iGrow Soybeans

Best Management Practices for Soybean Production

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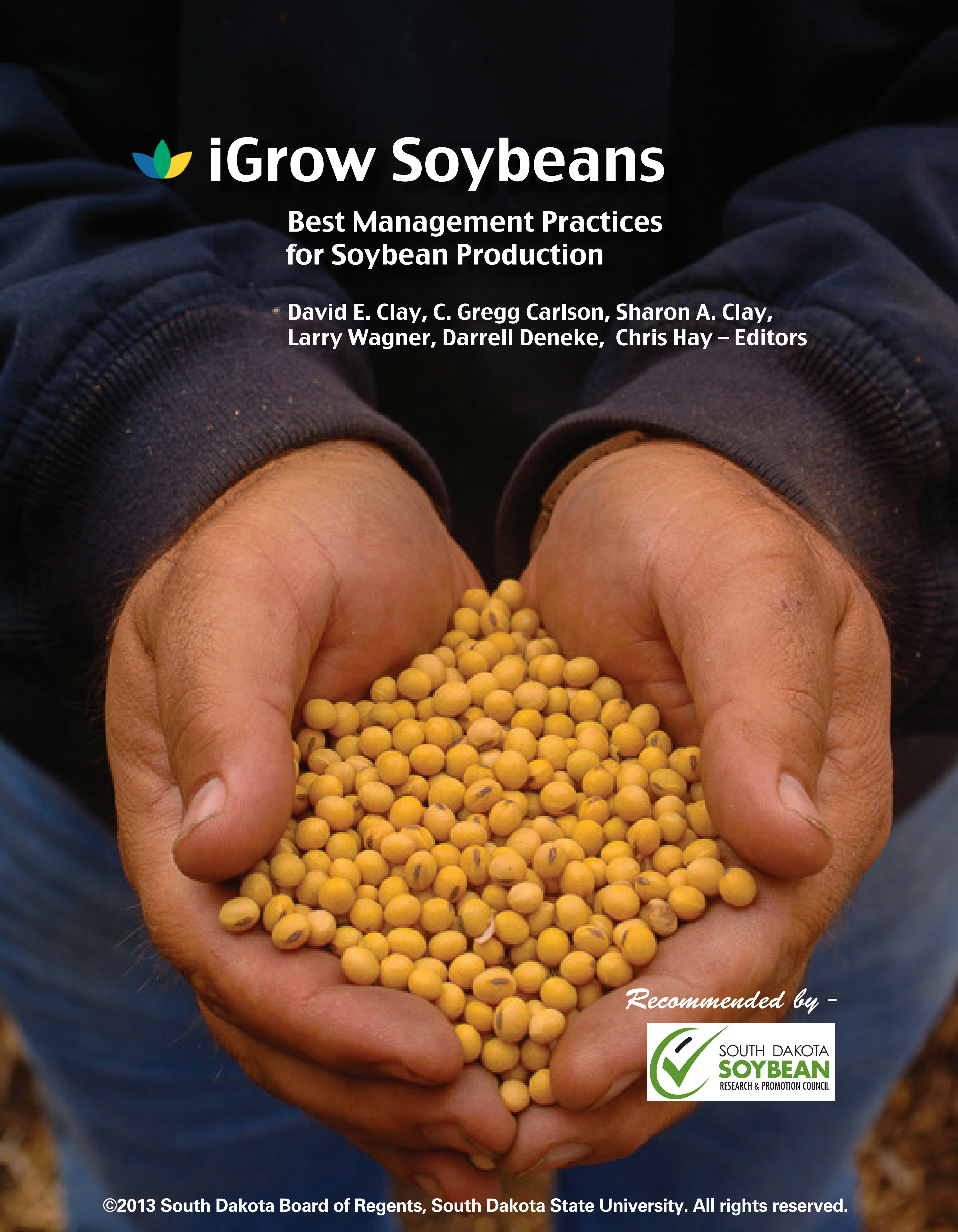

Recommended by –

SOUTH DAKOTA SOYBEAN RESEARCH & PROMOTION COUNCIL

CHAPTER ONE

Growing 100-Bushel Soybeans

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No magic bullet exists that will result in 100 bushels of soybeans per acre (Table 1.1). Reaching this goal will require the development of new, high yielding cultivars, as well as adopting site-specific management practices that optimize production efficiency. One approach for testing your soybean production program is to enter the South Dakota Soybean Yield Contest sponsored by the South Dakota Soybean Research and Promotion Council and managed by the South Dakota Soybean Association. Although 100-bu/acre yields may seem out of reach, increasing your yield several bu/acre per year will put you there sooner than you think.

This chapter draws on production surveys completed by producers entering the South Dakota Soybean Yield Contest (Table 1.2). These surveys provide a starting point in the creation of a roadmap leading to 100 bu/acre. Topics discussed in this chapter include the importance of selecting the right variety, optimizing sunlight collection, controlling pests, eliminating nutrient deficiencies, minimizing harvest losses, paying attention to details, and using a proactive management style.

Table 1.1. Creating a 100-bu soybean/acre roadmap.

1. Conduct on-farm research to optimize your production system.
2. Adopt a nutrient management program that increases soil test values.
3. Consider including fall/winter cover crops in the rotation.
4. Base your management decisions upon long-term data trends.
5. Keep trying to do better.
6. Learn about new products and pay attention to both the benefits and limitations.
7. Be a life-long learner.
8. Seed at an appropriate rate and avoid hair pinning seed into residue.
9. For irrigated soybeans:
    a. Select varieties with high lodging resistance and low heights.
    b. Conduct research to assess the relationship between population level and productivity.
10. Capture as much sunlight as possible (keeping in mind):
    a. Row spacing, plant date, variety, starter fertilizer, and population level.
11. Use a proactive approach to control pests and minimize nutrient deficiencies.
12. Practice early weed management until V3.
13. Consider using a Fe seed treatment in high pH soils containing lime.
14. Pay attention to details.
15. Till only when necessary and minimize soil compaction.

Table 1.2. Factors common to 2010 and 2011 South Dakota soybean contest winners.

1. Planted prior to May 15.
2. Used a narrow row spacing (15-22").
3. Used a relatively high plant population (160,000 seeds/acre seeded).
4. Treated the seed with seed inoculants, fungicides, and insecticides.
5. Applied foliar fungicides and insecticides when needed.
6. Selected soybean varieties carefully.
7. Managed soil moisture and fertility.

South Dakota Soybean Yield Contest

The South Dakota Soybean Yield Contest was created to encourage the development and testing of new innovative management practices. Producers enrolled in the contest are requested to complete a production survey which is summarized and distributed to producers at various events. Entering this program provides an opportunity for you to compare your practices with other growers. For details about the contest see, http://www.sdsoybean.org/Producer_Resources/Yield_Contest. Results from 2010 and 2011 are provided in Table 1.2.

Capturing sunlight

The efficient capture of sunlight is a key component of striving to produce 100 bu/acre (Fig. 1.1). Soybean plants convert sunlight, nutrients from the soil, and carbon dioxide from the air to complex forms of chemical energy, which is eventually harvested as soybean grain. Different plants convert sunlight to chemical energy with different efficiencies. Not all soybean plants fix the same amount of CO_2. Leaves growing in full sunlight generally fix more CO_2 than those under reduced sunlight. Adopting management practices that increase the efficiency of CO_2 capture will increase the likelihood of achieving 100-bu/acre soybean yields.

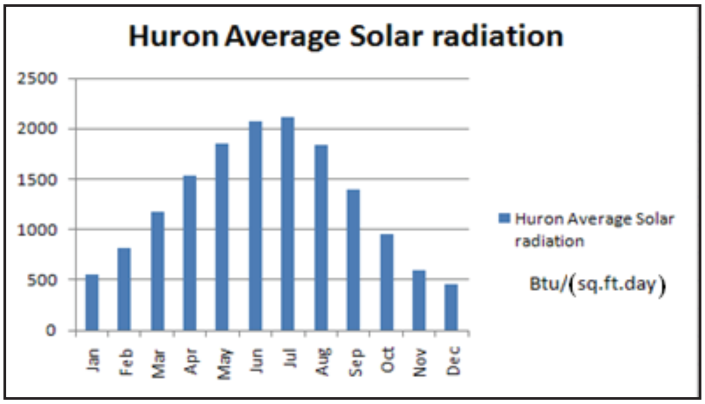

Figure 1.1. Average solar radiation at Huron, South Dakota.

In South Dakota the maximum amount of solar radiation occurs during the months of June and July (Fig. 1.3). To maximize light energy capture, it is critical that soybeans be seeded as early as possible, but late enough to avoid spring frost injury. Winners of the South Dakota Soybean contest generally seeded before May 15 (Table 1.2). Bigger plants with more leaf area in the critical months of June and July have higher sunlight capture potential.

However, seeding too early in cool, wet soil can result in the reduced emergence of live seedlings. Practices that reduce this risk involve selecting varieties proven to emerge under these conditions and avoiding mechanically damaging these seeds prior to or during planting. Seed treatments also help to improve emergence. Early planting risks increase as you travel from south to north across South Dakota. If soil and weather conditions are favorable, planting early offers a great opportunity to capture increased sunlight. To enable uniform, quick emergence of healthy seedlings, planting should be no earlier than when the soil temperature at the 2-inch depth averages at least 50°F (optimum has been reported to be 77°F) (Table 1.3). Data from across the Corn Belt indicates that high yielding soybeans will lose 0.25 to 1 bu/(acre day) after the optimum planting date.

Table 1.3. Measuring soil temperature.

1. Determine the desired planting depth.
2. Place your thermometer at that depth.
3. Measure the temperature in the morning and early evening.
4. Average those temperatures.
5. Measure temperatures at multiple locations and different landscape positions.

Selecting a variety (Chapter 6)

One of the most important decisions to reach 100 bu/acre is the selection of the variety to plant. We recommend that yield, pest resistance, yield stability, maturity rating, lodging resistance, and findings from multiple years and multiple locations be considered when selecting a variety. Varieties should be selected with the appropriate pest package and maturity group rating. South Dakota State University conducts annual testing of many cultivars. A summary of these tests are available at http://www.sdstate.edu/ps/extension/crop-mgmt/cpt/soybean-variety-trials-results.cfm.

To evaluate the ability of a variety to optimize yields within your production system, we recommend that you:

1. Conduct side-by-side trials.
2. Carefully study all soybean performance testing reports and choose varieties with the greatest probability of success in your growing environment.
3. Select an appropriate pest package.
4. Use seed with a high germination percentage.
5. Discuss your decision with knowledgeable people in the region.

Row spacing and seeding rate (Chapter 10)

Producers have a number of options of row spacing. The three dominant options are 15-, 22-, and 30-inch row spacing. Generally, planters do a much better job at controlling seed spacing and depth than cantilever linked drills. Precision seed placement is important because plant stand variability reduces yield. The number of seeds/acre and the actual plant population may be different. We recommend that the actual plant population be measured. A comparison between actual populations and seeding rate may help identify planter or emergence problems.

Planting soybeans into corn residue can be very challenging. It is important to avoid hair pinning seed into residue. This causes unevenness in emergence. When soybeans follow corn, this could be a large problem. Possible solutions are using tillage and disking to reduce surface residue, attention to coulter operation on planting equipment, ridge tillage, and corn residue harvesting.

Research across the Midwest suggests that narrowing row spacing increases yield. These results were confirmed by the winners of the South Dakota yield contests. Benefits from narrow rows may be increased if delays in the planting date are unavoidable. However, narrow rows may reduce yields in fields with a high risk of white mold or if water is limited at the end of the season (Chapters 58, 59).

Seeding rate can also impact yield. Typically the optimum seeding rate has been reported to be between 140,000 and 150,000 seeds/acre. However, the top yielding entries in the 2011 South Dakota Soybean Yield Contest were planted at rates greater than 160,000 seeds/acre.

Rotation impact (Chapter 4)

Rotating crops can help reduce pests and increase yields. Research in Iowa showed that both corn and soybean yields were increased by crop rotation. For example, soybean yields were 5 to 6% higher in a Corn-Corn-Soybean rotation compared with a corn-soybean rotation. The major factor increasing yield was due to reduced pest pressure. http://www.extension.iastate.edu/CropNews/2011/0225alkaisi.htm

Controlling pests: Seed and field treatment at R3 with fungicides (Chapter 8)

With the cost associated with soybean production, many producers consider insecticide and a fungicide seed treatment as insurance. When seed is planted into cool, wet environments, research suggests that seed treatment can increase yields. Table 1.2 indicates that top yielding entries in the recent South Dakota Soybean Yield Contests utilized seed inoculants, seed fungicide, and seed insecticide treatments.

Analysis of kitchen sink experiments (experiments where everything including the kitchen sink is added) suggests foliar-applied fungicides applied at R3, containing strobilurin, produce significant yield increases. Yield increases are often observed when the disease scores are below threshold levels. Research conducted in Iowa suggests that there is a 60-70% chance of breaking even when fungicides containing strobilurin such as Headline© or Stratego YLD© are applied at R3. When disease is present, the chances of breaking even is increased (Bestor et al., 2011). This research suggests that the economic threshold levels and diagnosis tools for diagnosing diseases need additional research. It should be noted that the wide scale strobilurin applications can lead to pest resistance.

Weed control (Chapters 32 -34)

It is important to start the growing season with a weed-free field. Research suggests that soybean yield losses occur when a pre-emergent herbicide is not applied and the first post emergent herbicide treatment is first applied 2-3 weeks after planting. Weeds that are resistant to herbicides are likely to increase future problems. In South Dakota, weeds with resistance to glyphosate herbicides include kochia, horseweed, common ragweed, common water hemp, and volunteer corn (Chapter 33).

Eliminating nitrogen (N) deficiencies: Rhizobium seed inoculation (Chapter 23)

If a field is rotated out of soybean for an extended period of time (greater than three or more years), you should consider inoculating the soybean seed with rhizobia (Fig. 1.2). Rhizobia are soil bacteria that fix atmospheric nitrogen (N_2). Nitrogen fixation has been found to be inhibited by the availability of a significant amount of soil inorganic N. Rhizobia bacteria are plant species specific. If soybeans are not seeded on a frequent basis, rhizobia bacteria populations will gradually decline. Sandy soils may require more frequent inoculations than fine-textured soils. In fields where soybeans have never been seeded or where soils have been flooded for extended periods of time, inoculation is a must.

It is important to note that for the first 20 days after emergence, soybean seedlings may appear nitrogen deficient. Yellowing can occur due to a time lag between when nitrogen stored in the seed is exhausted and active nitrogen fixation begins. This deficiency will have a minimal impact on yield. One hundred bushels of soybeans contains approximately 380 lb of nitrogen in the grain. This N must be provided either by the soil or through N fixation in the nodules.

Figure 1.2. Nodules containing rhizobia on a soybean root. Active nodules when cut in half are red. (Photo courtesy of Becker Uderwood, Iowa State University and Top Crop. Available at http://www.agannex.com/field-crops/match-the-soybean-inoculant-formulation-to-the-planting-setup)

Starter fertilizer (Chapter 21)

Starter fertilizers refer to a small amount of fertilizer applied near the seed. Starter fertilizer has mixed impacts on soybean production. Most data from across the lower Midwest indicates that if soil test phosphorous levels are medium or above, there is no benefit from applying starter fertilizer. An exception occurs when soybeans are planted in cool, wet soil. Many producers in the South Dakota yield trial contest used starter fertilizers to promote early season growth. Starter fertilizer can stimulate early growth, reduce the period of time to canopy closure, and increase yields.

Fertilizer placed in contact with the seed should be used with caution since soybeans are quite susceptible (as much as twice as susceptible as is corn) to fertilizer salt injury. Producers that plan on using an in-furrow fertilizer application should study the information in the below website to identify the maximum amount that can be placed in contact with the seed. http://www.sdstate.edu/ps/soil-lab/upload/FertSeedDecisionAid.xls

Late season N (Chapter 24)

There is some evidence that rhizobia bacteria may not produce adequate N for yields higher than ~70 bu/acre. Late season applied N may increase yield in these high yield environments. Additional research is needed to evaluate the possibility of yield response to late season N application for South Dakota producers. http://www.fluidfertilizer.com/pastart/pdf/25P16-19.pdf

Uniform seeding at the correct depth

To obtain an ideal plant stand the seed must be uniformly spaced within the row and planted at a uniform depth of ¾ to 1½ inches. Soybean should not be seeded deeper than two inches. Cooler temperature with increasing depth slows germination and growth. Planters that use the parallel linkage generally have more accurate seed depth placement than drills using cantilever placement. Fluted feed-metering mechanisms on grain drills generally do not space soybean seed uniformly in the row and may split or damage large seeds. http://ohioline.osu.edu/agf-fact/0114.html

Minimize field compaction

Yield losses due to compaction can be reduced by many techniques including controlling traffic and minimizing driving across the field. The weight of tractors has increased from less than 1-3 tons in the 1930s to tractors weighing more than 20 tons. Driving heavy equipment across fields can reduce yields. The most damage is done when the soil is moist. However, this damage may not be visible. To obtain the highest yields possible, limit grain cart and grain loads to the ends of the field.

Prepare the combine for harvest

A significant amount of the soybean yield can be left in the field. These losses can be minimized by planning and tracking performance. Harvesting as soon as possible after grain moistures allow is recommended. In the area behind the combine, 5 small beans/ft^2 represents 1 bu/acre of yield loss. Setting the cutting bar too high can also reduce yields. For example, 50 beans found post harvest on the stems of 4 feet of row (in 30-inch rows) represents a yield loss of 1 bu/acre.

Use proactive management for pests

Scout frequently for nutrient deficiencies, insects, and disease and treat appropriately to assure that pests are controlled as effectively as is warranted. Table 1.2 indicates that top yielding entries in the recent South Dakota Soybean Yield Contest scouted their fields frequently and applied foliar insecticide and fungicide as needed.

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Acknowledgements

Funding for developing this chapter was provided by the South Dakota Soybean Research and Promotion Council, USDA-AFRI, and South Dakota 2010 research program.

Ricks, D., R. Christensen, and C.G. Carlson. 2013. Growing 100-bushel soybeans. *In* Clay, D.E., C.G. Carlson, S.A. Clay, L. Wagner, D. Deneke, and C. Hay (eds). iGrow Soybean: Best Management Practices for Soybean Production. South Dakota State University, SDSU Extension, Brookings, SD.