PRESENTATION WILL COVER

- Tractor Operation Basics
  - Common Tractor Hazards
  - Accident Prevention
  - Rollover Protection Structures (ROPS)
TRACTORS: FRIEND & FOE

- Tractors are often considered a farmer’s best friend. Yet, tractors continue to cause serious injury and death among users & ground workers.

- Even though tractor hazards have been identified for years, the same injuries/accidents continue to occur, even though there are known engineering controls and standard procedures to deal with these hazards.

- Few of the recorded tractor injury accidents have been caused by equipment failure-

MOST ARE CAUSED DIRECTLY OR INDIRECTLY BY OPERATOR ERROR OFTEN INVOLVING CARELESSNESS, BAD JUDGEMENT OR UNNECESSARY HURRY
AGE OF THE TRACTOR

- Newer tractors have many safety controls that automatically protect the user
- Our state-wide tractor fleet contains many older tractors
- Knowledge gap exists for younger workforce and new hires of any age on how to operate tractors safely (esp. older models)

Training tractor drivers on **each** tractor and its implements is essential
TRACTOR OPERATOR MANUALS

- Tractor and tractor implement operator’s manuals are the “oracle” on proper tractor operation & maintenance

- As many of WSU tractors are older, manuals are sometimes lost. If manuals aren’t on-site, find a copy:
  - Contact manufacturer
  - Internet search
Heed tractor labels
EMPLOYER’ RESPONSIBILITIES

- Provide employees with a properly maintained tractor
- Provide safety features for the tractor
- Provide operator training
- Supervise and enforce responsible operation of equipment
Equipment operators **MUST**

- be *18* and have a valid drivers license
- be trained on the specific tractor and implements they will be using prior to operating equipment
TRACTOR OPERATOR RESPONSIBILITIES

- Stay alert and avoid potential hazards
- Preview your route for obstacles, holes, slopes, ditches, terrain, etc. Remove debris
- Maintain and use the tractor’s safety features (such as, ROPS, seat belt, & PTO shields)
- Conduct tractor pre-operation checks
- Operate the tractor and implements safely and according to manufacturer’s directions
- Use the right tractor and implement for the job
- Know equipment blind spots
TRACTOR OPERATOR RESPONSIBILITIES

Use tractor as intended

- Slow down!
- No passengers!
- No horseplay!
TRACTOR OPERATOR RESPONSIBILITIES

- Fuel tractor when **engine is off and cool**
- Use tractor responsibly in enclosed spaces to avoid carbon monoxide poisoning
- Never leave a tractor running unattended
- Before dismounting switch off the engine and wait for the tractor and PTO implements to come to a complete stop
- **Take the tractor key with you!**
TRAINING AN OPERATOR

Training should include classroom and field lessons on:

- Tractor hazards and operational basics
- Familiarization with equipment operator manuals and manual location
- The importance of not operating equipment with mechanical problems or missing shields and other safety devices
- Familiarization of terrain hazards where the tractor will be used including holes, obstacles, slopes, embankments, stumps, ditches, etc.
- Hands-on operational instruction on tractor(s) and implement(s) to be used
- Competency test drive for tractor and for implement attachment operation
- Written training documentation
TRACTOR SAFETY FEATURES

- PTO shield & other machine guards
- ROPS
- Seat belt
- Rear view mirrors
- Head/Tail/Turn/Warning Lights
- Back-up alarm
- Slow Vehicle Warning Triangle
- Fire extinguisher
- First Aid Kit
COMMON MISHAPS

- Rollovers: rear and side
- Front-end loader incidents
- Falls from tractor
- Tractor run-over's
- Caught-between crushing
- PTO shaft entanglement
- By-pass starting
TRACTOR ROLLOVERS

Tractor rollovers happen when the center of gravity moves past a baseline of stability, either to the side or rear of the machine.

Many rollovers happen at speeds <8 mph and on slopes less than 5°. Avoid sudden motions.

Contributing factors to rollovers are:
- Various sizes, shapes and weights of implements
- Speed!!!
- Terrain
- Human error

Know the safe working load of each tractor & never exceed it!
CENTER OF GRAVITY

Center of gravity affected by slopes, loads, turns & terrains

Stay Centered!

When the center of gravity is raised the risk of rollover increases
REARWARD ROLLOVERS

Common causes for rear-ward rollovers:
- Tractor is stuck in mud or snow preventing rear wheels from rotating
- Rear wheels can’t turn because of chains, boards, or other materials used to improve traction
- Climbing a hill that is too steep
- Clutch is released too quickly w/ transmission in a lower gear and engine at high speed
- Load is too heavy and/or hitched above the drawbar of the tractor
REARWARD ROLLOVERS

- Usually caused by rear axle torque and/or drawbar leverage as tractors easily tip to the rear when the rear wheels can’t rotate enough to move the machine forward.

- Tractor can tip in as little as \( \frac{3}{4} \) of a second.
PREVENTING REARWARD ROLLOVERS

- Release clutch only when rear wheels can rotate forward
- Do not climb steep hills in a forward direction. Instead, use a reverse gear to back the tractor up a the hill
- Use only enough engine speed to start tractor moving while engaging the clutch smoothly
- Change speed gradually by applying power smoothly
- Ballast (counter-balance) the tractor properly for the job
- Hitch loads properly to drawbar
- Use reverse gear to break tractor tires free from frozen conditions

It is preferred to use another tractor to pull out a tractor from a ditch or muck. To avoid injury take care in using tire chains, boards, and other traction materials to improve tire traction
SIDEWAYS ROLLOVERS
SIDEWAYS ROLLOVERS

Common causes for sideways rollovers are tractor:

- Driven on hillside that is too steep
- Driven too close to the edge of a roadside ditch or embankment
- Cornering too sharply or too fast
  - (centrifugal force pivots tractor on outside wheels)
- The tractor’s front-end loader is elevated too high on a hillside or in a turn at excessive speed
Rollover Protective Structures

R-O-P-S

Stationary or Foldable
ROLOVER PROTECTIVE STRUCTURES (ROPS)

- ROPS work by **limiting a rollover to 90°** and preventing the operator from being crushed under the weight of the tractor.

- ROPS work only if the operator is **wearing a seatbelt** to keep them in the operator station as the tractor is rolling.
What is a Protective Zone?

- An imaginary space surrounding an operator’s body
- **ROPS and a seatbelt** keep the operator within this safe space in the event of a rollover

This is the Protective Zone
*No ROPS-cause for the majority tractor-related fatalities (~130/yr)!

*Runovers are second (fatalities ~ 60/yr)!
ROPS AND SIDEWAYS ROLLOVER DEMO

1. Two hillsides depressions
2. Tractor hits depression & tips
3. Past point of no return
4. ROPS & seatbelt protect operator
With ROPS & a seatbelt, operator has an excellent chance of being contained in the protective zone and surviving a rear rollover.
WHEN ARE ROPS REQUIRED BY LAW

WHEN:
- Engine greater than 20 horsepower
- Vehicle is 2-wheel, 4-wheel or track driven (crawler-type) and designed to pull, propel, or carry implements designed for agricultural use (disk, tiller, plow, etc.)
- Manufactured after October 25, 1976
- The manufacturer made a retrofit ROPS option available or it was available at the time tractor manufactured *(no matter what year tractor manufactured)*
ROPS must come from the manufacturer and must not be made “on-the-job” or “home-made”

One **limited** exception to ROPS requirement is low profile tractors used under certain conditions (see following slides)
LOW PROFILE TRACTOR ROPS & INTENDED USE EXEMPTION

Low profile tractors do not require ROPS when used in:

- Orchards, vineyards, hop yards where ROPS would interfere with normal operations or related work
- Farm buildings or greenhouse where vertical clearances are insufficient to allow ROPS
- When tractor has mounted equipment that is incompatible with ROPS

THESE USES ARE THE ONLY EXCEPTIONS - LOW PROFILE TRACTORS ARE NOT TO BE USED FOR ANY OTHER PURPOSES
INTENDED USE MATTERS!

ROPS are required on this low-profile racing tractor!
WHAT IS A LOW PROFILE TRACTOR?

Low-profile tractors:
- Are wheeled
- Have equal spacing between wheel centerlines of the two front and rear tires
- Have clearance of 18” or less from bottom of tractor chassis to ground
- Hood’s highest point is 60” or less from ground
- Are designed so operator straddles the transmission when seated
ROLLOVER PROTECTION
FOLDABLE ROPS

- Foldable ROPS are available for some tractors
- Fold down in low vertical clearance areas
- Return ROPS to upright position as soon as possible after close clearance work is done
- It is recommended to install foldable ROPS on low profile when available
ROLLOVER PREVENTION
OPERATING ON SLOPES

- Avoid working on steep slopes
- Follow operator manual instructions on operating equipment on slopes
- **Set wheels wide**
- Drive slowly
- Make wide **slow** turns
- Know the terrain: small holes, depressions, or stump can cause tip over
- Stay back from embankment edges as they are often soft
- Go down slope in low gear
- Follow operator manual instructions on side mount implement placement (up or down hill)
ROLLOVER PREVENTION
OPERATING ON SLOPES

Harper-Deweze All Terrain Mower

Remote Control-Kubota
ROLLOVER PREVENTION
IMPROPER HITCHING

- Hitch loads for pulling to the drawbar or the three-point hitch only
  Loads that are attached by looping a chain around the axle housing, seat base, or upper link of the 3-point hitch reduce the pulling capacity and increase the possibility of rear-ward rollover.

- Use draw bar at height recommended in operator’s manual. Don’t alter or raise height of the drawbar. Raising the drawbar decreases safety & pulling effectiveness.

- Install stay races where feasible to maintain a safe drawbar height.
HITCHES

3-point hitch is desired

Always hitch to the drawbar
FRONT-END LOADER INCIDENTS

- Front-end loaders are used for lifting & moving materials
- Mishaps are caused by exceeding lifting capacity, lack of safety equipment, or inappropriate use including:
  - Front-loader attachment not intended for lifting people
  - Speed: working too fast for existing conditions
  - Rear of tractor may not have proper counter balance for the load
  - Weight of load: Exceeding front loader lift capacity
TRACTOR FRONT LOADER INCIDENTS
KEEP LOADS LOW!

Lifting loads too high can cause instability, rollover, and injury

- Remember center of gravity changes as bucket rises
Shape of load can cause instability
Use proper tools to lift odd shapes
Many injuries happen while hauling hay-this bale type can crush a driver or ground worker
FALLS FROM TRACTORS

- Most falls are due to improper mounting or dismounting of the tractor. Injuries to wrist, arm, hip, leg, ankle & runovers can result.
- Don’t “jump” down from tractor (WSU accident reports from several locations- ankles & feet)
- Use a **3-point mount** (either 2 hand and one foot or 2 feet and one hand in contact with steps at all times)
- **Face the tractor** when going up and down the steps and use handholds. There is less chance of catching pant’s cuffs or boot loops on clutch pedal, etc. which can pitch a person off the tractor
FALLS FROM TRACTORS

Beware slippery, wet, and muddy surfaces

Accident photo:
A person slipped on these muddy stairs and was run over and killed by this tractor
FALLS FROM TRACTOR

- Most tractors are not designed to carry passengers
- Maintain a no rider policy
- Injury occurs to passengers by falling from tractor & being run over once they have fallen
RUNOVER INCIDENTS

Usually happens due to:
- Inability to see small children or others in the line of travel
- Extra riders falling off from steps, cab, or drawbar
- Backing the tractor toward machinery to be attached
- By-pass starting

Avoid runovers by:
- Keeping speed down
- Keeping others esp. children out of the area where a tractor is operating
- Not allowing ground workers to enter area between tractor and implement until the tractor has been stopped, shifted into neutral and the brakes applied
- Having ground workers step out of the area when adjustments have to be made between the tractor and implement
- Clear communication methods between operator and ground workers
COMMUNICATION!
HAND SIGNALS for SAFETY

HAND SIGNALS
Use when noise or distance does not allow normal voice communication.

SLOW IT DOWN - DECREASE SPEED
THIS FAR TO GO
MOVE OUT - TAKE OFF

RAISE EQUIPMENT
MOVE TOWARD ME - FOLLOW ME
STOP
STOP THE ENGINE

START THE ENGINE
COME TO ME
SPEED IT UP - INCREASE SPEED
LOWER EQUIPMENT
CAUGHT-BETWEEN INCIDENTS

“Caught between” means a ground worker is crushed between the tractor and an implement.

This often occurs when the tractor is backing up to an implement to hook up.

Common causes of caught-between accidents:
- Break down of communication between operator and person on the ground
- Loss of control of the tractor
- Worker in wrong spot
- Operator can’t see worker
- Operator misjudges and tractor moves rearward too far
- To avoid caught-between incidents refer to run over prevention procedures

To avoid caught-between incidents refer to run over prevention procedures.
CAUGHT BETWEEN ARTICULATING TRACTOR INCIDENTS

There is potential to crush a person on either side of the tractor in the area between the front and rear wheels

Stay out of this danger area as much as possible

- Slight movement of steering wheel causes tractor to articulate in the middle bringing the front and rear wheels of one side or the other closer together

- If steering wheel is moved, even with engine not running, the tractor may articulate upon start-up
By-pass starting is an unsafe practice of starting a tractor while standing on the ground and can result in the person being run over by the tractor.

Starting the tractor from the ground is accomplished by rigging unsafe electrical connections or reaching up & over the tractor from the ground to turn ignition key (on older tractors).

New tractors are sold with shield covering the starter. Retro-fits can be gotten for some older tractors.

Dead man’s seat switch is also a built-in safety factor. No one on seat, the tractor shuts off or won’t start.
PTO produces a rotating torque and directly transfers it to another machine or tool. For a mower implement the rotating torque is used to turn the mower blades.
PTO ENTANGLEMENT INCIDENTS

The most gruesome of injuries resulting in severe injury, dismemberment, or death by the human body becoming entangled in (literally wrapped around) equipment

- A PTO operating at 1000 rpm will pull in clothing at a rate of 8’ per second.

- PTO powered implements operating at 540 rpm can entangle a shirt sleeve or pant leg around the drive shaft 9 times in 1 second dragging your arm or leg with it

Happens in a blink of an eye!
PTO GUARDS HELP PREVENT INJURY

- Master Shield
- PTO Shaft Guard Installed
- Fully Shielded Power Shaft
- Implement Guard
- Safety Shield
- Drawbar Locked in Position
PTO ENTANGLEMENT

- Proven accident prevention is to **keep PTO shaft shields in place**, and never remove them except for maintenance work.

- While the tractor is **off**, always inspect shaft, driveline & universal joint to ensure guarding prior to use.

- Spin driveline guard to ensure it is not stuck to the shaft.

This does happen
Click to see an actual recent incident report
SIX COMMON MACHINE HAZARDS

1. **Wrap points** (hay baler, PTO shaft, auger)

2. **Hydraulic systems** (high pressure 1000-3000psi. Hot! Hoses can whip around; equipment fails and can crush)

3. **Pinch points** (gears, sprockets, moving parts of belt or pulley drives/chains)

4. **Shear & cutting points** (sickle bars, rotary blades grain augers)

5. **Crush points** (between two machinery parts or machines)

6. **Thrown objects** (ejected or propelled objects, stones, sticks, chaff, etc.)
SAFETY PRECAUTIONS AROUND MACHINERY

Field work is tiring and tired people make mistakes:

Beware of carelessness, impatience and fatigue
SAFE OPERATION OF TRACTORS ON THE HIGHWAY

- Attach a slow moving vehicle emblem.
- Use headlights, flashing lights, safety clearance flags.
- Use an escort vehicle when feasible.
- Keep PTO level in neutral.
- Don’t travel on the shoulder-soft spots.
- Take it slow and pull over when feasible to let normal traffic pass.
- Take special care at intersections, turns, & curves.
- Always leave room to stop.
- Independent brakes must be locked together to avoid uneven panic stop situations.
- Watch for blind spots.
- Have a cell phone with you.
- Carry instructions to your site.
- (contact info)
PPE (Personal Protective Equipment)

Depending on the situation, wear some or all of the following:

- **Hearing protection** for prolonged noise exposure (plugs or muffs)
- **Gloves** that fit and are the right type for the job can help guard against cuts, abrasions, skin irritants and chemicals
- **Long pants** protect against flying debris, skin irritants, and burns from exhaust
- **Respirators** prevent inhalation of dust and other particulates, and most pesticide vapors
- **Eye protection** - impact-resistant and UV
- **Sturdy work shoes** (steel toes preferred)
RECAP

✓ Use the right tractor and implement for the job
✓ Conduct pre-operation checks
✓ Maintain tractor safety features (esp. ROPS, seat belt, & PTO shields)
✓ Operate the tractor and implements safely (consult operator’s manual)
✓ Know equipment blind spots
✓ Stay alert and avoid potential hazards-preview or know your route, obstacles, and terrain
✓ Fuel when engine is cool; and never when engine is running
RECAP

✓ Use the tractor as intended No passengers!
✓ No horseplay!
✓ Slow down! Speed kills
✓ Never leave a tractor running unattended!
✓ Before dismounting switch off the engine and wait for the tractor and PTO implements to come to a complete stop
✓ Take the tractor key with you!
THINK SAFETY! ~ ACT SAFELY!

To Complete this training,
PROCEED TO TRACTOR QUIZ
THINK SAFETY! ~ ACT SAFELY!

To complete this training,
push the arrow to
PROCEED TO TRACTOR QUIZ