Epidemiology and Disease Management of Rice Brown Spot: Research Priorities and Knowledge Gaps

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Delivered May 27, 2014 at "Plant Pathology in Genomic Era", Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, India

Rice brown spot is a disease that chronically affects millions of hectares of rice every growing season and is found in all rice growing areas of the world, with reported yield losses ranging widely in relative terms from 4 to 52%. The disease was even associated with the Great Bengal Famine in 1943, however, in spite of its historic impact and its widespread occurrence and apparent impact, there is much that is to be learned about this disease. It seems that traditionally brown spot is thought of as a secondary problem that is a reflection of rice that is experiencing physiological stresses such as drought or poor soil fertility, rather than a truly infectious disease like blast or bacterial blight. This prevailing attitude has lead to a lack of accurate and systematic estimates of yield losses and the real effects of brown spot on rice.

As brown spot is known to be favoured in conditions where water is limiting and where soil nutrition is lacking, it makes this disease an interesting case study for climate and global change. Water shortages and changes in rainfall are likely to occur as a result of climate change, which will have direct impacts on rice crops. Changes in the availability of fertiliser and the costs of these products are likely to have an impact on the disease. Additionally, work done by IRRI in the past decade indicated that shifts from intensive manual labor inputs to less intensive, e.g. manual transplanting to direct seeding, coupled with decreases in water availability lead to an increase in brown spot incidence in surveyed fields across tropical and sub-tropical Asia. As we are confronted with the changes surrounding global change and climate change, this makes brown spot an important disease in rice to be considered.

However, several gaps exist in our knowledge surrounding this disease including a good understanding of the epidemiological process, resistance and biocontrol methods. Overall we know little about the frequency with which brown spot occurs and the areas that are chronically affected. What is the intensity of the disease in these areas? At smaller scales, starting with the basic life cycle of the disease, we lack a clear understanding of the sources of inoculum and their effects on disease development.

The main source of inoculum is thought to be seed-bourne with secondary infections arising from left-over debris, but some studies have cited weeds and soil as possible reservoirs as well. However, the nature and importance of these different inoculum sources is not well understood yet. We also do not yet have good understanding of infection efficiency, predisposition to infection and delays in incubation, latency and infectious periods. And while resistance is touted commonly as a way of managing diseases, our understanding of the sources of resistance in rice to brown spot is lacking, perhaps again due to a focus on more acute diseases like blast and bacterial blight. It is not enough to discuss knowledge gaps in brown spot without the mention of the use of biocontrol as well. While there are several promising uses of biocontrol agents to to control other diseases, few reports have been conclusively made on brown spot, but some promising reports have been made in this area.

If we are able address these knowledge gaps in a proper and systematic way it will allow us to have a better understanding of how brown spot is impacting rice production in the context of our current production systems and possible future systems.The most obvious benefit would be to the farmers that currently suffer the effects of this chronic disease of rice. A clear understanding of the processes involved in the epidemiological processes could lead to better control methods, including biocontrol. An improved understanding of the sources of resistance and their genetic bases is critical because of a lack of connection between the host and pathogen and this relationship to epidemics. Because of the linkage of the disease with environmental factors, this becomes difficult to disentangle, but it would be of great benefit to breeders and crop managers alike.

As we examine all of these things, it becomes clear that this disease is more important than the amount of attention that it receives would suggest. We may be able to think that brown spot as an indicator of climate change shifts in socio-economic contexts and because such interactions are not totally unique to this pathosystem. This may mean that brown spot can be used as a model system in characterising the behaviour of many complex pathosystems in the face of global and climate change. Additionally, the losses caused by the disease, due to a lack of standardised measures, may be perhaps underestimated and attributed to other causes, e.g. drought and fertility. There is much to be learned about this pathosystem and much that it can contribute to our knowledge of other pathosystems.