DEPARTMENT OF AGRONOMY

Narrow Row Corn Production in Kansas

Row spacing has been of interest in crop production for decades. Yield increases from narrow rows have been attributed to better light interception and more efficient water use. Plant productivity is at its highest near the time the crop closes the canopy, therefore, a crop that closes its canopy earlier in the growing season should have an advantage over a crop with slower canopy development.

Agronomic Considerations for Narrow Row Corn

Growing Conditions

Research conducted by Kansas State University at several locations in central and eastern Kansas indicates corn yield response to narrow rows depends on environmental conditions. Under high-yielding conditions (those with yields above 175 bushels per acre), narrow rows produced grain yields that were greater than the 30-inch rows (Table 1). Corn planted in 15-inch rows produced grain yields that were 15 bushels per acre higher than corn grown in 30-inch rows, and corn in 20-inch rows produced grain yields that were 12 bushels per acre greater than corn in 30-inch rows. In this study, these high yields were attained under irrigated conditions. However, it is reasonable to assume that this yield response to narrow rows will be consistent under high-yielding rain-fed conditions.

Under medium-yield conditions (yields from 120 to 160 bushels per acre), the yield advantage of narrow rows decreased. Grain yields from the 15- and 20-inch rows averaged 6 bushels per acre greater than the 30-inch rows. When below-average rainfall was received during the growing season, grain yields suffered (yields less than 120 bushels per acre). Under these conditions, planting corn in narrow 15- or 20-inch rows decreased grain yields by more than 18 bushels per acre compared to corn grown in 30-inch rows.

Considerations for making narrow row corn decision

1. Greatest yield advantage is under high-yield environments (yields consistently above 160 bushels per acre).
2. Select hybrids based on yield and standability under above-average incidence of gray leaf spot or leaf rust diseases.
3. Weed control can be enhanced because of more rapid canopy development.
4. Narrow rows reduce intra-row plant competition and allow producers to take advantage of higher seeding rates.
5. Grain drills and air seeders do not meter seed as precisely as row crop planter units, therefore their use to plant narrow row corn should be carefully considered.
6. Conventional, reduced, or no-till seedbed preparation can be used in a manner similar to wide rows.
7. Cultivation as a weed control method is extremely difficult in rows less than 20 inches wide.
8. Availability of narrow row corn headers should be considered before adopting a planting system. The use of platform headers is not desirable in narrow row corn.
9. Spraying with narrow profile tire sprayers is advisable to minimize traffic injury to corn plants.

Table 1. Corn grain yields for three row spacings in 13 environments in Kansas.

Row Spacing (in)	Yield Potential High > 160 bu/a		Medium 160-120 bu/a		Low < 120 bu/a	
	- - - - - Grain Yield (bu/a) - - - - -					
15	202	a*	145	a	39	b
20	191	ab	144	a	41	b
30	182	b	139	a	58	a
Number of Environments	4		7		2	

* *letters followed by the same letter are not statistically different from other values in the same column.*

Corn response to narrow rows is similar to those observed in other crops such as soybeans and grain sorghum. When growing season moisture is adequate, such as under irrigation, planting corn in narrow rows increases yields because of more rapid canopy development and greater light interception. However, when the crop experiences an extended dry period, more rapid canopy closure increases water use by the crop and results in longer, more severe water stress than the wide rows.

Plant Populations and Hybrid Selection

Recent research has illustrated that corn yields increase as plant populations increase until a plant population is reached at which yields then level off. For a given population, as row spacing is reduced, the distance between plants within the planted row increases. Therefore, higher plant populations can be achieved in narrow rows without increasing competition between plants within the row. In the high yield environments in the research conducted at Kansas State University, the highest yields were achieved at the highest plant population in the 15-inch rows. These results indicate that as narrow row corn production is adopted under high yielding conditions, plant populations should also be increased based on individual hybrid responses to higher seeding rates.

Hybrid Selection

When selecting a hybrid to plant in narrow rows, yield should be the focus. After selecting hybrids for yield potential, a secondary concern should be disease tolerance. Narrow rows reduce the amount of light penetrating into the corn canopy, thus increasing humidity within the canopy. During years with high incidence of diseases that thrive under high-humidity conditions, such as gray leaf spot and leaf rust, narrow row systems may be more susceptible to these diseases. Research has shown that crop rotations can reduce the impact of these diseases. Therefore, using high yielding hybrids in an appropriate crop rotation should maximize narrow row corn yields. However, if narrow rows are to be used in a continuous corn system, selecting hybrids that are resistant to foliar diseases is desired.

Tillage systems

Adapting narrow rows to either conventional, minimum, or no-tillage systems is certainly possible if key issues are considered. The management differences among the tillage systems deal primarily with pest control and nutrient placement. In most scenarios, pest management strategies that work under a given tillage system will work in narrow rows in that tillage system. Herbicide and insecticide application equipment for narrow rows will be discussed in the “Machinery Considerations” section. One consideration — from a disease standpoint — for narrow row corn production using no-till would be selecting a hybrid that yields well when disease pressure increases. The quicker developing canopy of narrow row corn may increase the spread of the disease in a minimum or no-tillage system.

Placement of fertilizer in a no-till system should also be considered when adopting narrow row corn production. For the most part, the nitrogen application methods used in each tillage system under wide rows will work adequately in narrow rows. However, the placement of phosphorous fertilizer may be a greater challenge in narrow rows. If a producer is currently applying phosphorous fertilizer with the planter in a band with the seed, this also can be accomplished in narrow rows. Narrow rows have the advantage when placing fertilizer with the seed in that the recommended rate of nitrogen containing fertilizer can increase from 10 pounds nitrogen per acre to 15 or 20 pounds nitrogen per acre (depending on narrow row spacing) since the fertilizer concentration in a given row is reduced as more rows are planted. If a producer is currently applying phosphorous fertilizer in a band next to the planted row (2 × 2 placement), then fertilizer placement shanks can be used to achieve the same type of placement on a grain drill. However, increasing the number of soil engaging tools on a seeding unit will make it more difficult to get that implement through crop residue in minimum and no-till systems.

Weed Competition and Weed Control

Light interception advantages of narrow row corn systems offer weed control advantages over wider rows since early canopy closure reduces the number of weeds that emerge during the growing season. Research conducted at Kansas State University indicated the growth of weeds that did emerge was reduced by 25 to 45 percent in narrow row crops when compared to crops in 30-inch rows.

Since cultivation is not possible, herbicides are required for in-season weed control in narrow rows. For control of grassy weeds, soil applied herbicides are currently the most reliable option for corn. Post-emergence herbicide selection and timing should not be different than those used in wide rows.

Machinery Considerations for Narrow Row Corn

Growing narrow row corn will likely require equipment modifications or the purchase of new equipment for most growers. There are, however, some items that most growers should consider when planting corn in narrow rows. For this publication, equipment considerations will be divided into planting, crop management, and harvesting.

Planting

Row crop planters will be the most likely piece of equipment used for planting narrow row corn. Currently, equipment manufacturers offer planters configured to plant 20-inch rows. Most companies also manufacture split-row planters, planters that have a separate toolbar equipped with units attached to the rear of the planter that split 30-inch rows into 15-inch rows. Split-row planters are currently used to plant soybeans in 15-inch rows.

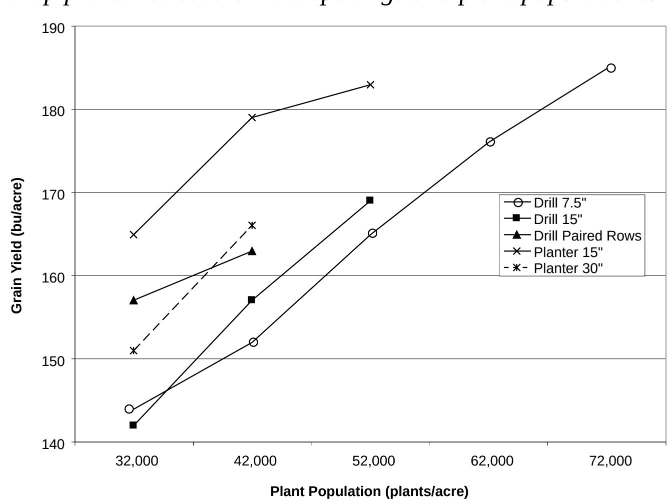
Converting split-row planters to plant corn should only involve the installation of the appropriate plates or seed metering units on the planting units. The planting configuration used will dictate the harvesting equipment needed or conversely, the harvesting equipment available may dictate the row spacing used when planting narrow row corn.

The use of a grain drill or air seeder to plant corn has been researched at Kansas State University. In 1991 and 1992, researchers drilled short season corn at a wide range of seeding rates. In 1998, an air seeder was used to plant corn in 7.5- and 15-inch rows as well as a paired row treatment. The paired row treatment consisted of two rows 7.5 inches apart, but centered on 30-inch row spacings.

Two issues concerning use of a drill or an air seeder to plant corn must be addressed. First, grain drills and air seeders do not singulate corn seed in a manner that is achieved with current row crop planters. As a result, intra-row plant spacing is erratic. Even though overall seed drop may be achieved, the number of double and triple seed drops increases and distance between plants within a row is more erratic. Erratic stands and large skips can be detrimental to corn yields, as illustrated by the difference in grain yields between drilled and planted corn in both 15- and 30-inch rows at a given plant population (Figure 1). Corn planted with an air seeder in 15-inch rows produced yields that were on average 20 bushels per acre lower than those planted in 15-inch rows with a planter. When paired rows planted with an air seeder were compared with 30-inch rows planted with a planter, the difference was 9 bushels per acre.

It should be noted that corn planted with an air seeder in 7.5- or 15-inch rows had yields similar to corn planted in 30-inch rows only when the seeding rate for the air seeder was 10,000 seeds per acre higher than the planter. A seeding rate increase of 20,000 seeds per acre was needed for the air seeder to achieve yields similar to those with a planter in 15-inch rows.

Figure 1. *Corn yields for corn planted with a drill and row crop planter at several row spacings and plant populations.*



The second issue — if grain drills or air seeders are to be used to plant corn — is the ability to accurately place and cover seed to ensure adequate stands. Previous research with grain sorghum planted with a grain drill suggested that seeding rates had to be approximately 10 to 20 percent higher than with a planter to achieve the desired stands. This difference was attributed to the difference in seed placement and seed covering abilities of a grain drill and a planter. New air seeders with single disk openers may be able to place and cover seeds in a manner similar to row crop planters, but there is little research on this topic.

Crop Management

Crop management machinery includes sprayers and row crop cultivators. A row crop cultivator may not be an option for row spacings of 20 inches or less. Some growers with 20-inch rows are still cultivating. Cultivating 20-inch rows will require some significant changes in the cultivator and possibly tractor tire setup and width. It will be challenging to cultivate with a tractor equipped with tires with an 18.4-inch cross section.

Applying postemergence herbicides on narrow row corn with a ground applicator also may present challenges. It is possible to drive between 20-inch rows, but narrower rows will make it more difficult. Consider spraying perpendicular to the planted rows in a narrow row crop. When spraying perpendicular to the planted rows, use the widest possible boom to minimize the area being driven over. A high-clearance sprayer with 18.4-inch tires will drive on 10 percent of the area sprayed when the sprayer is equipped with a 30-foot wide boom. However, a sprayer with the same tire setup and a 60-foot boom will only drive on 5 percent of the area being treated.

Harvesting

Since corn is normally harvested with row units, harvesting equipment probably has limited the adoption of narrow row corn. Corn headers for 20-inch rows are currently available from most manufacturers. It is also possible to modify 30-inch corn heads to harvest corn in 20-inch rows. Corn heads for 15-inch rows may be available from custom fabrication companies. Harvesting corn with a platform head is certainly possible, but not recommended. Harvesting efficiency is severely limiting, due to the volume of plant material that must go through the separator. Getting the crop under the reel on the header also may be challenging.

It may be tempting to harvest corn planted in 20- or 15-inch rows with a corn head configured for 30-inch rows. Research has shown that this will result in severe harvest losses by the header. Yield losses of more than 18 bushels per acre were recorded for corn planted in 7.5-inch rows and harvested with a corn header with 30-inch row spacings. In 15-inch rows, yield losses averaged 11 bushels per acre, with some plots losses of more than 55 bushels per acre.

Either of these methods is acceptable for small acreages while evaluating narrow row corn, but a long-term harvest plan should be formulated before planting narrow corn a larger scale.

Economic Considerations

The decision to use 15- or 20-inch row spacing for corn is largely one of weighing the benefits of narrow rows versus the cost of narrow rows. As previously noted, corn yield advantages in the range of 12 to 15 bushels per acre can occur for 20-inch and 15-inch rows compared to yields from 30-inch rows in high-yielding environments. However, that advantage in yield may be offset by the cost of narrow row equipment. Assuming that a producer wants to plant and harvest the same amount of cropland in the same timeframe, narrow row equipment will cost more, as more row units are required to do the same amount of work.

For example, consider a 16-row planter with 30-inch spacings with a working width of 40 feet versus a 24-row planter with 20-inch spacings with an identical working width. The 16 row, 30-inch planter sells for approximately $75,000, while the 24-row, 20-inch planter sells for approximately $90,000. Looking at it another way, the 30-inch planter has an initial value of $4,688 per row while the 20-inch planter has a value of $3,750 per row. Similarly, narrow row corn heads of identical working widths to 30-inch corn heads also will cost more. For instance, a 12-row, 20-inch corn head will sell for approximately $46,000 while an eight-row, 30-inch corn head with the same working width will sell for $31,000 to $33,000. These prices are just a few examples; prices can vary by size, configuration, and manufacturer.

Using the prices in the examples listed above, how much more would the 20-inch corn have to yield to cover the cost of 20-inch row equipment? When determining the additional yield needed to cover the cost of 20-inch row equipment, the relevant costs are depreciation, interest, and repairs. Fuel and labor are likely to be similar whether planting in 15-inch, 20-inch, or 30-inch rows, as long as the working width of the machine is the same. Depreciation and repairs for each of the planters were estimated using the American Society of Agricultural Engineers (ASAE) depreciation formulas. Likewise, repairs for the corn head were also estimated with the ASAE repair formulas. Depreciation on the corn heads was estimated using average values from the North American Equipment Dealers Association (NAEDA) *Official Guide*, as the ASAE does not have a depreciation formula for corn heads. Interest, in this instance, is an opportunity cost, or charge for owning the equipment during its useful life.

Based on the formulas used, 20-inch row equipment costs $4.57 per acre more than 30-inch row equipment, assuming that both sets of equipment were used annually on 1,500 acres. Thus, 20-inch equipment would require yields of 2 to 3 bushels per acre more than average 30-inch yields to break even. If higher depreciation or repair rates were used for this equipment, breakeven yields for 20-inch row corn would likely be a bushel or two higher. Similarly, 15-inch equipment, with the same working width, would require even higher yields. Because there are so many options, sizes, and configurations of corn planters and heads available from the major equipment manufacturers, it is difficult to determine exactly how much more narrow row corn equipment will cost compared to standard 30-inch row equipment. However, a safe estimate would probably be 3 to10 bushels per acre. Furthermore, the decision to convert to narrow rows should be made at the same time the decision to trade planters or corn heads is made. Otherwise, it may be cost prohibitive to trade when standard width equipment is relatively new.

Summary

Corn planted in narrow rows has the ability to produce higher yields than corn planted in conventional row spacings in highly productive environments when water does not limit yields (yields typically above 160 bushels per acre). However, due to corn's relative drought sensitivity, in environments where water stress can be expected (yields typically 120 bushels per acre or less), narrow row corn has significant risk and should be avoided. Corn producers should alter seeding rates when converting to narrow rows, since narrow rows will allow higher plant populations without increasing within row plant competition. Producers should choose high-yielding hybrids that perform well under above average incidence of gray leaf spot or leaf rust diseases. Although corn planted in narrow rows can reduce weed competition, chemical weed control programs should not be drastically altered when adopting narrow corn production systems. Economic analysis suggests that converting to narrow rows may be feasible in higher yielding dryland and irrigated scenarios.

Related Kansas State University Research and Extension Publications

Corn Production Handbook, NCR-326
Management of Urea Fertilizers, MF-984
Management Practices Affecting Nitrogen Losses from Urea, L-782
Phosphorous Facts, C-665
Chemical Weed Control for Field Crops, Pastures, Rangeland, and Noncropland, SRP-777

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