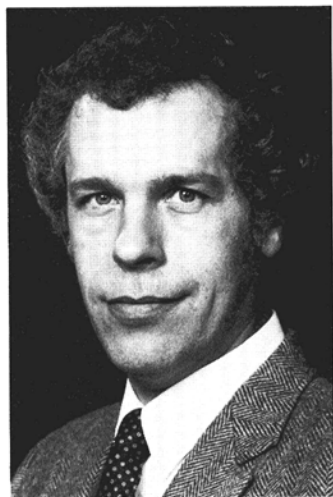


Loss Assessment: A Requisite for Crop Research and Production

M. V. WIESE

Professor of Plant Science, University of Idaho, Moscow



If the Malthusian moment of truth for the world is to be avoided, some formidable challenges will have to be met en route to increasing the distribution, quantity, and/or quality of our food supply. Basic to meeting such challenges now and in the future is research that will provoke efficient and sufficient crop production.

The status of global crop agriculture was reviewed in 1979 at the 9th International Congress of Plant Protection. This congress of more than 2,000 scientists from more than 20 countries called for

1) more efficient crop production through better identification and resolution of yield constraints and 2) improved delivery and conservation of crop produce. The first of these issues and contemporary crop production research are addressed here. Without better guidance and more comprehensive, interdisciplinary, and multivariate approaches, our traditional discipline-oriented and univariate research could emerge as yet another constraint to efficient crop production.

Crop production is a challenging art and a complex science. Some variables influencing yield are manageable, others are not. During yield formation, some yield-determining variables, eg. soil class and cultivar, are static; others, eg. disease development and moisture, are in constant flux. We must, therefore, study yield development as a multivariate phenomenon and characterize yield losses in an ecological (systems) context.

Any good science has two facets. The first involves observation and assessment to define problems and formulate objectives. The second, guided by the first, is immersed in resolving problems and attaining objectives. To date, crop production research has neglected the former. Scientists are steered toward particular production constraints (weeds, diseases, insects, cultural practices, weather, genetic potential, soil characteristics) by oscillating political forces, influential administrators, constituent pressures, and by their own volition, intuition, and disciplinary bias. Few have been encouraged, let alone trained or funded, to measure the yield impact of diseases and other constraints inherent to crop production. Where is the impartial and credible scientific corps that identifies and measures the loss that constraining variables impose across fields, farms, and counties?

Over the years, univariate research in isolated experimental plots has identified hundreds of variables that influence yield but has told us little about the relative importance of these variables in commercial crop settings. How then can we intelligently focus our problem-solving research on the major

and particular yield constraints at work today in our real crop production units?

For too long, crop scientists have justified their existence and research using "expert opinion" and short paragraphs preceding a problem-solving research proposal. For too long, yield losses have been quantified and attributed to constraining variables by independent committees in conference rooms rather than by integrated research in the field. If we total the yield losses that each of us claims for our discipline or for the particular constraint we investigate, we see the magnitude of our ignorance, for too often these sums approach or exceed the actual yield of the crop in question.

The incidence of a disease and its impact on yield in a defined crop production unit are revealed not by opinion but by careful and sometimes costly survey and measurement. Yet, comprehensive crop surveys over space and time are rarely conducted. Instead we expend resources to collect piecemeal crop data—data that inevitably are stored, analyzed, and used by agencies, individuals, and disciplines in isolated, disjointed packages. Who is assembling these packages into comprehensive models of crop and yield development—models that identify yield-determining variables, characterize their interactions, and quantify their relative impact on yield?

Over the last 40 years, we have generously segmented our crop ecosystems for study by specialists. Each specialist (plant pathologist, entomologist, etc.) is charged with unraveling a piece of nature. In the rare instance when yields are determined by a single variable (drought, disease, etc.), one stimulus—one response research is justified and applicable. In everyday crop production, however, a community of plants, according to its inherent genetic potential, produces a yield in response to many promotional and stressful stimuli within its environment. The time is right, if not overdue, to perceive these stimuli and determine their relationship to yield. The plant-environment continuum as well as its relevant subsystems should be a focus for intensive quantitative investigation.

Multidisciplinary and interdisciplinary studies of pest and crop management alternatives are new steps in an appropriate direction. Integrated pest management (IPM) efforts, for example, are providing a portion of the needed comprehension. Yet, our ultimate objective is broader than IPM; it is ICM (intelligent crop management). Ultimately, the community of managed crop plants comprising a defined production unit must be a center of research attention. In this regard, systems science, ecology, statistics, economics, and computers stand ready to assist. Today, many scientists have the logic, if not the training, for multivariate research. We can better now, than ever before, collect, manage, and interpret comprehensive crop data and characterize yield losses. With motivation by administrators and incentives from granting agencies, we can quantify the relative impact of the positive and negative stimuli that determine crop yield. To focus on weeds, insects, diseases, practices, genotypes, weather, or soil *after* credibly defining the relative yield loss each imposes is our challenge for the future and the shortest route to efficient, sufficient crop production.