Calculating Standard Deviation

How do I find the standard deviation of plant spacing in my fields? It's actually quite easy. The only tools you need are a tape measure, a pencil, and some paper. We'll show you how to estimate the standard deviation in the field, and how to use a computer spreadsheet program to make an accurate calculation.

You'll first need to mark off 20 feet in a corn row. Choose a section that is representative of your field. Then record the actual distances between each plant.

If you're comfortable with a spreadsheet program such as Microsoft® Excel, just lay out the tape measure on the ground and record the locations of each plant—for example 0, 6, 15, 23, 26 inches, etc. List these values in the "A" column of your spreadsheet. (See example below). In the "B2" cell, type in the formula "=A2-A1", then drag that formula down along the measurements recorded in the "A" column (so that the next cell reads "=A3-A2", then "=A4-A3", etc.) Column "B" will then display the calculated plant spacing.

The formula for computing the standard deviation for your numbers can be written as: "=STDEV(B2:B30)" (See Cell B31 in Figure 1). The final number in the equation should represent the cell of the last recorded spacing that was measured—for example if you measured 30 plants, the equation would be "=STDEV(B2:B30)" The resulting value in that cell will represent the standard deviation for all the spacing you entered. A formula for calculating the average spacing is also shown in Figure 1, cell B32.

Figure 1
Example of Plant Spacing in Excel Spreadsheet

	(Location of plants)	(Calculated spacing)
	A	B
1	0	
2	6	=A2-A1
3	15	=A3-A2
4	23	=A4-A3
5	26	=A5-A4
	>	>
	<	<
27	34	=A27-A26
28	40	=A28-A27
29	49	=A29-A28
30	55	=A30-A29
31	Standard Deviation	=STDEV(B2:B30)
32	Average Spacing	=AVERAGE(B2:B30)
33	Coefficient Of Variation	=B31/B32*100

Repeat this measurement and calculation process in three more areas of the field and average the four standard deviation values to get a good representation of the field.

How to estimate your spacing standard deviation in the field. If you don't have access to a computer spreadsheet program, you can estimate the standard deviation with just paper and pencil. You'll need to make three columns on the paper, similar to what you see on Figure 2.

You'll again want to mark off 20 feet in a representative corn row. In the first column record the actual spacing between each plant—6, 9, 8, 3 inches, etc. In the next column calculate the plant spacing deviation from the spacing goal. In our example the spacing goal is 7 inches (30-inch rows, 30,000 plant population) so the second column becomes 1, 2, 1, 4, etc.

Next, create a third column, listing all of the 'deviations' from lowest to highest. The value that resides 2/3 down that third column will be a good estimate of the standard deviation.

Figure 2
Example of Estimating Standard Deviation in the Field

Measured spacing	Deviation from ideal (e.g. 7 inches)		Deviations sorted lowest to highest Standard Deviation will be the value 2/3 down the list
6	1		1
9	2		1
8	1		1
3	4		1
8	1		1
6	1		2
9	2		2
6	1		4
2	5		5

This example shows how you can estimate your spacing standard deviation with just a pencil and paper. *(Note: When actually collecting spacing on a 20-foot row you will have about 30 readings in each column.)*

Again, to get a true representative sample, you'll want to repeat this process in three additional field locations, and take the average of those four standard deviation values.

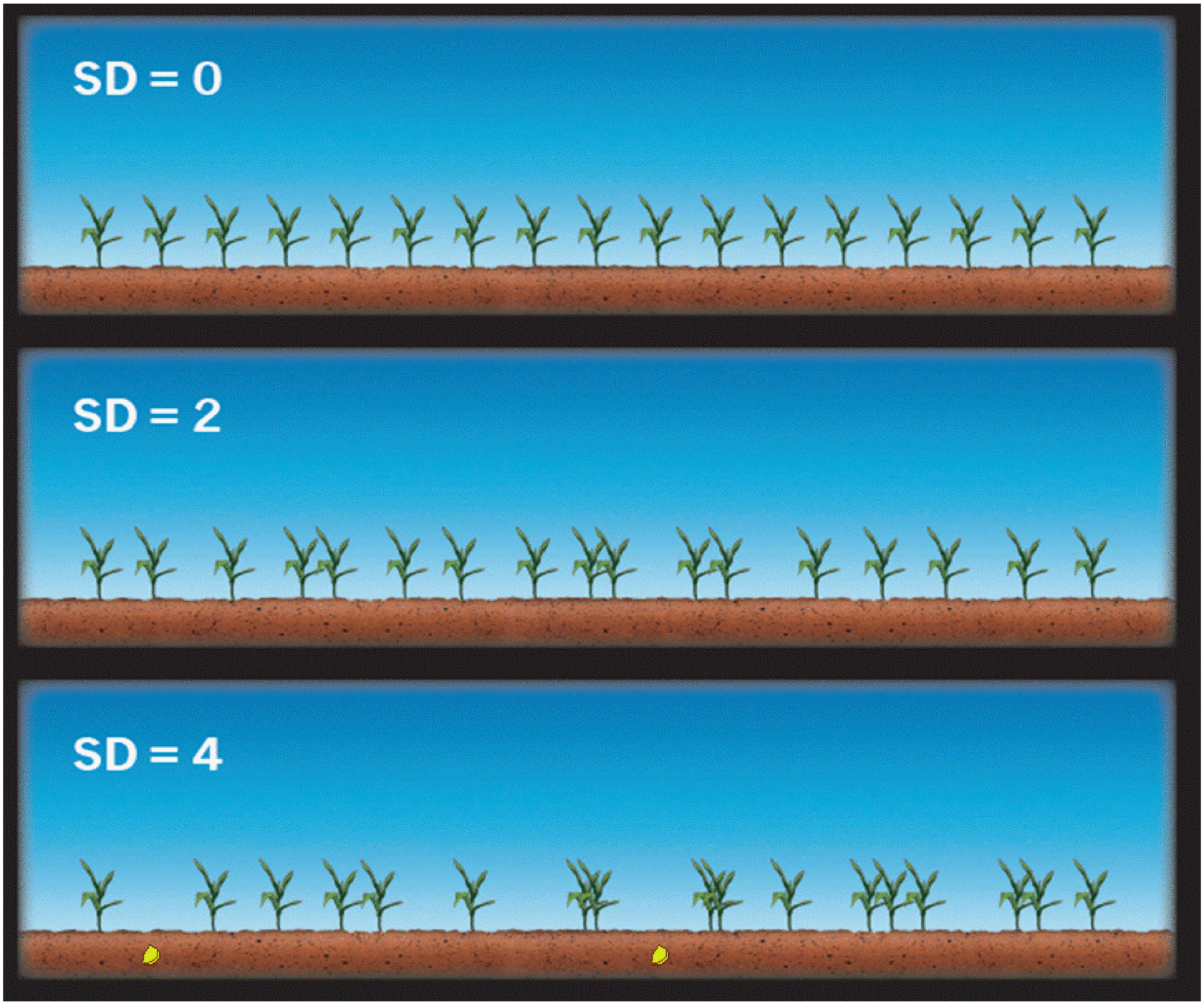
Remember, this field method just gives you an approximate standard deviation. It is best if you can calculate the actual standard deviation on a computer spreadsheet.

Plant spacing standard deviation examples:

Remember, not every seed successfully emerges. Even with perfect spacing, a 95-97% germination rate will result in a standard deviation of 2 inches due to seeds that did not grow. You will need to dig in the furrow to determine if a missing plant is the result of a meter "skip" or just unsuccessful germination.

Below are a few examples of what standard deviations of 0, 2, and 4 would look like in the field.

Figure 3



Coefficient of Variation

A formula for calculating the **coefficient of variation (COV)** is also shown in Figure 1, cell B33. Many experts will use coefficient of variation (the standard deviation divided by the average spacing) to gauge crop spacing. An advantage of coefficient of variation is the ability to compare field plots that are planted at different populations. Standard deviation of a field would decrease as population is increased even if the planting performance stays constant. However, COV stays roughly the same as population changes and planting performance stays constant.

Below are some examples of standard deviations converted to COV percentages. This information is based on planting 30 inch rows.

Figure 4

Coefficient of Variation Seed Spacing							
Seed Spacing (inches)	**Standard Deviation**						
	1	1.5	2	2.5	3	3.5	4
8.50	11.8%	17.6%	23.5%	29.4%	35.3%	41.2%	47.1%
8.25	12.1%	18.2%	24.2%	30.3%	36.4%	42.4%	48.5%
8.00	12.5%	18.8%	25.0%	31.3%	37.5%	43.8%	50.0%
7.75	12.9%	19.4%	25.8%	32.3%	38.7%	45.2%	51.6%
7.50	13.3%	20.0%	26.7%	33.3%	40.0%	46.7%	53.3%
7.25	13.8%	20.7%	27.6%	34.5%	41.4%	48.3%	55.2%
7.00	14.3%	21.4%	28.6%	35.7%	42.9%	50.0%	57.1%
6.75	14.8%	22.2%	29.6%	37.0%	44.4%	51.9%	59.3%
6.50	15.4%	23.1%	30.8%	38.5%	46.2%	53.8%	61.5%
6.25	16.0%	24.0%	32.0%	40.0%	48.0%	56.0%	64.0%
6.00	16.7%	25.0%	33.3%	41.7%	50.0%	58.3%	66.7%
5.75	17.4%	26.1%	34.8%	43.5%	52.2%	60.9%	69.6%
5.50	18.2%	27.3%	36.4%	45.5%	54.5%	63.6%	72.7%
5.25	19.0%	28.6%	38.1%	47.6%	57.1%	66.7%	76.2%
5.00	20.0%	30.0%	40.0%	50.0%	60.0%	70.0%	80.0%