PopSci
Science for Society

Mapping out plant disease

by Luis Wilfrido Atienza

Agriculture is essential to life in the Philippines. It is the main livelihood for millions of farmers, and local crops feed people all over the country. One of the most significant locally grown crops is rice. Aside from being a source of food and an important part of the Philippine economy, it occupies a central part in Filipino culture.

Studying rice, including the best ways to plant, harvest, and cultivate it, is a very active area of local scientific research. This is evidenced by the presence of institutions such as the International Rice Research Institute in Laguna.

Lots of work go into creating varieties of rice that are hardy and easy to grow and maintain—varieties that are more resistant to difficult conditions such as flooding, droughts, or other types of harsh weather. Another side to this is making sure that the rice being grown is able to fight off harmful organisms such as insects or even microorganisms that can cause plant diseases.

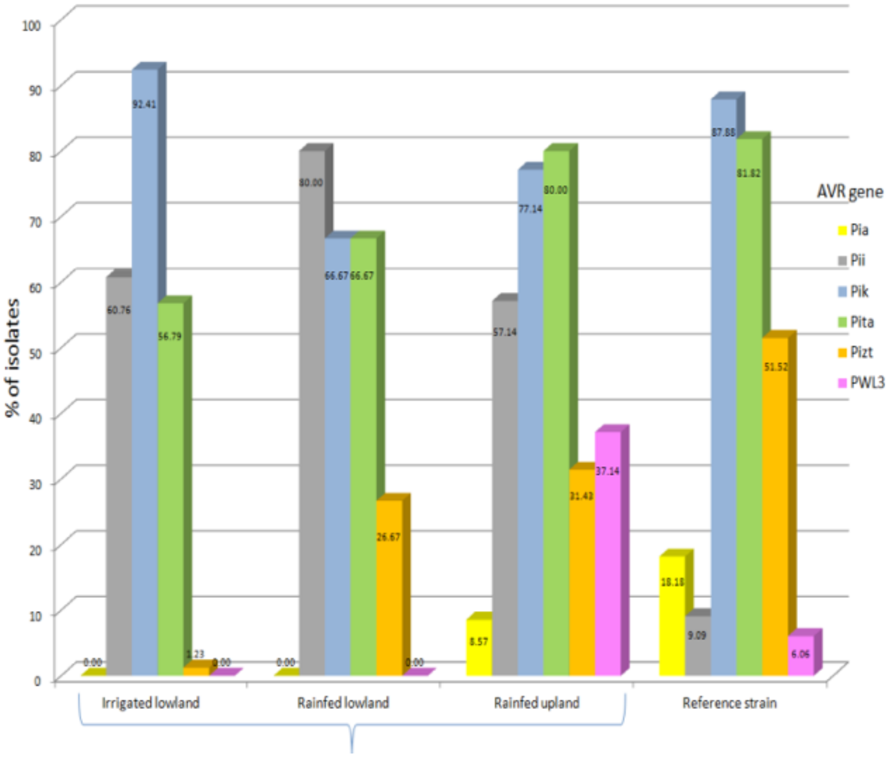
One of the biggest enemies of rice is *Magnaporthe oryzae*, commonly known as the rice blast fungus. This fungus infects rice plants and cause lesions on the plant's leaves and other parts, leading to structural weakness and death of the plant.

A team of scientists from Jose Rizal Memorial State University and the University of the Philippines Los Baños is looking into rice blast fungus and trying to help drive new, more effective methods of creating rice strains resistant to this fungus and deploying such strains where needed.

The scientists are studying what are called *avirulence genes* in the rice blast fungus. Like all genes, they code for proteins that serve a variety of functions. These genes in particular are important because they code for proteins that are essential for the fungus to be able to enter and infect plants. They are also important because the proteins they code for can be detected by the rice plants, triggering an immune response.

The scientists took samples of rice blast fungi from nine provinces all over the Philippines, featuring different common environments where rice is grown. They extracted DNA from all these fungus samples and analyzed it to figure out how avirulence genes were present in each of the samples. In this way they hoped to discover if certain genes were more common in a certain province or region and if the environment the rice is grown in affects the genes present in fungi that infect it.

After analyzing the DNA extracted from all the DNA samples, the scientists compared the results from different provinces and found that there were no major differences in the avirulence genes of the rice blast fungi. Instead they found that the specific conditions that rice is grown in played a bigger role. Most notably, they found—from a limited number of samples tested—that rice blast fungi in highland regions had more avirulence genes than fungi from lowland areas.



The frequency that the different types of avirulence genes were found in each type of environment.

From their analysis of the rice blast fungus DNA, the scientists were also able get an idea of the genetic compositions of the rice itself in these different areas. The proteins coded by avirulence genes are detected by specialized corresponding genes, called *resistance genes*, in plants. Because the scientists were able to discover which avirulence genes the fungi had, they also knew which resistance genes the rice plants in those areas had.

Getting an idea of where rice is more or less resistant to one of its main pathogens is key to effectively creating and distributing resistant varieties of rice. For example, upland rice is generally more susceptible to the blast fungus than lowland rice.

This means that farmers in highland areas should be provided with rice varieties with corresponding resistant genes matching the avirulence genes of the blast fungus. Providing farmers with resistant varieties of rice also reduces the amount of antifungal chemicals that must be used. This not only saves farmers from having to purchase these chemicals but also prevents the risk of applying these chemicals improperly.

This research can also serve as an important baseline of rice blast fungi avirulence. As rice breeders develop and release new resistant varieties against the fungus, the fungus will evolve in turn, creating new avirulence genes which will help it overcome the plants' defenses. Comparing the DNA of future rice blast fungi to these results could give us a picture of how and how fast this fungus is evolving, and how best to combat it, keeping our rice resilient and healthy.

REFERENCES

Lopez AL, Yli-Matilla T, Cumagun CJR. Geographic distribution of avirulence genes of the rice blast fungus *Magnaporthe oryzae* in the Philippines. Microorganisms 2019; 7(1):23.

Luis Wilfrido Atienza graduated from the Ateneo de Manila University, with a BS in Biology and a minor in poetry. He currently works as a writer for a medical communications agency and spends some of his free time writing about science.