RICE DROUGHT PHENOTYPING FOR MODELING

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Drought occurs generally in major rice producing regions of Brazil, which occasionally causes severe crop losses (Steinmetz et al., 1988). To cope with this problem, it is desirable to develop drought resistant rice cultivars. Increasing knowledge on physiological bases of drought resistance and applying modeling to assist this analysis and find out the effect of main physiological parameters on rice adaptation to drought can increase breeding efficiency for developing adapted cultivars.

Five experiments dedicated to model application (SARRAH, Dingkuhn et al. 2003, and inititally planned but not realized: Ecomeristem, Luquet et al. 2006), were conducted during the rainy season or dry period in two phenotyping sites with different environments conditions. Two experiments were conducted at Embrapa Rice & Beans Research Center, Santo Antônio de Goiás-Goiás, where rainy season is from October to April. Genotypes were sown on January 11 2006. Three experiments, with and without drought stress, were conducted during the dry season, at AGENCIARURAL Experimental Station, Porangatu-Goiás. One set of experiments, with drought stress and without drought stress, was seeded on May 12 2006 and repeated on June 11 2006. A last experiment was organized and started in April 2007. In both sites, soil is a Dystrophic Red Latosol (Oxisol).

Experimental plots were made of nine rows of 6m long and 0.35m inter-row at Santo Antônio and 0.4m at Porangatu. Plants were thinned to 20 per linear meter just after emergence. The fertilizer rates applied were 16 kg ha^{-1} N, 120 kg ha^{-1} P_2O_5, 64 kg ha^{-1} K_2O, 20 kg ha^{-1} FTE and 5 kg ha^{-1} Zn. The N topdressing was done at the rate of 20 and 30 kg ha^{-1}, 40 and 55 days after sowing respectively at Santo Antônio, and 30 kg ha^{-1}, at pre-heading, at Porangatu. Weeds were controlled by using 1000 g i.a. ha^{-1} of oxadiazon. There were four replications and the five genotypes tested were: BRS Soberana, BRS Curinga, Primavera, Guarani, and CNA 9019. All of these Sativa, japonica genotypes have similar growth cycle, except BRS Curinga (longer). These genotypes present different plant type growth modern, with erects leaves and traditional, with droopy leaves. In addition, these genotypes also present different response to drought stress.

In well-irrigated treatment, the soil matrix potential was maintained higher than – 0.025 MPa, at 15 cm depth (Stone et al., 1988) during the plant growth, while in drought stress treatment, natural weather conditions were maintained. However, under severe drought stress (dry season Porangatu 2006, 2007) the experiments were well irrigated until 30 days after emergence and then a moderate drought stress was applied, with the application of 50% of water applied to well irrigated plants up to harvest (soil matrix potential about –0.07 MPa).

Three sets of data were collected. The first set concerns fine phenology characterization. These data were collected at weekly interval, from the first week after emergence. Four plants per plot were used for these observations. The phenology data were: number of green leaves of the main stem, number of dead leaves on the main stem, number of liguladed green leaves on the main stem, % of length of the growing leaf, length of last ligulated leaf, width of the last ligulated leaf, height of the plant, number of tiller and total number of tillers per plant. The second set of data consisted in destructive measurements for growth analysis at about 20, 50, and 75 days after sowing and at physiological maturity. Data were collected on one linear meter (about 20 plants) and concerned: tiller number, blade area, blade dry weight and weight of the rest of the plant. During the fourth reading, number of panicles, number of grain and weight of grain were also included. The crop yield and the 100 seed weight were evaluated in three rows of three meters length. The number of grain and spikelets was determined on 20 panicles.

The third set of data collected concerned soil physicals and chemicals properties: bulk density, % silt, % clay, % sand, water saturation, field capacity, permanent wilt point, C, N, P, K, Al, Ca, Mg, Zn, Cu, Fe, Mn, and CEC (Embrapa, 1997) at 0-20, 20-40, 40-60 and 60-80 cm soil depths.

Soil moisture was determined at weekly interval using just one replication of all genotypes on well irrigated and with drought stress. Data were successfully collected and used to parameterize and validate the crop model Rice06, from ECOTROP platform, for the Brazilian Savanna region.

Figure 1. The front view is the irrigated modeling experiment at AGENCIARURAL Experimental Station, Porangatu-GO.

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