Salad Crops & Greens Crops (“Leafy”)

- **Lettuce**
  - *Lactuca sativa*
- **Spinach**
  - *Spinacia oleracea*
- **New Zealand Spinach**
  - *Tetragonia tetragonioides*
- **Collards & Kale**
  - *Brassica oleracea* Acephala group
- **Mustard Greens**
  - *Brassica juncea*, other *Brassica* sp.
- **Turnip Greens**
  - *Brassica rapa* Rapifera group
- **Swiss Chard**
  - *Beta vulgaris* Cicla group
- **Endive, Escarole, Anugula, Cilantro, Radicchio, Dandelions, Chicory, Parsley**

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**Lettuce**

- Family: Compositae
- Self-pollinated annual (all varieties are self-pollinated inbreds, “OP”)
- Generally considered a cool season crop
  - < 85°F Optimum: 70°F day, 50°F night
- Cultivated Types:
  - Crisphead/Iceberg (*L. sativa* var. capitata)
  - Butterhead/Boston/Bibb (*L. sativa* var. capitata)
  - Cos/Romaine (*L. sativa* var. longifolia)
  - Looseleaf/Leaf (*L. sativa* var crispa)
  - Batavia – Intermediate between crisphead and butterhead (‘loose-head’)

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**Crisphead**

- Most popular type in the US
- Tolerate shipping and handling better than other types
- California & Arizona produce most of the lettuce in US
Butterhead
- Semi-heading
- Veins, midrib and stem not as prominent as in crisphead types
- Considered better quality than crisphead
- Susceptible to bruising and tearing
- 'Boston' type larger and lighter green than 'Bibb' type

Cos - Romaine
- Long narrow leaves, upright growth and loose head
- More tolerant of extreme weather conditions than crisphead or butterhead
- Not as tolerant to shipping/handling as crisphead, but better than butterhead

Looseleaf – Leaf - Bunching
- Forms rosette of leaves, not a head
- Variable color, texture and shape
- Generally more tolerant of environmental extremes than any of the heading types – easiest to grow
- Leaves bruise easily and has short shelf-life – not adapted for long-distance shipping
Plant Growth & Development - Seed

- Seed is a dried fruit (achene)
  - Outer layer is the pericarp (ovary wall) surrounding the seed coat, endosperm and embryo
  - At maturity, the endosperm is generally used up
- Lettuce seed usually has dormancy (up to several months, determined by genetics)
- Germination can be inhibited by high temperatures
  - Degree dependent on genetics
  - Related to seed coat or endosperm
    - When removed there is no inhibition

- Visible light required for germination
  - Degree dependent on genetics
  - Phytochrome in the embryo can be converted to germination promoter (under visible light) or germination inhibitor (under far-red wavelengths) – reversible process
- Chemicals (plant hormones) are sometimes used to treat seed to overcome high temperature and light requirements to avoid induced dormancy problems

Plant Growth & Development - Vegetative

- Lettuce growth rates greatly influenced by temperature
  - High temperatures = faster growth rates
  - High temperatures = bitterness
- If heading is initiated prematurely because of high temperatures, smaller head sizes and poor quality will result
  - Genetics have influenced this for fall production in Arizona
Plant Growth & Development - Reproductive

• Lettuce is a “long-day” plant
  – Photoperiod >12 hour of light required for flowering (exact duration determined by genetics)
• Premature flower initiation (bolting) can happen under high temperatures and long days:
  – Plants reach vegetative maturity quickly because of high temperatures, and flower because of long days

Crop Establishment

• Primary method: Direct seeding
  – Requires thinning, although precision planting with pelleted seed is reducing the need
• Transplants used in areas where optimal growing season is short (usually due to high temperatures)

Crop Establishment

• Direct seeded fields are overhead irrigated to maximize soil contact of shallow planted seed and initiate germination
Crop Establishment

• Once crop is established, furrow irrigation is the most common practice

Crop Establishment - Spacing

• Plant spacing is critical for optimum yields of quality produce
• Crispheads are typically spaced at exactly 11” by commercial growers today, but genetics play an important role
  – Close spacing delays maturity but reduces chances of premature bolting
  – Doubles may not head at all
• Optimum yields of the other types typically occurs with closer spacing

Weed Control

• Weed removal critical for quality crop
• Only effective chemical controls are pre-plant herbicides (must apply before planting)
• Hand-weeding still sometimes practiced, but very expensive (> $100/acre, depending on weed pressure)
Diseases

• Lettuce Drop
  – Sclerotinia sclerotiorum
• Widespread disease organism
• Creates survival structures (sclerotia) that can survive for a long time under adverse conditions

Diseases

• Lettuce Big Vein Virus
  – Virus transmitted by soil fungus

Diseases

• Lettuce Mosaic Virus
  – Transmitted by aphids, but primary inoculum is infected seeds
  – Seed companies go to great lengths to produce LMV-Free seed
  • Grow seed crop in isolation where LMV is currently not found, being certain to use LMV-free seed
Physiological Disorders

- **Tipburn**
  - Brown spots along the outer margins
  - Related to calcium (like blossom end rot), because calcium in leaves is abnormally low, even though soil levels may be high
- **Premature bolting**
  - Factors previously mentioned
  - Just the initiation of flowering can reduce quality
  - Genetics can play a strong role

Harvest & Postharvest Handling

- Hand harvested and field packed
- Usually once-over harvest
- Commercial crop vacuum cooled to 32-34°F and high humidity
- Shelf-life of crisphead types is 3-4 weeks @ 32°F
  - At 37°F, shelf-life decreases approximately 50%
  - Freezing injury occurs at 31.7°F
  - Looseleaf types respire at about twice the rate of heading types, so shelf-life is reduced proportionately
  - Sensitive to ethylene
    - Exposure causes russet spotting

Mesclun Mix Greens

- Blend of greens combined for their variety of textures, flavors and colors grown and sold together
- May include various types of lettuces with other types of greens
Leafy Vegetable Greens

- Other than Lettuce
- Most are cool season crops
  - Best quality when grown in cool environment
  - Exceptions:
    - New Zealand Spinach (warm season)
    - Swiss Chard: cool season, but doesn’t lose quality as much in warmer environment

Spinach

- Spinacia oleracea - Chenopodiaceae family
- Center of Origin: Central Asia
- The only commercially important Leafy Vegetable Green
- Dioecious
  - Two types of males: vegetative males & extreme males
  - Extreme males are small plants that flower quickly
  - Vegetative males and females are more productive
  - Breeding has eliminated extreme male genetics from current varieties
- Cool season annual
  - Temperatures as low as 20°F, but optimum = 60°-65°F
  - Flowers in response to temperature (cool→warm, but not considered a biennial) & photoperiod (long-day: 12-15 hour depending on genetics)

Crop Establishment

- All commercial production is direct seeded in the field
- Seed germinates at relatively low temperatures. Optimum: 45-75°F
- Fresh market crop is sometimes thinned
- Processing crop is planted to stand, often drilled in rows 5 – 20 inches apart
- Typical plant spacing is 3”
  - Too close and the stems grow too long
Weed Control

• Much of crop is machine harvested, so weed control is critical
  – No one wants weed in their canned spinach!
• No good chemical for broadleaf weeds, so cultivation has been the norm
  – But because spinach is a “quick” crop (40-50 days), using a clean field with grass herbicides and one cultivation is usually effective

Spinach Types

- Savoy Leaf
  - Fresh
- Smooth Leaf
  - Processed

Harvesting

• Ready for harvest when big enough to eat
  – “baby” spinach
• Processing crop tends to be harvested at maximum size, before yellowing or deterioration
• Multiple harvest possible even with machine harvest
• Must be harvested prior to bolting – loss in quality
• Long-standing cultivars: resist bolting, and “stand” in the field for a longer period of time
Postharvest

- Highly perishable
  - Shelf-life 10-14 days at 32°F and 95-100% RH
- Controlled atmospheres of 10-40% CO₂ and 10% O₂ reduce yellowing and improve quality
- Usually packed in bags to maintain environment and prevent wilting

New Zealand Spinach

- Not a true “Spinach”
- Tetragonia tetragoniodes
- Looks like spinach, consumed like spinach, but much more heat tolerant, not very frost tolerant
- Large spreading plant 3-4’ across, 1-2’ tall
- Require wide spacing between plants (12-24” plant spacing, 36” row spacing)

Crucifer Crops as Greens
Collards & Kale

- *Brassica oleracea* Acephala group
- Non-heading cabbage
  - Collards have smooth leaves
  - Kale has curled, savoy leaves
- Collards in particular are much more tolerant of temperature extremes than cabbage (esp. warmer temperatures), but still do best as a cool season crop.
- Both are biennials
- Multiple harvests are made by cutting single leaves without damaging the growing point

Mustard Greens

- May be multiple *Brassica* species, but leaf mustard is *B. juncea*
- Spinach mustard is *B. rapa* (Perviridis group)
- Resemble spinach in growth habit and culture
- All are members of Crucifereae, and are cool season biennials (or pseudo-biennials)
Mustard Greens

- Leaf mustard (B. juncea)
  AKA India mustard
  - Gets spicy hot if grown under stress or in hot weather
  - Taste is milder after cooking
- Spinach mustard (B. rapa) accumulates less spice under warm conditions
- Both are susceptible to bolting, especially in spring (warm weather following cool periods)

Turnip Greens

- *Brassica rapa* Rapifera group
  - Same as Turnip grown for roots
  - Some cultivars don’t have the typical enlarged root of turnips – genetics
- Cool season biennial
- Multiple harvests are made by cutting single leaves without damaging the growing point

Pests

- Same as for other Crucifer crops
- Worms & other leaf eaters
Swiss Chard

- Beta vulgaris Cicla group
- Chenopodiaceae Family
- Same species as beets grown for enlarged root
- Cool season biennial, but will tolerate warm temperatures

Swiss Chard

- Harvest single leaves without damaging the growing point for multiple harvests
- Leaf stalks may be consumed separately from the leaves
- Leaf stalks may be white, green or red with variations between these colors

Other Leafy Crops

Salad type

- Endive & Escarole (Cichorium endivia) Compositae Family
  - Endive: Curled, fine-cut, fringed leaves
  - Escarole: Broad leaf selection of endive
- Chicory (Cichorium intybus) Compositae Family
  - Roots may be roasted and ground and used as coffee additive or substitute
  - Radicchio is type of chicory used as salad additive or sometimes cooked
  - Strong flavor
Other Leafy Crops - Salad/Herb Type

- Parsley (*Petroselinum crispum*)
  - Umbelliferae Family
  - Biennial, grown as an annual
  - 2 types:
    - Curly-leaf type
    - Used for leaves
    - Italian (Flat Leaf)
    - Leaves and fleshy roots

- Coriander, Cilantro (*Coriandrum sativum*)
  - Umbelliferae Family
  - Coriander: seeds used as spice
  - Cilantro: Leaves used as spice