Achieving higher grain yield through integrated crop establishment in irrigated rice fields

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Abstract

Crop management strategies need to be improved and integrated in irrigated rice fields in order to approach yield potential, improve crop efficiency and decrease labor requirement. Crop establishment techniques (direct-seeding, nursery management, sowing date), in relation to genotype characteristics, appear to provide the options with the highest impact on productivity. Several trials involving first, direct-seeding and transplanting with the same sowing date and seedling density, second a range in nursery management considering seed density, transplanting age and nursery types, and third contrasted cropping seasons and plant densities, together with distinct patterns of growth amongst genotypes, have been implemented in the IRRI farm from 2003 to 2006. Increase in grain yield up to 1.5 t ha^{-1} was obtained from broadcasting compared with transplanting for most genotypes during both wet and dry seasons as long as land leveling and irrigation were highly controlled. In these cases, higher panicle density at maturity was observed as a result of earlier tiller emergence and leaf area production per plant. Seed rate as low as 25 kg ha^{-1} for hybrids generated a highly productive crop. As early as early tillering, some genotypes were even capable of adapting their spatial plant structure in response to the distance of their neighbors in order to increase light interception and leaf area production. As in direct-seeding, earlier tiller emergence and leaf area production contributed to the increase in grain yield, up to 1 t ha^{-1}, in early transplanting (7 days, i.e. 3-leaf stage) over late transplanting (21 and 35 days, i.e. 7 and 11-leaf stage) regardless of the genotype. In case of same transplanting date, the same observation was valid for low seed rate in the nursery (500 to 3 000 seed m^{-2}) compared to high seed rate (10 000 to 40 000 seed m^{-2}), for which tiller emergence was delayed and grain yield was reduced. No transplanting shock was observed in all these trials. Rather high seedling competition in the nursery, due to either late transplanting or high seed density, was reported to be critical to achieve high leaf area production and high grain yield in irrigated rice fields. No significant impact of nursery type, when comparing seedling trays, wet-beds, dapogs and improved mat nurseries, was quantified on plant growth, as long as the same seed density and seedling age for transplanting were applied. Even if tiller mortality was higher in case of early tiller emergence, this was proven not to have affected grain yield in a trial when aboveground water depth was increased up to 8 cm during late tiller emergence: the maximum tiller number was then reduced but the final tiller number was not affected. Quicker leaf area coverage appears to be a critical factor for high performance despite its role in tiller mortality. Regardless of the genotype, crop management in irrigated fields for direct-seeding and transplanting should induce early tiller emergence per plant, with the required adjustment for nitrogen application, in order to increase grain yield. This is also critical to weed competitiveness.