

# **Unit D: Agricultural Equipment Systems**

**Lesson 6: Operating, Calibrating,  
and Maintaining  
Forage Harvesting and  
Handling Systems**

# Terms

- Baling
- Cutterbar lead
- Direct cut silage
- Green chop
- Hay
- Haylage
- Knife register
- Mower
- Rakes
- Silage
- Wilted silage
- Windrow

# Objective #1

What are the operating principles of forage harvesting and handling systems?

# Hay & Forage Management

- Requires a complete understanding of the many machines that handle cereal and legume crops from cutting to storage.
- Requires preservation of as much of the nutritional value in the crop
- Want the lowest investment of labor and money

# Type of Forage Systems

- ***Green chop***
  - Not less than 70 percent moisture
  - Cut, chopped, and fed directly without being stored
- ***Hay***
  - Green forage crop harvested for feed and stored at low moisture levels (12 to 22 percent moisture)

# Hay

- Crop is cut and cured in the field before harvesting and packaging into bales
  - Small bales = less than 100 pounds
  - Large bales = more than 1,000 pounds
  - Stacks = 1 to 6 tons

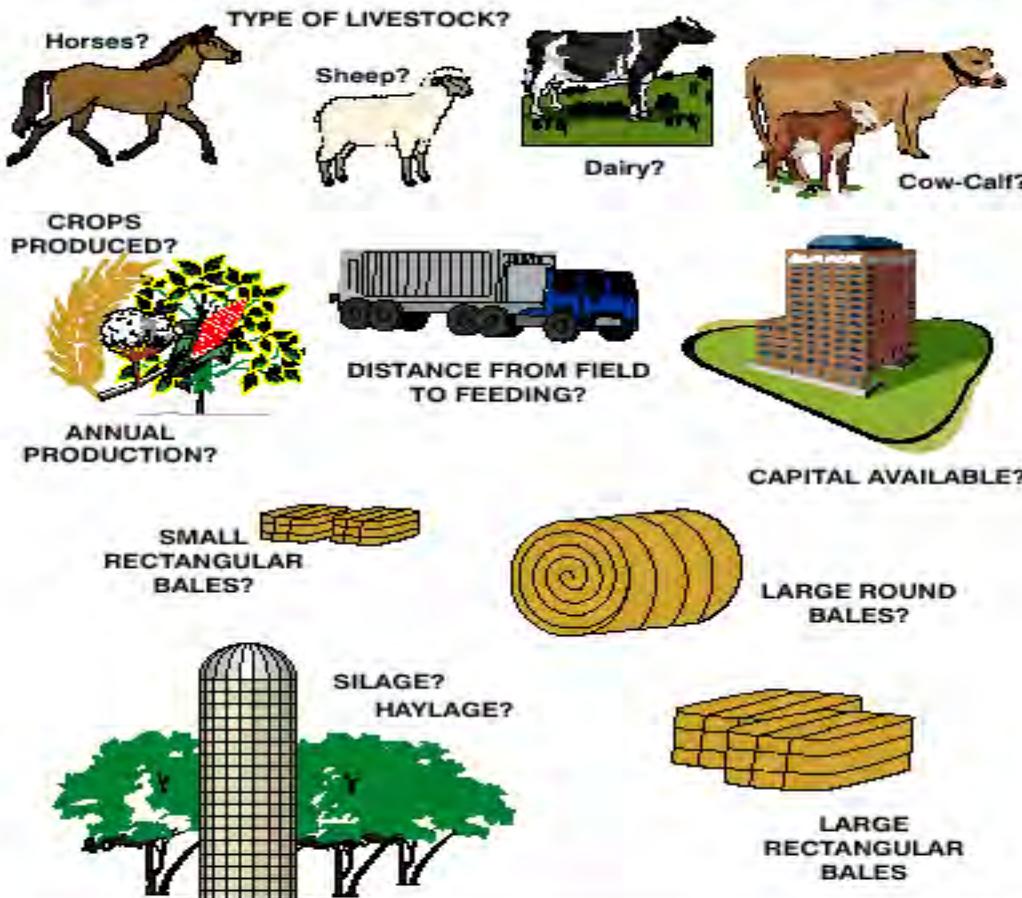
# Forage Harvesting Methods

- ***Silage***
  - Fermented green forage that is harvested in a high moisture condition to prevent leaf loss
  - Stored in oxygen limiting unit
- ***Direct cut silage***
  - Not less than 70% moisture, cut, chopped, and immediately ensiled

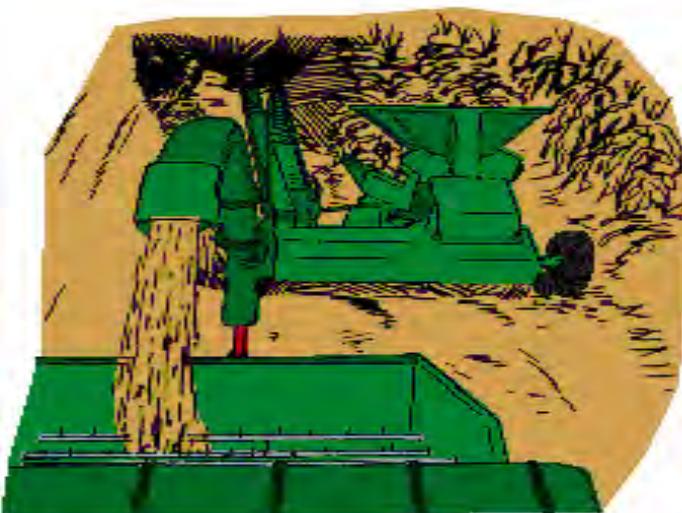
# Forage Harvesting Methods

- *Wilted silage*
  - Has 50 to 70% moisture
  - Cut, field dried, chopped and ensiled
- *Haylage*
  - Contains 40 to 50% moisture
  - Typically an on-grain crop
  - Chopped, field dried and ensiled

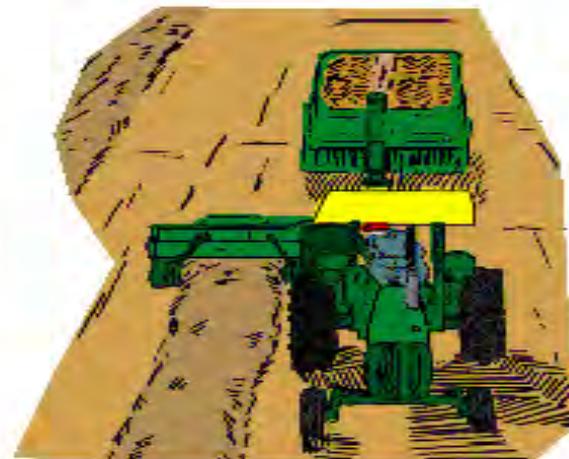
# **QUESTIONS ASSOCIATED WITH A FORAGE MANAGEMENT PROGRAM**



## **TWO TYPES OF FORAGE HARVESTING**



**Direct-Cut-Forage Harvesting**



**Wilted-Forage Harvesting**

## Objective #2

How is cutting equipment  
operated and prepared for  
use in forage management?

# Mowers

- ***Mowers***
  - Used to cut standing vegetation
  - Either by shearing or through impact
  - Cutting should be clean and sharp

# Types of mowers

- Rotary mower
  - Has one or more rotating blade
  - Used to cut weeds, stalks, grass & brush
  - Low profile and closely coupled to tractor
- Rotary disk mower
  - Hug and float over the ground
  - High speed rotating disks that cut at a high rpm



# Types of mowers

- Flail cutters
  - Flails attached to a rotating horizontal shaft
  - Used to clip grass, weeds, and brush
  - Not used for cutting hay crops because tendency to shred and pulverize the hay
- Sickle cutterbar
  - Reciprocating knife shears plant stems
  - Most commonly used hay-cutting device

# Mower Efficiency

Dependent on:

- Ground speed
- Cutting height knife selection and register
- Cutterbar tilt and lead

# Mower efficiency

- Correct cutting angle is necessary for clean cutting referred to cutterbar tilt
- ***Cutterbar lead***
  - Position the outer end of the cutterbar slightly ahead of the inner end when the mower is stopped
- ***Knife register***
  - Knife sections are an equal distance from the centerline of the guards at each end of the stroke

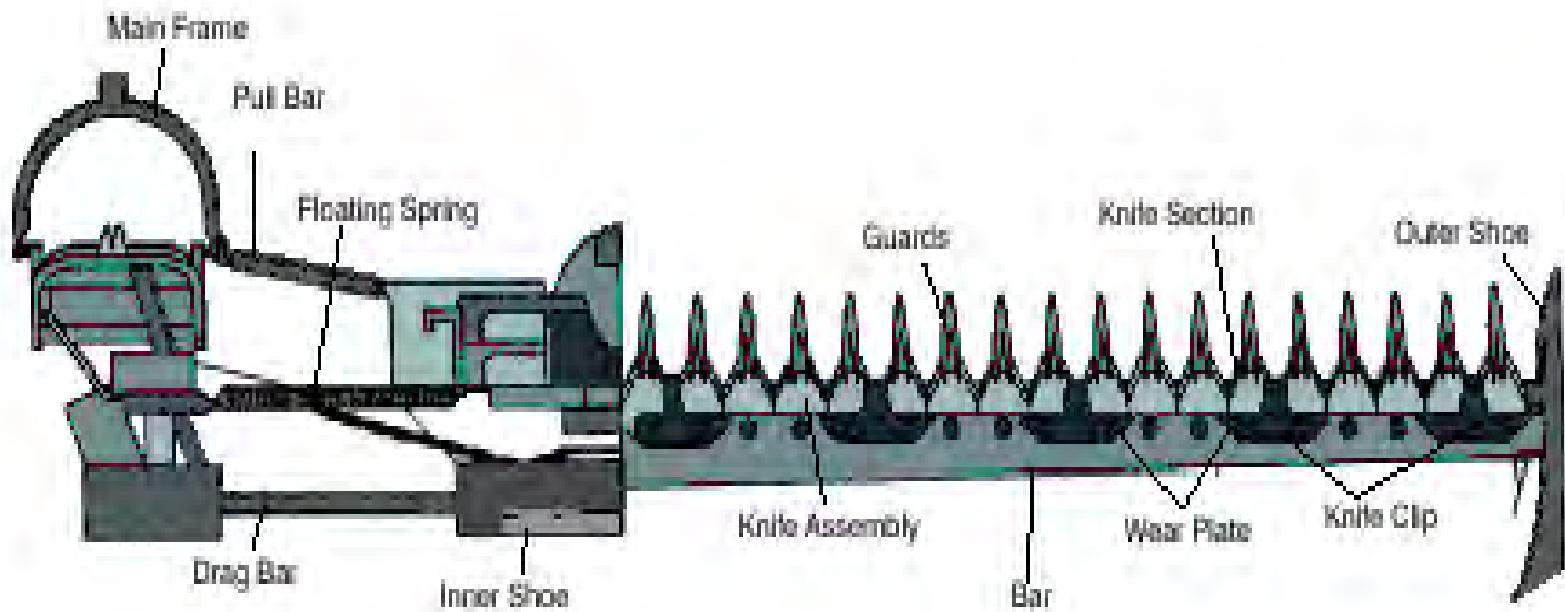
# Mower Conditioners

- Combine a mower and conditioner
- Cut, condition, and windrow hay in one operation
- Mechanically condition hay by cracking, crushing, or bruising the stems as hay is mowed
- Permits more rapid moisture loss from inside the stems

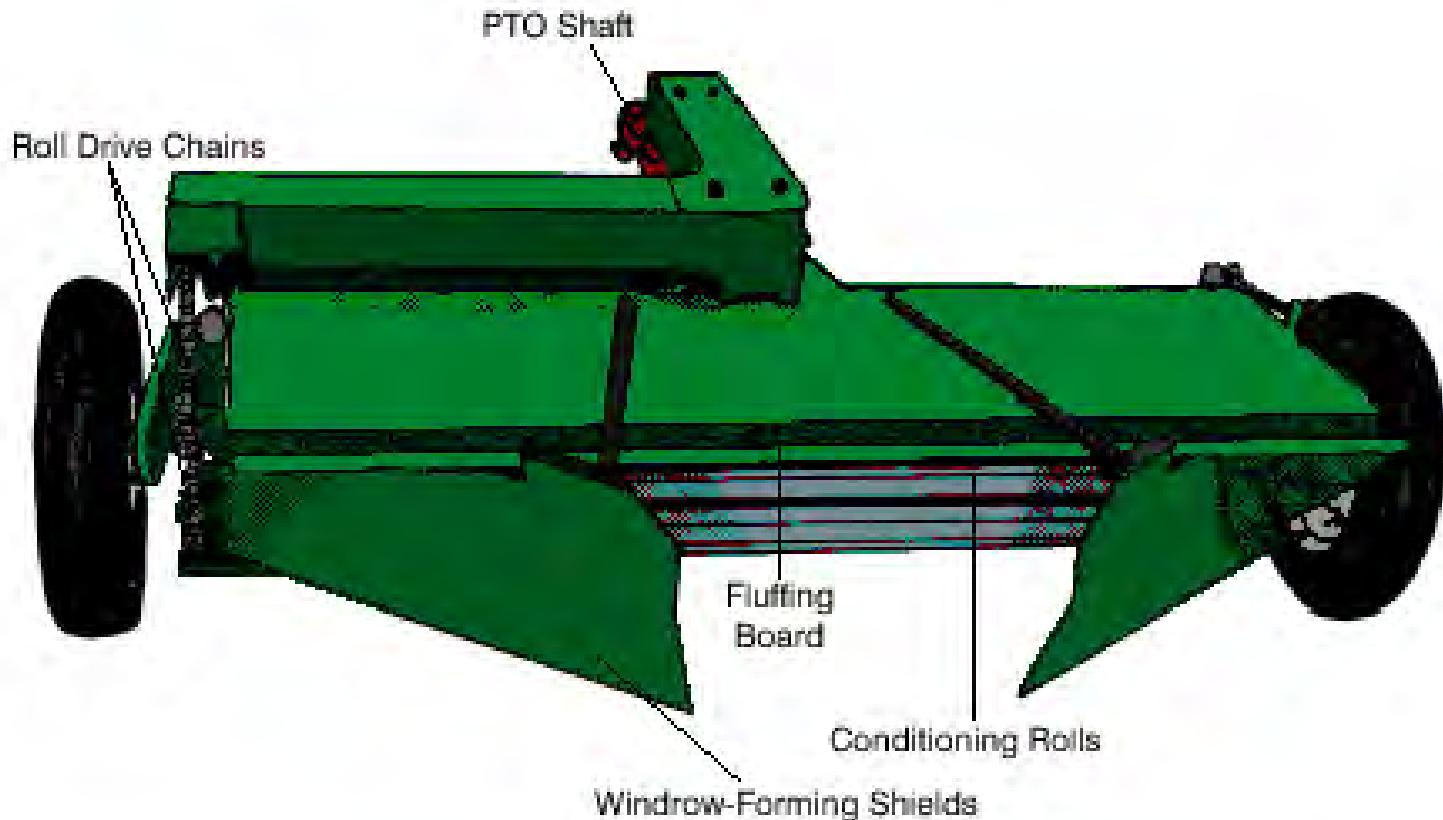
# Types of Conditioners

- Crimper
  - 2 corrugated rolls which mesh like gears that bend and crack the stems every 1- 3 inches
- Crusher
  - Molded rubber rollers with wide intermeshing cleats that provide crimping & crushing
- Impeller
  - Pick up plants and cause them to rub against a hood or other plants
  - Removes waxy covering and bruises the plant for faster drying

# MOWER COMPONENTS



# HAY CONDITIONER COMPONENTS

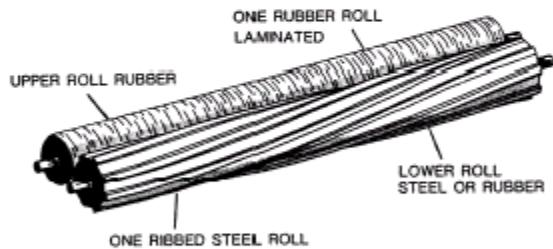


## **TYPES OF CONDITIONER ROLLS**

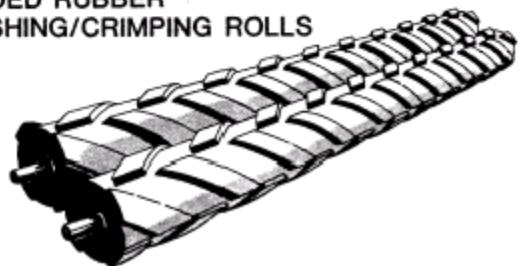
CRIMPER ROLLS



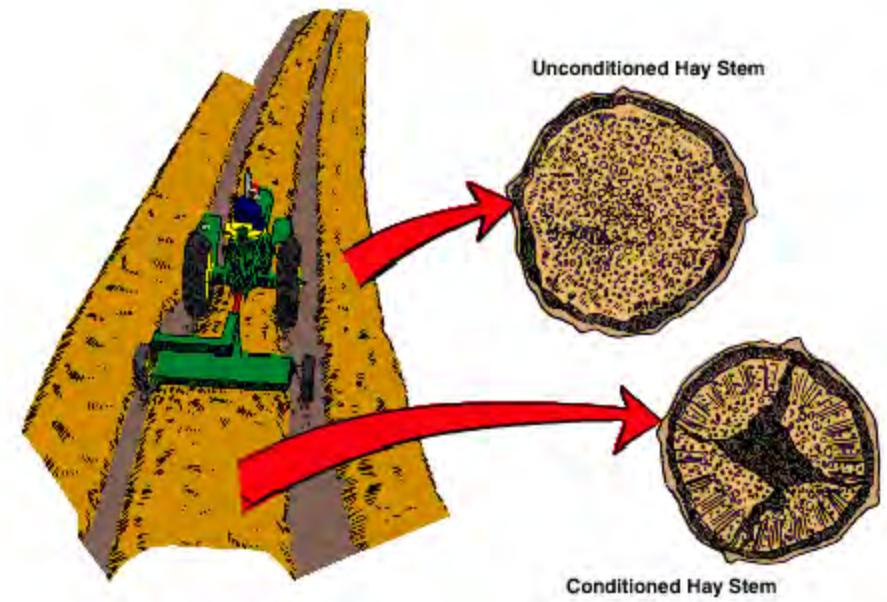
CRUSHER ROLLS



MOLDED RUBBER  
CRUSHING/CRIMPING ROLLS



## **CONDITIONERS SPEED DRYING**



# Objective #3

How is raking equipment  
operated and prepared for use  
in forage management?

# Raking

- ***Rakes***
  - Gather newly-cut hay into windrows to make collection easier
  - Lift mowed hay, place it in a loose, fluffy windrow with the green leaves inside, protected from the sun
- ***Windrows***
  - Row of hay to be picked up later by a harvesting

# Types of Rakes

- Parallel-bar rakes
  - Power source to drive the rake reel and bars
- Wheel rakes
  - No chains, belts, or gears needed to drive wheels, turned by the ground
  - Windrow is tight and dries slowly
- Tedders (fluffers)
  - Raise loosen and partially turn hay so dry faster





This machine is called a "tedder". The yellow teeth spin around and flip the cut grass up and fluff it to help it dry faster. Although the horses have to pull the tedder around the field, there is a motor under the driver's seat that spins the yellow teeth around.

# Field operations for raking

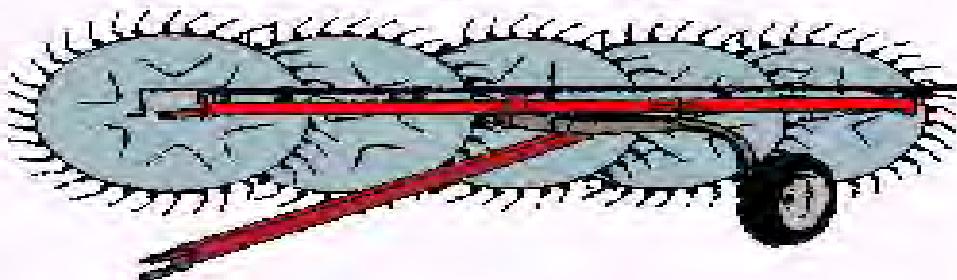
- Hay is wilted slightly is ready to rake
  - If too dry leaf loss may be excessive
- Travel same direction as the mower
  - Places most of the leaves inside windrow
- Speed curing, turn windrow upside down
- Proper ground speed and tooth height are adjustments to be made

# **TYPES OF RAKES**

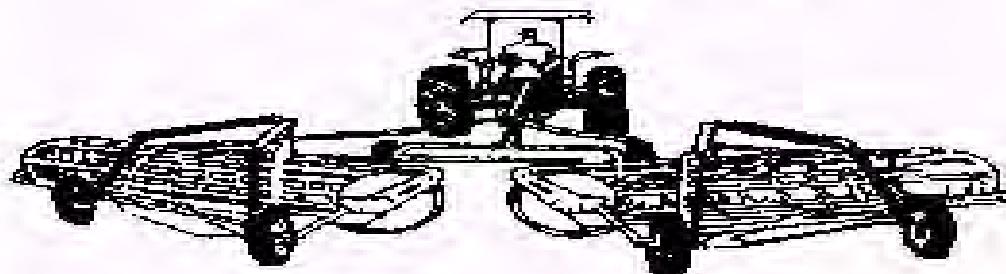
Rear-Mounted, Parallel Bar Rake



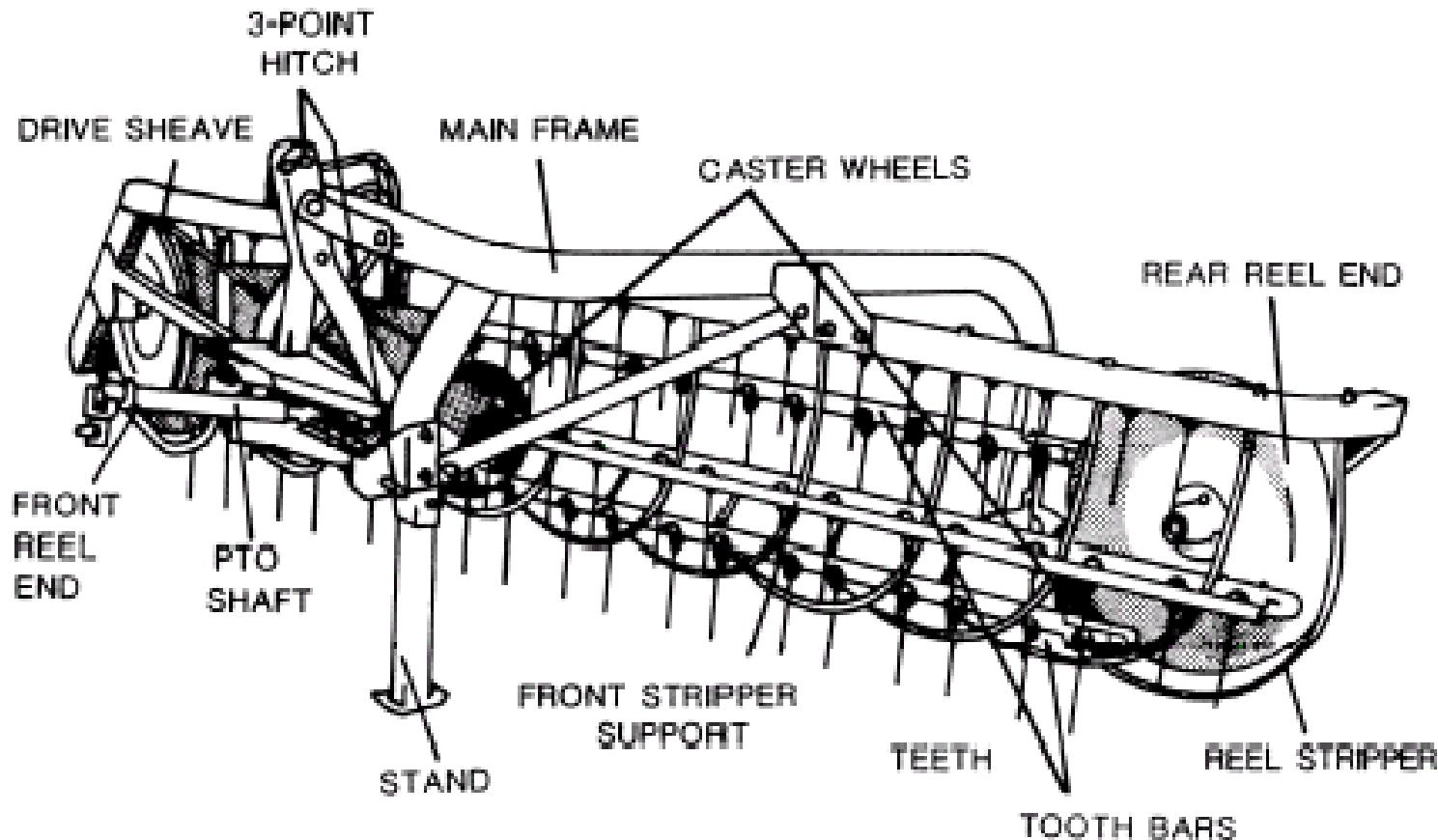
Rear-Mounted, Wheel Rake



Two Rakes with Tandem Hitch



# RAKE COMPONENTS



## Objective #4

How is baling equipment  
operated and prepared for use  
in forage management?

# Harvesting hay crops

- *Baling*
  - A packaging operation
- Baler
  - Lifts windrowed hay, compacts into a dense package, and ties wire or twine
  - Box shaped makes easy to stack, transport, store & feed
  - Labor required is a disadvantage

# Labor saving devices

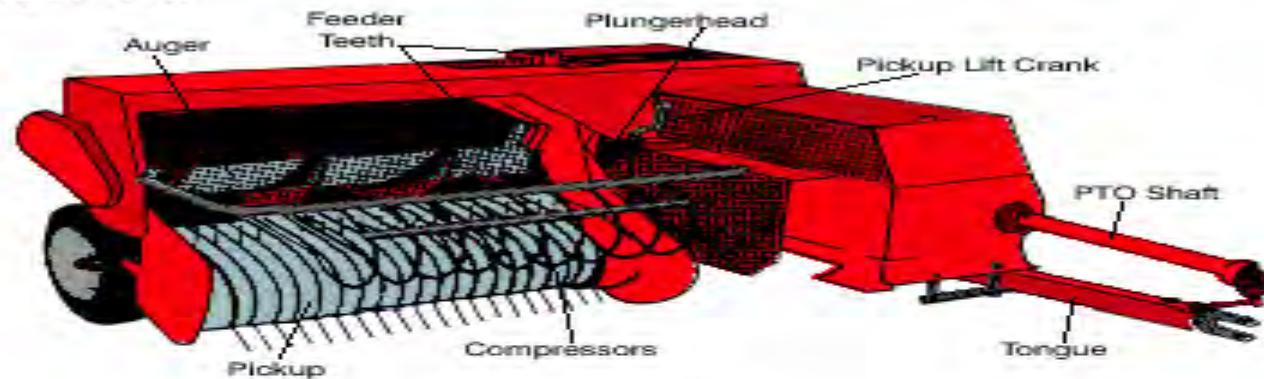
- Adding an extension chute to bale chamber and pull wagon behind
- Automatic bale ejectors
  - Throws bales into a trailing wagon
- Bale accumulators
  - Bunches bales and drops them in the field to be picked up with a tractor

# Field operations for baling

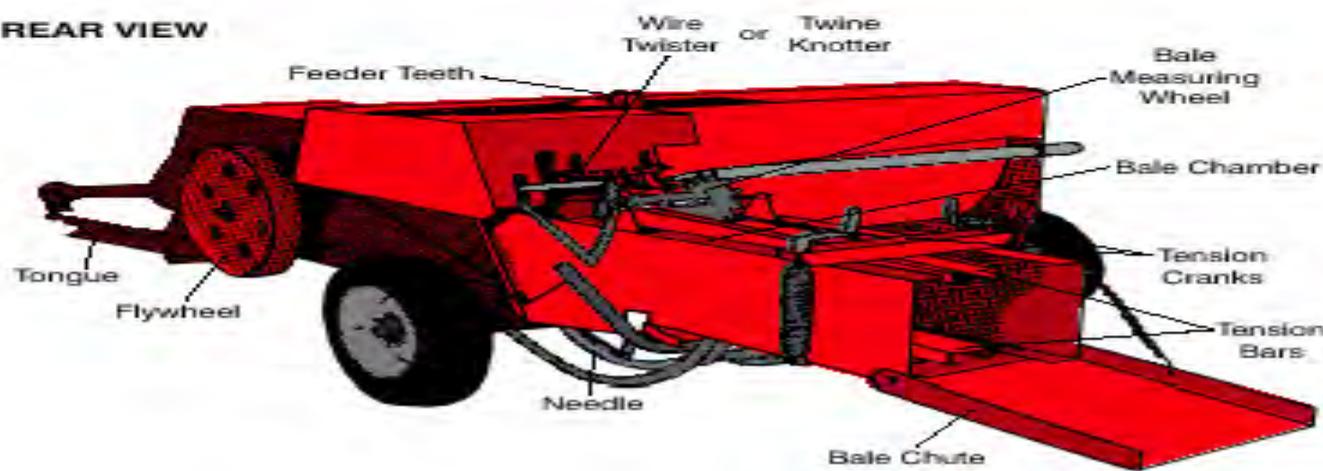
- Make preliminary adjustments to avoid unnecessary wear or breakdowns before going to field
- Follow guidelines in owner's manual
- Adjust pickup height for clean pick up
- Teeth should operate just below the top of the stubble
- Check bale weight during operation

# **TYPES OF BALING EQUIPMENT**

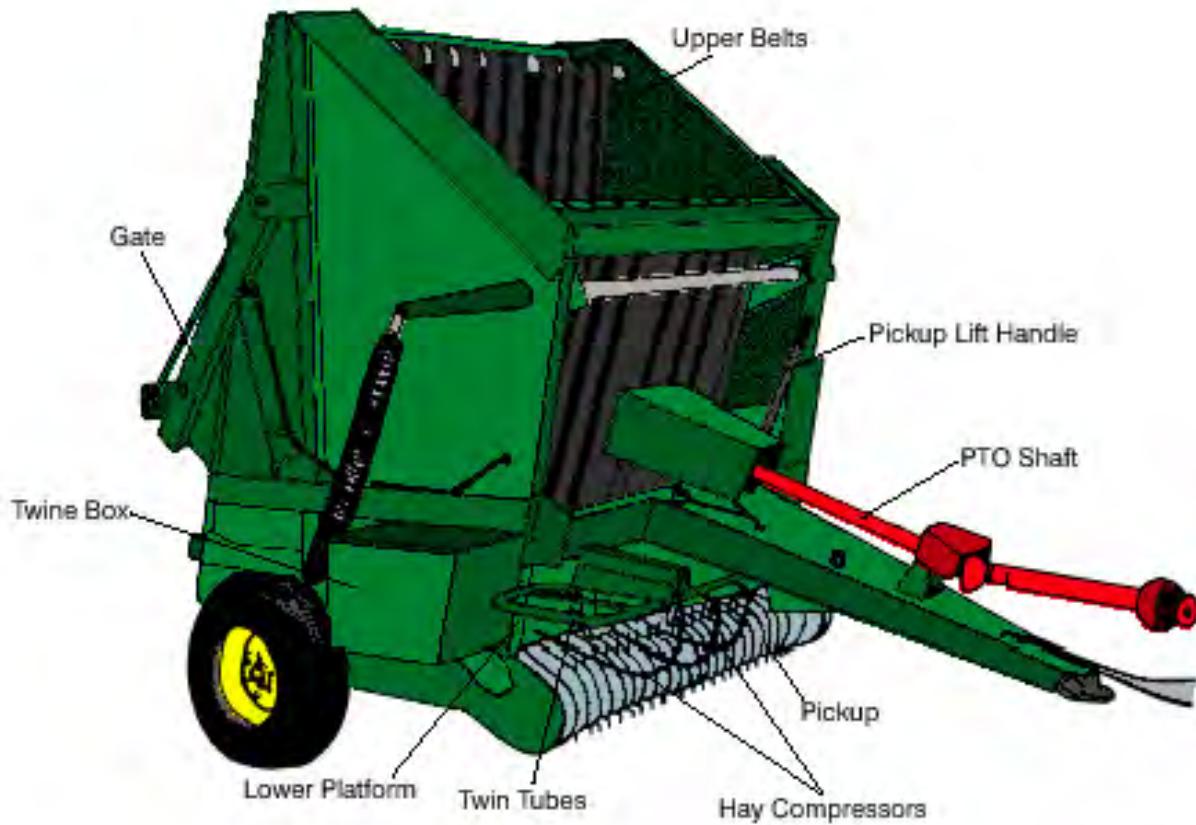
**FRONT VIEW**



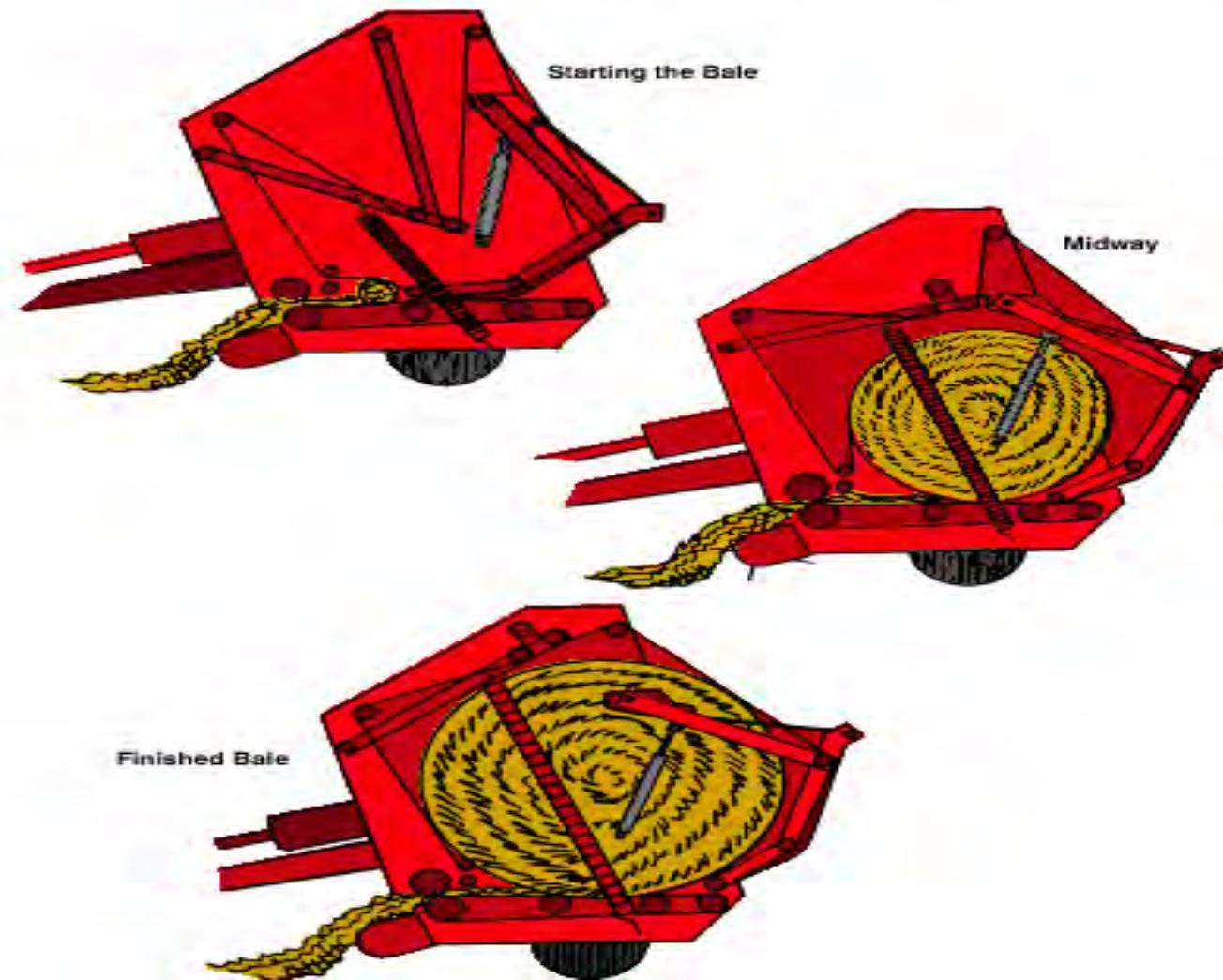
**REAR VIEW**



# LARGE ROUND BALER COMPONENTS



# **FORMING LARGE ROUND BALES**



# Objective #5

How is forage harvesting  
operated and prepared?

# Chopped forage

- Forage harvesters chop crops into short uniform lengths for storage in silos
- Three types
  - Cut and throw
  - Cut and blow
  - Flail

# **THREE DISTINCT TYPES OF FORAGE HARVESTERS**

- **Cut-and-Throw Harvesters—**  
**Cutterhead or flywheel does the cutting and delivers the crop to a wagon or truck.**
- **Cut-and-Blow Harvesters—**  
**A separate blower mounted behind or to the side of the cutterhead delivers the crop to a wagon or truck.**
- **Flail Harvesters—**  
**Cut and chop standing forage in a single operation.**

# Field operation considerations

- Operate harvester at ground speed to full capacity but not overloading
- End of row, raise the forage head before turning
- Control wagon loading process by adjusting spout & deflector cap
- Fill wagon evenly from rear to front
- Turn blower spout at turns

# Objective #6

What equipment is used in  
forage handling systems?

# Hay Balers

- Small rectangular
  - Load on bale wagons or hay racks
  - Use ejectors, loaders or accumulators
  - Storage site moved with elevators or conveyors
- Large bales
  - Bale mover in an integral tool, some lift, haul, & unload the bales

# Silage & haylage equipment

- Self unloading boxes
  - Unload into a front chamber & discharge out the side
  - Material is moved forward by a chain and slat system
- High dump wagons
  - Raise material high into air and dump into another vehicle
  - Decreases the number of wagons needed because use of high speed trucks
  - Transfer materials to trucks without having them enter the field

# Storage systems

- Bunkers or trench silos
  - Unloaded into a pile, moved and packed by tractor and blade
- Upright silo
  - Require a blower ( throwing device) that uses a fan with paddles to throw silage to top of silo
  - Performance influenced by power, fan speed, fan-blade tip clearance, type of material, delivery pipe size, arrangement & feed rate of material

## EQUIPMENT USED FOR HANDLING SILAGE AND HAYLAGE



Forage Box

(Courtesy, John Deere)



High-Dump Wagon

# **TRANSFERRING MATERIAL FROM A HIGH DUMP WAGON TO A TRUCK**



**Transferring the material to a truck allows for  
quicker transport.**

# Review

- What are the operating principles of forage harvesting and handling systems? How is cutting equipment operated and prepared for use in forage management?
- How is raking equipment operated and prepared for use in forage management?
- How is baling equipment operated and prepared for use in forage management?
- How is forage harvesting operated and prepared?
- What equipment is used in forage handling systems?