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Plant Populations and Seeding Rates for Corn

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Selecting proper plant population is a major management decision in striving for optimum corn yields. Many factors are involved in determining the 'right' population level for a given field and the seeding rate to assure that desired stand. They include the hybrid planted, the environment in which the corn will grow, and the producer's management system.

This publication discusses the particular factors that should be considered, how to manage them and how to calculate seeding rates to insure desired plant population levels. Suggestions are also given for planter adjustment, population checks and record-keeping to insure maximum corn yields.

FACTORS AFFECTING PLANT POPULATION

Hybrid characteristics, soil type, moisture availability, fertility level, planting date, planter adjustment, germination rate and field growing conditions all determine what the final plant stand will be. Some of these factors the farmer has little control over; others he can manipulate almost completely. In any case, he must be aware of them and adjust his calculations accordingly, if he is to achieve desired harvest population levels.

Hybrid Characteristics

Corn hybrids vary greatly in ability to tolerate high population rates. Some yield best at about 22,000 plants per acre, while others continue to produce a good-sized ear at 26,000 plants or more per acre. Some hybrids have a tendency to 'go barren' as population increases or as they encounter stress during the growing season. If soil fertility and moisture levels are adequate, some hybrids will produce optimum yields at 28,000 to 30,000 plants per acre.

In areas where moisture stress is common, it is best to choose a hybrid that will produce a sound ear at its recommended 'optimum' population level but will add a second ear *if* conditions are favorable. Avoid those that go barren under stress.

Also be concerned about the stalk strength characteristics in any hybrids you are considering. To be useful under high populations, a hybrid must have good standability, since increasing plants per acre generally reduces stalk diameter and increases plant height.

Your hybrid seed corn dealer should be able to tell you the optimum population levels for the hybrids you're interested in. If considering increasing population rates, be sure your hybrids will respond favorably.

Soil Characteristics

Soil type often dictates the population limits for a corn crop. For example, optimum plant populations are usually lower on soils that tend to be drouthy than on soils that have high water-holding capacity. Even more important, the yield loss for a crop planted at too high a rate will be greater if the soil is drouthy.

Hardpans, poor tilth and other soil factors that restrict water and nutrient supply to the crop will also lower optimum plant population levels.

Water Supply and Irrigation

When available soil moisture at planting time is already low and the seasonal outlook is for below-normal rainfall, don't plan for high populations that year. By the same token, if normal moisture is expected, do not underplant just to 'play it safe.' Corn, once it is waist high, uses nearly the same amount of water regardless of population level. Thus, reducing plants per acre to below normal optimums not only has little effect on water-use efficiency, but will severely limit the crop's ability to maximize yield potential if favorable weather should occur.

Where irrigation is planned, higher populations are usually a part of the high-level management required. To maximize return on investment, it is necessary to boost yield levels. This means more ears per acre, which requires a higher plant population.

Many farmers find populations of 28,000-34,000 plants per acre to be acceptable under irrigation. Since irrigation removes the threat of moisture stress, the risks associated with such planting rates are greatly reduced. Nevertheless, it will still be necessary to select a hybrid that responds to high populations.

Fertility Level

In planning for increased plants per acre, be sure the fertility program is adequate to sustain the higher population. This is especially true if irrigation is to be used. Increasing population and moisture supply has little value if the fertility level cannot support the crop. (See Purdue Extension Publication AY-171, 'Corn Fertilization', for details.)

Planting Date

When planting early, populations usually can—and should—be increased 10-15 percent. The major reasons for doing so are that: (1) early-planted corn is usually shorter, so lodging will not be much of a problem; (2) germination and emergence are apt to be reduced somewhat; and (3) pollination will likely occur before the hottest, driest part of the season, thus lowering the chances of plant stress at critical times.

Germination Rate and Field Mortality

While seed corn is generally of very high quality, final plant stand may still be 10-15 percent lower than the seeding rate, even under good field conditions. This reduction is due, in part, to non-germination of some of the seed and losses during the growing season. Among the field loss factors are: death of low-vigor, abnormal seedlings; bird and rodent feeding; seedling diseases; cultivator damage; drowning in low spots; etc.

To attain final harvest population goals, be sure to allow for these germination and plant mortalities when determining your seeding rate. Laboratory germination percentage is shown on the seed corn tag. 'Normal' field loss is tied to your individual situation and management level, but will probably average around 10-15 percent.

DETERMINING PROPER SEEDING RATE

The following formula, examples and data in Table 1 illustrate the various ways that seeding rates can be determined.

Example A

Assume the optimum population of the hybrid selected to be 20,000 plants per acre, a seed tag germination rate of 95%, and a 10% plant loss to disease and mechanical damage (90% survival rate). What should be your seeding rate to insure a 20,000-plant population level?

1. $$\text{Seeding rate} = \frac{\text{Desired final population}}{\text{Germination} \times \text{Expected survival}}$$

Where: *seeding rate* is number of seeds to plant per acre; *desired final population* is number of plants per acre at harvest; *germination* is the warm-germination rate shown on the seed tag (converted to decimal form); and *expected survival* is percent of emerged seedlings expected to reach harvest maturity (converted to decimal form).

2. $$\text{Seeding rate} = \frac{20{,}000}{.95 \times .90} = 23{,}391$$

3. Thus, the planter would be set to drop about 23,400 seeds per acre.

Example B

Assume a desired final harvest population of 25,500 plants per acre and a 15% stand loss throughout the season in that particular field. What seeding rate will result in a 25,500-plant harvest population, and what seed spacing is required if planting in 30-inch rows?

Table 1. Seed Spacing and Harvest Populations (Assuming 15% Normal Stand Reduction) for Selected Seeding Rates and Row Widths.

Seeding rate	Harvest population with 15% stand loss	Space between seeds when row width is —					
		20 in.	28 in.	30 in.	36 in.	38 in.	40 in.
no.	no.	inches between seeds					
16,000	13,600	19.6	14.0	13.1	10.9	10.3	9.8
18,000	15,300	17.4	12.4	11.6	9.7	9.2	8.7
20,000	17,000	15.7	11.2	10.5	8.7	8.3	7.8
22,000	18,700	14.3	10.2	9.5	7.9	7.5	7.1
24,000	20,400	13.1	9.3	8.7	7.3	6.9	6.5
26,000	22,100	12.1	8.6	8.0	6.7	6.3	6.0
28,000	23,800	11.2	8.0	7.5	6.2	5.9	5.6
30,000	25,500	10.5	7.5	7.0	5.8	5.5	5.2
32,000	27,200	9.8	7.0	6.5	5.4	5.2	4.9
34,000	28,900	9.2	6.5	6.1	5.1	4.9	4.6
36,000	30,600	8.7	6.2	5.8	4.8	4.6	4.4
38,000	32,300	8.2	5.9	5.5	4.6	4.3	4.1
40,000	34,000	7.8	5.6	5.2	4.4	4.1	3.9

1. Under the above assumptions, Table 1 can be used. The table shows that a 25,500 final population with 15% stand loss (column 2) requires a 30,000-plant-per-acre seeding rate (column 1).

2. To get 30,000 seeds per acre if row width is 30 inches, seeds must be spaced 7 inches apart (column 5).

Example C

Assume a desired final stand of 28,000 plants per acre and good growing conditions that will keep your stand losses throughout the season to about 10%. What should be the seeding rate and then proper seed spacing for 30-inch rows?

1. Since Table 1 does not fit your situation, seeding rate is estimated using the following formula:

$$\text{Seeding rate} = \frac{\text{Harvest population}}{1.00 - \text{Pct. loss}}$$

2. $$\text{Seeding rate} = \frac{28{,}000}{1.00 - .10} = \frac{28{,}000}{.90} = 31{,}111$$

3. Referring now to Table 1, for a seeding rate of a little over 31,000 (column 1), seed spacing for planting in 30-inch rows would be around 6.7 inches (interpolated from column 5).

ADJUSTING THE PLANTER FOR PROPER SEEDING RATES

Consult the seed tag and your planter operator's manual to determine adjustments that must be made for the desired seeding rate. But don't rely entirely on those recommendations. Tire size and inflation, drive mechanism and plate wear, plus seed size variation can cause considerable planting rate error.

When you start to plant, and again each time you change seed, uncover a few feet of row and measure seed spacing. Accurate measurement is important in confirming the seeding rate you selected.

If your planter is equipped with an *electronic seed monitor* capable of adjusting population as it goes through the field, take advantage of it! First, use the monitor to help you be sure the seeding rate is consistent. And secondly, consider using it to increase planting rates in the best soil areas and to reduce rates in poor soils and drouthy parts. In highly variable fields, this is usually more desirable than planting an average rate over the whole field.

But don't depend on the monitor entirely, for it gives only an approximate reading. Make some actual counts once or twice a day and

after each seeding rate adjustment. Uncover kernels in 10 feet of row, and measure the spacing between them.

CHECKING POPULATION LEVELS AND KEEPING RECORDS

Determining actual seeding rates, emerged stand or final stand in the field is relatively easy. Table 2 shows the lengths of row that are equal to 1/1000 of an acre when planting at various row widths.

To check on the seeding rate or plant population, merely count the number of seeds or plants within the appropriate row length from Table 2 for your row width, and multiply by 1000. It is important to check each row of the planter, because populations may vary substantially from one row to another. Repeat this procedure in at least five different places over the field to get an estimate of average population or seeding rate.

In making field checks on population, it is sometimes necessary to calculate the area counted. The following formula may be used at any time to determine populations:

$$\text{Plant population} = \frac{\text{No. plants counted} \times \text{Sq. ft. per acre}}{\text{No. rows counted} \times \text{Length of row counted} \times \text{Row width}}$$

Example: Assume 120 plants were counted in a 20-foot section of four rows spaced 30 inches (2.5 feet) apart. What is the estimated population per acre?

$$\text{Plants per acre} = \frac{120 \text{ plants} \times 43{,}560 \text{ sq. ft./A}}{4 \text{ rows} \times 20 \text{ ft./row} \times 2.5 \text{ ft.}} = 26{,}136$$

It is a good idea to double-check plant population several times during the growing season and at harvest to be sure your stands are as high as you intended. Be careful not to count tillers when making late-season checks.

Keep accurate records on all corn fields as to hybrid planted, planting date, seeding rate, emergence, final stand and yield. These data will be valuable in planning for future crops. After several years, you should be able to determine optimum planting rates for each field under your particular management system.

For additional publications on other aspects of corn production, contact your county Extension office.

Table 2. Length of Row for Various Row Widths in Which to Make Plant or Seed Counts for Population Check.

Row width	Length of row to equal 1/1000 acre
in.	ft.-in.
20	26-2
28	18-8
30	17-5
36	14-6
38	13-9
40	13-1
42	12-5

Procedure:

1. Measure appropriate distance for 1/100 acre corresponding to your row width.
2. Count number of plants (or seeds) in that distance.
3. Repeat procedure in at least five different places in the field to get an estimate of average population (or seeding rate).
4. Check each planter; they may be considerably different.

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