



SIMPLE SOLUTIONS:

ERGONOMICS FOR FARM WORKERS



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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health



SIMPLE SOLUTIONS: ERGONOMICS FOR FARM WORKERS

Edited By:

Sherry Baron¹
Cheryl F. Estill²
Andrea Steege¹
Nina Lalich¹

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service, Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

¹Division of Surveillance, Hazard Evaluations, and Field Studies

²Division of Applied Research and Technology

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4676 Columbia Parkway
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Simple Solutions: Ergonomics for Farm Workers

Summary

- Backaches and pain in the shoulders, arms, and hands are the most common symptoms that farm workers report.
- These injuries can be disabling, which can affect the worker's earnings and the grower's profits.
- There are cost-effective ways to prevent or reduce these symptoms.
- The “tip sheets” in this booklet show how to make or order inexpensive new tools or to modify existing ones to reduce the risk of pain.
- Solutions discovered for one type of crop can be modified for use with other kinds of crops.
- Worker-management ergonomics teams can be formed to discover your own simple solutions.



Newly designed stands for potting plants. The stands hold the plant bins at an angle. The slope lets gravity move the plants to the front of the bin so that the plants are always close to the worker and reaching is minimized.

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Oh, My Aching Back!

Farm work is hard work, and farm workers feel the results. Farm workers get backaches and pains in the shoulders, arms, and hands more than any other health problem. A third of the injuries that cause them to miss work are sprains and strains, and a quarter are back injuries. These are also the most common causes of disability.

The technical term for these sprains and strains is “work-related musculoskeletal disorders” (WMSDs). WMSDs hurt! They hurt:

- workers’ bodies
- workers’ earnings
- growers’ profits.

In California agriculture alone, the annual workers’ compensation costs for the more than 3,000 back injuries that happen each year may be over \$22 million.

This pamphlet is about early intervention to prevent such injuries. It is directed toward growers, safety specialists, human resources managers—anyone with an interest in having safe farms.

Over the years, many kinds of farm work have not changed much at all. Field work is still done in a stooped position. Workers carry heavy weights in awkward positions, kneel often, work with their arms above shoulder level, or move their hands and wrists repetitively. Sometimes the whole body is subject to vibration from farm equipment. When workers are paid on piece rate, they have a reason to keep up a rapid, sustained pace. Overexertion intensifies all the other risk factors.

Many people in the farm industry may believe that these kinds of tasks—and the resulting sprains and strains—are just an unavoidable part of farm work. But NIOSH (National Institute for Occupational Safety and Health) asked university researchers, specialists in the science of ergonomics, to look into how farm work could be made safer. They worked with growers and employees on different types of farms to come up with some simple, practical, inexpensive solutions. This pamphlet is a result of that hands-on cooperation.

NIOSH believes that better work practices and tools will reduce the sprains and strains of farm work.

As you read this pamphlet, the specific solutions may or may not apply to your particular operation. But we think you'll learn three things from it anyway:

**These
suggestions
can be
adapted
for your
own
farm.**

- what sorts of work are most likely to cause injuries
- basic ergonomic rules of thumb for working more safely
- inspiration to sit down with employees and come up with some simple solutions of your own

The ideas in this pamphlet can be adapted for many types of crops and for different sizes of farm operation.

Don't get discouraged if some solutions seem out of reach. A small tool change or adjustment in the work layout can make a big difference in preventing injuries. Good luck!

What Is Ergonomics?

The goal of the science of ergonomics is to find a best fit between worker and job conditions. Ergonomics looks at:

- the physical capabilities of the human body
- the limitations of the human body

in relation to

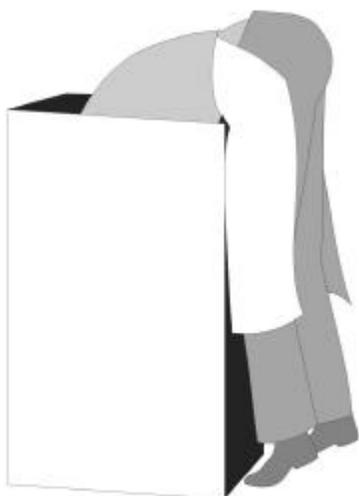
- a person's work tasks
- tools used
- the job environment

The goal is to make sure workers are uninjured, safe, and comfortable, as well as productive.

Work-related musculoskeletal disorders (WMSDs) are:

- the leading cause of disability for people in their working years
- caused by chronic exposure to these physical stresses
 - forceful gripping
 - kneeling
 - lifting
 - squatting
 - bending
 - vibrating equipment
 - twisting

Ergonomics finds the best fit between worker and job.



Bending



Twisting

The best way to reduce WMSDs is:

- redesign the tools
 - redesign how the work process is done
- } using the principles of ergonomics

Relatively simple changes can make a big difference. When jobs and tools are ergonomically redesigned, you don't have to rely on a carrot or a stick to get people to work safely. Injuries are prevented as a natural result of improved work posture, reduced force, or less repetition. Ergonomic changes should be put into operation along with worker training on how to work safely.

How Do I Know if I Need an Ergonomics Program?

- Do some jobs cause strain, localized fatigue, discomfort, or pain that does not go away after an overnight rest?
- Do injury records or workers' compensation claims show hand, arm, or shoulder pain, low back pain, or carpal tunnel syndrome?
- Do workers visiting the clinic make frequent references to physical aches and pains related to certain types of work assignments?
- Do jobs involve repetitive and forceful exertions, frequent heavy or overhead lifts, awkward work positions, or use of vibrating equipment?
- Are cases of WMSDs found among competitors or in similar businesses?
- Do trade publications or employers' insurance information indicate risk of WMSDs?

Ergonomic Rules of Thumb

Strains and sprains are caused by excessive reaching, bending, lifting, gripping, squatting, or twisting of hands, shoulders, or body. In general, any work performed with high force, with many repetitions, or in a position that feels awkward is risky. Even a motion that is harmless in and of itself, like stretching out the arm to grasp an object, or squeezing a tool, may put the worker at risk of injury if it is repeated over and over.

Following these guidelines will reduce the chance of sprains and strains. You may need to reposition the work, or redesign the way the job is done, or use a different tool.

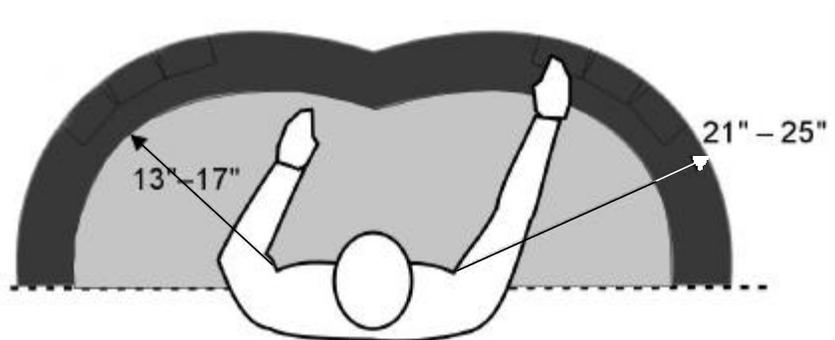
⇒ **Remember: You may not be able to implement all the changes recommended here. But even partial changes or small changes can reduce injuries.**

Guidelines for Hand Work

- Avoid placing needed tools or other items above shoulder height.

- Position items that are used often within 17 inches of the worker.

- When movements are repeated over and over, as in picking or weeding, allow enough time in between for adequate recovery, by having the worker alternate with a low-repetition task. For example, a worker who performs a high-repetition weeding task should be given other tasks that don't require repetitive hand motions, like carrying the finished boxes to the loading area.



Primary and secondary areas for table top work.

Position items that are used often close to the worker.

- Provide seated jobs. Sitting down while working reduces the strain on the lower back and legs. Standing causes legs to swell (more than walking does). The best jobs are ones that allow workers to do different types of work, changing from sitting to standing to walking and back again.
- Allow foot and knee clearances for both standing and sitting workers, so they can get close to the work.

- Provide floor mats for standing work stations, to reduce fatigue.
- For standing work, use the proper work station height.

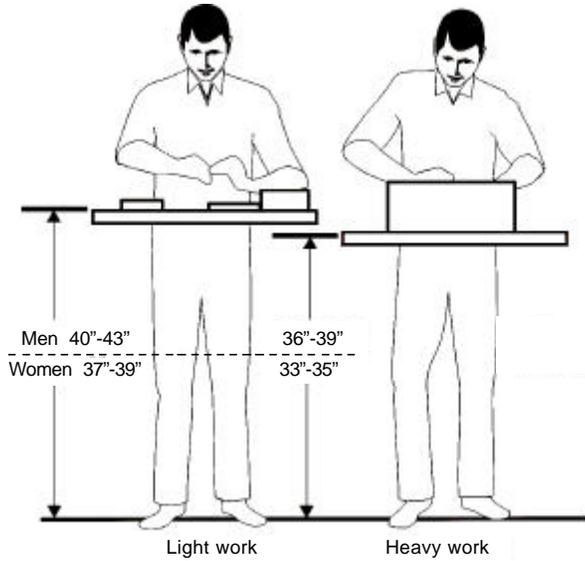
Guidelines for Hand Tools

- When tools require force, handle size should allow the worker to grip all the way around the handle so that the forefinger and thumb overlap by 3/8". Handle diameter should range from 1-3/8" for small hands to 2-1/8" for large hands, with an average of 1-3/4".

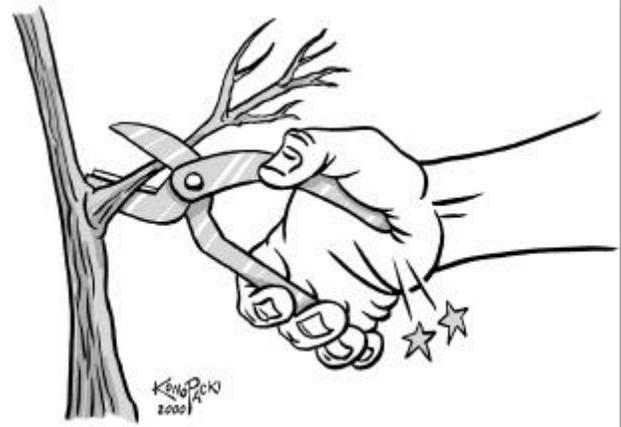


Handle diameter is large enough for small overlap of thumb and fingers.

- Handles should be covered with smooth, slip-resistant material (plastic or rubber). Dual-handed tools (like shears or pliers) should have a handle length of at least 4" and preferably 5". They should have a spring return to maintain an open position, and handles that are almost straight without finger grooves.



Proper work station height for light and heavy work.



Poorly-designed tool: Handle presses into base of palm and requires user to open after each cut (no spring).



Well-designed tool: Handles are long. Spring return keeps tool open. Handles are covered with rubber or plastic grip.

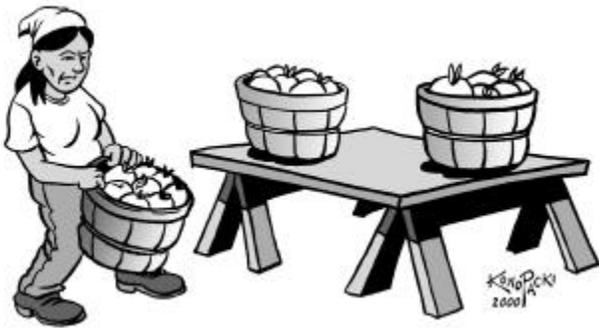
Guidelines for Lifting

- Keep lifts between hand level and shoulder level. Avoid lifts from the floor or over shoulder level.
- Provide handles on containers.
- Redesign loads so they can be lifted close to the body.
- Provide dollies, pallet trucks, or utility carts for objects that have to be carried more than a few feet. Provide roller conveyors for bags or boxes of vegetables or chemicals that are handled often. This will reduce the amount of lifting.



Lifting from a good height, between waist and shoulder level.

- Keep bag or box weight below 50 lbs. Or use the NIOSH Lifting Equation to determine an acceptable weight. See the Resources section for information on the Lifting Equation.



Poorly-designed load: No handles, and load must be carried too far from the body.



Better-designed load: Handles are provided and the load is closer to the body.

Guidelines for Stooped Work

- Redesign the job to avoid stooped work:

Attach long handles to tools. (For an example, see pages 9-10.)

Provide stools. (For an example, see pages 15-16.)

- If stooped work is required, provide employees with other short tasks that require walking or sitting.

Tip Sheets

The following 28 pages show some simple ergonomic solutions that farms have tried out. Some show new or adapted tools that were invented to make work safer or easier. Others show more efficient ways to do the work. Sometimes the solutions reduce the time needed to perform an operation. The basic rule is that the solutions (a) should not cost much in relation to the benefit achieved, and, if possible, should result in quick savings, and (b) should reduce injuries.

As you look through these tip sheets, try not to concentrate on whether they refer directly to your type of crop. Most of the ideas are adaptable for use on many different types of farms. They're also meant to stimulate your creativity to think up your own simple solutions. Or, as described on pages 17-18, you can get your employees brainstorming about ideas that will work in your operation.

Lifting Tool for Carrying Plant Containers

Problem:

Lifting and carrying plant containers by hand can cause injuries.



- Worker must stoop, grip, and lift repeatedly.
- Forward stooping can contribute to lower-back injury.
- Finger-pinch gripping can lead to tendinitis in hands.

One Solution:

Use specially designed handles to pick up and carry containers.



- Tool handle allows a full-hand “power grip” rather than a pinch grip.
- Decreases forward bending angle and amount of time spent in stooped posture.
- Reduces lifting strain.
- Can improve worker productivity.

Tips for Use of Tool:

The tool is designed to allow the container to swing back and hang at a comfortable angle. Do not apply excessive wrist torque when setting container down onto a surface. Instead, allow space for a gentle forward swing that is timed with placement of the container on the surface. The back-grip design keeps hands clear of thorns on certain types of plants and allows for a straight wrist position while carrying a container. It is advisable to use two tools and carry two plants, to balance the load on the body. Avoid carrying containers heavier than about 22 pounds in each hand; this would exceed guidelines for safe lifting.

Lifting Tool

How Does the Lifting Tool Work?

The tool has three parts: a) the hand-grip, b) the container coupling, and c) the 16-inch extension. It is made of aluminum and steel and has proven to work best with 5-gallon containers that have an external lip. From a standing position the worker slides the coupling point under the container's lip and lifts.



How Much Difference Does the Lifting Tool Make?

The tool shown here was designed for use in outdoor nurseries specializing in ornamental and bedding plants. At nurseries in California where it was tested, it reduced workers' forward bending angle by as much as 47%. The time spent working at a forward-bent angle of more than 20 degrees was reduced by nearly half. Hand gripping effort was reduced by more than half. Lifting strain was reduced by 40%. Workers reported less work-related pain when using the handles, and those who had the most severe symptoms at the start reported the most improvement.

How Much Will It Cost?

Materials should cost about \$15 each plus the cost of fabrication, whether done in-house or jobbed out.

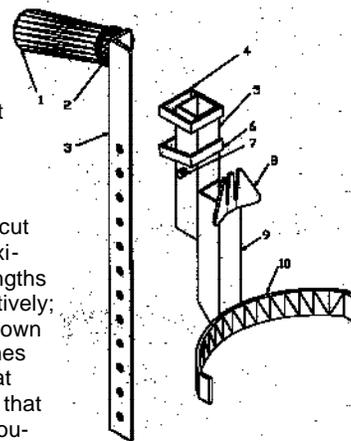
How Does Tool Use Affect Productivity?

Use of the handle resulted in the same or slightly improved productivity for ground-to-ground container spacing, its recommended use.

How to Make a Lifting Tool

Materials List & Construction Information:

1. Rubber grip; tapered from about 1-3/16" to 1-7/16" OD; to fit 1" OD tube; typically available in industrial supply catalogs.
2. 1" OD x 0.065" wall aluminum tube; cut at 21°; 4-3/4" on long side; welded at 69° angle to Part 3.
3. 1" x 1" x 1/8" x 16"-long aluminum angle; holes drilled on 1" centers and 0.5" from edge measured on 1"-wide side.
4. 1.5" x 1.5" x 0.094" x 3/8"-long steel sq. tube; welded along top joint.
5. 1" x 1" x 0.065" x 5"-long steel sq. tube; 1/4" hole drilled 2-1/2" from end and 3/8" from edge; welded to Part 9 with 2" overlap.
6. 1.5" x 1.5" x 0.094" x 3/8"-long steel sq. tube; remains loose on tube.
7. 1/4" D x 1"-long steel round; inserted into Part 5 and welded flush on the non-visible side in drawing above.
8. 1-1/2" x 1/8" steel flat bar cut at about 45° with approximate top and bottom lengths of 1" and 2-1/2", respectively; notched generally as shown in drawing above (notches are for container lips that have reinforcement ribs that may interfere with the coupling of the "point" and the container); ends bent slightly forward after welding; welded to Part 9 with 1/2" overlap.
9. 1" x 1" x 0.065" steel sq. tube; cut at 45; 4-1/2" on long side.
10. 1" x 1/8" x 9-1/2" long steel flat bar; 1/2" end-bends pointing forward; approx. 7-1/4" overall width after rolling; welded at bottom of Part 9.



Note: Steel may be substituted for aluminum for cost or fabrication reasons, but steel will increase the tool's weight from its current 1-3/4 pounds.

Contact Information:

This Tip Sheet was produced by the University of California Agricultural Ergonomics Research Center under a grant from the National Institute for Occupational Safety and Health.

UC Ag Ergonomics Research Center, Bio & Ag Engineering, UC Davis, One Shields Avenue, Davis, CA 95616-5294. Or visit <http://ag-ergo.ucdavis.edu>.

Weeding Stand for Plant Nurseries

Problem:

When plants are kept on the ground, workers must bend completely forward to weed them, risking low-back problems.



- Newly propagated plants are often kept in plastic flats on the ground for initial growth before “potting.”
- Worker must stoop and stay in bent position to weed trays on ground.
- Worker fatigue and pain can lead to lower work quality.

One Solution:

Use a movable table to elevate trays while weeding.



- Worker can stand while weeding, relieving prolonged stress on back.
- Worker must still stoop to pick up and replace trays, but change of position is better than prolonged position.
- Tray is closer to worker, reducing strain from reaching.
- Strain reduction will improve worker performance.

Weeding Stand

Why Bother With a Table?

You can help prevent chronic back injuries among weeders and should see improved work quality.

Won't Moving the Table Slow the Worker Down?

Probably not, if you calculate productivity over the work shift. Use of the table may result in slightly slower progress while workers are fresh. By mid-day, however, when back fatigue is setting in, workers using the table will be less tired and likely to move faster.

Should I Make or Buy a Table?

Either approach is fine provided that the table is the right size to fit the workers. As pictured, the ideal table will give workers a platform for the trays at just above their waist height. It should be light enough to move easily, but sturdy enough to be stable in use.

What If Weeding Flats Is Only a Part-Time Job in My Nursery?

The weeding table is still a good investment. Lots of nursery tasks other than weeding involve stooped posture. Relief, even in a part-time job, will help prevent long-term injury and will improve worker performance.

How Can I Make a Weeding Table?

With simple materials from your facility's shop or a home improvement store. The recommended material is light-duty steel, which will hold up under wet conditions, will not be too heavy to move around, and can be welded with typical shop equipment.

The drawing on this page shows 3/4"x 3/4" x 1/8" angle iron used for the table's legs, bottom bracing, and top bracing. The tabletop could be a

piece of metal grating welded to the frame in a number of spots or a metal plate welded or bolted to the top. Cost for materials would be about \$25.

Another possibility would be to make the table of aluminum, which is lighter in weight, and bolt the parts together rather than welding them. This would require a hacksaw, drill motor, wrenches, and some additional diagonal bracing. In any case, the key elements of the stand are height and portability.

An existing table could be retrofitted, if you have access to a shop and a welder. Two of the legs could be shortened and fitted with a steel rod, two lawnmower wheels (about \$7.50 each), and push-on retaining caps, all of which are available at hardware stores.

A collapsible four-wheeled table is available ready-made for \$227.99. This table has a push handle and is 24" long x 19-3/4" wide x 30" high. Contact, for example, Materials Handling Equipment, 7433 US 30 East, Fort Wayne, IN 46803. 219-749-0475. <http://63.87.5.30/mhec/catalog.shtml>



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Or visit <http://ag-ergo.ucdavis.edu>.

Smaller Picking Tub

Problem:

In hand harvest of wine grapes, the tubs used are heavy when full and, thus, can contribute to back and knee injuries.



- Workers cut grapes directly into plastic tubs and then carry the tubs to trailer-mounted gondolas. When full, the tubs weigh an average of 57 pounds.
- Worker must stoop, grip, lift, carry, and dump up to 20 times per hour, not including the stooping, gripping, and relocating of the tub as the worker moves down the row of vines.
- A side-sweeping motion of the leg is often used to move the tub along the vine until it is about half full, at which point the tub is lifted.
- For dumping into the gondola, the full tub is often lifted above the head.

One Solution:

Use a smaller, lighter tub (on the right) that has add-on grips and weighs an average 46 pounds when full.



- The lower weight is easier on the back, knees, and arms. The narrower width positions the tub's center of gravity closer to the worker, which reduces stress on the back.
- Lighter weight and smoother bottom surface reduce the sideways forces on the knees when pushing the tub down the row.
- Better handles reduce pressure points on the fingers.
- Can have minor negative impact on production, but has gained approval of piece-rate workers.

Picking Tub

How Much Difference Does the Smaller Tub Make?

The smaller tub was tested at several vineyards in a NIOSH-funded ergonomics study in California's Napa and Sonoma counties.

After the harvest season, workers reported pain and symptoms of injury that were only one-fifth of what they were with the large tub. Reduction of pain symptoms indicates a lower risk for future chronic injury or cumulative trauma disorder such as nagging back or joint pain.

How Does the Smaller Tub Affect Productivity?

Only negligibly. In a three-year field trial, the smaller tub resulted in a 2% reduction in pounds of grapes delivered to the gondola per day. Neither managers nor workers perceived the reduction in the field.

The reduction in productivity was not as much as might be expected, given that the two tubs are significantly different in size. This was apparently because workers using the small tub were less tired throughout the day and made 20 more carries per shift.

Despite making more carries, workers using the small tubs used less energy and had lower heart rates. They liked the smaller tubs better, reporting that they were less tired at day's end.

Here is the best "proof" that the smaller tub is better for workers: Workers on piece rate, who usually are eager for maximum productivity, preferred the smaller tub.

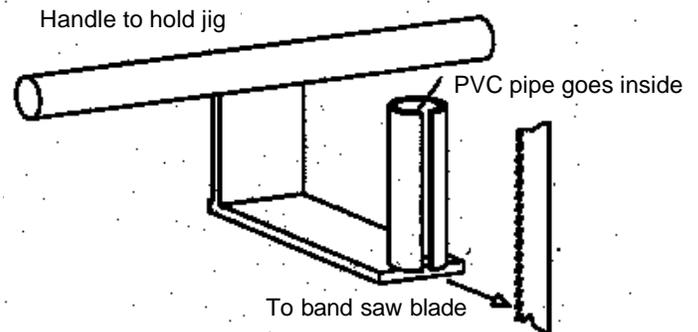
Where Can I Get a Smaller Tub?

The tub used in the study was a LEWISystems SN2414-8 stack/nest tub by Menasha Corporation of Watertown, Wisconsin, 800-558-9563. Cost is about \$13 each.

The SN2414-8 is two inches narrower and over two pounds lighter than the old tub. Ask your existing supplier for a smaller tub that is similar to the one used in the study; you may find good alternatives.

How Do I Make the Add-On Grips?

The add-on grips are simple to make using 1/2" PVC pipe (Schedule 40), a saw (preferably a band saw), and a jig such as suggested in the diagram below. The jig will cost about \$75 to have made.



Cut the PVC pipe to 5" lengths and cut an approximately 1/32"-wide slit lengthwise in the PVC using the jig. Use a slotted screwdriver to help slide the PVC over the edge of the tub's existing grip.

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Or visit <http://ag-ergo.ucdavis.edu>.

A Specialized Harvest Cart for Greens

Stooping or kneeling and crawling to harvest salad greens requires a lot of time and energy. Lifting and moving your harvest container many times as you fill it adds to the work load. An alternative is to build a simple cart, which allows you to sit and roll while you harvest. This is less tiring for the knees, back, hamstrings, and torso. The cart also holds your harvest container, so it rolls along with you.

How Does It Work?

The cart straddles the crop bed or rows, so that the wheels are on the paths between the beds. A seat is mounted low to the ground, between the rear wheels, allowing you to work directly over the bed without stooping. The seat swivels so you can harvest all parts of the bed without twisting your body. A sternum pad supports your torso so you can lean forward and ease strain on your lower back. Move the cart forward by pushing the rear wheels with your hands, wheelchair fashion, or scoot along with your feet on the ground. Prop your harvest container on the front corner of the cart frame, within easy reach. The front wheel swivels for easy steering.



Benefits of Using a Harvest Cart

Less fatigue and discomfort. Prolonged kneeling to harvest, transplant, or weed puts small-scale growers in one of the highest risk groups for occupational injuries. Harvesting from a seated position eliminates knee strain and is less tiring for the back, hamstrings, and torso. Kneeling requires at least 25% more energy and stooping requires at least 45% more energy than sitting does.

Harvest Speed and Posture Analysis	Without Cart	With Cart
Avg. harvest speed (mins/3lb crate)	7.8	4.6
% time spent in unacceptable postures	46	0
% time spent in marginal postures	48	93
% time spent in acceptable postures	6	7

This data is based on a case study with the same worker performing the same task. Postural analysis was compiled using the Ovaco Work Analysis System.

Faster. Using the cart lets you harvest the same amount of greens 40% more quickly. Faster har-

Harvest Cart

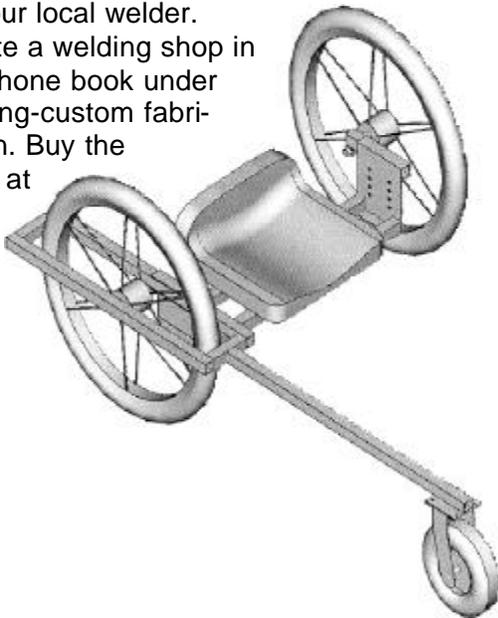
vesting and quicker time to the cooler maintains high crop quality.

Less soil compaction. Instead of kneeling or walking in the crop row or bed, the cart supports your weight. Your weight, plus the weight of the cart, is transferred through the wheels to the paths between the crops.

Improves profits. Cutting harvest time can save labor costs. A typical scenario might be that your labor costs are \$7.00 per hour, and you harvest four days a week. If you save 30 minutes per harvest day by using the cart, in 11-18 weeks the cart will have paid for itself. If the harvest cart prevents back or knee pain, you might also save money on medical bills.

Where Can I Get a Specialized Harvest Cart?

These carts, designed by Bob Meyer and Hal Bohne of the University of Wisconsin Agricultural Engineering Lab, are not available in stores or catalogs. We can provide plans for you to make your own cart from readily available materials. Some welding is required, which can easily be done by your local welder. Locate a welding shop in the phone book under welding-custom fabrication. Buy the parts at



a hardware store or from a tool and equipment catalog such as: Northern Hydraulic, P.O. Box 1499, Burnsville, MN 55337. 800-533-5545. (This reference is provided as a convenience for our readers. It is not an endorsement by the University of Wisconsin.)

How Much Will it Cost?

The parts for this cart cost about \$150. Labor costs, custom welding, or welding shop rental times will vary.

Steel: (1 1/4" square tubing, 1/8" wall thickness. 3/32" flat stock for gussets and supports)	\$ 15
Seat: (small tractor replacement)	\$ 28
Rear Wheels: (26" pneumatic)	\$ 28/ea.
Front Wheel: (10" swivel caster)	\$ 36
Swivel: (boat seat)	\$ 15
Total	\$150

Cart width should be 6"-12" wider than beds so that wheels will roll in the paths. Overall cart length is 42 1/2".

Contact Information

This material was developed by the Healthy Farmers, Healthy Profits Project, whose goal is to find and share work efficiency tips that maintain farmers' health and safety and also increase profits. For more information, visit our web site at <http://bse.wisc.edu/hfhp/> or call 608-265-9451.

Healthy Farmers, Healthy Profits Project,
Department of Biological Systems Engineering,
College of Agricultural and Life Sciences,
University of Wisconsin, 460 Henry Hall,
Madison, WI 53706.

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Participatory Ergonomics Team

Problem:

Management and workers want to decrease injuries, but lack knowledge of ergonomics. Instructions on safe practices from outside experts in ergonomics or from management may fall on deaf ears.



- Management may be unaware of the severity and costs of ergonomic hazards.
- Changes made without worker input may be resisted. Old habits die hard.
- Ergonomics consultants can address immediate problems, but not ongoing education and follow-through.

One Solution:

Set up a joint ergonomics team of workers and managers.



- Knowledge of ergonomic principles leads to better solutions.
- Workers' job insight ensures the most important problems will be addressed.
- Workers' day-to-day knowledge provides a reality check on suggestions.
- Ergonomic concerns filter down from management team members to other levels of management, and from worker team members to rest of work force.
- Ergonomics experts and other resources can be brought in as consultants, as needed.
- Team can develop ongoing ergonomics education program and address new problems as they arise.

Ergonomics Team

Why Set Up a Participatory Ergonomics Team?

The participatory approach—involving workers and managers—produces the best ideas for preventing injuries. It also means that the ideas will be used, rather than collecting dust on the shelf. The participatory approach recognizes workers' knowledge and uses it both to single out the worst hazards and to develop solutions. Workers are in on the decisions about which jobs to improve, and how to improve them. They spread the knowledge of ergonomics and of the specific solutions to the rest of the work force.

Who Should Be On an Ergonomics Team?

Keep the size of the team small. Involve production workers and supervisors from the different departments—the people who will put the job improvements into use—and also the maintenance workers or engineers who will build the needed tools. Include a representative from each major type of job. It is important that the person who has decision-making power to implement the team's recommendations also be a team member.

Hold training and meetings during work hours; participation should be seen as part of the job, not an extracurricular activity. Hold training and meetings in the workers' first language. Sometimes this will mean using two languages, with translation.

What Are the Tasks of an Ergonomics Team?

1. The team should receive training in basic ergonomic principles. See the Resources section of this pamphlet for a good training video, *Listen to Your Body*, and a pamphlet, *Blueprintstwo*.
2. Identify the ergonomic risk factors in each major job.
3. Rank jobs by urgency, based on the risk factors present, number of people affected, and number of injuries. The team should have permission to look at all injury and cost data, to help them set priorities.
4. Develop solutions. Look at equipment or tools available in your industry or in other industries, or design new tools. Call in engineers or consultants as necessary. Look for ways to change how the job is designed, so work safety is built into the job. This is

more effective than changes in instructions or work rules.

5. Try out the solutions in daily use.
6. Get feedback and modify as necessary.
7. As it works, the team should keep management and the work force fully informed of its goals, progress, and successes.
8. Design a program to educate all workers on ergonomic principles. For example, at one tree nursery, the Ergonomics Team drew up information sheets, specific to the nursery, that outlined the risk factors for the major jobs and some methods to work more safely. This information became part of new employees' orientation training.

What Are the Costs of an Ergonomics Team?

Workers' and managers' time spent working on the team should be paid at their regular rate. New tools may have to be ordered or built. Reduced costs because of decreased injuries should outweigh these short-term costs.

Where Can I Get More Information About Setting Up an Ergonomics Team?

See the Resources section for a video, *Ergonomic Programs That Work*, and a pamphlet, *Elements of Ergonomics Programs*.

Where Can I Find a Consultant on Ergonomics?

Look in the Resources section for a list of free OSHA consultation services (there is one in each state).

Contact Information

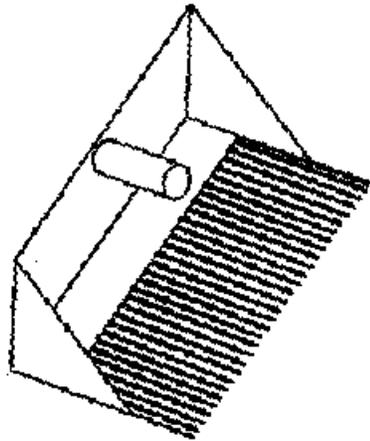
This Tip Sheet was produced from material developed by the Safety and Health Assessment and Research for Prevention (SHARP) Program, Washington State Department of Labor and Industries.

SHARP, Washington State Department of Labor and Industries, PO Box 44330, Olympia, WA 98504-4330. Or visit <http://www.wa.gov/lni/sharp/>.

New Rakes for Harvesting Berries

Problem:

Harvesting blueberries with a traditional rake is hard on the body.

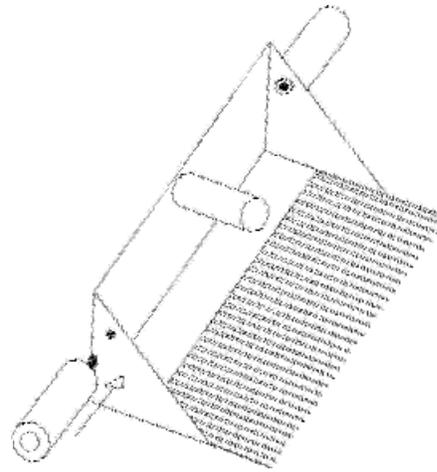


- Stooped position hurts the back.
- Thin handle is hard to grip comfortably.
- Rake design causes worker to flex wrists and to use pinch grip with fingers, risking tendinitis in wrists and hands.
- Steel rake is heavy, up to four pounds.

Two Solutions:

1. Modify existing rake.

- Add electrical tape or pipe foam to make the handle diameter right for the worker.

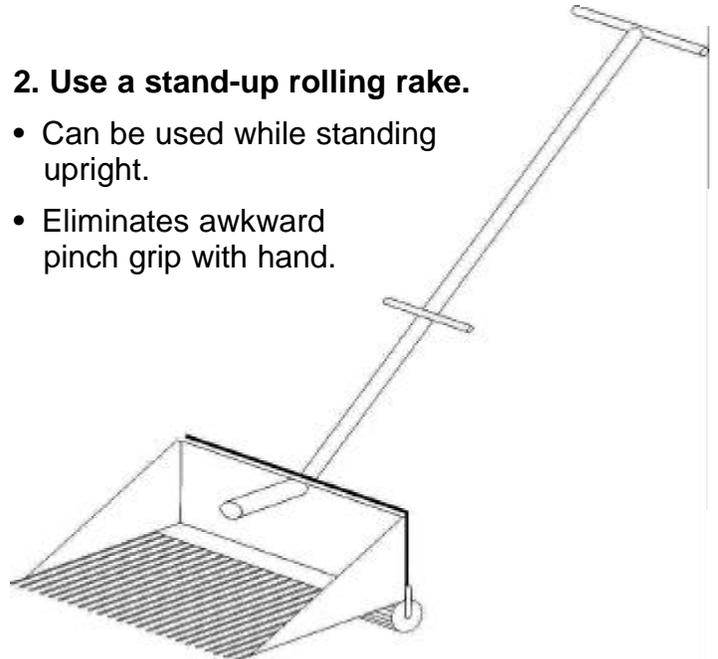


- Add a handle on each side of the rake, so it can be held with both hands.

- Use an aluminum rake rather than steel.

2. Use a stand-up rolling rake.

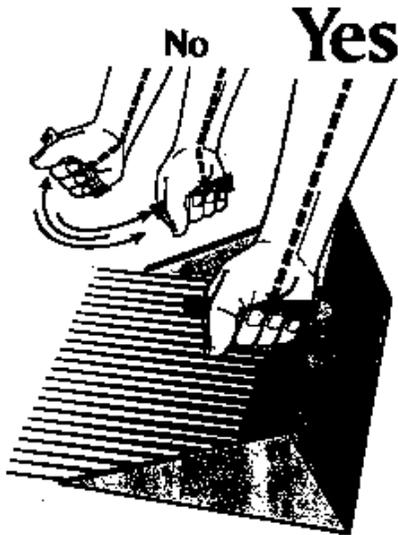
- Can be used while standing upright.
- Eliminates awkward pinch grip with hand.



Blueberry Rake

Why Not Use a Traditional Rake?

Because wild blueberries grow only about eight inches from the ground, harvest workers rake in a very stooped position. Their short-handled steel or aluminum rake, costing about \$60, causes the wrist to flex as the rake is dragged through the berries. To help guide the rake, most workers hold on to its side, using a pinch grip, which can cause tendinitis in the hands. The rake handle is too thin, at 1¼ inches in diameter, for most people to use comfortably.



Encourage workers to keep their wrists straight while working.

How Can I Improve a Traditional Rake?

1. Add electrical tape or foam pipe insulation, available in hardware stores, to enlarge the diameter of the center handle. The best size is 1-3/8" for small hands, up to 2-1/8" for large hands, with an average of 1-3/4". When gripping, the finger and thumb should overlap slightly.
2. Attach a handle on each side of the rake, which workers can grab without using a pinch grip. The idea is to have one hand on the center handle and the other hand on one of the side handles. Holding the rake by two hands will stabilize it and decrease its tendency to swivel when raked through the plants. Also, having a handle on either side will allow the worker to switch the main raking hand.

Use handles that have a rubber or plastic coating and that are 1-3/8" to 2-1/8" in diameter, depending on the hand size of the worker who will be using the rake. Drill a hole in each side of the rake. Put the bolt of the handle through the hole and connect with a washer and nut on the inside of the rake (see drawing on page 19).

3. Encourage workers to keep wrists straight while raking (see illustration, left). They should let the larger muscles of the shoulder and elbow do the work, and switch hands often.
4. Encourage workers not to fill their rakes or buckets too full. Tell them to stop if they feel pain, and to put something cold on the sore spot. Encourage stretch breaks.

Where Can I Get a Long-Handled Rake?

Acadian Machine Works Ltd.
Tignish, Prince Edward Island C0B 2B0 Canada
902-882-2349
Cost: \$550 Canadian or about \$300 U.S., plus shipping

This rake rolls on two wheels, making it easy to push through the bushes.

Some workers have also made homemade stand-up rakes, by attaching a long handle to a traditional rake, via a frame around the back and a cylindrical roller (like a rolling pin) attached to the bottom. Such homemade roller rakes are heavy, but still easier on the back than the traditional rake.

Cost Analysis

At a cost of \$300, it would take 17 to 30 hours for a blueberry harvester to pay for a manufactured stand-up rake. The rake should be sturdy enough to last for many seasons.

Contact Information

This Tip Sheet was produced by NIOSH.

NIOSH, 4676 Columbia Parkway, Cincinnati, OH 45226. Or visit <http://www.cdc.gov/niosh>.

Power Cutter for Woody Plants

Problem:

Thick woody plants are difficult to cut with small propagation shears. Repetitive gripping can contribute to chronic problems in the hand, wrist, and arm.



- Nursery workers use hand shears to make cuttings from plants for future propagation. Some plants, such as juniper, have thick and woody stems.
- Highly repetitive hand work can contribute to chronic injury of the hand, wrist, and arm (such as tendinitis or carpal tunnel syndrome). When workers have to squeeze forcefully, the risk of injury is increased even more.
- Repetition leads to fatigue of small muscles and to increased wear on tools.
- Besides the injury factor, woody plants can be prickly and difficult to handle.

One Solution:

Use a bench-mounted power cutter to relieve repetitive gripping and speed the work.



- Reduces need for repetitive and forceful gripping.
- Reduces need for handling of cuttings.
- Can improve productivity.

Power Cutter

How Does the Cutter Work?

The cutter uses air pressure to power a pneumatic cylinder that closes and opens a set of mounted hand shears, which have been modified for this purpose. Each cycle is activated by a light touch of the plant material against the trigger lever of an air micro-switch.

How Does the Cutter Affect Cutting Quality?

The cutting quality is unchanged, because the blades are identical to those of current hand shears. Workers new to the powered cutter will need one to two hours of practice before they can use it as well as the hand shears.

How Does the Cutter Affect Productivity?

Reducing fatigue may increase productivity over the course of the day. Also, workers with physical limitations may be able to use the machine much more easily than the hand shears, and thus be more productive.

Where Can I Get a Power Cutter?

Contact:
MG Enterprises
Rocky Canyon Road
Creston, CA 93432

Prices will likely run about \$1,000 for a smaller cutter and \$1,250 for a larger one.

Contact Information:

This Tip Sheet was produced by the University of California Agricultural Ergonomics Research Center under a grant from the National Institute for Occupational Safety and Health.

UC Ag Ergonomics Research Center, Bio & Ag Engineering, UC Davis, One Shields Avenue, Davis, CA 95616-5294.
Or visit <http://ag-ergo.ucdavis.edu>.