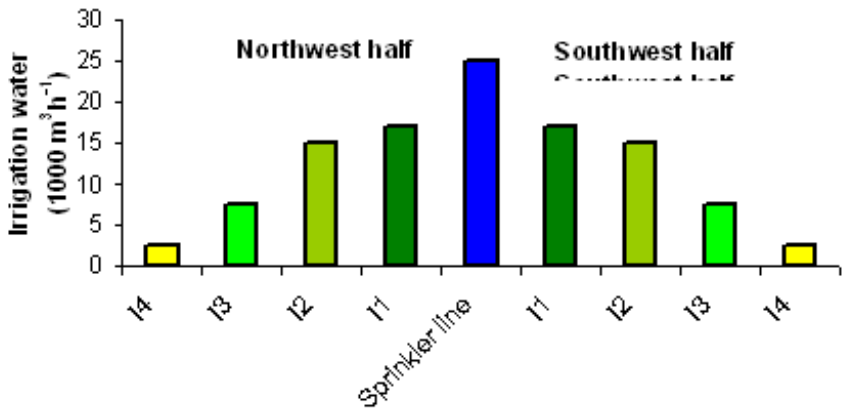

Figure. 1. Total amount of applied water along sprinkler line

Figure 2. Measurement of irrigation water after each irrigation

Figure 3. Southeast part of the field at final growth stage

Result

The most important agronomical characters and physiological responses of the crop in different irrigation treatments are shown in table 1, figures 4 and 5. However, there was no significant difference between the varieties in this experiment (data are not presented)

Table 1. Effect of Irrigation treatments on sugar content, root yield, shoot weight and sugar yield

Irrigation treatment	Sugar content (%)	Root yield (t/ha)	Shoot weight (t/ha)	Sugar yield (t/ha)
I1	14.52	37.09	16.98	5.40
I2	14.85	36.71	18.51	5.12
I3	16.38	32.15	16.28	5.21
I4	17.07	13.01	5.98	2.23

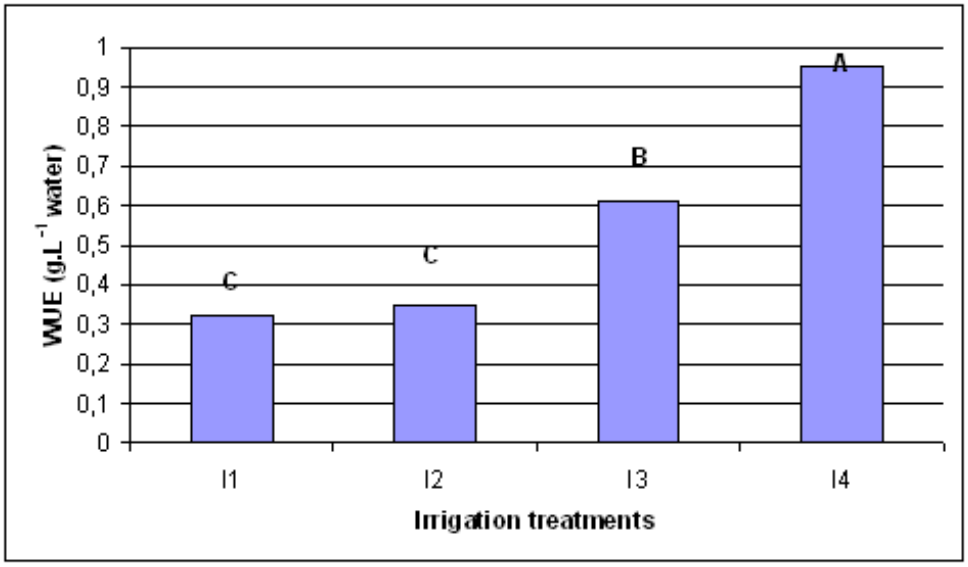

Figure 4. Water use efficiency in irrigation treatments

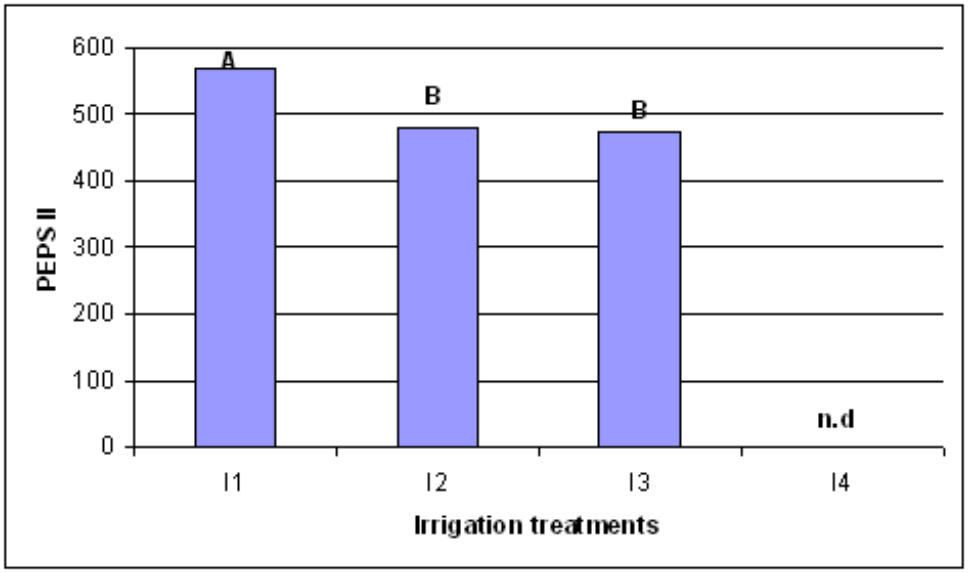

Figure 5. Photo chemical efficiency of photosystem II

Conclusion

Sugar content as an important qualitative factor of sugar beet crop increased with decreasing water consumption. Treatments I3 and I4 comprised higher sugar content, however, root yield and shoot weight were severely decreased only in treatment I4.

Comparison of sugar yield and water consumption among irrigation treatments showed treatment I3 can be practically applied in Iran.

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