



LESSON PLAN – GROWING SOYBEANS

Episode one 401 – Indiana Agriculture (Life Science)

Indiana often gets labeled as “The Corn State” -- but, as one Indiana amusement park has stated, “There's More Than Corn in Indiana”. That's true, there's soy, tomato and popcorn – just to name a few. WFYI's newest program, The Science of Agriculture, gives you an in-depth look at how some of the products you have in your pantry or refrigerator are made right here in the Hoosier state. We're going to take you to Eldwood and go inside the Red Gold plant to see how ketchup is made, along with a trip to Cousin Willie's Popcorn operation in Ramsey, Indiana. We'll also take you inside one of the POET Biorefining plants to show you how ethanol is created.

Funded by:
Telamon Corporation

Growing Soybeans

Adapted from

Center for Agriculture and Environmental Research and Training, Inc.

Indiana Animal, Plant, and Soil Science Lesson Plan Library

<http://www.caert.net/>

Overview

The following lesson contains four different lessons and objectives that provide a comprehensive understanding of the soybean production. The lessons are designed to understand the process of growing soybeans.

Background Information

Information for each learning objective is embedded in the following lesson.

Connections to the Indiana Academic Core Standards for Science, Grades 6 – 12

Indiana's Ag Area. PS.P: Plant and Soil Science: Students shall analyze the impact of several factors on the selection of a cropping system and cultural practices.

Indiana's Ag Standard. 2: Describe the factors that must be considered when selecting a crop.

5: Analyze how conservation is affected by cropping systems and cultural practices.

Identify and evaluate two specific cropping systems used in Indiana.

Indiana's Ag Area. PS.Q: Plant and Soil Science: Students shall investigate the harvesting of crops in Indiana.

Indiana's Ag Standard. 1: Relate the history of the development of three specialized types of harvesting equipment used in Indiana to the crop each is used to harvest.

3: Explain characteristics that determine harvest maturity for corn and soybeans.

4: Discuss the economic impact of delayed harvesting of crops in the fall.

5: Describe problems involved with the storage and transportation of major Indiana crops. Address how these relate to the placement of towns, rivers, and railroads historically.

Indiana's Academic Standard. B.1.19: Recognize and describe that metabolism consists of the production, modification, transport, and exchange of materials that are required for the maintenance of life.

Science Process Skills

- Classifying
- Communicating
- Hypothesizing and predicting
- Inferring
- Measuring
- Posing questions

Estimated Time Requirement

Two 60 - minute session

Materials

- Transparencies from attached TM worksheets
- A variety of soybean samples
- Picture, videos, or examples of soybean pests
- A variety of soybean products

Objectives

Students will be able to:

1. Identify soybeans and their uses.
2. Identify areas where soybeans are grown and their soil and climatic requirements.
3. Describe the different types of soybeans.
4. Explain the cultural practices related to soybean production.

Lesson Procedure: Growing Soybeans

Anticipatory set:

- View the *The Science of Agriculture* Indiana Expeditions segment
- Visit the website: www.IndianaExpeditions.org

Preparation prior to the lesson: Growing Soybeans

Use an interest approach that will prepare the students for the lesson.

Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Collect a variety of articles related to soybean production and soybean usage. Have the students read the articles and summarize them for the class. Explain to the class that soybeans are one of the most important crops in the United States. You may even want to display a number of products made from soybeans. Finish the discussion by pointing out that most of the articles were printed using soybean ink!

Vocabulary

The following terms are presented in this lesson:

- Biological control
- Chemical control
- Cultural practice
- Geographic information system
- Global positioning system
- Harvest loss
- Inoculation
- Legumes
- Mechanical control
- Oil crops
- Precision farming
- Pre harvest loss

Summary of Content and Teaching Strategies

Lesson 1 Objective: Identify soybeans and their uses.

Anticipated Problem: What are soybeans and what are their uses?

Like corn, soybeans are one of the most important crops grown in the United States. There are more soybeans grown in the U.S. than the rest of the world combined. Soybeans are oil crops. Oil crops are plants grown to produce vegetable oil from their seed or fruit. Soybeans, or *Glycine max*, are an annual legume. A legume is a plant that can fix nitrogen from the air in the soil. Soybeans have many industrial, human, and agricultural uses.

A. Soybeans, or some part of the soybean, are used in a number of industrial products. Personal products such as soap, lotion, and creams made from soybeans are increasing in popularity. Household items such as linoleum, candles, plastics, paints, and adhesives may also include soybeans. Soybeans can also be used to produce insecticides, printing ink, and lubricants.

B. In human foods soybeans are used in a variety of forms. Soy products are becoming popular with health conscious people because soybean meal contains twice the protein of beef and fish. Soybean products that can be found on many grocery store shelves include: soy milk, soy yogurt, soy hot dogs, and soy cheese. Soybean by-products are also used in salad dressings, margarine, cocoa, chocolate, candies, and flour.

C. Animals also benefit from soybeans and soybean by-products. Soybean oil meal, soybean oil cake, and soybean meal can be used as sources of protein in animal feeds.

Bring in grocery store ads to show the variety of soy health foods now available. If possible, have a soybean plant available for students to observe. TM: C9–2A shows the major parts of the soybean plant.

Lesson 2 Objective: Identify areas where soybeans are grown and their soil and climatic requirements.

Anticipated Problem: Where are soybeans grown and what are their soil and climatic requirements?

Soybeans are grown throughout the Midwest and in the southern United States. However, some cultivars are adapted to the climatic conditions of the northern U.S.

A. Approximately 60 million acres of soybeans are planted in the U.S. each year. Annual production is 1.5 billion bushels; one bushel is equal to 60 pounds. One bushel of soybeans typically produces 11 pounds of oil, 43 pounds of meal, 4.2 pounds of hulls, and 1.8 pounds of other matter.

B. Soybeans grow best in soils that are high in organic matter and are well-drained. However, soybeans are tolerant of wet, acidic soils.

C. The climatic conditions for soybeans are similar to those of corn. Warm weather, sunshine, and moderate rainfall are all preferable. Established soybean plants are more tolerant of light frosts.

Include information in your discussion about the cultivars grown in your area. Local farmers and seed salespeople would be useful resources for this lesson. Use TM: C9–2B to review the information covered in this objective.

Lesson 3 Objective: Describe the different types of soybeans.

Anticipated Problem: What are the different types of soybeans?

Soybeans in the U.S. are divided into ten maturity groups. The cultivars in each maturity group are developed for the specific latitude in which they're grown. Maturity ratings range from 75 to 200 days.

A. There are many differences amongst soybean cultivars. These differences include: flowering date, maturity, lodging resistance, seed color, seed size, seed shape, plant height, podding height, disease resistance, shattering resistance, oil percentages, and protein percentages.

B. Soybean cultivars are also classified according to their use. These classifications include commercial or seed, forage, and vegetable.

Include information in your discussion about the cultivars grown in your area. Local farmers and seed salespeople would be useful resources for this lesson. It would also be beneficial to have pictures or examples of different cultivars available for students to observe. TM: C9–2C illustrates a soybean plant from seed to first leaves.

Lesson 4 Objective: Explain the cultural practices related to soybean production.

Anticipated Problem: What are the cultural practices related to soybean production?

Cultural practices are the control or manipulation of a plant's environment to encourage growth. Cultural practices include planting, amending soil, crop rotation as well as other practices. When planting soybeans, only the highest quality seeds should be planted. Soybean seeds should be free of cracks, broken seeds, weed seeds, and other varieties of seeds. Planting depth, moisture, pests, nutrients, and harvesting issues should also be considered in choosing a cultivar.

A. Soybeans are planted in rows, drills, or broadcast. The average planting rate is 52 pounds per acre. Soybean seeds are usually planted 1 to 1½ inches deep. They may be planted deeper in drier land.

B. Moisture is essential for plant growth. A moisture deficiency during blooming can greatly reduce soybean yield. Blooming begins 6 to 8 weeks after planting, and mature beans are produced after 12 to 15 weeks.

C. Soybeans are susceptible to insect, disease, and weed pests. A combination of biological, mechanical, and chemical methods can be used to control these problems. Biological control methods involve the use of natural enemies of a pest to control it. Mechanical control methods involve the use of tools or equipment such as hoes or plows to control pests. Chemical control methods involve the use of chemicals such as poisons, growth regulators, sterilants, and attractants and repellants to control pests.

D. Common soybean insect pests include wireworms, white grubs, bean leaf beetles, grasshoppers, Mexican bean beetles, and fall armyworms.

E. Crop rotation, sound cultural practices, and planting resistant cultivars are ways of avoiding some of the over 50 known soybean diseases. Common soybean diseases include bacterial blight, bacterial pustule, anthracnose, brown stem rot, Septoria leaf spot, powdery mildew, Phytophthora rot, stem canker, purple seed stain, bud blight, and nematodes.

F. Weed problems should be handled early so that yield is not reduced. Tilling before planting and when plants are young is one method of weed control. Pre-emergence herbicides are also used to control weeds. The use of genetically modified soybeans that can withstand selected herbicides is another method of weed control.

G. Fertilizer needs vary from field to field and throughout fields. In order to ensure proper nutrient application, soil testing is suggested. Precision farming, including global information systems (GIS) and global positioning systems (GPS), combined with soil testing would provide information on fertility, texture, previous crop yields, and a variety of other data essential to optimum plant growth. Precision farming is information and technology based crop management system. Geographic information systems are the methods used to map fields into grids for precision farming. Global positioning systems are the methods used to connect orbiting satellites and a ground receiver to locate exact points on a field.

H. Soybean plants are legumes which mean they are capable of using the free nitrogen in the air. In order for this to happen, the seed must be inoculated. Inoculation is the mixing of nitrogen-fixing rhizobia bacteria with the seed just before planting. The seed may not need to be inoculated if the field has previously been planted with soybeans.

I. Soybeans grow best in fields with a pH of 5.8 to 7.0. Higher pH increases the availability of many essential and trace elements.

J. Soybeans require relatively large amounts of phosphorus and potassium.

K. Most soybeans are harvested once they reach 14 percent moisture. Harvesting is done by combine and begins when the stalks and pods are golden brown, the leaves have fallen from the plant, and the beans are mature. Preharvest loss is a loss that occurs before harvest begins. It is also known as preharvest shatter. In order to reduce this loss, soybeans may be harvested before reaching the optimum 14 percent moisture level. These soybeans would then require artificial drying. Harvest loss is loss that occurs as a result of the harvesting process. Harvest loss can be minimized with proper combine adjustment. Operating the combine at an efficient speed will also assure a maximum harvest yield.

Display a variety of seed samples for students to compare. Samples should range from acceptable to unacceptable. Contact local seed salespeople for seed samples. Pictures, videos, or examples of common soybean pests would also help reinforce this objective. TM C9–2D highlights information covered in this objective.

Resources

Biondo, Ronald J. and Jasper E. Lee. Introduction to Plant and Soil Science and Technology. 2nd Edition. Danville, Illinois: Interstate Publishers, Inc. 2003 (Textbook and Workbook, Chapter 18)

Delorit, Richard J. et al. Crop Production. 5th Edition. Englewood Cliffs, New Jersey: Prentice Hall, Inc. 1984

Source of Lesson

Center for Agriculture and Environmental Research and Training, Inc.
Indiana Animal, Plant, and Soil Science Lesson Plan Library
<http://www.caert.net/>

Review/Summary

Use the anticipated problem for each objective to review this lesson. Reinforce the key terms and concepts during the review.

Application

Students can apply the information learned in this lesson to the following activities:
Biondo, Ronald J. Introduction to Plant and Soil Science and Technology Activity Manual. 2nd Edition. Danville, Illinois: Interstate Publishers, Inc. 2003 (Workbook, pages 125–130)

Suggested Student Assessment/Evaluation

Student comprehension of these objectives can be measured with the following sample test.

Answers to Sample Test:

Part One: Matching

1 = f, 2 = c, 3 = a, 4 = e, 5 = b, 6 = d

Part Two: Completion

1. Chemical control
2. Inoculation
3. Global positioning systems
4. Geographical information systems

Part Three: Short Answer

1. Precision farming is information and technology based crop management system.
2. Oil crops are plants grown to produce vegetable oil from their seed or fruit.

Growing Soybeans Test

Name _____

Lesson C9-2:

Part One: Matching

Instructions: Match the term with the correct response. Write the letter of the term by the definition.

- a. Biological control
- b. Mechanical control
- c. Precision farming
- d. Preharvest loss
- e. Harvest loss
- f. Legume

- _____ 1. A plant that can fix nitrogen from the air in the soil.
- _____ 2. An information and technology based crop management system.
- _____ 3. The use of natural enemies of a pest to control it.
- _____ 4. Loss that occurs as a result of the harvesting process.
- _____ 5. The use of tools or equipment such as hoes or plows to control pests.
- _____ 6. Loss that occurs before harvest begins.

Part Two: Completion

Instructions: Provide the word or words to complete the following statements.

- 1. _____ methods involve the use of chemicals such as poisons, growth regulators, sterilants, and attractants and repellants to control pests.
- 2. _____ is the mixing of nitrogen-fixing rhizobia bacteria with the seed just before planting.
- 3. _____ is the connecting orbiting satellites and a ground receiver to locate exact points on a field.
- 4. _____ is the mapping of fields into grids for precision farming.

Part Three: Short Answer

Instructions: Provide information to answer the following questions.

- 1. What is precision farming?
- 2. What are oil crops?

TM: C9-2A

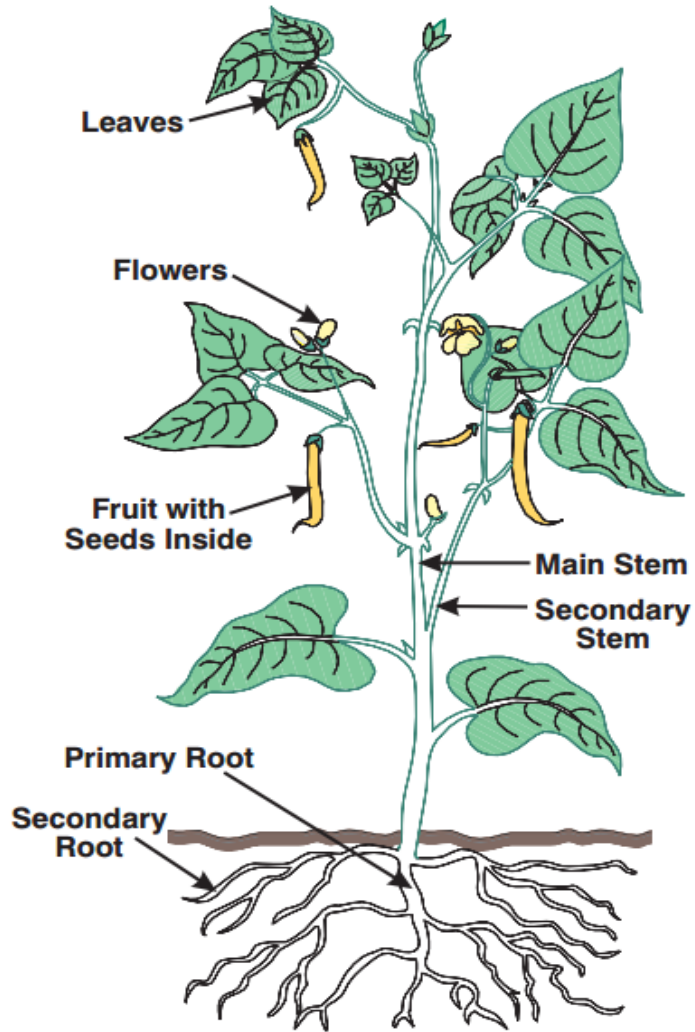
MAJOR PARTS OF A SOYBEAN PLANT

Primary Root
Secondary
Root
Flowers

Fruit with
Seeds Inside
Main Stem
Secondary

Stem
Leaves

MAJOR PARTS OF A SOYBEAN PLANT



TM: C9–2B

SOYBEAN PRODUCTION YIELDS

- Approximately 60 million acres of soybeans are planted in the U.S. each year.
- Annual production is 1.5 billion bushels; one bushel is equal to 60 pounds.
- One bushel of soybeans typically produces:
 - 11 pounds of oil
 - 43 pounds of meal
 - 4.2 pounds of hulls
 - 1.8 pounds of other matter

TM: C9-2C

GERMINATION OF A BEAN SEED

First true leaves

Cotyledon

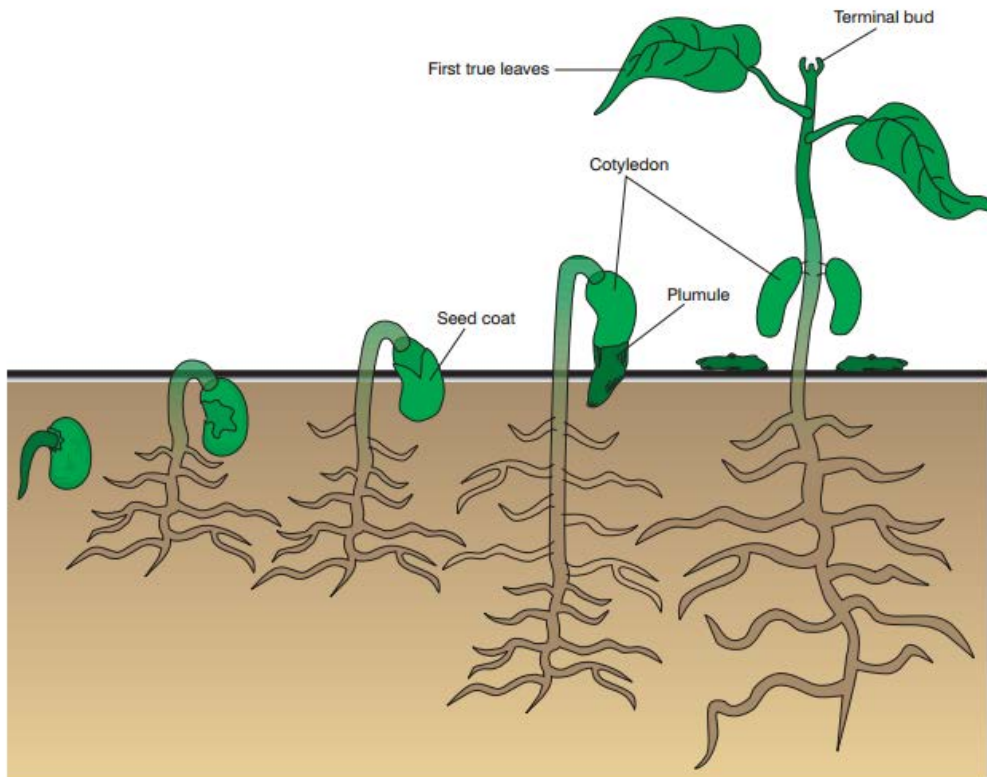
Seed coat

Plumule

Terminal bud

TM: C9-2C

GERMINATION OF A BEAN SEED



TM: C9–2D

TYPES OF PEST CONTROL

Biological control:

- The use of natural enemies of a pest to control it.

Mechanical control:

- The use of tools or equipment such as hoes or plows to control pests.

Chemical control:

- The use of chemicals such as poisons growth regulators, sterilants, and attractants and repellants to control pests.