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Using Soybean Yield Data to Improve Variety Selection — Part I

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This NebGuide discusses the plant trait information normally provided in variety descriptions and how producers can use it to select seed. A companion NebGuide, G1547, guides the reader through a process for using variety trial data to select the best varieties for a given farm situation.

Variety selection is one of the most important decisions a soybean grower has to make. Right or wrong decisions can enhance or negate all other factors. When selecting seed, consider these variety characteristics: yield potential, maturity, growth habit, plant type, height, lodging, seed size, shattering, herbicide, disease and insect resistance, protein and oil content, and enhanced traits.

The objectives of this NebGuide are to:

- increase familiarity with the traits listed in variety information;
- relate variation in these traits with their suitability to a farmer's specific production system;
- evaluate data from plots, based on location; and
- take advantage of information provided in variety trials to separate normal variability from actual differences in variety performance.

Yield Potential

Harvested grain yield is one of the most important factors to consider when selecting varieties. Results of the state variety tests are the best source of information on how specific varieties have performed under Nebraska conditions. These tests include varieties which private companies feel have the best potential in Nebraska plus the University's popular entries.

Yield varies from year to year and location to location due to environmental factors (soil, rainfall, temperature, etc.). Thus, care needs to be taken when interpreting the yields of different varieties. The more locations tested and the more years represented, as well as the extent of similarity between the test and grower's field environments, the more reliable the information will be.

Maturity

Soybean varieties are classified according to maturity group. Maturity grouping is greatly influenced by latitude. Consequently, maturity Group-00 varieties are best suited to Canada and extreme northern regions of the United States, while maturity Group-0, Group-I, and Group-II varieties are suited to South Dakota. Group-II through Group-IV varieties are suited to Nebraska, and so on with Group VIII being suited to southern Texas.

Group-II varieties would be suited to northern and central Nebraska, Group-III to central and southern Nebraska, and early group IV to extreme southeast Nebraska. Cultivars from Group-II or -III, when planted in mid-May in Nebraska, will reach maturity by early September to early October, depending on the weather, locations, and planting date. Many companies are now including maturity as part of the variety designation.

The onset of flowering in soybeans is photoperiod controlled. Soybeans are classified as "short-day plants", which means the plants will develop vegetatively until a critical day length short enough to "trigger" the flowering response is reached. In Nebraska, flowering usually begins in early July as the day length decreases after the maximum day length on June 21. For example, day length in Lincoln is 15 hours on July 5, decreasing to 14 hours on August 11. This period is the time when most of the adapted soybean varieties in Nebraska flower.

Growth Habit

There are two types of stem growth habits in soybeans — indeterminate and determinate. Flowering activity of indeterminates is spread over a three- to five-week period once the critical day length has occurred. In indeterminate types,

flowering begins at the lower nodes and progresses upward on the plant. The longer flowering period allows these types to adjust to the effects of short-term stress or unfavorable environmental conditions. Indeterminates have terminal buds that continue to grow several weeks after flowering and at maturity have a relatively even distribution of pods on the stem, but with fewer pods toward the tip of the stem. Determinates have terminal buds that cease to grow when the plant starts to flower, thus they have a short flowering period. At maturity, the determinate plants also have a rather dense cluster of pods on a terminal raceme. Indeterminate varieties are almost always taller than determinate varieties when maturity is approximately the same.

Most varieties in Maturity Groups 000 to IV are indeterminates and most varieties in Maturity Groups V to X are determinates. There are a few exceptions to this general rule. A few people have postulated that indeterminates, in general, produce higher yield in stress environments (drought, poor soils, late planting, etc.) compared to determinates, but most research has not supported this hypothesis. Our data is clear that determinates are less productive in low yield areas and this mirrors what was found by Dick Cooper, the breeder who developed them. The problem comes when the stress occurs in the vegetative stages, considerably reducing plant height and reducing yield.

Plant Type

Soybean varieties have different plant types that can be exploited to best fit a particular production system. The range is from highly branching types to thin-line types that produce a single main stem. Knowing the type of production system to be used (narrow-row versus wide-row, irrigated versus dryland) allows growers to select the most beneficial plant type. Row width and plant population may alter the plant type of soybeans enough to change the degree of branching. Branching may be beneficial if lodging is a problem or if hail is a risk.

Plant Height and Lodging

Taller varieties are generally more susceptible to lodging. Lodging reduces harvest efficiency and increases harvest losses. Furthermore, if lodging occurs before or during the early pod-filling stage, it can reduce yield by limiting pod set and seed fill. If lodging has been a problem in the past, selecting a more lodging-resistant variety and evaluating plant populations may help improve yields.

Although lodging is genetically controlled to a large extent, other factors such as high plant population, high soil moisture, and high soil fertility can stimulate vegetative growth and increase plant height, leading to lodging. As plant populations increase, soybean stems become longer and more slender and plant standability decreases. Therefore, under irrigated, high soil moisture, or high fertility conditions, one should select a variety with good lodging scores and adjust plant populations to the low end of the optimum range to reduce lodging. Consult performance trial results to determine plant height characteristics of varieties.

Seed Size

Seed size is not directly correlated with yield potential as several smaller-seed varieties have high yield records and vice versa. Seed size is markedly influenced by the environment during the seed enlargement period of growth. Seed size reduction caused by moisture or other stress at the seed-enlargement period can reduce yield substantially.

Larger-seeded varieties could encounter more difficulty in emergence than smaller seeded varieties, particularly in cool soil conditions or after crusting. Since the germinating soybean seed is "pulled" to the surface to become the cotyledonary leaves, a larger seed will give more resistance to emergence. Research in Mississippi indicated small- and medium-sized seed gave more rapid emergence and greater early root development than large seed. However, this effect has not been observed in the range in seed sizes grown in Nebraska (2,270 to 3,780 seeds/lb). Environment plays a large role in affecting seedling emergence. Heavy rainfall immediately after planting can cause compaction and crusting on some soil types, making emergence difficult. Use of a rotary hoe or crust buster type of implement will help break the crust and enable even the largest-seeded varieties to emerge.

Because of variance in seed size among varieties, seeding rates should be calculated on viable seed planted per acre rather than on seed weight.

Shattering

The development of varieties that do not shatter has improved harvest characteristics of soybeans. Environmental conditions at the time of maturity influence shattering. Rain and wind after the seed has dried to harvest moisture will promote shattering. Shattering is one of the characteristics evaluated in the Nebraska testing programs. Early maturing varieties tend to be more prone to shattering than later maturing varieties, but this could be due to longer exposure to the weather while waiting for later maturing beans to mature. Data from Kansas trials indicate shattering is markedly different from year to year.

Herbicide Resistance

The introduction of variety traits that allow better tolerance to herbicide rates that would normally injure or kill the crop has made a tremendous impact on variety selection. Varieties are now available with increased tolerance to sulfonylurea herbicides (identified as STS soybeans) and resistance to the non-selective herbicides: Roundup®, Touchdown® and Liberty®. These developments have greatly enhanced a producer's ability to manage weeds.

It is important to note that herbicide-resistant technology protects yield but does not add to the yield potential of a variety. Variety selection within a maturity group should depend primarily on yield, pest resistance traits, and net return after seed and weed control costs are subtracted. A few bushels less yield from variety selection can easily outweigh any advantage of new technology. However, just as one would

not plant a nematode-susceptible variety in a field known to be heavily infested with nematodes, neither would one plant a non-Roundup-Ready or non-STS variety in a field where the weed spectrum requires that herbicide. Weeds can cause yield losses far exceeding those which might result from improper variety selection.

For additional information see the NebFact NF539, *Yield Suppression of Glyphosate-Resistant (Roundup Ready) Soybeans.*

Disease Resistance

Soybean losses due to disease usually are not a serious problem in Nebraska, but every year there are a significant number of acres which would benefit from proper genetic resistance selection. Genetic resistance packages currently available are for Soybean Mosaic Virus or SMV (30 percent of Nebraska fields surveyed have this aphid-vectored virus); Phytophtora (10 percent of Nebraska soils have this); and soybean cyst nematode (SCN) (about 2 percent of fields have this). Many diseases are seed-borne, so it is important to recognize these seed diseases and select seed accordingly to reduce production losses.

Seed diseases include purple seed stain, caused by the fungus *Cercospora kikuchii*. The infected seed has purple to brown discoloration and the seed coat may be roughened and cracked. This disease usually will not affect seed quality for processing, but planting seed with purple stain is not recommended. Treating seed with a fungicide before planting may reduce early seed-borne infection. Another fungus-caused disease is phytophtora rot and stem rot.

Soybean rust, also referred to as Australasian soybean rust, has been of high interest since it started moving around the world over the last few years. Soybean rust is native to eastern Australia, eastern Asia, Japan, the Philippines and Taiwan. The disease was not found in Africa until 1997 and by 2001 it had spread through most of the continent and has now spread to South America. It is believed that soybean rust will spread to the United States over the next few years. In other countries this disease has reduced yield by 10 percent to 80 percent. In Brazil, for example, losses have ranged from 10 percent to 60 percent. At present genetic resistance is not available.

Soybean cyst nematode (SCN), *Heterodera glycines*, is an increasing problem for Nebraska soybean producers. It has been confirmed in 26 counties in eastern Nebraska and is well established in counties along the Missouri River. In the last two years, it also has been confirmed in areas west of these counties in Antelope, Boone and Nance counties. Soybean varieties resistant to SCN are a very effective management tool. Check with seed companies for SCN resistant cultivars that perform best in your area and review the results of University of Nebraska tests on SCN resistance.

Soybean mosaic virus (SMV) typically is not a major disease of soybean in Nebraska, but with the establishment of soybean aphids, this is changing. The best management for soybean mosaic virus is to use virus-free seed and rogue out infected plants in seed production fields.

Insect Resistance

Until recently, insect damage of soybeans has not been extensive in Nebraska. Foliage feeding insects can be present but not cause yield reduction, depending on time and extent of feeding. Soybeans can tolerate fairly high levels of defoliation (10 percent to 35 percent) during the vegetative development stages without a yield reduction. After blooming, loss of up to 20 percent foliage will not be detrimental.

The soybean aphid appeared in Nebraska with a big splash in 2003. In northeast Nebraska yield losses of over 20 percent were documented at the University of Nebraska Haskell Agricultural Laboratory near Concord. While this is alarming, most fields had low to moderate aphid populations. Since this insect is so new to Nebraska, and North America for that matter, management guidelines are constantly being refined.

The bean leaf beetle is a common insect found in Nebraska soybean fields. As with most pests, it is best controlled through the use of integrated pest management practices.

Protein and Oil

Protein and oil content have not been factors in determining the price farmers receive when soybeans are sold for processing. However, official grade standards may be changed in the future so that soybean with very low protein or oil will be penalized. These constituents are influenced by the weather, but to a greater extent, by genetics since varieties generally rank similarly from one environment to another. In other words, a variety that is high in protein in one test will be high in most tests containing the same varieties. Specific details on how much prices will be affected by protein and oil content are not available yet, so the best advice is to avoid any varieties that rank among the lowest in protein and oil for their maturity group.

New Traits in Soybean Varieties

As in other crops, there is a trend toward "specialty" varieties with new traits that make them more suitable for various uses. These varieties often can be sold for premium prices, but usually the seeds need to be stored and processed separately from other varieties, adding to the cost of production. Locating a sound financial market is important when considering growing specialty varieties. Some of the traits under development or already available include low palmitic acid, low linolenic acid, high protein, small seed and large seed.

Palmitic acid is a saturated fat, which health conscious consumers are attempting to reduce in their diets. Linolenic acid is a constituent of soybean oil that causes it to become rancid. In order to minimize this rancidity, manufacturers will hydrogenate the oil. This hydrogenation gives soybean oil characteristics similar to saturated fats, causing it to be less "heart-healthy" for the consumer. Reducing linolenic acid in soybean oil will increase its shelf life and preserve its dietary advantage. Higher protein soybeans will produce

higher protein meal, which would be desirable for feed. Small-seeded and large-seeded varieties are usually preferred for certain soyfood products, such as natto and tofu.

Variety Selection

Because we don't have the perfect variety, most producers plant more than one variety on their farm. This strategy offers many benefits. The first is having genetic diversity. This increases the possibility of having the best variety for a given year. One method of obtaining diversity is to select varieties from the top yielding group that differ in plant height or other traits. Growing varieties with varying disease and insect resistance will help spread the risk and workload.

Data on soybean varieties are available from many sources. The *University of Nebraska Seed Guide* EC101 is a good starting place for choosing a new variety. This publication is updated annually and is available at local Cooperative Extension Offices and on the World Wide Web at *http://varietytest.unl.edu.* This publication allows for entries from many companies to be fairly compared. It includes information on yields, bushel weight, plant lodging, plant height, seed weight, grain protein and oil, and other characteristics when available. These data are summarized over multiple locations and years. After identifying some superior varieties from these tests, consult literature or seed company representatives about their strengths and weaknesses.

Summary

Gathering and comparing information on soybean traits and yield histories is a valuable first step in selecting the varieties which together will provide the high yields and trait diversity needed for a successful soybean crop.

A companion publication to this NebGuide, *Using Soybean Variety Yield Data to Improve Selection of Varieties Part II (G1547),* provides a step-by-step guide to using the variety trial data to select a variety best suited to a particular production system. It is available from your area Extension office or online at the Institute of Agriculture and Natural Resources Publications Web site.

This publication has been peer reviewed.

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