Crop Science Investigation Workshop Series Lesson Plans

Subject: Crop Production- Figuring Yields **Grade Level(s):** 4th – 12th grades
Lesson Title: When is corn and soybeans ready to harvest and how can yield estimates be calculated? (Mostly corn driven)
Time period: 2-3 hour session (depending on activities conducted)
This lesson can easily be adapted to address as few as one learning objective or all. Objectives and corresponding learning activities are numbered accordingly.

These lessons can be adapted for youth of any age depending on level of technical content taught. When working with youth of varying ages, it is suggested to have older youth help the younger ones.

Lesson Objectives:

1. Determine when corn and soybeans are physiologically mature.
2. Understand limiting factors that affect yield.
3. Name the parts of an ear of corn and corn kernel and understand what affects the development of kernels and ears.
4. Calculate yield estimates on corn plants.
5. *(Optional) Create a display outlining how yield is determined and describe factors that affect why a yield could be outstanding or poor.

Materials, audio-visual aids:	**Resources & Handouts**
Ears of Corn (if possible, have 2 ears in differing maturities for comparison) Soybean Plants (with pods) Tape Measurer Clipboards Pencils Ruler(s) Calculating Yields Power point Grain Moisture Tester - Optional *Location for lesson is best in an area where instruction can be held in addition to trips to a field.*	1. Be'an All you Can Be, Unit 3, ISU Crops Manual (pgs. 36-44) 2. NCGA CORN CURRICULUM - WWW.NCGA.COM *NCGA Unit 1, lesson 1, worksheet 3, pg. 8 handout* *NCGA Unit 9, lesson 2, pg. 14 handout* *NCGA Unit 1, lesson 3, pg. 15* 3. University of Kentucky Extension: Estimating Corn Yields Fact Sheet http://www.ca.uky.edu/agc/pubs/agr/agr187/agr187.pdf 4. It's Harvest time or is it worksheet.

Solving the Problem	
Interest Approach/Attn Focusing Activity	Ask youth the following: **What is the optimal time to harvest grain?** Can grain be harvested too early? Too late? How do farmers know if their crops are ready to be harvested? Can they estimate the yields? How and can they estimate accurately? Why would farmers want to estimate yields? *Grain can be harvested too early if it has not reached physiological maturity or if the moisture is too high. Grain with high moisture can spoil easily if not stored properly. Grain harvested too late can*

	result in a loss of yield from stalk lodging or ear droppage or shattering in soybeans. Poor hybrid characteristics, high winds or storms and late harvesting are main reasons that losses can occur before harvest. Show youth a piece of corn and a soybean plant. If these were in a field, would they be ready to be harvested? How can you tell? *When corn has reached black layer and is the optimal moisture for the situation (usually around 15-16% moisture) to store it, or 18% to combine.*
Objective 1: Determine when corn and soybeans are physiologically mature.	*Full maturity (R8) of the soybean plant is defined as when 95 percent of the pods have reached their mature color which means that typically after five to 10 days of good drying weather after this stage, soybeans should have less than 15 percent moisture or harvest moisture. Soybeans will lose moisture rapidly with warm and dry weather at this point but should be harvested soon to prevent losses.* *Try to harvest as much of your soybeans as possible before the moisture level falls below 12 percent to reduce splits and cracked seed coats. Shatter losses have been shown to increase significantly when seed moisture falls below 11 percent and when mature beans undergo multiple wetting and drying cycles. Shatter losses can be reduced by harvesting in the morning or evening when relative humidity is higher.*
Problem statement When is corn and soybeans ready to harvest and how can yield estimates be calculated?	With two differing ears of corn, ask youth to determine if there is a difference in maturity. (It helps if each youth has at least one kernel to examine.) Now that we understand how to determine when to harvest our crops, let's talk about yields. What determines yields and how can yield estimates be calculated?
1. **Objective 2**: Understand limiting factors that affect yield.	*1.1 Hold up ear(s) of corn and soybean plants.* *1.2* Looking at this ear of corn/soybean plant, why do you think it will do good/bad?

2. Objective 3: Name the parts of an ear of corn and corn kernel and understand what affects the development of kernels and ears.	*There are many factors that contribute to an exceptional or poor yield.* *Good yielding crops:* • *Are fertilized according to soil tests for the production level desired.* • *Selected for the best hybrid suited to the farming operation.* • *Planting at appropriate time, correct population and spacing.* • *Have no or limited competition from weeds, diseases, and insects.* • *Is managed with cultural practices to maximize the rate and length of time of dry matter accumulation in the grain.* 1.3 If any of these factors are less than desirable, there is potential for a yield loss. 1.4 So, why would it be important for a farmer to estimate yield? *It can be helpful when making crop management decisions such as when to harvest a field or in making grain marketing decisions. It it not always accurate though, so should be used with caution.* 1.1 In order to successfully estimate yields for corn, we must understand the components of an ear of corn and the corn kernel. 1.2 Let's examine the parts of an ear of corn…. Show youth an ear of corn and where these are located and/or use the NCGA Unit 1, lesson 1, worksheet 3, pg. 8 handout **Ear leaf** **Silks** **Kernels** **Husks** **Stem** **Ear Node** 1.3 Show youth kernel of corn and where these are located and/or use the NCGA Unit 9, lesson 2, pg. 14 handout What's in a kernel? **Endosperm** – 82% of kernel's dry weight & source of starch/energy and protein for the germinating seed. **Pericarp** – outer covering of kernel that protects it

3. **Objective 4:** Calculate yield estimates on corn plants.	**Tip Cap** – only area of the kernel not covered by pericarp, attachment point of the kernel to the cob **Germ** – only living part of the kernel; 25% of germ is corn oil A kernel of corn contains: 61% Starch 19.2% Feed 3.8% Oil 16% Water 3.1 There are several methods for determining corn yields. Using the information sheet from University of Kentucky Extension, we will briefly describe each one and then estimate on an actual ear. - **Simplest & Least Accurate Method** Example: You count 12 rows per ear and 50 kernels per row to equal 600 kernels per ear. Using the table on the Kentucky fact sheet, multipliers based on ears per acre and kernel size are used to calculate expected yield. So if corn kernels are large, the multiplier is .30. Take 600 kernels x .300 = 180 bushels/acre In a highly productive year, kernel size will be larger. In a highly stressful year, kernel size will be smaller. - **Adjusting for Population and Seed Size** Example: If you have 600 kernels per ear and you assume 25,000 ears per acre, then in an average year, 600 x .278 = 167 bushels/acre, using .278 as a multiplier on the Fact Sheet. - **Using Ear Counts to Estimate Ears per Acre** Count ears per 1,000 per acre, so for 30 inch rows, count how many ears there are in 17' 5 ". If there are 26 ears in 1/1000 acre = 26,000 ears per acre. 600 kernels x (26,000 multiplier for medium kernels) .289 = 173 bushels per acre - **Improving Estimate of Ears per Acre** Counting ears in 100 feet will provide the most accuracy. If you could 30 inch rows for 100 feet, a multiplier would be 174.24 for an acre so… With 600 kernels/ear and you counted 145 ears in 100 feet of row, which has a value of 25,265

	ears/acre, round to 25,000 ears/acre and on table one the multiplier is .278 x 600 kernels = 167 bushels/acre 3.2 ACTIVITY: Use the simplest and least accurate method using the handout as a guide. (NCGA Unit 1, lesson 3, pg. 15) Then, use that number for kernels with the rest of the activity and use the ear counts to estimate ears per acre with a tape measure. Another group could do the improving estimate per ears per acre method. 3.3 Compare the results among all of the methods. Which one was the most accurate? Why? Discuss answers with youth. Summarize yield estimates: 3.4 Remember that yield estimates are only as accurate as the field area that was sampled. The yield calculations mean little if you have selected the best or worst area in the field to estimate yield. Repeating yield estimates in several areas of a field will improve accuracy. 3.5 Water availability, insects, weeds, diseases, and other factors can affect seed fill and final yields. As the corn plant approaches black layer or maturity, environmental stresses have less impact on final yield. The exceptions to this are when a catastrophic stress causes severe yield losses, such as a heavy rain that knocks down corn. Since environmental stresses have less impact on final yield as the corn matures, yield estimates made on corn that is closer to maturity should be more accurate than yield estimates made on corn that is in the early stages of seed development. 3.6 The simpler and less accurate methods are better suited to making yield estimates when the corn is in the dough and dent stages. The

	more complicated but more accurate methods are better suited to making yield estimates when the corn is in the dent stage or past black layer. 3.7 Discuss corn harvesting & soybean harvesting losses in ISU manual Unit 3, pgs. 38 & 41 3.8 Optional if you have a moisture tester: Test grain for moisture content and discuss importance of hauling or storing grain at the optimal temperatures. 3.9 As a review, complete the It's Harvest time or is it worksheet.

Summary (Closure) – Conclusion to the Problem:
When is corn and soybeans ready to harvest and how can yield estimates be calculated?

1. How do you know when corn and soybeans are physiologically mature?

2. What are limiting factors that affect yield?

3. What are the parts of an ear of corn and corn kernel?

4. What are some ways to get yield estimates on corn?

5. How can you get more accurate yield estimates?

6. What are potential harvest losses that can occur?

*(Optional) Create a display outlining how yield is determined and describe factors that affect why a yield could be outstanding or poor.

Performance Assessment:

1. Youth are able to explain and show when corn and soybeans are physiologically mature.
2. Youth can list factors that affect yield.
3. Youth can name and identify parts of a corn ear and corn kernel.
4. Calculate yield estimates on corn.
   Optional:
5. Youth are encouraged to create a poster, small report, or report back to the group related to factors that affect yield, show how yield is determined, etc., which could be entered as a 4-H project (if applicable).

It's Harvest Time or is it?

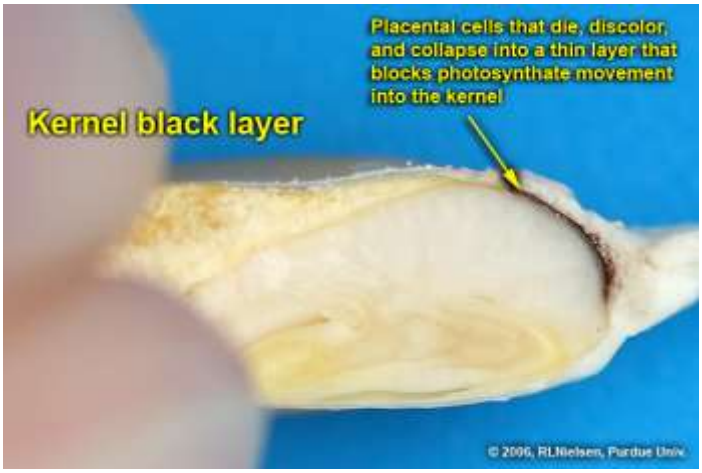
Directions: Complete this sheet with the correct answers in the blanks provided.

Farmer George wants to start harvesting because all of his neighbors are starting, but how can he determine if his corn is ready to be harvested?

When his corn has reached black layer and is the optimal moisture for his situation (usually around 15-16% moisture) to store it.

What is the optimal time to harvest corn? Once it is dry enough to store, but before ear loss occurs

What is black layer? Why is it important? It is achieved when corn is physiologically mature from cells that die, discolor and collapse into a thin layer that blocks nutrients into the kernel.



When corn is just at black layer is usually around 30% moisture and will dry based on conditions present.

Why would Farmer George want to estimate his corn yields?
It can be helpful when making crop management decisions such as when to harvest a field or in making grain marketing decisions. It it not always accurate though, so should be used with caution.

What information is needed to calculate yields? Are some methods more accurate than others? Why or why not?
Ears of corn, seed size, corn population, row spacing
Simple methods do not require as much information therefore, it is much less accurate. Calculations that take the row spacing and population into accurate are more accurate because they have more data.

It's Harvest Time or is it?

Directions: Complete this sheet with the correct answers in the blanks provided.

Farmer George wants to start harvesting because all of his neighbors are starting, but how can he determine if his corn is ready to be harvested?

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What is the optimal time to harvest corn?

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What is black layer? Why is it important?

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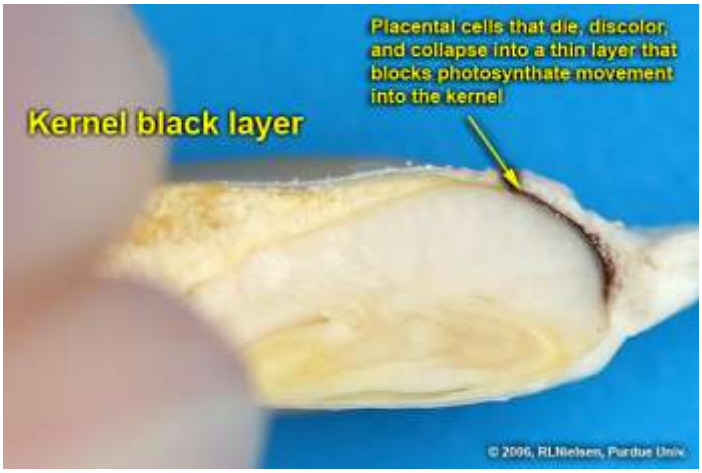

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Why would Farmer George want to estimate his corn yields?

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What information is needed to calculate yields? Are some methods more accurate than others? Why or why not?

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