Research in the Ord has found ways to improve rice yields

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Siva Sivapalan and Craig Palmer setting up the lysimeters to quantify leakage losses under paddy rice.

Study into 'time of sowing' puzzle

A new record yield of 14.3 tonnes per hectare was achieved from a Vietnamese rice variety grown in the Ord (northern WA) during the dry season of 2013.

A total of five varieties with three replicates were tested for three planting dates – namely April 22, May 8 and May 21 – using the traditional flooded (paddy) growing system.

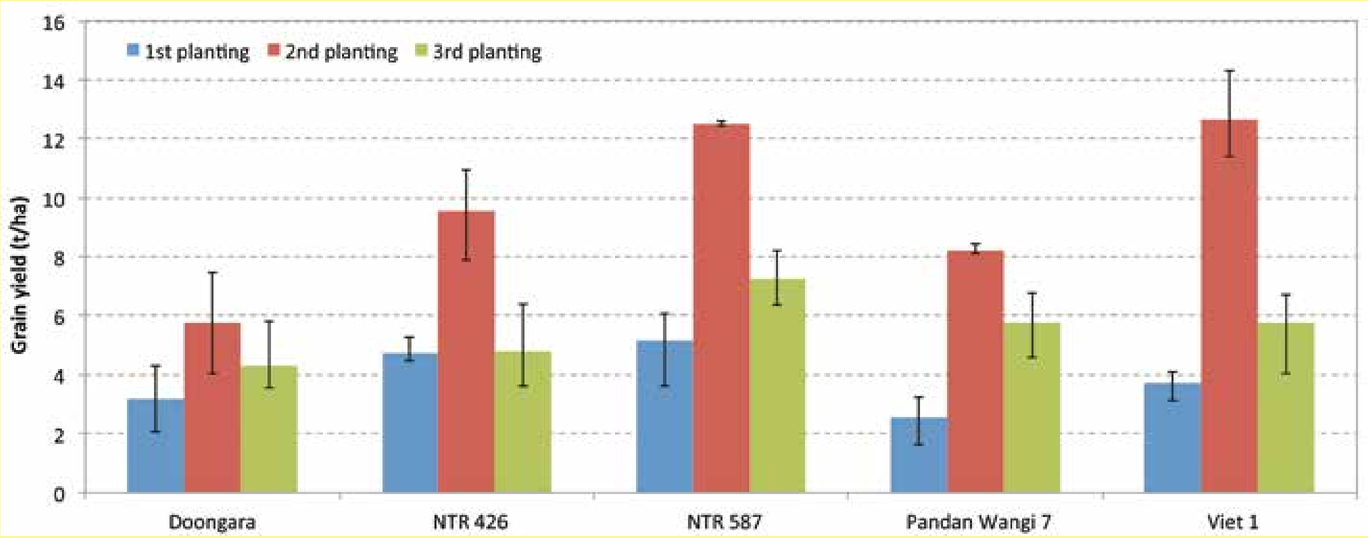
The highest yield of 14.3 tonnes per hectare was achieved for one replicate of the variety Viet 1 with a planting date of May 8 2013. But Viet 1 takes two to four weeks longer than the other varieties to reach maturity. This indicates that the later maturing Viet 1 variety might lead to higher irrigation water usage, extended bird control measures and reduced quality of harvested grain due to more exposure to the harsh climatic conditions of the late dry/early build-up during grain maturity.

Among the three planting dates tested in 2013, May 8 appeared to produce the best results (Figure 1). Varieties NTR 587 and NTR 426 achieved average yields of 12.5 and 9.6 tonnes per hectare, respectively, on this planting date. This is similar to average yields of 11.5 and 10.7 tonnes per hectare for NTR 587

AT A GLANCE…

- Planting in early May is crucial to achieve high yields for selected rice varieties in the Ord River Irrigation Area.
- To maximise yield from aerobic rice, it is essential to implement an irrigation interval of less than seven days.
- Deep percolation losses from flooded rice crop in Cununurra Clay soil were less than one mm per day.

FIGURE 1: Grain yield of five varieties tested at three planting dates (error bars indicate the maximum and minimum values)



and NTR 426, respectively, for the May 2, 2012 planting date. In a previous trial in 2011, the highest yield of 13.6 tonnes per hectare was achieved with a May 15, 2009 planting date for one replicate of the variety, Doongara.

Over the past four years, trials with planting dates outside the May 2–15 interval failed to produce high yields. It appears that for the tested varieties, a planting window during the first two weeks of May is essential in achieving good yields.

Clearer picture of 'irrigation scheduling' for aerobic rice

Variety Yunlu 29 was tested for aerobic growing management in field trials. The crop was furrow irrigated once every 12–17 days (average 14.3 days). A fixed irrigation scheduling adjusted according to water availability was used to determine whether the rice plants can utilise the subsoil moisture. An EnviroScan system was installed to monitor soil moisture status.

Attendees at the Rice Field Day inspecting the aerobic trial. (Photo: Noel Wilson, DAFWA)

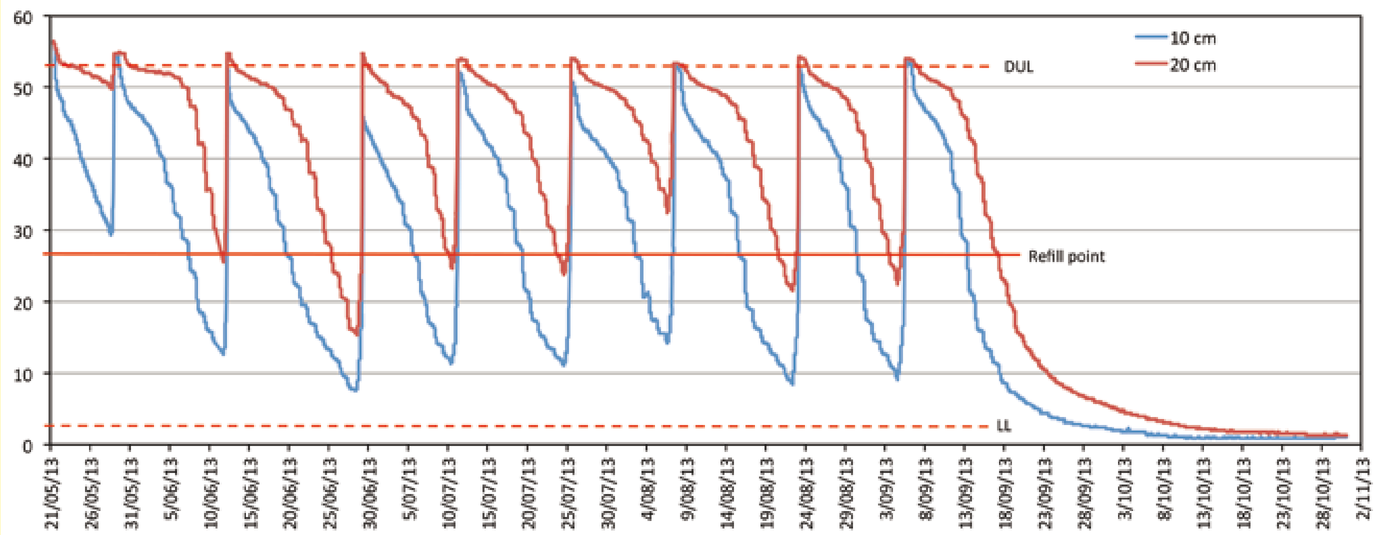
Data from the EnviroScan system showed that the soil moisture dropped below the desired critical soil moisture level (i.e. the refill point at 50 per cent depletion of plant available water) at 10 and 20 cm depths (Figure 2). The root system had grown to a depth of 40 cm. But 70 per cent of the absorbed water was extracted from the top 20 cm of the root zone. This means that the soil moisture data at both the 10 cm and the 20 cm depths are critical for irrigation scheduling purposes.

Rice is a semi-aquatic plant and thus a heavy user of water. Soil moisture levels closer to the drained upper limit (DUL) are necessary to avoid water stress leading to reduced yields. The data on Figure 2 suggests that the soil moisture at 10 cm depth reached the refill point in approximately seven days.

Any delay beyond seven days in commencing the next irrigation will subject the crop to water stress, especially for the root zone within the first 10 cm which absorbs 40 per cent of total water uptake. The irrigation intervals for the 2013 trials varied from 12 to

Siva Sivapalan and Mark Warmington observe harvesting of the rice plots by Maurice Darlington. (Photo: David Hadden, DAFWA)

FIGURE 2: Fluctuation of soil moisture at 10 and 20 cm depths under aerobic rice conditions (DUL, drained upper limit; LL, lower limit)



17 days (average 14.3 days) and this caused severe water stress to plants. The ideal irrigation interval for rice in Cununurra Clay has been estimated to be seven days. This is supported by the previous aerobic trials in 2011 and 2012 (Table 1).

Study explores deep percolation issues

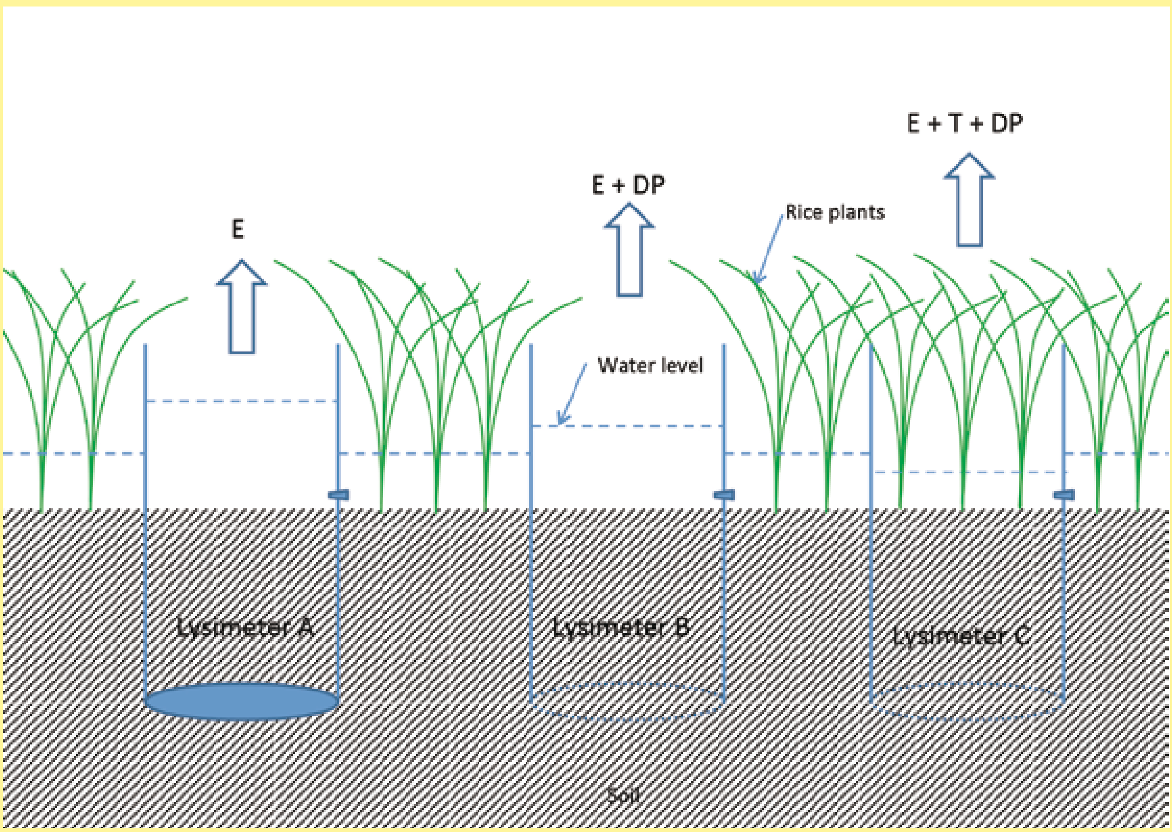
Using a set of three lysimeters and lockup bay tests, the trials estimated the evaporation, transpiration, and deep percolation losses for ponded rice culture (Figure 3).

TABLE 1: Yield of Yunlu 29 in aerobic rice trials

Year	Yield (t/ha)	Irrigation frequency (days)
2013	2.0	14.3
2012	9.9	7.7
2011	11.7	7.0

The data shows that evaporation losses were high at the beginning when the rice plants were small (Figure 4). As the crop

FIGURE 3: Diagram of lysimeters to measure evaporation (E), transpiration (T) and deep percolation (DP) losses in a paddy field, where the arrows indicate combined water losses



developed to full canopy which provided a shading effect and reduced the evaporation losses.

Transpiration losses increased rapidly as the plants reached full canopy and then started to decline when the plants approached full maturity. The increase in transpiration was mainly due to more leaf surface area contributing to more stomata openings for water loss. At full canopy, transpiration losses were almost double the evaporation losses.

The amount of deep percolation losses generally fluctuated between 0 and 2 mm per day over the period and this variability in loss may be due to the nature of measurements performed in the lysimeters. The total deep percolation losses over a period of 90 days were 88 mm. Hence the average deep percolation loss over the period was 0.97 mm per day.

The average of 0.97 mm per day was less than previously reported for Cununurra Clay in 1982 and 2002, reflecting the improved crop and water management used with modern rice varieties. Climatic conditions can impact processes such as evaporation and transpiration, but have no effect on deep percolation.

If this deep percolation can be replicated at the paddock and farm scale, it is predicted that recharge of groundwater under extensive rice cultivation using the traditional flooded system in Cununurra Clay soil should be within manageable limits.

It was estimated that the total water usage might reach the 13 ML per hectare mark for rice depending on weather conditions. The average deep percolation losses were estimated to be approximately one ML per hectare for the crop cycle. At this rate, deep percolation under ponded rice culture in Cununurra Clay soil is within manageable leakage rates of one mm per day.

The leakage under ponded rice culture compares well with irrigated cotton or sugarcane in the Ord. Leakage under irrigation was estimated to be 160 to 250 mm per irrigation season for cotton, and between 190 and 340 mm per crop-cycle for sugarcane.

Given the experimental results are able to be scaled to bay and farm scales, the rates should not unduly affect growers, or environmental managers, in terms of rising groundwater levels, waterlogging and salinity.

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FIGURE 4: Evaporation, transpiration and deep percolation losses as measured by the lysimeters (data points relate to average water losses within an irrigation cycle)