



Green and Growing

4H 381B January 2004

Note to the Project Helper



What a wonderful opportunity you have in store for you! A 4-H'er has asked for your help to explore the world of crop production; this includes as many learning experiences for you as for the 4-H'er. As a project helper, you don't need to know all the answers; you only need to know how to help the 4-H'er discover the learning process and find information to help answer the questions. You will be guide, teacher, and mentor as you explore crop production together. You may learn much more about yourself and your 4-H'er while you both learn more about corn and soybeans. Remember that the goal of 4-H is to help youth develop life skills such as leadership, communication, information seeking, and confidence building in themselves; the 4-H crops project is simply the tool to help develop these skills.

As a project helper, you should become familiar with these materials so that you can guide the 4-H'er through the learning experience. You also should help the 4-H'er learn the importance of setting goals and recording the learning experience. Your support and encouragement in following the experiential learning model will both strengthen the member's learning experience and provide the much needed support of a caring adult. The 4-H'er will know you are a trusted friend who offers support through 4-H and other life experiences.

This manual is based on the experiential learning model, in which you do an activity, reflect on what was done and learned (also called sharing), and think about ways to apply what was learned to other real life experiences. By learning experientially, youth have more fun, retain their learning longer, and are better able to apply their learning experiences to new situations. Your role is to help youth share what they learned and guide them in applying what they learned to new situations. The **4-H Crop Project—Soybean and Corn** is divided into three levels. Level one is intended for youth in grades 4 to 6, Level two for youth in grades 7 to 8, and Level three for youth in grades 9 to 12. However, youth may work through these levels as fast as they would like. You also may want a computer companion CD that includes more activities and up-to-date crop industry information. The CD will be updated more frequently with new research, new products, and new information.

Thank you for your commitment of time and talent to the 4-H'ers in your life. We hope you enjoy learning with your 4-H'ers, and serving as a mentor for them! What a wonderful opportunity to positively influence the lives of today's youth and tomorrow's leaders!



IOWA SOYBEAN
PROMOTION BOARD

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Welcome

INTRODUCTION

Welcome to the 4-H Crop Project Guide. This guide is intended to help you learn the basics about crop production and careers related to crop production.

Here are some of the things you will learn.

- ▮▮▮ More about soils and nutrition
- ▮▮▮ Selecting the right seed
- ▮▮▮ Planning for a crop season
- ▮▮▮ More plant pests
- ▮▮▮ New uses for soybeans and corn
- ▮▮▮ All about setting goals, making good decisions, communicating to others about what you have learned, and exploring how to learn more about crop production.

You've already learned many basics of plant growth, pests, and environmental management. Now is the time to challenge yourself to learn more about how nutrition, pest management, and the environment can affect your cropping operation.

- 1 What are your intermediate goals for the crop project? _____

- 2 What activities do you plan to participate in to further your knowledge about crops? _____

- 3 What exhibits would you like to share with others or take to the fair? _____

Soyfoods contain all nine essential amino acids.

Did you know?

- 4 What information would you like to share with others through a presentation or working exhibit?

- 5 What new information do you need to include in your crops record keeping system? _____

- 6 What careers would you like to explore and learn more about? _____

Fun Fair Exhibit Ideas

Here are a few ideas for fair exhibits, but you will find many more in each activity.

- ▀▀▀ Compare different seed varieties or hybrids; plant growth; effects of planting date, rate, depth, or spacing; effects of herbicides, insect damage, etc.
- ▀▀▀ Measure crop residue for several neighbors, compare the differences based on tillage used.
- ▀▀▀ Dream of a new use for corn or soybeans and discuss its potential with others.
- ▀▀▀ Plant your own crop plot with an adult.
- ▀▀▀ Enter a grain quality contest with grain you raised.
- ▀▀▀ Scout a field for pests, record what you see, determine if they are at an economic threshold.
- ▀▀▀ Develop a soil conservation/water quality display.
- ▀▀▀ Take pictures of soil profiles at construction sites and roadsides, soil erosion, crops and production operations for a county fair display.

Agronomy is the study of crops, soils, and atmospheric sciences.

Did you know?



Agronomy Online

Visit the Iowa State University (ISU) Agronomy Department Homepage,

www.agron.iastate.edu

That All-Important Soil

CHAPTER 1

Understanding Soil

Our state is well suited for crop production because of the climate, topography, and productivity of its soil. Understanding soils is necessary in order to conserve soil and to be able to achieve top yields.



Why Worry about Soil?

What effect does soil have on how plants grow? Try this experiment to see.

Materials

Four containers with drainage holes
Four types of soil
Seeds
Clear plastic bags or plastic wrap

- 1 Get four containers of equal size. (Each should hold a gallon—cut-off gallon milk jugs or ice cream buckets will work.) Punch drainage holes in the bottom of the containers if no drainage holes are present. Label the containers a, b, c, and d.
- 2 Fill each container with the soil listed below.
 - a. Surface soil from a field or garden
 - b. Subsoil from the same area (This is taken from a depth below an observable change such as color, texture, or structure.)
 - c. Sand
 - d. Well-fertilized garden soil
- 3 Plant six seeds of corn or soybeans 1 ½ inches deep in each container. Water the soil, and cover the containers with a clear plastic bag or plastic wrap. Set the containers in a warm, well-lit place. When the seeds germinate, remove the plastic covering. Record the number of seeds that germinate in each container.

Sandy soils do not hold much water and have a low ability to store plant nutrients.

Did you know?



- From which soil did the most seedlings emerge? What are some of the reasons this happened?
- From which soil did the fewest seeds germinate? What are some of the reasons this happened?
- Which soil grew the tallest plants? Why?
- Did any of the plants appear yellowish or brown in color or die? Why?
- Which soil would you conclude is best for growing plants? Why?

- 4 Keep the soil moist. Once a week for the next six weeks, record the height of the plants in each container.

Sample	a	b	c	d
Date Germinated				
Week 1 Height				
Week 2 Height				
Week 3 Height				
Week 4 Height				
Week 5 Height				
Week 6 Height				



Project or Exhibit Ideas

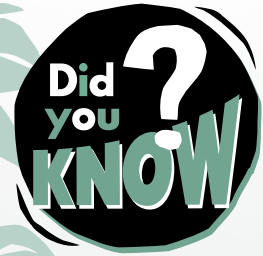
- 1 Create a display showing the different growth rates from different soil types. Explain the differences.
- 2 Keep a journal comparing the rate of plant growth in different fields or different areas of your garden.
- 3 Draw a comparative picture of the plants from different soil types at each week's timeline.
- 4 Do an educational presentation on the effects of different soils on plant growth.

The Make-up of Soil

- Soil is the result of rocks being broken down over a very long period of time by climate and vegetation. Soil contains air, organic matter, water, and living organisms. Soil also provides nutrients for plants.
- Soil is made up of four parts
 - small mineral particles,
 - organic matter (both living organisms and decaying plant material),
 - air, and
 - water.



- ||| A typical silt loam soil is about half mineral and organic material, and half air and water. Immediately after a rain, there may be very little air in the soil; after the soil drains and as plants remove water from the soil, air moves into the spaces where water was.
- ||| The **mineral particles** come from rock material. They develop slowly into soil particles over hundreds to thousands of years. Heat, cold, water, wind, as well as plants and animals help break rock into mineral particles. The original mineral particles of a soil, called parent material, may have developed in their current location, or they may have been moved to the location by glacier, wind, or water. We need to work hard to protect our soil from erosion because it takes so very, very long to form that it is almost a nonrenewable resource.



- ||| The parent materials making up most Iowa soils are called glacial drift, loess (pronounced "luss"), and alluvium.
- ||| Glacial drift is material deposited by glaciers thousands of years ago.
- ||| Loess is a silty material that was blown by wind and deposited.
- ||| Alluvium is material moved and deposited by water.



Soil Bits and Pieces

All soil is made up of three sizes of mineral particles—sand, silt, and clay. The proportion of different sized particles determines the texture of the soil. Soil texture can be fine, medium, or coarse. In this activity you will compare these three particles to better understand the differences in each.

Materials

- Sand, flour, and modeling clay
- Bowl or bucket
- Measuring cup
- Jar or clear container with lid
- Water

- 1 Rub some sand between your thumb and finger. (You can use sand from a child's sandpile.) Note that sand feels distinctly gritty. This is the way a sandy soil feels. Now rub some flour between your thumb and finger. This is the way a silty soil feels. Finally, rub some modeling clay between your thumb and finger. This is the feel of a clay soil.
- 2 Mix flour and sand together in equal amounts and rub the mixture between your thumb and finger. Try other combinations of flour and clay to become familiar with the feel of different amounts of the two.
- 3 Collect several soils from four different areas and number the soils 1, 2, 3, 4. Rub them between your thumb and finger. Classify them as sand, silt, or clay. You should now have the "feel" of soils and be ready to classify soils by texture.

Clay soils can be so wet that root growth is restricted.





- 4 Double check your guesses by putting some of your soil sample in a jar, filling it with water, and shaking well. Let it set a few hours and observe how the soil particles settle out. Record your observations.

- ▮▮▮ Why can you feel the difference between differing soil textures?
- ▮▮▮ What particles settle to the bottom of the jar? What particles settle toward the top? Why?
- ▮▮▮ Were the differences in the soil samples more obvious by feel or by how they settle out in water?
- ▮▮▮ What would be the “just right” combination of sand, silt, and clay to produce the best crops?
- ▮▮▮ How would you expect soils to feel that were on a hilltop versus in a valley?
- ▮▮▮ If you wanted to build a pond on your land, what would be the “just right” type of soil?

Soil Sample	Feel	Observations after Settling Out	Estimated Texture Classification
EXAMPLE	Feels like flour	The top layer is the largest of the three layers	Mostly silt
1			
2			
3			
4			

Project or Exhibit Ideas

- 1 Do a working exhibit to show people the difference between sand, silt, and clay.
- 2 Create an exhibit showing the different types of soil particles.
- 3 Explore all the different soil combinations on your farm.
- 4 Discuss with your Farm Service Agency officer what soils on your farm are best suited for cropping, ponds, etc.



Soils

Soil Texture



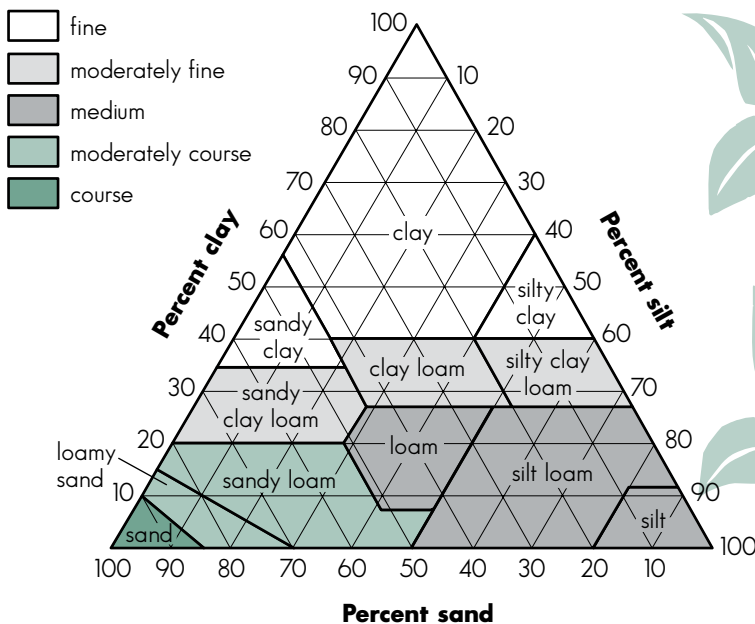
- Very few soils are pure sand, pure silt, or pure clay. Rather, most soils are a mixture of two or three particle sizes. The categories are named using the terms sand, silt, clay, and loam. Loam is a soil that has some of the properties of sand, some of the properties of silt, and some of the properties of clay.
- The United States Department of Agriculture **textural** triangle is used to determine in which textural category a soil will be placed. For example, if a soil has 40 percent sand particles, 40 percent silt particles, and 20 percent clay particles, the soil scientist could find 40 percent on the base (sand) of the triangle, and follow the line upward and to the left. The scientist could then find another 20 percent on the left (clay) side of the triangle and follow that line straight to the right. The point at which the two lines intersect is in the loam texture. Note that if you find 40 percent on the right (silt) side of the triangle and follow that line down and to the left, it meets both of the other lines at the same point.



Textural Categories

Soils are placed in one of twelve textural categories based on the percentage of each soil particle size in it. The categories, from most coarse to finest, are

- sand
- loamy sand
- sandy loam
- loam
- silt loam
- silt
- sandy clay loam
- clay loam
- silty clay loam
- sandy clay
- silty clay
- clay



Soil textural triangle.

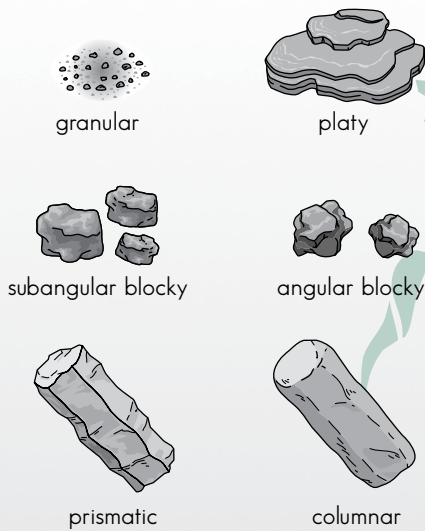
Taken from the Soil Survey of Scott County, Iowa.

Particle Sizes

- Sand = 0.05 mm–2.0 mm in diameter
- Silt = 0.002 mm–0.05 mm in diameter
- Clay < 0.002 mm in diameter

Proportional Comparison

If a clay particle were about the size of a pingpong ball, that would make the silt particle about the size of a baseball, and the sand particle about the size of a basketball.



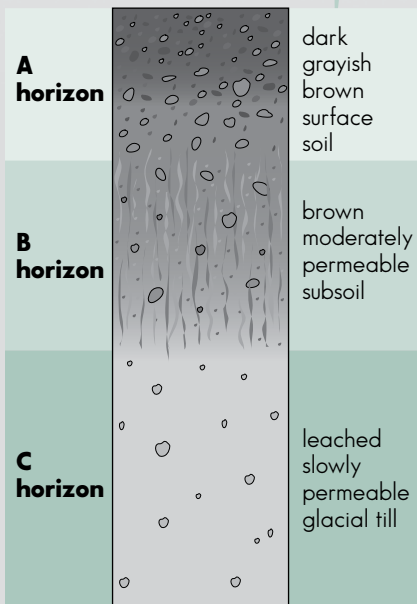
Soil peds.

Based on *Soils and Soil Fertility*, Fifth Edition, by Frederick R. Troeh and Louis M. Thompson, Oxford University Press.

Soil Structure

Soil particles tend to stick together to form small clumps, or **peds**, that are easily broken when you squeeze them between your thumb and finger. Decaying organic matter provides the glue that binds these particles together in peds. The shape these peds have is called structure. The illustration *Soil Peds* shows soil structures commonly found in topsoil and subsoil. A soil with good structure will have more large, open pore spaces, which help drain excess water and provide a good opportunity for air to enter the soil; this is especially important in soils with moderate to high amounts of clay. If soil structure is destroyed by excessive tillage, by tilling when it is too wet, or by driving over soil repeatedly, it is more difficult for air, water, and plant roots to move through the soil. A granular structure is generally the best for plant growth.

Soil has three layers, called **horizons**. Topsoil, often called the A Horizon, is the organic matter enriched layer that extends from the ground surface down to the subsoil. Organic matter (OM) contains material that helps bind individual soil particles into aggregates, promoting soil structure. Therefore, developed soil structure is found in the A Horizon and, to a lesser degree, in the B horizon. The subsoil (B Horizon) is the layer beneath the topsoil and lies on top of the parent material (C Horizon). The C Horizon has little or no soil structure. Beginning at the soil surface, as you move down, you may notice that the color, texture, or structure of the soil changes at certain places; this point is where one horizon ends and the next begins. The percent organic matter, internal drainage, and age determine a soil's color.

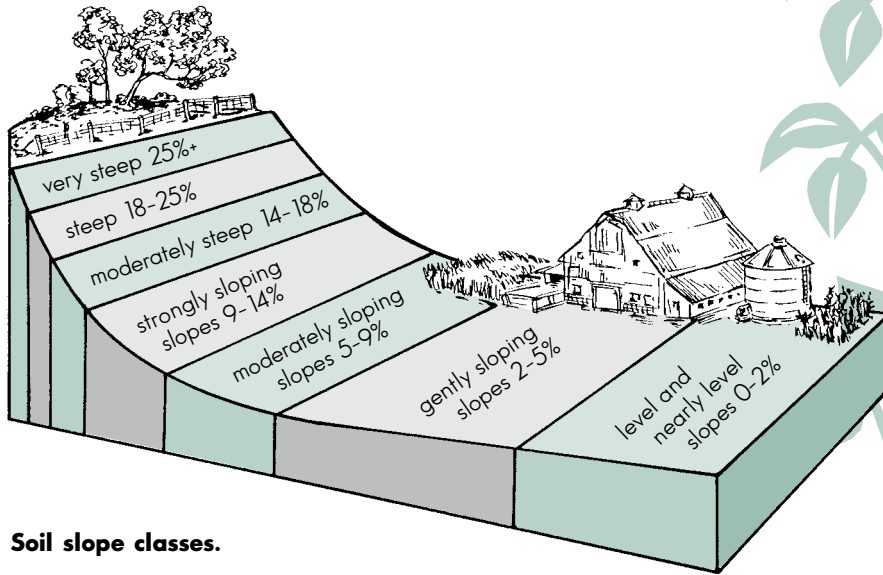


Soil horizons.

Based on *Soils and Soil Fertility*, Fifth Edition, by Frederick R. Troeh and Louis M. Thompson, Oxford University Press.

Topography—Those Hills and Valleys

Slope is another property to consider in row crop production. Slopes may be gentle or steep, short or long. Slope characteristics influence soil productivity, surface water runoff, soil erosion, and land use. Soils with steeper and longer slopes will tend to erode more easily. Nearly 60 percent of Iowa farmland occupies slopes of 5 percent or less.



Soil slope classes.

Soil Descriptions

- Soils are divided into soil types. In order for two soils to be called the same soil type, they must have the same color, texture, structure (in all three horizons), and similar slope. Iowa soils are grouped into 21 major soil associations. Each association is made up of two or more major soil types. Each association includes some of the most productive, as well as some of the least productive, soils in Iowa. For example, in the Clarion-Nicollet-Webster soil association, the Nicollet soil type (loam) is more productive than the Sparta (loamy fine sand).
- One way in which soils are compared to each other is by using the Corn Suitability Rating (CSR). A CSR has been developed for every soil in Iowa. The CSR ranks each soil type for its potential row-crop productivity, adjusted for how difficult it is to manage the soil. The CSR considers average weather conditions as well as how often the soil can be used for row crop production. Your county assessor also uses CSRs to determine the property taxes for your farm. Ratings range from 100 (for soils that have no physical limitations, occur on minimal slopes, and can be continuously row cropped) to as low as 5 for soils with severe limitations for row crop production. CSRs for soils in your area can be found in the county soil survey report or a supplement to the soil survey report, depending on your county. These are available at your county office of Iowa State University Extension or the Soil and Water Conservation district office.

The most productive soils usually are loams, silt silty clay loams.

Did you know?

Field Preparation and Tillage

CHAPTER 2

Field Conditions

For corn and soybeans to germinate and grow successfully, they must be planted in soil that is warm, moist, and well aerated. A well-aerated soil has plenty of airspaces between the soil particles. The soil texture must be fine enough so that the soil and the seed can have close contact during planting. You should choose a tillage system that does three things: (1) helps control weeds, (2) reduces soil erosion, and (3) provides a good germination environment for the seed.

When you choose tillage and planting methods, you also will need to consider whether the land is level or rolling, the texture of the soil, whether the soil is fine (contains a lot of clay) or coarse (contains a lot of sand), and the wind or water erosion problems of the field. Some tillage options might include no-till, zone-tillage, minimum tillage, or traditional tillage methods.



The Soil Saver

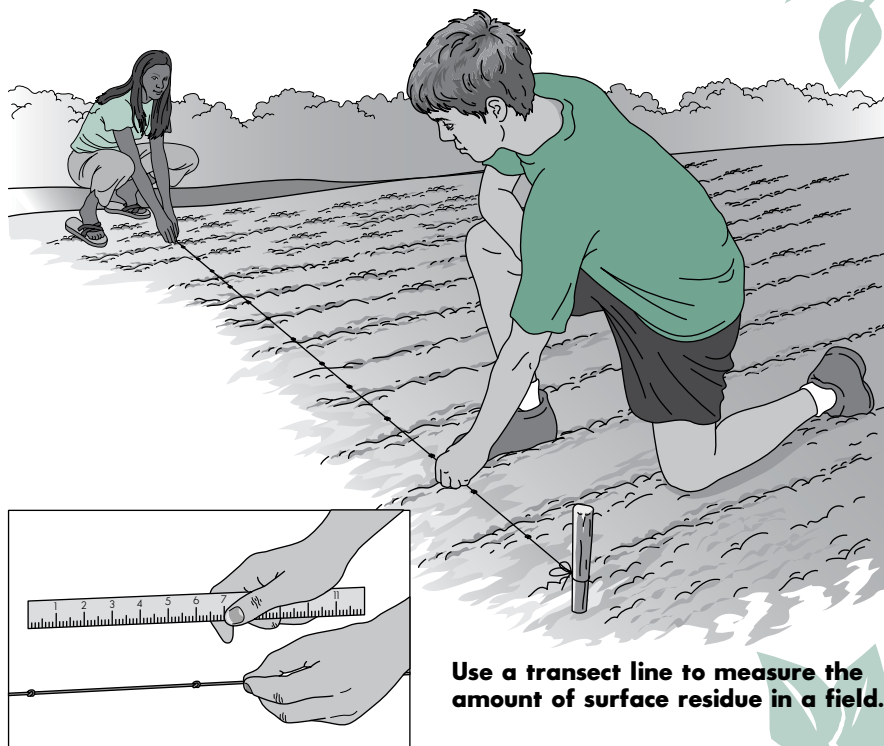
Crop residue is the old plant material that remains in the field after harvest. This residue is pretty important stuff. It adds organic matter to your soil and helps reduce soil erosion. In this activity you will learn how to measure crop residue on the soil surface. You could take residue counts after harvest, after each tillage operation, and after planting to determine how much residue is present at each stage.

Materials

- A line transect (50-foot long line marked off at 6-inch intervals or a 50-foot tape measure)
- Two stakes or large nails
- Pencil and paper

Extra tillage tips across the field waste time and fuel.

Did you know?



Use a transect line to measure the amount of surface residue in a field.

This is a transect line marked at 6" intervals.

- 1 This technique involves using a line 50-foot long marked off at 6-inch intervals. You can use cord or heavy string and mark it every 6 inches with a piece of tape or by tying a knot. You will have 100 knots or 100 pieces of tape when completed. If you tie knots, you will need to start out with more than 50 feet of cord. You also could use a measuring tape and record the residue at every 6-inch mark.
- 2 At five randomly selected sites in the field, lay your transect line on the surface across the rows in the field. Your line must start on a row. Helpers can hold the line tight for you, or you can tie the line to tent pins or large metal nails at each end and use the pins to anchor the line.
- 3 Count the number of knots or pieces of tape that have residue directly under them. The total number of places where you counted residue is the percent of residue cover.
- 4 Average the residue counts from the five different field measurements to get the average percent of residue cover in the field. Use the table on the following page to help you.

Did you know?

To increase residue, operate tillage implements shallower and slower.



- Why is it important to measure crop residue?
- Why does the residue level in different fields differ?
- What is the residue level needed in your farm's conservation plan?

Residue Counts

1. _____
 2. _____
 3. _____
 4. _____
 5. _____
- Total _____

Total divided by 5 = _____ % residue cover.

How Does Residue Save Soil?

Now that you know how to measure crop residue, you will learn why this is important. This activity will demonstrate how crop residue helps to conserve our precious topsoil. Do this activity outside!



- Which pan had more soil erosion? Why do you think that happened?
- How did the straw affect soil erosion in your cake pan?
- How does crop residue affect erosion in a field?
- What responsibility do farmers have for preserving topsoil?

Materials

Two cake pans filled with soil
 A 2 x 4 piece of wood
 Sprinkle can or spray bottle
 Handful of straw or grass clippings
 Newspaper

- ➊ Fill each cake pan with soil from your garden or field. Firmly pack the soil into each pan. This is your field.
- ➋ Sprinkle the straw or grass clippings on the top of one of the pans of soil so about half of the surface is covered in straw and half is soil surface. Gently press the straw or grass clippings into the soil surface.
- ➌ Spread the newspapers out on a sidewalk, driveway, or any level surface. Set one end of both pans on the 2 x 4 and the other end over the old newspapers, so the pans are sitting at an angle.
- ➍ Gently sprinkle or spray water at the top of the cake pans (over the 2 x 4) and observe what happens to the water. Try to apply the same amount of water to both pans. Gently sprinkle more water on top and observe what happens.



Residue reduces erosion.



Project or Exhibit Ideas

- ❶ Create a display showing the effects of crop residue on reducing erosion.
- ❷ Do an educational presentation on the importance of crop residue.
- ❸ Create a poster on crop residue.
- ❹ Keep a photo journal of different fields and areas of soil erosion. Measure the crop residue in these fields at various times throughout the year.

Soil-Saving Residue

➡ A blanket of residue left on the soil surface is extremely effective in controlling erosion, and, therefore, should be part of every farmer's conservation plan. Complete residue cover can reduce soil erosion 95 to 98 percent, as compared to unprotected bare soil. Effective conservation tillage practices on highly erodible soils should leave at least 30 percent residue after planting.



No-till improves soil structure and organic matter, but takes time and patience.

Getting an even crop residue distribution while harvesting is critical in stopping soil erosion. Combine operators need to set up straw and chaff spreaders or choppers properly, so that the combine distributes residue evenly. Concentrated crop residues insulate the soil's surface from the sun, reduce seed to soil contact, make it tougher to plant in the spring, and can slow seed germination and crop development. Row cleaner attachments on the planter can remove a narrow band of residue from the soil at planting.

When You Need to Till. Remember: Keep Soil Structure

- ▶▶▶ If you decide tillage is needed, work the soil when it has the correct amount of moisture so that soil structure is maintained. If soils are worked when they are too wet, their granular structure can be destroyed. Soils with good granular structure are easy to work and provide good drainage and aeration.
- ▶▶▶ Overworking the seed bed can cause problems, too. It can cause the soil to be compacted (packed down), especially if the soil is a little too wet. If the soil surface is worked until the soil particles are very small or fine, the soil particles will conglomerate (cluster or clump together) and seal during a heavy rain. This leaves a hard surface or crust that is difficult for young plants to push through. Also, water runs off the hard soil surface more quickly, which increases soil erosion. Overworking the soil also reduces the amount of moisture near the surface during a dry spring. The result may be that the seed will not have enough moisture to germinate.

Other Internet Resources

- Conservation Technology Information Center, www.ctic.purdue.edu/CTIC/CTIC.html
- USDA Natural Resources Conservation Service, www.ia.nrcs.usda.gov
- USDA National Soil Tilth Laboratory, www.nstl.gov/
- Iowa Department of Natural Resources, www.iowadnr.com/

ISU Resource

- *Soil Erosion, Crop Productivity and Cultural Practices*, PM 1870

Your soil conservation plan.

You measure crop residue and

conservation district office can help

Did you know?

Soil Erosion

CHAPTER 3

Erosion or Conservation

The loss of soil by water or wind movement is called **erosion**. Erosion removes plant nutrients and organic matter from the soil surface. Erosion also removes the finer soil particles, which decreases the amount of water the soil can hold. Erosion occurs in undisturbed nature, but most forms of agriculture that are practiced on sloping land increase erosion potential. If soil erosion is not controlled, then over many years, the productivity of the soils will be decreased. In addition, the materials that are eroded often enter water bodies, such as streams, ponds, lakes, and rivers, where the materials may fill up the water bodies and/or may cause injury to aquatic life.

Conservation tillage is the practice of leaving plant residues on the soil surface or leaving ridges or a rough surface to decrease the loss of soil. It is the most effective and least costly system to reduce soil erosion. This method controls erosion on level to gently sloping land. At least 30 percent of the soil surface of sloping land must be covered by plant residue. On steep slopes, surface residue alone will not control erosion; however, it can be combined with other erosion control practices to greatly reduce soil losses. Some disadvantages of surface residue are that it insulates the soil and makes the soil slower to warm up and dry in the spring, delaying planting, germination, and early crop growth. Residue may also interfere with how well herbicides control weeds. Most producers use “residue managers” on their planters that move the residue to the side just before the planter unit opens the slot to drop the seed, or they use some type of device, such as coulters attached to the planter, to till a narrow strip of soil right where the seed will be planted.



Conservation tillage leaves residue on the soil surface.



Erosion Managers

Crop producers can use a number of practices to help control erosion and conserve soil. Most often a combination of practices will be necessary for good erosion control. These practices include conservation tillage, contouring, strip cropping, building terraces, and planting grass waterways. In this activity you will learn about several conservation practices, and be able to identify them wherever you go!

- 1 Talk to some farmers and ask them why they use a particular conservation practice and what they think it has done for the profitability of the farm operation. Write their comments in this booklet or in a journal.

Type of Conservation Practice	Farmer's Comments on this Practice
<p>Ridge-Tillage</p> <ul style="list-style-type: none"> • A tillage system that uses narrow ridges of soil in which the crops are planted. • The areas between the ridges are left undisturbed. • Ridge tops are removed at planting with a sweep or row cleaner. • Advantages include warmer, dryer soils at planting and row banding of pesticides. • Requires specially designed equipment, and takes more time and labor during the season. • Managing fertilizer is a challenge on ridges, as is timely cultivation to control weeds and build ridges for the following crop year. 	
<p>No-Till</p> <ul style="list-style-type: none"> • A tillage system in which soil is not disturbed prior to planting, except for injection of liquid manure or anhydrous ammonia fertilizer. • Saves time and money (fewer trips), conserves soil moisture, and reduces soil erosion. • Requires learning a new weed management system. Wetter, cooler soils at planting may slow germination and increase seed and seedling diseases. 	

Most of Iowa's soil loss occurs on moderate to strongly sloping land (5 to 14% slopes).





Type of Conservation Practice

Farmer's Comments on this Practice

Fall Strip Tillage

- Tills only one-third of the soil in strips 6 to 8 inches wide in the fall by using one of the following tillage implements: modified anhydrous ammonia applicator knives, a rototiller, in-row chisel, row cleaners, double-disks, or another adapted tillage tool.
- May bury too much residue following soybeans on highly erodible soils.
- Provides dryer and warmer soils at planting and reduces soil erosion.
- Residue may blow back over the strips during the winter months.

- ▶▶▶▶ What conservation practice do you see the most in your area? What reasons can you give for the use of this practice over other practices?
- ▶▶▶▶ What conservation practice do you use on your farm or would like to try? Why?
- ▶▶▶▶ What reasons can you give other than economic to use conservation practices on your farm?
- ▶▶▶▶ How would the use of conservation practices on neighboring farms affect crop production on your farm?

Minimum Tillage

- Performs only those tillage operations that are absolutely necessary. Examples include field leveling, weed control, or fertilizer incorporation.
- Minimum tillage should leave at least 30 percent crop residue on the surface of highly erodible soils after planting.

Strip Cropping

- Alternates strips of sod with strips of a row crop.
- The sod strips catch the soil that erodes from the row cropped area.

Contouring

- The practice of farming across the natural slope of a field rather than farming up and down the slope.
- Slows the speed of water runoff and may reduce erosion as much as 50 percent.
- Does not work well as a single practice where slopes are irregular or on rolling land where slopes exceed a nine percent incline.



Project or Exhibit Ideas

- 1 Visit your Soil and Water Conservation district office and ask staff to share with you how to calculate soil loss on your farm. Ask for their recommendations on how to reduce this soil loss.
- 2 Create a display showing some different conservation practices.
- 3 Do an educational presentation on one of the conservation practices and how it reduces erosion.

Type of Conservation Practice

Farmer's Comments on this Practice

Terracing

- Permanently divides a slope.
- Shortens the length of the slope so sloping land can be planted to row crops without causing excessive erosion.
- The highest initial cost of all conservation practices and requires periodic maintenance.
- More effective than strip cropping or contouring for erosion control on long, steep slopes.

Grass Waterways

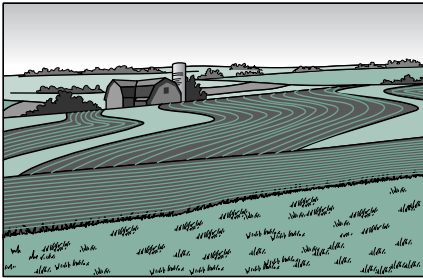
- Channels of permanent grass vegetation.
- They prevent deep erosion cuts in places in a field where water flows quickly enough to cause excessive erosion.

Crop Rotation

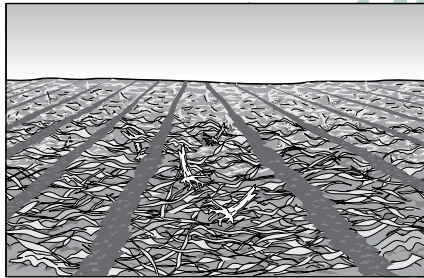
- Planting a different kind of crop in a field from one crop season to the next.
- Pasture or meadow included in a crop rotation will help reduce erosion.
- Research has shown that highest long-term crop yields are produced when crops are rotated.
- Average annual soil losses are less when crops are rotated.
- Can provide better control of weeds, insects, and diseases, and help increase yields and profits.

- 2 Look at several neighboring farms. List a farmer who is using each of these conservation practices.
- 3 Fill in the blanks under the drawings with the conservation practices listed below. If you aren't sure, read through the conservation practice information again to make your decision.

- ridge-tillage
- no-till
- fall strip tillage
- minimum tillage
- strip cropping
- contouring
- terracing
- grass waterways
- crop rotation



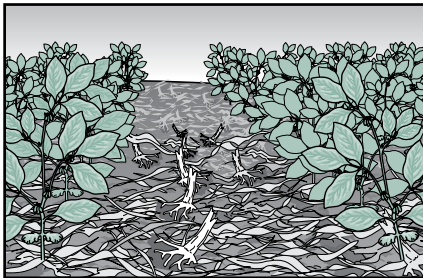
1. _____



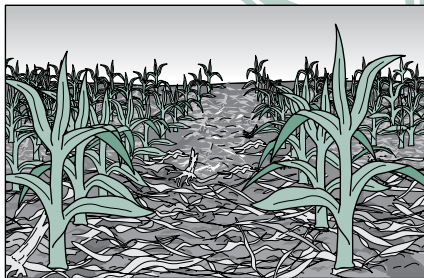
2. _____



3. _____



4. _____



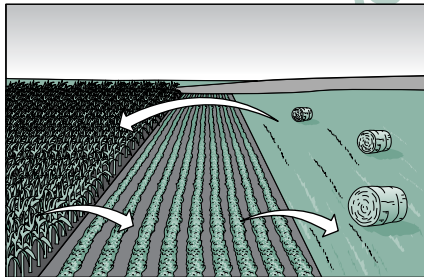
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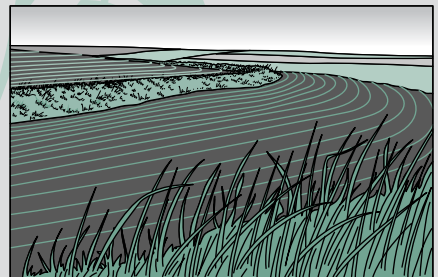
6. _____



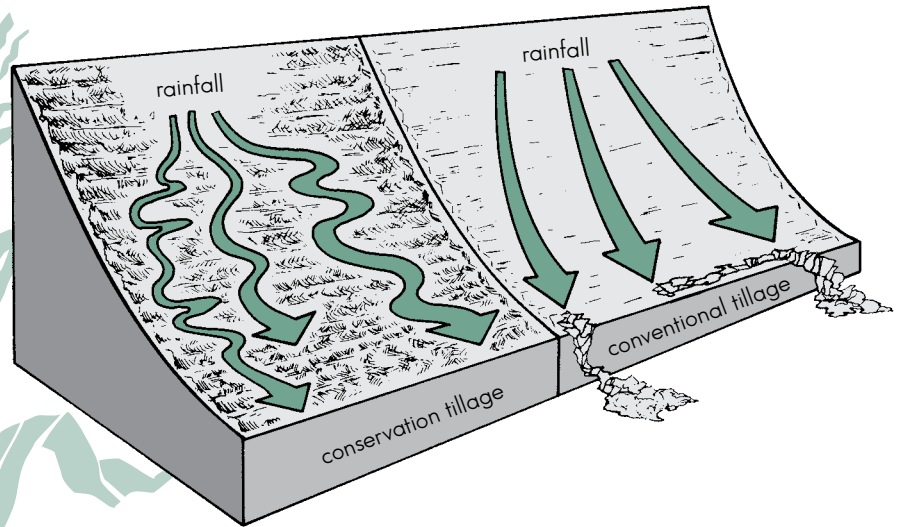
7. _____



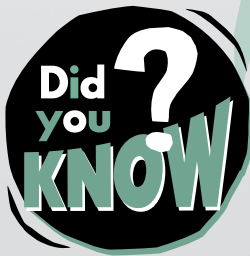
8. _____



9. _____



Surface residue combined with other erosion control practices will help slow down water surface runoff, thus reducing soil losses. When conventional tillage is done on steep slopes, water runs straight down the slope causing large soil losses.



- ▶ Iowa loses 4.9 tons of topsoil per year from cultivated cropland due to water erosion.
- ▶ This is down from a high of 7.7 tons per acre per year in 1982.
- ▶ A 5-year rotation of 3 years of corn, 1 year of small grain, and 1 year of meadow has less than half the soil loss than if continuously planted to corn.

Soil Erosion

- ▶ Raindrops can strike the ground with a surprising amount of force! In a normal rainfall, drops 6 millimeters in diameter (about 0.24 inch in diameter) can hit the soil's surface at 20 miles per hour. Large, pounding raindrops dislodge soil particles, splashing them up to 3 feet. This also works to "seal" or crust the soil's surface, reducing water infiltration into the soil and allowing rainwater to move down slopes, carrying dislodged soil particles and causing soil erosion. This also increases the sediment load in nearby water bodies. It takes centuries to create new soil from minerals, so we need to reduce erosion to protect our topsoil.
- ▶ More information on soil conservation practices can be found at your county Extension office and Soil and Water Conservation district office.



Nutrients and Fertility

CHAPTER 4

Plant Nutrition

In Level 1, you learned that plants require 17 nutrients, called the essential nutrients, to grow and reproduce. These essential nutrients are supplied by soil, air, and water. Three are supplied by air and water; they are carbon, hydrogen, and oxygen. The remaining 14 nutrients are supplied by the soil and are divided into three groups—primary nutrients, secondary nutrients, and micronutrients.



Missing Plant Nutrients

Most nutrients that plants need for growth are found in the top soil—the top few inches of soil. This activity will help demonstrate how missing nutrients in the soil can affect crop growth.

Materials

2 clay pots or 3-pound coffee cans
Shovel
Soil from a highway work area or construction site
Garden soil

- 1 Collect some soil from a highway cut area, where most of the top soil has been removed. Gather the soil from an area about 4 to 5 feet down the slope from the surface.
- 2 Prepare two containers in which to grow corn. You can use regular clay pots or 3-pound coffee cans. The containers should have holes in the bottom to let excess water drain out. Covering the bottom of the containers with small chunks of gravel before you put in the soil also will help to drain excess water.
- 3 Fill one container with the subsoil you collected from the road-cut. Fill the other container with good soil from your garden.

Apply nutrients to maximize profit, not yield!

Did you know?

4 Predict which container will yield the healthiest plants.

- List your reasons.



- ▣▣▣▣ Which soil grew the best-looking plants?
- ▣▣▣▣ What are the characteristics of this soil?
- ▣▣▣▣ Which soil had plants with the most symptoms (yellow leaves, purple leaves, stunted growth)? What reasons can you give for this?
- ▣▣▣▣ What could you do to improve the health and appearance of the plants in the container that did not grow the healthiest plants?
- ▣▣▣▣ Look back at the soil activity on page 10. What is the name of the soil horizon you used in each container?

5 Test your predictions by planting several corn seeds about 1 inch deep in each container. Water them occasionally, but do not waterlog the soil. Keep the containers outdoors in a place where they will be in the sun all day long.

6 After 4 to 6 weeks, record your observations about the plants grown in each container. Look for the following things when you compare the plants in the two containers.

- **Yellow leaves**—A lack of nitrogen or potassium can cause leaves to have an unhealthy yellow appearance. The lower leaves usually turn yellow first. When nitrogen is lacking, the yellowing will be in a V-shaped pattern up the middle of the leaf. If the edges of the leaves become yellow and then brown, potassium is probably lacking. A shortage of some other nutrients also can cause yellowing.
- **Reddish purple leaf coloring**—A phosphorus deficiency often causes young plants to develop a purplish color along the edges of the older leaves.
- **Stunted growth**—Plants grown in poor soil usually appear stunted, although it is not easy to decide which nutrients are lacking. This sometimes occurs when plants are grown in soils in pots.

7 As the last step, observe the root development. Carefully remove plants from the container. Note the amount of root growth in each soil type.

Observations about plant growth:

Type of Soil Used	Soil Color Characteristics	Leaf Color	Plant Height	Number of Leaves	Root Development	Other Observations
Garden						
Highway or Construction Site						

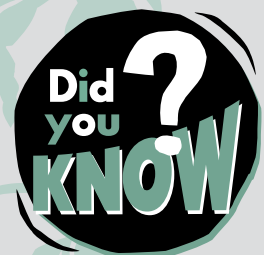


Project or Exhibit Ideas

- 1 Share with a helper or parent your plant growth observations. Look back at your original prediction. How close was your prediction to the actual observations?
- 2 Create a display showing the effects of crop nutrients and soil horizons on plant growth.
- 3 Keep a photo journal showing the effects of nutrient deficiencies on crops.

Resources

- Resources Conservation Practices: Residue Management and Cultural Practices, PM 1901A
- Resources Conservation Practices: Consider the Strip-Tillage Alternative, PM 1901C
- Resources Conservation Practices: Considerations in Selecting No-Till, PM 1901D



- You should take soil samples every 3 to 4 years, preferably at the same time of year and following the same crop.
- Lime and nutrient recommendations are only as good as the soil-testing program itself.



Nodules on the roots of a soybean.



Project or Exhibit Ideas

- 1 Produce a video or a role play about the role of legumes in fixing nitrogen in the soil—use your creativity.
- 2 Create a melodrama about the role of the essential elements in creating healthy soil and healthy crops.
- 3 Explain to your helper the role of the soybean plant in providing nitrogen to the soil and how it works.



Soybean Nitrogen Nodules

Soybean plants are unique because they can take nitrogen from the air and make it usable to the growing plant. This is called a symbiotic nitrogen fixation system. The nitrogen fixation system involves the soybean roots and the bacterium, *Bradyrhizobium japonicum*. The bacteria, which form nodules on the soybean roots, obtain food from the roots. The bacteria take nitrogen from the soil atmosphere and change it to a form the soybean can use. The bacteria and the plant live together quite well, helping each other. In this activity you will observe the nodules on soybean plants.

Materials

Shovel
Soybean field

- 1 Visit a soybean field in the middle of the growing season. With a shovel, dig up a few plants, being careful not to damage the roots, and gently shake the soil off the roots. Look at the nodules that have formed there.
 - How many nodules did you count on the average soybean root system? _____
- 2 Next, cut 10 nodules in half and look at their colors. A pink or red color inside indicates that it is fixing nitrogen.
 - How many nodules were pink or red inside? _____
 - Did you find much smaller white or brownish-colored bumps on the roots? These may be soybean cyst nematodes (SCN), a serious parasitic nematode (worm) pest of soybeans. Ask a crop specialist to look at the roots to see if SCN are present.
 - ▮▮▮▮ What effect does planting a crop like soybeans have in maintaining soil fertility?
 - ▮▮▮▮ What other crops form nodules?
 - ▮▮▮▮ Why is it important to know that soybeans can provide nitrogen fertilizer?
 - ▮▮▮▮ What impact does this have on crop rotations?



Plant Food

Nitrogen



- Nitrogen is needed for plants to grow and produce high yields. Nitrogen is a major part of proteins found in plants and seeds.
- Since corn plants do not contain a nitrogen fixation system, they must obtain nitrogen from the soil. Usually more nitrogen is needed than is supplied naturally in the soil, so producers often need to apply nitrogen to the soil to increase corn yield. Supplemental nitrogen can be added from nitrogen fertilizer or manure. If a legume crop, such as soybean, alfalfa, or clover, was grown the previous year, much less or no supplemental nitrogen may need to be added. The preferred time to apply nitrogen fertilizer is in the year the crop is raised, either in the spring before planting or during the growing season. This reduces the amount of nitrogen that is needed to get an optimum yield and also reduces the potential loss to the environment.
- Nitrogen is unique because it travels in the soil. It can easily change forms, become unusable or “unavailable” to corn plants, and be lost from soils. So, it is important to supply adequate nitrogen for corn and manage the nitrogen to minimize losses.
- Two soil tests are available to assist the producer in determining whether or not enough nitrogen is available.
 - The first is the Late Spring Soil Nitrate Test (LSNT), which is a one-foot deep soil test taken when the corn is 6 to 12 inches high at the whorl. The LSNT can be used to determine if any additional nitrogen is needed or if there is adequate available nitrogen in the soil.
 - The second test is the End-of-Season Cornstalk Test, which is a test conducted on corn stalks (8-inch segments of stalk from 6 to 14 inches above ground) one to three weeks after physiological maturity. The stalk test indicates if too little or too much nitrogen was available in the soil that year, and can indicate a possible adjustment for the next time corn is grown in that field. It is especially useful if excess nitrate is measured in the stalk over several seasons.
 - More information on these tests can be found at your county Extension office.

Minimize nitrogen losses by supplying the nitrogen in the spring instead of the previous fall.

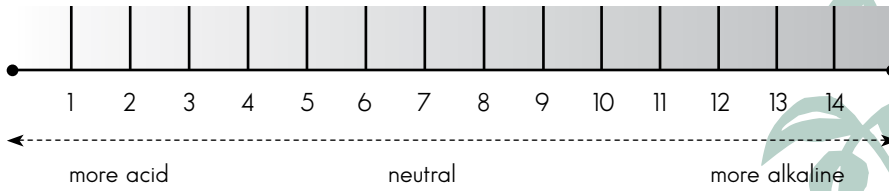
Did you know?

Phosphorus and Potassium

- ▶▶▶▶ Phosphorus, like nitrogen, is a primary nutrient that plants need to grow and reproduce. Unlike nitrogen, it is relatively immobile in the soil. Phosphorus is important to young plants because it stimulates early root formation and growth. It also helps flower or tassel development and seed development. Because it is immobile, phosphorus levels can be built up in the soil over time. Phosphorus fertilizer or manure will need to be applied to soils where soil tests show that levels of available phosphorus are optimum, low, or very low.
- ▶▶▶▶ Potassium also is an essential nutrient. Crops require potassium in large amounts for vigorous growth and good stalk strength. Plants contain large amounts of potassium. If the entire above ground plant material is removed from fields through harvesting, large quantities of potassium will be removed. Potassium will need to be added to the soil by applying fertilizer or manure if soil test levels are optimum, low, or very low.

Secondary and Micronutrients

- ▶▶▶▶ Other nutrients also are essential for good plant growth. They are secondary and micronutrients. They are just as important as nitrogen, phosphorus, and potassium, but plants use them in smaller quantities, especially the micronutrients.
- ▶▶▶▶ Calcium, magnesium, and sulfur are secondary nutrients. A good liming program gives crops the calcium and magnesium they need. Iowa soils typically supply enough sulfur.
- ▶▶▶▶ Most micronutrients are available in sufficient quantities in Iowa soils. However, iron deficiency occurs on soybeans grown in central and north central Iowa on calcareous or high pH soils. It is best corrected by selecting tolerant soybean varieties. If caught early, applying an iron chelate to the leaves can reduce the severity of the problem. In addition, zinc deficiency occurs in corn that is grown on low organic matter and high pH soils. The soil test for zinc can help determine if a zinc deficiency exists. A zinc deficiency can be corrected by applying zinc fertilizer to the soil.



The soil pH scale.

Soil pH

- ▣▣▣▣ A soil's pH is very important. Soil pH is a measure of the acidity or alkalinity of the soil. It is measured on a scale of 1 to 14, with 7 being neutral. If pH is too high or too low, some nutrients may be less available while others may become available at levels toxic to the plant; there are also some other effects of very high or very low pH levels. The ideal pH for corn and soybeans is 6.0 to 7.0. If alfalfa is in the rotation, the pH should be kept above 6.5.
- ▣▣▣▣ Iowa soils generally fall in the pH range of 5.0 to 8.0. Where soil pH is low, lime can be added. Occasionally pH is too high (above 7.4), but there is really nothing that can be done on a field scale to lower the pH because these soils typically contain large quantities of free limestone (which is the reason the pH is high). The largest problem that occurs in those soils is iron deficiency chlorosis on soybean and zinc deficiency in corn. Also, high pH soils have a higher incidence of soybean cyst nematode. These problems occur because the pH impacts soil chemistry in a way that lowers the solubility and availability of those nutrients. Proper pH levels help plants grow better. In addition, pH can affect how some herbicides work.

**Did
you
know?**

Put on only as much nitrogen as the crop will need.

Weather

CHAPTER 5

Air Temps

Weather directly affects crop growth. In Level 1 you learned about the importance of rainfall and soil temperatures on plant growth and crop yield. Air temperatures also affect the rate of crop growth. How fast a crop grows and matures depends on the average temperature of the area in which it is growing. The higher the average temperature (within reason), the faster a crop matures.



Growing Degree Days

The “growing degree day” is a measure of temperature effects over a period of time for corn, other crops, and pests. The National Weather Service degree day is based on a 50° F threshold or minimum. Some other crops or pests may have degree day bases higher or lower than 50° F. The base temperature is the lowest temperature at which an organism is biologically active.

Materials

Outdoor thermometer
Weather reports—newspaper/radio/Internet as determined by the National Weather Service
Notebook or journal
Calculator

Corn grows when the temperature is above 50° F, and growth may be slowed by temperatures above 86° F. Corn degree days are calculated by averaging the high and low daily temperatures and subtracting 50. If the low temperature is less than 50° F, it is assigned the value of 50°. If the high exceeds 86° F, it is assigned the value of 86°. The degree-day

Growing degree days can be used to calculate the growth rates of several crop insect pests.

Did you know?

values are accumulated throughout the growing season. Degree days may not have a negative value.

Degree days may be determined with a calculator or found on the Internet at www.ipm.iastate.edu/ipm/degreeday/.

- ① To calculate growing degree days, listen to the weather reports every day, and record the daily high and low temperature as reported by the National Weather Service, or you may use your own maximum/minimum thermometer if you have one.
- ② You can begin calculating growing degree days on March 1 for evaluating the development of weeds and insect pests that are influenced by the early season conditions.
- ③ To determine the developmental conditions for your crop, begin calculating the degree days the day your crop is planted.

Growing degree days are determined by using the following formula:

$$\begin{aligned} &\text{Daily high temperature} \quad \text{_____} + \text{Daily low temperature} \quad \text{_____} = \text{_____} \\ &\text{Divided by 2} = \text{Average daily temperature} \quad \text{_____} - 50 = \text{_____} \text{ growing degree days} \end{aligned}$$

EXAMPLE

Daily high temperature = 80

Daily low temperature = 60

Total = 140. $140 \div 2 = 70$. $70 - 50 = 20$ growing degree days.

- ④ Record the growing degree days for each day in your journal or on your worksheet from the end of this book. Additional worksheets can be found on the computer companion CD Rom. Accumulate them over time on a table similar to the one in the example below.

Example of growing degree days record:

Date	High Temperature	Low Temperature	Growing Degree Days	Accumulated Growing Degree Days
March 1	60	30	5	5
March 2	60	40	7.5	12.5
March 3	64	45	7	19.5

EXAMPLE

$60 + 50 = 110 \div 2 = 55 - 50 = 5$ growing degree days

Remember, any temp below 50° F is calculated at 50.

You can determine when insects will begin to damage crops using degree days.

Did you know?



- ▶▶▶▶ How many growing degree days had accumulated from March 1 to the time you planted your crop?
- ▶▶▶▶ What crop did you plant? Why would the crop make a difference on growing degree days?
- ▶▶▶▶ How many growing degree days accumulated by silking or flowering time?
- ▶▶▶▶ How many growing degree days accumulated by crop maturity?
- ▶▶▶▶ How can you use growing degree days to determine when insects might be a pest to your corn?
- ▶▶▶▶ Why is it important to know approximately when your corn will reach the silking stage?
- ▶▶▶▶ Why is it important to know approximately when your corn will reach maturity?
- ▶▶▶▶ For what other crops can we use growing degree days to determine the likely time of insect feeding?

Project or Exhibit Ideas

- 1 Share your record of growing degree days with your neighbor to help them in scouting for insects.
- 2 Create a poster showing how you projected when your corn would start silking or reach maturity.
- 3 Create a display comparing insect growth and feeding, and plant growth, based on degree days.



Temperatures

- ▶▶▶▶ How much heat crops are exposed to over a period of time is measured in units called growing degree days. Corn requires from 2,400 growing degree days in northern Iowa to 2,800 in southern Iowa to reach the “black layer” maturity stage of the corn kernel.
- ▶▶▶▶ When temperatures fall to 32° F or lower, crops can be damaged. The condition that results is known as frost injury and can kill plants. Frost is of most concern in the spring until mid-May and in the fall until crops have matured.
- ▶▶▶▶ Temperatures also can get too hot for crops to grow normally. This condition is known as heat stress. Most plants are not affected by heat until temperatures rise over 100° F. However, if enough water is not available to the plant, stress will occur sooner. In Iowa, soil water availability is such that on the average, temperatures above 86° F are stressful.
- ▶▶▶▶ Rainfall, air, and soil temperature records for the crop growing season can be recorded on Crop and Weather Record and Air and Soil Temperature Record, found on the computer companion CD Rom.

Decisions! Decisions! Decisions!

CHAPTER 6

Preplanting Decisions

Before planting corn and soybeans, there are a number of things to consider—what tillage to use, planting date, planting rate, row spacing, variety or hybrid selection, weather predictions, and most importantly, how all these factors relate to each other! Some of these factors are outside of your control, like the type of soil you have on your farm or the weather. Other factors are based on things you can control, like tillage, fertility, variety or hybrid selection, and planting details. But all of these factors and the decisions you make about them are dependent on each other and will determine your final yield.

One of the first decisions is what seed to plant. There are many different types of corn, soybean, and other crops to consider. The types may differ in many ways, such as yield, number of days needed to reach maturity, and resistance to diseases and insects. You need to select the hybrids or varieties that are best suited to your special growing conditions. How well a hybrid or variety will perform can vary from one area of lowa to another or even from one field to another. You need to know how well the hybrid or variety grows and produces in different areas with different growing methods.

Study Seed Tags

- 1 Find a bag of seed corn or soybeans with a tag attached, and write down the following information from the tag.
 - Origin of seed (where it came from)

Lot number _____

Pure seed percentage _____



Company sales representatives can help you choose the right hybrids for your growing conditions.

Did you know?



- ▮▮▮▮ Is there a seed treatment applied? If yes, what is the treatment for?
- ▮▮▮▮ Visit a seed dealer and compare information on different bags.
- ▮▮▮▮ How can you use the information provided on the label or bag?
- ▮▮▮▮ What might happen if adequate information weren't provided on the bag?
- ▮▮▮▮ If the label were lost, where else could you find this information?
- ▮▮▮▮ How does this information help you in selecting the best variety or hybrid for your farm?

- Percentage of other crop seeds _____
- Percentage of inert matter _____
- Germination percentage _____
- Date of germination test _____
- Now calculate the percentage of Pure Live Seed (PLS)
% PLS = Pure Seed % x Germination % _____
- What is the cost of the bag of seed? _____
- What is your cost per pound of PLS?
\$/pound PLS = \$/pound of seed ÷ % PLS _____
- ② Next, look at what is printed on the seed bag itself, and copy the following information.
Net weight _____
Number of seeds _____
Grade size of seeds _____
Maturity group or maturity in days or heat units _____

Planter recommendations (planter plate or rate) _____



Project or Exhibit Ideas

- ① Design a poster to teach others about the information provided on the seed labels.
- ② Compare several varieties of seeds you might use on your farm.
- ③ Discuss with your parent or helper what information they depend on when selecting seeds.

Selecting the Right Corn Hybrid

- ▮▮▮▮ Each different corn plant type is called a hybrid. When you select a corn hybrid, consider several important factors. Maturity time, yield, and standability are the three most important factors.



- **Maturity time** is the length of time it takes for corn to grow from the day it is planted until the kernels are mature (safe from frost). The presence of a black layer at the tip of the kernel is an indication of physiological maturity. Usually hybrids that take longer to mature yield more than hybrids with shorter maturity periods. That is because hybrids that mature later use more of the growing season. If the hybrid matures late, though, you may lose part of the yield to an early frost, or you may need to harvest the corn before it dries. Corn that is harvested when wet needs to be dried artificially after harvest; that will cost the farmer more money.

For corn to produce full ears, the silks must receive pollen at the right time. Pollination occurs when the tassels release their pollen. Under stressful conditions the silks may not emerge from the husks at the same time the pollen is shed. To reduce some risk, you can plant several different hybrids of corn with different maturity times, so that if one fails, chances are good that the other hybrids won't.

- The second important factor to consider when selecting a corn hybrid is **yield**. Yield is difficult to predict due to factors such as the number of ears on a plant, the ear size, the number of kernel rows, the length of the ear, or the kernel size. Also, each growing season is different, and hybrids of corn will produce different yields when they are grown under different conditions. One hybrid might do better with more rainfall and lower temperatures, whereas another one might produce more in hotter, drier weather. To see this, look at several years of the *Iowa Crop Performance Test Report*—

Corn, PM 660, and compare how the same hybrid yielded in different years. The crop performance test report is also available on the web at www.agron.iastate.edu/icia/YieldTesting3.html.

- **Standability**, the ability of a plant to stand up on its own until harvest, is another factor to consider. Plants that lodge (fall over) before harvest reduce the yield because the combine may not pick all the corn from the lodged plants. Lodging can be caused by very high plant populations, spacings, diseases, insect damage, nutrient imbalance, or weather stress.
- ▶▶▶ Other factors to think about when choosing a corn hybrid include germination rate and vigor, disease resistance, stress tolerance, insect resistance, herbicide resistance, how you plan to use the corn (to sell or to feed to livestock), and how reliable the dealer is from whom you buy the seed.

Seed companies do not all use the same method to rate their hybrids on maturity.

Did you know?

Selecting the Right Seed for You!

Visit with a seed dealer, farmer, or county Extension specialist. Find out which hybrids or varieties are being grown where you live. What are the advantages of each? Record what you learned in the space below.



- If you are growing a crop for your project, answer the following. What hybrid or variety did you plant? What were the reasons for your choice?
- Will all your neighbors use the same hybrids or varieties?
- What reasons might cause them to select different varieties or hybrids?
- Will you use only one hybrid or variety in your project?
- Why might you consider using more than one?
- What might happen if a farmer used only one hybrid or variety in every field?
- Did everyone you talked to consider the same trait advantages? Why or why not?

Variety or Hybrid _____

Advantages _____

Variety or Hybrid _____

Advantages _____

Variety or Hybrid _____

Advantages _____

Variety or Hybrid _____

Advantages _____



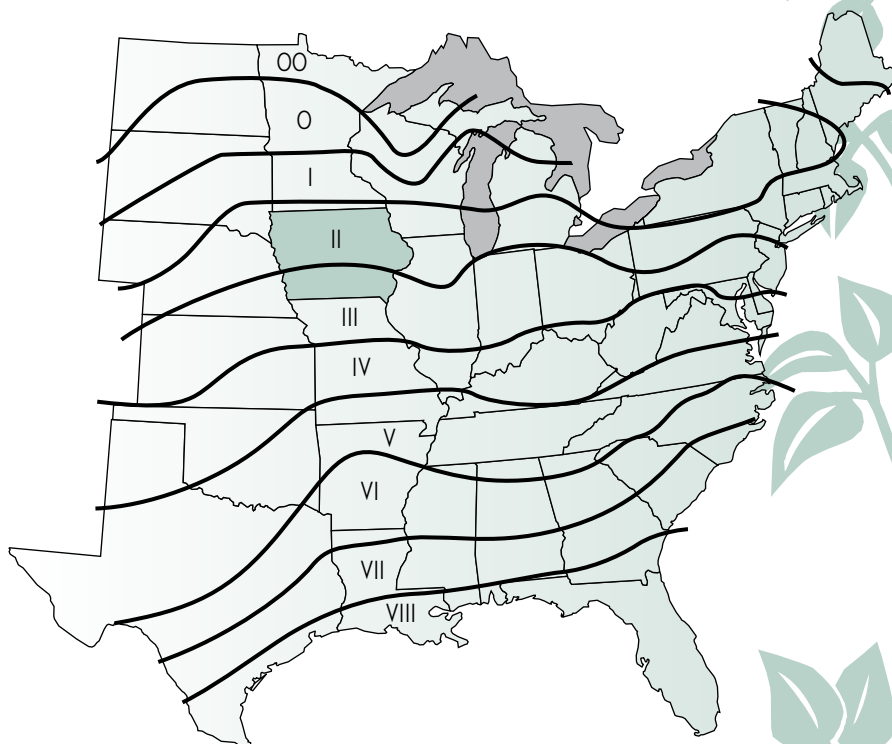
Project or Exhibit Ideas

- ① Create a journal showing the advantages and disadvantages of several varieties or hybrids. Compare the advantages and disadvantages for different fields.
- ② Develop a poster showing the reasons for selecting certain varieties or hybrids.
- ③ Consider giving an educational presentation to share what you learned.

Soybean Variety Selection

- Each different soybean plant type is called a variety. Since you cannot judge the performance of a variety by looking at the seed, soybean varieties also must be tested to compare the performance of different varieties. New test report bulletins are published each year. Check out some of the soybean varieties listed in the *Iowa Crop Performance Test Report—Soybeans*, AG 18, available from the county Extension office or on the web at www.agron.iastate.edu/icia/YieldTesting3.html.





Soybean maturity zones.

When selecting a soybean variety, you should select a variety that has high yield potential, is resistant to falling over or lodging, tolerates diseases and nematodes, has a maturity date suitable for your area, and is good quality seed.

It's Not Just a Soybean Anymore!

Find out about differences in flowering among soybean varieties.

Materials

Small field plot or garden area
10 to 20 seeds from three different maturity beans
Pencil and paper or journal

- 1 Get seeds of one early, one average, and one late maturity soybean variety grown in your area. You can ask your seed dealer to help you get some. You only need a small number of seeds (10 to 20) of each variety.
- 2 Plant seeds 1 to 2 inches apart in rows 30 inches apart. Plant each variety on the same day sometime between May 1 and May 25. Be sure to mark the rows and section with stakes, and record where you plant each variety.

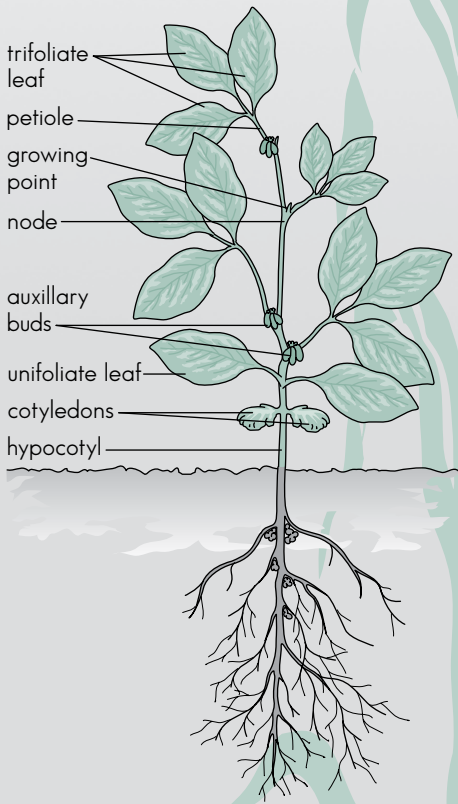


Buying seed from a reputable dealer is a good way to be sure you are buying high quality seed.

Did you know?

Record your results:

	Variety Name	Date Planted	Date First Flower Was Seen	Number of Trifoliolates Visible When the First Flower Was Seen
Early Maturing Variety				
Medium Maturing Variety				
Late Maturing Variety				



Trifoliolate leaves are clusters of three leaves on a petiole.

- ▮▮▮ How did the three varieties compare?
- ▮▮▮ Which flowered first? Why?
- ▮▮▮ What did you expect?
- ▮▮▮ Which variety had more trifoliolates at the time of first flowering? Why?
- ▮▮▮ How might that impact final yield? Why?



Project or Exhibit Ideas

- 1 Keep a photo log of the growth of the three varieties, and share it with other 4-H'ers.
- 2 Create an exhibit showing the difference in flowering dates between three varieties.
- 3 Develop a poster showing what maturity soybeans are appropriate for your area.

Soybean Maturity

▮▮▮ Day length controls flowering and maturity of soybeans. The decrease in the number of hours of night prior to June 21 triggers the flowering process in soybean plants, but the flowers are not seen until late June. As the days become shorter in late summer and fall, the soybean plant begins to mature and drop its leaves.



▶▶▶ The length of a specific day varies according to how far north of the equator it is. A variety should not be planted much farther north or south of the region for which it is adapted. If, for example, you planted a variety adapted to northern Iowa in southern Iowa, it would flower and mature too early and lower yields would result. From the map on page 37, you can see that soybean varieties in Maturity Group II are adapted to grow in most of Iowa, except for the extreme northern and southern parts of the state.

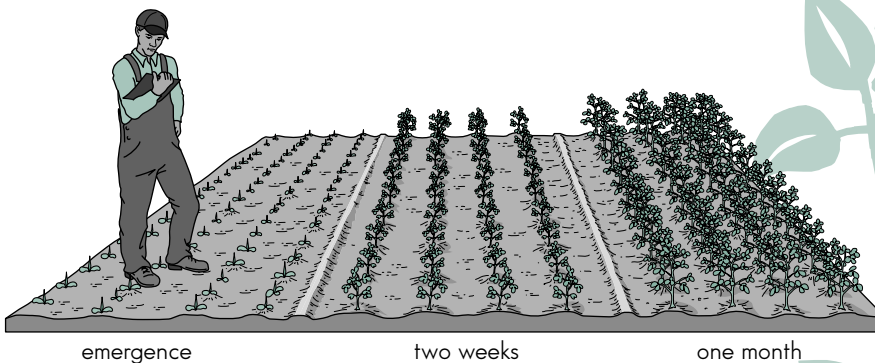
What's in a Date?

This activity will help you better understand how planting date affects yield.

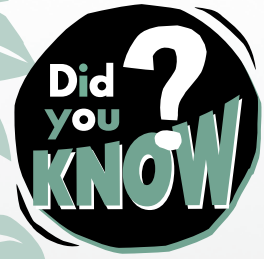
Materials

36 seeds of a soybean variety adapted to your region.
Small field or garden plot
Planting equipment

- 1 Plant the seeds on three different dates, each about 15 days apart. For example, plant seeds on May 15, June 1, and June 15. Plant the seeds 1 to 2 inches apart in rows spaced 30 inches apart.
- 2 Observe your plantings weekly and record the information on the chart on the following page. Soybean flowers may be difficult to see. The flowers are small and white or purple colored. They are located at the base of leaf stems (petioles) and the main stem.



Soybeans planted on three different dates.



- ▶▶▶ Disease resistance is another important factor to consider when choosing a soybean variety.
- ▶▶▶ High quality seed germinates a high percentage of seeds, is low in foreign material and weed and other crop seed, and is of a known variety.



Soybeans need soil temperatures above 50° F to germinate.



Variety used _____

Date of Planting	Growth and Development (i.e. Number of Trifoliolate Leaves)	Date When 5 Percent of Plants Are Flowering	Number of Days from Planting to Flowering	Average Number of Pods/Plant on September 1 (Count on 10 Plants)



Project or Exhibit Ideas

- 1 Present your data to your 4-H club and have members speculate which date would be best to plant.
- 2 Create a news article to educate non-producers on the importance of when to plant.

- Take a look at the chart you filled out. Analyze the data. What is interesting about the information you recorded in the chart?
- Compare the differences between when the plants flowered to when they were planted. What do you think accounts for the differences?
- Based on the number of pods, which date of planting do you think will yield the most soybeans?
- Why did that planting date yield more?
- Based on what you learned about emergence in cool temperatures, what might happen if you planted two weeks earlier?
- Will your ideal planting date be the same as for Minnesota? Missouri? Why?
- How do you think your results might differ if you did this in a very cool year?
- How do you think your results might differ if you did this in a very hot year?



The ISU Soy Page, www.agron.iastate.edu/soybean/soybean.html, may help you answer some of the above questions.

Planting Date

- Corn and soybeans should be planted on the best planting date to get the highest yields. In Iowa the optimum or best planting dates



for corn and soybeans are from April 20 to May 10 after the soil temperatures are 50° F or higher. Because corn needs a little longer growing season, it is planted before soybeans in Iowa.

- ▣▶ Planting crops earlier than recommended can lead to problems. Cool, wet soil delays germination and emergence. Also, weeds may become more of a problem if the crop plants emerge slowly because weeds will get a head start on growth. Planting too early also gives insects and diseases a longer time to attack and destroy the seed or seedling. In addition, crops may be injured or killed by frost.
- ▣▶ Planting too late also presents problems. If you plant corn later than May 20 to 25, you may have to plant a hybrid that matures in a fewer number of days (a shorter season variety). Late planting also can produce a higher grain moisture content at harvest, which means more costs to dry and store grain. If soybeans are planted the last week of June, select a shorter season variety. The ideal time to plant depends on where you live in Iowa. What is the ideal planting time for your area of the state?
- ▣▶ The ideal depth to plant corn is 1 1/2 to 2 inches. For soybeans it is 1 1/2 inches. If you plant too shallow (not deep enough), the soil surface may dry out, leaving too little moisture for the seeds to germinate. Also, the emerging root system may be too shallow, and, if the soil surface dries out, the plant will not receive enough water and become stressed. If corn is planted in mid- or late-May and soil surfaces are dry, it may be necessary to plant corn 2 inches to a maximum of 3 inches deep in order to place the seeds in moist soil. Soybeans should not be planted deeper than 2 inches because they may not be able to emerge.

How Many Seeds to Plant?

- ▣▶ Have you ever driven in the country during planting season and seen farmers digging in the soil behind their planter? They aren't crazy, they are just double checking their planting depth and rate. Seeding rate or planting rate means the number of seeds planted per acre. But since it is sometimes difficult to dig for and count seeds behind the planter, we'll measure the plant stand or plant population. Plant population is the number of growing plants in a certain amount of space.

soybean flowering will be delayed about 1 day for every 2 days of delay in planting.

Did
you
know?

Bean (or Corn) Counting!

Since it is much easier to count plants, we'll start with this activity to determine the plant population in a corn or soybean field.



Materials

Corn or soybean fields
Measuring tape
Flags or stakes
Pencil and paper or journal

Soybeans

To determine the number of soybean plants in your field, select six to eight different areas in your field.

① Count the number of seeds or plants in 10 feet of row and divide by 10 to get the average per foot of row.

② Record these numbers below.

Soybean plants in my field:

Sample Area	Example	Number of Plants or Seed/Foot of Row
1	6	
2	5	
3	6	
4	3	
5	4	
6	3	
7	5	
8	4	
Total	36	

Total ÷ Number of sample areas taken = Average number of plants/foot of row.

EXAMPLE

$$36 \div 8 = 4.5 \text{ plants/foot of row}$$

③ Now use the formula on the following page to convert from plants per foot to plants per acre.

soybean populations usually are measured by number of plants per foot of row.

Did you know?

- You can find out the plant population by using the following formula.

$$43,560 \text{ square feet/acre} \div \text{Row spacing in feet} \times \text{Plants or seeds/feet of row} = \text{Plant population}$$

EXAMPLE

$$43,560 \text{ square feet/acre} \div 1.25 \times 4.5 = 156,816$$

Recommended soybean populations for different row widths:

Row Width in Feet	Plants/Foot of Row	Plants/Acre
2.5 (30")	9	157,000
1.67 (20")	6	156,000
1.25 (15")	4.5	157,000
0.58 (7")	2.25	169,000

EXAMPLE

$$4.5 \text{ plants/foot of row with } 15\text{-inch row spacing} = 157,000 \text{ plants/acre}$$

- If you would like to determine seeding rates at planting time, follow the same process but count the number of seeds the planter is putting into the soil, rather than the plants. While you are digging for seeds, be sure to check for uniform planting depth and seed spacing in each row of the planter. For more information, ask your county Extension office for pamphlets PM 1885, *Corn Planting Guide* and PM 1851, *Soybean Replant Decisions*. These pamphlets can be downloaded at the ISU Extension Crops publications website, www.extension.iastate.edu/pubs/.



- ▶▶▶▶ What plant population did you determine was present in your field?
- ▶▶▶▶ What effect do you think plant population has on yield?
- ▶▶▶▶ How uniform was the plant spacing in the rows you checked?
- ▶▶▶▶ Why do you think that is important?
- ▶▶▶▶ If you check seed population, how uniform was your planting depth?
- ▶▶▶▶ How can a farmer change the plant population?
- ▶▶▶▶ How close was the average number of plants counted to the number of seeds planted?

Corn

For corn, the table below indicates the length (feet) of row equal to 1/1,000 of an acre at various row spacings:

Row Width in Inches	Length of Row in Feet Equal to 1/1,000 Acre
7	74' 9"
10	52' 3"
15	34' 10"
30	17' 5"
36	14' 6"
38	13' 9"

- 1 At four different locations in your field use a tape measure and flags to mark the length of row that equals $\frac{1}{1,000}$ of an acre. You can find the length of row that equals $\frac{1}{1,000}$ acre from the table on the previous page. For example, if your rows are 30" apart, you would measure off 17'5" in a row.
- 2 Count the number of plants in each of the four marked areas.
- 3 Record the numbers below.
- 4 Calculate the average of all four of your measurements. Multiply this number by 1,000 to get the number of plants per acre.

Corn plants in my field:

Row spacing _____

Row length to check _____

Sample Area	Example	Number of Plants or Seeds Counted in Row Length
1	36	
2	40	
3	37	
4	39	
Total	152	

Total \div 4 = (Average number plants/seeds in row length) \times 1,000 = _____ plants/acre

EXAMPLE

$152 \div 4 = 38 \times 1,000 = 38,000$ plants per acre

- Did your experiment show that the plant populations were near the recommended 28,000 to 32,000 plants per acre for corn?
- If you counted seeds, was your final stand close to the percent germination listed on the seed bag?

Project or Exhibit Ideas

- 1 Teach a younger 4-H'er how to count corn or bean stands.
- 2 Develop a map showing the locations in each field you checked and stand counts. Can the map help explain the differences?
- 3 Create a field journal and compare the stand counts to the final yields.



Did you know?

Plant Stands and Yield



- ▶ Plant population, the number of plants per acre, will have an effect on final yields. Ideally, corn harvest stands of 28,000 to 32,000 plants per acre and soybean harvest stands of 100,000 to 150,000 plants per acre are recommended. To get these stands, increase your planting rate based on the seed's percent germination.
- ▶ Plant stands that are less than the ideal populations will cause lower yields because the crops will be slow to develop a canopy over the soil. Then it will be easier for weeds to start growing and compete with crops for available nutrients and moisture. On the other hand, plant stands with too high a population also will result in lower yields because the plants will become tall, weak stemmed, and lodge or bend. Corn plants will not pollinate properly and will produce fewer kernels per ear. This also makes harvesting the crop more difficult and more of the crop may be left in the field.
- ▶ The number of seeds per acre to plant depends on the hybrid or variety you choose, soil fertility, and amount of rainfall.
- ▶ Row spacing also can influence crop yields. For many years, farmers planted corn and soybeans in 40-inch rows. More corn is being planted in 30-inch rows rather than wider rows. Soybeans respond even more than corn to narrower row widths. Some soybeans are being planted in row spaces of 15 inches and less. With narrower rows, crop plants make better use of available sunlight. They also help conserve moisture by shading more of the soil surface, particularly early in the growing season.

Not all seeds will germinate and produce a growing plant, so check the seed bed for plant extra seed.

Did you know?

Those Pesky Pests

CHAPTER 7

Protect Your Plants

Crop plants, whether they are grown in a field or garden, have natural enemies—weeds, insects, and diseases. Crops must be protected from these enemies if you are to produce maximum yields. But what is the “best” way to protect plants? The only correct answer is Integrated Pest Management (IPM). Integrated Pest Management is the process of determining how bad the pest is (usually how many pests), the stage of development of the plant, the stage of development of the pest, how much damage they can do to the crop, what treatments are available, and how they may be used together in a coordinated management program.

Who's Gonna Win?

Many of us know what competition is in school sports—it is the other team that you are trying to beat! Plants have competition, too; plants and weeds compete with each other for sunlight, moisture, and nutrients.

This activity will study the effect of weed competition on the corn plant.

Materials

Three containers with drainage holes
(clay pots or ice cream buckets
with holes in the bottom)

Soil from three
different locations
Corn seeds

- 1 Collect some soil that contains weed seeds. You can get some from a fence row, pasture, or a field that has not been treated with herbicides.
- 2 Prepare three containers in which to grow corn. You can use clay pots, 3-pound coffee cans, or ice cream buckets. If you use coffee cans or ice cream buckets, punch some holes in

Herbicides are helpful in controlling weeds, but they can be harmful to crops and people if misused.

Did you know?

the bottom for drainage. Put a layer of gravel in the bottom of the containers before you fill them with soil to help drain excess water.

- 3 Label the containers 1, 2, and 3; then do the following.
 - Fill container 1 with soil collected from the fence row, pasture, or field. Plant two corn seeds about 1 inch deep in the soil.
 - Fill container 2 with vermiculite or potting soil. Plant two corn seeds about 1 inch deep in the soil.
 - Fill container 3 with vermiculite or potting soil and plant eight corn seeds about 1 inch deep in the soil.
- 4 Water the containers occasionally, but do not waterlog the soil. Keep the containers outdoors and make sure that they receive full sunshine.

Look for the following things as you compare the corn plants in containers 1, 2, and 3:

- **Leaf color**—The color of the leaves can be an early indication that the plant is not receiving enough nutrients. (See *Missing Plant Nutrients* on page 23 for more information on the effects of nutrient deficiencies.)
 - **Stunted growth**
 - **Poor leaf development**
- 5 Observe the corn plants for 1 month, and record your observation for each container in this chart or in your journal.

Observations of corn plants:

	Leaf Color	Plant Height	Number of Leaves	Other Observations
Container 1				
First Week				
Second Week				
Third Week				
Fourth Week				
Container 2				
First Week				
Second Week				
Third Week				
Fourth Week				
Container 3				
First Week				
Second Week				
Third Week				
Fourth Week				





- ▶▶▶ Compare leaf color, root development, and number of leaves counted among each of the containers from week to week. What can you say about the role of competition in growing healthy plants?
- ▶▶▶ What other factors could have affected color, root, and leaf development?
- ▶▶▶ How did container 1 compare with container 3?
- ▶▶▶ How does competition affect field crops?

Some insects are beneficial and some can damage crops.

Did you know?

- 6 After the fourth week, remove the plants from the containers and observe the root development. Do you notice any differences in root development among container 1, 2, and 3?

- If so, what are the differences? _____
- What conclusions can you make based on your observations? _____

Those Nasty Weeds

- ▶▶▶ A weed is simply any plant growing in a place where it is not wanted or needed. Weeds compete with crops for water, sunlight, and nutrients. The two basic types of weeds are grasses and broadleaf weeds. The first step to take in controlling them is to identify the weeds in your field. Several of the common weeds in Iowa can be seen in Extension publication NCR 281, *Weeds of the North Central States*; your county Extension office should have a copy. In addition, Internet sites listed at the end of this book may be helpful. A useful website for weed identification and information is www.weeds.iastate.edu.
- ▶▶▶ Weeds usually are controlled by mechanical cultivation, cultural practices, and chemicals (herbicides). If you know what the weed is and what its life cycle is, you can make the best decision about which practice or practices to use. You learned about weed life cycles in Level 1.



Tillage

- ▶▶▶ Tillage can be used to help control weeds. Tillage can be used independently or in combination with chemical and cultural weed control methods. It is most effective when done while the weeds are still small and before they become a problem. Tillage can be done with several different implements; disk, spring-tooth harrow, field cultivator, rotary hoe, and cultivator.

Cultural Management

- ▣ Cultural practices are another way of controlling weeds. Planting weed-free seed is an economical cultural practice that helps to control weeds in crops. Rotating types of crops, such as corn, soybeans, and alfalfa, will aid weed control. Rotation exposes the weed population in a field to various combinations of chemical and mechanical control processes. Adjusting the plant population at the time of planting also is an effective weed management tactic.

Chemical Management

- ▣ Herbicides kill many types of weeds without killing the crop plant.
- ▣ The three basic timings of herbicide applications include the following.

1 Preplant-incorporated

This type of herbicide is applied and worked into the soil before the crop is planted.

2 Preemergence

This type is applied after planting the crop, but before the crop and weed plants emerge from the soil.

3 Postemergence

This type of chemical is applied over the young crop and weed seedlings after they have emerged from the soil. There are two groups of postemergence herbicides.

- *Contact* herbicides kill only the part of the plant that they contact. However, if the plant cannot survive without the part of the plant that is killed, the plant will die.
- *Systemic*, or translocated, herbicides enter the plant, move throughout the plant, and kill the plant. If killing the root is important, as in the case of biennials and perennials, a systemic herbicide may be required.



Project or Exhibit Ideas

- 1 Create a display comparing crops with competition and without competition.
- 2 Keep a photo journal of actual crop fields with a lot of weed competition.
- 3 Duplicate this activity but create different levels of weed competition by selectively thinning out some of the weeds in a few containers. How do the results compare?

Let's
DO
something!

Crop Scouts Needed

Scouting means checking your crops to see if pests are present. If pests are present, they must be identified. Next, determine if the pest problem is bad enough that control is necessary. When there are enough pests present to reduce yields, pests need to be controlled. This amount of pest population is called the economic threshold level. When the economic threshold level has been reached, you must select the best control methods. This pest management technique is called Integrated Pest Management or IPM.

In this activity you will learn the basic process of scouting for crop pests. You can use the same method to scout for weeds, insects, or disease pests.

Materials

Field to scout
Bright colored flags or stakes
Bright colored cloth
GPS unit or map of the field
Crop Scouting Form from page 63 or the computer companion
Measuring device

- 1 Choose a minimum of five areas at random to scout in the field. These areas should be away from the edges of the field. Also avoid waterways and drainage areas to get a true picture of the pest level. Go out into the field when your crop is young.
- 2 Mark the five or more different areas with bright colored plastic flags or stakes. Mark off 20 plants in each area. To help relocate your areas each time, make a map of how many rows each area is from the edge of the field and how many paces you have to walk into the field to get to each area. Also, you could tie a bright colored cloth on the fence at the end of the row where each area is located. If you have access to a Global Positioning System (GPS) unit, you could record the coordinates of each area.
- 3 Record your findings on the Scouting Form at the end of this book. Additional copies of the *Crop Scouting Form* are available on your computer companion.

Your county Extension office or crop consultant can help you identify insects.

Did you know?



Measure extended leaf height from the soil level to the tip of the highest extended leaf.

How to fill out the Scouting Form:

- Record the year.
- Record the date you scout the field. Use a separate form for each scouting trip. Record all five areas of the field on one form.
- In each of the five areas, measure the height of 10 plants from soil to the extended leaf tip and record the average height in inches. The extended leaf tip is the tip of the highest leaf as far as you can hold the tip up from the ground.
- Circle the soil conditions and weather conditions at the time of scouting.
- The insects and disease symptoms found should be recorded in those sections of the form. Record the number of insects found for the 20 plants in each area. For diseases, record the number of plants showing a particular disease symptom.
- To determine the percent of plants affected, divide the total number of each organism by the total number of plants examined; then multiply by 100 and record this figure.



- ▶▶▶▶ What pests did you find in your field?
- ▶▶▶▶ Were they at levels high enough to treat or control?
- ▶▶▶▶ How many different kinds of pests did you find?
- ▶▶▶▶ What time of year did you find the most pests?
- ▶▶▶▶ How did you use your scouting results to make crop management decisions?

EXAMPLE

Percent of plants cut or fed on by black cutworms (BCW):

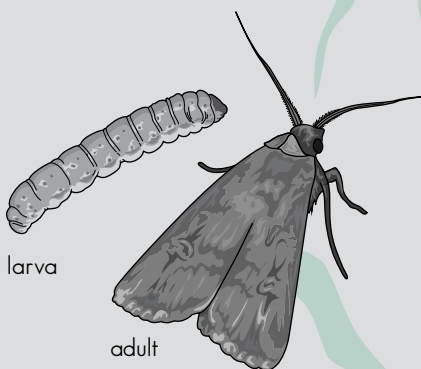
	Area						Total	Total Number of Plants in All 5 Areas	Percent of Crop Affected
	1	2	3	4	5	Total			
BCW	3	2	5	1	0	11	100	11	

$11/100 = .11 \times 100 = 11\%$



Project or Exhibit Ideas

- 1 Keep a journal of your scouting results. Share this with your helper.
- 2 Create a display showing a map of your field and the pests you found.
- 3 Create a poster showing various stages of an insect or weed pest. Share this at your local elevator.
- 4 Contract to scout fields for a neighbor.
- 5 Start an entomology collection.



larva

adult

Black cutworm.

- For the weeds section of the Scouting Form you will need one square meter or square yard section in each of the five areas. Count the number of weeds in those sections. Record your findings on the Scouting Form. Total the number found from the five areas; divide by five to get the average number of weeds per square meter or square yard.
- Be sure to mark the areas scouted for weeds on the map on the form. This map represents only one field. It has been divided into four sections to help you map where to scout each time.
- Describe damage symptoms, and write any other comments you want to make in the space for Descriptions and Comments at the bottom of the form.

The scouting techniques listed here have been simplified. If you want more specific scouting details, use Extension publications that are available for many of the common crop pests. Check with your county Extension office for the publications.

Corn Insects

➡ The three major corn insect pests are black cutworm, European corn borer, and corn rootworm. All three insects have complete metamorphosis. Review Level 1 for more information on insect life cycles.



- **Black cutworm** does not survive over winter in Iowa. Black cutworm moths may fly into Iowa on southerly winds in the spring and lay eggs. When larvae are about the length of the diameter of a dime and the corn plants have fewer than five leaves completely unrolled from the whorl, black cutworms may severely damage or kill the young corn plants. Young larvae (less than $\frac{3}{4}$ inch long) feed only on leaves. Older larvae (over $\frac{3}{4}$ inch long) can cut through plants. This insect is generally managed with insecticides, if necessary.
- **European corn borers** survive over winter as larvae. Mature larvae are one inch long and have a dark head. Young larvae are a dull white while older larvae are dirty white to tan with darker, halo-shaped spots and a dark line down the center of the back. There are usually two generations per year. They feed on leaf tissue and pollen and may tunnel into the midrib of the corn leaves. Older larvae will bore into the stalk and, in late summer, the ear shank and the ear. They weaken the plant and reduce yield, making stalks more likely to rot and plants more likely to

lodge or drop their ears before harvest.

The European corn borer moths (adults) are attracted to the tallest corn, which is the early planted corn for the first generation and the late planted corn for the second generation of the insect. Many producers use this fact to manage the insect by trying to not plant the first or the last corn in the area, so that the corn will be less attractive to the moths at any time during the year. In the mid-1990s, Bt corn, which is resistant to European corn borers, was introduced. Bt corn produces a Cry protein that is poisonous to the European corn borer.

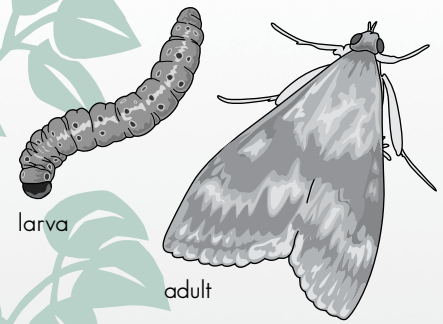
The toxic protein is produced due to a gene inserted into the corn from a bacterium called *Bacillus thuringiensis*, or Bt. Some producers apply a product containing the Bt protein to corn fields.

Finally, several insecticides are available for control of European corn borers and are sometimes applied.

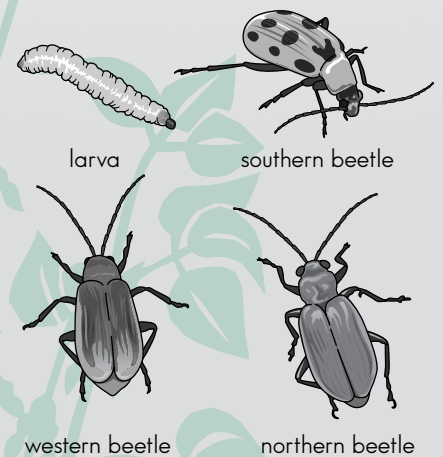
- **Corn rootworms** survive over winter as eggs, which hatch in early June. The slender white larvae (worms) have a dark head and a black plate on the top of the last segment. They grow to a length of about $\frac{1}{2}$ inch before pupating and turning into the adult beetle. Corn rootworm larvae feed on corn roots, causing yield loss and making the plants more likely to lodge in a strong wind. Lodging makes harvesting more difficult and increases the amount of corn missed during harvesting. Three species of adult corn rootworm beetles (western, northern, and southern) may be found in a field, beginning in July, and may rarely cause damage if they feed on silks before pollination. If the silks are clipped to within $\frac{1}{2}$ inch of the end of the ear, pollination may be poor, causing ears without kernels. This insect is most often managed by using a crop rotation. Adult beetles lay their eggs in corn fields. If next year's corn field was not corn this year, corn rootworms will generally not be present to feed on corn roots. Chemical control is also available through several rootworm insecticides. Planting Bt corn with a Cry protein to control corn rootworm larvae is also possible.

- Some other common corn insects include seedcorn maggots, white grubs, and wireworms, which attack seeds. Stalk borers drill into the stalks of young plants, severely stunting or killing them. Armyworms feed on the leaves.

More information on insects can be found at the ISU Department of Entomology website, www.ent.iastate.edu/imagegallery/.



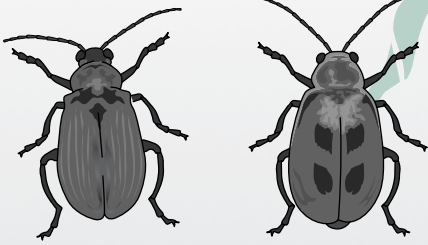
European corn borer.



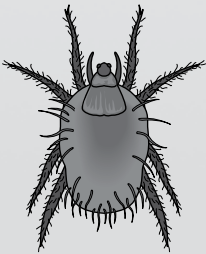
Corn rootworm.

Soybean Insects

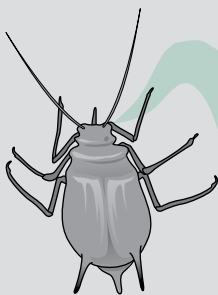
Three common soybean insects are bean leaf beetles, spider mites, and soybean aphids. Bean leaf beetles have complete metamorphosis while spider mites and soybean aphids have gradual metamorphosis (as explained in Level 1).



Bean leaf beetle.



Spider mite.



Soybean aphid.

- Bean leaf beetles** are small, drab brown, red, or yellow beetles, and usually spotted. They always have a black triangular spot behind the neck. They overwinter as adults, which feed on the hypocotyl and cotyledons and sometimes on the foliage of young soybean plants. Damaged leaves look as if they have been shot full of holes. The beetles lay eggs and later die. The first generation hatches, the larvae feed on soybean root nodules, the larvae pupate, and the adults emerge to lay eggs. The second generation then hatches, larvae feed on nodules, the insect pupates, and beetles emerge to feed on leaves and pods late in the growing season. Late season feeding can severely reduce yields and lower seed quality. This insect also carries bean pod mottle virus from plant to plant. Bean leaf beetles that survive the winter are attracted to soybean fields that emerge earliest in the year. Some producers may avoid planting early to reduce problems from this insect. Several insecticides are available for chemical control.
- Spider mites** are technically not insects—insects have six legs and adult spider mites have eight legs. However, spider mites are very much like insects. They can be found in soybean fields from July through August and can be a serious problem under dry weather conditions. Spider mites can complete a generation in 5 to 7 days. They are very small (about the size of a grain of pepper) and greenish-white with a dark spot on each side of the body. They feed on leaf sap and leave a fine, white webbing on the undersides of leaves. Mite injury first causes tiny, yellow dots on leaves, then leaf yellowing, browning, eventual leaf death, and, if severe enough, death of the plant. In most years, natural enemies already in the field maintain the population at levels so low that other management is not needed. Several insecticides are available for chemical control.
- The **soybean aphid** was first reported in Iowa in 2000. Soybean aphids are about $\frac{1}{16}$ inch in length, pale yellow



Scouting Calendar for Corn Insects

Corn Growth	Insect	Calendar	Comments
Emergence and early whorl	Black cutworm	300 degree days (base 50° F) after significant moth flight; often mid-May to early June	See ICM newsletter for scouting dates
Mid-whorl	Corn rootworm larva	Early to mid-June	Mostly in continuous corn
Mid- to late-whorl	European corn borer (first generation)	June through early July; begin when corn reaches "knee height" or 200 degree days (base 50° F) after first moth flight	Most common in earliest planted fields
Silk	European corn borer	Late July through August	Most common in latest planted fields
Silk	Corn rootworm adult	Late July through August	

or green, and have dark-tipped cornicles (tail pipes) on the back of their abdomen. They feed on soybeans through piercing-sucking mouthparts. They carry a number of plant virus diseases including soybean mosaic and soybean stunt. Soybean aphids seem to do better in cooler temperatures and lower humidity. They cause leaf distortion by sucking the plant liquids from leaves. Lady beetle larvae are a natural predator of the soybean aphid and help to control them. Several insecticides are available for chemical control.

- More information on insects can be found at the ISU Department of Entomology website, www.ent.iastate.edu/imagegallery/.
- IPM information can be found on the following webpages:
 - ISU Pest Management and the Environment, www.pme.iastate.edu/
 - ISU Weed Science, www.weeds.iastate.edu/Default.htm
 - ISU Department of Entomology, www.ent.iastate.edu/
 - ISU Department of Plant Pathology, www.ag.iastate.edu/departments/plantpath/PlantPath.html
 - ICM Newsletter, www.ipm.iastate.edu/ipm/icm

Some insects are beneficial and shouldn't be killed

Did you know?

Adding Value

CHAPTER 8

Let's
DO
something!

What's New?

Value-added agriculture converts agricultural outputs such as soybeans and corn into products of greater value. Value-added agriculture serves to increase the money that Iowa producers receive for their products. It also gives farmers the opportunity to be involved in more aspects of processing their grain.

This exciting new area is providing new opportunities almost daily for producers and others with agricultural-related careers. For more information, visit the following Internet sites:

- Iowa Soybean Association, www.iasoybeans.com/isa/index.html
- Iowa Soybean Promotion Board, www.iasoybeans.com/ispb/index.html
- Iowa Corn Growers Association, www.iowacorn.org/icga.htm
- Iowa Corn Promotion Board, www.iowacorn.org/icpb.htm
- ISU Center for Crops Utilization Research, www.ag.iastate.edu/centers/ccur/
- ISU Extension Value Added Agriculture, www.extension.iastate.edu/Pages/valag/homepage.html

Materials

Computer with Internet access
Pencil and paper

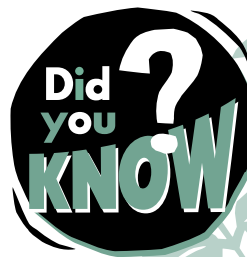
- 1 Explore three of the websites listed above.
- 2 Make a list of five value-added products for corn and five for soybeans. How many of these are you using at home or school? Which are new products that you were not aware of? Where can you purchase them?
- 3 Visit with some area crop producers. How many products do they use from your list? Be sure to ask them why they do or do not use these products made from soybeans or corn.

- ▮▮▮ How many new products did you learn about?
- ▮▮▮ Why is it important to keep developing new products using soybeans and corn?
- ▮▮▮ What value-added businesses are located in your community or area?
- ▮▮▮ How might you help make some of these products more available in your area?



Project or Exhibit Ideas

- ① Create a poster or display showing some of the new products you researched.
 - ② Talk to an elementary class about new uses for soybeans and corn during Ag Week.
 - ③ Work with your local corn or soybean growers group to start distributing some of these new products in your community.
 - ④ Visit with your local fuel suppliers to ask if they are providing renewable fuels like ethanol and soy diesel.
- ▮▮▮ Soybeans are being used to make paint strippers that are safer for the environment.
 - ▮▮▮ Some spray-on foam insulation is made from soybeans.
 - ▮▮▮ Soybean oil is being used to control dust on gravel roads.
 - ▮▮▮ Corn starch is used to make biodegradable plates, silverware, straws, and garbage bags.
 - ▮▮▮ Corn products are used for all kinds of cleaners, including shampoos, soaps, carpet cleaners, and more.



Other Internet Resources

- Value Added: Iowa Agricultural Opportunities—Organic Production, www.iowaagopportunity.org/organicprod/ophomepage.html
- ISU Extension—Organic agriculture, extension.agron.iastate.edu/organicag/
- ISU Extension—Iowa Grain Quality Initiative, www.extension.iastate.edu/Pages/grain

Crop Careers

CHAPTER 9



Careers That Dig Dirt

In this level of the crops project, you've learned a lot about the environment and its effect on your crop, and the many decisions you need to make to produce a crop. Throughout this guide we have focused on soils, environmental factors affecting crop production, seed selection, pest management, and plant nutrition.

- 1 Look back at each activity in this manual. List one career opportunity you might be interested in related to each activity.

Activities	Career Opportunity



2 Select two that are of most interest to you and explore them further. Consider why you would like them. Some questions to consider include:

- What are the main duties of this job?
- What type of education is needed for this job?
- What high school classes are needed to prepare for this job?
- What physical abilities are needed for this job?
- How often does this job involve working with people, objects, information, animals, or plants?
- What is the average income for a person in this type of job?
- In what kind of surroundings would a person in this job work?
- Are there a lot of employment opportunities in these careers?

3 Write in the box below what you would like or dislike about each of the two options.

- ▣▣▣▣ What did you learn about yourself as you explored these career options?
- ▣▣▣▣ If you had this kind of job, what type of friends might you develop through your job?
- ▣▣▣▣ How might this job affect your future family?
- ▣▣▣▣ Is this the kind of job you would do your entire career, or is it a “career starter” job?

Likes	Dislikes



Project or Exhibit Ideas

- 1 Create a display showing some different career opportunities in the field of crop production or processing.
- 2 Keep a journal of the career options you explore. List the advantages and disadvantages of each, and compare these to your personal likes and dislikes. How has that changed over time?
- 3 Begin developing a high school education plan that will lead you toward these career options.

Other Resources

(publications available from your county Extension office)

- AG 18, *Iowa Crop Performance Test—Soybeans*
- EDC 162B, *Value Added Agriculture*
- EDC 194, *Identifying Valuable Corn Quality Traits for Starch Production*
- EDC 195, *Identifying Valuable Corn Quality Traits for Livestock Feed*
- PM 660 (District 1 to 7), *Iowa Crop Performance Test—Corn*
- PM 1584, *Cornstalk Testing to Evaluate Nitrogen Management*
- PM 1688, *A General Guide for Crop Nutrient and Limestone Recommendations in Iowa*
- PM 1714, *Nitrogen Fertilizer Recommendations for Corn in Iowa*
- PM 1885, *Corn Planting Guide*
- PM 1851, *Soybean Replant Decisions*
- PM 1945, *Soybean Growth and Development*
- SR 48, *How a Corn Plant Develops*
- ST 8, *Soil Sample Information Sheet*
- NMEP 1, *Soil Testing*
- NMEP 2, *Phosphorus Application*
- NMEP 3, *Manure Resources*
- NMEP 4, *Residue Management*
- NMEP 5, *Crop Rotation*
- NMEP 6, *Crop Yields*
- NMEP 7, *Nitrogen Application*
- NMEP 8, *Nutrient Management Plan*
- NMEP 9, *Equipment Calibration (the Senior section)*
- NMEP 10, *Conservation Reserve Program*
- NMEP 11, *Conservation Practices*

Internet Sites

- ISU Extension Agronomy Department, extension.agron.iastate.edu/ (for soil fertility, weed management, water quality, soil and land use, soybeans, etc.)
- ISU Extension Agricultural and Biosystems Engineering—Extension and Outreach, www.abe.iastate.edu/extension_outreach.asp
- Iowa Corn Growers Association, www.iowacorn.org/icga.htm
- Iowa Corn Promotion Board, www.iowacorn.org/icpb.htm
- Iowa Soybean Association, www.iasoybeans.com/isa/index.html
- Iowa Soybean Promotion Board, www.iasoybeans.com/ispb/index.html
- ISU Center for Crops Utilization Research, www.ag.iastate.edu/centers/ccur/
- ISU Extension Value Added Agriculture, www.extension.iastate.edu/Pages/valag/homepage.html
- ISU Extension Entomology, www.ent.iastate.edu/
- ISU Extension Plant Pathology, www.extension.iastate.edu/Pages/plantpath/



Crop Air Temperature Worksheet

Name _____

Address _____

Township and Section Number _____

Air Temperature Record

Air temperatures can be taken at 12:00 (1:00 p.m. DST) and/or you may record the high and low temperatures for the day. The high and low temperatures may be used to calculate growing degree days.

Day	April			May			June			July			August			September		
	Temperature	Temperature	Temperature	Temperature	Temperature	Temperature	Temperature	Temperature	Temperature	Temperature	Temperature	Temperature	Temperature	Temperature	Temperature	Temperature	Temperature	
	12:00	High	Low	12:00	High	Low	12:00	High	Low	12:00	High	Low	12:00	High	Low	12:00	High	Low
1																		
2																		
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Were temperatures about normal? _____

How did temperatures influence your crop? _____

If you calculated growing days, was it for a crop or insect pest, and on what dates (based on growing degree days) did your crop mature or did the insect pest become a problem?



Crop Scouting Form

Map of
scouted areas

Crop _____
Date _____
Name _____

Plant Height
(average 10 plants)

Soil (Circle one of each)
Temperature—wet, moist, dry
Condition—loose, light crust, hard crust

Weather (Circle one of each)
Air temperature—cool, warm, hot
Wind—calm, light, strong
Cloud cover—partly sunny, cloudy, rainy

Name of Insects Found Is It Causing Damage?	Number per Area Scouted						Percent of Corn/Soybean Plants Affected
	1	2	3	4	5	Total	%
1.							
2.							
3.							
4.							
5.							
6.							

Name of Disease Symptoms Found	Number of Plants Affected						
1.							
2.							
3.							
4.							
5.							
6.							

Name of Weeds Found	Number per Square Yard or per Square Meter					Average Number/m ² or yd ²
1.						
2.						
3.						
4.						
5.						
6.						

Plant Population	Number of Good Plants					Average Population
1.						

Scouting Instructions

- 1 Select one or more of the crop pests to scout. Scout the same field throughout the season.
- 2 Choose five areas at random to scout in the field. These areas should be away from the edges of the field; also avoid waterways and drainage areas to get a true picture of the pest level.
- 3 Go out into the field when your crop is young. Mark the five different areas with bright colored plastic flags or stakes. Mark off 20 plants in each area. To help relocate your areas each time, make a map of how many rows each area is from the edge of the field and how many paces you have to walk into the field to get to each area. Also, you could tie a bright colored cloth on the fence at the end of the row where each area is located.
- 4 Record your findings on the Scouting Form.
- 5 How to fill out the Scouting Form.
 - a. Record your year in this activity.
 - b. Record the date you scout the field. Use a separate form for each scouting trip. Record all five areas of the field on one form.
 - c. In each of the five areas, measure the height of 10 plants from soil to the extended leaf tip and record the average height in inches.
 - d. Circle the soil conditions and weather conditions at the time of scouting.
 - e. The insects and disease symptoms found should be recorded in those sections of the form. Record the number of insects found for the 20 plants in each area. For diseases, record the number of plants showing a particular disease symptom.
 - f. To determine the percent of plants affected, divide the total number of each organism by the total number of plants examined and then multiply by 100 and record this figure.

EXAMPLE

Number of plants cut or fed on by black cutworms:

Area:	1	2	3	4	5	Total	Total Number of Plants in All 5 Areas	Percent of Crop Affected
	3	2	5	1	0	11	100	11

$$11/100 = .11 \times 100 = 11\%$$

- 6 For the weeds section of the Scouting Form you will need one square meter or square yard section in each of the five areas. Count the number of weeds in those sections. Record your findings on the Scouting Form. Total the number found from the 5 areas; divide by 5 to get the average number of weeds per square meter or square yard.
- 7 Be sure to mark the areas scouted for weeds on the map on the form. This map represents only one field. It has been divided into four sections to help you map where to scout each time.
- 8 Describe damage symptoms, and write any other comments you want to make in the space for description and comments at the bottom of the form.

Note: The scouting techniques listed here have been simplified. If you want more specific scouting details, use Extension publications that are available for many of the common crop pests. Check with your county Extension agriculture staff person for the publications.



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