
Increased Yields, Less Disease

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A few years ago, the journal *Nature* carried an exciting article called “Genetic diversity and disease control in rice” by Youyong Zhu et. al. An international team of scientists working with thousands of small farmers in China demonstrated a simple method to increase the yield of two varieties of rice (*Oryza sativa*) and to reduce incidence of a disease called rice blast. One of the rice varieties, glutinous (or ‘sticky’) rice, is more valuable economically but is also more susceptible to rice blast. The other, a hybrid variety, is much more resistant to rice blast. Rice blast is caused by the fungus *Magnaporthe oryzae*. Spores of the fungus are airborne. When they land on rice plants, they often cause necrotic (dead) spots on leaves and panicles. Farmers in Yunnan Province in China used to plant monocultures of the relatively resistant hybrid rice, planting only tiny plots of glutinous rice because the latter was so susceptible to rice blast.

In the experiment, instead of the usual monoculture fields, farmers planted the two varieties of rice together. They planted four rows of hybrid rice between each row of glutinous rice. Monoculture fields were also planted for comparison.

Results of the experiment were surprising. For one thing, when interplanted with hybrid rice, the incidence of rice blast on the disease-susceptible glutinous variety was 94% less severe than when glutinous rice was grown in monoculture. Why such a reduced incidence of disease? One reason might be because spores would have to travel further to land on a susceptible plant because of the greater distance between rows of glutinous rice in mixed fields compared to monoculture fields. A second reason for the reduced incidence of disease might be related to the fact that glutinous rice is taller than the hybrid variety. The authors suggested that this might lead to “temperature, humidity and light conditions less conducive for blast on glutinous varieties.” Though they do not explain the phrase further in their article, it makes sense that rice heads standing above the rest would be warmer and dryer and would receive more light.

Although low to begin with, rice blast incidence on the hybrid variety had also declined by the second year of the experiment. The authors raised an intriguing possibility to explain why the incidence of disease was so much less when the two varieties were planted in a mixture. They wrote, “Preliminary results indicate that fields with mixtures supported diverse pathogen populations with no single dominant strain. In contrast, pathogen populations from monoculture fields were dominated by one or a few strains.” This means there might have been “incompatible interactions” between certain rice blast strains and the hybrid rice variety.

A second positive result of the experiment was that the yield per hectare increased when the two varieties were planted in a mixture. Glutinous rice yielded almost twice as much when planted with hybrid rice as it did when planted in monoculture. Hybrid rice in the mixed fields yielded as much per hectare as it did when planted in monocultures. Overall, mixed populations produced more grain per hectare than monocultures.

Why was the yield of glutinous rice so much higher in fields planted with a mixture? The reduction in disease severity very likely played a role. The authors also suggested that improved light interception by the taller glutinous varieties may have played a role.

By the end of the two-year experiment, farmers had stopped using fungicides, which meant less expense for them. Since the farmers harvested rice by hand, the hybrid and glutinous grains could be easily separated.

Would other varietal combinations work? The authors pointed out that not all of the variety combinations that they experimentally identified provided rice blast control. However, there is potential that a similar method could be used for other crops.

Reference: Zhu, Youyong, et al. 2000. Genetic diversity and disease control in rice. *Nature* 406: 718-722. (Readers working in the area of agricultural development who would like a copy of the full article and who do not have access to this journal may write to ECHO and request a copy.)