FITTING THE FARMER: ERGONOMICS FOR WOMEN

A Practical Guide to Shovels and Pitchforks for Researchers, Educators, and Toolmakers

Extension
University of Missouri

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USDA National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE

NORTH CENTRAL SARE
Sustainable Agriculture Research & Education

CONTENTS

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Table of Contents

WHY ERGONOMICS MATTERS ON THE FARM

Farming is hard work. Many jobs, including digging, lifting, shoveling, scooping, moving, and throwing, are done repeatedly. Tools that don't fit your body can cause pain. You might hurt your back, shoulders, wrists, or knees. This guide shows how better tool design can make farm work safer and less tiring.

It also helps people who design and make tools, including scientists, engineers, and safety experts. The tips and ideas in this booklet are based on real farm trials and research studies. They show how to choose the right tool, use it the right way, and how even small changes, like adjusting a handle, can make a big difference.

The tips and advice found in this booklet are based on real feedback from women farmers and combined with ergonomic science and tool design.

Ergonomic Modified Tool

Ergonomic Auxiliary Handle B (EAHB)
BackEZ handle

Ergonomic Auxiliary Handle A (EAHA)
RAH! handle

Ergonomics designs tools to fit your body. This makes work safer and easier. Tools made with ergonomics in mind help farmers feel better, work faster, and stay healthier over time.

When tools are designed to match a person's height, hand size, and strength, farm work becomes safer and easier. This helps women farmers avoid injury, save energy, and keep doing their jobs well, year after year.

What Good Posture Looks Like

Natural body position

- **Bend at your knees**
- **Loads close to your body**

Poor posture

- **Bend at the waist**
- **Loads far from your body**

Body Posture Matters: Safe Joint Angles for Farm Work

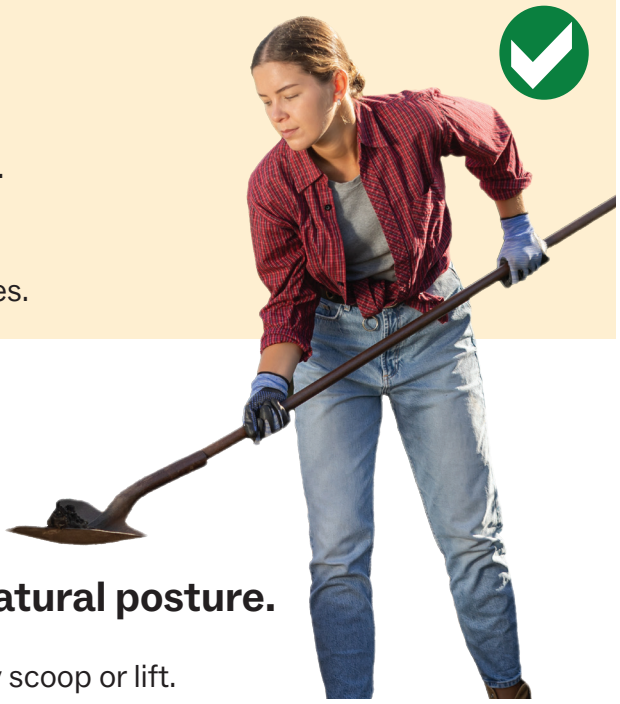
Using your body the right way when handling tools, including shovels and pitchforks, can prevent pain and injuries. Showing the best angles for your back, shoulders, elbows, and wrists based on trusted ergonomic systems like RULA, REBA, and OWAS.

When your body stays within these "neutral zones," you're at low risk of muscle strain or injury. That's why using tools designed to support these postures is so important.

Ergonomic joint angle ranges during farm tasks. Staying within these ranges, including a trunk bend under 20°, an elbow bend between 60° and 100°, and wrist movement under 15°, keeps your posture neutral and your joints safer.

Why Natural Body Positions Matter

- **Trunk:** Bending too far forward stresses the back.
- **Elbow:** Extreme bend or full extension causes fatigue.
- **Wrist:** Twisting or bending increases joint pressure.
- **Shoulder:** Raising arms too high strains upper muscles.



Use tools and handles that support your natural posture.

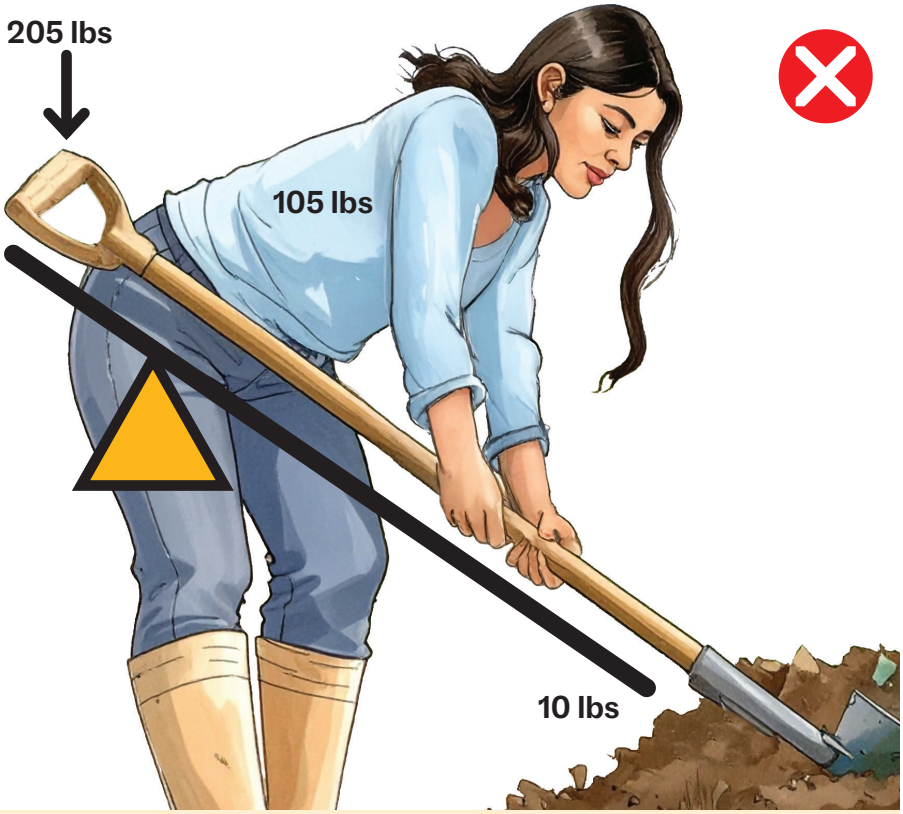
Better posture means less pain and more power with every scoop or lift.

Safe Lifting

Don't Bend at the Waist!

When you bend at your waist to lift something, it puts a lot of pressure on your lower back. Even lifting a small 10-pound object this way can put 100 pounds of stress on your back. That's like carrying a whole other person!

If you add the weight of your upper body (about 105 pounds), your back is handling over 205 pounds. Doing this over and over can hurt your back.



Tip: Always bend your knees and keep your back straight when lifting!

Grip and Forearm Rotation

Wrist Position

- Keep your wrist straight—not bent up, down, or sideways in safe zone.
- A "neutral wrist" means your hand stays in line with your arm.
- This helps avoid pain and makes it easier to use your tools.

Grip Strength

- Hold the tool firmly, but not too tight.
- A firm, comfortable grip gives you better control and keeps your wrist in a safe spot.
- Don't grip too loosely or at an awkward angle, it can cause wrist or hand pain.

Forearm Rotation

- Turn your forearm gently when you lift or throw something.
- Try not to twist your wrist too far in or out.
- Keep your hand slightly turned out
- When shoveling and throwing the load several feet, it's sometimes better to take a step or two towards where you want the load to go rather than trying to throw it all the way there.

Keep Your Wrist in the Safe Zone

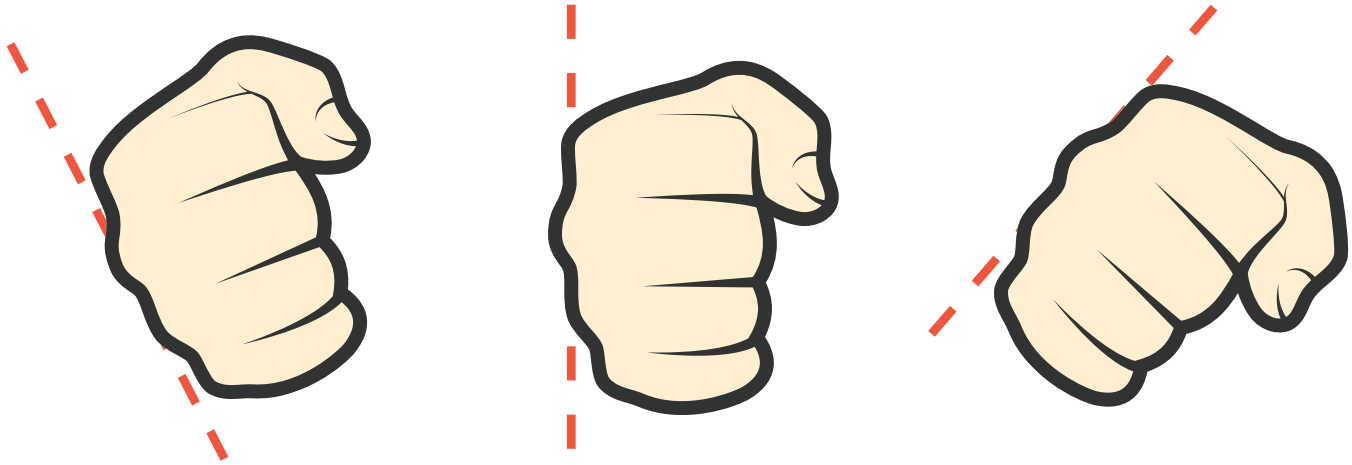
Safe Hand & Arm Positioning

Elbow Tips

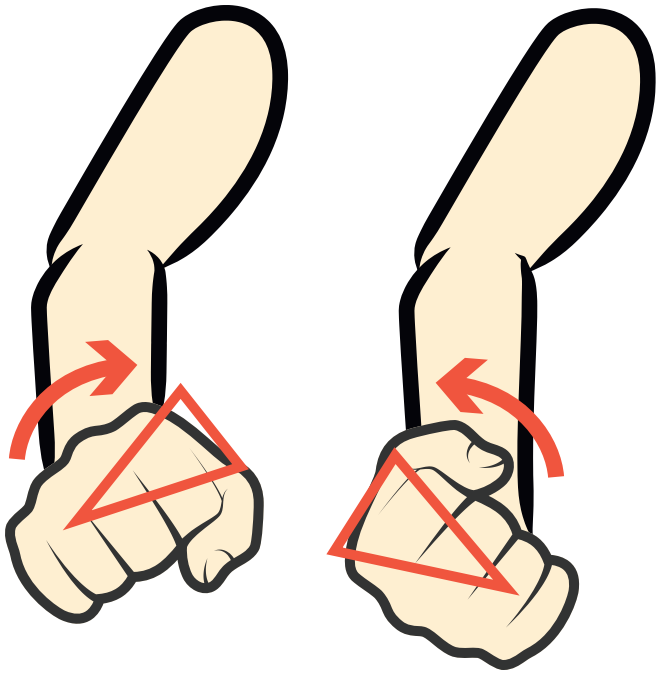
- Keep your elbows close to your body when you lift or work.
- Don't let your elbows stick out; it makes it harder to control the tool.
- Smooth arm movement is safer than fast or jerky motions.

Tip: Staying in your wrist's "safe zone" (not twisting or bending it too far) helps protect your muscles and joints.

Safe Hand and Arm Positioning



Neutral Wrist Position



KEY TAKEAWAYS

- Posture affects how your body feels
- Repeated bending and twisting cause pain
- Proper grip and lifting protect your joints

REMEMBER

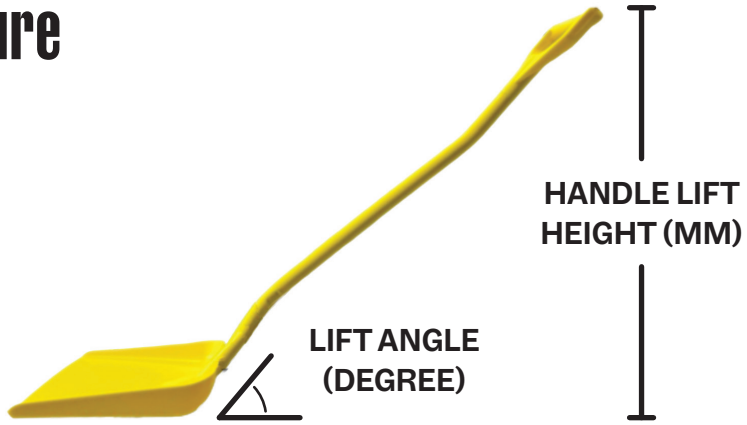
If it hurts, it's time to adjust your approach to work.

Tip: Keep tools close to your body.
Why it works: It reduces strain on your back and arms.

Key Ergonomic Hand Tool Feature

Three things help reduce strain:
lift angle, handle height, and tool weight.

When a tool fits your body, your back, arms, and shoulders feel less tired, and you can work more easily!



Helpful Features in Farm Tools

Not every tool works well for everyone. Your height, arm length, elbow standing height (ESH), and strength matter when picking the right tool. Good tools should match your body so you can work without hurting yourself.

Look for tools with these features:

- **Lift Angle:** Between 30° and 50°. This makes lifting easier and safer for your back.
- **Handle lift Height:** Should be at or slightly below your elbow when standing. That's usually between 1.8 and 2.9 ft. It helps you stay upright and bend less.
- **Tool Weight:** Between 3.8 and 4.4 lb. Heavy tools can make your back and arms hurt faster.
- **Handle Length:** Longer handles (about 3.4 to 4 ft) give more control and power, but only if they're not too heavy for you.
- **Fits You:** If you're taller, you may need a longer tool. If you're shorter, a shorter, and lighter, one is better.

Why Handle Design Matters

Reducing Trunk (Low Back) Strain

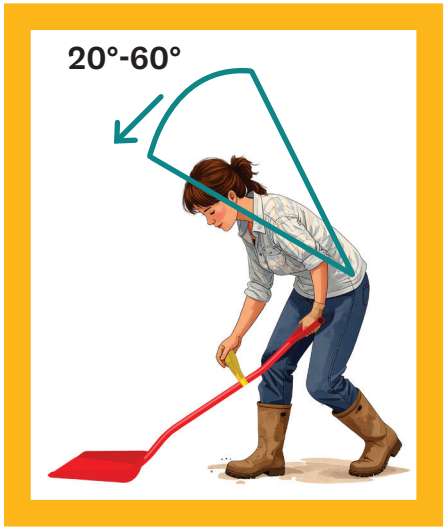
Different auxiliary handles can significantly impact how much you need to lift your arms and strain your shoulders and elbows during shoveling tasks. The diagrams below compare three handle positions and their corresponding trunk angles.

Ergonomic Position (Green):
Trunk remains low and close to the body (neutral zone). Best for comfort and injury prevention.

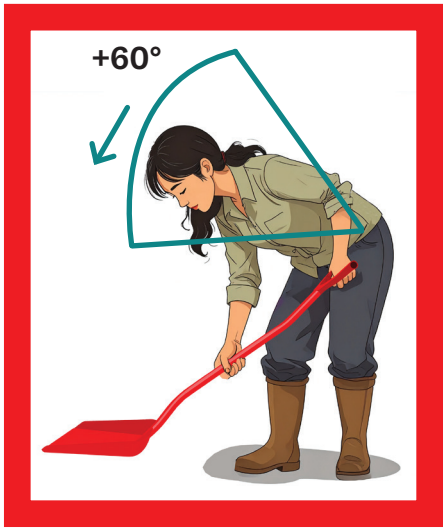
Moderate Strain (Yellow):
Trunk angle increases, making tasks less efficient and more tiring.

High Strain (Red):
Trunk angle exceeds 60°, increasing the risk of fatigue and musculoskeletal injury.

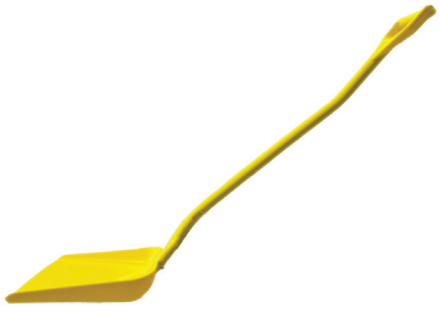
Ergonomic Modified Tool (EAHA)



Ergonomic Modified Tool (EAHB)



Conventional Tool



While auxiliary handles reduce trunk flexion and shoulder strain, rigid handle designs may cause a tradeoff leading to increased elbow flexion and wrist deviation. This underscores the need for adjustable or well positioned handles to balance benefits across all joints.

Why D-Grip Handles Are Helpful

D-grip handles are shaped like the letter "D." This shape helps your hand and wrist stay in a natural and straight position when you use the tool.

Why it matters: When your wrist is straight, it puts less stress on your hand, arm, and shoulder. That means you can work longer before feeling discomfort with less pain. These handles also give you better control, so it's easier to hold and move the tool, especially when lifting or tossing heavy stuff like dirt or straw.

NEUTRAL WRIST POSITION

How tools make work easier?

Tools make work easier by using the tool's shape and size to make hard work feel easier.

For example:

- A longer handle gives you more power to lift, depending on where the hands are placed on the handle, the farther the load is away from the body, the more strength will be required for lifting.
- Placing your hands farther apart on the handle spreads the weight better and reduces the effort.

MOST PREFERRED D-GRIP HANDLE

HANDLE LIFT ANGLE (30-50°) DEGREES

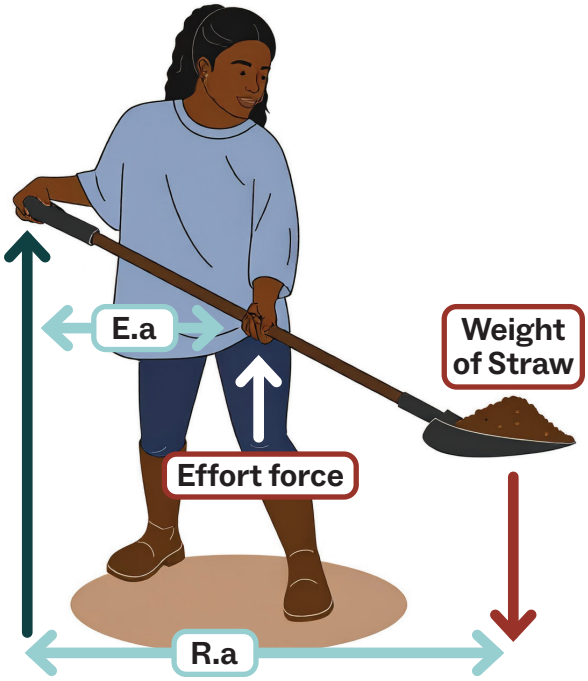
How Levers Make Tools Easier to Use

What Is an Effort Arm (E.a)?

This is the space between your second hand and the end of the tool handle. It's where your body pushes or pulls to lift something.

What Is a Resistance Arm (R.a)?

This is the space between your first-hand on the end of the tool handle and the weight you're lifting (like straw, dirt, or hay). This is where the tool works against the load.



Why This Matters

The way you hold the tool - and how long the handle is - can change how hard your body must work.

If your effort hand is placed nearer to where the shovel holds the load (straw), it's easier to lift. You don't have to push or pull as hard, so your back, shoulders, and arms stay less tired.

Use Smart Hand Placement

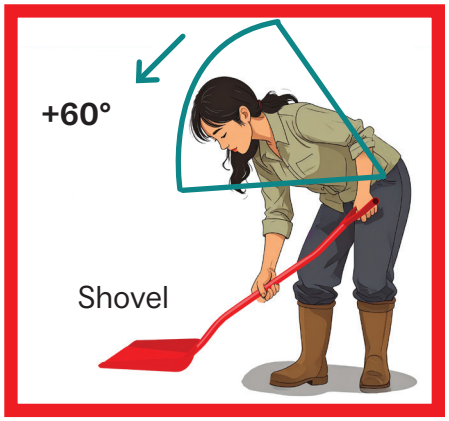
Using tools with longer handles—and placing your hands in the right spots—helps you

- Lift loads with less effort.
- Work faster and safer.
- Keep your body from getting sore.

This smart design is part of what makes ergonomic tools better. They're built to help women farmers stay healthy while doing hard work like scooping and throwing.

Handle Design Affects How You Stand and Feel

Conventional Tool



Trunk flexion: +60°
Poor posture

Ergonomic Modified Tool (EAHA)

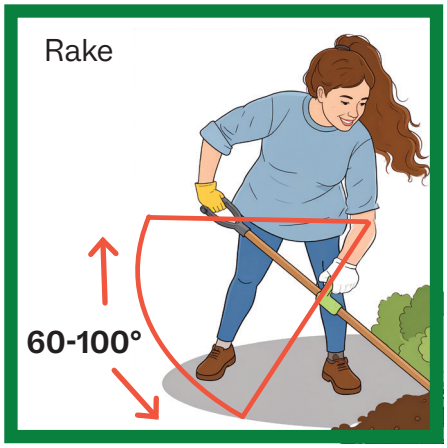
Trunk flexion: 0-20°
Good (upright) posture

Ergonomic Modified Tool (EAHB)

Trunk flexion: 20-60°
Poor posture

Elbow flexion angle: 0-60°
Increased strain

Elbow flexion angle 100°+
Increased strain



Elbow flexion angle 60-100°
Improved handle position

KEY TAKEAWAYS

- Pick tools that match your height
- Handles should reach your elbow level
- Lighter tools are easier on your back

REMEMBER
If it doesn't fit, don't use it!

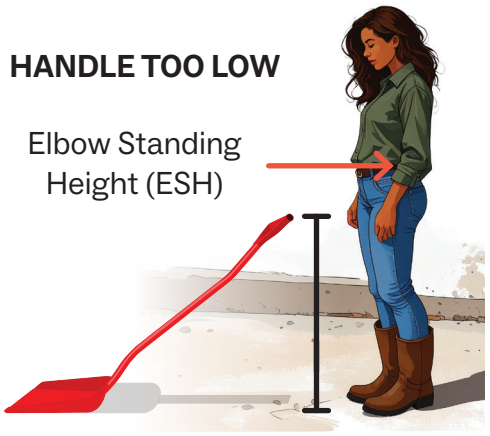
TIP: Test the handle height before buying tools.
Why it works: Better height = less bending and pain

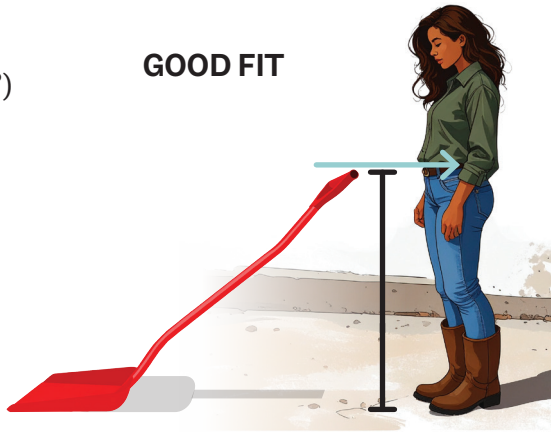
Special Note for Tool Designers and Researchers

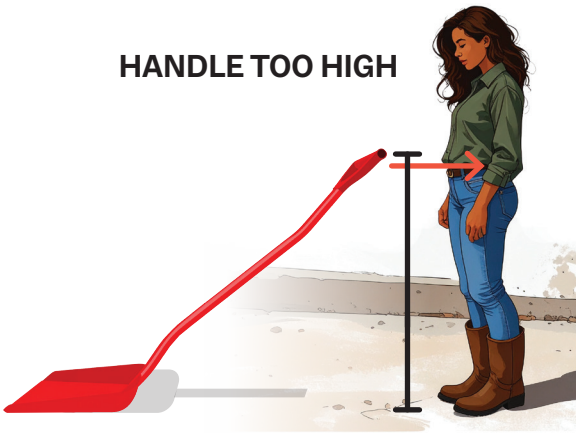
Tool Fit and Body Safety

Research shows that different body sizes need different tools:

- Taller users (>5.7 ft) preferred tools with a weight between 4.4 lb and 5.5 lb and a handle length of 3.7 ft to 4.5 ft, which might reduce trunk bending but might increase muscular load and spinal pressure.
- Shorter users (<5.4 ft) experienced more strain with long, heavy tools. Lighter options, including 1.7 lb, handle heights less than 3.0 ft. might reduce strain and improve posture.
- Ideal handle lift height should match user elbow standing height (1.8–3.6 ft), and moderate handle lift angles (27°– 56°) support Natural body positions.







KEY TAKEAWAYS

- Smart tech helps design better tools
- Posture sensors can prevent injury
- Feedback helps improve future tools

REMEMBER

Tech helps, but your comfort comes first!

Design Insight: Adjustable tools should be prioritized to accommodate diverse body sizes and shapes, improve comfort, and reduce body pain and injuries. Balance handle weight, angle, and how tools make work easier to fit different users' needs.

KEY TAKEAWAYS AND TIPS

KEY TAKEAWAYS

- Posture affects how your body feels
- Repeated bending and twisting cause pain
- Proper grip and lifting protect your joints
- Pick tools that match your height
- Handles should reach your elbow level
- Lighter tools are easier on your back
- Breaks help your body recover
- Stretching reduces injury risks
- Using the right tools helps long-term health
- Smart tech helps design better tools
- Posture sensors can prevent injury
- Feedback helps improve future tools

REMEMBER

- If it hurts, it's time to adjust your approach.
- If it doesn't fit, don't use it!
- Rest is part of safe farm work.
- Tech helps, but your comfort comes first!

TIPS

Always bend your knees and keep your back straight when lifting!

Staying in your wrist's "safe zone" (not twisting or bending it too far) helps protect your muscles and joints.

Test the handle height before buying tools.

Why it works:
Better height = less bending and pain.

Keep tools close to your body.

Why it works: It reduces strain on your back and arms.

Rest for 5 minutes every 30 minutes.

Why it works: Muscles need time to recover from hard work.

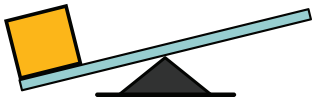
WHAT TO DO NOW

- Try ergonomic tools that fit your body
- Use safe lifting and tool-use tips
- Share this guide with others on your farm

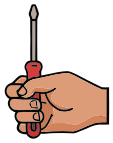
Glossary

Joint Angle
When two joints, like an elbow or knee, are bent at a safe position.

Lever
A long bar that is used to help move something.



Repetitive Strain
A kind of injury that happens from doing the same thing over and over.



Smart Technology
Designed to gather information and find easier ways to do a job.

Strain
When ligaments, muscles, or tendons become overstretched or overused.

Tool Handle
The part of a tool that is made for a person to hold.

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