Introduction

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This symposium was organized to provide a review of the literature, and to present and evaluate methodologies and techniques available for quantifying food-crop yield reductions that may be attributed primarily to stress factors associated with plant diseases.

In most cases, the accuracy of crop yield reduction estimates is limited by the quantity and quality of data available. Factors contributing to this problem include the vast variety of crops grown on heterogeneous soils, the diverse and fluctuating weather conditions encountered over large areas and long time spans, and the lack of appropriate survey techniques to detect and monitor plant pathogen populations.

The models and computerized simulators developed and proposed by our colleagues as tools to predict yield response have been formulated mainly from crop yield and plant disease data acquired from controlled laboratory studies, field experimentation, and field survey techniques. A majority of these proposed predictive models do not account for factors such as the effects of cultivars of a crop, stage of plant development when disease stress assessments are recorded, weather conditions at critical stages of crop development, or critical chemical and physical conditions of the soil. Instead of accounting for such physical, chemical, and biological factors, the models are often the simplest form of a mathematical statement that "adequately describes" the yield response as a simple function of disease intensity or severity data.

Often a suggested model has been developed from experimental data and proposed as a method to define loss for the crop under study. Since the models are extreme over-simplifications of a real system, the validity of the model must be tested over a range of conditions somewhat different from those in which the model was originally developed. Many models for predicting crop loss have not been subjected to rigorous validation procedures. In many cases, the models simply provide the assumed line of best fit describing the data, or a mathematical or statistical transformation of the values resulting from an experiment conducted under a limited set of environmental conditions. As such, many of the proposed models really are neither applicable nor useful under the varied conditions encountered during commercial production of our major food crops.

When we advance from the more simple models, which possess only one or two independent variables, to the more complex models and simulators that are driven by many variables, we may develop models more closely describing the real world system. A major problem with these latter types of predictive systems is the unavailability of the timely data required to drive the systems. Systems driven by temporal data may require daily averages, or even hourly records of many weather variables, eg, air and soil temperature, atmospheric humidity, rainfall, dew period, radiation, and wind speed and direction. Although these models may provide satisfactory comparisons to the actual process by accounting for biological and physical responses more realistically, their utility in large commercial cropping systems is questionable because the required temporal and spatial data are not available.

The APS Plant Disease Losses, Plant Disease Detection, and Epidemiology Committees co-organized this session to address several of the aforementioned problems. The first two reports review the techniques currently available to us to estimate and model disease stress and yield reduction in small populations of plants. The program then advances from the single plant to the next level of complexity with presentations of the state-of-the-art for making similar estimates in commercial-sized fields. The last report briefly reviews the techniques and models used by one agency for assessing crop condition and predicting yield reductions on a regional and worldwide basis. This final report also reveals the types of models that currently need to be used for large area inventories and assessments because of the unavailability of timely data required to drive our more complete, but very complex, predictive systems.

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