Increasing Adaptability of Cropping Systems using a Dynamic Crop-Sequencing Approach

Many cropping systems throughout the world are managed under extreme climatic conditions resulting in high risk for agricultural producers. Such a context applies to the Great Plains of North America, as this region is known for periods of instability caused by variability in precipitation and seasonal temperatures. Development of cropping systems resilient to this variability is a major challenge to agriculturists in the region.

Reduction in the use of fallow in Great Plains cropping systems has placed greater emphasis on proper selection and sequencing of crops. Crop selection and sequencing can take many forms. At a very basic level, crops can be sequenced in a consistent, unchanging pattern, thereby reflecting a fixed-sequence cropping system. Fixed-sequence systems, however, can lead to the development of weed, insect, and disease infestations; are generally less responsive to external stresses such as the weather; and may limit opportunities to take advantage of market conditions and/or government programs. To increase responsiveness to external factors, opportunity/flex cropping systems allow producers to adjust cropping system intensity and/or diversity based on externalities, such as soil water status at planting. Additional flexibility in annual crop sequencing can be realized through the application of a dynamic cropping systems concept, where crop-sequencing decisions are made annually based on externalities as well as management goals. This approach to crop sequencing possesses an inherent flexibility to adapt to high-risk conditions, and therefore may be more economically and environmentally sustainable than other approaches.

Crop strips during the first year of the crop-sequencing study.

Critical to the successful implementation of dynamic cropping systems is a thorough understanding of short-term (1 to 3 yr) crop-sequencing effects on relevant agronomic and environmental parameters. Such short-term research efforts can help identify crop sequence "synergisms" and "antagonisms," thereby providing the necessary foundation for developing strategies to sequence crops over a longer period of time. To that end, a team-focused, multidisciplinary research effort was undertaken at the USDA-ARS Northern Great Plains Research Laboratory (NGPRL) in Mandan, ND to investigate short-term crop sequence effects of 10 crops on crop production, plant diseases, soil residue coverage, and soil water depletion. Results from the project are published as a series of six papers in the July–August 2007 issue of *Agronomy Journal*.

Don Tanaka, project leader for the research effort, used a unique crop by crop-residue matrix design to evaluate 100 crop sequence effects over a period of three years.

"The crop by crop-residue matrix approach along with the multidisciplinary research team effort enhanced evaluation of crop interactions that may otherwise be overlooked in crop sequence research," Tanaka explains.

The research team at NGPRL is actively working to translate their research findings for use by agriculturists through an update of the Crop Sequence Calculator, an interactive computer program designed to help agricultural producers assess crop-sequencing options for optimizing economic, agronomic, and environmental goals within dryland cropping systems.

Liebig, M.A., D.L. Tanaka, J.M. Krupinsky, S.D. Merrill, and J.D. Hanson. 2007. Dynamic cropping systems: Contributions to improve agroecosystem sustainability. Agron. J. 99:899–903. View the full article online at http://agron.scijournals.org/content/vol99/issue4/