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Potential of Narrow Row Corn Production in Pennsylvania

Traditionally, corn produced in Pennsylvania and surrounding states is grown in rows that are 30 inches or wider. Now, producers and researchers are considering the potential of narrower rows such as 15 to 22 inches for corn production in Pennsylvania. The interest in narrow rows is sparked by several possible advantages of this production system: higher yields, better weed control, decreased potential for soil erosion, and increased nutrient uptake. Challenges to narrow row corn production include the additional investment in harvesting and planting equipment, increased seed and insecticide costs, and limitations for cultivating and sidedressing the crop.

The theory behind narrow row corn production is that yields of any crop will be maximized when plants are uniformly distributed across the field. To achieve this, the spacing between all plants between and within the rows must be equal. For an equidistant plant spacing with 30,000 plants per acre, both the row spacing and distance between plants within the row would be 17.4 inches. In a 15-inch row system, plants would be 13.9 inches apart in the rows. This spacing is much closer to an equidistant spacing than in 30-inch rows with plants 7.0 inches apart at a 30,000 population. Theoretically, this equidistant spacing should minimize the effects of competition among plants, especially early in the season before a complete canopy is formed.

In the mid-Atlantic region, narrow row corn production has been adopted by a few growers, but in some other regions the adoption rate has been much higher. In Michigan, for example, many growers in the sugar beet producing region have found that by switching to 22-inch rows from 30-inch rows they were able to increase the yields of not only corn but also sugar beets and edible beans they grow in rotation. In western New York, some growers have switched to 15-inch rows for corn silage production.

Plant distribution in 30-inch and 15-inch rows at a population of 30,000 plants per acre.

30-inch rows			15-inch rows					
x	x	x	x	x	x	x	x	x
x	x	x						
x	x	x	x	x	x	x	x	x
x	x	x						
x	x	x	x	x	x	x	x	x
x	x	x						
x	x	x	x	x	x	x	x	x
x	x	x						

GRAIN YIELD ADVANTAGES OF NARROW ROWS

A number of studies have been conducted comparing narrow rows to the more conventional 30-inch row spacings. Most show a positive yield response to narrower rows, some have resulted in no response, and a few have shown a negative response. Table 1 summarizes some of the grain yield responses to narrow rows reported in the studies.

The yield response to narrow rows seems to be greatest in shorter season environments and less or even negative in southern locations. A recent survey sponsored by John Deere concluded positive yield responses to narrow rows averaged 8.0 percent north of Interstate 90, 4.1 percent south of I-90 and north of I-80, 1.5 percent south of I-80 and north of I-70. Yield responses in eight studies conducted south of I-70 actually declined by 9.8 percent.

Table 1. Grain yield responses to narrow row spacing.

Location	Experiments	Narrow row spacing	Yield response
		(in)	%
Michigan State	10	22	8.8
Minnesota	6	20	7.3
Purdue	9	15	2.7
Iowa State	5	20	4.5
Pioneer Hi-bred	14	22	4.0
Univ. of Kentucky	5	20	0.0
Univ. of Tennessee	3	20	-4.3

Table 2. Row spacing and population effects on yield response to row spacing at Rock Springs in 1993 and 1994.

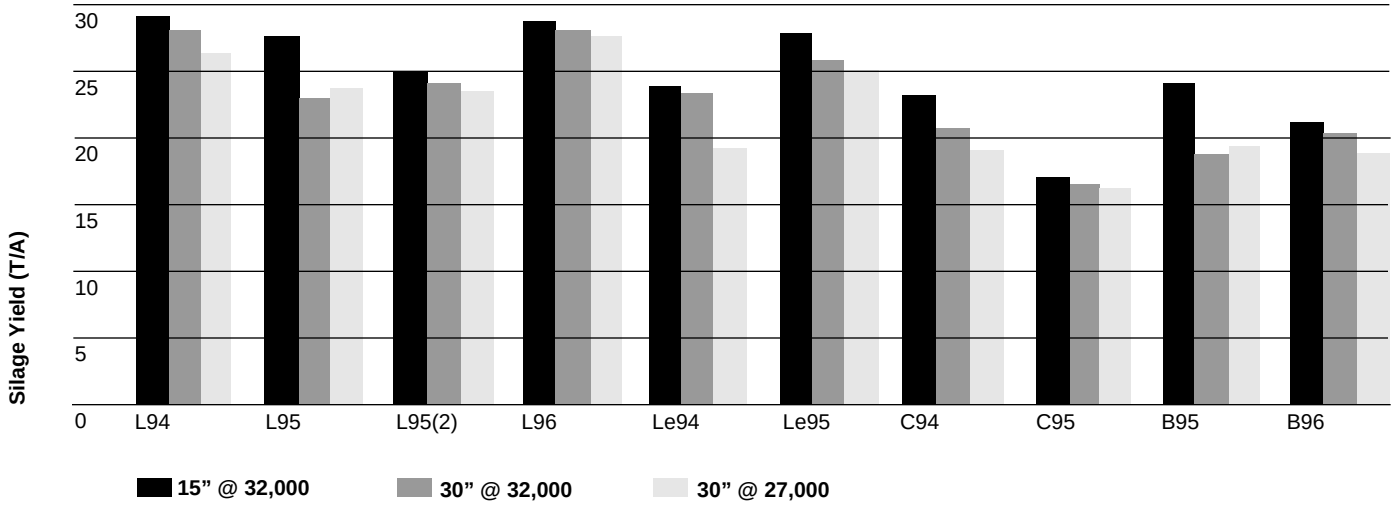
Row spacing	Population	1993	1994	Mean
(in)		Bu/A		
30	27,000	174	147	160
15	27,000	178	153	165
	Response	**+4**	**+6**	**+5**
30	34,000	175	163	169
15	34,000	186	174	180
	Response	**+11**	**+11**	**+11**

Research in Pennsylvania has shown results somewhat similar to those elsewhere. At Rock Springs, grain yield increases averaged 4.2 percent with narrow rows. Narrow rows in conjunction with a higher population (34,000 plants per acre) increased yields by as much as 12 percent compared to a "normal" population in 30-inch rows. At several long season sites in southeast Pennsylvania, however, grain yields were not increased with the narrow row program compared to 30-inch rows, even though silage yields were increased at some of these sites. This result appears to be consistent with the results from other studies—less response as you move south.

SILAGE YIELD ADVANTAGES OF NARROW ROWS

The response of silage yield to decreasing row width and increasing populations in ten experiments conducted throughout Pennsylvania has averaged 11.2 percent. The silage yield response to narrow rows alone at a population of 32,000 plants per acre was 8.8 percent. Yield increases have been greatest at locations where corn growth is slow in the spring, either because of stress or cool temperatures. Row spacing studies at Cornell on corn silage have shown about a 5 percent benefit to decreasing row spacing from 30 to 15 inches. Forage quality of corn silage produced in narrow rows has been similar to that produced in wide rows at the same plant population.

Table 3. Silage yields in ten experiments conducted in Lancaster (L), Lebanon (Le), Centre (C), or Bradford (B) counties in 1994 through 1996.



OTHER ADVANTAGES OF NARROW ROWS

Narrow row corn will form a closed canopy over the row approximately one to two weeks earlier than 30-inch row corn. One study from Maryland showed better weed control in corn in the narrow row system compared to normal row width corn. This result was similar to the weed control advantage that is associated with drilled soybeans compared to those planted in wide rows.

Narrow row corn could also provide some benefit for reducing soil erosion because of the early canopy development, the higher plant populations, and higher yield potential. The Pennsylvania NRCS staff are currently considering the conservation benefits of narrow row corn.

The higher yields combined with a similar nutrient content in the crop could also result in increased nutrient uptake by the crop. Results from the narrow row silage studies indicate an average increase uptake of N by the silage crop of 10 percent. This increase could be significant for situations where herd sizes are limited by the nutrient management plan.

Another practical advantage of narrow rows could be that one planter would suffice for planting multiple crops. In some areas, this has been the major factor causing growers to consider narrower rows in corn. In some areas of Michigan, narrow row corn is planted with the same planter that is used for sugarbeets, edible beans, and soybeans. As a result, the investment in a narrow row system (22 inch) in this crop rotation could be spread across several crops. In Pennsylvania, a 15- to 20-inch row planter could be used for planting both corn and soybeans, which might reduce or eliminate the need for a no-till drill on some farms.

PLANTING NARROW ROW CORN

Narrow row corn systems adopted by growers around the United States most often are 15, 20, and 22-inch systems. Planters have been modified to plant these row spacings by moving the units closer together or, in the case of 15-inch rows, by adding a row splitting unit with planter boxes behind, or in front of, the main toolbar.

Doubling back over fields and planting a second time to split the rows is also an option and can be effective, but it has several drawbacks. It is more time consuming, it is difficult to split the rows uniformly, and often the tractor's tires run over the first rows when doubling back, which can cause stand reductions. Some of the planting and traffic problems caused by doubling back can be avoided by adjusting the drawbar of the tractor so that the planter tracks about 15 inches off center. When doubling back, the tractor can be run in the same wheel tracks and the planter will be splitting the first rows planted. Larger planters such as eight and twelve row units will also be more effective for double planting because there are fewer tire tracks associated with each planter pass.

PLANT POPULATIONS FOR NARROW ROW CORN

Research at Penn State and in western New York suggests an increase in plant population may be warranted in narrow row corn production. However, some research from the midwest has not shown a benefit for higher populations in the narrow row system. The research conducted at Penn State used plant populations of 27,000 plants per acre in 30-inch rows to 34,000 plants per acre in 15-inch rows. The results indicated that plant populations of 34,000 in 15-inch rows may be too high for grain production except on the best soils. Populations of 30,000 to 32,000 are probably near the optimum for grain production in the narrow row system. For silage production, a population of near 34,000 plants per acre is probably close to the optimum in the narrow row system. Higher plant populations are probably not warranted except perhaps in short season areas. Plant populations higher than 34,000 can result in lower protein and net energy levels in the silage.

WEED CONTROL IN NARROW ROW CORN

The long-term, less tangible benefits of narrow rows on weed control may be opportunities for lower herbicide rates, fewer applications, and decreased weed competition that can occur with the earlier canopy and higher population. Narrow corn rows will make postemergent herbicide applications or cultivation more difficult, however. Postemergent applications are most challenging with a 15-inch row system and less with the 20- to 22-inch systems. Several management options are available to deal with this challenge. Growers in 22-inch row systems in Michigan have outfitted tractors with narrower (12- to 14-inch) tires to facilitate these operations and to help reduce soil compaction next to the plants in the traffic rows. Applying postemergent chemicals with trucks and tolerating some additional traffic damage may be one option. In the 20- to 22-inch systems, postemergent applications should be possible, but will be more difficult than in 30-inch rows. Some growers have relied on early postemergent applications when corn is in the 2 to 3 leaf stage and is less likely to be damaged when run over. Another possibility is to leave tram lines (unplanted rows) that could be used for postemergent applications. However, odd-shaped fields with point rows that are common in Pennsylvania do not lend themselves well to tram lines.

INSECTICIDE AND STARTER FERTILIZER CONSIDERATIONS

Soil insecticides are applied as product per linear foot of row, so reducing the row spacing would increase the amount of insecticide that would be necessary to provide adequate control. Changing from a 30-inch to 20-inch row system would therefore cause a 50 percent increase in insecticide costs, while changing to 15-inch rows would cause a 100 percent increase. Starter fertilizer rates per acre will also need to be increased if the same rate in the row is desired. If current starter fertilizer rates are more than 200 pounds per acre, it may not be necessary to increase the rate in narrow

rows, since starter rates often can be reduced to 100 pounds per acre in 30-inch rows or 200 pounds per acre in 15-inch rows with no effect on yields. Farms with high soil fertility levels may not need starter fertilizer at all.

FERTILITY ADJUSTMENTS FOR NARROW ROW CORN

Fertilizer requirements for a narrow row corn program should be based on the anticipated yield goal as in 30-inch rows. Given that yield increases of 5 to 10 percent and N uptake might be increased by the same amount, fertilizer inputs should be increased accordingly. There have been some reports that suggest the need for additional N in the narrow row/high population system, but none have been conclusive.

HARVESTING NARROW ROW CORN

For grain harvest, most of the adopters of narrow row corn have modified their combine corn heads to a 20- or 22-inch spacing. Recently some equipment manufacturers have revived 20- and 22-inch combine heads, so purchasing is now also an option. A prototype 15-inch head has also been developed and may be commercialized in the near future. Cost estimates for modifying a 6 row, 30-inch head to an 8 row, 22-inch head have run about $3,500. On small acreages, narrow rows have been harvested fairly well with 30-inch row equipment, but there could be an increased potential for harvest loss with large acreages or down corn.

For silage harvest, rotary drum type harvesters are commercially available for self propelled harvesters that can harvest corn planted in any row width. Cost estimates for these heads have been approximately $5,000 higher than conventional 30-inch factory heads, and they are only available for self-propelled harvesters. A few growers have reported that some of the conventional 30-inch row heads do an acceptable job of harvesting the narrow row corn for silage. Some Amish silage growers have found they can utilize a 20-inch row system with their existing binders and as such encounter little additional costs associated with harvesting the narrower row system.

CHOOSING A ROW WIDTH

Growers who are interested in the narrow row concept will need to decide which row spacing is best for them. There is likely little advantage to reducing rows to less than 15 inches, since then the distance between plants within a row becomes larger than the distance between rows and you start to move away from the equidistant spacing that is the objective of narrower rows. Also, planter alternatives such as grain drills for less than 15-inch rows are less desirable than row planters. For grain producers, the most practical options appear to be 20- to 22-inch rows. Grain head modifications are more feasible for these spacings than for 15-inch rows, postemergent applications can be accomplished without much damage to the stand, and yields will be comparable to those obtained in narrower rows. For silage producers, the decision is not as clearcut and depends on the harvest equipment. If 15-inch rows can be harvested, then this spacing may be most desirable, especially if a planter with row splitters is an option and late postemergent applications are not common. Otherwise the 20- to 22-inch row spacing option could also work well for silage.

ECONOMICS OF NARROW ROW CORN

The economic advantage, if any, of narrow row corn will vary among individual operations. Potential increased costs include planter modifications, increased seed, insecticide and perhaps fertilizer costs, combine or chopper modifications, and modifications to other machinery such as sprayers and cultivators. Increased returns would result primarily from increased yields of corn and other crops but could also come from reduced equipment needs, soil conservation, and long-term weed control advantages. Michigan State agricultural economists have estimated that, when amortized over time and sufficient acres, the cost of conversion for harvesting is approximately $5.00 per acre. Planter modifications also run in the range of $5.00 per acre. Costs for increased insecticide and starter fertilizer could total $20 per acre. The following three examples illustrate potential differences in the economic return to narrow row corn production that could be encountered on Pennsylvania farms.

Table 4. Example of estimated economic returns to narrow row corn production.

Input	Additional cost(-) or return in dollars per acre		
	Example 1	**Example 2**	**Example 3**
Seed	0.00	0.00	-7.00
Starter	-10.00	0.00	
Insecticide	-10.00	-2.50	
Planter	-5.00	0.00	-5.00
Harvest	-5.00	-5.00	-5.00
5% Grain yield (120 x 0.05 = 6 bu/) @ $3/bu	18.00	18.00	
10% Silage yield (20T x 0.10 = 2T/A @ $25 T/A)			50.00
Net	**-12.00**	**10.50**	**33.00**

Example 1. Estimated returns for conversion to 15-inch rows for grain production with the grower using insecticide, starter, and needing a planter modification. Plant populations remain constant and yield increases by 5%.

Example 2. Estimated returns for conversion to 20-inch row grain production with the grower using some (50% of acreage) insecticide, no starter, and not needing a planter modification. Plant populations remain constant and yield increases by 5%.

Example 3. Estimated returns for conversion to 15-inch rows for silage production with the grower not using insecticide or starter, and needing a planter and harvester modification.

SUMMARY

Narrow row corn production is an opportunity to increase corn grain yields by about 0 to 5 percent and silage yields by 5 to 10 percent or perhaps slightly more if plant populations are increased as well. Yield responses are still somewhat inconsistent, however, and this variability is not well understood. The largest benefits should occur in our medium- and short-season areas and silage yield responses should be larger than grain. Other benefits of narrow rows such as weed control, soil erosion reduction, and increased nutrient uptake should be considered when evaluating the narrow row system. Costs associated with machinery changeover and increased inputs also need to be considered carefully before making the switch.

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