LSU AgCenter
Research & Extension

4-H Project Book

Agronomy

7th – 8th Grade Level

18 USC 707

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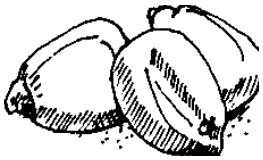

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Introduction

In the 6th grade project book you were introduced to the agricultural science of agronomy. You learned some basic principles of growing field crops and something about the most important ones in Louisiana. In this book you'll continue to learn about our Louisiana soils and what is important in a soil for good plant growth.

The first step in crop production is planting good seed. The seed and its importance to plant growth will be carefully examined. You'll make a seed collection and learn about regulations on selling seed.

Since we began to grow plants for food and fiber we have been trying to develop new, improved types. You will learn about the fantastic world of plant breeding and how we continue to feed and clothe the world because of this science. You will also learn the basics of genetics and plant reproduction.

Finally, you will look at a new science, that of weed control. Herbicides, identification and collection of weeds, and noxious weeds will all be discussed.

Project Requirements

What you will learn in Seventh Grade **7**

- The parts or makeup of our soils
- How soil texture and organic matter affect water-holding ability of soils
- About different soils in Louisiana
- About soil loss and ways to conserve soil
- How to find out what a soil needs to grow plants
- Some of the ways to tell whether seed are good to plant

Seventh Grade Requirements

Complete the following activities and report your results in the report section on page 28.

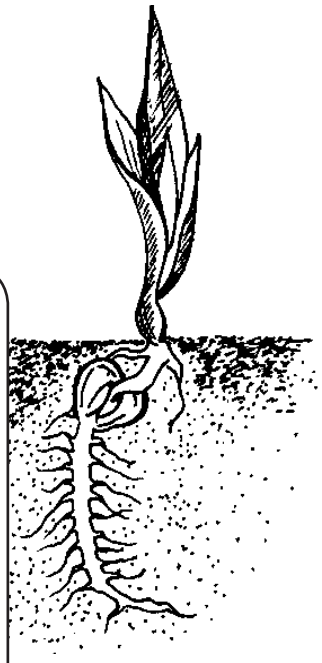
Activity 1 - Soils of Louisiana

Activity 2 - Soil Erosion and Conservation

Activity 3 - Soil Testing

Activity 4 - What's on a Seed Tag?

Activity 5 - Seed Germination



What you will learn in Eighth Grade **8**

- About the Louisiana Seed Certification Program
- How to identify different seed
- How to make a seed collection

Eighth Grade Requirements

Complete the following activities and report your results in the report section on pages 29 and 30.

Activity 6 - Learning About Certified Seed

Activity 7 - Making a Certified Seed Collection

Activity 8 - Making a Crop Seed Collection in the Field

Activity 9 - Making a Weed Seed Collection

Chapter I.

Understanding the Soil and its Characteristics

Soil Makeup

Soils are composed of mineral matter, organic matter and pore space (empty space). Each of these components is vital to the overall productivity of a soil. You learned about the mineral and organic components of soil in the sixth grade project book. Now, let's look at the role pore space plays in soil productivity.

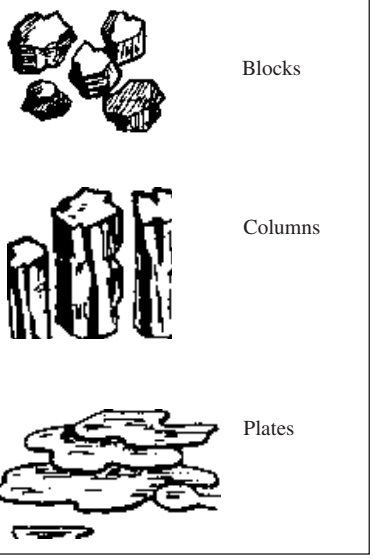
It may not seem that pore space, or empty space, would have much influence on soil productivity, but it does. This is because pore space determines the air and water movement in the soil. Ideally, a soil should contain 50% pore space and 50% combined mineral and organic matter. Of the 50% of the soil that is pore space, about one-half should contain air and one-half should contain water.

If the pore space contains a high percentage of air and a low percentage of water, plants will suffer from a lack of water. If the pore space contains mostly water, the roots will suffer from a lack of oxygen. It is vital that the pore space in the soil be equally filled with air and water.

One of the determining factors in how pore space is filled is the soil structure. Soil structure is the way individual soil particles are grouped together to form larger particles of soil. Soil may occur in single grains, or small particles may stick together to form granules. Larger groupings of these granules may be in forms which resemble **blocks, columns** or **plates** (fig.1)**.**

Soil structure helps determine how well air and water can enter the soil, how much water the soil can hold and how well roots can grow through the soil.

Figure 1. Soil Structure



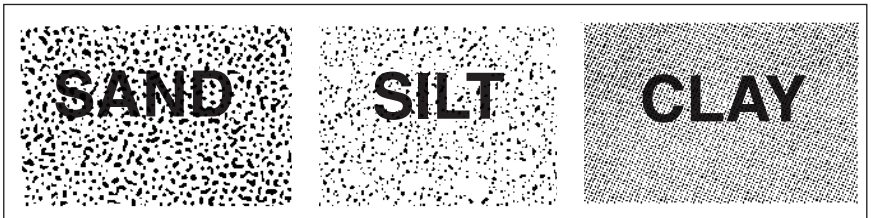


Figure 2. Soil texture

Soil - Water Relationships

Soil texture also determines how much water a soil can hold. **Sands** are large particles with large pore spaces, and water flows through, or percolates, quickly. **Clays** are very small with very small pore spaces, and water percolates very slowly through these soils. **Silts** are particles which are larger than clays and smaller than sand. Water flows through silts at a medium speed (fig.2).

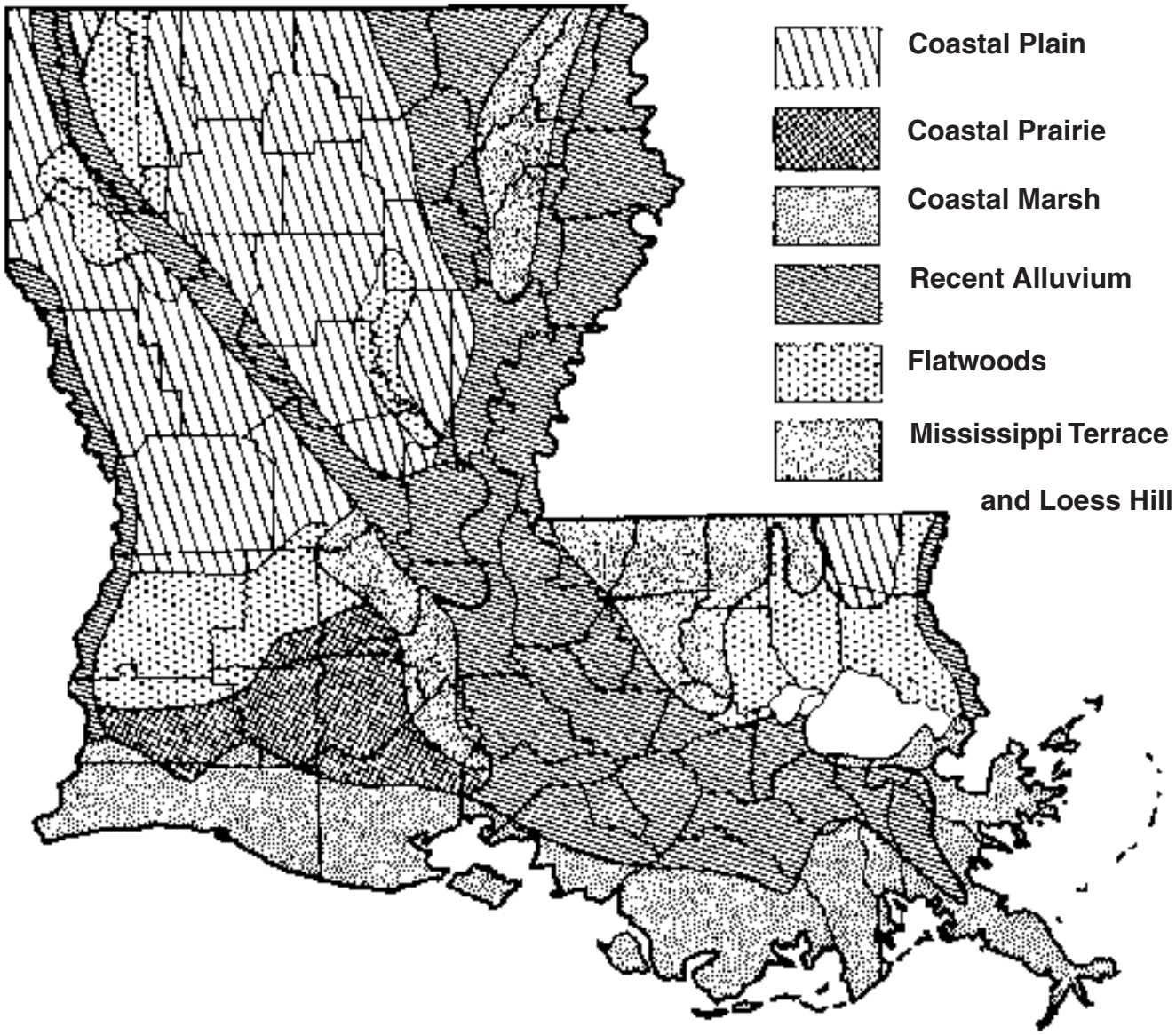
Clays also hold water very tightly. In fact, they can hold water more tightly than a plant can extract it. This is why plants can be in a drought in a clay soil even though there is some water in the soil.

Silt loams are ideal in their ability to supply water to a plant. This is because silt loam soils have pore spaces large enough to have good internal drainage and small enough to hold some water. Also the silt does not hold water to itself as tightly as clays, and plants can extract water more easily.

Organic matter also adds to the water-holding capacity of a soil. Soils with more organic matter will hold more water than soils with less organic matter.

In summary, sandy soils with low organic matter have little water-holding capacity. Clay soils hold a great deal of water, but hold it so tightly plants may not be able to get it. Silt loam soils with high organic matter are the most productive from a water relation standpoint.

Figure 3. Soil Areas of Louisiana



Soils of Louisiana

Louisiana is blessed with a wide variety of soil areas. Some of our soils are quite old in geologic terms, and others are very recent. Soil areas in the state range from the rolling hills of north central Louisiana to the coastal marshes of south Louisiana. A great diversity of crops and forests exists in these different soil areas.

There are six major soil areas in Louisiana:

(1) Coastal Plain
(2) Mississippi Terrace and Loess Hill
(3) Flatwoods
(4) Coastal Prairie
(5) Coastal Marsh
(6) Recent Alluvium (fig.3).

The Coastal Plain is found primarily in northwestern and north central Louisiana. These soils are usually rolling hills with sandy loam topsoils and sandy clay subsoils. About 23.5% of Louisiana is Coastal Plain. Although many crops are grown on these soils, the primary crops are forests and forage and hay crops. These soils are generally infertile, acid and well-drained.

Soils of the Coastal Plain were formed in place. This means they were weathered on the site where they now occur, and were not formed somewhere else and later deposited at the site.

The Mississippi Terrace and Loess Hill region occurs in three primary areas. One is in northeastern Louisiana, one is in south-central Louisiana and one is in the western Florida parishes. These soils are usually brown with silt loam topsoils and silt loam or silty clay loam subsoils. They are moderately fertile, acid and somewhat poorly drained. Most of the soils of the Mississippi Terrace and Loess Hill region are devoted to crops. They support a wide variety of crops, particularly cotton, soybeans, sugarcane, corn and horticultural crops such as tomatoes. The Mississippi Terrace and Loess Hill Region covers about 8.4% of the state.

These soils are formed from loess. Loess is windblown silt. These soils were formed over the years by the action of wind blowing silt particles into the area.

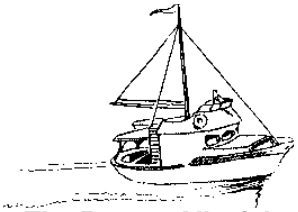
The Flatwoods region is found in scattered areas of southwest, northwest, north central and southeast Louisiana. These soils are generally silt loam or clay loam in texture, flat and poorly drained. They are naturally acid and infertile. They make up about 13.2% of the land area of Louisiana. The Flatwoods area supports many crops, primarily rice, soybeans, forests, pastures and vegetable crops.

The Flatwoods area was formed in place in ancient swamp sites. Providing good drainage is essential in making these soils productive.

The Coastal Prairie area occurs in southwest Louisiana. The soils are level, or nearly level, and are silt loams. They are acid, naturally infertile and poorly drained. They cover about 5.8% of the total land area in the state. The dominant crops in the Coastal Prairie are soybeans and rice, although pastures and other crops are also grown.

The Coastal Prairie was formed in place and was originally a flat plain covered with tall grasses.

The Coastal Marsh is a wetland soil region bordering the Gulf of Mexico. These soils are characterized by hydric (water-loving) vegetation. The marsh ranges from fresh water marsh to "brackish" (part fresh, part salt water) to the salt water marsh. The Coastal Marsh supports some pastures and rice, but it is generally not important agriculturally. The Coastal Marsh is quite important to the recreation, fur and commercial fishing industries. The Coastal Marsh occupies about 16.1% of the land area of the state.



The Recent Alluvial area consists primarily of the floodplains of the Mississippi, Red and Ouachita rivers. It is the most agriculturally important area in the state. Soils are mostly fertile and have a suitable soil pH. Soil texture varies from sandy loam to clay, depending on where the soil was deposited in relation to the river.

Alluvial means deposited by water. These soils were formed somewhere else, carried down the river and deposited when the river overflowed. Sands are the heaviest soil particles since they are the largest. Therefore, they settle out of the floodwater first. You find most of the sand in the alluvial area near the river. As you go farther from the river, silt falls out of the floodwater. You find silt farther away from the river than sand. Clays stay in suspension in water for long periods. Therefore, you find clay soils in the alluvial area in low places where water stood for long periods.

All major crops are grown in the Recent Alluvial area. The area covers about 33% of the land area of Louisiana.

Soil Erosion and Conservation

Erosion is the loss of soil caused by the forces of water or wind. In Louisiana, most erosion is from water. Erosion is damaging from both on-site and off-site effects.

On-site effects include the loss in productivity of the land because of the loss of the soil. This results in lower yields and higher costs to produce crops. On-site effects also include damage to equipment from crossing gullies and other eroded areas.

The off-site effects of erosion are also damaging. These include the silting in of ponds, rivers and lakes. Off-site erosion damages amount to billions of dollars in the United States each year.

Water erosion occurs when raindrops strike bare soil. The force of the water dislodges the soil and carries it away. Sometimes erosion moves soil only from one area of a field to another. Other times, erosion moves soil completely out of the field and into bodies of water.

There are three types of water erosion: **(1) sheet erosion, (2) rill erosion** and **(3) gully erosion.**

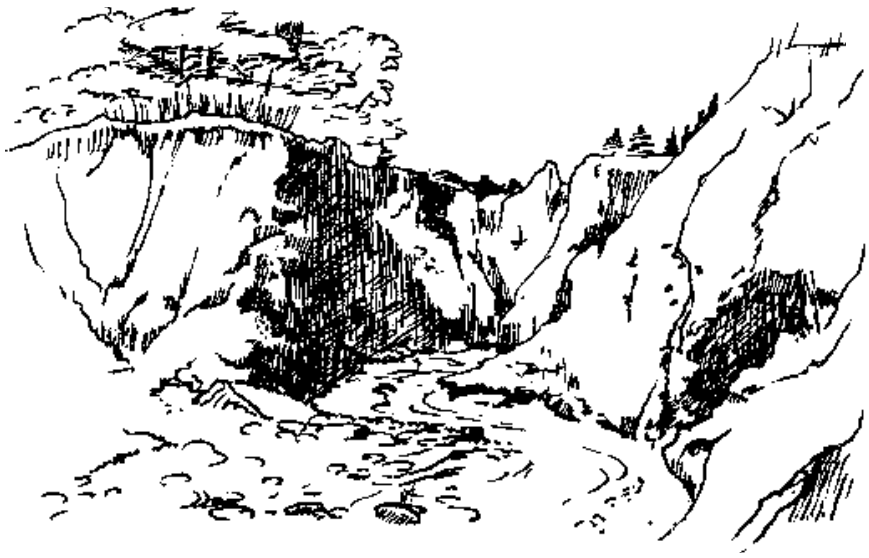
Sheet erosion occurs when water removes soil in a fairly uniform thin layer. This type of erosion is “sneaky” because it is difficult to see.

Rill erosion occurs when the soil erodes in narrow channels (fig.4). This is a common type of erosion.

Gully erosion is a more severe type of rill erosion. In gully erosion, the force of water cuts deep channels, or gullies, into the soil and moves the soil away. Some gullies may be several feet deep.

Figure 4.-Examples of erosion

Rill Erosion



Gully Erosion

There are ways to combat erosion. The main two ways are to **keep the soil covered** so that raindrops do not strike bare ground, and to **control the speed with which water moves** across the soil.

Farmers keep the soil covered by: (1) planting cover crops in the winter, (2) reducing tillage operations and leaving old crop residues on the soil surface and (3) planting crops in narrow rows so that a canopy is formed over the soil by the crop.

Water speed across the surface of the soil can be slowed by: (1) building structures such as terraces to break long slopes into shorter ones and (2) farming on the contour of hills rather than up and down the slope.

Soil Testing

In a previous book, you learned about the different nutrients plants need to grow. You also learned about the basic fertilizer elements. How can you tell how much fertilizer or lime a specific crop needs to do its best? The answer is soil testing.

A soil test helps you determine how much of a nutrient the soil can supply and how much you have to add as fertilizer for best plant growth.

There are four steps to soil testing. First, you collect a soil sample from your field, yard, garden, etc. Then, you send the soil sample to a soil testing laboratory. There, the laboratory analyzes the sample to determine its pH and nutrient status. Finally, experts interpret the results and make fertilizer and lime recommendations.

To receive reliable results from your soil test, **you must collect a good sample.** Soils vary greatly in their physical and chemical characteristics. So, you must sample in a very precise way to eliminate the variability in a field. **Follow the instructions in Figure 5 to ensure that you collect a good soil sample.**

From a soil test, you can learn the nutrient and lime status of your soil. This can help you determine how much fertilizer and lime to use. Fertilizing without a soil test may result in using more fertilizer than is needed, which wastes money. Adding more fertilizer than is needed can also harm the environment. A good soil test makes sense from both an economic and an environmental perspective.

Figure 5. Collecting a Soil Sample for a Chemical Test

You can have your soil analyzed for lime and fertilizer requirements. See your local Extension agent for instructions.

***1.** Spade out a V-shaped hole in the soil. Slice off a thin piece of soil on one of the sloped surfaces.*

***2.** Put the center of the slice in a pail.*

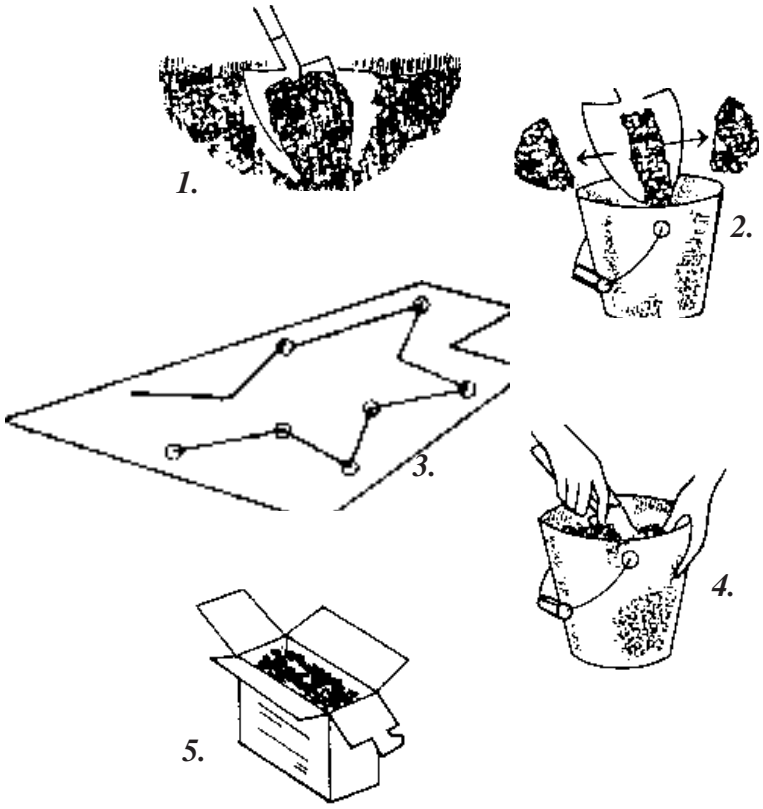
***3.** Take several samples to represent the area of soil to be tested.*

***4.** Mix the soil thoroughly in the pail.*

***5.** Fill a soil container or clean jar.*

Complete a soil testing information sheet available from your parish Extension office. Send to the LSU soil testing laboratory. See your county agent for the appropriate address.

When the results of the test are returned, study the suggested fertilization procedures with your leader or county agent.



Activity 1 - Soils of Louisiana

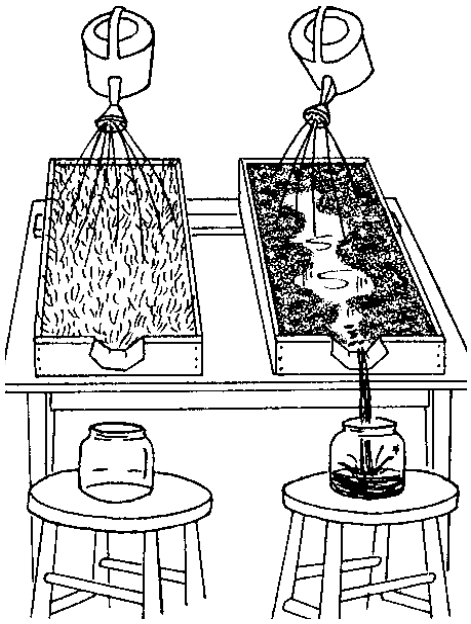
What major soil area occurs where you live? Write a short story about the major land uses in your area. Tell about the agricultural and forestry products in your area. Tell how the soil was formed or deposited in your area.

Activity 2 - Soil Erosion and Conservation

This activity shows the value of keeping soil covered to combat erosion.

You will need:

- Two small boxes about 16 inches long, 12 inches wide and 4 inches deep. (Line them with plastic to make them watertight. Cut a V notch 1-1.5 inches deep in one end of each box (see illustration).
- Two sticks of wood about 1 inch thick.
- Two sprinkler cans at least one quart in size.
- Two half-gallon wide-mouth jars.



What to do:

1. Fill both boxes with soil. In one box, add sod to the top of the soil so that the soil is completely covered with the sod. Leave the soil bare in the other box.
2. Set each box on a table, placing the sticks under the end without the notch. Let notched end hang over the table pointing at jars placed on stools below the notch.
3. Sprinkle the same amount of water slowly on each box.
4. Collect water from each box and measure amount. Record amount collected and any other differences you observe.

Activity 3 - Soil Testing

Using what you've learned about soil sampling, collect a soil sample from your crop field, lawn, garden or flower bed. Send the sample to:

Soil Testing and Plant Analysis Lab (STPAL)
Department of Agronomy
M. B. Sturgis Hall - LSU
Baton Rouge, LA 70803

Each soil sample costs $4.00. Your local Cooperative Extension Service office has information sheets and boxes you can use to mail the sample.

Chapter II. Seed and Its Production

What Are Good Seed?

Good seed are important to the farmer. The grower wants to be sure that what is planted will grow and mature normally. Several things are important:

1. The seed must germinate at an acceptable percentage.
2. The seed must be pure. This means that they should all be of the same variety and kind.
3. The seed should be free of weed seed.
4. The seed should be free of "inert matter." This is matter that is not seed but includes stones, dirt, hulls or broken pieces of seed.
5. The seed should be free of hard seed which do not absorb water and germinate easily.

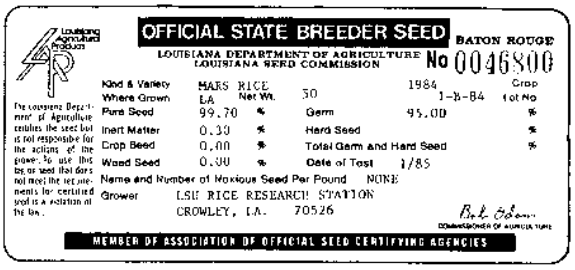
By law every container of seed sold in Louisiana is required to have a label. On it are printed in English facts about that seed which are important to the grower.

What Are Certified Seed?

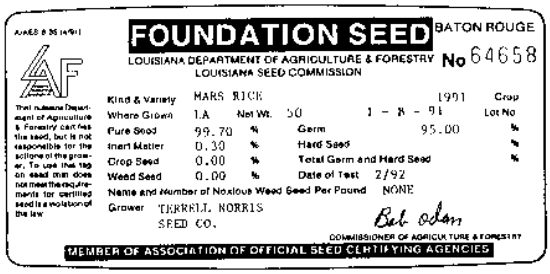
For the farmer to plant good seed it is important for someone to produce them. These seed growers are urged to enter the **State Seed Certification Program.** All farmers are urged to plant certified seed. This simply means that the seed have been checked by someone who is not biased. They check to see that the seed meet all the requirements necessary to produce a good crop. These requirements are determined by the Louisiana Seed Commission (committee of five experts who represent Louisiana agriculture). The Louisiana Department of Agriculture is the state certifying agency. **Certified seed are sold at a higher price but are worth it because the grower is assured of good quality.**

A seed producer must meet all the requirements from that crop to get his seed certified. Each crop has different standards which are determined by the Seed Commission. The seed grower must follow these regulations and have all seed fields and processed seed inspected by the Louisiana Department of Agriculture. Inspectors look at what was grown in each field the previous year. They check to see how far the seed field is from other fields of the same crop, and what weeds and diseases are present in the field. When the seed are harvested, cleaned and bagged, the inspector takes a sample and checks for purity, other crops, weed seed, inert matter (trash) and germination. All of these factors must be at acceptable levels for certification and reported on the seed tag.

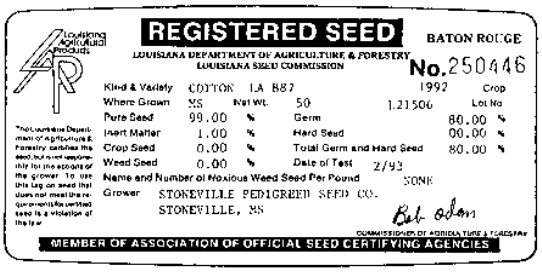
There are four classes of certified seed for agronomic crops. They are:



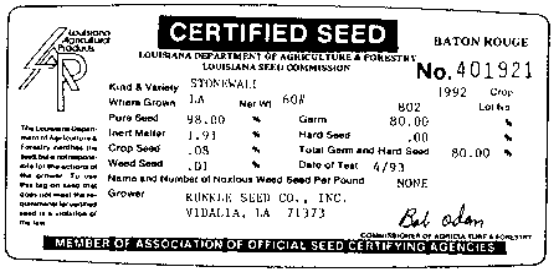
1. **Breeder seed -** These seed come from the plant breeder and have been carefully selected, isolated and cleaned to assure genetic purity.



2. **Foundation seed -** These seed are produced from breeder seed (white tag); seed growers start with this class.



3. **Registered seed -** These seed are produced from foundation seed (purple tag); seed growers are usually the only ones who plant these seed.



4. **Certified seed -** These seed come from registered seed fields (blue tag); these are the seed that are recommended to farmers to plant.

How Do We Identify Seed?

Seed makes possible the production of many of Louisiana's agronomic crops. Unfortunately weeds also produce seed, and weeds are reproduced in fields if planted with crop seed. The control of weeds depends on how effectively their seed production can be reduced in crop seed fields or how effectively the germination of these seed can be lowered.

It is important to be able to identify crop and weed seed. Several characteristics such as color, shape, size and surface texture can be helpful in identifying seed.

Color - Some seed are uniform in color, but others vary considerably. Examples: Alfalfa ranges from light yellow to red. Soybean seed is usually yellow, but there are also black and green seed. Pigweed seed is black.

Shape - This trait is very helpful in identifying seed. For example, sesbania is oblong, dock is triangular, corn is flat, alfalfa is kidney-shaped and vetch is round.

Size - Groups of seed of related species may look alike but differ in size. For example, white clover, red clover and alfalfa look alike, but differences in size can help identify each.

Surface Texture - This refers to whether the seed coat is smooth or rough. Singletary peas and hairy vetch look alike except that hairy vetch is a smooth seed and the singletary pea has a rough surface.

Seed Collection

In collecting seed from a growing plant, it is important to wait until the seed are mature. Harvest your sample as soon as mature and before bad weather has occurred so that the quality will be good. Seed should be dried further by putting them in a warm, dry spot for two to three weeks. After this, they can be stored in an envelope or a small plastic bottle.

Since plants are maturing at different times of the year, any collection must be made on several different dates. The best time to harvest seed of winter annuals (species which germinate and grow in the winter and mature in the spring) is in April and May. The ideal time to harvest summer annuals is in the fall.

Activity 4 - What's on a Seed Tag?

Look at a tag on a bag of seed from a seed store, and study it carefully. List the different facts from the tag which tell the grower about that lot of seed.

Activity 5 - Seed Germination

Go to a seed store and ask for a sample of seed from a bag of seed where the tag states its germination percentage. Count out 200 seed, and germinate them as you did in the 6th grade book. (You may need to go back and review pages 10-11 of this project book.)

Activity 6 - Learning About Certified Seed

Look in a seed store for certified seed. These seed will have a blue tag. Check the label, and list below six facts (as you did in Activity 4) about 3 kinds of crop seed. You may use soybeans, cotton, corn, rice, clovers, ryegrass, wheat or others.

Activity 7 - Making a Certified Seed Collection

Collect six different certified crop seed. You may go to a seed dealer, a farmer or to your agents for help.

Put each sample in a zip-lock bag with a label stating its germination percentage (copied from tag on seed bag). Instead of using the tag from the seed, you may also put the information from the tag on a small index card. The sample should contain 2 to 3 oz. of seed.

Each bag should then be attached to a plywood board using thumbtacks. Turn this collection in with your record at the end of the year.

Activity 8 - Making a Crop Seed Collection in the Field

Make a seed collection from the field of seven agronomic crops in your area. Each sample should be dried and put into a zip-lock bag as in Activity 7.

When mounting on a plywood board, label each sample with its **common name.** Your agent can help you identify those that you collect. Tell what characteristics of each seed type distinguish it from others.

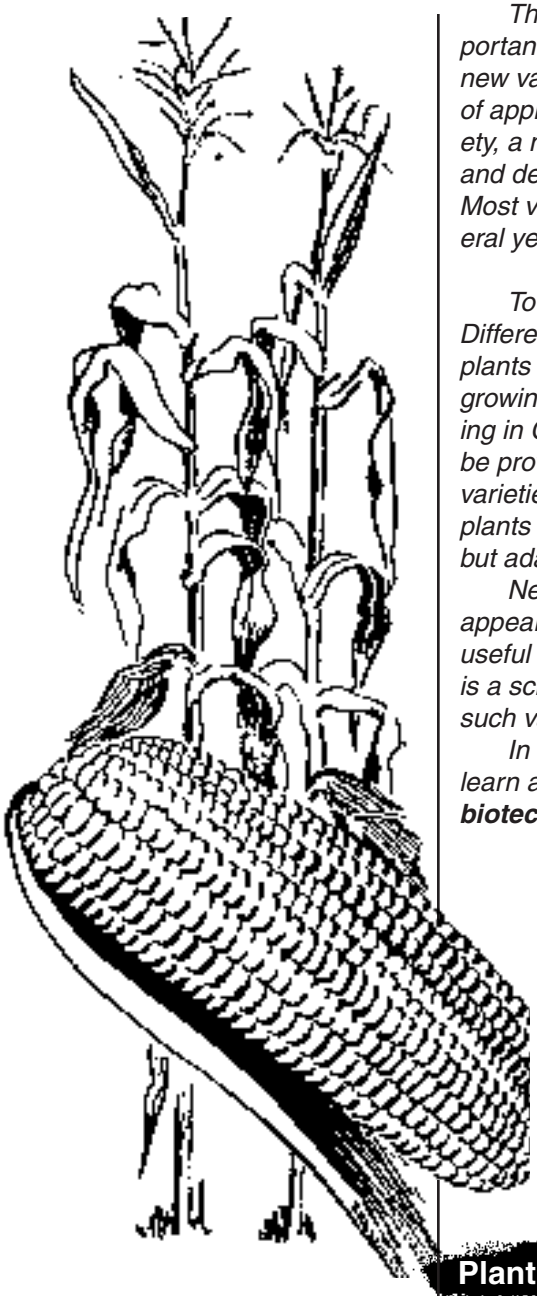
Activity 9 - Making a Weed Seed Collection

Make a collection of 20 different kinds of weed seed. Collect at several times during the year so that both winter and summer weeds can be found. Use the same methods as you did in Activity 7.

Identify by **common and scientific name**. The scientific name is a two-word Latin name which identifies the genus name and the species name of every living organism. For example, johnsongrass is the common name of a weed. The scientific name is *Sorghum halepense*. Your agent, agricultural teacher or parents can help you with identification.

Mount your collection for display as you did in Activity 7.

Chapter III. Plant Breeding



This section on plant breeding will give you an introduction to an important field of agriculture. Plant breeders are the people who develop new varieties of all kinds of plants. Whether a new variety is a new kind of apple tree, a new corn hybrid, a new clover variety, a new cotton variety, a new kind of tulip or rose or any new plant that is considered useful and desirable, it was probably developed in a plant breeding program. Most variety development programs are very complex and require several years to develop each new variety.

To develop new varieties, plant differences or variation must exist. Differences are often found between plants of the same species when plants from different geographic areas are compared. A wheat plant growing in Louisiana may be very different from a wheat plant growing in Canada or one growing in Brazil or China. Such variations may be provided by nature and may be used by plant breeders to improve varieties. For example, a wheat breeder in Louisiana may use parent plants from Canada to develop varieties that are more tolerant of frost but adapted to Louisiana's growing conditions.

New variations not previously present in parent plants may suddenly appear. Such sudden changes are called ***mutations.*** *They may be useful and desirable or may even be undesirable or harmful.* ***Genetics*** *is a science that studies both natural variations and mutations and how such variations are inherited from parents by their offspring.*

In this section you will learn some simple genetics. You will also learn about ***cell division, plant reproduction, flower structure*** *and* ***biotechnology.***

Plant Reproduction

Living green plants generally have the ability to produce offspring that are similar to themselves. This may occur through **sexual reproduction** (flowering and seed production) or through **asexual reproduction** (production of a new plant from a single vegetative part of a plant such as a leaf, stem or root). Some kinds of plants are reproduced most often by sexual reproduction. Others are reproduced most often by asexual reproduction, and others readily reproduce by either method.

Asexual Reproduction

Asexual plant reproduction, which is **production of a new plant from a vegetative part of a parent plant,** is very important agriculturally for some crops. It is the most common method of producing new plants for crops such as sugarcane, strawberries, sweet potatoes and Irish potatoes. Some examples of plants that reproduce by asexual means are listed.

Figure 6. African violet with new growth

Plants that reproduce by asexual means		
Plant	**Part Used**	**Name of Process**
Sugarcane	Stem	--
Fruit Tree	Bud or Twig	Grafting
Strawberry	Runner (stolon)	--
Irish Potato	Potato (Tuber)	--
African Violet	Leaf Cutting	Rooting
Hybrid Bermudagrass	Stem (stolon or rhizome)	--
Onion	Bulb	--
Sweet Potato	Root	--

When plants reproduce asexually, they grow from pieces of a single parent plant. The new plants are like the parent plant since they were formed by regeneration of missing plant parts.

For example, the leaf of the African violet forms new roots and eventually new stems (fig. 6). The sugarcane stem forms both new roots and leaves (fig. 7). These new plant parts are formed by normal cell division called **mitosis** followed by **cell enlargement.** This process results in new cells that have the same genes as the cells of the single parent plant they started from.

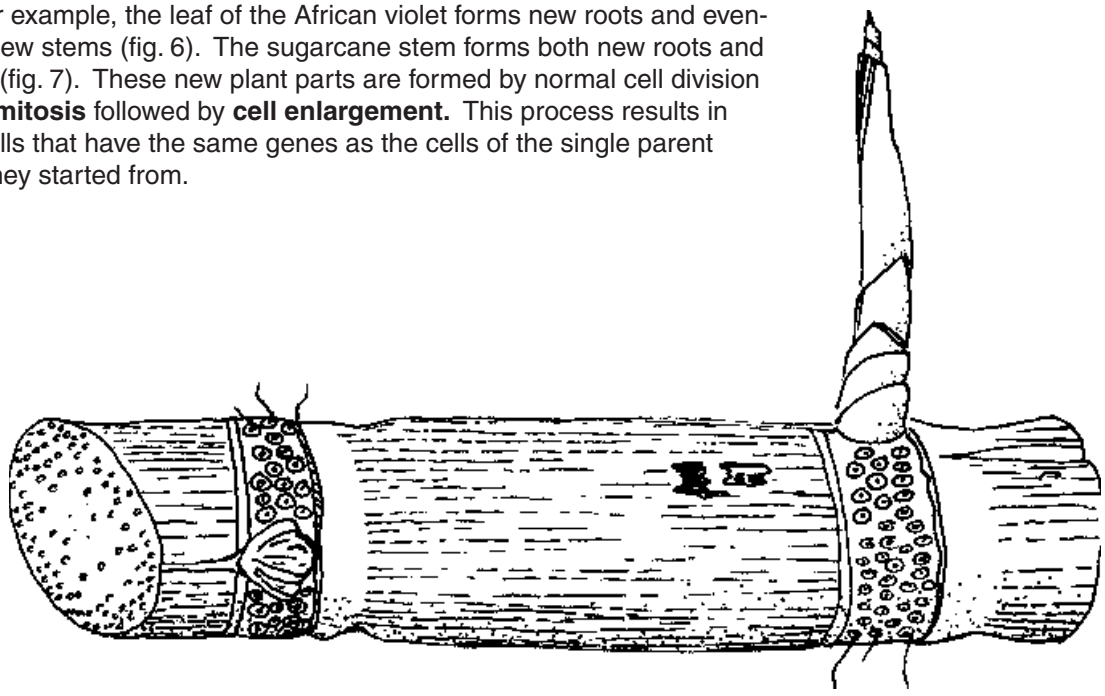


Figure 7. Sugarcane stalk with new growth

Sexual Reproduction

Plant reproduction that results from **the combination of gametes (special sex cells) leading to seed production** is called sexual reproduction. The **gametes**, which come from each parent plant, each contribute to the genetic makeup (genotype) of the seed that is formed. When the seed germinates to produce a new plant, the new plant may have some traits from each parent, or it may be more similar to one parent in appearance.

Cell Division

All living green plants are made up of small building blocks called **cells.** The cells are usually too small to be seen without a microscope, but when viewed through a microscope, they look like bricks or building blocks. Plants grow by cell division to form new cells and by cell enlargement. Every part of the plant is made up of cells, but the cells of a stem may be somewhat different from the cells of a leaf or of a flower.

Even though plant cells are very small, they contain even smaller objects where certain kinds of chemical and biological processes occur (fig.8). One of the objects found in each plant cell is the **nucleus.** The nucleus contains the genetic material that controls the plant's inheritance. This material is present in string-like structures called **chromosomes.** It controls the characteristics a plant inherits from its parents and the characteristics it will pass on to its offspring (fig. 9).

Since cell division is an important part of plant growth, and every cell of a plant contains the genetic material for that plant, the genetic material must also be divided with each cell division.

Figure 8.
Some parts of a typical plant cell. The nucleus is shown enlarged to make the chromosomes large enough to be seen. These chromosomes thicken and form pairs when cells reproduce.

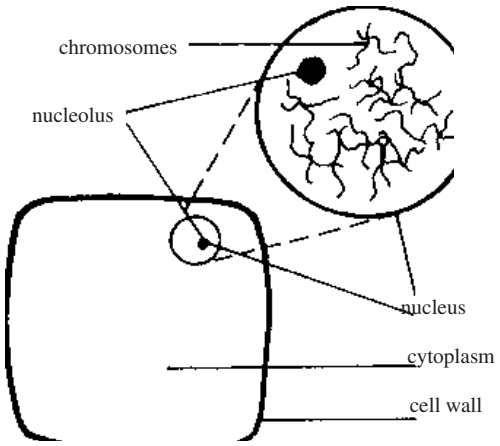
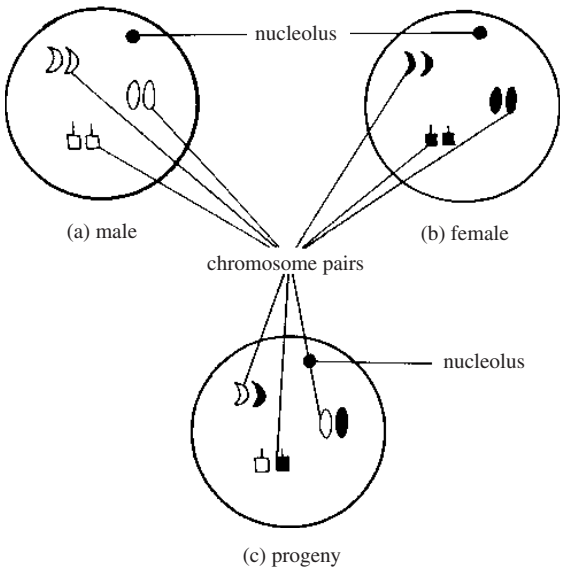


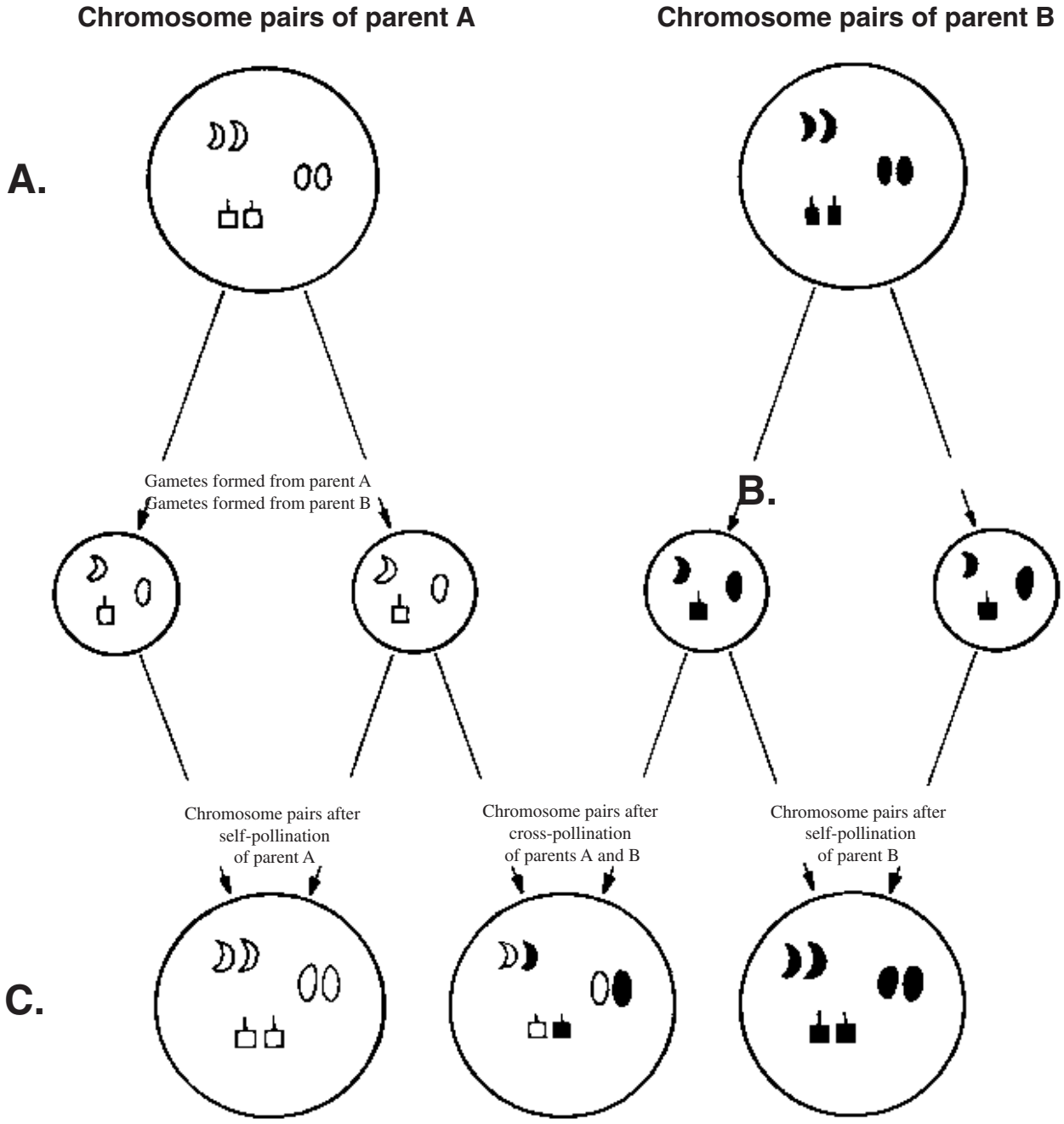
Figure 9. Cell nucleus of male(a), female (b) and progeny (c) plant. One half the chromosomes, one of each pair, come from each parent and end up in the progeny.



The process of normal cell division is called **mitosis.** Mitosis results in each new cell having identical kinds and amounts of genetic material as the original cell. For example, a cell in a corn leaf that contains 10 pairs of chromosomes before cell division will give rise to two new cells that each contain 10 pairs of chromosomes.

Another kind of cell division in plants is called **meiosis** and is found only in the sexual parts of the plant. Meiosis is a type of cell division that results in new cells being formed that have only half as many chromosomes as the original cell had before it divided. Meiosis occurs in the formation of **pollen cells** which contain the sperm (male reproductive cells or gametes). It also occurs in the formation of the **egg cell** (female gamete or reproductive cell) found in the ovary. Thus both the male and female **gametes,** which are formed by meiosis, contain only one-half of the normal number of chromosomes found in other cells of that type of plant. When gametes are united during fertilization in the flower, the resulting new cell will have the full number of chromosomes for that plant species (fig. 10).

Figure 10. Parent plants (A) form gametes (B) with one chromosome from each chromosome pair (B). When two gametes combine, progeny are formed with the same number of chromosomes as the parent plant or plants (C).



Environmental and Genetic Plant Differences

Some people claim that no two plants are exactly alike. Even two plants of the same species and variety will probably be different in some way. For example, the length or width of a particular leaf on the plant or the number and angle of branches of the roots will likely be different for every plant. Other plants may have differences that are more obvious. Plant size, flower color, plant vigor and other traits may be visible.

Differences between plants can be of two distinct kinds. Some variations are caused by the **environment.** One plant may be growing in more fertile soil or may have a better water supply or may be attacked by insects. Another plant may be exposed to a different environment. Plant differences caused by environmental effects are not passed on to the offspring when plants reproduce. Holes in leaves from insect feeding or small plant size because of drought are not passed on to the offspring.

Some plant differences are the result of the plants having different characteristics inherited from their **parents.** Plants with a particular flower color are more likely to produce offspring with the same flower color, especially if one parent plant is bred to another parent plant with the same flower color.

Genes and Chromosomes

The chemical substance in plants that controls inheritance is found in elongated rods or string-like particles called **chromosomes.** Chromosomes are made up of small sections called **genes.** The genes are the individual units of inheritance. One gene may determine whether a plant has white or red flowers, another gene may influence leaf size, another may determine the color of the seed coat and another may influence the tendency of the plant to grow tall or short.

Chromosomes in plants don't exist as single strands of material. Instead, they are found in **pairs of similar size and shape.** Each plant species has its own characteristic number of pairs of chromosomes. For example, corn has 10 pairs or 20 chromosomes, and rice has 12 pairs or 24 chromosomes in each cell. Since the two chromosomes of each pair are similar (they each contain genes for the same plant characteristics), each plant has two or more genes for each characteristic. Some characteristics, such as flower color, can be controlled by a single pair of genes. Other characteristics such as plant size can be controlled by several pairs of genes.

Gene Dominance

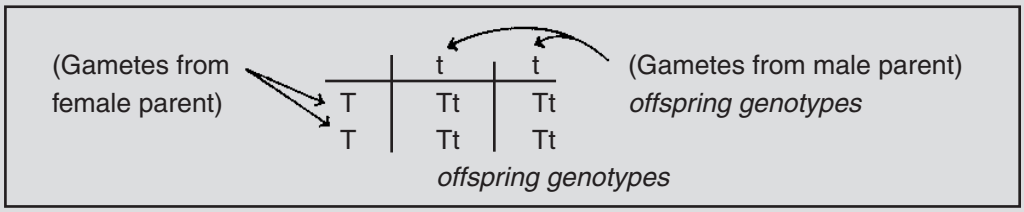
Plants usually have a pair of genes for each characteristic, one gene inherited from each parent. The two genes of a pair may be alike or may be different. For example, if one parent is tall and the other parent is short, then the offspring of these two parents may have one gene for tall stature and one gene for short stature. Whether the offspring will be tall, short or of intermediate height will depend on the nature of the genes. When some genes completely dominate others, they are said to have a **dominant-recessive relationship** or **complete dominance.** If tall is dominant over short, then a plant with one gene for tallness and another for shortness would be a tall plant. Such a pattern of inheritance is illustrated on page 19.

In this example the **genotype** (combination of genes for a particular trait) of each parent is indicated by letters. A capital letter is used for dominant genes and a small letter for recessive genes. When an individual has both genes alike for a trait (either both dominant or both recessive), it is considered to be **homozygous** for that trait. In this example both parents are homozygous. If an individual has two genes that are not alike for a trait (one dominant and the other recessive), it is said to be **heterozygous.**

In this example the gametes that could be produced by each parent are placed on the edges of a square. Each parent plant has two separate genes for tallness so each gene is represented by a gamete. All possible combinations of parent gametes will occur in the offspring if each parent freely contributes gametes. The offspring of the cross in our example are all heterozygous and are all tall since tall is dominant over short.

Cross Between Homozygous Tall and Homozygous Short Plants

Parents	**FEMALE**		**MALE**
Appearance or Phenotype	Tall	X	Short
Genotype	TT		tt

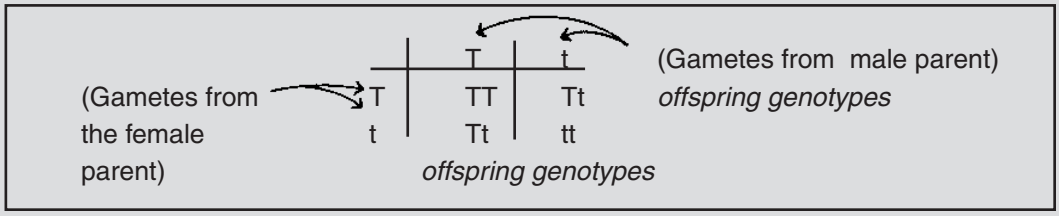


	Offspring	
No.	*Genotype*	*Phenotype*
O	TT	Tall
4	Tt	Tall
O	tt	Short

The cross between a tall and a short plant in our example resulted in offspring that were all tall. In this case, both parents were homozygous even though one parent was tall and the other was short. The offspring from this cross were all tall and were all heterozygous. If two plants from the offspring produced above are now used as parents to produce a second generation of offspring, what will the results be? The diagram below shows the results of such a cross:

Cross Between Two Heterozygous Tall Plants

Parents	**FEMALE**		**MALE**
Appearance or Phenotype	Tall	x	Tall
Genotype	Tt		Tt



	Offspring:	
No.	*Genotype*	*Phenotype*
1	TT	Tall
2	Tt	Tall
1	tt	Short

Pollination and Fertilization

The male part of a plant flower is called a **stamen.** It consists of a pollen sack called an **anther** where pollen grains are formed and a long supporting stalk called a **filament.** Pollen grains formed in the anther contain the **male gamete** or the male sex cell.

The female part of a plant flower is called a **pistil.** It consists of an **ovary** which contains the egg cells or ovules which are the **female gametes** or female sex cells. It also has a flattened surface called a **stigma** where pollen is received and a tube connecting the stigma and ovary which is called a **style** (see fig. 11).

Pollination is the transfer of pollen from the anther to the stigma. It may be accomplished by insects such as bees, or by wind, gravity, rain or other means. If pollen grains are transferred from an anther to a stigma within the same flower or to another flower on the same plant, it is called **self-pollination** (fig. 12). If pollen grains are transferred from an anther on one plant to a stigma in a flower on another plant, it is called **cross-pollination** (fig.13).

Fertilization is the joining together of the male gamete (found in a pollen grain) with a female gamete (found in the ovule) to form a new cell that will develop into a **seed**. For this to happen, the pollen grain must germinate on the stigma and send a pollen tube down through the style to the ovule in the ovary.

Figure 11. Parts of a flower

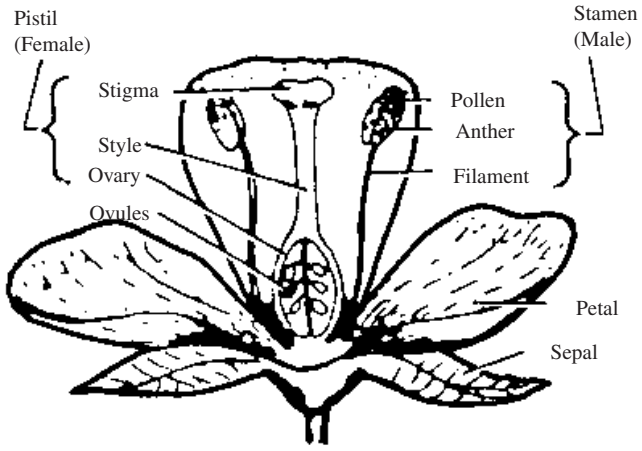


Figure 12. Self-pollination and fertilization

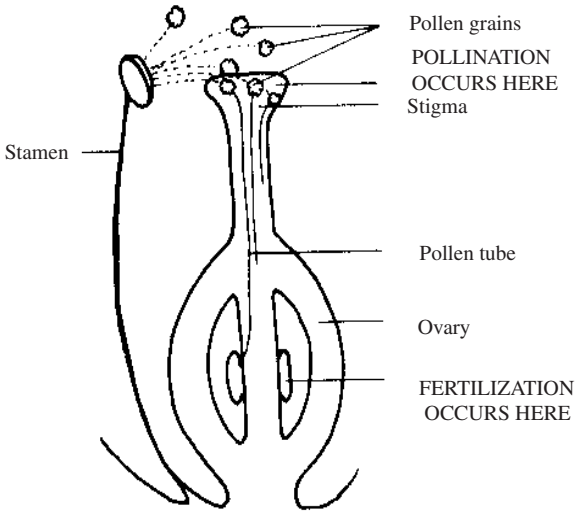
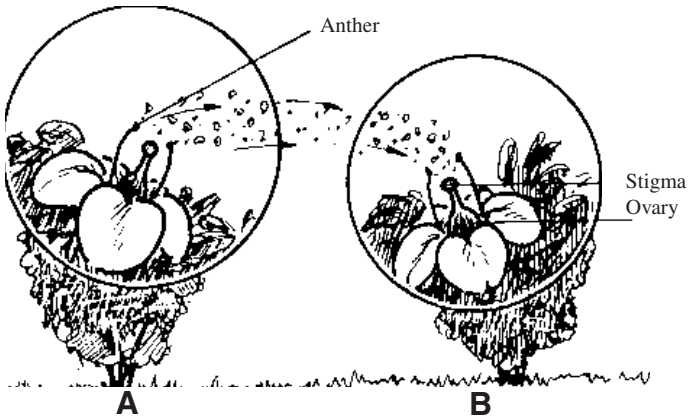


Figure 13. Cross-pollination. Pollen transferred from the anther of plant A to the stigma of plant B.



Plant Breeding and Improvement

Plant breeding is the art and science of **changing and improving the heredity of plants.** Our early plant breeding efforts probably consisted of nothing more than selecting seed from the best plants to save and plant for the next growing season.

Plant selection is still one of the important methods of crop improvement used by plant breeders. Breeders are constantly choosing which plants to keep for further examination and which ones to ignore or throw away.

Cross breeding of different plants (cross-pollination) to produce offspring with new characteristics or new combinations of characteristics is widely used to improve crops. This requires that the breeder have a good understanding of flower structure and plant reproduction. It also requires that the breeder have training in genetics.

Many plant breeders today either have some training in biotechnology or have a close working relationship with a biotechnologist. **Biotechnology** is a new field of science that deals with the movement of genes from one physical location on a chromosome to another location**.** The gene may be moved to a new location on the same chromosome or to a different chromosome. Genes from one plant can even be placed on a chromosome of a different plant. Some methods of biotechnology can even move a gene from a chromosome in one species into a chromosome of a different species. For example, a gene from an insect may be moved into a plant cell and added to the plant's chromosomes.

Biotechnology allows plant breeders to develop plants with characteristics not previously found in that kind of plant. It is hoped that such methods will allow plant breeders to improve the usefulness of plants.

Activity 10 - Identifying Flower Parts

A. Examine the flowers of at least two kinds of plants you find growing in the lawn, garden or an empty lot.

B. Identify the following:

Sepals - *green leaf-like structures that surround the flower when it is still in a bud.*

Petals - *the colorful, showy part of a flower.*

Anther - *the small structures where pollen is produced.*

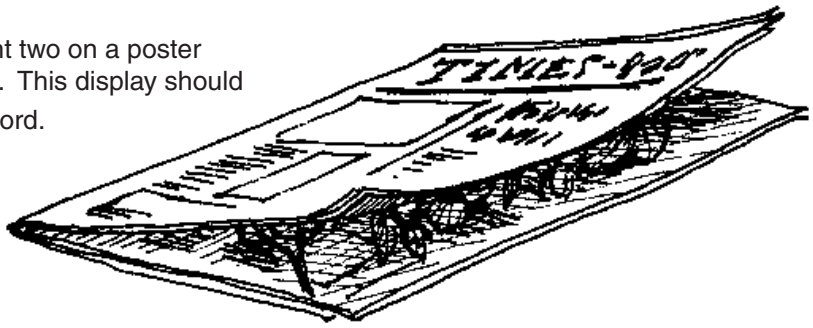
Filament - *the supporting stalk for the anther.*

Stamen - *a name for the male part of a flower. It consists of an anther and a filament.*

C. Cut open an ovary from an older flower, and locate the developing seeds.

D. Press several flowers and dry them in a plant press or put them between pages of a newspaper, and add some weight on top. You can also place them between the pages of a large phone book or catalog. Be sure to use an old one that is no longer in use.

E. After the flowers are dry, mount two on a poster and label the flower parts. This display should be turned in with your record.



Activity 11 - Genetic Ratios

Determine the genotypes for the offspring that would result from a cross between a plant that has red flowers and a plant that has white flowers. Assume that red is completely dominant and that both parent plants are homozygous.

Complete the square on page 32, and supply the requested information in your record.

Activity 12 - Genetic Ratios

Determine the offspring that would be produced from a cross between two of the plants that were produced as offspring in Activity 11. Assume that red is completely dominant.

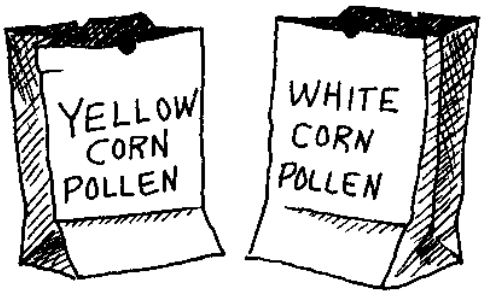
Complete the square on page 33, and supply the requested information.

Activity 13 - Practical Plant Pollination and Crossing

A. Obtain seed of both yellow and white sweet corn. Grow them in separate rows, side by side in the garden. Be sure that both kinds of corn are of similar maturity and are planted at the same time.

B. When the ears begin to emerge, but before the silks are showing, cover four ears of each kind of corn with paper bags.

C. When pollen begins to fall from the tassels, shake tassels from yellow corn into one bag and from white corn into a second bag. This will provide pollen for the experiment. Be sure you don't mix the pollen!



D. Remove the bags from two ears of white corn and shake some of the pollen from white corn onto the silks.

E. Next replace the bags over the two ears. Now remove the bags from the other two ears of white corn, and shake some pollen from the yellow corn onto the silks.

F. Replace the bags over the ears. Now repeat the same process for four ears on the yellow corn. Be sure to use the pollen from the white corn and that from the yellow corn on separate ears. Keep a record of which pollen was added to each ear.

G. When the corn is mature, harvest the ears from each of the plants that you protected with bags and two ears each from unprotected yellow and white corn in the garden. Record the results and photograph the ears for this project. Include the photographs with the record.

Chapter IV.

Weeds and Weed Control

Johnsongrass among sugarcane

What are Weeds?

Weeds are plants growing out of place. For example: A corn plant growing in a field of corn is naturally desirable, but a corn plant in a soybean field is a weed.

Many plants such as henbit, horsenettle and pigweeds are considered weeds because they serve no useful purpose and therefore are always growing out of place.

How Weeds are Harmful

Weeds can be harmful in several different ways. Weeds **compete with crop plants**. Weeds **may cause illness** in people or animals. Weeds may **cause physical injuries** to people or animals.

Weeds compete with crop plants by taking up water or nutrients that crop plants need. Weeds also can compete with crop plants by blocking sunlight from reaching the crop. Weeds competing with crops will **reduce the yield of crops.** Weeds competing with the crop may also **reduce the quality of the crop** by increasing moisture levels that must be reduced by drying or by increasing the amount of foreign matter present in the harvested crop. The reduction in the quality of the crop reduces the value of the crop.

Certain weeds such as horsenettle, wild cherry or caster bean contain **poisonous chemicals.** These plants, if eaten by livestock (or people), can cause a serious or even fatal illness. Other plants such as poison ivy or poison sumac cause painful rashes or other irritations when people come in contact with these weeds.

Certain weeds such as green briar, cactus and waterlocust have **sharp spines or thorns.** These sharp spines can hurt livestock or people coming into contact with them.

Finally, weeds cause losses by **reducing the value** of ornamental settings such as flower beds, parks, golf courses, etc. A weedy flower bed or park is not pleasing to the eye and, although the weeds may not be competing with a crop or harming livestock, they are reducing the aesthetic value of the location.

Life Cycle of Weeds

Weeds are grouped into four categories based on life cycles. These are summer annuals, winter annuals, biennials and perennials. Understanding these life cycles helps in identifying an unfamiliar weed and in determining if a weed is a serious crop pest.

Cocklebur

Summer annuals are those that germinate from seed in the spring, grow during the summer, produce a crop of seed and die in the fall. The seed generally remain dormant in the soil until the following spring. Examples are cocklebur and pigweed.

Chickweed

Winter annuals germinate from seed in the fall, grow through the winter, produce seed and die in the spring or early summer. Examples are buttercup and chickweed.

Cudweed

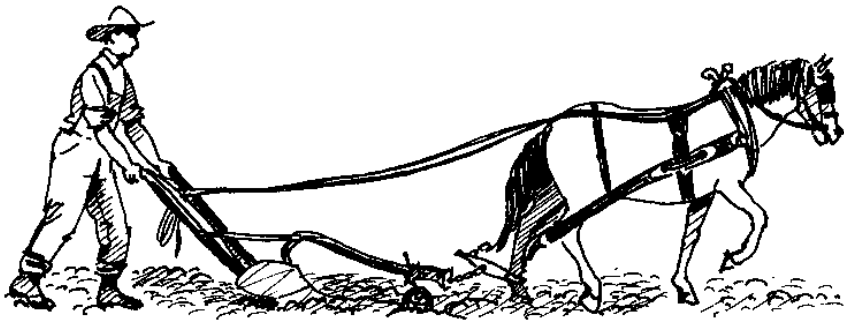
Biennials germinate from seed in the spring of the first year, grow through the summer, become dormant during the winter, flower and produce seed the second spring or summer, then die. Examples are cudweed and blackberry.

Johnsongrass

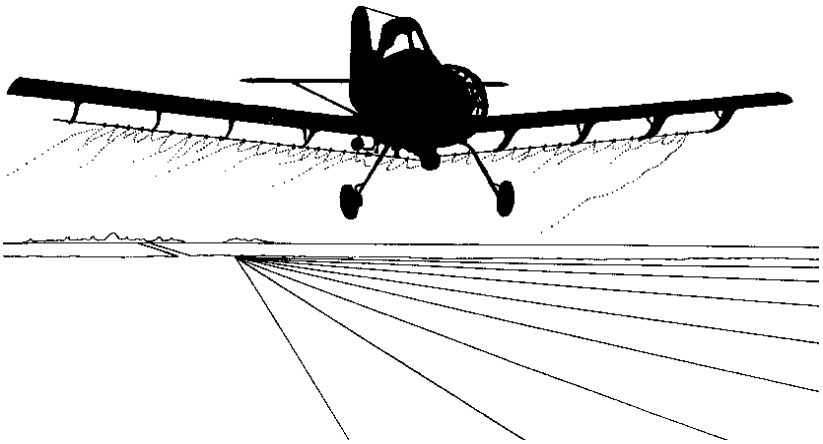
A perennial lives for more than two years and may live almost indefinitely unless destroyed. Most perennials produce seed each year. Perennials also reproduce vegetatively from plant tissue such as root segments, crown buds, bulbs, bulblets, rhizomes, stolons or tubers.

History of Weed Control

Farmers have struggled with weeds since the beginning of agriculture. Early farmers used crude wood and stone hand tools to uproot and destroy weeds. The domestication of the horse and ox led to the development of the plow and animal-drawn cultivator.



The planting of crops in rows was an attempt to help ease weed control by allowing for animal-drawn mechanical weed control implements. The development of the internal combustion engine led to the tractor. This took weed control one step further.



From the beginning of agriculture until the 1950s, we depended on some form of mechanical weed control to produce crops. Since that time chemicals known as **herbicides** have been developed. They control weeds while allowing the crop to develop normally. The first practical herbicide was 2,4-D. It allowed farmers to kill broadleaf weeds without harming corn or wheat.

Herbicides

Herbicides can be classified by **how and when they are used.** Herbicides such as Treflan and Eradicane must be mixed with the soil before planting. This group is referred to as **preplant incorporated herbicides.**

Atrazine, Lasso and Sencor are herbicides applied to the soil surface when the crop is planted. Since they are applied before the crop and weeds emerge, they are referred to as preemergence herbicides.

Blazer, Poast, Classic and Fusilade are applied to weeds after the weeds and the crop have emerged. They are referred to as postemergence herbicides.

Since there is no single herbicide that controls all weeds in all crops, there have been many different herbicides developed. New and better herbicides appear on the market every year, replacing older, less effective herbicides. Now there are more than 100 herbicides available to farmers.

Crabgrass

Noxious Weeds

Some weeds are more undesirable or costly to control than others. The Louisiana State Department of Agriculture and Forestry realizes the importance of weed control and undertakes to control the spread of these undesirable weeds through the State Seed Law.

Within the State Seed Law is a section that identifies noxious or harmful weeds. Certain weed seed are completely prohibited from contaminating certified crop seed. Examples are field bindweed, itchgrass and nutsedge. Other weed seed are limited to a certain number per pound of certified seed. Examples are cocklebur (5 per pound), red rice (9 per pound) and bermudagrass (300 per pound).

Making A Weed Collection

Identification is the first step in controlling weeds. You can learn to identify weeds by making a collection of common weeds and reviewing it.

Collect weeds in the flowering stage if possible. Many plants have leaves, stems and roots that are similar. But, the flowers are almost always different, allowing a distinction to be made. Collect the entire weed if possible. Plants that are very large will not fit properly into a press and may be cut into sections.

Place the plant between several sheets of newsprint with the plant arranged as flat as possible.

Don't forget to include a label stating what the plant is (if you can identify it), who collected it, when and where it was collected.

To dry the seed specimen properly, you need a **plant press** (fig. 14). A plant press is easily assembled by using two square or rectangular wooden frames of equal size. Cut a number of corrugated cardboard sections the same size as the frames. Insert the plant specimens between layers of cardboard, place the wooden frames on each side and secure the bundle as tightly as possible with straps or rope.

When pressing moist plants, it may be necessary to replace the sheets of newsprint until the plant is dry. This will prevent decay. Store the plant press for at least a week in a warm, dry place. Weed samples may be removed and mounted onto cardboard with tape and stored almost indefinitely.

Activity 14 - Collecting Weeds

Collect and press five summer and five winter weeds. Turn in your collection with your record.

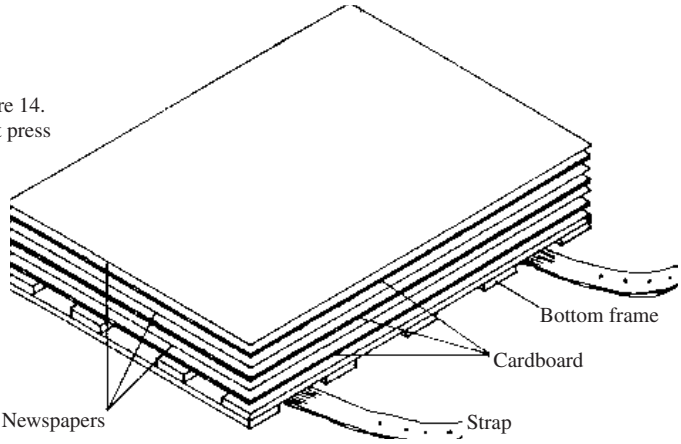
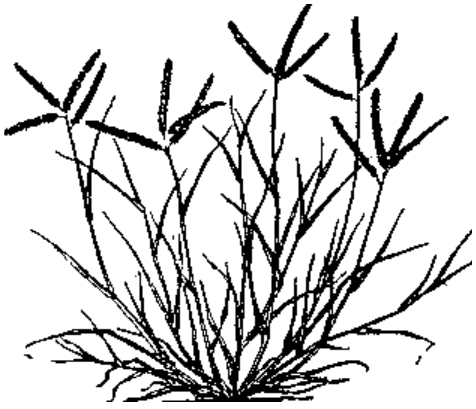


Figure 14.
Plant press



Goosegrass

Activity 15 - Practical Weed Control

What are the three major agronomic crops grown in your parish? Find out from your county agent or from local farmers which three weeds give them the most trouble in each crop and what methods are used to control them.

What to Collect

The following weeds are recommended for collection. All are found in Louisiana.

Common Name	*Botanical Name*
Annual bluegrass	*Poa annua*
Bermudagrass	*Cynodon dactylon*
Blackberry	*Rubus sp.*
Blue vervain	*Verbena hastata*
Broadleaf signalgrass	*Brachiaria platyphylla*
Carolina geranium	*Geranium carolinianum*
Chickweed (Common and	*Stellaria media*
Mouse-ear)	*Cerastium vulgatum*
Cocklebur	*Xanthium pensylvanicum*
Common ragweed	*Ambrosia artemisiifolia*
Crabgrass	*Digitaria sanguinalis*
Dichondra	*Dichondra repens*
Dock	*Rumex sp.*
Dogfennel	*Eupatorium capillifolium*
Goldenrod	*Solidago sp.*
Goosegrass	*Eleusine indica*
Henbit	*Lamium amplexicaule*
Johnsongrass	*Sorghum halepense*
Jungle rice, barnyardgrass	*Echinochloa sp.*
Knotweed or smartweed	*Polygonum sp.*
Little barley	*Hordeum pusillum*
Morningglory	*Ipomoea sp.*
Nightshade or horsenettle	*Solanum sp.*
Nutsedge	*Cyperus sp.*
Pigweed, careless weeds	*Amaranthus sp.*
Poorjoe or buttonweed	*Diodia sp.*
Prickly sida	*Sida spinosa*
Sesbania	*Sesbania exaltata*
Smutgrass	*Sporobolus poiretti*
Wild garlic	*Allium vineale*
Vaseygrass	*Paspalum urvillei*

Agronomy Activity Report - Seventh Grade

Name _____ **Date** _____

Activity 1 Report - Soils of Louisiana (see page 8)

Include the story in the record.

Activity 2 Report - Soil Erosion and Conservation (see page 9)

What happened as far as erosion was concerned in each box? Which box lost the most soil? Why? In which box did water stop running out of the notch first? Why? Which jar had the cleanest water? Why? Would you expect that leaving the soil bare or having it covered with sod is better for water quality in our lakes and rivers? Why?

Answer these questions and include your report in the record.

Activity 3 Report - Soil Testing (see page 9)

When the laboratory results from your sample of crop to be fertilized arrive about 2 to 3 weeks after mailing, fertilize and lime the area you sampled according to the recommendations. Include test result form in report.

What was the soil pH?_____

What was the soil texture?_____

What was the soil organic matter?_____ %

How much nitrogen, phosphorus and potassium was recommended?

_____	_____	_____
N	P_2O_5	K_2O

How much was applied?

_____	_____	_____
N	P_2O_5	K_2O

Activity 4 Report

The following facts were taken from my seed tag:
(Examples: 90% germination.; Date of test: Oct._____, 1993)

1. _____	4. _____	7. _____
2. _____	5. _____	8. _____
3. _____	6. _____	9. _____

Activity 5 Report

What was the germination percentage on the tag?_____%

Of the 200 seeds, how many germinated?_____

What percentage germinated?_____

Is there any difference between your germination and that found on the tag? _____

If so, can you guess why? _____

_____

_____

Agronomy Activity Report - Eighth Grade

Name _____ **Date** _____

Activity 6 Report - (See page12)

The following information was on the seed tags I looked at:

Crop	Crop	Crop
1. _____	1. _____	1. _____
2. _____	2. _____	2. _____
3. _____	3. _____	3. _____
4. _____	4. _____	4. _____
5. _____	5. _____	5. _____
6. _____	6. _____	6. _____

Activity 7 Report

I have collected the following certified seed samples (common name only) which are mounted on a plywood board:

1. _____ 4. _____

2. _____ 5. _____

3. _____ 6. _____

List the four classes of certified seed and the tag color for three of the four:

	Class	**Tag Color**
1.		
2.		
3.		
4.		

Activity 8 Report

Seed of the following agronomic crops in my parish have been collected:

Common Name	**Scientific Name**	**Distinguishing Characteristics**
Example:*corn*	*Zea mays*	*large, flat, yellow*
1.		
2.		
3.		
4.		
5.		
6.		
7.		

A sample of each seed has been mounted on a plywood board.

Activity 9 Report

What is the difference between a weed and a crop?_____

_____

Do crop seed look like weed seed?_____

_____

My weed seed collection contains the following species of plants: **(Common and scientific names)**

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____

My Agronomy Story

Name_____ **Grade** ____ **Date** _____

Your activities and record should show what you have done and learned in this project this year. Any study or work done that was not reported should be included in the story.

Tell what was hard for you to do and what was the most fun. Your story should tell how learning about agronomy is important to you, your family and your world. Tell how good a job you think you did and where you can improve next year.

If this experience has increased your interest in agronomy, you should tell what you are planning for future years in this project.

Agronomy Story (cont'd)

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www.lsuagcenter.com

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