UNIT VIII - WHEAT AND SMALL GRAIN PRODUCTION

Lesson 6: Harvesting the Crop

**Competency/Objective:** Identify factors to determine harvesting and post-harvesting management.

**Study Questions**

1. What factors determine harvest timing?
2. What factors affect seed damage at harvest?
3. What are the major sources of crop loss during harvest?
4. What are local storage options?
5. What are storage problems associated with wheat and other small grains?
6. How is crop quality maintained during storage?

**References:**

1. *Advanced Crop Science* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2000, Unit VIII.

2. Transparency Masters
   a) TM 6.1: Beginning Dates for Winter Wheat Harvest in the United States
   b) TM 6.2: Harvest Time Indications
   c) TM 6.3: Combine Settings for Wheat Harvesting
   d) TM 6.4: Checking Wheat Harvest Losses
   e) TM 6.5: Correcting Wheat Harvest Losses

3. Activity Sheet
   a) AS 6.1: Determining Grain Loss and Moisture
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TEACHING PROCEDURES

A. **Review**

Lesson 5 gave us an understanding of what to look for when scouting the growing wheat or other small grain crops for problems that may impede yields. We also looked at damage caused by weeds and insects and discussed when it may be appropriate to consider replanting.

B. **Motivation**

Secure grain samples that have a high moisture content, insect and/or mechanical damage, and a sample that is clean with about a 12% moisture content. Ask the students to identity the problems and discuss why buyers would dock the undesirable samples.

C. **Assignment**

D. **Supervised Study**

E. **Discussion**

1. Knowing when to harvest is a management practice that producers must know. This study question will discuss factors that must be considered when making that decision. TM 6.1 and TM 6.2 would be used during this discussion to show beginning dates for harvesting winter wheat in the United States and harvest time indicators.

**What factors determine harvest timing?**

a) Usual times for winter wheat harvest to begin in Missouri is between June 16 and June 30.
   1) Times may vary depending on the condition of the crop (usually the moisture content).
   2) Barley and oat harvesting takes place at approximately the same time.

b) Optimum time to harvest is when grain contains about 12.5% moisture.
   1) Harvest can occur at higher moisture levels (20%) if the producer has the capabilities of quick crop drying.
   2) High moisture grain delivered immediately to commercial buyers will be devalued (docked) according to the moisture amount.
   3) Moisture meter or oven-drying method may be used to determine when to harvest.
   4) Harvesting early, at higher moisture levels (above 15%) may have an advantage of increasing profit potential of a second crop in a double-cropping system.
   5) Early harvesting can increase yields owing to higher test weight and less shatter loss at the header.

2. The combine must be adjusted to the proper settings and then fine-tuned when harvesting to reduce harvest losses or damage of grain. Use TM 6.3 to show combine settings for harvesting wheat.

**What factors affect seed damage at harvest?**

a) The major portion of damage occurs during the threshing operation at harvest.
b) Threshing occurs at the cylinder or front portion of the rotor and is affected by the concave clearance and the cylinder/rotor speed.

c) Symptoms of overthreshing are cracked grain and excessive amounts of return.

d) To avoid overthreshing, set the cylinder speed and concave clearance according to operator’s manual.
   1) Some operators prefer to leave an occasional kernel in the head as a sign of the best balance in threshing action.
   2) Consult the operator’s manual for oat and barley settings.

3. While harvesting or operating the combine, the producer must check for harvest losses and for how well the combine is adjusted. This discussion will indicate where and how these inspections may take place. Use TM 6.4 and TM 6.5 to show examples of how to check for wheat harvest losses and options for correcting losses.

What are the major sources of crop loss during harvest?

a) Minor adjustments of the combine may make the difference of 8-10 bushels of grain saved during harvest.

b) Engine speed is one of the most important settings. Speed too slow will also cause the separator speed to be too slow and performance will suffer.

c) Fine-tuning the combine involves considering the five basic functions or operations of the combine.
   1) Cutting and feeding
   2) Threshing
   3) Separating
   4) Cleaning
   5) Handling

d) Cutting and feeding adjustments include header and cutting height, reel speed and height, and reel position (moved forward or backward).
   1) Cutting height is controlled by the operator raising and lowering the table as conditions change.
   2) The goal is to harvest all of the grain with a minimum amount of chaff and straw.
   3) The reel should be adjusted slightly ahead of the cutter bar so as to move the grain gently into the cutter.
   4) The reel should also turn slightly faster than the ground speed to lay the heads on the platform.

e) Threshing occurs between the concave and the cylinder/rotor.
   1) Check setting with the operator’s manual.
   2) Verify setting. Bars and concave may be worn so the distance may be greater than the pointer would indicate.
   3) Concave and cylinder must be parallel.

f) Separation takes place between the chaffer and the shoe openings.
   1) Airflow should be adjusted so the grain falls through the first 2/3 of the chaffer.
   2) Proper sieve opening should be large enough for grain to pass through without allowing foreign material into the grain bin.
   3) Ground speed should not overload the straw walkers.
   4) Reducing ground speed 25% on overloaded walkers could cut harvesting losses in half.

g) Three ground counts should be made to check harvest losses.
   1) A preharvest count in front of the combine
   2) A header count after backing up about 20 feet
   3) A separator count behind the combine

h) A usual (acceptable) loss is about 2% of the total yield. Acceptable loss is higher for downed or damaged preharvested grain.
4. What to do with the grain after it is harvested is a question that must be addressed and answered after each harvest season. Four options will be discussed.

What are local storage options?

a) On-farm storage
   1) Advantages
      (a) More efficient use of labor and equipment
      (b) Earlier harvest possible
      (c) Potential for grain drying returns
      (d) Additional marketing flexibility
      (e) Potential for higher net returns (if cash markets go up)
      (f) Provides tax management flexibility
   2) Disadvantages
      (a) On-farm storage of grain is costly.
      (b) Additional labor and management are required.
      (c) There is risk of grain quality loss.
      (d) There is a potential for lower net prices (if markets go down).
      (e) There are risks of selling overdry grain.

b) Commercial storage
   1) Space is rented at a grain elevator.
   2) Storage rent is usually 3 to 4¢ per bushel per month.
   3) Producers will not recover the exact grain but it will be the same quality.

c) Price-later contracts
   1) This is a deferred price agreement with the elevator that receives the grain.
   2) Producers retain the right to price at a later date, usually the same price offered on the particular day on the cash grain market.

d) Futures market positioning
   1) This means selling the grain on the cash market at harvest and purchasing a long (buy) position in the grain futures market.
   2) This option is considered a method of “storing on paper.”
   3) Substantial risk is involved. The price of grain could go down and would be the same as a cash loss.

5. There are four major problems that would be associated with storage of grain on the farm. This question discusses these problems.

What are storage problems associated with wheat and other small grains?

a) Poor initial grain quality
   1) Kernels may be cracked during threshing (harvesting).
   2) This may occur due to unfavorable harvest conditions at the time.
   3) Damaged kernels lead to storage mold development and possible insect invasion.

b) Moisture migration
   1) Moisture may shift from place to place.
   2) Changes in temperature may lead to air currents carrying moisture from one part of the bin to another.
   3) Pockets of moisture may be created and can spoil the grain.
   4) Problems may be corrected with aeration.

c) Storage mold development
   1) Significant damage is caused to the grain.
   2) Fungi are always involved when spoilage occurs.
   3) High moisture and high temperature cause serious grain quality losses.
d) Insect and rodent invasion
   1) Insects and rodents are a major cause of loss in stored grain.
   2) They consume grain and contaminate it with insect fragments, feces, webbing, and bad smelling metabolic products.
   3) Several hundred insects are associated with stored grain, but only a few cause serious damage.
   4) Insect invasion is usually associated with dirty facilities and inadequate control of moisture and temperatures.
   5) Insect identification and knowing insect control measures are important to preventing serious losses.

6. Producers should know what they can do to keep good quality grain from deteriorating during storage. This question will discuss this issue and provide some solutions to maintaining quality in stored grain.

How is crop quality maintained during storage?

a) Many physical factors affect the market quality of grain.
   1) Moisture content
   2) Test weight
   3) Shrunken and broken kernels

b) Deteriorated grain
   1) Molds discolor the germs of the grain, leading to increased damaged kernel counts.
   2) Discounts may range from 1¢ to 15¢ per bushel.
   3) Presence of insects may lead to 5-10¢ per bushel discounts.
   4) Uncontrolled molds lead to objectionable odors.
   5) Problems may lead to grain being designated as “sample grade” with discounts of 10¢ per bushel or complete rejection.

c) Preventing discounts
   1) Sanitation
   2) Monitoring
   3) Aeration
   4) Proper use of chemicals

d) Drying grain
   1) Grain must be dried to less than 12.5% moisture and cooled within 4 days to ensure against growth of molds and invasion of insects.
   2) The higher the moisture of stored grain, the faster heated air should be moved through the storage bin.

e) Insect damage
   1) Insects are the most difficult part of farm storage to control.
   2) Over 20 different insects survive in grain.
   3) Stored grain insects have a life cycle of 4-12 months.
   4) Insect reproduction is related to temperature during their life cycle.
   5) Optimal feeding temperatures are from 70 to 90°F.
   6) The lesser grain borer is the most damaging grain insect during storage.
   7) Temperatures below 50°F control insect reproduction.
   8) Discounts related to insect presence can be reduced with IPM (integrated pest management).
   9) There are minimum insect densities at which controls are cost-effective.
      (a) If more than two insects are found in samples, take a total of five samples/bin.
      (b) If lesser grain borers or weevils (internal feeders) are found in more than one sample, fumigation may be necessary unless entire grain mass can be cooled to below 50°F within 3 weeks.
(c) If only external-feeding insects (flat or rusty grain beetles, flour beetles, meal moths, saw-tooth grain beetles, etc.) are found, an average of two per sample is usually acceptable if the grain can be cooled to below 50°F within 2 months.

f) Structures
1) Should hold the grain without loss from leaks or spills
2) Prevent rain, snow, or soil moisture from reaching the grain
3) Protect grain from rodents, birds, objectionable odors, and theft
4) Provide safety from fire and wind damage
5) Permit effective treatment to prevent or control insect infestation
6) Provide headroom over the binned grain for sampling, inspecting, and ventilating

g) Sanitation
1) Cleaning and sanitizing the storage area are critical in maintaining small grain quality while in storage.
2) Cleaning and sanitizing should be done immediately after emptying and again 4-6 weeks prior to filling.
3) Critical infestation areas to clean include floor area, unloading pits, augers, sump pits, bin walls, ladder rungs, opening with attached debris, handling equipment, and aeration ducts.
4) Crossover infestation can occur if adjacent grain bin is dirty.
5) New grain should not be placed on top of old grain.
6) Treat bins after cleaning with insecticides.
7) Insecticides may be placed on grain kernels entering storage (as bin is being loaded). This may be in a spray or dust form.
8) Fumigation requires special training and is usually done by a licensed commercial applicator.

h) Monitoring
1) Best management practice is monthly inspections throughout the storage period.
2) Frequent monitoring can reduce risk of major deterioration.
3) Grain probe, moisture meter, temperature measuring device, and screening pans are required.
4) Inspect more than just the surface of the grain - insects tend to concentrate in top layer and gives false impression of infestation levels.

F. Other Activities
1. Visit a local small grain producer and examine the grain storage and handling facilities.

2. Visit a local grain elevator and have the manager give a tour of the grain storage, drying, and handling facilities. Ask the manager to explain what happens to the grain received from producers.

G. Conclusion

It is important that small grain producers know harvest signals and times. The calendar and moisture levels signal when harvest should begin. Producers should also know how to adjust combines to reduce harvest losses and be able to inspect in front of and behind combines to check losses. Most grain is lost during the threshing operation. Grain is usually stored on the farm before marketing; however, there are some other options. These include storing at the local grain elevator, using a price-later contract, or purchasing a futures contract. Storage losses may be reduced by properly cleaning the facilities, monitoring grain quality during the storage period, knowing and using proper aeration methods, and properly using chemicals to treat grain problems.

H. Answers to Activity Sheet
1. Average of 35, 44, and 38 is 39. Average of 56, 52, and 63 is 57.
   \[
   \text{Header loss} = \frac{57 - 39}{20} = .9 \text{ bushel}
   \]

2. Average of 128, 140, and 134 is 134
   \[
   \text{Separator loss} = \frac{134 - 57}{80} = .96 \text{ bushel}
   \]

3. .9 plus .96 = 1.86 bushel

4. \(\frac{.5 - .4 \times 100}{.5} = 20\% \text{ moisture}\)

I. **Answers to Evaluation**

1. d
2. d
3. d
4. During the threshing operation. Make sure the concave/cylinder clearance is properly adjusted and the cylinder/rotor speed is correct.
5. Any three of the following: more efficient use of labor and equipment, earlier harvest is possible, potential for grain drying returns, additional marketing flexibility, potential for higher net returns, and/or provides tax management flexibility.
6. Any three of the following: poor initial grain quality leading to mold development or insect invasion, moisture migration, storage mold development, and/or insect and rodent invasion.
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EVALUATION

Circle the letter that corresponds to the best answer.

1. Small grain harvest time in Missouri usually begins _____________________________.
   a. May 1 - May 15
   b. May 16 - May 30
   c. June 1 - June 15
   d. June 16 - June 30

2. Small grain that is harvested with over a _______ % moisture level should be dried when entering storage.
   a. 10
   b. 11.5
   c. 12
   d. 12.5

3. Grain bins should be cleaned and sanitized _____________________________
   a. 1 month after emptying
   b. Immediately after emptying
   c. 4 to 6 weeks before filling
   d. Both b and c

Complete the following short answer questions.

4. During which function of the harvesting operation is most grain lost? Explain how this can be corrected.

5. List three advantages of storing grain in on-farm storage after harvesting and before marketing.
   a.
   b.
   c.

6. What are three possible problem areas that may develop in stored grain?
   a.
   b.
c.
Beginning Dates for Winter Wheat Harvest in the United States

Advanced Crop Science, VIII-79
# Harvest Time Indications

<table>
<thead>
<tr>
<th>Crop</th>
<th>Percent Moisture</th>
<th>Plant Maturity Stage</th>
<th>Physical Plant Signs for Harvest</th>
<th>Method Used to Harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>below 14%</td>
<td>a little past hard dough stage</td>
<td>majority of kernels shell out when rubbed between hands</td>
<td>direct combine</td>
</tr>
<tr>
<td>Oats</td>
<td>no more than 13-14%</td>
<td>hard-dough or 2-3 days later</td>
<td>when the straw shows no greenness and the heads have turned a dull white</td>
<td>direct combine or windrow-pickup combine</td>
</tr>
<tr>
<td>Barley</td>
<td>below 14%</td>
<td>hard-dough stage</td>
<td>when heads have turned golden yellow but straw may be slightly green</td>
<td>direct combine or windrow pickup combine</td>
</tr>
</tbody>
</table>
## Combine Settings for Wheat Harvesting

<table>
<thead>
<tr>
<th>Setting</th>
<th>Range</th>
<th>Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chaffer opening (inches)</td>
<td>1/4 to 3/4</td>
<td>5/8</td>
</tr>
<tr>
<td>Sieve opening (inches)</td>
<td>1/8 to 3/8</td>
<td>1/4</td>
</tr>
<tr>
<td>Fan setting (speed or choke)</td>
<td>medium to high</td>
<td>near high end</td>
</tr>
<tr>
<td>Cylinder/rotor speed (rpm)</td>
<td>750 to 1350</td>
<td>1000</td>
</tr>
<tr>
<td>Cylinder/rotor &amp; concave spacing (inches)</td>
<td>1/8 to 1/2</td>
<td>1/4</td>
</tr>
</tbody>
</table>
Checking Wheat Harvest Losses

Check preharvest loss here

Check header loss here

After cutting into field, back combine to check header loss

Check separator loss here

Standing wheat

Advanced Crop Science, VIII-85
Correcting Wheat Harvest Losses

Separator Loss Over 1.5%? Yes → Adjust

Engine Separator Speed OK? Yes → Slow Down

Ground Speed Too Fast? No → Raise

Header Too Low? No → What Type of Loss?

What Type of Loss? Untreshed Kernels → Raise Cylinder Speed or Decrease Clearance

Loos Kernels → Lower Cylinder Speed or Increase Clearance

Shattered Kernels → Pulverized Straw Behind Machine or Cracked Grain in Tank?

Yes → Lower Cylinder Speed or Increase Clearance

No → What Type of Loss?

Header Loss Over 5%? Yes → What Type of Loss?

No → Whole Heads

Real Speed Too Fast?

Poor Knife Condition?

Ground Speed Too Fast?

Cutterbar Too High?

Real Speed Too Slow?

Real Height Incorrect?

Chafor Opening Too Narrow?

Fan Blast Too Strong or Too Weak?

Chafor Extension Too Low or Too Narrow?
Determining Grain Loss and Moisture

Objective: Students will determine the amount of grain that may be lost from certain harvesting conditions.

Directions: Using the information supplied in the student reference, determine the answer to the following situations.

1. The producer laid a 1-foot square frame down three times in standing wheat and secured a count of 35, 44, and 38 grains of wheat. The same procedure was then done in front of the header after the combine was backed about 20 feet and counts of 56, 52, and 63 kernels of wheat were obtained. What was the “header” loss (bushels/acre) from the harvesting operation?

2. The producer then made a count behind the combine not equipped with any type of straw-spreading device and secured the following numbers: 128, 140, and 134. What did the producer figure as the “separator” loss (bushels/acre) from the harvesting operation?

3. What was the producer’s total loss of grain (bushels/acre) from the harvesting process?

4. The producer was also interested in finding out the moisture content of the grain but did not have a moisture meter. He took a 1/2-pound sample of the harvested grain, dried it in an oven at 260°F overnight, and found that it weighed .4 of a pound the next morning. What was the moisture content of the grain sample?