Bulb Crops

- Alliaceae Family
- *Allium* sp.
  - Onion (*A. cepa*)
  - Garlic (*A. sativum*)
  - Leek (*A. ampeloprasum*)
  - Chives (*A. schoenoprasum*)
- Hardy, cool season crops
- Biennials or Perennials
- All have onion-like pungency

Onion

- *Allium cepa*
- Native to Southwest Asia, including Afghanistan, Iran, Southwest China
- Very old crop
  - Records date to at least 3200 B.C.
- Mostly used as flavoring agents, but still have a high per capita consumption
  - US per capita consumption:
    - 1976 = 11.8 lbs.
    - 1996 = 18.7 lbs

Onion Industry

- Grown and marketed as two types:
  - Dry onions (bulb)
  - Green bunching onions
- Majority of onions in US are dry, but world-wide, both types about equal
- Dry onions are marketed either fresh (with or without storage) or processed (dehydrated or frozen)
- Production Value in U.S. ~$650 Million (1997)
- U.S. accounts for ~7% of world-wide production
Onion Types

- Long day types:
  - Require "long" daylength to initiate bulb formation
  - Generally more than 14 hours
  - Typically planted in the spring in the north for a fall harvest
- Short day types:
  - Require "shorter" daylength to initiate bulb formation
  - Generally more than 11-1/2/12 hours
  - Typically planted in the fall in the south for a spring harvest
- Intermediate types:
  - Fall in between long day and short day types
  - Generally require ~13 hours of daylength

Onion Types

- American or Domestic:
  - Comprise ~75% of U.S. production
  - Pungent bulbs, 2-3" diameter, very good storage
- European or Foreign:
  - Bermuda types
    - Large, sweet, mild-tasting, adapted to southern latitudes
    - Includes Grano-Granex sub-type
    - Texas 1015, Vidalia, Maui, Walla Walla
  - Spanish types
    - Large, round, mild, adapted to more northern latitudes

Plant Growth & Development

- The first leaves emerge from a cavity at the base of the cotyledon
- Leaves are hollow, tubular structures that emerge from inside the previous leaf
- Stem is a plate-like structure during the vegetative phase
Plant Growth & Development - Bulbing

• Bulbs are concentric, swollen leaf bases arising from the stem
  – During early stages of development, the leaf bases form a slender cylinder
  – When initiated (proper daylength), the inner leaf bases swell, forming the bulb, while the outer leaf bases remain thin, eventually becoming dry and papery, forming a protective layer as the bulbs mature

Bulbing (cont.)

• Once the critical photoperiod for bulb initiation is reached, further increases in photoperiod will hasten bulbing
• Bulbing is not affected by plant age
• Once bulbing is initiated, the plant will not create new leaves
  – Must have proper leaf development prior to bulbing
• Generally, warmer temperatures favor bulbing (50-80°F)
• Cold temperatures (<25°F) will inhibit bulbing

Bulbing (cont.)

• A fully mature bulb remains in a rest period for about 6-8 weeks
• After this rest period, growth may be either vegetative, forming a new bulb, or reproductive
• Reproductive growth will result if the bulb has been vernalized by temperatures below 40-50°F for ~1 week (depending on the variety)
Flowering

- Onions flower in response to vernalization, regardless of photoperiod or bulbing
  - Generally, 45°F for 1 week will vernalize onion
  - Temperatures and plant size interact to determine flower initiation
    - Plants with 4 leaves can be vernalized, but may require cooler temperatures or longer time than older plants or mature bulbs
- During floral initiation, the stem plate elongates and forms an umbel with up to 2000 flowers
- Plants grown from seed usually produce one seed stem
- Plants grown from bulbs may produce several seed stems since they may have more lateral buds

Climatic & Cultural Requirements

- Temperature range: 45-85°F
- Optimum temperature range: 55-75°F
  - Best when cool during early development and warmer during bulbing
- Frost tolerant to at least 28°F
- Must plant according to daylengths:
  - If photoperiod is not long enough during bulbing, poor bulb formation will result
  - If photoperiod is long enough to initiate bulbing very early in development, small bulbs will result
- Requires high fertility – limited root system
  - Often planted on muck soils

Planting & Crop Establishment

- Three methods:
  - Direct seeding
  - Transplants
  - Planting sets
    - Transplants & sets are used when timing is critical
- Commercially, most onions are produced from direct seeding, but some commercial growers use transplants for dry onions and sets for bunching onions
- Home gardeners often use transplants & sets because of time to maturity
Cultural Practices

• Onions do not compete with weeds
  – Slow growth, shallow root system, and lack of dense foliage
  – Rely on chemical weed control
    • Easy to damage shallow root system with cultivation
• Onions require a fairly constant moisture supply
  – Shallow root system
  – Muck soils can produce a crop without irrigation, but mineral soils will almost always require irrigation

Harvesting

• Dry bulbs should be harvested when the bulbs are mature and the tops are dry
• Usually can’t wait for complete drying:
  – Under warm conditions (Spring harvest in the South), usually harvest when about 25-50% of the tops are down
  – Under cool conditions (Fall harvest in North), usually harvest when at least 50% of the tops are down

Harvest & Postharvest

• To hasten drying, some growers will undercut the rows with a blade or roll the tops when ~10% have fallen
• Harvesting is done by lifting the bulbs and cutting the tops about 1-2” above the neck by machine or by hand
• Bulbs are then cured, either by leaving in windrows in the field for 2-3 weeks, or in bins which may be taken to a shed with forced air at 85-90°F
• Bulbs for long term storage may have their tops left on
• Optimum storage of dry onions is best at 32°F and 65-70% RH
Harvest & Postharvest

- Onion bulbs are dormant for 6-8 weeks, so any long-term storage requires treatment with a sprout inhibitor
- Maleic hydrazide is sprayed on the foliage 1-2 weeks before harvest, when the tops are still green, but not too early (can cause soft bulbs)
- Long day onions can usually store for up to 8 months
  - Long day onions are typically more pungent & have high dry matter
- Short day onions will usually not store for more than 2 months
  - Short day onions are typically mild with less dry matter

Harvesting

- Green bunching onions are undercut with a blade and hand harvested, removing the discolored outer skin and tied in bunches
- Size may be from pencil size until just before bulbing
- Green onions are highly perishable and will store for 3-4 weeks at 32°F

Health Benefits

- Source of vitamin C, calcium, iron and vitamin A
- Flavanoids
  - Quercitin: acts as an antioxidant
  - Higher in colored onions
    - Red > Yellow > White
- Volatile sulfur compounds
  - Allyl-propyl-disulfide: give onions their pungency
    - Thought to reduce risks of heart disease and cancer
    - Acts as an anti-inflammatory, may lower blood pressure
  - Higher in pungent onions
Unusual Onions

- Multiplier onion (potato onion)
  - *A. cepa*, Aggregatum group
  - Produces compound bulbs that can be divided
  - Each bulb produces 6-12 plants
- Egyptian onion (tree onion)
  - *A. cepa*, Proliferum group
  - Produces bulblets at the top of stalks instead of flowering
- Both types used to produce bunching onions from sets

Garlic

- *Allium sativum*
- Perennial, grown as an annual
- Produces small compound bulblets called cloves
- Per capita consumption in US:
  - 1976: 0.5 lbs
  - 1996: 2.1 lbs
- Variable production in US: 3,000 to 15,000 acres

Plant Growth & Development

- Leaves have solid, thin blades compared to onion
- The inner leaf has a thickened base and makes up most of the total mass of the clove
- Bulbing occurs in response to increasing photoperiod and increasing temperature up to 77°F
- Will not bulb under short days
Climatic Requirements, Planting & Culture

• Garlic is a cool-season crop similar to onion
• Usually planted in winter for a late spring or summer harvest
• Propagated by planting cloves
  – Cloves should be exposed to cool temperatures (40-50°F) for several months prior to planting
  – Cloves should not be separated until just prior to planting because whole bulbs store better
• Fertilization & cultural practices similar to onion except not as requiring of water management

Harvest & Postharvest

• Essentially the same as onion:
  – Ready for harvest when the tops bend over and dry
  – Bulbs pulled & placed in windrows for curing
  – Tops may be left on or removed
  – Stored at 32°F and 65-70% RH
  – Shelf-life: 4 months
  – Sprout inhibitors (maleic hydrazide) may be required for long-term storage

Leek

• *Allium ampeloprasum*, Porrum group
• Does not form a bulb
• Grown for its blanched sheath of basal leaves, similar to green onions
• More cold tolerant than onion early in development, but can be damaged by frost near harvest time
Planting

- Leeks are often planted in a shallow trench, in order to blanch as much of the fleshy leafstalk as possible by hilling up soil around the plants during the growing season.

Harvest & Postharvest

- Leeks are ready to harvest when the basal portion is at least $\frac{1}{2}$" dia.
- Growers often wait until the plants reach 2" dia. to harvest.
- The blanched portion may reach 6-8" long.
- After harvest, the tops are removed at about 2" above the blanched basal region.
- Optimum storage: 32°F & 95-100% RH.
- Shelf-life: 2-3 months.

Chives

- *Allium schoenoprasum*
- Cool-season, cold-tolerant perennials
- Closely resemble wild onion
  - Small plants develop into busy clumps and grow by means of tillering (develop new shoots from the base of the original plant).
- Grown for their tube-like leaves which are used for flavoring.
- Minor crop.
Farmers Market Project

• Write a 1 page summary of your Farmers Market experience
• Include the following:
  – Your group
  – What you did for your group
  – What worked well for the Farmers Market
  – What we could change to make it better in the future
• Summaries due at final (Tuesday, December 14, 8:00 a.m.)
  – Feel free to email summaries if you prefer
  – Size limitation: Should be at least 1 page, double spaced, 12pt font, 1-1/2" margins, but not more than 2 pages, single spaced, 10 pt font, 1" margins.
  – Grading: 50 points of final grade.