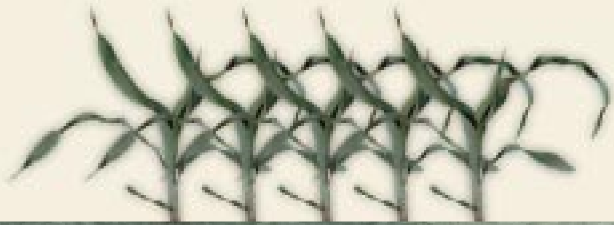
IOWA STATE UNIVERSITY
University Extension

Corn Planting GUIDE



CORN IS GROWN ON MORE ACRES OF IOWA LAND THAN ANY OTHER CROP. *Planted acreage reached a high in 1981 with 14.4 million acres planted for all purposes and has hovered near 12.5 million acres since the early 1990s. Table 1 shows the trend in corn acreage, yield, and production since 1900 as reported by the Iowa Agricultural Statistics Office. Total production and average yield per acre records were set during the 1994 season.* • *Corn yields have trended upward over the past 40 years. Considerable year-to-year variation indicates that the weather has a major influence on corn production. Many factors are responsible for these yield increases, including better hybrids, more efficient use of fertilizers, better pest management (weeds, insects, and diseases), and better management overall. Producer-controlled management factors (row spacing, planting dates, planting depth, plant densities, and replant options) that affect yield will be addressed in this guide.*

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Planting Dates and Planting Depth

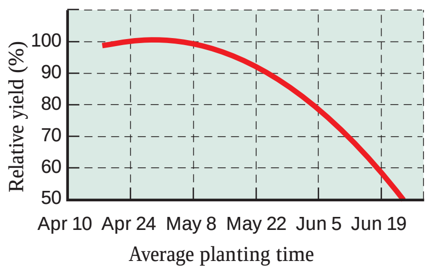
The optimum time to plant varies from year to year; however, finishing planting by mid-May is a goal most producers should strive to achieve . . . More recent studies indicate that the optimum time for planting corn in Iowa still falls between April 20 and May 5.

IN THE PAST, CORN PLANTING WAS DELAYED until late May or early June for several reasons: 1) time was needed for spring plowing; 2) soils were warmer at later dates, contributing to the success of less vigorous races or hybrids; and 3) preplant tillage facilitated weed control. As more vigorous hybrids came into use along with herbicides for weed control, planting dates for corn were moved earlier and earlier. Studies in the 1980s in Iowa indicated that on average, the best time to plant corn was from April 20 to May 10.

The optimum time to plant varies from year to year; however, finishing planting by mid-May is a goal most producers should strive to achieve

FIGURE 1

Effect of planting date on corn grain yield response in Iowa (1997–2000).



(Fig. 1). Corn can be planted before the threat of freezing temperatures has passed for two reasons: 1) the time delay between planting and emergence, and 2) the growing point

A 2-inch planting depth is ideal for average conditions.

TABLE 1

Iowa corn grain harvested acreage, average yield, and total production (by decade) from 1900 to 2000.

Year	Harvested acres (x 1,000)	Average yield per acre (bushels)	Production (x 1,000 bushels)
1900s	9,378	38	356,922
1910s	9,774	39	379,487
1920s	9,267	40	373,250
1930s	9,220	38	357,555
1940s	9,884	51	505,706
1950s	10,184	56	569,737
1960s	10,274	83	843,417
1970s	11,958	100	1,197,463
1980s	12,045	115	1,395,875
1990	12,400	126	1,562,400
1991	12,200	117	1,427,400
1992	12.950	147	1,903,650
1993	11,000	80	880,000
1994	12,600	152	1,915,200
1995	11,600	123	1,426,800
1996	12,400	138	1,711,200
1997	11,900	138	1,642,200
1998	12,200	145	1,769,000
1999	11,800	149	1,758,200
2000	12,000	145	1,740,000

Source: Iowa Agricultural Statistics Office remains below the soil surface for some time following emergence. More recent studies indicate that the optimum time for planting corn in Iowa still falls between April 20 and May 5 (Table 2). However, numerous factors influence the decision of when to start planting corn. Rather than an exact date, soil condition is a key factor to consider. Planting when soils are too wet is not advised, regardless of the date. Under most circumstances, the best time to begin planting corn in Iowa is as early as conditions (soil and temperature) allow.

Many producers use soil temperature as a guide to start planting. Planting corn in April generally is not advisable until the soil temperature at planting depth is near 50° F or above. Time to emergence in the field ranges from greater than three weeks for 50 to 55° F soil temperatures to less than one week for soil temperatures greater than 70° F. Soil temperature can be ignored if planting is in May; the condition of the seedbed becomes the critical issue then.

How early one needs to begin planting corn in order to be completed by mid-May depends on soil conditions, acres planted per day, work days available, and total number of acres to be planted. During late April and early May, only about half the days normally are suited for field work. A useful method for estimating a start date for corn planting is to add up the number of days expected to plant all acres plus the number of days of anticipated weather, mechanical, and personal delays, and back up that many days from May 10. That date should be a target date for beginning corn planting. From a practical standpoint, April 15 is about the earliest planting date most farmers should consider.

Corn yields do not begin to decline rapidly until planting is delayed beyond mid-May (Fig. 1). Corn hybrids used today appear to have more yield stability over time in the early part of the season. If planting is delayed until late May, hybrids characterized as earlier than "full season" should be used, especially in northern Iowa. A rule of thumb for changing hybrid maturities is if planting is delayed until May 25, select a hybrid that matures five days earlier than an adapted full season hybrid for that area. If planting is delayed another seven to ten days beyond that, select a hybrid that matures another five days earlier than the previous one. Generally speaking, if corn planting is delayed until June 10 to 15, very early maturing corn hybrids should be used; after June 10 to 15, corn planting is risky unless the corn can be used for silage.

Ideal planting depth varies with soil and weather conditions. Generally speaking, a 2-inch depth is ideal for average conditions. When planting early (April) and soils are cool, the ideal depth may be slightly less. Planting depth should never be shallower than 1.5 inches, however. When the surface soil is dry, especially when planting has been delayed until mid- or late May, planting depth may need to be increased to 2 inches or more. Careful control of planting depth will improve stand levels and produce more even plant emergence.

TABLE 2

Corn yield response to planting date.*

Date	Relative yield potential (percent)
April 20–May 5	100
May 13–19	99
May 26–June 1	90
June 10–16	68
June 24–28	52

* Average of three locations (Nashua, Ames, and Lewis) and three years (1998-2000).

Plant Population

Optimum plant population depends on factors such as hybrid, moisture stress level, soil fertility, and yield goal.

PLANT POPULATION REFERS TO THE NUMBER of plants per acre; planting or seeding rate refers to the number of seeds planted per acre. The two should not be confused. Producers typically need to plant more seed than their intended plant population goal. How much more will depend on the germination percentage of the seed being used, soil conditions, and anticipated pest problems. Tables 3 and 4 should be helpful in making planting rate and plant population measurements.

Average plant populations for the state of Iowa have shown a steady increase over the last decade. Plant populations have increased at a rate of 400 plants per acre since 1992. Much of this increase can be attributed to improved hybrids that are much more tolerant of high population stress than hybrids used previously. Figure 2 shows the response of plant population on corn grain yields.

Optimum plant population depends on factors such as hybrid, moisture stress level, soil fertility, and yield goal. Each producer should adjust populations according to these factors. The optimum plant population will not only vary between regions of the state, but from season to season, and field to field on the same farm. Research results from Iowa State University are presented in Table 5. These data show that optimum populations do vary across locations, but these variations are relatively small. When environmental conditions are favorable, soil fertility levels are optimized, and appropriate hybrids are selected, optimum yields likely will occur when populations in the range of 28,000 to 32,000 plants per acre are used. Recommendations for silage production are 2,000 to 4,000 plants per acre higher than for grain production.

FIGURE 2

Effect of plant population on corn grain yield response in Iowa (1997–2000).

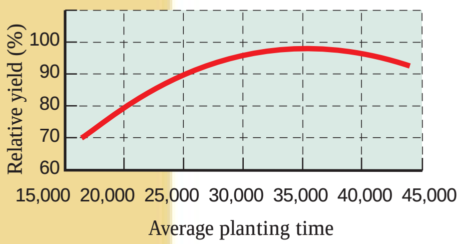


TABLE 3

Relationship between seeds planted, distance between seeds, and projected final stand.

Seeds planted (per acre)	Row spacing, inches: 15	20	30	36	38	Plant population* (per acre)
	(inches between seeds)					
24,000	17.4	13.1	8.7	7.3	6.9	20,400
26,000	16.1	12.1	8.0	6.7	6.3	22,100
28,000	14.9	11.2	7.5	6.2	5.9	23,800
30,000	13.9	10.5	7.0	5.8	5.5	25,500
32,000	13.1	9.8	6.5	5.4	5.2	27,200
34,000	12.3	9.2	6.1	5.1	4.9	28,900
36,000	11.9	8.7	5.8	4.8	4.6	30,600
38,000	11.0	8.3	5.5	4.6	4.3	32,300
40,000	10.5	7.8	5.2	4.4	4.1	34,000
42,000	10.0	7.5	5.0	4.1	3.9	35,700
44,000	9.5	7.1	4.8	4.0	3.8	37,400

* Assuming 15 percent mortality.

TABLE 4

Method of estimating plant population.*

Row width (inches)	Length of row (in feet equal to 1/1000th acre)
15	34' 10"
20	26' 2"
30	17' 5"
36	14' 6"
38	13' 9"

* Count plants (not tillers) and multiply by 1,000 to estimate plants per acre.

Row Spacing

CORN ROW SPACING HAS BEEN STUDIED for decades with very mixed results. A 2000 survey of Iowa producers reported that approximately 56 percent of the corn acres in Iowa were in 30-inch rows with approximately 43 percent of the corn acres in row spacings greater than 30 inches and 1 percent in row spacings less than 30 inches. The trend toward narrower row spacings continues, but identifying the optimum row spacing for maximizing corn production is still a challenge for many producers.

Recent research at Iowa State University has examined the effect of 15-, 30- and 38-inch row spacings on corn grain yields. The results of these studies are summarized in Table 6. Narrowing rows to less than 30 inches showed very small and inconsistent results with the overall effect showing no yield benefit for row spacings less than 30 inches. Previous research comparing 30- and 38-inch row spacings indicated a 4 to 6 percent yield advantage for 30-inch rows. More recent research, however, suggests that the yield benefit will vary from year to year but the overall effect has decreased to only a 3 percent advantage for 30-inch rows.

30-inch row spacing (left) versus 15-inch row spacing (right).

TABLE 5

Corn yield response to plant population at six Iowa locations, 1997-2000.

		Location						
		Northwest	North Central	Northeast	Central	Southwest	Southeast	State Average
Final stand	Years tested	Relative yield potential (percent)						
44,000	1	90	90	93	99	86	—	93
36,000	4	92	95	97	100	93	98	97
32,000	4	100	100	100	99	100	98	100
28,000	4	90	95	92	96	90	100	94
24,000	4	95	95	92	92	93	97	94
20,000	1	78	79	76	89	78	—	81

TABLE 6

Relative yield differences of corn grown in 15- and 38-inch row spacings when compared with 30-inch row spacings.

	Relative yield difference (percent) compared with 30-inch rows	
Year	15-inch	38-inch
1995	+2.2	—
1996	0	—
1997	-1.9	—
1998	+1.2	-7.5
1999	-1.2	-0.5
2000	+1.8	-2.7
Average	+0.3	-2.9

Corn Planting GUIDE

Replanting Decisions

Interseeding into an existing thin stand can be risky.

To be profitable, a replant yield must cover the extra costs involved with replanting. This may include the costs of tillage, planting, seed, and any additional fertilizers and pesticides if needed.

GENERALLY, A CONSIDERABLE AMOUNT OF stress accompanies a decision to replant. Reasons for replanting are numerous and the decision to replant presents a whole series of problems that producers must consider. Yields likely will be lower and grain moisture higher at harvest. Earlier maturing hybrids likely will be required, or perhaps switching to an alternate crop such as soybeans will be necessary. If soybeans becomes a better choice, will there be herbicide problems? Many difficult decisions must be made rather quickly.

There are some preliminary considerations that all producers must take into account before making the decision to replant. The first should be to thoroughly evaluate the current stand, both in terms of the plant population, the uniformity of the stand, and the overall health of the existing plants. Stand counting was covered previously (see Table 4). Take enough counts so that a representative view of the replant area is achieved.

Table 7 combines the plant population and planting date information for corn into a single table to aid in making replant decisions. It is assumed that hybrids of an optimum maturity for each date are used. Yields are based on an even plant distribution, which is often not the case in a replant situation. A University of Illinois study indicates yields are reduced by about 2 percent if the stand includes small gaps of 1 to 3 feet. Numerous gaps of 4 to 6 feet in length may reduce yields by an additional 5 to 6 percent.

Following is an example of how to use Table 7:

1. Corn was planted on April 25 near Ames, Iowa, with the desired population of 32,000 plants per acre.
2. In late May, it was observed that only 16,000 plants per acre were present and the stand was somewhat uneven.
3. It would be possible to replant on June 1. Should the field be replanted?

Based on Table 7, the April 25 planting date and 32,000 population goal would produce 100 percent of full yield potential. A stand of 16,000 plants per acre planted on the same date would produce 74 percent of full yield potential, minus an additional 2 percent for some unevenness, or 72 percent yield potential. If the field were replanted with a target population of

TABLE 7

Influence of planting date and plant population on corn grain yields.

	Planting Date				
	April 20–May 5	May 13–19	May 26–June 1	June 10–16	June 24–28
Final Stand*	Relative yield potential (percent)				
28,000–32,000	100	99	90	68	52
24,000	94	93	85	64	49
20,000	81	80	73	55	42
16,000	74	73	67	50	38
12,000	68	67	61	46	35

* Assumes a uniform plant spacing.

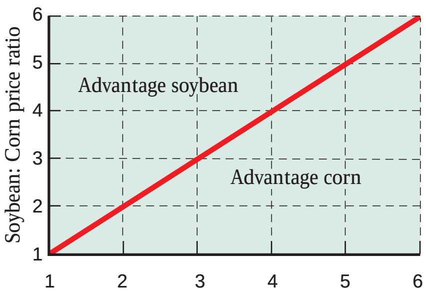
32,000 plants per acre on June 1, the yield potential in this case would be 90 percent of full potential. Replanting on June 1 would produce an 18 percent (90 percent minus 72 percent) yield increase over leaving the existing stand. For a yield potential of 160 bushels per acre, this would mean an increase of approximately 29 bushels per acre. These figures also assume that the stand achieved by replanting is 32,000 plants per acre. If the original stand was poor because of disease, insect, or herbicide injury, it is highly possible that the replant stand could be diminished also, resulting in a lower return on the replant investment. The information in Table 7 should not be considered "absolute fact," but merely as guidelines for helping make replanting decisions. Each case will be somewhat unique and must be considered on its own merits.

Other replanting considerations include the costs of replanting, crop maturity choices, or alternate crop choices. To be profitable, a replant yield must cover the extra costs involved with replanting. This may include the costs of tillage, planting, seed, and any additional fertilizers and pesticides if needed. Replanting costs may amount to $30 to $50 per acre or more, depending on the situation. In some cases, interseeding into the existing stand (drilling seed alongside the existing rows of plants) may save considerable time and expense related to replanting. This should be done with caution, however, and only after a thorough evaluation of the existing stand is made noting the current stand level and stage or size of the plants. To increase the success of this type of replanting, crop stage should be V2 (two leaves with collars exposed) or smaller. Interseeding into stands that are larger than V2 is risky and may result in reduced yields. Plant population of the existing stand should be noted and the replant planting rate should be adjusted to account for these plants, thus ensuring that final plant populations are not excessive. In addition, the planter operator must drive carefully so that minimal damage is done to the existing plants.

Crop maturity choices relating to planting date have been discussed and the same guidelines should be followed for replant situations. If replanting is considered late enough in the season, choice of an alternate crop such as soybeans may be warranted. This decision should be based on the economic potential of both crops for a given planting date and should take into account the yield potential of both crops for that planting date, the costs associated with replanting, as well as the expected market price. As planting date is delayed, the yield potentials for corn and soybeans decline at fairly similar rates (see ISU Extension publication PM 1851, Soybean Replant Decisions, for information on soybean replanting). Under most circumstances, however, the relative advantage will move rather strongly towards soybeans after June 10 to 15. Figure 3 can be used as a guide for determining whether corn or soybeans should be selected for planting based on yield potentials and market prices. In essence, if corn yields are three times greater than soybean yields (150 bu/acre vs. 50 bu/acre), soybean market price must be three times greater than corn or more in order for soybeans to be more profitable to plant than corn. If corn yields are four times greater than soybean yields, soybean price must be four times greater than corn, and so on. The relationship is linear and does not take into account the cost of production for replanting either crop or the expenditures already realized for the initial planting.

FIGURE 3

Relationship between the ratio of corn: soybean yield and the ratio of soybean: corn price. Figures are based on gross revenue and do not take into account any costs of production for either crop.



Following is an example of how to use Fig. 3:

1. A producer is faced with a replant decision and is wondering whether to plant corn or soybeans.
2. The producer determines that corn yields on average are 3.5 times greater than soybean yields (taking into account the yield penalties for the delayed planting).
3. The producer also determines that expected soybean prices will be approximately 5 times greater than corn prices.

Based on Fig. 3, replanting to soybeans would be the obvious choice. There are, however, several other less obvious factors that may influence crop choice for replanting. Herbicide program, fertilizer program, desired rotation, potential crop pest problems, livestock feed needs, and erosion concerns on sloping soils all should be considered before making the decision to replant to an alternate crop. When considering all these other factors, replanting to soybeans may be the obvious choice, but it wouldn't necessarily be the most practical or profitable choice.

Summary

THERE ARE NUMEROUS CROP MANAGEMENT factors that corn producers can use to their advantage in order to optimize yields. These include planting date, planting depth, plant population, row spacing, and replanting decisions. Understanding the impact each of these factors has on corn yield, as well as any interactions they have together should enable producers to optimize their corn production systems.

Early planting should be encouraged, but close attention must be paid to weather and soil conditions. The target window should be April 20 to May 5. Corn yields will decline slowly as planting is delayed until mid-May but then begin a fairly rapid decline as planting is delayed until late May or later. Optimum planting depth is dependent on weather and soil conditions also. Ideal depth is 2 inches, but may be adjusted either shallower or deeper if soils are cool or dry. Minimum planting depth should be 1.5 inches regardless of conditions.

Planting rate and plant population are not synonymous terms. Plant population is the number of plants per acre. Under optimum conditions, plant populations in the range of 28,000 to 32,000 plants per acre should maximize yields. The optimum plant population will vary with year, location, soil and weather conditions, and yield goal.

A majority of the corn acres in Iowa are planted in rows spaced 30 inches apart. There is, however, an appreciable acreage planted in rows spaced wider than 30 inches and a very small percentage planted in rows narrower than 30 inches. Recent research at Iowa State University shows little yield advantage to narrowing row spacings less than 30 inches. There is a small (3 percent) yield advantage for corn grown in 30-inch rows compared with corn grown in 38-inch rows.

A replant decision is one of the most difficult decisions a producer must make. Many factors are involved in the decision, including a thorough evaluation of the original stand, and each factor should be considered carefully before a final decision is made. If an alternate crop is selected, consideration should be given to the current herbicide program, fertilizer program, desired rotation, potential crop pest problems, livestock feed needs, and erosion concerns before making the decision to replant to the alternate crop.

Recent research at Iowa State University shows little yield advantage to narrowing row spacings less than 30 inches. There is a small (3 percent) yield advantage for corn grown in 30-inch rows compared with corn grown in 38-inch rows.

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