Iranian Saffron Picking: Interventions for Ergonomic Picking strategies

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Saffron picking practice is more than a thousand years old.

Why should we change it now?
Improves Health
Improves Morale
Improves Productivity
Reduce Fatigue
Increase Competitive Advantage
+ Reduce Occurrence of Mistakes

Higher Yield & PROFIT
OUTLINE

I. Literature Review
II. Postural Simulation & Analysis
III. Proposed Interventions
IV. Intervention continuum & Recommendations
V. Conclusion
Numerous studies review the ergonomic issues associated with hand-picking agricultural goods

**General consensus:** Hand picking low-growing crops is an inherently poor ergonomic task, however certain interventions can work to reduce the inherent risks.

Some notable conclusions are:

- Prone posture has the potential to improve working conditions and when compared to prolonged stooping and bending (Meyer 2004, 2007)

- Prolonged static contraction of the lower back and hamstring muscle groups needed to maintain the stooped posture, with the hamstrings taking the majority of the stress leads to discomfort. (Chapman & Meyers, 2001).
Stooping Review: REBA Analysis

- The neck was extended backwards putting it out of neutral alignment
- The torso is bent forward beyond 60 degrees

In some parts of motion:

- Torso is twisted as one arm reaches towards the floor
- The arm is abducted and rotated to reach the material on the ground
POSTURAL ANALYSIS

Kneeling & Crawling

Body is supported at three points: Both knees and one hand.

Picking bag is supported by one arm or hung off chest.

Crawling is a specific 4-beat gait involving the hands and knees. A typical crawl is left-hand, right-knee, right-hand, left-knee, or a hand, the diagonal knee, the other hand then its diagonal knee...This is the most natural of the crawls and is the one that requires the least effort.
Squatting

Picker supports body weight on two legs and bends at the knees to get to ground level. Both hands are free to hold bag and pick saffron.
POSTURAL ANALYSIS: Conclusions

- Prone posture has a measurable reduction in discomfort and strain when compared to stooping and bending.

- Stooping should be avoided.

- Prolonged static contraction or the lower back and hamstrings should be avoided.

- Strain of the neck occurs when in extension to properly view flowers while picking.
INTERVENTIONS: Outline

- Behavioral
  - Pre-picking
  - Post-picking
- During
- Technological
INTERVENTIONS: Behavioral

Pre-Picking:
  Heat
  Stretching
  Hydration
  Nourishment

While Picking:
  Job rotation
  Breaks
  Alternating positions: Crawling / Kneeling

Post-picking:
  Heat / Cooling
  Stretching
  Exercises
Pre-picking Interventions

1. **Heat** – inexpensive. Use hot moist towel on aching/sore muscle groups/frequently used before work.

2. **Stretching** – inexpensive. Low back, hamstrings.

3. **Hydration** – inexpensive. Sounds simple and unimportant, but muscle fatigue and function is STRONGLY related to hydration. Prevent injury.

4. **Protein and Electrolytes** – moderate expense. Excess muscle use causes breakdown à high protein turnover. Small increase in intake. Electrolytes lost due to manual labor à needed for nerve and muscle function. (Mg, Ca, K, Na in addition to P, Zn, Fe)
**INTERVENTIONS: Flowchart**

**Exercises:**
- Wall slides
- Prone leg raises
- Supine leg raises
- Semi Sit-Ups

**Stretches:**
- Standing Back Stretch (Do frequently throughout the day)
- Standing toe touch

**Does sitting relieve pain**
1. Knee to chest exercises Flexion Exercises
2. Curl ups

**Does standing relieve pain**
- Extension Exercises
- Press up back extension
- Bird-Dog Exercise

*Never do exercises or stretches that increase your pain*
INTerventions: Exercises

Wall Slides
Prone Leg Raises
Good Morning
Standing Back Stretch
Supine Leg Raises
Standing Toe Touch
Semi Situps
Standing Back Stretch
INTERVENTIONS: Stretches

Prone Buttocks Squeeze

Bridging

Pelvic Twist

Bird-Dog
INTERVENTIONS: During Picking

These are the two postures that we recommend alternating between. Our physical interventions will work to improve these postures further.
Based on our research and postural analysis’ crawling was found to be the optimal posture for avoidance of MSDs in Saffron picking.

We suggest that Iran's Saffron pickers employ a posture that uses both knees and one hand to support the body's weight. The free hand is then able to pick the flowers.

Reasons:
- Weight distributed between 3 points
- Close proximity to ground enables good range of motion and easy access to low growing crop.
Post-picking Interventions

1. **Ice** – inexpensive. Cold wet towel or ice (ice may be expensive). Apply to aching/tight muscles or, if injury occurs, APPLY IMMEDIATELY and take ibuprofin. à stops inflammation via vasoconstriction.

2. **Exercises** – see pamphlet designed for workers/flow chart. Do on days w/ no work. Abs, Back, Legs.

3. **Stretches** – keep flexible, improve blood flow to static muscles that have constricted all day.
Combination of:

Prone posture machine
Knee pads for picking
Hands-free picking bags
INTERVENTIONS: Technological
Hands-free Picking Bags

Both recommended postures require arm support: therefore, each worker should be equipped with **adjustable, hands-free picking bags**.

Bags should have one or more adjustable straps to fit snugly around the front of the body (symmetrically) or to alternate between sides.

Bags should not have any holes to prevent loss of stamens (preferably cotton canvas).

**Quick & Cheap Solution:** Have workers loop plastic bags through belts or string around waist. This is not an ideal scenario because thin plastic bags are prone to ripping on rocks.
INTERVENTIONS: Technological

Hands-free Picking Bags: Justification & Relation to Research

Again, both recommended postures require or are greatly benefitted by the addition of arm support. Therefore, a hands-free bag solution is necessary.

There is no precedent for picking bags specific to the harvesting of fragile flowers.

Certain decisions related to the bag design are influenced by research conducted on apple harvesting.

- Symmetrical or alternated between sides
- Adjustable
- Cotton canvas preferable for durability and mold, mildew, and abrasion resistance.
Effect of various knee pads on distribution of weight

INTERVENTION ANALYSIS
RECOMMENDATIONS

Implement Behavioral & low-cost interventions immediately

Work toward implementing more costly options such as a prone-picking posture machine in the future
QUESTIONS...?

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REFERENCES

Back Pain:
Prevention & Treatment
Back Injury Prevention: Advice and Frequently Asked Questions

Why will exercising and stretching help?

Exercises and stretches should never be done if they cause your back pain to worsen. It’s strongly advised that you discuss all exercises with a physician before beginning these routines, if possible. The purpose of exercising and strengthening is to make your postural muscles more durable and fatigue-resistant, leading to decreased risk of injury in the field. Stretching is done for safety; you want to warm up stiff tissue that is less elastic (e.g. tendons and ligaments) so that injury doesn’t occur during quick or strenuous movements. Both stretching and exercising is important because strong and flexible muscles maintain posture and prevent back strain.

How often should I stretch and exercise?

You should stretch every day and every time before returning to work. This is because, after a break, your soft tissue has cooled down, making it more rigid and prone to injury. You should also take breaks to stretch while working.

You can do exercisers on days that you do not spend an inordinate amount of time in the field. Otherwise, do exercises every other day. Overtraining of muscles can cause them to become too fatigued and actually increase your risk for injury. The best thing would be to begin a regimented exercise routine where you train your abs, back, and legs every other day in the months leading up to October and November – attaining strength takes time.
Should I do exercises if I have or get a back injury?

You can and should do exercises even if you do have or do develop back pain, just don’t do those exercises that make the pain worse. However, DO NOT do exercises if you have just acquired acute back pain (i.e. have just injured yourself). You want the acute pain to disappear before beginning exercises, and make sure to see the section on icing and taking ibuprofen immediately after the injury occurs.

Should I stay active or rest if I get back pain?

You should try to be active soon after noticing pain and gradually increase your activity level. If not, little activity can lead to decreased flexibility in the injured area, less strength and endurance, and more pain. Again, do not do movements that increase your pain.

How should I carry heavy loads of flowers to prevent injury?

The farther from the body you carry an object, the more stress you place on your back and the more your risk for injury will increase. Lift with your legs and carry the load as close your body as possible.
Back Injury Prevention: Exercises and Stretches

How long do I have to exercise for AND what exercises should I do if I get injured?

Just 10 minutes of stretching and exercising a day can greatly decrease your risk of back pain. Exercises that move you toward your more comfortable position when injured or when feeling fatigued or cramped are more successful. For example, if you feel better sitting down, do partial sit-ups or knee-to-chest exercises which stimulate a sitting down position. When doing stretches or exercises, it is important to always warm up beforehand. You want muscles to be flexible and less likely to tear when you stretch and exercise them.

What are the muscles I should focus on to prevent injury?

The three major muscles that will help to prevent back injury are:

Back
Legs
Stomach

Why are these the muscles I should focus on?

Keeping the back, leg, and abdomen muscles strong will support your spine and decrease risk of disc injury.
What about aerobics?
Aerobics are good because keeping your vasculature healthy allows more oxygen to be delivered to the muscles, preventing fatigue and decreasing the risk for injury while working.

Why should I stretch, especially the hamstrings?
Shortened muscles of the back, quads, hamstrings, and glutes can pull on the spine through articulating structures and put it out of alignment. Stretching is important to lengthen these muscles, align the fibers, and prevent injury.

Stretching extension-in-standing should be done frequently during the day if you sit or stand in one position for long periods of time. This is why it’s important to take breaks while working and stretch while also being conscious of your posture and taking time to readjust when you feel yourself getting tired. Hamstrings should be stretched twice a day.
Back Injury Prevention: Exercises and Stretches

What exercises should I do if I DO NOT have back pain (i.e. if I have a healthy back)?
Exercises to do to Prevent Back Injury (do these if you don’t have back pain)
1. Wall slides – leg strength
2. Prone leg raises – stomach and leg strength
3. Supine leg raises – stomach and leg strength
4. Semi Sit-Ups – stomach and leg strength
5. Standing Back Stretch/Prone Back Stretch – back strength/stretch NOTE: Do frequently throughout the day
6. Standing toe touch – hamstring stretch
7. Good mornings – back strength

What exercises should I avoid if I have back pain?
Exercises to avoid if you have low back pain
1. Sit-ups of any kind
2. Leg raises
3. Lifting heavy objects above the waist
4. Toe touches

What exercises should I do if I have back pain?
Exercises to do if you have back pain
1. Prone buttocks squeeze
2. pelvic tilts
3. bridging
4. hamstring stretch
5. wall sit

NOTE: Only lift one leg at a time
Extension – these exercises reduce pain caused by herniated discs. Good choice for people who’s pain is alleviated by standing/walking. Do these exercises:
1. Press up back extension
2. Bird/Dog exercises

Flexion – These exercises are good choices if your back pain is eased by sitting. Do these exercises:
1. Knee to chest exercises
2. Curl ups
### Flexion Exercises
1. Knee to chest exercises
2. Curl ups

### Extension Exercises
1. Press up back extension
2. Bird-Dog Exercise

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**Never do exercises or stretches that increase your pain**

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### Exercises/Stretches to do if no back pain

**Exercises:**
- Wall slides
- Prone leg raises
- Supine leg raises
- Semi Sit-Ups

**Stretches:**
- Standing Back Stretch (Do frequently throughout the day)
- Standing toe touch

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Do you have back pain?

**Exercises to avoid if you have low back pain**
- Straight leg sit-ups
- Bent leg sit-ups
- Leg lifts
- Lifting heavy objects above the waist
- Toe touches

**Exercises to do if you have back pain**
- Prone buttocks squeeze
- Pelvic tilts
- Bridging
- Hamstring Stretch
- Hip Flexor Stretch
- Wall sit

(Only lift one leg at a time)

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Does sitting relieve pain?

Flexion Exercises
1. Knee to chest exercises
2. Curl ups

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Does standing relieve pain?

Extension Exercises
1. Press up back extension
2. Bird-Dog Exercise

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**Never do exercises or stretches that increase your pain**
Back Injury Prevention: 
Heat and Cold Therapy

When should I use ice or cold compression?
Only ice after you are done with an activity, such as after a day of work (cold restrics blood vessels and thus decreases inflammation and inflammatory cytokines that cause tissue damage at the injury site).

When should I use heat therapy?
Only heat before work or before doing an activity (heat expands rigid tissue and prevents injury due to strain. Apply hot towel on low back before work (or take a warm shower). Heat should never be done after an injury or immediately after work. Heat increase elasticity of join connective tissue and relaxes stiff muscles.

- Only apply a heating source for 10-15 minutes to avoid burns.
- MOIST heat is the best
- Never heat while sleeping (you could get burns if you fall asleep with it on).

ALWAYS ICE AFTER AN INJURY
If injured, apply ice IMMEDIATELY to decrease inflammation, halt tissue damage, and decrease internal bleeding. For ice, apply it in 10-15 minute intervals but not directly on the skin (use a towel or cloth between the ice and your skin). Also, you should wait for your skin to return to its normal temperature again before applying ice a second or third time.

- ICE YOUR BACK AFTER WORK
- If you acquire an acute injury, you can apply ice multiple times a day for up to 3 days.
Morning
- Warm wet towel on sore muscles/joints?
- Breakfast?
- Stretches (esp. hamstrings)?
- Packed lunch/Water for the day?

Work Day
- Regular water breaks?
- Regular stretching breaks?
- Am I changing posture regularly?
- Have I gone 5 hours without eating?
- Acute Injury? \(\rightarrow\) ice immediately, take rest of the day easy, take ibuprofin
- Do I have time for at least a half hour nap?

Post-picking / Evening
- Cold compress on sore muscles/joints?
- Dinner? Have I had protein today?
- Rehydrate with water?
- Fruits/veggies or vitamin/mineral source?
- Does back feel susceptible to injury (see flowchart)?
- Have I done strengthening exercises and stretches (see flowchart)?
- Will I get at least 6 hours of sleep?
Back Injury Prevention: Exercise Instructions

Wall Slides

1) Stand upright with your back against a wall and feet shoulder width apart
2) Slowly bend your knees, sliding your back down the wall, for a count of five until your knees are bent at a 45 degree angle. (do not bend too much further than this as it will cause increased strain on your knees)
3) Hold this position for 5 seconds
4) Begin straightening your knees for a count of five, sliding up the wall until you are fully upright with knees straight
5) Repeat the above steps five more times
6) Do three times per day
Prone Leg Raises

1) Lie flat on your stomach
2) Lift one leg off the ground 2 feet into the air
3) Hold for 10 seconds
4) Relax
5) Repeat with opposite leg
6) Repeat the above steps five more times
7) Do three times per day
Back Injury Prevention:
Exercise Instructions

**Supine Leg Raises**
1) Lie flat on your back
2) Lift one leg off the ground 2 feet into the air
3) Hold for 10 seconds
4) Relax
5) Repeat with opposite leg
6) Repeat the above steps five more times
7) Do three times per day
Back Injury Prevention: Exercise Instructions

**Semi Sit Ups**
1) Lie flat on your back with your knees bent and feet on the floor
2) Raise you head and shoulders only off the floor
3) Hold for 10 seconds
4) Relax, returning head and shoulders to the floor
5) Repeat the above steps five more times
6) Do three times per day
Standing Back Stretch
1) Stand upright with feet shoulder length apart
2) Place your hands in the small of your back
3) Bend back slowly, as far as tolerated, while keeping your knees straight
4) Hold this position for 5 seconds
5) Relax
6) Repeat the above steps five more times
7) Do three times per day
Back Injury Prevention: Exercise Instructions

Prone Back Stretch

From the prone position (lying flat on the stomach), press up on the hands while the pelvis remains in contact with the floor. Keep the lower back and buttocks relaxed for a gentle stretch.

This position is typically held for 1 second, repeated 10 times.
Standing Toe Touch

Bend at the hips and keeping your head up, try to touch your toes. Try to go as far as possible, but don’t try to stretch beyond your limits (if you can’t touch your toes, that’s OK... grab the back if your lower legs and try to pull your upper body down). Hold this position for 10 seconds, then relax and stand upright. Repeat 3 or 4 times.
Back Injury Prevention: Exercise Instructions

**Good Morning Exercise**

Hold something of moderate weight in front of you or behind your head. Bend at the waist, keeping your head up and looking ahead. You will feel tension in your low back. After you bend, extend back up, keeping your back straight. Do this 10 times.

You can repeat this exercise 3 or 4 times.
Back Injury Prevention:
Exercise Instructions

Prone Buttocks Squeeze

1. Begin by lying on your stomach.
   2. Squeeze your buttock muscles.
   3. Hold for 5-10 seconds.
   4. Repeat 5-15 times.
Back Injury Prevention:
Exercise Instructions

Pelvic Tilt

Tilt pelvis backward and flatten back into ground.
Back Injury Prevention: Exercise Instructions

Bridging

Start by lying on the back with the knees bent, then slowly raise the buttocks from the floor. Hold bridge for eight to 10 seconds, then slowly lower to starting position. As strength builds, aim to complete two sets of ten bridges.
Back Injury Prevention: 
Exercise Instructions

Bird-Dog

For a slightly more advanced exercise, raise one leg with the knee slightly bent and no arch in the back or neck and also raise the opposite arm. Hold for four to six seconds, then slowly lower to starting position. As strength builds, aim to complete two sets of ten leg raises.
Back Injury Prevention:

References


- When to Use Ice and When to Use Heat on a Sports Injury. Elizabeth Quinn. [http://sportsmedicine.about.com/cs/rehab/a/heatorcold.htm](http://sportsmedicine.about.com/cs/rehab/a/heatorcold.htm)
Knee/Knuckle Pad Intervention; Instructions for assembly

START

FLOUR

PLASTIC BAG

HANDKERCHIEF

HARD SURFACE
WOOD/PLASTIC

FLOUR IN ZIPLOCK BAG

LEG

FLour KNEE PAD

KNEE

HANDKERCHIEF
HARD SURFACE
FLOUR

Hands-free bag intervention
REFERENCES