Rice Production in Australia: Responses to Short - and Long -Term Climatic Fluctuations

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The primary factor influencing rice production in south-eastern Australia is the availability of irrigation water. Australian rice production is entirely reliant on irrigation water, as rainfall during the growth period is generally minimal. The Murray-Darling basin, in which the rice production area is located, has been in the grip of drought since 2002. Average river-storage inflows throughout the past 9 years are approximately half their long-term values. Consequently, storage levels in the Murray-Darling system have been below long-term levels, varying from 44% of capacity to a low of 6% of capacity. Average storage levels were reached in only one season, and the lack of irrigation water has seriously impacted rice production during this period. Rice production in Australia averaged more than 1.2 million tonnes annually for the 10 years up to 2002, however, from the 2003 harvest to the present, the annual average has fallen to 360,000 tonnes. As a result of this long period of reduced inflows, the annual allocation of water for irrigation from the Murray-Darling system will be reduced.

Hence there is a pressing need to continue to improve the water productivity of rice-based farming systems. During the years of normal production until 2002, significant improvements in water productivity were made as a result of the removal of more permeable soils from production, use of shorter-duration cultivars, and improved fertilizer management, leading to improved yield potential. Over the 10 year period prior to 2002, the water productivity of Australian rice production increased by around 60%, from 500 kg to 800 - 900 kg of paddy rice per megalitre (ML) of water used. Future improvements are likely to come from changed production systems: such as changing from broadcasting pre-germinated seed into standing water to direct-seeding into dry soil, followed by intermittent irrigation until the mid-late vegetative stage. This will minimize evaporative losses prior to canopy closure. Further savings in total water use may be possible by using intermittent irrigation, or maintaining aerobic conditions for the entire crop growth cycle, however water productivity may not increase, and the plants will be more directly exposed to temperature extremes.

A number of adaptive traits will be required to secure the future for the Australian rice industry with limited water, including tolerance to low temperatures, drought, and high temperatures. Foremost among these is cold tolerance, particularly at the reproductive stage. The thermal mass of standing water in the current production system minimizes exposure of the developing panicle to damaging low temperatures. In a completely aerobic system, this protective effect is lost. Secondly, tolerance to transient periods of drought stress will also be required to ensure survival between irrigation applications. Finally, as temperatures become more variable, tolerance to periods of intense heat will also be required, particularly during periods of reduced water supply, (i.e. between irrigations), when the evaporative cooling effect associated with transpiration flow is reduced. Understanding of these adaptive traits is critical for continued success in rice breeding for limited water.