

URBAN AGRICULTURE

A Participatory Primer Course

Part 4b: Harvest and Post Harvest Tools and Operations



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**First, More Biological Tools
and
Mechanical Equipment for
Urban Agriculture Production**

Equipment Guidelines

Table 1. Estimated equipment needs for various sizes of vegetable farms.

Scale	Seed starting	Power source and tillage	Direct seeding	Equipment	Cultivation	Harvesting	Post-harvest handling	Delivery
1-3 acres	small hoop house, grow lights, planting trays	rototiller or walking tractor, custom work	Earthway seeder, Cyclone seeder	Back-pack, sprayer, irrigation, tools	Wheel hoe, hand hoes, digging forks, spades	Field knives, hand boxes, buckets, carts	Bulk tank, canopy, packing containers	Pickup with topper or van
4-6 acres	1,000 sq. ft., greenhouse, cold frames, field tunnels, planting trays	35-40 hp tractor, with creeper gear, power steering, high clearance	Planet Jr. plate seeder	1-row transplanter, irrigation, more tools	Cultivating tractor (IH Super A or IH 140)	Potato digger, bed lifter, wagon, more boxes, buckets	Roller track conveyor, hand carts, walk-in cooler	Cargo van
7-10 acres	Additional cold frames, planting trays	40-60 hp tractor, chisel plow, spader	Stanhay precision belt seeder with belts	2-row transplanter, sprayer	Tool bar implements: beet knives, basket weeder	More field crates	Barrel washer, spinner, pallet jack	1 ton truck with refrigeration
20 + acres	2,000 sq. ft. greenhouse	80 hp tractor with loader bucket and forks, compost spreader	Nibex or Monosem seeder	Irrigation, bed shaper, mulch layer	Sweeps (Besserides), Buddingh finger weeders, flame weeder, potato hiller, 2nd cultivating tractor	Asa lift, harvest wagon	Wash line, larger cooler, packing shed and loading dock	Refrigerated truck

Adapted from a table distributed at Michael Fields Institute Advanced Organic Vegetable Production Workshop, 2/2001, Jefferson City, MO.

Equipment and Tools

❖ Appropriate Technology Resources

“Technology that saves energy & resources”

✓ National Center for Appropriate Technology

see - <http://www.ncat.org/>

✓ Univ. of CA-Davis, Appropriate Technology for Small and Subsistence Farmers

see - <http://asi.ucdavis.edu/programs/rr/education-and-outreach/itech-appropriate-technology-for-small-and-subsistence-farms/itech-appropriate-technology-for-small-and-subsistence-farms>

Equipment and Tools

FARM HACK
A COMMUNITY FOR FARM INNOVATION



Watch the video at
<http://farmhack.org/tools>

Equipment & Tools Care Basics

- Scrape off any excess mud or dirt. Use a stick to knock off large pieces and a wire brush for tougher spots. If the soil is really caked on, you may need to let the tool soak in a bucket of water for a few minutes before tackling it again.
- Wipe off the tool with an old rag and let it dry thoroughly.
- Remove any rust by rubbing it vigorously with a small piece of steel wool. (Be sure to wear gloves.)
- Sharpen the tool, if it has a sharp portion (this includes spades), with a file made especially for sharpening tools. Hold the tool steady against a solid object, such as a tool bench, and draw the file repeatedly across the edge at a 45-degree angle.
- Condition wooden handles by sanding any rough or splintery portions with sandpaper. Follow up by rubbing paste wax over the handle.
- Spray metal parts with a penetrating lubricating oil to protect from rust.
- Store in a dry spot. Avoid leaving tools on the floors of garages or other places likely to get damp during the winter.

eHow Home & Garden Editor. "How to Clean and Store Gardening Tools..."

http://www.ehow.com/how_10814_clean-store-gardening.html?ref=fuel&utm_source=yahoo&utm_medium=ssp&utm_campaign=yssp_art

Field Production Equipment Types

- **Manual implements**
 - Shovels, etc
 - Double dug bedding
- **Biological-based “implements”**
 - Animal-driven not covered in this course
 - Animal examples
- **Mechanical-driven implements**
 - Walk behind tractors
 - Four wheel tractors

Field Preparation Hand Tool Examples



Digging Spade



Digging Fork



Root Jack



Broad Fork or U-Digger



✓ Purchase of hand tools of high quality metal is worth the extra expense for reliable & safe usage

Biological Field Preparation

- **Animal Tractors**

- mobile, bottomless, shelter-pen systems where animals prepare and fertilize market garden growing areas
- **key to creating an effective animal tractor system is to integrate the needs, behaviors, and products of the animals with the farm system as a whole**

A. Lee, Animal Tractor Systems, The Overstory #50
<http://www.agroforestry.net/overstory/overstory50.html>



Chicken Tractor



Pig Tractor



Pig tilled land

Biological Field Preparation

- **Animal Land Clearing**

- small livestock, e.g., goats, can be use to clear unwanted brush in order to prepare land for market gardening
- **use with electrical fencing and guard animals**
- saves on fossil fuels and mechanical equipment
- **produces potential meat sales**



See -

<http://exopermaculture.com/2011/07/31/animal-power-for-habitat-restoration-goats/>

Equipment and Tools



Watch these short videos:

- “Market Garden Tool Wall” – see <https://www.youtube.com/watch?v=D8GfGvpFsS0>
- “What's in Jean-Martin's Tool Shed?” – see <https://www.youtube.com/watch?v=4GGB723wEhg>

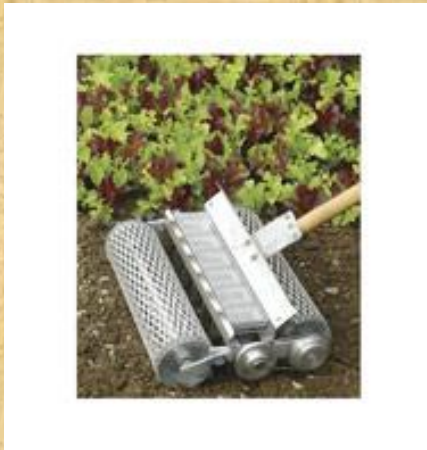
Planter Examples



Earthway Seeder



Planet Jr.



Six Row Seeder

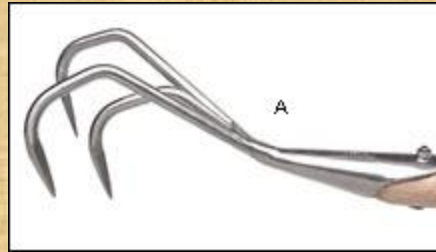


Seed Stick Planter

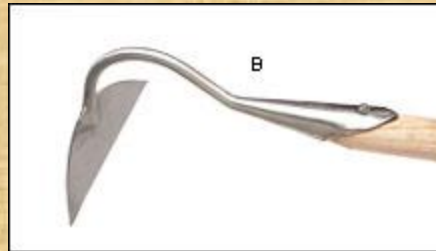
Cultivator Examples



Wheel Hoe



Cultivator



Half Moon Hoe



Stirrup Head Hoe



Colinear Head Hoe



Mantis Cultivator

Cultivator Examples

❖ Flame Weeders



Watch the video at

https://www.youtube.com/watch?v=vDpeHp_98zQ

<http://flameengineering.com/collections/agricultural-flamers>

Biological Cultivators

- Weeder Geese



- used successfully both historically and in more recent times
- used with great success to control and eradicate troublesome grass and certain weeds in a variety of crops and plantings
- crops include strawberries, corn, sugar beets, potatoes, onions, raspberries, blueberries, grapes, asparagus, mint, tree fruits, etc
- can practically eliminate the need to hoe and pull grass and weeds with proper use
- are "manure spreaders" as well as "cultivators."
- two to four geese per acre are enough in row plantings

Mechanical-Driven Tractor

“Walk-Behind Tractor”

- **Types**

- Belt driven transmission
(e.g., Troy Bilt)

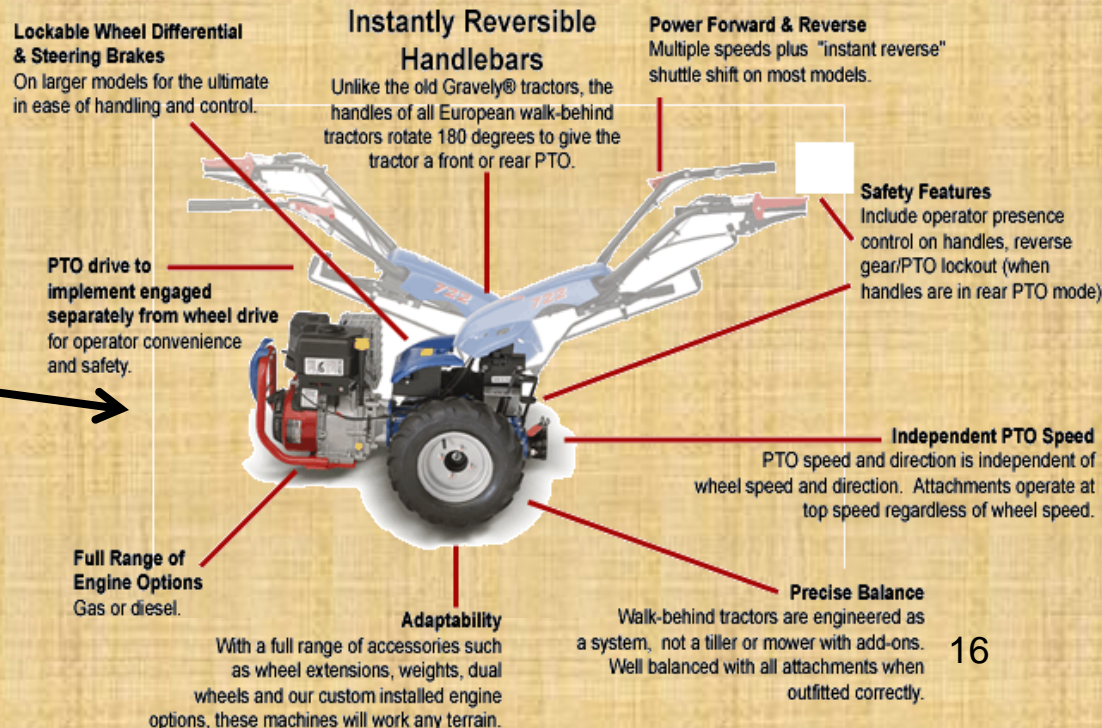


Troy Bilt

- Limited selection of attachments

- Gear driven transmission
(European Brands)

- Expanded selection of attachments



European Walk-behind Tractor & Attachment Examples

Planters



Cultivators



Flail Mower



Tiller



Swivel Handles



Transplanter



See video at https://www.youtube.com/watch?v=7jAr6K_hB7U

Mechanical-Driven Tractors

- Small size 4 wheel tractor



John Deere



Kubota

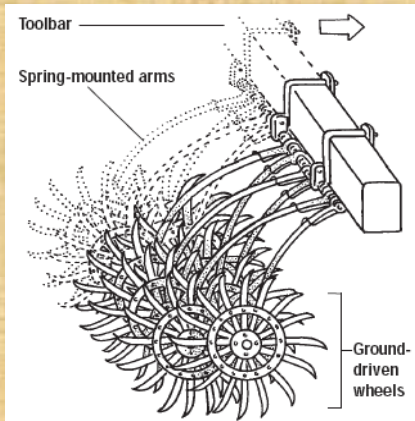


International-Farmall Cub
(used, older tractors are found at auctions and are very affordable & useful too)

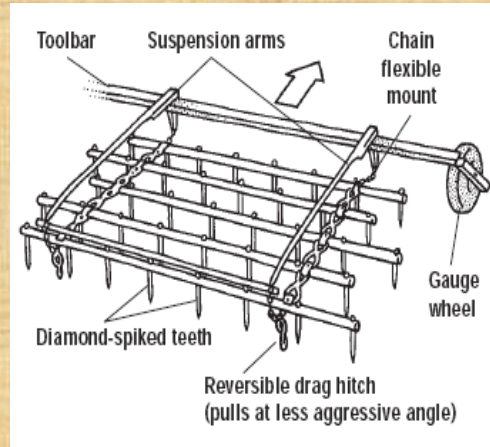
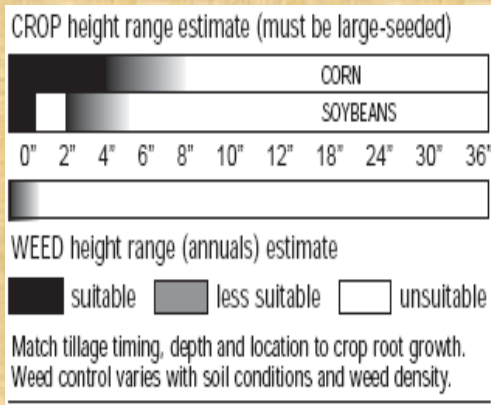


Carte

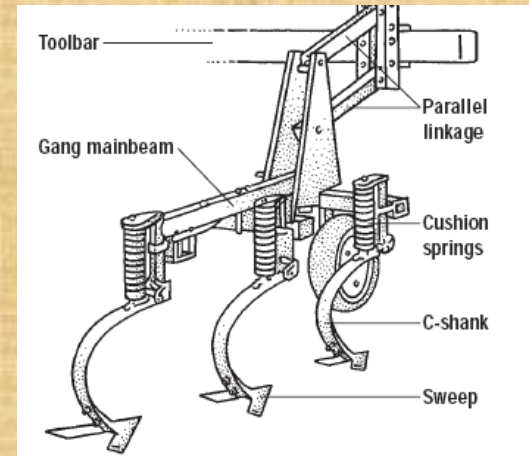
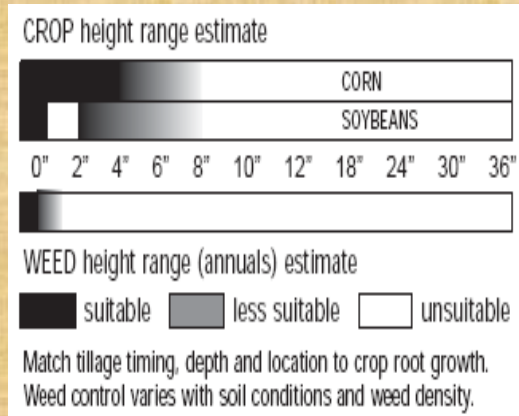
4 Wheel Tractor Cultivation Attachment Examples



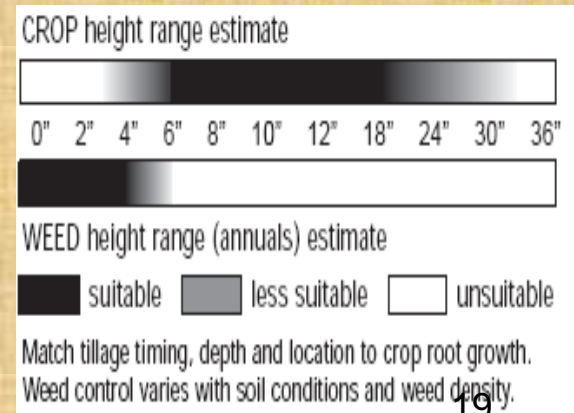
Rotary Hoe



Harrow

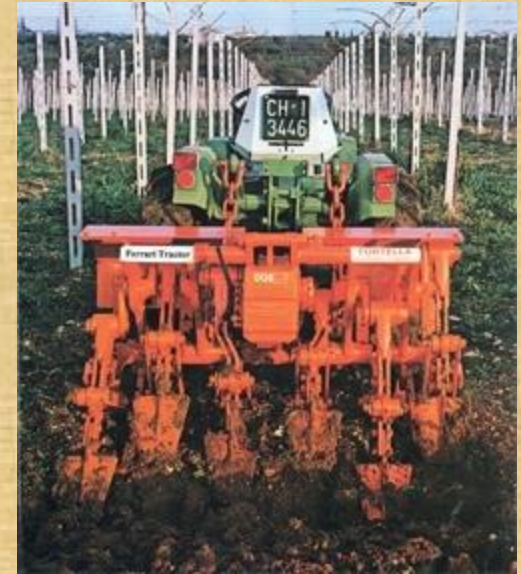


Cultivator



Soil Spader Implement

- the state of art in soil preparation
- the mechanized equivalent of several digging shovels
- the concept behind spading is to mechanically reproduce the age-old technique of "double digging,"
- maintains the basic organic structure; and because they tear and do not cut or slice the soil, they help maintain the soil's tilth



Watch the video at

<http://www.youtube.com/watch?v=ycadZjZ1Vnw>

Utility Vehicle Examples



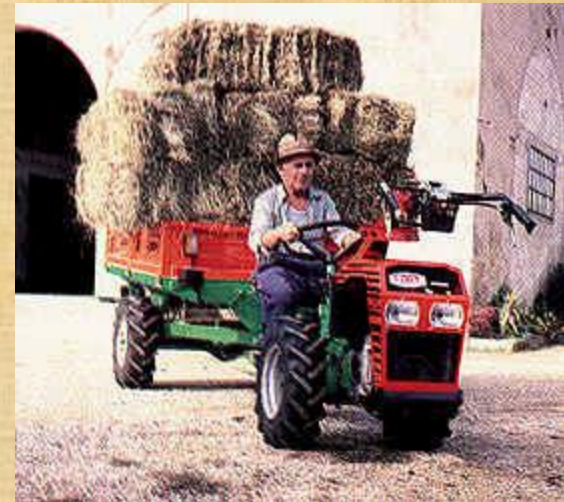
John Deere Gator 4x2



Timberwolf Powerwolf 4x2



Highly recommended for labor saving benefits.



Tall Tunnels/Hoop Houses

- **Unheated greenhouses that can help market gardeners extend their growing season so that they can improve the profitability of their farms.**
- **Unlike commercial greenhouses that cost up to \$20 per square foot to construct, high tunnels can cost as little as \$0.50 per square foot**
- **Greenhouse structures may be covered with glass, rigid panels, or double-layers of plastic, but high tunnels are usually covered with a single layer of plastic**



Tall Tunnels/Hoop Houses

- Tall enough to walk-in comfortably and to grow tall, trellised crops such as tomatoes
- No standard dimensions but they typically fall within the ranges of 14-30 feet wide by 30-96 feet long
- Setup info for an urban location – see <https://attra.ncat.org/attra-pub/summaries/summary.php?pub=552>
- High Tunnels Information Website <http://www.hightunnels.org>



The use of high tunnels in urban agriculture can reduce risks and increase profitability. Photo: NCAT



Some high tunnel manufacturers offer substantial gutter systems to collect water for irrigation. Photo: Chris Lent, NCAT

Low Tunnels



Slitted row covers have pre-cut slits that provide a way for excessive hot air to escape. Photo courtesy of Ken-Bar.

- ❖ Shade cloth versions give warm season extension for cool season crops.

Shade House

- A shade house protects cultivated plants from excessive heat, light or dryness.
- Crop shade tolerances:
 - 40%: vegetable seedlings
 - 50%: tomatoes, peppers, lettuce
 - 70%: ferns, indoor plants



<http://www.protect-o-net.com/guidelines.shtml>

Hydroponic shade house ²⁵

Emerging Protected Urban Ag



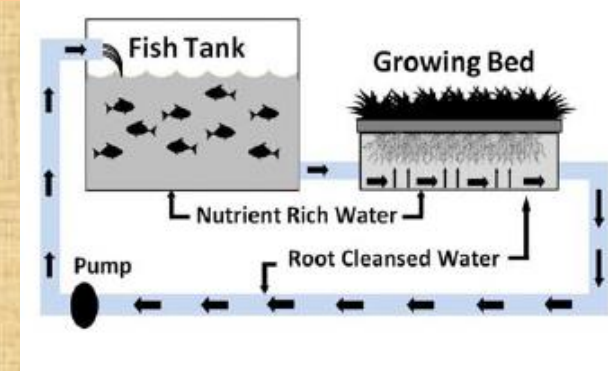
See short video “The Globe (Hedron) Is a Geodesic Greenhouse for Urban Farmers” at <https://www.youtube.com/watch?v=ha71UrOzG5M>

Hydroponics Equipment Examples



Aquaponics Equipment

❖ Aquaponics is a bio-integrated system that links recirculating aquaculture with hydroponic vegetable, flower, and/or herb production.



❖ The technology associated with aquaponics is complex. They require intensive management & they have special considerations.

❖ Model systems include the following:

- The North Carolina State University System - fish tanks sunk below the greenhouse floor
- The Speraneo System – use of 500-gallon aboveground tanks inside a greenhouse
- The University of the Virgin Islands System – use of fish rearing tanks with the aquacultural effluent linked to floating raft hydroponics

Vertical Farming Equipment

❖ Commercial-scale vertical farms can make use of the following:

- abandoned warehouses in our cities
- new buildings built on environmentally damaged lands
- used shipping containers from ocean transports.



❖ Important equipment features include:

- types of vertical farming production systems
- LED lighting
- climate control system
- building design

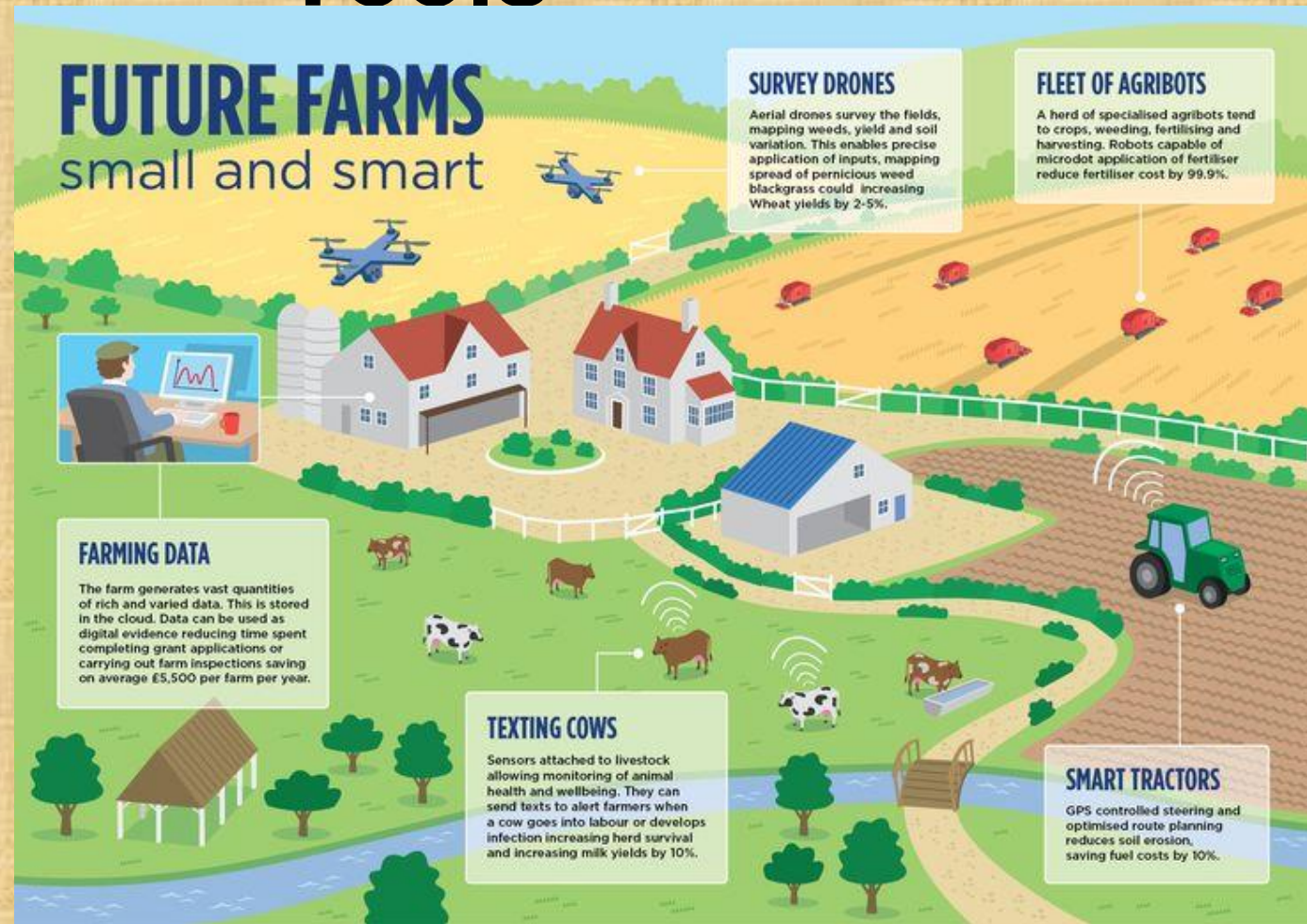


❖ Refer to “Vertical Farming Online Resources” slide for training & information



Crop Production Technological Tools

- Sensors
- Computers
- Alternative Energy



Watch the videos “Revolutionizing the Way We Grow Food | Nat Geo Live” at <https://www.youtube.com/watch?v=P3p8sFGxepE>
And “Solar Powered Urban Farm” at https://www.youtube.com/watch?v=GAwkmP5_c3M

Ergonomics & Urban Ag

- Ergonomics
 - the science of fitting the job to the worker.
 - when there is a mismatch between the physical requirements of the job and the physical capacity of the worker, repetitive stress injuries (RSIs) can result.
 - workers who must repeat the same motion throughout their workday, who must do their work in an awkward position, who must use a great deal of force to perform their jobs, who must repeatedly lift heavy objects, or who face a combination of these risk factors are most likely to develop RSIs.
- Urban farming
 - like farming, involves physical activity susceptible to the development of RSIs.

Ergonomic Tools Examples

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 $1-3/4$ ".

Men 40"
Women 3"



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



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



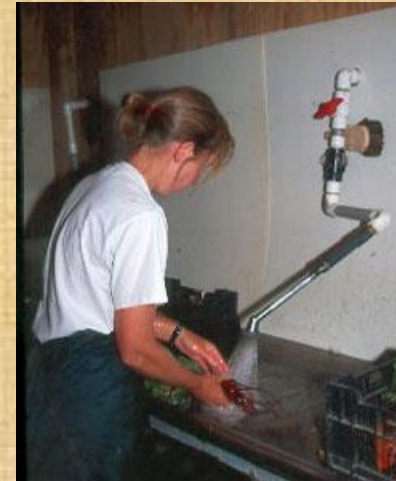
Well-designed tool: Handles are long. Spring return keeps tool open. Handles are covered with rubber or plastic grip.

- Handles should be covered with smooth, slip-resistant material (plastic or rubber). Dual-handled 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.

Ergonomic Tools Examples



Strap-on stool



Hands-free crop washer



Harvest cart for greens

Healthy Farms, Healthy Profits Project
<http://bse.wisc.edu/hfhp/index4.htm>

The AgrAbility Project

- Purpose
 - assist people with disabilities employed in agriculture
 - assists people involved in production agriculture who work both on small and large operations
 - provide training, site visits, on-farm assessments, technical assistance, and other information directly to the farmer or rancher with a disability
 - national program but no state program is available for FL residents

Farming Safety

- Statistics
 - Farm accidents and other work-related health problems claim as many as 1300 lives and cause 120,000 injuries a year, most of which are preventable (1990)*
 - Each year, approximately 70 children ages 14 and under die from injuries occurring on a farm**
- National Ag Safety Database
 - Information on safe operation of farming equipment

* US Dept of Labor Fact Sheet No. OSHA 91-39 "Farm Safety"

** National Safe Kids Campaign "Rural Injury"

Urban Ag Harvesting and Post Harvest Equipment and Operations

Harvesting Equipment Examples



Greens harvester – see https://www.youtube.com/watch?v=OPIfw5_WoLU



Harvest knives



Harvest basket



Harvest tub



Harvest cart

<http://www.marketfarmtoolbox.com/>

- Appropriate tools promote proper handling & minimal physical damage to crops during harvesting activities.

Harvesting Operations

- ❖ The main factors for maintaining quality from the point of harvest forward are:
 - Harvest at proper maturity for the intended market.
 - Minimize mechanical injuries.
 - Maintain sanitation procedures.
- ❖ Harvest is the beginning of a series of critical operations in the production cycle. All the investment of time, money and energy necessary to grow a crop can be quickly lost from this point on.
- ❖ To avoid significant losses, growers must pick the crop at proper maturity and handle properly. Initial preparations include:
 - Establish the market(s) & know the quality expectations of the buyers.
 - Maintain the cleanliness of picking containers.
 - Set up product transport to and from the field(s).
 - Secure adequate labor for the harvest season.

Harvesting Operations

Challenges to Marketing Fruits, Vegetables & Herbs

- Harvest: when, container,
- Transport to market: time delays
- Pulp temperature
- Food safety & security

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Harvest Management Tips

- Each vegetable has a window of opportunity for harvest. The best way to determine when a vegetable is ready to harvest is from the characteristics of the plant itself.
- While some vegetables are quite forgiving in having a long harvest window, others can go from tender and tasty to tough and bitter overnight.
- For a guide to proper harvest maturity stages & techniques of different vegetables - see



<http://www.motherearthnews.com/crop-guide-growing-organic-vegetables-fruits-zl0z1211zsto.aspx#axzz3KnoGP3v7>

Produce Quality Standards

- ❖ U.S. Grade Standards provide the produce industry with a uniform language for describing the quality & condition of marketed fresh foods – see <http://www.ams.usda.gov/AMSV1.0/ams.fetchTemplateData.do?template=TemplateN&navID=USGradeStandards&rightNav1=USGradeStandards&topNav=&leftNav=&page=FreshGradeStandardsIndex&resultType=&acct=freshgrdcert>
- ❖ Food industry associations and retailers also are developing food grade standards to meet goals for alternative markets; e.g., Whole Foods – see <http://www.wholefoodsmarket.com/about-our-products/quality-standards>
- ❖ Alternative quality standards are being developed for niche markets, e.g., high Brix values – see <http://ohioline.osu.edu/hyg-fact/1000/pdf/1651.pdf>

Produce Quality Standard Example

Stage 1 Green: The tomato surface is completely green. The shade of green may vary from very light to dark. This is the ideal stage for preparing Fried Green Tomatoes, a southern favorite that involves coating seasoned, sliced tomatoes with corn meal, and shallow or pan frying. Tomatoes in this stage must be specified when ordering.

Stage 2 Breakers: There is a definite break of color from green to yellow, pink or red on 10% or less of the tomato surface. Tomatoes are typically shipped at this or the following stage.

Stage 3 Turning: Yellow, pink and/or red color shows on over 10%, but no more than 30% of the tomato surface.

Depending on your purveyor, you may receive fresh, field-grown tomatoes at any of the following stages. With proper handling (never falling below 55° F) and timely usage, you will maximize flavor in every use.

Stage 4 Pink: Pink or red color shows on over 30%, but no more than 60% of the tomato surface. When receiving tomatoes at this stage, hold in dry storage, away from onions, and monitor daily.

Stage 5 Light Red: Pinkish-red or red color shows on over 60%, but red color does not cover more than 90% of the tomato surface. Hold in dry storage, away from onions, and sort to pull out any tomatoes in stage 6. To speed ripening, trap ethylene gas released by tomatoes (see next section). Perfect for QSR tomato slicers.

Stage 6 Red: Red color shows on over 90% of the tomato surface. Perfect for slices and wedges, and ready to serve.



Produce Quality Standard Example

CALIFORNIA TOMATOES

RIPENING STAGES



Green-Stage 1

"Green" means that the surface of the tomato is completely green in color. The shade of green may vary from light to dark.



Breakers-Stage 2

"Breakers" means there is a definite "break" in color from green to tannish-yellow, pink or red on not more than 10% of the surface.



Turning-Stage 3

"Turning" means that more than 10% but not more than 30% of the surface, in the aggregate, shows a definite change in color from green to tannish-yellow, pink, red, or a combination thereof.

Pink-Stage 4

"Pink" means that more than 30% but not more than 60% of the surface, in the aggregate, shows pink or red in color.



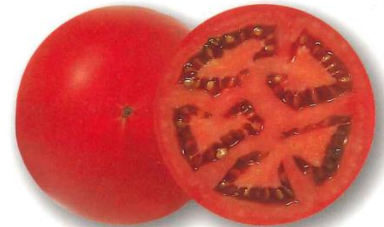
Light Red-Stage 5

"Light red" means that more than 60% of the surface in the aggregate, shows pinkish-red or red, provided that not more than 90% of the surface is red.



Red-Stage 6

"Red" means that more than 90% of the surface, in the aggregate is red.



Harvesting Operations

Minimize Mechanical Injury

Types:

- ***Bruises***

- ***Impact: Drops***

- ***Compression: Excessive pressure***

- ***Harvest temperature***

- ***Cuts, Punctures, Abrasion***

Post Harvesting Operations

Package closure:

- **Stapling into fruit**
- **Over-filling crate**



**Sand abrasion
from dirty harvest bucket**



Loss of Quality Examples



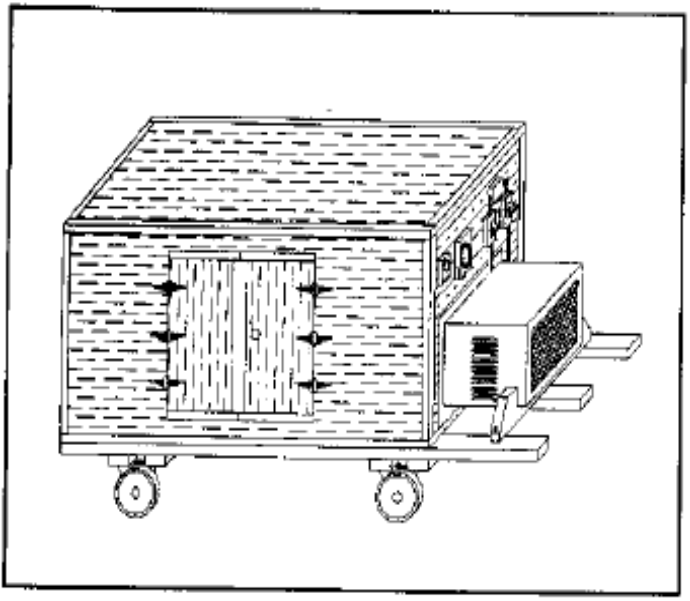
Post-Harvest Handling Basics

- How you handle produce before, during and even minutes after harvesting makes a huge difference to the long term crop quality
- Deterioration factors include temperature, loss of water, physical damage, disease micro-organisms and even natural ripening processes
- Postharvest life and quality can be significantly extended by proper handling and cooling to remove field heat within a couple of hours of harvest.

Post-Harvest Handling Management

- The cooling operation must be at 95% relative humidity to minimize water loss, while not excessively cooling which could cause injury
- Cooling temperature examples
 - Near 32°F – leafy vegetables & most produce
 - Near 50°F - chilling-sensitive crops like pepper, cucumber, squash, and eggplant
 - Near 53°F - tomatoes
- Properly “cure” crops, e.g., onions & potatoes, at 50-90°F, depending on crop
- Do not allow condensation on harvested crops with good air ventilation during storage

Post-Harvest Equipment



- **Portacooler**
 - designed to be transported to the field for harvest
 - <http://www.ams.usda.gov/AMSV1.0/getfile?dDocName=STELDEV3102433>
 - See video at <http://www.youtube.com/watch?v=5Paw1IZqhuk>

- **CoolBot**, a small device that, according to the company's website, turns a window air conditioner into a turbo-charged cooling machine to transform a highly insulated room into a walk-in cooler – see <http://www.storeitcold.com/>

THANK YOU . . .



Equipment/Post Harvest Resources & Referenes

- Agrability Project
 - Assistive Technology - <http://www.agrability.com/index.cfm>
 - Buyer's Guide to Small Farm Utility Vehicles - <http://www.agrability.com/assistivetech/tips/utilityvehicleguide.cfm>
- Armstrong. K. Urban Ag and Beekeeping - <https://www.slideshare.net/MarkMiller185/nadine-armstrong-20160330-urban-agriculture-and-beekeeping>
- ATTRA Publications
 - Alternative Pollinators: Native Bees - <http://attra.ncat.org/attra-pub/nativebee.html>
 - Farmscaping to Enhance Biological Control - <http://attra.ncat.org/attra-pub/farmscape.html>
 - Flame Weeding for Vegetable Crops - <http://attra.ncat.org/attra-pub/flameweedveg.html>
 - Horticultural Crops - <http://www.attra.org/horticultural.html>

Equipment/Post Harvest Resources & Referenes

- ATTRA Publications (cont.)
 - Market Gardening: A Startup Guide - http://extension.oregonstate.edu/sorec/sites/default/files/market_gardening.pdf
 - Season Extension Techniques for Market Gardeners <http://attra.ncat.org/attra-pub/seasonext.html>
- Bees of Florida - <http://chiron.valdosta.edu/jbpcascar/Intro.htm>
- Biorationals: Ecological Pest Management Database http://www.attra.org/attra-pub/biorationals/biorationals_main_srch.php
- Coleman, E. Focus on Tools - https://www.youtube.com/watch?v=wETK-lh4y3A&list=PL5Ygyz09Ed4cecpC15z2tvYAez8gBF_DO&index=3

Urban Ag Equipment/Post Harvest Online Resources

- Energy Farms Network - see <http://www.energyfarms.net/>
- Journey to Forever, Appropriate Technology Agriculture Resources
http://journeytoforever.org/at_linkag.html
- Market Farm Toolbox -
<http://www.marketfarmtoolbox.com/>
- McGregor, S.E., Insect Pollination Of Cultivated Crop Plants
<http://gears.tucson.ars.ag.gov/book/>
- National Ag Safety Database – <http://nasdonline.org/>
- Peet, M. Sustainable Practices for Vegetable Production in the South.
<http://www.cals.ncsu.edu/sustainable/peet/>
- Schonbeck, M. 2011. Utilize Biological Processes to Further Reduce Weed Pressure – see
<http://www.extension.org/pages/18548/utilize-biological-processes-to-further-reduce-weed-pressure>

Urban Ag Equipment/Post Harvest Online Resources

- Small Tractor FAQ - http://www.andrew.cmu.edu/user/kb13/ans_brands.htm
- UC Agriculture Ergonomics Research Center
<http://ag-ergo.ucdavis.edu/>
- UF/IFAS Post Harvest Program - <http://postharvest.ifas.ufl.edu/>
- UF/IFAS/FAMU Small Farm & Alternative Enterprise Program
 - Post harvest handling publications - <http://smallfarms.ifas.ufl.edu/>
- Univ of Missouri Extension, Weeding With Geese
<http://extension.missouri.edu/xplor/agguides/poultry/g08922.htm>
- USDA/SARE Sustainable Soil Management: Building Soils for Better Crops - <http://www.sare.org/Learning-Center/Books/Building-Soils-for-Better-Crops-3rd-Edition>

Urban Ag Equipment/Post Harvest Online Resources

- UF/IFAS EDIS
 - Handling, Cooling and Sanitation Techniques for Maintaining Post Harvest Quality – see <http://edis.ifas.ufl.edu/pdffiles/CV/CV11500.pdf>
 - Pesticide Applications and Equipment Publications - see http://edis.ifas.ufl.edu/TOPIC_Pesticide_Applicators
 - Portable Demonstration Forced-Air Cooler - <http://edis.ifas.ufl.edu/AE096>
 - Protected Ag Information Network – see <http://gcrec.ifas.ufl.edu/faculty/dr-shinsuke-agehara/protected-agriculture-information-network-painet/>
 - Small Farms and Alternative Enterprises – see <http://smallfarms.ifas.ufl.edu/>
- US Dept of Labor Fact Sheet No. OSHA 91-39 “Farm Safety”
http://ehs.okstate.edu/training/OSHA_FARM.HTM
- Xerces Society: Farming for Bees - <http://www.xerces.org/guidelines-farming-for-bees/>

Urban Ag Equipment/Post Harvest Online Video/Podcast Resources

- Biointensive Farming – see <http://growbiointensive.org/>
- Dirksen, K. FarmBot: open source backyard robot for a fully automated garden – see <https://www.youtube.com/watch?v=BqYrAWssrY>
- The NOFAVT. The Market Gardener with Jean-Martin Fortier, Six Figure Farming. 5 Parts – see <https://www.youtube.com/watch?v=0hBUOdv2vn8>
- Youtube Videos
 - City. Secrets to Successful Urban Farming – see <https://www.youtube.com/watch?v=6FVRw6ROkVI>
 - The Urban Farmers Channel – see <https://www.youtube.com/user/urbanfarmercstone>
 - Eliot Coleman Channel – see <https://www.youtube.com/playlist?list=PLgVHK3pelUa5GsnOuP5lHhLUfURKsFEF>
 - Urban Agroecology Channel – see <https://www.youtube.com/playlist?list=PLEdS4pqqZUJGrNh5SZRIw09WjLqSY6okD>

Vertical Farming Online Resources

- Agritecture – see <https://www.agritecture.com/>
- Appropriate Vertical Farming – see <https://brightagrotech.com/technology/>
- Association of Vertical Farming – see <https://vertical-farming.net/>
- Center for Research in Alternative Farming Technologies – see craftagro.com/
- Frazier, I. 2017. The Vertical Farm. – see <https://www.newyorker.com/magazine/2017/01/09/the-vertical-farm>
- Mouser Electronics. Urban Farming – see <https://www.mouser.com/empowering-innovation/smarter-cities/urban-farming>
- Seedstock. 10 Educational Programs Helping to Support the Growth of Indoor Agriculture – see <http://seedstock.com/2016/08/22/10-educational-programs-helping-to-support-the-growth-of-indoor-agriculture/>
- Urban Ag Podcast – see <http://www.microbe.tv/urbanag/>
- Vertical Farming Institute – see <http://www.verticalfarminstitute.org/en/>

Urban Ag/Post Harvest Equipment Vender Resources

- Earth Tools – Walk Behind Tractors & Compatible Implements

<http://www.earthtoolsbcs.com/index.html>

- Cool.bot - <http://www.storeitcold.com/index.php>

- FarmTek - <http://www.farmtek.com/farm/supplies/home>

- Gemplers: Agricultural Sprayers

http://www.gemplers.com/list.aspx?listNo=sprayers&s_kwcid=pesticide%20sprayers|976478065

- Johnny's Select Seeds - <http://www.johnnyseeds.com/>

- Peaceful Valley Farm & Garden Supply: Tools

http://www.groworganic.com/browse_389_Tools.html

- Tiny Farm Gear - <http://gear.tinyfarmblog.com/>

Used Farm Equipment Resources

- Agriculture Equipment Classifieds
 - Florida Farmer & Rancher
<http://www.farmerandrancher.com/>
 - Farm Equipment, Tampa SuperAds
http://www.tampasuperads.com/Farm_Equipment_Classifieds/index.aspx
 - Florida Market Bulletin, FL DACS
<http://www.florida-agriculture.com/fmb/agmachinery.htm>
- Auction Companies
 - Atkinson Auction Co., Lake City, FL
<http://www.atkinsononline.com/cgi-bin/mndetails.cgi?atkinson13>
 - Tampa Machinery Action, Tampa, FL - <http://www.tmauction.com/>
 - Weeks Auction Co., Ocala, FL - <http://www.sunshinefarmersmarket.com/>
- Craigslist - <http://sarasota.craigslist.org/grd/>
- Farm Equipment Dealers in Florida
http://www.business.com/directory/agriculture/equipment_and_supplies/dealerships/florida/
- Florida Farm Link - <http://www.floridafarmlink.org/>
- Rural Ads - <http://www.ruralads.com/>
- Used Farm Equipment & Supplies in FL
<http://www.superpages.com/yellowpages/C-Used+Farm+Equipment+&+Supplies/S-FL/>