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Growth of Three Rice Cultivars (*Oryza sativa* L.) under Upland Conditions with Different Levels of Water Supply

2. Grain Yield

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Abstract: Upland rice production has great potential as a water-saving form of agriculture if yield can be increased and stabilized across a range of environments with different levels of water supply. The objective of this study was to clarify the effects of water supply and plant characteristics on grain yield of rice (*Oryza sativa* L.) grown under upland conditions. We compared grain yield (ranging from 346-685 g m^{-2}) and yield components of three rice cultivars (‘Yumeno-hatamochi’, YHM; ‘Lemont’, LMT; ‘Nipponbare’, NPB) grown under upland conditions with three water regimes (rain-fed, RU; irrigated, IU; and water deficit during the panicle-formation stage, WD) with those of rice grown under flooded lowland (FL) conditions (ranging from 394-649 g m^{-2}) from 2001 to 2003 at Nishitokyo, Japan. Grain yield and each yield component of NPB in RU were comparable to those in FL when there was ample rain during the 40 days before heading in 2003. However, grain yield of NPB decreased with decreasing water supply during the period of 20-40 days before heading under upland conditions (r = 0.93) as a result of reduced number of spikelets per unit area and reduced harvest index. Water productivity (grain yield per unit water supply) in rice in RU and IU ranged from 0.43 to 1.05 kg m^{-3} in the three cultivars across the 3 years, and was more than twice the corresponding value in FL. We found a cultivar – water regime interaction for grain yield within each year and a cultivar × environment interaction across all the 5 upland conditions in 2002 and 2003. In FL, NPB and LMT had higher

yields than YHM, while LMT had the highest yield under all upland conditions and NPB grain yield under the suboptimal upland environments (i.e. RU and IU in 2002) decreased to the largest extent compared with that under optimal upland environment, i.e. IU in 2003 among the three cultivars. The reasons for the highest grain yield of LMT across upland conditions were maintenance of large panicle and high harvest index. Maximum yield was lowest in YHM. In WD, yield potential and growth recovery, rather than crop growth during water stress, affected the cultivar ranking in terms of grain yield. We conclude that water supply during panicle development is important for maintenance of high yield and that a high potential yield and harvest index, as well as yield stability under different water regimes, are important putative plant characters for developing new elite varieties for water-saving upland rice production.

Keywords: Grain yield, Harvest index, Upland rice, Water productivity, Water supply, Yield potential

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