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How far, how soon

Taking soybean yields to the limit

Crop yields in the United States have risen steadily during the last 50 years. Still, yield improvement will have to continue well into the next century to meet the dietary needs of the ten billion people expected to occupy earth by the year 2050.

From 1924 to 1997, US soybean yields rose at a linear rate of .34 bushels per acre (Fig. 1) During the last quarter century (1972-1997), soybean yield improvement has been 40% faster, .46 bushels per acre (Fig. 2). In Nebraska the soybean yield trend for irrigated production is about 40% higher than that for rainfed production. The absolute difference between irrigated and rainfed yields was about 12 bushels per acre in 1997, clearly reflecting the impact of rainfall deficits on soybean yield. About 36% of the year-to-year variance in the irrigated vs. rainfed yield differential arises solely from year-to-year variance in rainfed soybean yield.

Corn vs. soybean

Consider the degree of yield improvement in soybeans versus corn. The linear rates of yield improvement of these two crops in Nebraska irrigated production suggest yield improvement in corn is about three times faster than that in soybean (Fig. 3). This 2.8/1.0 corn/soybean yield ratio persists in two measures of yield (one in absolute terms, the other in terms of rate of improvement), and reflects an intrinsic difference in corn-soybean productivity.

There are at least two biological reasons why corn productivity is better than that of soybean. The first is the photosynthetic mechanisms of the two crops. Corn fixes CO₂ via the quite efficient C-4 mechanism of photosynthesis, an evolutionary adaptation that did not develop in soybean. The second is that the two species deposit in their seed substantially different fractions of (Continued on page 49)
Field updates

Ralph Kulm, Extension educator in Holt County: Soil moisture is good. Corn planting started this week. Army cutworms are a problem in some area alfalfa fields.

Steve Pritchard, Extension educator in Platte County: Field conditions vary in the Platte Valley with rainfall amounts extending from 2.5 to 4 inches. Several fields still had water standing in low spots. As of Tuesday, corn planting was not officially underway although a few producers have tested their equipment.

Randy Pryor, Extension educator in Saline County: The 2-2.5 inches of rain last week delayed planting. On Monday, however, a few farmers were no-tilling corn into bean stubble and were able to plant while others that have never tried this watched. In no-till the soil is firmer and farmers have a one to two day planting window advantage when it is wet.

Dick Ronnenkamp, Extension educator in Boone/Nance counties: Field work started up on Tuesday, especially on well drained soils. The first corn planting began on upland, soybean ground. Work will be limited by the weather forecast, if the rain starts again. Soil moisture is good for the start of the season.

Gary Zoubek, Extension educator in York County: We received about 2.5 inches of moisture last week. Some corn had been planted prior to the rain and more is going in this week.

Paul Hay, Extension educator in Gage County: There have been reports of cutworm activity in soybean stubble fields. It's too early to tell if treatments are warranted in corn. They were not necessary in wheat or alfalfa.

Alfalfa weevil activity is increasing. Corn planting is underway in strong fashion.

Precipitation

The map shows precipitation amounts from April 12 to April 18.

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Yield forecast (Continued from page 47)

Carbohydrate, protein, and lipid (i.e., about 84%, 10%, and 5% for corn, and about 38%, 38%, and 20% for soybean). Protein and lipid are much more costly for the plant to make (relative to the amount of photosynthetic that must be spent to make these seed constituents). More seed mass can be produced from a given supply of glucose when carbohydrate is the predominant seed constituent (i.e., corn), than when it is not (i.e., soybean). To make soybean yield improvement as fast as that of corn would require radical changes in its seed composition, destroying the very characteristics for which it is valued as a crop. When each crop’s yield improvement rate is expressed as a percentage of its current absolute yield, the relative rates of improvement for both crops are identical.

What’s causing yield improvement?

Annual improvement in US soybean yields (Fig. 1) can be attributed to two factors:

1) Rapid producer adoption of agricultural innovation, mostly genetic, agronomic, or genetic x agronomic technologies. Producer adoption of newly released higher-yielding cultivars is so fast that genetic improvement in soybean yield averages is about .37-.45 bushels per acre per year. In contrast, there is usually a significant lag between the development of an agronomic technology and its adoption by most producers. Not surprisingly, producers are slower at adopting agronomic technology that requires capital expenditures for equipment or products (e.g., combine yield monitors or GPS software).

2) The annual rise in atmospheric CO₂ concentration (currently increasing 1.5 parts per million per year). Each annual increase in this “carbon fertilizer” enhances soybean photosynthesis, yield, and water-use-efficiency. Continued increases in atmospheric CO₂ would greatly benefit soybean productivity (much more so than maize). I like to paraphrase what a colleague said about the benefits of higher CO₂ on crop plants: “... doubling the CO₂ concentration is almost the same as doubling the rainfall in terms of its impact on crop productivity...”.

What is the biological limit to soybean yield and what does that limit portend for future soybean improvement? The biologi-
Planting 150,000 soybean seeds/acre still provides optimum yields

Seeding rate is the most easily managed yield component for optimum soybean performance. Farmers have little direct control over other yield components: pods/plant, seeds/pod, and seed weight, but can control the seeding rate.

What is the recommended seeding rate for soybeans in Nebraska? Results from numerous seeding rate experiments conducted across Nebraska over the years have consistently shown the same thing: seeding about 150,000 viable seeds per acre will optimize yield. Fig. 1 shows data from one of those studies. This figure also reflects findings from other Nebraska studies. Seeding rates over 150,000 seeds per acre will neither increase nor decrease yield if plant lodging does not occur. This planting rate with normal plant losses during emergence and the remaining growing season will result in 100,000 or more harvestable plants. Plants in fields with harvest stands less than 100,000 plants per acre will be short, have thick stems, be particularly heavy branched at the lower nodes, and will have many pods close to the ground making harvesting difficult. Furthermore, weed control is more difficult with poor soybean stands.

Conversely, plants in fields with seeding rates above 150,000 seeds per acre will be tall, spindly, and more susceptible to lodging. Yields may decrease because not only does lodging make harvest difficult resulting in greater harvest losses, but lodging causes canopy disruption and impacts grain development and yield.

Does the recommended seeding rate vary across the state? No. Results from across Nebraska as well as most Midwestern states show the same thing. Seeding rates of around 150,000 viable seeds per acre will optimize yields.

Is the recommendation the same for both rainfed and irrigated fields and for tillage and no-till systems? Yes. Research shows that soybean responses to seeding rates are the same in both rainfed and irrigated Nebraska fields and conventional and no-till systems. It is important to achieve good seed-soil contact in any planting system.

Table 1. Seed requirements for three seeding rates and different seed sizes.

<table>
<thead>
<tr>
<th>Seed size</th>
<th>Seeds per 50-pound bag</th>
<th>Seeding rate/acre</th>
<th>--- pounds of seed per acre ---</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>150,000</td>
<td>175,000</td>
</tr>
<tr>
<td>Very large1</td>
<td>1800</td>
<td>90000</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>1900</td>
<td>95000</td>
<td>79</td>
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<tr>
<td></td>
<td>2000</td>
<td>100000</td>
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<td>2200</td>
<td>110000</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>2400</td>
<td>120000</td>
<td>63</td>
</tr>
<tr>
<td>Medium</td>
<td>2600</td>
<td>130000</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>2800</td>
<td>140000</td>
<td>54</td>
</tr>
<tr>
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<td>3000</td>
<td>150000</td>
<td>50</td>
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<tr>
<td></td>
<td>3200</td>
<td>160000</td>
<td>47</td>
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<td>4000</td>
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<td>27</td>
</tr>
<tr>
<td></td>
<td>6000</td>
<td>300000</td>
<td>25</td>
</tr>
</tbody>
</table>

1 'Very large' and 'very small' soybeans are for speciality food markets.

(Continued on page 52)
Yield expectations (Continued from page 49)

cal yield limit for soybean at current CO₂ levels would appear to be 120 bushels per acre. Fig. 1 shows that either the linear or exponential model provides a good fit to the long-term (1924-1997) US yield improvement data.

The soybean yield improvement scenarios projected in the distant future by the exponential, logistic, and linear models are shown in Fig. 4. The linear model provides a quite conservative projection of future yield improvement in that an average US yield of 60 bushels per acre is not expected until the year 2063. Conversely, the exponential model provides a very liberal estimate of future yield improvement in that an average US yield of 60 bushels per acre would be expected by the year 2029. Note that the logistic model does not project this occurring until 2043. This represents a 60% increase over the 1998 US average soybean yield of about 37 bushels per acre.

The projection of 120 bushels per acre probably overstates the yield limit for the "average" US producer since this is the yield obtainable only with perfect weather, soil, and management. In most countries, the annual improvement in national crop yield slows to a crawl once the crop reaches 80% (or so) of the potential productivity established by the nation's very best producers. If this 80% figure holds for soybean, average US yields in the future would not be expected to move higher than 95 bushels per acre (i.e., 80% of the highest soybean yield ever documented). This "functional" yield limit would result in considerably more pessimistic trends than those displayed in Fig. 4.

The long-term soybean yield projections shown in Fig. 4 are based on the assumption that technological development and innovation will continue. Such technologies arise from basic and applied research (public and private) at rates proportional to funding and effort. Policymakers should not underestimate the importance of their current and future attitudes toward crop productivity research. Their policies will determine which path in Fig. 4 that crop yield improvement is likely to take during the first 100 years of the next millennium.

J. E. Specht, Professor, Soybean Genetics, Department of Agronomy

Seeding rate (Continued from page 50)

Is it the same for all varieties? No. Most varieties grown in Nebraska have indeterminate stem growth habits. They flower over a relatively long period and continue to grow during flowering. Indeterminate varieties usually respond to increases in seeding rates; however, in some cases they do not respond at all to changes in seeding rate. Nebraska growers do grow some determinate varieties known as semi-dwarfs. They flower over a shorter time and the stem stops elongating at the onset of flowering resulting in shorter plants (20-25 inches). These are extremely lodge-resistant and were intended for high-yield environments where lodging reduces yield potential. The soybean breeder who developed determinate varieties found that they perform best with planting rates 50% higher than conventional, indeterminate varieties. Nebraska data does not necessarily support this. It is true that higher seeding rates will increase plant height and increase the lowest pod heights. You may want to increase the seeding rate for these reasons.

Should seeding rates increase with narrow row spacings? No. In Nebraska research soybean response to seeding rate was the same in the 10-, 20-, and 30-inch row spacings. This presumes good seed-to-soil contact is possible with the narrow-row planting equipment (drill) and optimum soil conditions are present at planting. Yield response is also best optimized in narrow rows when plants are more uniformly distributed in the row. If these presumptions are not met, consider increasing seeding rates by 10-20%.

When are seeding rates higher than 150,000 viable seeds per acre recommended? Higher rates may be recommended with replanting or late planting situations, with narrow rows where drills do not provide good seed-to-soil contact, to increase low pod heights and with determinate varieties to increase plant heights. They also might where early canopy closure is important for weed control. As with earlier planting dates, higher seeding rates and narrower rows hasten canopy closure. This may be especially important with thin-line or narrow canopy varieties.

Why are seeding rate recommendations based on seeds per acre rather than on pounds per acre? Seed weights vary considerably among varieties and among production seasons. This can really throw off seeding rates and final stands. For example, planting a bushel per acre of a variety with 2000 seeds per pound would result in 120,000 seeds per acre. Planting a bushel per acre of a variety with 3500 seeds per pound would result in 210,000 seeds per acre. The effect of seed size on planting rates is shown in Table 1. Seed tags may have seed per pound listed. If not, ask your seed dealer to provide the seed weight information. Once your planter is set, be sure to check actual seed drop to insure you are getting what you want.

Roger W. Elmore
Extension Crops Specialist
James E. Specht
Professor of Agronomy
Seed quality a key tool to profitability

Everyone wants and works toward higher crop profits. In times of lower market prices, producers with self-pollinated crops like soybean may reduce out-of-pocket costs by planting farm-saved grain. Such seed is commonly, but usually inaccurately, referred to as “bin-run seed”. The specific qualities of such “seed” are usually not fully known by those who plant it. As you prepare to make final planting decisions for 1999, don’t let unknown seed quality cut your profit opportunity. Remember the following points:

On-farm research and experience in Nebraska and other states has proven that farm-saved seed rarely has an economical advantage over seed purchased from a reputable seed enterprise (Table 1). This can be attributed to three major factors:

1) Professional seed is higher in genetic purity;
2) Professional seed is more uniform for all seed quality factors (e.g. germination, seed size, purity), and
3) Germination is consistently higher in professional seed. It is simply not possible for the seed to establish a uniform plant stand or for each plant to build more yield from the available inputs unless all the key quality factors — genetic, physiological and physical — are consistently at optimum levels.

There are always risks with farm-saved seed, but especially so in soybeans and in years such as 1999, when seed quality factors show above normal variation and below normal performance. As the number of varieties grown by a producer increases, the opportunity for variety mixtures and mix-ups in harvesting and handling increases even more. Aren’t you growing more varieties than you used to?

Advancements in genetic technology and biotechnology have provided today’s producer with more choices, but also more responsibilities toward his use of intellectual property rights.

Few producers today can claim to be unaware of the prohibition of and risks associated with planting farm-saved Roundup Ready seed. Yet, there are other restrictions and prohibitions less well known that may apply for other varieties through the seed purchase agreement, trademark law, U.S. Plant Variety Protection Act and other conditions of sale. Owners of these technologies are actively pursuing violators and have won substantial judgements against growers with pirated seed. Seed piracy can cost a producer hundreds of dollars per acre in cash settlements, lost income, legal fees and multiple years of on-farm and business records inspection. Learn and know your rights and responsibilities.

Planting farm-saved seed has always been a balance of benefits versus risks, but today the ratio of risk per production investment is even greater. Most realistic producers fully recognize the value of well-adapted varieties/hybrids and high quality seed to the profitability and stability of their individual production system. The top varieties, available moisture, effective pest control, adequate nutrients, and high quality seed work together for higher yields. Higher yields will cut production costs per bushel and build higher crop profits. The risks are in relying on the unknown. Control what you can.

Table 1 - Yield and income comparison of seed sources

<table>
<thead>
<tr>
<th>Variety</th>
<th>Seed Source</th>
<th>3-year average yield (Bu/A)</th>
<th>$ Return/acre*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Certified quality</td>
<td>42.2</td>
<td>189.90</td>
</tr>
<tr>
<td></td>
<td>Farm saved</td>
<td>40.0</td>
<td>180.00</td>
</tr>
<tr>
<td>B</td>
<td>Certified quality</td>
<td>42.1</td>
<td>189.45</td>
</tr>
<tr>
<td></td>
<td>Farm saved</td>
<td>39.2</td>
<td>176.40</td>
</tr>
<tr>
<td>C</td>
<td>Certified quality</td>
<td>48.5</td>
<td>218.25</td>
</tr>
<tr>
<td></td>
<td>Farm saved</td>
<td>44.2</td>
<td>198.90</td>
</tr>
</tbody>
</table>

*$4.50 per bushel market grain value

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Calendar

- Continue scouting for pale western cutworms as they are likely to be just about big enough to have an impact on wheat — if there are any out there.
- Scout for army cutworms in emerging sugarbeets over the next few weeks.

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Next week:

- Preemergence weed control
- Benefits of rotation
- Fertility issues
- Roundup Ready research

Steve Knox
Field Services Supervisor
Roger Hammons, Manager
Nebraska Crop Improvement Association
Select seed and plan planting to avoid early season disease problems

Seedling diseases can be a major factor in the quality of stand establishment of spring and winter cereal grains and legumes in Nebraska. Damaged, weathered, or moldy seed germinates poorly. Even with high-quality seed, seedborne and soilborne fungi can cause severe reductions in stand and seedling vigor if conditions conducive to seedling diseases prevail during or shortly after planting.

Corn, sorghum, soybeans and sunflowers

Problems with stand establishment of corn, sorghum, soybeans or sunflowers in Nebraska generally occur when these crops are planted in cold wet soils. High soil moisture promotes attack by most soilborne seedling pathogens and is essential for Pythium and Phytophthora spp. These important pathogens survive in soil and germinate in response to seed and root exudates in wet soil. In cool, wet soil seedlings may be more vulnerable to infection because of slowed seed germination, delayed emergence, reduced growth of primary roots, and slower establishment of roots from the crown. Postemergence damping-off occurs when the primary root system is destroyed before the permanent root system from the crown has been established.

Seed infection is a means of survival for pathogens; infected or infested seeds provide inoculum that may infect the new crop when the seeds are planted. Some pathogens produce distinct symptoms or signs on infected seeds. An example would be purple seed stain on soybean seeds caused by Cercospora kikuchii. Lack of symptoms, however, does not mean seeds are free of pathogens. Moreover, more than one pathogen can infect the same seed, resulting in a variety of symptoms.

The earliest disease expression is failure of the seed to germinate. Although seed decay or seed rot is primarily the result of poor-quality seed, it can be caused by soilborne fungi that infect the seed before germination. Preemergence damping-off occurs when the embryo is killed before germination or when seedlings are killed before they emerge. If diseased seedlings emerge, or if seedlings become infected after emergence, postemergence damping-off occurs. Above ground symptoms vary from stunting and mild chlorosis to wilting to necrosis of lower leaves and eventually to seedling death. Since above ground symptoms may be confused with environmental, mechanical, or chemical injury, examination of the roots is necessary for accurate diagnosis. Many seedling problems in corn, sorghum, soybeans, and sunflowers in 1998 were initially blamed on herbicide injury. This was true in some instances; however, in others, seedling diseases were involved. With postemergence damping-off red, brown, or black lesions form along the roots. Severely infected roots often turn completely red, brown, or black. When field troubleshooting a seedling problem, look for patterns that might indicate certain factors. Chemical or mechanical injury often appears in a more uniform pattern than the irregular skips in the stand caused by diseases or insects.

Any factor that promotes quick germination and good seedling vigor after planting reduces the risk of stand losses due to seed decay and seedling diseases. Good management practices that discourage losses from seedling diseases include seedbed preparation, seed quality, and chemical seed treatment.

Detecting alfalfa weevils

Base 48 growing degree days accumulated Jan. 1-April 19. Spring hatching weevil larvae usually cause noticeable damage at about 300-375 growing degree days. Producers in southern Nebraska should be scouting now.
How do soybean costs stack up with new weed control options

Generally we have not had to consider the choice of variety/hybrid as directly related to the weed control alternatives available. Although using Roundup Ready (RR) soybeans does not preclude using weed control measures other than Roundup, it does facilitate the use of Roundup. Potential yield, weed control, and the ability of a particular variety to compete with weeds and withstand weed control measures all help determine harvest yield. The costs of the seed and weed control measures versus the yield will determine the profitability of any particular seed/weed control combination.

Potential yield depends critically on plant genetics. Both yield lag due to less-adapted genetics and yield drag can influence potential yields. As a result, herbicide resistant varieties may not have the highest potential yield.

Preliminary research suggests yields of some Roundup Ready soybean varieties may be depressed when Roundup is applied under specific environmental conditions. Other herbicides may have the same effect, but perhaps have not received the same attention. Even cultivation involves some tradeoff between reduced weed competition and root pruning and moisture loss.

Ultimately, successfully producing a soybean crop depends on weed pressure and practices, including seed selection and weed control measures. If a Roundup Ready package is the only effective approach to weed control, any sacrifice in yield potential due to yield lag and/or drag may be relatively unimportant compared to the yield loss from uncontrolled weeds with a conventional soybean.

Weed competition, however, also can be a problem in Roundup Ready soybeans if the Roundup application is not timely. No doubt this is one reason preemergence applications have been popular since they avoid some timing problems.

Since Roundup Ready implies a seed-weed control package, consider both the cost of seed and weed control measures when comparing options (see case studies below). Roundup Ready involves buying new seed each year, perhaps at a premium, plus any technology fee. Using conventional seed may be more economical and offer better yield potential.

Case 1. Yield drag and/or yield lag, effective pre-emergence control in soybean

<table>
<thead>
<tr>
<th>ROUNDUP READY</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield</td>
<td>50 bu</td>
<td>$5.00/bu</td>
<td>$250.00</td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>1.25 bag</td>
<td>$24.00/bag</td>
<td>$30.00</td>
<td></td>
</tr>
<tr>
<td>Roundup</td>
<td>3 pt</td>
<td>$36.00/gal</td>
<td>6.75</td>
<td></td>
</tr>
<tr>
<td>Ammonium sulfate</td>
<td>2.55 lb</td>
<td>$0.09/lb</td>
<td>0.23</td>
<td></td>
</tr>
<tr>
<td>Herb. application</td>
<td>1.5 appli</td>
<td>$4.00/A</td>
<td>6.00</td>
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</tr>
</tbody>
</table>

Listed costs $42.98
Net over seed and weed control cost $207.02

<table>
<thead>
<tr>
<th>CONVENTIONAL HERBICIDE</th>
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<tbody>
<tr>
<td>Yield</td>
<td>52 bu</td>
<td>$5.00/bu</td>
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<tr>
<td>Seed</td>
<td>1.25 bag</td>
<td>$17.00/bag</td>
<td>$21.25</td>
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<tr>
<td>Pursuit Plus</td>
<td>2.5 pt</td>
<td>$5.25/pt</td>
<td>13.13</td>
<td></td>
</tr>
<tr>
<td>Herb. application</td>
<td>1 appli</td>
<td>$4.00/A</td>
<td>4.00</td>
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</table>

Listed costs $38.38
Net over seed and weed control cost $221.62

Case 2. Heavy weed pressure, ineffective conventional weed control in soybean

<table>
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<td>50 bu</td>
<td>$5.00/bu</td>
<td>$250.00</td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>1.25 bag</td>
<td>$24.00/bag</td>
<td>$30.00</td>
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<tr>
<td>Roundup</td>
<td>4 pt</td>
<td>$36.00/gal</td>
<td>9.00</td>
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<tr>
<td>Ammonium sulfate</td>
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<tr>
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Listed costs $47.31
Net over seed and weed control cost $202.69

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<tr>
<td>Yield</td>
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<tr>
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<td>1.25 bag</td>
<td>$17.00/bag</td>
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<tr>
<td>Canopy</td>
<td>6 oz</td>
<td>$2.61/oz</td>
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<td></td>
</tr>
<tr>
<td>Dual II Magnum</td>
<td>1 pt</td>
<td>$6.60/pt</td>
<td>8.60</td>
<td></td>
</tr>
<tr>
<td>Select</td>
<td>6 oz</td>
<td>$1.10/pt</td>
<td>9.00</td>
<td></td>
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<tr>
<td>COC</td>
<td>1 qt</td>
<td>$4.25/gal</td>
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<tr>
<td>Herb Appl.</td>
<td>2 appli</td>
<td>4.00/acre</td>
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<tr>
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Listed costs $69.57
Net over seed and weed control cost $155.43
Nebraska Weed Tour June 21-24

This year’s Nebraska Weed Tour will begin in Concord June 21. The tour, conducted by the University of Nebraska Cooperative Extension and Department of Agronomy, provides a first-hand look at university research herbicide trials. While most participants are from the agricultural chemical industry, the tour is open to the public. Individuals may attend all or any part of it.

Monday – June 21, 1 p.m., Haskell Ag Lab, Concord
Tuesday – June 22, 9 a.m., NU Havelock Research Farm, Lincoln
3 p.m., South Central Research and Extension Center, Clay Center
Wednesday – June 23, 9 a.m., West Central Research and Extension Center, North Platte
3 p.m. (MDT) High Plains Agricultural Laboratory, Sidney
Thursday – June 24, 8:30 a.m. (MDT), Panhandle Research and Extension Center, Scottsbluff

Soybean costs (Continued from page 55)

Involve considerable savings. The price of Roundup is lower than before, however, prices of competing materials also have been dropping. In some cases a preemergence herbicide may be used in conjunction with a postemergence Roundup application. Remember to evaluate the cost of the complete system.

There is no one answer for all situations. A relatively weed-free field may be most profitable with conventional seed, band application of a preemergence herbicide, and cultivation. Conversely, a field with heavy pressure from weeds that can be effectively controlled with Roundup and where application timing is not a problem, may be able to produce a profitable soybean crop only with the Roundup Ready system. Two case situations are illustrated by the table on page 55.

Case 1 illustrates a situation where an economical preemergence herbicide provides effective weed control and the yield exceeds the Roundup Ready system yield. (The Roundup Ready variety has a 4% yield penalty in this example.) In contrast, Case 2 considers a heavy weed pressure situation that is not effectively controlled with conventional preemergence herbicides and results in a lower yield than the Roundup Ready system. Problems with volunteer corn or perennial weeds like dogbane or milkweed would be typical of Case 2. The Roundup Ready system would be attractive where early-season flooding or hail damage is a risk and/or replanting is required and grain sorghum would be a preferred alternative replacement crop. Rotation to other crops would limit preemergence herbicide choices.

Roger Selley, Extension Farm Management Specialist
Fred Roeth
Extension Weeds Specialist
Roger Elmore
Extension Crop Specialist
All at the South Central REC near Clay Center

Weight important with narrow-row no-till

Excellent erosion control is achieved when no-till planting in rows of 15-inch spacing or narrower. No-till reduces the forces of erosion by leaving crop residue on the soil surface to absorb raindrop impact and limit the effect of wind. The narrow-row crop forms a full canopy sooner, shading the soil earlier, reducing weed pressure and soil moisture evaporation. After harvest, the narrow-row stubble holds soil and residue in place, further reducing erosion, especially if the next crop is no-tilled into the residue.

To make no-till successful, drills and narrow-row planters must be able to cut or handle residue, penetrate the soil to desired seeding depth, establish good seed-to-soil contact, and close the seed furrow, just like planters used in no-till (see April 9 issue of Crop Watch). However, narrow-row planters and drills, depending on the row spacing, have about two to four times the number of openers per unit width compared to a row crop planter. The total weight of a no-till drill needs to be approximately four times the weight of a planter of the same width.

Most drills do not have sufficient weight for the down-pressure springs to transfer to the openers to cut residue and ensure penetration in tough no-till conditions. Or, as the springs are tightened, they may physically lift the drive mechanism off the ground. In these conditions, additional weight will be needed for proper penetration and to keep the seed metering drive in firm contact with the soil. Most drill manufacturers offer brackets to attach cast-iron weights or water-filled barrels to the drill or coulter carrier frame.

Depending on coulter width (if used), opener design, and field conditions, up to 500 pounds per row may be necessary for adequate penetration. Down-pressure springs on individual rows must transfer enough weight from the drill frame to the openers to ensure penetration and keep all depth control devices and seed press wheels in firm contact with the soil. Then the seeding depth is actually gauged by the wheels and not determined by soil resistance against the openers. Also, the seed then is firmed into the soil, establishing good seed-to-soil

(Continued on page 56)
Narrow- or wide-row soybeans?

Producers often wonder whether to plant or drill their soybeans and at what row spacing. Research has shown that, if the planter or drill is properly set up, there aren’t consistent yield differences because often plant spacing uniformity is not the yield limiting factor. Some producers, however, cite better weed control, quicker shading of the ground, ease of combining in any direction, and others benefits of narrow-row production. Disadvantages include increased diseases because of reduced air movement, difficult furrow irrigation, and no cultivation. Planting method often is an equipment and crop management decision rather than a yield decision.

Several sets of replicated, demonstration plots have been established at the University of Nebraska Rogers Memorial Farm 10 miles east of Lincoln to evaluate row spacing and planting methods for soybeans, grain sorghum, and corn to answer some machinery management questions. The table lists the yields for the plots where soybeans were no-tilled into corn or grain sorghum residue (at equal populations each year). For both the planter and the drill, the narrower rows had higher yields; however, at the 15-inch row spacing, the planter had better yields, attributed to improved depth control and better seed-to-soil contact.

Improved planter performance is one reason why many producers are using narrow row planters (or a drill with planter units) rather than drills for soybean production. The choice becomes a machinery management question based on 1) whether they already have a drill for wheat production, 2) whether they are using the same planter for corn and soybean production, or 3) whether they need to be able to plant corn and soybeans at the same time. These questions get more involved when adding grain sorghum. Many producers simply do not have the acreage required to justify two pieces of planting equipment and may own only a planter (or only a drill if they do not raise corn) and plant all their crops at the same row spacing.

**Weight** (Continued from page 55)

Drills without coulters have an advantage because they have fewer soil engaging components and thus require less weight for proper penetration and operation.

Some of the newer drills use a modified planter unit to place the seed into the soil rather than a typical drill seed furrow opener. These drills offer better depth control and better seed-to-soil contact (and cost more) since the openers are designed like those on a planter. Typically, a 15-inch row spacing is used on these drills which reduces the amount of weight needed for penetration (and the price) since half as many openers are needed compared to a standard 7.5-inch drill. Seed metering is still performed with a typical drill metering system, keeping the cost of this type of drill below that of planter on 15-inch row spacing. The 15-inch row spacing allows residue flow and more air movement through the crop, reducing the potential for some diseases, yet still giving most of the benefits of narrow row production (see above story on narrow-row yields).

To determine how much weight to add to planting equipment, producers must multiply the number of rows times the weight required for the downpressure springs to work and subtract the weight of the empty implement. For example, 24 openers on a 15-foot drill with downpressure spring claims of 500 pounds per row would require at least 12,000 total pounds in tough no-till conditions. Often these drills weigh only about 2,000 pounds, so about 4,000 pounds would need to be added. (Author’s note: We added more than 3,800 pounds to the 15-foot drill on our research farm.) Check the penetration, downpressure, and weight in the field, just like with planters. Make sure that the depth control devices, seed press wheels, and seed metering drive are all in firm contact with the soil to ensure proper operation.

Paul Jasa, Extension Engineer

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* Drill was not tested in 1996.