Developing and Refining Best Management Practices for Optimum Yields

The overall goal of this project includes increasing the production and profitability of South Dakota’s soybean farmers. Currently in year four of a five-year project, soybean researchers use a combination of on-farm research and targeted university studies to provide information to maximize advances in crop genetics under a variety of environmental conditions and management strategies.

Components include investigating the feasibility of double-cropping soybeans into small grain stubble and using cover crops in soybean-corn rotations. Research also includes looking at the effect of weed stress at different stages in the growing season, along with the effect of water stress on overall yield. To address farmers’ yearly budgeting needs, crop planning budgets that compare alternative and no-till rotation systems to traditional corn-soybean rotations are being developed. Results of some components can be applied immediately, such as the planting-date and seeding-rate research. Others focus on longer-term impact, such as responses to stress based on genetics, which may be incorporated into future variety development.

One of the keys to high-yielding soybeans includes their ability to capture sunlight. Soybeans convert sunlight into chemical energy. Higher energy conversion results in higher yields. Research from this project has shown that to maximize light-energy capture, soybeans should be seeded as early as possible, yet late enough to avoid frost. The most sunlight in South Dakota occurs in June or July. Therefore, earlier seeding means a bigger plant, more leaf area and greater conversion of light energy to soybeans during these months. A review of recent South Dakota Soybean Yield Contest winners showed that a common factor of success involved planting prior to May 15.

Research data suggests that high-yielding soybeans will lose 0.25 to 1 bu./acre per day when planted after the optimum planting date. Optimum planting dates vary based on location and variety selection. Short-season varieties respond differently to later planting dates than full-season varieties. As a general rule for South Dakota, soybeans with maturity group categories between 1.5 to 2, out-yield soybeans with maturity group categories less than 1 or greater than 2.5, but exceptions can be found. For example, during years with an extremely dry July, August and September, early-maturity-group soybeans (less than 1) perform better. In years with below-normal moisture in June and July and above-normal August and September moisture, long-season maturity varieties (greater than 2.5) perform better. As one goes from north to south, optimum maturity group numbers increase.

Row spacing and seeding rates also impact yield. University research on small plots suggests that reducing row spacing increases yields by as much as 20 bu./acre. As part of this project, researchers also conducted on-farm investigations with soybean farmers. The results indicate that the differences in yield may not be as large as anticipated. Some on-farm research in 2011 shows only a 2 bu./acre difference between narrow 10-inch rows and 30-inch rows. Researchers continue to conduct additional on-farm trials during 2012. Data indicates that fungicide and insecticide seed treatment responses correlate with planting dates. The earlier the date, such as late April to early May, the more likely that a seed treatment will provide a positive yield response. A later planting date, such as late May, does not seem to show a significant response to seed treatments.

The South Dakota Soybean Checkoff plans to share these best practices with soybean farmers through the Best Management Practices of Soybean Production guidebook as a final product from this research. Planned for publication in spring 2013, the book will highlight the many methods of increasing overall yield and profitability.
Controlling Challenging Weeds in South Dakota Soybeans with Modified Herbicide Programs and Crop Rotations

Due to the widespread expansion of glyphosate-resistant weed species, successfully managing weeds to achieve optimum soybean yield has become more difficult. With funding support from the South Dakota Soybean Research and Promotion Council (SDSRPC) and the soy checkoff, South Dakota State University (SDSU) confirmed glyphosate-resistant biotypes of several weeds in South Dakota during the past few years. These include common ragweed in 2007, kochia in 2009 and waterhemp and horseweed, also known as marestail, in 2010.

Among these weeds, kochia presents the greatest concern due to a lack of alternative herbicide options. Cobra® (lactofen) may be one of the few effective postemergence herbicides in soybeans. However, this contact herbicide causes significant soybean foliar desiccation and thus should not be applied to drought-stressed soybeans. It must be applied to small kochia plants, ideally measuring three inches or less, and requires a water carrier of at least 20 gallons per acre.

Biology research indicates that kochia has two weaknesses that could be exploited to achieve adequate control. Kochia’s first weakness includes being the earliest-emerging weed species. As a result, effective burndown programs that include contact herbicides such as Liberty® (glufosinate), Gramoxone® (paraquat) and Cobra may drastically reduce populations in no-till fields. Residual herbicides such as Valor® (flumioxazin) and sulfentrazone products, such as Authority® and Sonic®, may provide very good soil residual control. Then, if necessary, Cobra could be used postemergence to control kochia escapes. Kochia’s second weakness: its seed survives approximately one year in the soil. Due to this, it may be possible to aggressively manage kochia in rotational crops to rapidly deplete the seed bank.

Waterhemp persists as the second-greatest concern, but SDSU trials demonstrate that herbicides such as Flexstar® (fomesafen) and Cobra provide good control. Fortunately, the industry is developing exciting new technologies currently undergoing testing by SDSU to evaluate weed control programs in soybeans that will be tolerant to herbicides such as 2,4-D, dicamba and Balance® (isoxaflutole).

In addition to managing glyphosate-resistant weeds, the South Dakota Soybean Checkoff supports research on managing difficult weed species, such as dandelions and scouring rush, in no-till soybean fields. SDSU research also helps to allay fears that glyphosate accumulates in soils and could be inhibiting micronutrient uptake. Support from the SDSRPC has been critical for field research that helps maintain the sustainability of soybean pest management in South Dakota. Research results and fact sheets may be found online by searching “SDSU Extension Weeds.” Timely articles regarding soybean management can be found on SDSU’s iGrow soybean webpage found at www.igrow.org/agronomy/soybeans. Soybean farmers may also sign up for SDSU’s weekly crop and pest newsletter on the iGrow website.
Management of Soybean Insect and Mite Pests in South Dakota

Soybean farmers use certain types of insecticides nearly everywhere in soybean production, either as seed treatments or foliar applications. In some states, the use of neonicotinoid insecticides has been associated with outbreaks of spider mites, which are not susceptible to the treatment. No research exists yet for South Dakota soybean farmers that would identify a link between neonicotinoid insecticides and outbreaks of spider mites. The first step in this project includes surveying soybean farmers who used treated seed and those who used untreated seed in 2012. The second step includes monitoring fields to determine if any differences occur in the frequency or severity of spider mite outbreaks.

Widespread use of insecticidal seed treatments for soybean aphids also exists. Some farmers question whether the cost of treatment provides an economic benefit in the management of soybean aphids. This study also provides South Dakota-specific data on the cost/benefit ratio of using insecticidal seed treatments for aphid management in both aphid-resistant and conventional soybeans.

Soybean Diseases — Monitoring, Risk Assessment, Management and Outreach

Objectives of this project cover fungal and viral diseases including root rot, stem canker, brown stem rot, soybean mosaic virus, bean pod mottle virus and sudden death syndrome. Another project focuses on surveying and mapping for soybean cyst nematodes, especially in counties where they have not previously been identified. Management of diseases includes use of fungicidal seed treatments and foliar applications. The study looks at the effectiveness of these treatments as well the economics of application. A key component includes developing outreach education that is easily accessible to farmers through the iGrow website (www.igrow.org) and soybean farmer meetings. Providing unbiased research results in electronic and printed formats, along with face-to-face interaction, will help soybean farmers with economical, long-term and sustainable pest management.

High-Value Protein for Aquaculture Feeds from Defatted Soybean Flakes

Commercial aquaculture production of fish and shellfish remains one of the fastest-growing segments of U.S. animal agriculture. The primary constraint of this industry is the availability of a high-quality, cost-competitive protein ingredient for inclusion in feeds. This project investigates the feasibility of replacing fish meal, the traditional protein source for aquaculture feeds, with soy products. The quality of current soy protein concentrates on the market, however, is not adequate to completely replace fish meal. This investigation looks at an extrusion process that should achieve a high-quality, economic soy protein concentrate with protein levels over 70 percent — without needing the expensive extraction process currently available.

Influence of Farming-System Contributions to Best Management Practices for Improving Soybean Yield, Soil Carbon Levels, Pest Management Control and Profitability

Comparisons of tillage and no-till systems, along with residual removal versus residue-retained systems, show the effects of these systems on soybean yield. These comparisons take into account soil fertility, crop rotations, nutrient loss and pest populations. The project identifies those combinations of production practices that enhance the recycling of nutrients contained in crop residues in order to trim high fertilizer costs. Initial results from 2011 indicate few differences in yield; however, the late spring of 2011 had a negative impact on all yields—thus the study is being repeated in 2012.
“BUILDING A BETTER BEAN” (GENETICS)

Stability Evaluation for Soybean Genotypes in South Dakota Environments

This project has the goal of identifying the underlying genetics of soybean varieties that maintain high yields under a variety of conditions. The project uses Crop Performance Testing Program data from 2001 through 2009. A second component continues crop performance testing in 2012 using 15 glyphosate-tolerant cultivars from thin and bushy lines. It evaluates difference in yield, oil content, protein content, pod numbers per plant, and seed numbers per pod, especially under drought or other stress conditions.

Increased Profitability for South Dakota Soybean Farmers and Breeders Using Genes for Enhanced Tolerance to Environmental Stress

This project provides crucial foundational research by analyzing more than 200 lines of inbred beans originating from a wild/cultivated crossbreed both in the laboratory and in field experiments. Researchers have made significant progress in identifying specific genes and gene markers for drought-tolerant soybeans. The lines will be evaluated for resistance to common problems including iron chlorosis and Asian soybean rust.

Development of High-Yielding and High-Quality Soybean Varieties Adapted to South Dakota and Elite Germplasm

Based on gene mapping and identification of genetic markers, this project focuses on traits of resistance to major pests and diseases such as soybean aphids, cyst nematodes, root rot and white mold. Development of varieties with these traits will result in increased yields of 5 to 8 percent. Furthermore, elite germplasm with the potential to incorporate into future varieties will be developed. The merits of the germplasm include high protein (39 to 40 percent), high oil (19 to 20 percent), pest resistance and stress tolerance.

Biochemical Profiles of Soybean Varieties and Germplasm for Nutritive Suitability in Aquafeeds and Potential for Genetic Improvements

Soy products for use in aquaculture require soybeans that have a high-protein and balanced-amino-acid profile and a low composition of fat, fiber and carbohydrates. From a basic, laboratory-based research approach, development of these soybeans requires identification of specific lines and varieties that can meet these specifications. This five-year project, currently in the first phase, focuses on evaluating existing lines and varieties that have the breeding potential to meet higher protein and lower fat production.