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Corn Seeding Rates and Maturity Selection

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Overview

This module takes place in two sessions over a span of weeks.

- ***Activity #1 is best adapted to farms from northern Pennsylvania through New England. Conduct** it prior to planting, preferably prior to seed purchase.*
- *Activity #2 also takes place it prior to planting, preferably prior to seed purchase. It applies to all areas of the Northeast.*
- *Activity #3 goes with Activity #1 but takes place in the field after germination.*

Concept	Activity	Handouts
To select optimal seeding rates for corn, you need to understand the role of "yield potential" in determining harvest populations, the benefits of densely planted stands, and how planting dates and conditions affect drop rates.	#1: Preplanting Decisions on Seeding Rates	A. *Optimum Corn Seeding Rates: Grain and Silage*
To select the right hybrids for their farm and hedge their bets for the highest overall yields season after season, participants should understand how "growing degree days" determine season length and learn how to apply the 20/60/20 rule.	#2: About GDDs and the 20/60/20 Rule.	B. *Understanding Growing Degree Days (GDDs* C. *Northeast GDD Map)* D. *Planning Sheet for Corn Planting (optional)*
To plan for coming years, participants should evaluate their seeding rate plan by checking it against actual field conditions. *Ask participants to bring past records if they have them.*	#3: Verifying Plant Populations	E. *Plant Population Card*

Resources

Cornell Field Crops and Soils Handbook

Corn Management/Diagnostic Guide, Pioneer Hi-Bred International, Inc.

How a Corn Plant Develops, Iowa State University Coop. Ext.

Related topics

Module #2: Principles of Scientific Sampling

Here s what you ll do:

Beforehand

- Decide if you'll be doing all three activities or just the second.
- If you're doing activities 1 and 3, find a host farmer who's willing to schedule two sessions for this module, a couple of months apart.

Today, on site

- Learn how silage and grain corn respond differently to dense planting schemes;
- Learn how soil types influence optimum harvest populations;
- Choose and calculate a drop rate for a given soil type.

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ACTIVITY # 1: Preplanting Decisions on Seeding Rates

Setting	***Time Required***	***Materials***	***Handouts***
In a farmer s home, prior to planting preferably, before seed has been ordered *Group size: 2 to 10 or more*	*30 minutes*	*Your state s database of soil/yield relationships*	Optimum Corn Seeding Rates: Grain and Silage

Q:	***Pose a series of questions:*** ***A:***
What are the benefits of densely planted stands? *(See resources list.)*	Recent corn hybrids have been selected to perform well and produce maximum yields when planted densely.
Anything else?	Densely planted stands reduce weed pressure slightly—and lead to somewhat faster dry-down and earlier harvest for silage corn.
Why is weed pressure reduced?	Weeds controlled by herbicides or cultivation give corn an early start; the corn grows tall and shades the weeds.
Why faster dry-down?	The lack of sun through the canopy yellows and dries the stalks.
What is a field's yield potential? How important is it in deciding how densely to seed your crop?	Yield potential is the sum of all the factors that affect the quantity and quality of your harvest. It has to do with soil type, fertility, drainage, the date you planted, the field's rotation history—and the weather.
Too bad you never quite know till the end of the season what your yield potential was at the start. But… regardless of soil type or what the previous year's crop was, or how cold or wet the weather was at planting time—*except in droughty soils* higher planting densities provide higher yields. *Show charts or other data describing the relationship between soil type and yield potential from your state's soil database.*	
But doesn't soil type affect planting density?	Sure it does. Deep soils with good water-holding capacity can support greater corn populations than can sandy or shallow soils.

Q:	Continue the discussion:	A:
Why is silage corn typically planted at higher rates than grain corn?	Because it's harvested at a different level of maturity, silage can tolerate more competition for water and nutrients. And silage quality—fiber and digestibility—remain about the same (at densities below 35,000 plants per acre).	
Hand out the worksheet Optimum Corn Seeding Rates: Grain and Silage *Participants may fill out one or both pages, naming their fields in the second column of each table and determing the drop rate in the fourth columnaccording to whether they are using conventional or no-till planting methods. Go through them together, discussing each scenario as needed.*		
What's the function of the "drop rate"?	The drop rate accounts for the fact that some seeds won't germinate.	
How do you calculate drop rate—and why is it different for conventional and no-till fields?	To calculate, divide your target harvest population by the factor in the table. Seed-to-soil contact isn't quite as good under no-till conditions. *(With no-till corn planted late—as after hay harvest—it's better not to plan for the highest populations.)*	
If you plan to do Activity 3 after the corn is up, remind your host to hold on to the worksheet. *You ve got just one evaluation formfor this module either hang on to them and include impressions fromboth sessions, or photocopy an extra set for Activity 3.* *Remind everyone of the next class.*		

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Corn Seeding Rates and Maturity Selection

ACTIVITY # 2: About GDDs and the 20/60/20 Rule

Setting	Time Required	Materials	Handouts
In a farmer s home, preferably with a table to work at. Prior to planting best before seed has been ordered. *Group size: 2 to 10 or more*	*30 minutes*	*Pencils, clipboards and calculators* *Scrap paper*	Understanding Growing Degree Days (GDDs) Northeast GDD Map Planning Sheet for Corn Planting (optional)

Q:	*Pose a series of questions:* A:
Under what range of temperatures does corn grow best?	Below 50°F and above 86°F, corn growth just about shuts down, especially if it’s dry. Between those temperatures you get steady growth, with 80°F being about optimum.

Hand out Understanding Growing Degree Days (GDDs) *and* the Northeast GDD Map.

Give this simple explanation of Growing Degree Days (GDDs) as it relates to corn growth:

The GDDs concept lumps together corn-growing temperatures (that is, temps above 50¡F but below 86¡F) for an entire growing season. This gives you a measure of how corn maturities match your climate. (Actually, there are two GDD methods used for corn, but this is the most common and recommended method.)

- *Work through the example to show how degree days accumulate for corn.*
- *Using the* Northeast GDD Map, *estimate the expected GDDs for your farm.*

Use the chart (Average GDD accumulations) *to explain that corn varieties are ranked as early-, mid-, or late-season according to how many total GDD hours are required to bring them to maturity.*

- *Discuss how estimated GDDs may help participants select corn varieties.*

Exercises 2 and 3 are optional; do them at the end of the activity.

Is a corn variety that’s rated as mid-season by a seed company or agricultural experiment station always going to perform as a mid-season corn for you?	Maybe not. Your microclimate may be different than one just a few miles away. Each season is different, too. And even a few days’ variation in the growing season can influence whether or not corn ripens on time.
Given so much variation from one season to the next, and taking into account which of your fields are ready to plant early and which aren’t workable till late in the spring, what are possible planting schemes that will hedge your bets and virtually guarantee good yields—on time?	Go by the 20/60/20 rule: 20% full-season, 60% mid-season, 20% early-season.

Q:	Continue your series of questions:	A:
And the 20/60/20 rule is…	Plant fields you can get into first with full-season corn. Plant the fields you have to plant late with a short-season corn. Plant everything else with a mid-season corn. Harvest the earlies first, then mids, then lates.	
If we plant late ones first and early ones last, won't that be the order of harvest?	Actually, the hybrid maturity spread will override the order you planted them in (assuming a typical year). You'll maximize production by giving full-season hybrids as much time to mature as possible.	
Designate varieties as full-, mid-, and early-season corn according to your experience and your seed salesperson s experience.		
What if we need silage very early?	Consider planting some acreage of early season hybrids in your earliest fields for late summer or early fall feedout.	
Will the yields of full-season corn, planted early, be higher than yields for mid-season corn—or for full-season corn planted later? If so, how much greater?	Yes…that's usually the case… and yields are 10 to 15 bushels higher.	
Do you need to plant at a different rate when you plant early?	Yes. It's cooler early on, so the corn doesn't germinate as well. Plant early-seeded full-season corn at rates 10 to 15% higher than what's recommended for the soil type.	
What if the soil is wet?	Hold off. Planting early into compacted soil reduces yields substantially.	
How early is early for planting corn?	*Answer depends on your region:* ________________________	
What's the latest you can plant a full-season corn?	*Answer depends on your region:* ________________________	
How late can you plant mid-and early-season corn?	*Answer depends on your region:* Mid-season: ____________________ Early-season: ____________________	
What planting strategies would you use for a really wet spring and early summer?	If it's so late that even an early-season corn won't fill in the ears, plant late-season corn and harvest as silage. Or switch to annual forage crops such as sorghum-sudan crosses, sudangrass, or millets.	
Optional: hand out the Planning Sheet for Corn Planting *and have people assign fields to early-, mid-, and late-season corn using the 20-60-20 rule.* *If there s time and interest, go through parts 2 and 3 of the GDD worksheet. People who find the exercise too academic are welcome to leave but not before you ve reminded them of the next class in the series, and set a date for coming back to check how well the planting plan worked.*		

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ACTIVITY # 3: Verifying Plant Populations

Setting	***Time Required***	***Materials***	***Handouts***
In a farmer s field after the corn has emerged. Host farmer should have the worksheet, Optimum Corn Seeding Rates: Grain and Silage *from Activity 1, with answers for grain and/or silage.* *Group size: 2 to 10 or more*	*30 minutes*	*String, stakes, measuring tapes*	Plant Population Card

Q:	***Pose a series of questions:***	***A:***
Explain that we ll be sampling planting densities and finding out how many plants there are in several representative plots scattered throughout the field to see how well our seeding plan actually worked. Each plot will equal 1/000 of an acre.		
Ask the host farmer: What was your target population?		*Go through the math again as a refresher, so that everyone remembers how we got here.*
Why should we randomize our starting point?		It has to do with the importance of being unbiased that we discussed earlier in this series.
How do we randomize our starting point?		Avoid field margins and headlands… avoid the best or the worst in the field… when you get to an what seems to be an average stand, look away, then push your marker into the soil.
Why do we need to count a number of plots scattered throughout the field, preferably on the classic zigzag “W” pattern?		It’s another technique to reduce bias.
What else might skew our counts? *Hint—what about those “turn-around” rows? It’s not always easy to control just where and when we turn at the field’s end.*		In a wide field with a small planter, a different guess row (turn-around row) distance can affect how many plants are in the field… and thus our ability to discover how well our pre-season targets—intended for ideal conditions—match reality.
Now it s time to actually check those calculations. Grab the stakes, the string, and the measuring tape hand out the Plant Population Cards *and have at it.*		

Use these instructions to fill out the Plant Population Card:	
1. Measure across several rows (equaling the number of boxes on the planter) to determine the average distance between rows. *Reminder: Don't include stats on the guess rows!* Confirm with the host farmer that the result matches the equipment setup (the spacing of planter boxes).	***2.*** Use the chart on the *Plant Population Card* to determine, for this average row spacing, how much of each row to measure off in order to determine planting density in 1/1000 acre. The group will measure and mark (with string and stakes) this distance in as many rows as equal planter boxes.
3. Assign one row to each participant. Count the plants in each row for the marked distance.	***4.*** Match planter box/rows to rows on the card. You must know which way the planter was going to avoid confusing the outside and inside planter boxes. Record in column 1.
5. Continue to other sites ("W" pattern); record several counts. If possible, continue to match rows with particular planter boxes. (Which, frankly, isn't very easy to do.)	***6.*** When all samples are taken, compute the row average and place it in the far right column of the data card. Add together and compute field average. Multiply by 1000 to determine the planting rate for the field.

Q:	***A few last questions***	***A:***

Answers will vary

- Does the population match the farmer's target?
- If so, is the target a good one? *[Review part 1 of this module.]*
- Are any rows (corresponding to planter boxes) consistently too high or too low?
- Does the box need calibrating?
- If the target is off, what changes can be made? *[Possibilities: planter calibration, soil preparation, seed depth, moisture problems, pest problems.]*

If there are no fields left to plant, write down the adjustments for next year.

And a reminder:

- Record your data!
- Maintain your data!
- Share your data!
- Know where to find it next year!

A. *Optimum Corn Seeding Rates: Grain and Silage*

Worksheet for Activity 1

Grain:

Fill in your field name(s) as according to soil type. Select your target within the range of recommended harvest populations. Determine the drop rate (tilled ***or*** no-till).

Soil Conditions	***Field(s)***	***Target Population at Harvest***	***Drop rate***
Very deep loams and silt loams with high moisture-holding capacity ***and*** Well- to moderately well-drained loams to clay loams		Recommended: 28,000-30,000 26,000-28,000 yours:______	(0.9 for tilled fields) (0.85 for no-till) yours:_________
Sandy loams, clays, or somewhat poorly drained loams to clay loams		Recommended: 24,000-26,000 yours:______	yours:_________
Droughty soils, including very gravelly, sandy, or shallow soils		Recommended: 24,000-26,000 yours:______	yours:_________

Silage

Fill in your field name(s) as according to soil type. Select your target within the range of recommended harvest populations. Determine the drop rate (tilled *or* no-till).

Soil Conditions	***Field(s)***	***Target Population at Harvest***	***Drop rate:***
Very deep loams and silt loams with high moisture-holding capacity		Recommended: 32,000-34,000 yours:______	(0.9 for tilled fields) (0.85 for no-till) yours:_________
Well- to moderately well-drained loams to clay loams		Recommended: 30,000-32,000 yours:______	yours:_________
Sandy loams, clays, or somewhat poorly drained loams to clay loams		Recommended: 28,000-30,000 yours:______	yours:_________
Droughty soils including very gravelly, sandy, or shallow soils		Recommended: 26,000-28,000 yours:______	yours:_________

B. *Worksheet: Understanding Growing Degree Days (GDDs)*

Worksheet for Activity 2, p.1

Temperature is the major factor that determines the development and maturity of corn. Corn grows best at temperatures above 50° but below 86°. So if you add up—by the day or week or month or season—all the degrees in each day that fall between 50 and 86, *MINUS the base temperature (50°)*, you've got the accumulated Growing Degree Days for that time period.

Here s how you do it for one 24-hour period:

Add the day's low to the day's high (the high being no more than 86°). Divide by two to get the average temperature. Subtract 50°. The result? Your accumulated GDDs for that day.

In other words:

$$\frac{\text{Daily maximum temperature + daily minimum temperature}}{2} - 50 = x \text{ GDDs}$$

REMEMBER: if the day s high is over 86¡, use 86¡ for your daily max.

Exercise I:

Calculate the GDD for each of these three days: *(use scrap paper)*

High 78°, low 65° High 94°, low 72° High 61°, low 47°

$\frac{\_\_\_\_\_ - \_\_\_\_\_}{2}$ -50 = ____GDD $\frac{\_\_\_\_\_ - \_\_\_\_\_}{2}$ -50 = ____GDD $\frac{\_\_\_\_\_ - \_\_\_\_\_}{2}$ -50 = ____GDD

- *What are your accumulated GDDs for this three-day period?* ___________ GGDs

Pretend that the daily temperatures repeated in this three-day sequence for the whole month of June.

- *What are your accumulated GDDs for the month?* __________ GDDs x 10 (there are ten 3-day sequences in the 30 days of June)

To estimate the season s expected GDDs for your farm:

- *Find your location on the* Northeast GDD Map. _________
- *Add 100 GDDs if you are on a valley floor or other area that warms up fast.*
- *Subtract 100 GDDs if you are on a high hill or in a frost pocket.*

Result: _________

Average GDD accumulations needed for corn development stages

Growth Stage	***80 day (early)***	***95 day (mid)***	***110 day (late)***
Emergence	~110	~ 110	~110
Silk Stage	~1,100	~1250	~1400
1/2 Milk Stage (optimal silage harvest)	~1800	~2100	~2400
Maturity	~1900	~2200	~2500

B. *Worksheet: Understanding Growing Degree Days (GDDs)*

Worksheet for Activity 2, p.2

Exercise II (optional):

To determine what s a full-, mid-, or early-season corn for your farm:

Refer to the estimated GDDs for your farm (from Exercise I).

‹ Full-season grain corn is exactly the estimated GDD.

` Silage corn is harvested at 1/2 –milk-line stage and doesn’t need as many GDDs. Subtract 100 GDDs from ‹ to compensate.

´ Mid-season grain corn requires 200 -300 fewer GDDs to mature. Subtract 200, then 300, from your farm’s estimated GDDs.

ˆ Subtract 100 from ´ for mid-season silage corn.

Early-season graincorn requires even fewer GDDs to mature. Subtract 300—or more—from your farm’s estimated GDDs.

— Subtract 100 from for early-season silage corn.

	Grain	***Silage***	***Season length:*** (from Exercise III, below)
Full-season: Total expected GDD =	‹ _________ GDD	` (-100) ________ GDD	________
Mid-season: total expected GDD less 200, to total expected GDD less 300) =	´ _________ to _________ GDD	ˆ (-100) ________ to ________ GDD	________
Early-season: total expected GDD less 301 (or more) =	_________ GDD	— (-100) ________ GDD	________

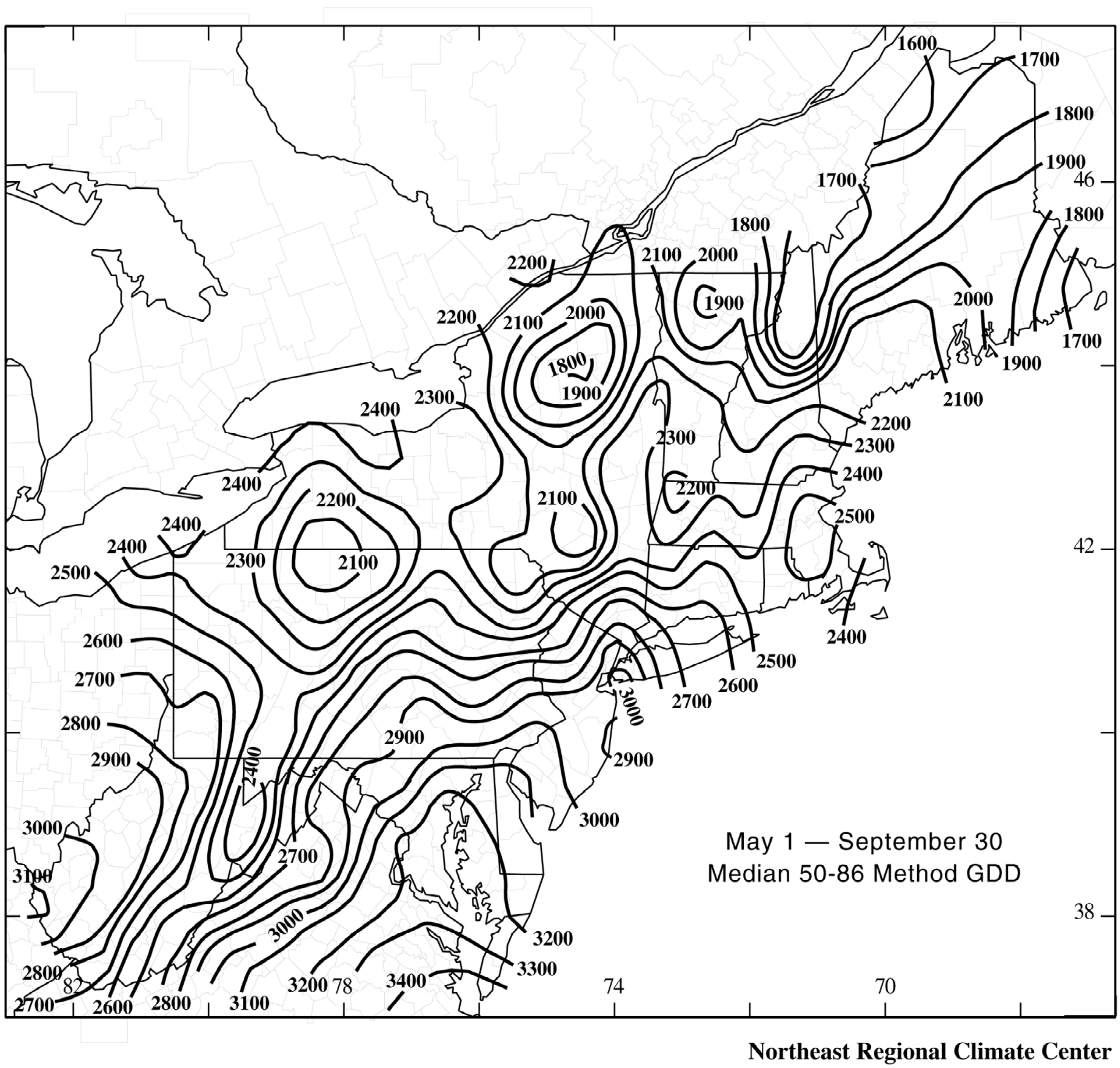
Exercise III

Match your GDDs to a maturity unit: Seed companies and research institutions sometimes use different methods of calculating GDD requirements for corn hybrids. You can convert to season-length requirements with this table:

GDDs available on your farm	***Season length***	***GDDs available on your farm***	***Season length***
2350 — 2450	110 -day	1850 — 1950	85 -day
2250 — 2350	105 -day	1750 — 1850	80 -day
2150 — 2250	100 -day	1650 — 1750	75 —day
2050 — 2150	95 -day	1550 — 1650	70 -day
1950 — 2050	90 -day		

C. *Northeast GDD Map*

Handout for Activity 2



D. *Planning Sheet for Corn Planting*

Optional Worksheet for Activity 2

Fill in target acres for each hybrid maturity class according to the 20-60-20 rule and using the following order:

1. List cornfields by planting time, with your earliest field first and your latest field at the end. Note the acres of each field. (It isn't necessary to determine precise rankings between similar fields.)
2. Starting with the earliest field, assign fields to full-season (F) corn. Keep track of the running total (acreage). Stop assigning fields to full-season when the target is reached.
3. Starting with the next available field, assign fields to midseason (M). Start a new running total. Stop assigning fields to "midseason" when its target is reached.
4. Continue assigning fields to short season (S).

- *Total acres in corn:* ______________
- *Target acres full season:* _______________
- *Target acres mid-season:* _______________
- *Target acres short-season:* ______________

Season Running

Field ID *Acres* *(F,M,S)* *Total Acres*

(First Planted)

Field ID *Acres* *(F,M,S)* *Total Acres*

(Last Planted)

E. *Plant Population Card*

Worksheet for Activity 3

Date: ______________ Growth Stage: ______________ Plant Ht. ______________

Procedure: In alfalfa use a 2 sq.ft. sampling frame to sample at least 10 areas of the field. Count number of alfalfa crowns/ 2 sq. ft.
In corn, sample 1/1000 acre units. Count number of plants/row distance for 1/1000 acre.
It is recommended that you sample all rows of the planter. Make sure you record the size of your sample unit.

Sample	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average / Sq.Ft. or Acre**
R1											
R2											
R3											
R4											
R5											
R6											

Sampling Unit: ______________

Comments:

Conversions:

Row Spacing (inches)	1/1000 Acre
30	17ft. 5 in.
32	16ft. 4 in.
36	14ft. 6 in.
38	13ft. 9 in.
40	13ft. 1 in.

In alfalfa, Average ÷ Sample Sq. Ft. = Plants per Square Foot

In corn, Average Count X 1000 = Plants per Acre

Map:

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Module Feedback

Corn Seeding Rates and Maturity Selection

Tell us a little about yourself:

I m a	*My commodity area is:*
♦ Farmer ____________	♦ Dairy and field crops ____________
♦ Crop advisor ________	♦ Vegetables ______________________
♦ Industry rep _________	♦ Fruits and berries ________________
♦ Extension educator ___	♦ Greenhouse and nursery stock _____
♦ Other ______________	♦ Other ___________________________

Let us know what you think:

What part of the workshop was most interesting for you?
What part of the workshop was most valuable to you?
What two new ideas would you like to try on your farm or in your business?
Do you feel you understand IPM—and how to use it—better now?
What other information should be included in this module?
What other topics would you like us to cover in future modules?

Teachers, please fill out an evaluation as well. Photocopy and send all informative evaluations to:

NE-IPM Modules, NYS IPM Program, Box 28 Kennedy Hall, Cornell University, Ithaca NY 14853