Measurement of transpiration on maize with surface irrigation in Adana region

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1. Introduction

The field observation was conducted to investigate the efficiency of furrow irrigation with maize field near Adana from 14 to 28 August 2003. Evapotranspiration was measured by Bowen ratio method while transpiration was measured by the heat pulse method and the stem heat balance method. Soil evaporation was measured by microlysimeter. These values are classified for estimating detailed crop water requirements.

Practical furrow irrigation has been applied every 13-15days. During our observation period, one cycle irrigation period was obtained. Root depth and profile was surveyed for evaluating application efficiency and consumptive use efficiency.

Temporal results of observation are reported in this paper.

2. Measurement

2.1 Site

The observation was conducted at commercial field located 40km south from Adana and 100 km from the Mediterranean Sea. During observation period, no rain was accounted.

Maize (*Pioneer G-98*) was grown on furrow and the distances between plants are about 20cm. (Fig.1) Crop height was 3-3.5m. Irrigated water was applied by furrow surface irrigation on 10 and 23 August.

2.2 Transpiration

The measurements of sap flow in the stems are widespread in studies of plant-water relations. The stem heat balance method had the tendency to overestimate flow rate for higher than 100g h^{-1} values. On the other hand, although the heat pulse method requires a calibration coefficient to convert heat velocity in the stem to transpiration, the evaluated flow rate agreed with the discharge

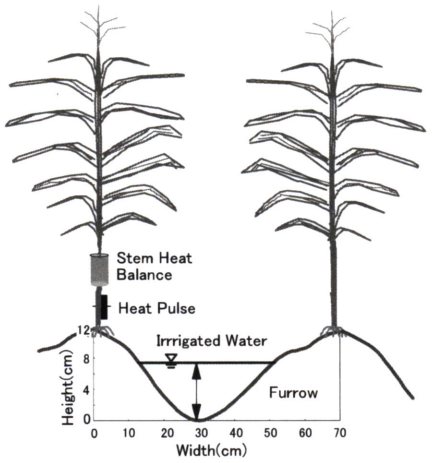

Fig.1 Schematic diagram of furrow for observation

rate even when the flow rate was higher than 100g h^{-1}. (Cohen et al,1993) However, the accuracy of the measurement is dependent upon the position of temperature sensors in the stem. As an application for the estimation of transpiration in field conditions, the hourly variations of transpiration was estimated satisfactorily by using both methods at the same time without using predetermined calibration coefficient for the heat pulse method. (Takeuchi et al.1995) In this study, the heat pulse method and the stem balance method was applied on same stems.

Six sample plants (1.9-2.2cm in diameter, 309-347cm height) for monitoring sap flow were selected form 100 plants with measuring the diameter of each stem. Heat pulse probes were inserted at No.3 nods (23-31cm) while the stem heat balance gauges were installed at No.4 nods (37-44cm).

2.3 Evaporation

The microlysimeter technique allowed researchers make gravimetric measurements of daily evaporation under a crop canopy without drastically modifying the field and soil environment. Three microlysimeters, 0.2m long and 0.105m in diameter were installed midway between the rows, 2 rows from the sap flow plot.

2.4 Additional measurements

Other meteorological measurements are given by manuscript of Dr. H. Odani. Root profile was surveyed and determined by root analyzer. Leaf temperature was also measured by inferred radiometer

3. Results

An example of obtained data is shown in Fig.2. It was clear sky day on 16 August, air temperature on the canopy showed constant value from 11:00 to 17:00. In the afternoon, prevailing wind blew from the south seacoast constantly.

Sap flow rate measured by the stem heat balance method were shown higher than 100g h^{-1} at mid-noon, so combined approach with the heat pulse and the heat balance methods was applied to compute accurate sap flow rate. Daily sap flow rate was 741, 679, 784,903,770,919g d^{-1} among 6 plants, while average value was 800g d^{-1}. These values are corresponding to 85 to 115% of average value.

In Fig.3, sap flow rate on cloudy day (26 August) is shown. On this day, daily sap flow rate was 661, 631, 752, 969, 673, 849 g d^{-1} among 6 plants, while average value was 756 g d^{-1}. These values are corresponding to 84 to 128% of average value. On cloudy day, sap flow rate was fluctuated among plants clearly.

Transpiration rate was computed by normalizing the sap flow data on a population basis, 5.33 and 5.04 mm d^{-1} for 16 and 26 August respectively.

Soil evaporation rate was reduced from 1.3 to 1.0 mm d^{-1} during first 3 days after irrigation, and then indicated 0.9 to 1.0 mm d^{-1} constantly. The ratio between transpiration and evaporation was changed from 16.9% to 24%.

54 % of plant root was concentrated from 10 to 20 cm from soil surface within 40cm furrow. Between furrow, root was not find significantly.

4. Irrigation efficiency

It is possible to conclude that maize were not suffered water stress condition and water saving will be achieved on farm basis and irrigation system bases.

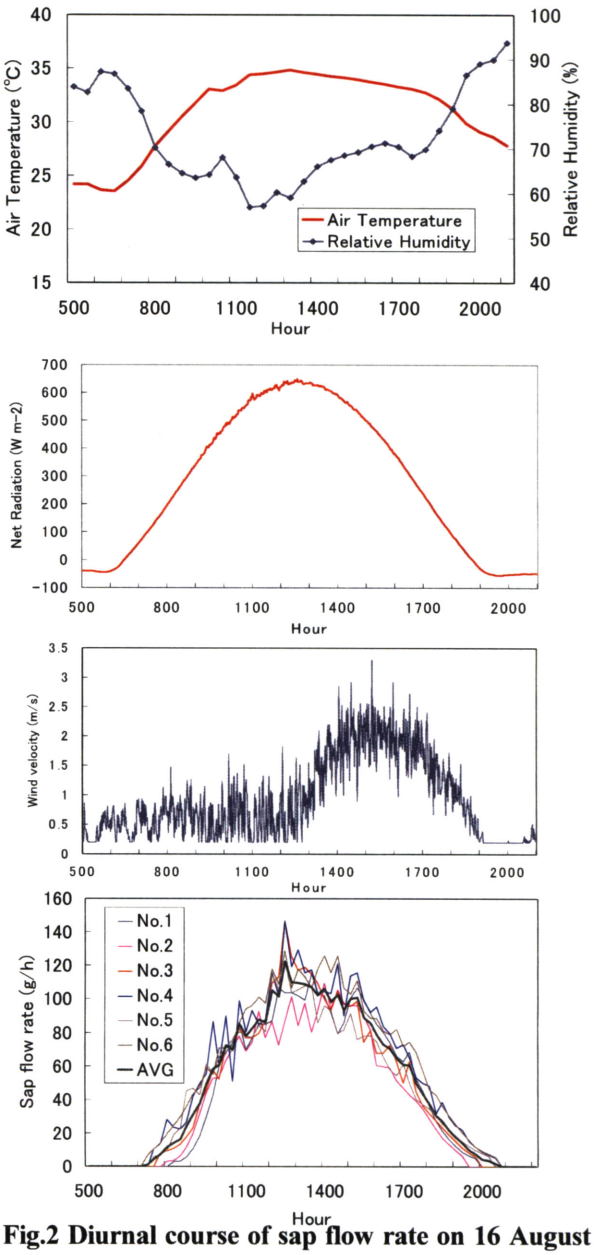

Fig.2 Diurnal course of sap flow rate on 16 August with air temperature, relative humidity, net radiation and wind speed data. (Clear day)

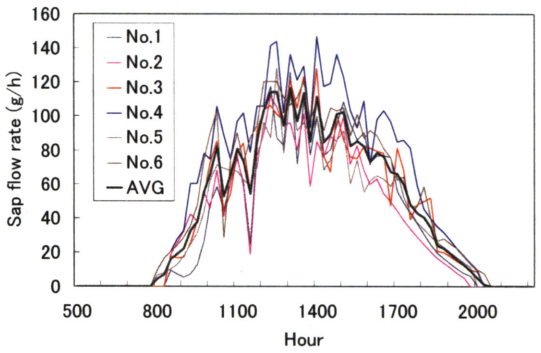

Fig.3 Diurnal course of sap flow rate on 26 August (Cloudy -day)

References

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