Rice: Characterizing the Environmental Response of a Gibberellic Acid-Deficient Rice for Use as a Model Crop

Scientists often use model systems to represent larger more complex systems. Many biochemical pathways and physiological mechanisms are identical between small and large organisms, so these smaller organisms are commonly used to predict responses in large organisms. In the past few decades there has been a major effort to sequence the genomes of these model organisms. Rice is the first crop plant to have a complete genome sequence available for study.

The next challenge is to relate the form with function. The study of functional genomics will benefit from model crops that facilitate laboratory studies. *Arabidopsis thaliana* has been capitalized upon by researchers because of its compact size, rapid life cycle, and massive number of seeds produced from a single plant. Its weedy characteristics, however, do not make it a good model for the major food crops of the world. A multitude of rice lines were examined for their potential at modeling food crops. Super Dwarf was identified as a mutant line from the cultivar 'Shiokari' and tested for its response to different environments to determine the environmental factors that result in high yields, high harvest index, and short life cycle. The results of these tests can be used to establish baseline growth conditions for laboratory studies and predict response to experimental conditions the deviate from the optimum.

Super Dwarf's temperature sensitivity, photo period sensitivity, and light response were studied along with its reaction to growth hormones, nitrogen, lamp types, and water stress. Temperature strongly influenced development, decreasing days to heading by up to 10 days. Super Dwarf appears to be a facultative short-day plant, as days to heading increased by 1 day per hour increase in photoperiod. Both vegetative biomass and grain yield increased almost linearly with increasing light. Heads per square meter increased with light as well, but harvest index remained at about 50% for all PPF levels. When exposed to high rates of the growth hormone gibberellic acid, the number of tillers slightly decreased and the days to heading increased. Mild nitrogen and water stress promoted earlier flowering. Previous studies have shown that life cycle length is identical in ambient and elevated CO_2. Finally, increasing planting density decreased the number of tillers per a plant, but the number of tillers per area was increased.

It is important to understand the baseline growth characteristics of any species before using it as a model crop. The unique biochemistry of Super Dwarf rice results in cultural considerations that differ from more common rice cultivars. Days to panicle emergence was the most variable developmental parameter, ranging from 35 to 54 days. Heading was the most consistent variable, occurring on or around 54 day in most studies. In spite of a few problems, Super Dwarf rice is extremely useful in controlled environment studies where space is limited.

Figure 1.'Super Dwarf' rice is a useful model crop because it stands only 20 cm at maturity, about 60 cm shorter than previously identified "dwarf" rice varieties such as 29-Lu-1. By characterizing its environmental responses, 'Super Dwarf' can be a useful tool to study many influences on grain yield for globally important field crops.

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