

## **Unit D:** Production of Field Crops

### **Lesson 5:** Growing Sugar Crops

**Student Learning Objectives:** Instruction in this lesson should result in students achieving the following objectives:

1. Describe sugar cane and its value
2. Describe sugar beets and its value

**Recommended Teaching Time:** 2 hours

**Recommended Resources:** The following resources may be useful in teaching this lesson:

- A PowerPoint has been developed for use with this lesson plan
- [http://www.solarnavigator.net/solar\\_cola/sugar\\_beet.htm](http://www.solarnavigator.net/solar_cola/sugar_beet.htm)
- <http://en.wikipedia.org/wiki/Sugarcane>

### **List of Equipment, Tools, Supplies, and Facilities:**

Writing surface  
PowerPoint Projector  
PowerPoint Slides  
Transparency Masters  
Variety of products that are made from sugar

**Terms:** The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide 2):

- **Furrow**
- **Brown sugar**
- **Taproot**
- **Beet hook**
- **Purified**

**Interest Approach:** 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 samples of products that can be made from sugar. Have students try to figure out what all of these products have in common. Lead this into discussion about the two main sources of sugar in the world.

# Summary of Content and Teaching Strategies

**Objective 1:** Describe sugar cane and its value

**(PowerPoint Slide 3)**

I. Sugar cane

A. Sugar cane is a member of the grass family.

**(PowerPoint Slide 4)**

B. Sugar cane is grown from sections of stalk, not seed. These sections are called sets and are planted in **furrows**, which are long, narrow, shallow trenches made in the ground.

1. Stalks are cut into sections that range from 45-91 centimeters long. These are laid end to end in a furrow and covered with soil 5-8 centimeters deep. The nodes then grow tiny shoots that develop into mature stalks. Roots also grow this way.

**(PowerPoint Slide 5)**

C As a tropical climate crop the stalk may grow 2-4.5 meters tall.

D. Inside the stem is a white pulp where the sugar is stored.

E. Harvested after two years, sugar cane can be harvested after only seven months, though the yield is not as high.

**(PowerPoint Slide 6)**

F. At maturity it will produce seeds in tropical climates, so the cane is usually harvested by then, or the seeds are infertile.

G. 101-127 centimeters of rainfall or irrigation is needed during the growing season.

**(PowerPoint Slide 7)**

H Common ways to harvest around the world:

1. Sugar cane may be harvested by hand, using a machete knife

**(PowerPoint Slide 8)**

2. Field is burned to remove leaves before cutting, and then stalks are raked into piles.

3. Mechanical harvester- cuts stalks, removes leaves and loads stalks.

**(PowerPoint Slide 9)**

I. After being cut, sugar cane must be processed quickly because it begins to lose its sweetness as soon as it is cut.

J. To process, the cane is crushed to remove a brown liquid. This liquid is boiled and impurities are removed. The juice thickens as water evaporates. Brown crystals appear and are then melted down and cleaned to result in white crystals.

**(PowerPoint Slide 10)**

K. The same sugar cane field may be harvested several times before it needs to be replanted.

L. Sugar cane is the major source for molasses.

M. **Brown sugar** is processed white sugar with some molasses added back in.

**\*\*Use TM: D5-1 or PowerPoint Slide 11 to illustrate the major parts of a sugar cane stalk. After you review the major parts hold up a sugar cane plant, if available, and point to the parts the class just went over. Have the class say each part together as you point to it.**

**Objective 2:** Describe sugar beets and its value

**(PowerPoint Slide 12)**

II. Sugar beets

A. Sugar beet is a hardy biennial vegetable that can be grown commercially in a wide variety of temperate climates.

**(PowerPoint Slide 13)**

B. During its first growing season, it produces a large (1–2 kg) storage root whose dry mass is 15–20% sucrose by weight. If not harvested, during its second growing season, the nutrients in this root are consumed to produce the plant's flowers and seeds.

**(PowerPoint Slide 14)**

C. Seed production and sugar production need to take place in different locations because frost resistance is poor, but plants need a cold shock to flower and produce seed. Requires a deep well drained stone free soil that is not acid.

**(PowerPoint Slide 15)**

D. Sugar beets are grown from seeds.

E. Sugars accumulate in the **taproot**, the large main root that grows downward in a taproot system.

F. Sugar formation increases rapidly in late summer as nights get cooler and nitrogen sources are diminished in the soil.

**(PowerPoint Slide 16)**

G. Harvesting is delayed as long as possible in the growing season to assure maximum sugar content.

H. The growing season for sugar beets is approximately five months.

**(PowerPoint Slide 17)**

I. Harvesting

1. In parts of the world sugar beets are harvested by a machine that cuts off the tops and lifts the beets from the soil.

**(PowerPoint Slide 18)**

2. If harvested by hand, it can be highly labor-intensive. Weed control is managed by densely planting the crop, which then it has to be manually thinned with a hoe two or even three times during the growing season.

**(PowerPoint Slide 19)**

Harvesting also requires many workers. Although the roots can be lifted by a plough-like device which could be pulled by a horse team, the rest of the preparation is done by hand. One laborer will grab the beets by their leaves, knock them together to shake free loose soil, and then will lay them in a row, root to one side, greens to the other.

**(PowerPoint Slide 20)**

A second worker equipped with a **beet hook** (a short handled tool something between a billhook and a sickle) will follow behind, and lifts the beet and swiftly chops the crown and leaves from the root with a single action. Working this way, would leave a row of beet that could then be forked into the back of a cart.

**(PowerPoint Slide 21)**

- J. To process sugar beets, they must be washed, sliced, and soaked in hot water to separate the juice from the beet fiber. The juice is then **purified** (to free from anything that debases, pollutes, adulterates, or contaminate the crop) filtered, concentrated, and dried.
- K. The tops and beet pulp residue of sugar beets can be used for livestock feed.

**\*\* Use TM: D5-2 or PowerPoint Slide 22 to illustrate the major parts of a sugar beet plant. After you review the major parts hold up a sugar beet plant, if available, and point to the parts the class just went over. Have the class say each part together as you point to it.**

**\*\*Have the students use LS: D5-1 to record the similarities and differences in various types of sugar. The students could write a short paper based on the information they gather from the worksheet.**

**Review/Summary:** Summarize the lesson by asking students to explain the content of each objective. Reinforce the key terms and concepts. **LS: D5-1** will also help with this.

**Application:** Students can apply the information learned in this lesson to the following lab sheets: **LS: D5-1.**

**Evaluation:** Student comprehension of these objectives can be measured with the attached sample test.

## **Answers to Sample Test:**

### ***Part One: Matching***

1=c; 2=e; 3=b; 4=a; 5=d

**Part One: Fill in the blank**

1. beets, cane
2. sugar cane
3. seeds
4. stalk
5. sugar cane

## Sample Test

Name \_\_\_\_\_

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# Test

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## Unit D: Lesson 5: Growing Sugar Crops

### **Part One: Matching**

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

- |                |              |
|----------------|--------------|
| a. Furrow      | d. Beet hook |
| b. Brown sugar | e. Purified  |
| c. Taproot     |              |

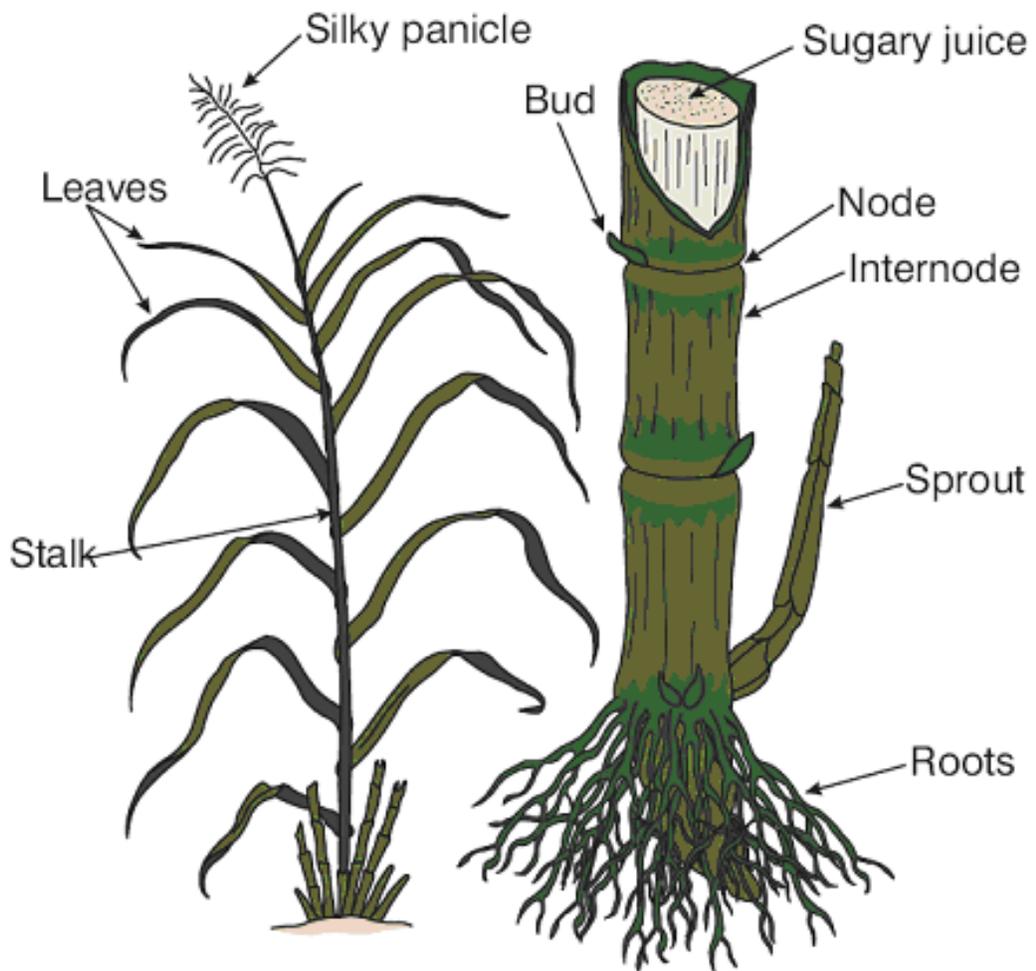
- \_\_\_\_\_ 1. A large main root that grows downward.
- \_\_\_\_\_ 2 to free from anything that debases, pollutes, adulterates, or contaminate the crop
- \_\_\_\_\_ 3 processed white sugar with some molasses added back in.
- \_\_\_\_\_ 4 long, narrow, shallow trench made in the ground
- \_\_\_\_\_ 5 a short handled tool something between a billhook and a sickle

### **Instructions. Complete the following statements.**

1. In sugar \_\_\_\_\_, the sugar accumulates in the taproot and in sugar \_\_\_\_\_, the sugar is stored in the stem.
2. \_\_\_\_\_ is the major source for molasses.
3. Sugar beets are grown from \_\_\_\_\_.
4. Sugar cane is grown from sections of \_\_\_\_\_.
5. Sugar \_\_\_\_\_ need a cold shock to flower and produce seed.

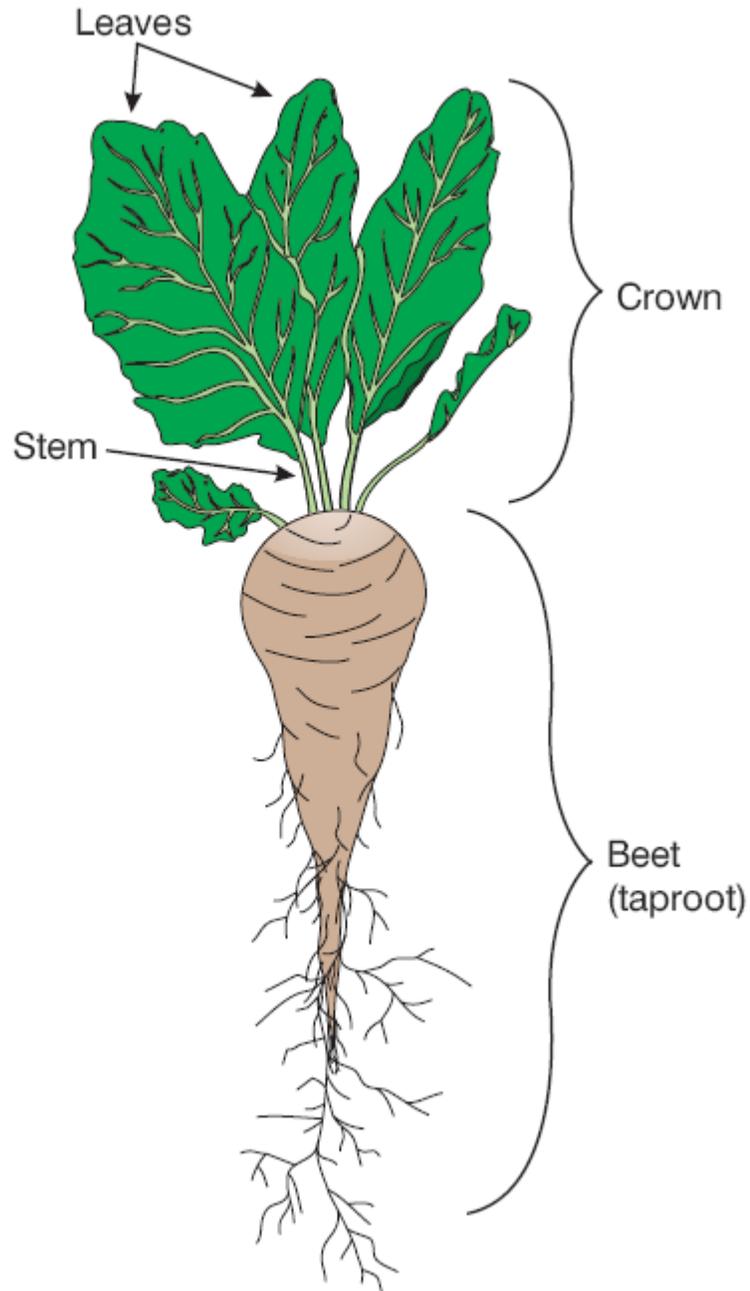
TM: D5-1

## STRUCTURE OF A SUGAR CANE STALK



TM: D5-2

# MAJOR PARTS OF A SUGAR BEET PLANT



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# Lab Sheet

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## Sugar Sampling

**Materials Needed:**

- Sample of cane sugar
- Sample of beet sugar
- Sample of brown sugar
- Sample of molasses
- Sample of sugar substitute

**Procedure:**

1. Look at the samples and record their appearance in the Data Table.
2. Touch the samples and record their texture in the Data Table.
3. Smell each of the samples and record your findings in the Data Table.
4. Taste a small amount of each of the samples and record their flavor in the Data Table.
5. Write a short paper about the similarities and differences of the samples based on the information you gathered.

**Data Table**

	Look	Feel	Smell	Taste
Cane sugar				
Beet sugar				
Brown sugar				
Molasses				
Sugar substitute				