Dealing with the Problems of Fungal Damage in Soybean and Other Oilseeds

R.F. Wilson*

USDA, ARS, Raleigh, North Carolina 27695

The following papers were presented in the session entitled, *Improving Oilseed Quality: Biocontrol of Pathogenic Fungi*, at the 85th AOCS Annual Meeting & Expo held in Atlanta, Georgia. The intent of these presentations was to explore the basis for assumptions or practices regarding the apparent problems associated with fungal damage in soybeans. Various fungal pathogens were considered, but special attention was given to diseases caused by *Fusarium, Cercospora,* and *Phomopsis* spp. These papers spoke to the fairness of the current grading/discount system for fungus-damaged soybeans, how these pathogens cause seed deterioration, the impact of fungal damage on seed composition and constituent value, the potential occurrence of fungus-derived mycotoxins in soybean products, genetic resistance to these pathogens, advances in molecular genetic technologies to control mycotoxin synthesis, and current permissible levels of mycotoxins in soybean and soybean products.

Moldy, weathered, bicolored, or other indicators of discoloration are characteristics associated with fungal damage in soybean and in other oilseeds. These conditions occur most frequently when warm, wet weather delays the soybean harvest. Based on appearance alone, it seems obvious that seed infected with *Fusarium, Cercospora, Phomopsis,* or other fungal pathogens should be an inferior product. Thus, in the interpretation of U.S. Grade Standards, discoloration caused by any fungus or virus becomes a prime consideration in determining seed quality. However, the paper presented by J.B. Sinclair suggests that discoloration, attributed to certain fungi, such as *Peronospora manchurica* (downy mildew), or to the soybean mosaic virus, has a limited effect on seed quality. Indeed, there appears to be a wide range of impact on seed quality, from severe to cosmetic, among the most common pathogens of soybean. Hence, without clinical analysis of the species present, there is a high probability that soybean appearance alone may not always be an adequate indicator of quality or grade.

The fact remains that these fungi affect seed through production of certain mycotoxins, which are required for pathogenicity. The specter of mycotoxins in food products rings an acute alarm. However, the knell is tempered somewhat by the attention the U.S. Federal Drug Administration has given this potential problem. In the paper presented by S. Nesheim, some comfort may be gained from the knowledge that mycotoxins are not considered a significant problem in soybeans. At least, no regulatory action or program seems warranted at this time.

Still, mycotoxins produced by the subject fungi may directly or indirectly affect the chemical quality of soybean seed. In highly infected seed, these pathogenic agents destroy lecithin and form nonhydratable phospholipids, increase the level of free fatty acids, oxidize lipids to form undesirable color in processed oils, and may introduce toxins that compromise meal quality. Upon entry into seed, the pathogens also metabolize carbohydrates, which causes lower test weight per bushel. Therefore, fungal damage may have significant deleterious impact on chemical and physical properties of soybean. Perhaps, little more needs to be said about the relation of fungal damage to soybean quality, but it is interesting to find that the concentrations of both oil and protein are directly proportional to the level of fungal damage in soybean seed. This condition may be attributed to loss of seed carbohydrates. After laboratory-scale refining, the photometric color index of the oil may increase linearly with the level of fungal damage, but little change is noted in the fatty acid composition of triacylglycerol. Darker color may limit markets for such oil, yet blends with uninfected seed should alleviate this problem. Thus, there may be practical and economically advantageous ways to capitalize on the higher protein levels in heavily discounted fungus-damaged soybeans.

Of course, prevention is the best solution to fungal damage in soybean. In general, there is little known genetic resistance to fungal pathogens in the USDA Soybean Germplasm Collection. However, this does not mean that resistance is nonexistent. The paper by Minor *et al.* demonstrates that excellent progress has been made to discover soybean germplasm that exhibits resistance to *Phomopsis*, a fungal pathogen that may cause extreme damage to soybean quality. Research on the genetic basis for such resistance shows great promise for biocontrol solutions to fungal damage through plant breeding. Likewise, molecular genetic approaches also figure in the development of strategies for managing fungal pathogens in an environmentally acceptable manner. The pre-

*Address correspondence at Department of Crop Science, 4114 Williams Hall, North Carolina State University, Raleigh, NC 27695.

sentation by Upchurch calls attention to the possible regulation of fungal pathogens through molecular genetic or physiological inhibition of mycotoxin production.

Taken together, this unit publication focuses attention on the principal aspects and issues associated with pathogenic fungi. Hopefully, these papers also have outlined potential opportunities for dealing with the problems of fungal damage in soybean and other oilseeds.

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