

4.7 CSA Harvest and Post-Harvest Handling

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Lecture Outline: CSA Harvest and Post-Harvest Handling of Fruit and Vegetable Crops

A. Importance of Skillful Harvesting and Post-Harvest Handling

1. The influence of harvest and post-harvest handling on the aesthetics, flavor, and texture of produce
2. Crop quality and the success of direct marketing farming businesses. A primary attraction of direct marketing outlets for many consumers is high quality produce. Sound produce harvesting, post-harvest handling, and packaging will preserve the quality of produce, which is critical to the success of any market farm or CSA operation.
3. Post-harvest handling, long-term storage and nutrition
 - a. Post-harvest handling and long-term storage of onions, garlic, winter squash, potatoes, etc.
 - b. The influence of post-harvest handling on the nutrient profile of perishable crops

B. General Pre-Harvest Guidelines: When to Harvest

1. Harvesting crops at peak maturity and quality (see Appendix 1: Handling Information for Fruits and Vegetables, and Appendix 2: Suggested Displays and Storage Groups for Selected Vegetables)
2. Time of day to harvest. Most crops (with the exception of dry storage crops) are best harvested in the cool of the morning to avoid moisture stress at time of harvest and preserve marketability
3. Crop turgor, soil moisture, and irrigation considerations prior to harvest (see Appendix 3: Estimating Soil Moisture by Feel)
 - a. Leafy crops (e.g., lettuce, carrots, beets, spinach, greens, etc.). Soil at 75% of field capacity to assure good turgor pressure and avoid soil compaction due to wet soil. Irrigating 24 hours prior to harvest is often ideal.
 - b. Storage crops (e.g., onions, garlic, potatoes, winter squash, etc.). Soil and crops should be thoroughly dry prior to harvest and storage.

C. Considerations for Individual CSA Harvests

1. Define the amounts needed for each full and half share (see Appendix 4: CSA Harvest Amounts for Full and Half Shares)
2. Define total volume of produce needed for a given harvest for all shares (e.g., 50 bunches of carrots, 150 lbs potatoes, etc.)
3. Estimate yield per length of row (e.g., 200 lbs carrots/100 foot row) to gauge needed crop area to achieve harvest goals (see: seed catalogues for yield/row foot information)
4. Maximize harvest volume by using specific harvesting techniques
 - a. Harvest throughout an entire planting and select for optimal maturity rather than harvesting from one section of a given planting (e.g., sweet corn, tomatoes, fresh beans, cut flowers, summer squash, etc.)
 - b. Harvest certain crops (e.g., carrots) all at once from a mature section, with immature carrots culled or bunched in large quantities

D. Small Group Field Demonstrations

A review of harvesting and post-harvest skills and practices (see Appendix 1, and Appendix 5: Harvest and Post-Harvest Handling Practices) to be done in the field

1. Assessing the maturity and quality of each crop
 - a. Define/describe and provide examples of selection criteria used to determine whether a given crop has reached harvestable maturity

- b. Define how much of a given planting/crop is currently mature
 - c. Define when crop may next be harvested from
 - d. Assess the maturity of subsequent plantings (if available)
2. Tools and techniques used for harvesting each crop
 - a. Demonstrate tool safety and efficiency of use when cutting, pulling, or digging specific crops for harvest
 - b. Discuss and demonstrate harvesting vessels used for each crop
 - c. Demonstrate mechanical harvesting techniques (if available)
 3. Demonstrate and describe the post-harvest handling for each crop (see Appendices 1 and 5)
 - a. Harvest temperature – All crops should be kept cool once harvested by placing in the shade or refrigeration
 - b. Washing – With the exception of onions, garlic, zucchini, summer squash, hard squash, fresh fruit and basil, all crops require washing by either spraying with water or dunking to remove soil and/or reduce “field heat” (see below)
 - c. Removing field heat – The term “field heat” refers to the heat stored in crops from being out in the sun. In harvest and post-harvest handling you want to manage for reducing/ taking out the field heat in your crops to ensure better storability and crop quality.
 - d. Humidity and post-harvest handling
 - e. Post-harvest handling for crop sensitivity to ethylene gas
 - f. Demonstrate, describe post-harvest handling of dry storage crops (e.g., onions, garlic, hard squash, potatoes, etc.)

E. Packing for CSA

1. Common packing sequence for mid to large CSA operations
 - a. Pre-harvest and pack less perishable crops (e.g., tomatoes) and dry crops (e.g., garlic, onions) on the day prior to distribution. Fresh harvest, pack, and distribute highly perishable items on the day of distribution.
2. Packing CSA shares for presentation and post-harvest quality (see Appendix 2 and Appendix 6: CSA Pack—Presentation and Placement of Fresh Fruits and Vegetables)
3. Other forms of CSA pack
 - a. Pack your own: Shareholders select produce from bulk with posted quantity list at pick-up site
 - b. Pick your own: Shareholders harvest their own produce from field with quantity list
 - c. Harvest in bulk: Shareholders divide produce into individual shares and distribute
 - d. Harvest prior to day of distribution and refrigerate

F. Harvest Record Keeping

1. The role of harvest records (see Appendix 7: CSA Harvest Record)
 - a. Soil fertility management and variety trial assessment tool—tracking yields from a given field or crop variety
 - b. Helps to define regional harvest period by recording first and last harvest dates for crops
 - c. National Organic Program standards for tracking produce sales to point of origin
 - d. Tracks quantities of produce per share for use in making adjustments to share size when yields have been previously low or high

- e. Tracks retail value of CSA shares in order make future price adjustments, if necessary

G. Managing a Harvest Crew

1. What is the critical information that a manager must convey to the harvest crew?
 - a. Accurately assessing maturity
 - b. Harvesting tools and techniques
 - c. Efficiency and safety
 - d. Post-harvest handling strategy for each crop
 - e. Packing

Resources

PRINT RESOURCES

Commercial Cooling of Fruits, Vegetables, and Flowers, by James Thompson, et al. University of California, ANR Publications # 21567, 1998. 65p.

Detailed descriptions of proper temperature management for perishables and commercial cooling methods. Complete discussion of design for hydro-cooler and forced-air cooler systems, the two most commonly used cooling methods. 25 graphs and illustrations, 11 color plates, and 15 tables. Available from anrcatalog.ucdavis.edu.

The Commercial Storage of Fruits, Vegetables, and Florist and Nursery Stocks, by Robert Hardenburg et al. USDA Handbook No. 66. United States Department of Agriculture, Agricultural Research Service. 1986. 136 p.

Growing for Market.

Growing for Market is a national monthly newsletter for direct market farmers. Growing for Market is written by growers and covers all topics relating to growing and marketing produce, herbs, and cut flowers. See: www.growingformarket.com

Knott's Handbook for Vegetable Growers, by Donald N. Maynard and George J. Hochmuth. John Wiley and Sons Ltd., 1996.

An excellent growers' reference text with abundant information and charts on yield, harvest, and post-harvest handling of fruits and vegetables for market farmers.

Postharvest Handling and Cooling of Fresh Fruits, Vegetables and Flowers for Small Farms, by L. G. Wilson, M. D. Boyette, and E. A. Estes. Leaflets 800-804. North Carolina Cooperative Extension Service, 1995. 17 p.

Available online at www.foodsafety.org/nc/nc1055.htm.

Produce Handling for Direct Marketing. Natural Resource, Agriculture, and Engineering Service (NRAES), NRAES-51, 1992. 26 p.

For growers selling seasonal produce at farmers' markets and roadside stands. Describes post-harvest physiology, food safety, produce handling from harvest to storage, refrigeration, produce displays, and specific handling recommendations for over 40 fruits and vegetables.

Refrigeration and Controlled Atmosphere Storage for Horticultural Crops. NRAES-22, 1990.

General construction procedures for storage facilities: structural considerations, site selection, thermal insulation, vapor barriers, and attic ventilation. Explanations of various refrigeration systems, with descriptions of equipment and operating procedures. Controlled atmosphere storage construction, testing, and operation, especially in relation to apple storage. See: www.nraes.org.

WEB SITES

Appropriate Technology Transfer to Rural Areas (ATTRA):

attra.ncat.org/attra-pub/postharvest.html

Covers post-harvest practices suitable for small-scale operations, and points out the importance of production and harvesting techniques for improving quality and storability. Various methods for cooling fresh produce are discussed, and resources are listed for further information, equipment, and supplies.

Kansas State University:

www.oznet.ksu.edu/library

This site offers the following publications on post-harvest management of commercial horticultural fruit and vegetable crops including: Containers and Packaging-Fruits and Vegetables; Fruits and Vegetables-Precooling Produce; Harvest Maturity Indicators for Fruits and Vegetables; Storage Conditions: Fruits and Vegetables; Storage Construction; Storage Operations; Storage Options. See: Post-harvest Management for Commercial Horticulture Crops for an excellent 10-page article on post-harvest handling and packing facilities. All available online at www.oznet.ksu.edu/library. Requests for copies may be made at: orderpub@lists.oznet.ksu.edu

North Carolina State University Horticulture

Information Leaflets—Postharvest Handling of Horticultural Crops:

www.ces.ncsu.edu/depts/hort/hil/post-index.html

A five-part series on post-harvest handling and cooling of fresh fruits, vegetables, and flowers for small farms. Covers Quality Maintenance, Cooling, Handling, Mixed Loads, and References.

North Carolina State University also offers a comprehensive listing of fact sheets on crop-specific post-harvest cooling and handling techniques, post-harvest technologies and links to others post-harvest resources: www.bae.ncsu.edu/programs/extension/publicat/postharv/

Sydney Postharvest Lab:
www.postharvest.com.au

This Australian web site offers post-harvest handling and storage information, with extensive links to other post-harvest sites.

University of California, Davis Produce Facts:
postharvest.ucdavis.edu/Produce/ProduceFacts/
Provides separate post-harvest fact sheets for a great variety of fruit, vegetable, and ornamental crops. Each fact sheet includes information about maturity and quality indices, optimum temperature and relative humidity, rates of respiration and ethylene production rates, responses to ethylene and controlled atmospheres, physiological and pathological disorders, their causes and control, and other relevant information.

University of Nebraska, Lincoln Cooperative Extension, Institute of Agriculture and Natural Resources:
ianrpubs.unl.edu/horticulture/
See: Post-harvest Handling of Commercial Vegetable Crops – Resource List. Contains a listing of publications on cooling, transporting, grading vegetables, the USDA standards for vegetable grading, and information on building and operating on-farm packing sheds.

University of Wisconsin:
learningstore.uwex.edu/Care-C279.aspx
The University of Wisconsin has produced a very helpful set of “Work Efficiency Tip Sheets” for fresh-market vegetable growers. These materials were developed by the Healthy Farmers, Healthy Profits Project, with the goal of sharing labor-efficiency practices that maintain farmers’ health and safety while increasing profits. Topics in the series include specialized harvesting equipment.

MANUFACTURERS AND SUPPLIERS OF HARVESTING AND POST-HARVEST HANDLING EQUIPMENT

Note: This list is neither comprehensive nor exclusive. Endorsement of any particular product or company is not implied.

American Vegetable Grower Magazine
Meister Publishing Company
37733 Euclid Avenue
Willoughby, OH 44094
(440) 942-2000

AVG provides coverage of regulatory and labor issues, retailer demands, and production information. The annual “Source Book” issue is a comprehensive listing of manufacturers and suppliers of every type of product for farmers, including post-harvest equipment and supplies.

Barr, Inc.
1423 Planeview Dr.
Oshkosh, WI 54904
(920) 231-1711
www.barrinc.com
Distributor of used coolers, freezers, and refrigeration systems.

Bio Safe Systems
80 Commerce St.
Glastonbury, CT 06033
(888) 273-3088
www.biosafesystems.com
Sells organic-approved, eco-friendly washwater treatments and disinfectants for post-harvest handling of fruit and vegetable crops.

Appendix 1: Handling Information for Fruits and Vegetables

CROP	RELATIVE PERISHABILITY ¹	DESIRABLE HARVEST QUALITY	OPTIMUM STORAGE CONDITIONS		CHILLING ² SENSITIVE?	COMMENTS
			Temp (°F)	Humid (%)		
Beans, Lima	M	Seeds developed and plump with tender green seed coats.	40-45	95	Yes	Sprinkle lightly.
Beans, pole & snap	H	Seeds immature; crisp pods free from blemishes	38-42	95+	Yes	Sprinkle lightly.
Beets	M	Roots firm, deep red, 1.5" to 3" diam.	32	98-100	No	Sprinkle lightly; remove tops.
Broccoli	VH	Green heads, flower buds developed but tight.	32	95+	No	Sprinkle lightly.
Brussels Sprouts	H	Firm sprouts, 1" diameter	32	95+	No	Sprinkle lightly.
Cabbage	M	Crisp, firm, compact heads.	32	95+	No	Sprinkle lightly.
Cantaloupes	M	Stem scar at maturity; skin yellowish tan; sweet, firm flesh with deep color.	38-41	95+	Yes	
Carrots	M	Tender, crisp, sweet roots, deep orange.	32	95+	No	Sprinkle lightly; remove tops; ethylene exposure may cause bitterness.
Cauliflower	VH	Heads with compact, white curds.	32	95+	No	Sprinkle lightly.
Celery	VH	Stalks with crisp and tender petioles; no seed stalks.	32	95+	No	Sprinkle lightly.
Chard & Collards		Leaves fresh, green, young and tender.	32	95+	No	Sprinkle lightly.
Corn, Sweet	VH	Kernels plump, sweet, milky, tender	32	95+	No	Sprinkle or top ice.
Cucumbers		Pickling: (1-4" long), crisp, green. Slicing: (6" long), crisp, green.	50-55	95+	Yes	
Eggplants		Shiny, deep purple skin; seeds immature.	50-55	95+	Yes	Sprinkle lightly

CROP	RELATIVE PERISH-ABILITY ¹	DESIRABLE HARVEST QUALITY	OPTIMUM STORAGE CONDITIONS		CHILLING ² SENSITIVE?	COMMENTS
			Temp (°F)	Humid (%)		
Endive & Escarole	VH	Leaves fresh, crisp, and tender, free from discoloration.	32	95+	No	Sprinkle lightly.
Honeydew Melons	M	Surface waxy, white to creamy white in color; blossom-end springy under moderate pressure; characteristic aroma.	45-50	95+	Yes	
Lettuce	VH	Heads compact and firm, fresh, crisp.	32	95+	No	Sprinkle lightly; ethylene exposure may cause russet spotting.
Mustard & Turnip Greens	H	Leaves tender and crisp; plants without flower stalks.	32	95+	No	Sprinkle lightly.
Onions, Dry	L	Firm bulbs, tight necks, dry leaf scales.	32	65-70	No	
Onions, Green	VH	Crisp, green stalks with long white shanks.	32	95+	No	Sprinkle lightly.
Parsley	VH	Tender, crisp, green leaves.	32	95+	No	Sprinkle lightly.
Peas, English	VH	Seeds developed, but tender and sweet; pods still green.	32	95+	No	Sprinkle lightly.
Peas, Snow/Chinese	VH	Crisp, tender, green pods; seeds immature.	32	95+	No	Sprinkle lightly.
Peppers, Green		Crisp, firm, with shiny appearance.	50	95+	Yes	
Potatoes, Irish	M	Well-shaped tubers free from sunburn and other defects.	55-70	90	Yes	If washed, dry thoroughly.
Potatoes, Sweet	L	Firm, smooth-skinned roots free from growth cracks and other injuries	55	90	Yes	All open surfaces should be well healed.
Pumpkins	L	Hard rinds, good color; heavy.	50-60	60	Yes	
Radishes	M	Firm, crisp roots; red should be bright red, sizes up to 1.25" in diameter.	32	95+	No	Remove tops; sprinkle lightly.
Rutabagas	L	Firm roots with smooth surface.	32	95+	No	Sprinkle lightly.
Spinach	VH	Tender leaves, dark green, fresh, crisp	32	95+	No	Sprinkle lightly.

CROP	RELATIVE PERISH-ABILITY ¹	DESIRABLE HARVEST QUALITY	OPTIMUM STORAGE CONDITIONS		CHILLING ² SENSITIVE?	COMMENTS
			Temp (°F)	Humid (%)		
Squash, Yellow and Zucchini	H	Firm, shiny fruits, 4 to 6" long.	50	95+	Yes	
Squash, Acorn	L	Fruits with hard, dark green skin with small, yellowish-orange areas.	50-60	60	Yes	Trim close, allow to heal.
Squash, Butternut	L	Fruits with hard, cream-colored skin.	50-60	60	Yes	Trim close, allow to heal.
Strawberries	VH	Berries firm, plump and red.	32	95+	No	
Tomatoes, Green	H	Solid fruit with light green color, mature seeds, and locular jelly.	70	95+	Yes	
Tomatoes, Ripe	VH	Solid fruits with uniform pink or red.	50-70	95+	Yes	Avoid storage below 50°F.
Turnips	M	Firm, heavy roots with good color.	32	95+	No	Remove tops; sprinkle lightly.
Watermelons, Whole	L	Mature with good flesh color; flesh sweet and crisp.	>55	80-90	Yes	Trim stems close to fruit and allow to heal.
Watermelons, Sliced (overwrap slices for protection)	H	Mature with good flesh color; flesh sweet and crisp.	32	95+		

¹Relative perishability under good storage conditions: L = Low, M = Moderate, H = High, VH = Very High.

²Chilling-sensitive crops should not be stored below their optimum temperature.

Adapted from Family Farm Series Publications: Marketing for the Small Farmer: Direct Marketing and Quality Control. Used by permission of the University of California Small Farm Center - 5/20/04

Appendix 2: Suggested Display and Storage Groups for Selected Vegetables

Crops within a group are compatible with respect to temperature, humidity, and ethylene sensitivity or production

GROUP 1.

TEMPERATURE = 32°, RELATIVE HUMIDITY = 90-95%, ETHYLENE SENSITIVE OR LOW ETHYLENE PRODUCING

Beets	Cauliflower	Kohlrabi	Radishes
Broccoli	Celery	Lettuce, All Types	Rutabagas
Brussels Sprouts	Swiss Chard	Mustard & Turnip Greens	Spinach, All Types
Cabbage	Collards	Green Onions	Strawberries
Chinese Cabbage	Sweet Corn	Parsley	Turnips
Carrots	Endive & Escarole	Peas, All Types	Sliced Watermelons

GROUP 2.

TEMPERATURE = 32°, RELATIVE HUMIDITY = 65-70%, LOW ETHYLENE PRODUCING

Dry Onions

GROUP 3.

TEMPERATURE = 50°, RELATIVE HUMIDITY = 90-95%, CHILLING AND ETHYLENE SENSITIVE CROPS

Beans, All Types	Eggplants	Peppers	Zucchini Squash
Cucumbers	Okra	Yellow Squash	

GROUP 4.

TEMPERATURE = 50°, RELATIVE HUMIDITY = 90-95%, CHILLING SENSITIVE CROPS THAT PRODUCE ETHYLENE

Honeydew Melons	Muskmelons	Ripe Tomatoes
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GROUP 5.

TEMPERATURE = 70°, RELATIVE HUMIDITY = 60-80%, CROPS THAT ARE TOLERANT TO HIGHER TEMPERATURES

Irish Potatoes	Sweet Potatoes	Mature Green Tomatoes	Watermelons
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GROUP 6.

TEMPERATURE = 70°, RELATIVE HUMIDITY = 60-80%, CROPS TOLERANT TO HIGHER TEMPERATURES AND LOWER HUMIDITIES

Dry Onions	Pumpkins	Acorn & Butternut Squash	Watermelons
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Appendix 3: Estimating Soil Moisture by Feel

SOIL MOISTURE LEVEL	HOW SOIL FEELS OR LOOKS			
	COARSE (sand)	LIGHT (loamy sand, sandy loam)	MEDIUM (fine, sandy loam, silt loam)	HEAVY (clay loam, clay)
0-25% No available soil moisture. Plants wilt. Irrigation required. (1st range)	Dry, loose, single grained, flows through fingers. No stain or smear on fingers.	Dry, loose, clods easily crushed and will flow through fingers. No stain or smear on fingers.	Crumbly, dry, powdery, will barely maintain shape. Clods, breaks down easily. May leave slight smear or stain when worked with hands or fingers.	Hard, firm baked, cracked. Usually too stiff or tough to work or ribbon (1) by squeezing between thumb or forefinger. May leave slight smear or stain.
25-50% Moisture is available, but level is low. Irrigation needed. (2nd range)	Appears dry; will not retain shape when squeezed in hand.	Appears dry; may tend to make a cast when squeezed in hand, but seldom will hold together.	May form a weak ball (2) under pressure but will still be crumbly. Color is pale with no obvious moisture.	Pliable, forms a ball; will ribbon but usually breaks or is crumbly. May leave slight stain or smear.
50-75% Moisture is available. Level is high. Irrigation not yet needed. (3rd range)	Color is darkened with obvious moisture. Soil may stick together in very weak cast or ball.	Color is darkened with obvious moisture. Soil forms weak ball or cast under pressure. Slight finger stain, but no ribbon when squeezed between thumb and forefinger.	Color is darkened from obvious moisture. Forms a ball. Works easily, clods are soft with mellow feel. Will stain finger and have slick feel when squeezed.	Color is darkened with obvious moisture. Forms good ball. Ribbons easily, has slick feel. Leaves stain on fingers.
75% to field capacity (100%) Soil moisture level following an irrigation. (4th range)	Appears and feels moist. Color is darkened. May form weak cast or ball. Will leave wet outline or slight smear on hand.	Appears and feels moist. Color is darkened. Forms cast or ball. Will not ribbon, but will show smear or stain and leave wet outline on hand.	Appears and feels moist. Color is darkened. Has a smooth, mellow feel. Forms ball and will ribbon when squeezed. Stains and smears. Leaves wet outline on hand.	Color is darkened. Appears moist; may feel sticky. Ribbons out easily, smears and stains hand, leaves wet outline. Forms good ball.

(1) Ribbon is formed by squeezing and working soil between thumb and forefinger.

(2) Cast or ball is formed by squeezing soil in hand.

Appendix 4: CSA Harvest Amounts for Full and Half Shares

	HALF SHARES	FULL SHARES
Apples	2-4 each	4-6 each
Basil	1 plant each	2 plants each
Beans	1 pound	2 pounds
Beets	3-4/bunch	5-6/bunch
Broccoli	1 head	2 heads
Bunch Onions	6-8/bunch	12-14/bunch
Cabbage	1 or 1 small	2 or 1 large
Carrots	6/bunch	10/bunch
Chard	6-7 leaves/bunch	12 leaves/bunch
Cilantro	1 small bunch	large bunch
Corn	3 ears	6 ears
Cucumbers	1-2 of each var.	2-4 of each var.
Dill	1 small bunch	large bunch
Eggplant	2-4 each	4-6 each
Fennel	1 each	2 each
Garlic	1 bulb	2 bulbs
Green Garlic	3/bunch	5/bunch
Kale	6-8 leaves/bunch	12-16 leaves/bunch
Kohlrabi	2 each	4 each
Leeks	3/bunch	5/bunch
Lettuce	1 head	2 heads
Melons	1 ea. or 1 small	2 ea. or 1 large
Onions	1 each	2 each
Pears	2-3 each	4-5 each
Peppers/sweet	2 each	4 each
Peppers/hot	2 each	4 each
Plums	4-5 each	6-10 each
Potatoes	1 1/2 - 2 pounds	3-4 pounds
Pumpkins	1 each	2 each
Radish	4/bunch	6-8/bunch
Salad Mix	1/4-1/2 pounds	1/2-1 pounds
Spinach	3/bunch	5/bunch
Squash	2 each	4 each
Strawberries	1 basket	2 baskets
Tomatoes	2 pounds	4 pounds
Watermelon	1 or 1 small	2 or 1 large
Winter Squash	1-2 each	2-4 each
Zucchini	1-2 each	2-4 each

Appendix 5: Harvest and Post-Harvest Handling Practices

Adapted from UC Davis Small Farm Center; used by permission

When do you harvest?

- o Harvesting at optimum maturity is key. Crops that are immature lose water rapidly and don't store well, in addition to not tasting their best. Crops that are over-mature can be tough and starchy, like beans and corn, or too soft and easily damaged, like plums. Both immature and mature crops are subject to decay.
- o Harvesting during the coolest part of the day is important because high temperatures lead to deterioration in highly perishable crops. The term "field heat" refers to the heat stored in crops from being out in the sun. In harvest and post-harvest handling you want to manage for reducing/taking out the field heat in your crops.
- o Harvesting when foliage has dried can be important to minimize the spread of some diseases.

How to harvest?

- o It's critical to handle produce gently. Fingernails can easily cut into crops like summer squash and zucchini, which leads to deterioration. The more steps in the harvest handling, the more cuts, bruising, and abrasions that can occur. Decay and shriveling (water loss) result on damaged produce. It's best to eliminate as many steps as possible between harvesting and getting your produce to your members.
- o Keep harvest containers clean—to minimize spread of disease you can use water containing 70ppm chlorine to rinse containers. Plastic containers are easier to clean than wooden ones.
- o Load harvest containers wisely—don't overpack, this causes bruising. Especially with soft fruit and vegetables like plums, tomatoes, summer squash, stack only two layers high.
- o Use sharp tools—this will make your harvesting much easier and faster, especially with crops like salad mix, broccoli, and lettuce.
- o Keep produce out of the sun as you harvest—Try to place boxes of harvested produce in the shade as you work—this will minimize wilting and heating of the produce which leads to deterioration.
- o Make sure to transport harvest produce gently, whether it's in wheelbarrows, carrying boxes, or driving a truck—avoid vibrations that can cause considerable damage to produce.

POST-HARVEST HANDLING

In from the harvest—what now?

- o The first thing is to get the field heat out of your harvested crop and/or to re-hydrate. How this is done depends on the crop. Leafy greens are usually dunked in water; broccoli is often packed with ice for wholesale—but for CSA, dunking in cold water works fine; carrots and beets are hosed down or put through a root washer. Some crops like potatoes store better if they're not washed but stored in a cool, dry place. Garlic, onions, strawberries, and basil are typical crops that should not be washed or they will deteriorate; rather, they should be stored in a cool, dry place. Basil's roots can be soaked in water or wrapped in wet newspaper to retain freshness.

Temperature

- o Controlling temperature is the most important thing you can do to slow deterioration and to maintain quality. High temperatures increase decay through water loss. Low temperatures cause chilling injury such as decay, discoloration, loss of flavor.
- o See Appendix 1 of this unit and www.sfc.ucdavis.edu/Pubs/Family_Farm_Series/Marketing/directmk-qual.html for a list of ideal temperature ranges for produce storage.

Humidity

- o Maintaining a humid or moist environment is important for many crops because water loss will cause wilting and shriveling. Misting produce with fresh water can help retain freshness—this can be done during the post-harvest phase, before the product gets to the consumer, at farmers' markets stands, and CSA pick-up sites. Make sure not to mist crops like strawberries, tomatoes, garlic, onions, etc., as a moist environment for these crops will hasten decay and deterioration. Trimming tops of carrots helps reduce water loss and using plastic packaging for crops like salad mix can provide a moist environment and ensure high quality.
- o See Appendix 1 of this unit and www.sfc.ucdavis.edu/Pubs/Family_Farm_Series/Marketing/directmk-qual.html for a list of ideal humidity levels.

Packing

- o Packing shed design can be a critical component in any farming operation. Small to mid-size CSA farms will often pack the day of harvest. The boxes are laid out and packed as the crops come in and are washed. Larger CSA farms will harvest the day before distribution and packing is more of an assembly-line. Some use a conveyor belt—one person places the box on at the start, while others fill the box as it passes by, and finally one person packs the boxes into a refrigerated truck at the end of the line.
- o Things to think about for the ideal packing shed are –
 - equipment: wash tubs, screens, containers, etc.
 - drainage
 - flooring—you don't want to slosh around in mud while you're post-harvest handling and packing your produce
 - shade—keeping the produce out of the sun is critical
 - flow of packing
 - Once you've washed, sorted, and graded your produce and it's time to pack for CSA, farmers' market, etc., make sure not to overpack or underpack your containers, as both can cause unnecessary injury to produce. Make sure to use clean containers to avoid disease and use the containers that are not damaged. Your stack of freshly harvested pears in the cooler won't look so great if even one box has damaged corners. Also make sure that your containers are well ventilated.

Storage

- o Correct temperature and humidity levels are critical. See Appendix 1 for information.
- o Ethylene gas—often used to ripen produce in larger operations—is dangerous when it causes unwanted ripening. For example, if you want to store kiwis until June, make sure that they are harvested into plastic bags tied tightly and placed in boxes. If one box rots, the ethylene gas released won't affect the other kiwis in the cooler. Make sure to not store ethylene sensitive and ethylene producing crops in the same place.
See: www.oznet.ksu.edu/library/hort2/MF1033.pdf for a list of ethylene sensitive and ethylene producing crops.

Appendix 6: CSA Pack—Presentation and Placement

CROP	PRESENTATION	IDEAL PLACEMENT IN BOX
Apples	Loose or Brown Bagged	Bottom
Basil	Bunched	Top
Beans	Plastic Bagged	Middle
Beets	Bunched	Bottom
Broccoli	Loose	Bottom
BunchOnions	Bunched	Middle/Bottom
Cabbage	Loose	Bottom
Carrots	Bunched or Loose	Bottom
Chard	Bunched	Top
Cilantro	Bunched	Top
Corn	Loose	Bottom
Cucumbers	Loose	Bottom
Dill	Bunched	Top
Eggplant	Loose	Bottom/Middle
Fennel	Loose	Middle/Bottom
Garlic	Loose	Middle/Bottom
G.Garlic	Loose or Bunched	Middle/Bottom
Kale	Bunched	Top
Kohlrabi	Loose	Bottom
Leeks	Loose or Bunched	Middle
Lettuce	Loose or Twist Tied	Middle/Top
Melons	Loose	Bottom
Onions	Loose	Bottom
Pears	Brown Bagged	Middle/Bottom
Peppers/sw.	Loose	Middle/Bottom
Peppers/hot	In Potato Bag	Middle/Bottom
Plums	Brown Bagged	Middle
Potatoes	Brown Bagged	Bottom
Pumpkins	Loose	Bottom
Radish	Bunched	Bottom/Middle
Salad Mix	Plastic Bagged	Top
Spinach	Bunched or Plastic Bag	Top
S. Squash	Loose	Bottom
Strawberries	Basket	Top
Tomatoes	Brown Bagged	Middle
Watermelon	Loose	Bottom
W.Squash	Loose	Bottom
Zucchini	Loose	Bottom

Appendix 7: CSA Harvest Record

Harvest Week:

Date:

Total number of shares:

CROP/VARIETY	FIELD	TOTAL YIELD	FULL SHARE	HALF SHARE	SURPLUS	PRICE(FULL)	PRICE (HALF)
Apples:							
Apples:							
Apples:							
Basil							
Beans: Blue Lake							
Beans: Yellow Wax							
Beets							
Broccoli							
Bunching Onions							
Cabbage: Savoy							
Cabbage: Red							
Cabbage: Arrowhead							
Carrots: Nelson							
Carrots: SugarSnax							
Chard							
Cilantro							
Collards							
Corn							
Cucumber: Marketmore							
Cucumber: Lemon							
Dill							
Garlic							
Kale							
Kohlrabi							
Leeks							
Lettuce:							
Lettuce:							
Lettuce:							

CROP/VARIETY	FIELD	TOTAL YIELD	FULL SHARE	HALF SHARE	SURPLUS	PRICE(FULL)	PRICE (HALF)
Lettuce:							
Melons:							
Melons:							
Onion							
Parsley							
Parsnips							
Peppers:							
Peppers:							
Peppers:							
Plums:							
Plums:							
Plums:							
Plums:							
Plums:							
Potatoes:							
Radish:							
Salad Mix							
Squash: Zephyr							
Squash: Raven							
Squash: Gold Rush							
Squash: Magda							
Squash: Revenue							
Tomatoes							
Other:							
PRICE PER BOX:							
TOTAL HARVEST VALUE:							