Soil temperature in the rooting zone of rice plants grown in pots and in a paddy field

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1. Introduction

A widely used approach in agronomic studies is to conduct experiments where plants are grown in pots with a volume usually varying from 5 to 15 liters (PETERSON et al., 1984; ELLIS et al., 1993; MICHELON, 2006; MARTINS & STRECK, 2007). An important concern when using this approach is if the microclimate that plants grown in pots is the same as the microclimate plants grown in the field are exposed to. Among microclimate variables that may be affected in pots is soil temperature, a major environmental factor that drives plant growth and development.

Rice is an important agricultural crop in Southern Brazil. The majority of rice crop in this region is grown in flooded pads (paddy fields). Experiments with rice grown in pots have recently been performed in Southern Brazil and the results of these experiments have been extended to a paddy field (STRECK et al., 2006a,b; STRECK et al., 2007). Therefore, it is important that soil temperature is not a limiting factor for extending such results to a field. The objective of this study was to quantify soil temperature in pots and in a field pad grown with rice.

2. Material and methods

An experiment was conducted at the research area, Crop Science Department, Federal University of Santa Maria, Santa Maria, RS, Brazil

(latitude: 29°43'S, longitude: 53°43'W, and altitude: 95m) during the 2006-2007 rice growing season. Rice plants (cultivar IRGA 421) were grown in pots and in a paddy field. Pots were black plastic pots, 30 cm in diameter and 26 cm in height (volume=12 liters), buried in the soil leaving a 5 cm rim above soil surface. There were a total of 44 pots spaced 1.5 m x 0.8 m among them. The paddy field was a 10 ha area grown with flooded rice located about 500m from the pots site. Fertilization and other field managements followed local recommendations for rice (SOSBAI, 2005).

Soil temperature at 5 cm depth was measured in the center of one pot and in the center of one 1.0 m x 0.7 plot in the paddy field with mercury-in-glass thermometers (accuracy 0.1°C). Temperature readings were taken during daytime (from 6 a.m. to 8 p.m.) every two hours, except from 1 p.m. to 4 p.m. when readings were taken every hour. Four clear and sunny days were selected for taking daytime soil temperature readings: 30 January 2007, one day before flooding; 01 February 2007, one day after flooding; 12 February 2007, twelve days after flooding; 12 March 2007, forty days after flooding. These days covered a wide range of soil moisture, canopy cover, and crop ontogeny. During these days, the main stem Haun Stage (Haun, 1973) was measured in five plants located near the thermometers as a measure of plant developmental stage by $HS = (NL - 1) + L_n/L_{n-1}$, where NL is the number of leaves, L_n is the blade length of the expanding leaf and (L_{n-1}) is the blade length of the penultimate leaf.

3. Results and discussion

When plants were small (one day before flooding), soil temperature was similar in the pot and in the field, with an average difference (paddy field minus pot) of only 0.6°C. This difference is negligible and did not affect plant growth and development. One day after flooding, soil temperature was on the average 1.5°C greater in the paddy field. This result is quite surprising and may be explained as a result of water temperature that entered the paddy field came from a surrounding area where temperature was high.

At twelve days after flooding, soil temperature was on the average 1.4°C higher in the paddy field, with greater differences near the minimum and maximum temperatures. However, this difference in soil temperature did not have a major impact on rice plant growth and development, measured by the Haun Stage that indicated that plants in both environments had 8 leaves. Later on in the experiment, when plants completey covered the soil surface, soil temperature was again similar between the two

environments, as the difference between field and pot forty days after flooding was only 0.3°C.

The results of this study indicate that there are small differences in soil temperature in the rooting zone of rice plants grown in buried pots and in a field rice pad. These differences are negligible from a plant perspective, as rice plants growth and development was similar in both environments throughout the experimental period. This result indicates that results of previous studies with rice grown in pots (STRECK et al., 2006a,b; STRECK et al., 2007) can be extended to a paddy field.

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