Olericulture – Hort 320
Lesson 13, Onion & other Allium

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General Information

All classified in the Alliaceae (historically Amaryllidaceae) family and the Allium genus

Cultivated types mostly Asian in origin but found throughout the northern hemisphere

Center of origin in Afghanistan and Pakistan, secondary center in the Mediterranean
General Information

Species preference is often culturally influenced:

Onion – worldwide acceptance and use
Garlic – Asian, especially Korean
Leek – western Europe
Bunching onion – China and Japan

Source of flavoring, not a major contributor to calories or nutrition in most cultures
Cultural Information

All are considered to be cool-season, hardy crops but grow in many climates

Most are frost tolerant during seedling stage, less so during vegetative growth and maturation

Most species are easy to produce

Most bulbing species can be stored without sophisticated facilities
General Management

Climate – Best quality with abundant sun and dry weather in late development

Soil – grow in many types of soil, but best quality bulbs are produced on light soils

Fertility – considered heavy feeders

Season-long weed control essential

Often transplanted in market-garden and subsistence production

Extended storage feasible and common (bulbing)
Onion

Taxonomy

Monocotyledon

Family: Amaryllidaceae (Alliaceae)

Genus and species: *Allium cepa* L.

Related species: wild onion, garlic, leek, members of the lily family
Onion

Domestication

Originated around Iran and West Pakistan
Parental wild types unknown
Used by ancient Egyptians, 3200 BC
Spread to India in 600 BC
Written about by the Greeks and Romans
Brought to American by 1600 AD
Onion

Use and importance

Greek historian Herodotus wrote that 9 tons of gold were used to purchase onions to feed the builders of the Egyptian pyramids.

Widely used to flavor other foods.

Historically considered important medicinally:
- ward off evil spirits
- remove warts
- lower blood pressure
- prevent infections
- prevent acne
- help kidney function
## Onion

### Major producing countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>20,817,295</td>
</tr>
<tr>
<td>India</td>
<td>8,178,300</td>
</tr>
<tr>
<td>United States</td>
<td>3,349,170</td>
</tr>
<tr>
<td>Pakistan</td>
<td>2,015,200</td>
</tr>
<tr>
<td>Turkey</td>
<td>2,007,120</td>
</tr>
<tr>
<td>Iran</td>
<td>1,849,275</td>
</tr>
<tr>
<td>Egypt</td>
<td>1,728,417</td>
</tr>
<tr>
<td>Russia</td>
<td>1,712,500</td>
</tr>
<tr>
<td>Brazil</td>
<td>1,299,815</td>
</tr>
</tbody>
</table>
Onion
Onion
Onion

Most onions in Washington are grown in the eastern part of the state. Storage onion production is centered in the Columbia Basin region in Grant, Franklin, Benton, and Adams counties. The leading county for non-storage bulb onion production is Walla Walla. The Columbia Basin is the main region where onion seed is produced. Approximately 40 acres of green bunching onions are grown primarily in western Washington.
Onion

Washington onion production

11th most important agricultural commodity

Washington ranks #2 in onion production in U.S. (2012)

Produced 1.5 billion pounds, 23.1% of total U.S. harvest

In 2007, Walla Walla Sweet Onion named state vegetable
Onion

Washington onion production

3,100 acres non-storage, valued at $36.5 million
Average yield 18.5 tons/acre

23,500 acres storage, valued at $147.6 million
Average yield 29.5 tons/acre

Onions grown on 734 farms in 2012
Onion

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Onions grown on 734 farms in 2012
Onion

Genetics and breeding

Hybrid varieties dominate production in US, Europe, Japan

Hybrids using male-sterile cytoplasm are common (sterility genes that are not nuclear), created by planting a sterile female parent next to a fertile male parent
Onion

Varieties

Bulbing
  Spring-seeded types, fall-seeded types

Bulbing green types
  Any bulbing variety harvested early

Non-bulbing types
  A. fistulosum or hybrids, include related perennial species
### Onion

#### Varieties

Classed by photoperiod needed for bulb growth (all are “long day” plants)

<table>
<thead>
<tr>
<th>Type</th>
<th>Required Photoperiod</th>
<th>Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short day</td>
<td>12 to 13 hour</td>
<td>subtropical</td>
</tr>
<tr>
<td>Intermediate</td>
<td>13.5 to 14 hour</td>
<td>warm temperate</td>
</tr>
<tr>
<td>Long day</td>
<td>14.5 to 15 hour</td>
<td>temperate</td>
</tr>
<tr>
<td>Very long day</td>
<td>&gt;16 hour</td>
<td>cold temperate</td>
</tr>
</tbody>
</table>
Onion

Daylength in Raleigh, Chile, and Maine

- SD IM
- LD
- VLD

Time of the year

- Bangor, Maine
- Raleigh, North Carolina
- Santiago, Chile
Onion

Daylength effect modified by temperature – complicated by flowering response

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Photoperiod</th>
</tr>
</thead>
<tbody>
<tr>
<td>High temperature:</td>
<td></td>
</tr>
<tr>
<td>21°C (70°F)</td>
<td>No bulbing: No floral</td>
</tr>
<tr>
<td></td>
<td>initiation (no emergence of previously formed initials)</td>
</tr>
<tr>
<td></td>
<td>Rapid bulbing: No floral</td>
</tr>
<tr>
<td></td>
<td>initiation (previously formed initials - destroyed)</td>
</tr>
<tr>
<td>Low temperature:</td>
<td></td>
</tr>
<tr>
<td>10°C (50°F)</td>
<td>No bulbing: Floral</td>
</tr>
<tr>
<td></td>
<td>initiation (slow bolting)</td>
</tr>
<tr>
<td></td>
<td>Bulbing: Floral</td>
</tr>
<tr>
<td></td>
<td>initiation (rapid bolting)</td>
</tr>
<tr>
<td></td>
<td>formed can emerge)</td>
</tr>
</tbody>
</table>

Source: Adapted from Brewster (1977).
FIG. 17.2. Soil temperature effect on onion (*Allium cepa*) bulb shape. 
*From Yamaguchi et al. (1975).*
Onion

Bolting (going to seed)

Induced by vernalization

Modified by genetic background, stage of development

Caused by daytime temperatures below 50 °F

Greater incidence of cool days increases bolting

Modified by age and size of plant

Older plants more prone to bolting
Onion

Production – Climate and soils

Benefits from a climate with dry fall weather – aids in curing and harvest preparation
Onion

Propagation

Grown from seed (preferred), transplants, or sets/bulbs

Sets are grown in nursery beds, harvested, stored dry

Vernalized bulbs are utilized for seed production
Onion

Production – Diseases and Pests

Onions are prone to many disease and pest problems
  Fungal leaf diseases
  Storage rots
  Onion maggots
  Leaf feeding insects
  Nematodes
  Weeds (lack competitive nature)

Heavy use of pesticides is common in modern-intensive production systems
Onion

Pink Root (*Phoma terrestris*)
Onion

Bacterial Soft Rot (*Pectobacterium carotovora*)
Onion

White Rot (*Sclerotium cepivorum*)
Onion

Iris Yellow Spot Virus (IYSV)
Onion

Onion Thrips (*Thrips tabaci*)
Onion

Onion Maggot (*Hylemya antiqua* or *H. platura*)
Onion

Harvest Preparation

Curing essential

Best under dry conditions, ambient temps (68 - 82 °F; field or ventilated storage)

Curing is complete when necks seal, scales dry

Topping is completed by hand or mechanically
# Onion

## Curing

<table>
<thead>
<tr>
<th>Method</th>
<th>31 days</th>
<th></th>
<th>63 days</th>
<th></th>
<th>87 days</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Weight</td>
<td>Rot (%)</td>
<td>Weight</td>
<td>Rot (%)</td>
<td>Weight</td>
</tr>
<tr>
<td>No curing</td>
<td>11.8</td>
<td>76.7</td>
<td>a</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>Artificial curing</td>
<td>6.3</td>
<td>12.3</td>
<td>10.8</td>
<td>16.3</td>
<td>13.2</td>
</tr>
<tr>
<td>Field curing</td>
<td>6.1</td>
<td>20.0</td>
<td>11.2</td>
<td>23.3</td>
<td>14.5</td>
</tr>
<tr>
<td>LSD at $p = 0.05$</td>
<td>3.3</td>
<td>14.9</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

*a All rotted after first month.

NS = Not significant.

*Source:* Ref. 108.
Onion

Storage of bulb onions

Optimal at 32 degrees and 65-75% RH

Can be stored for 5-6 months (if free from rot problems)
Onion

Aspects of Modern-Intensive Production

Management tends to be chemically intensive

Heavy applications of fertilizers
Herbicides for weed control
Soil and foliar insecticides
Onion

Aspects of Modern-Intensive Production

Mix of mechanized and hand operations

Mechanized seeding, cultivation, harvest

Hand labor for transplanting, topping
Onion

Aspects of Modern-Intensive Production

Storage

Maleic hydrazide used for sprout control

Fungicidal dips or powders often used for rot control
Onion

“Onions are greatly affected by weeds, insects, and diseases. One of the most important challenges in onion production today is how to produce onion crops in ways that are sustainable and environmentally responsible while not losing the yields achieved by use of crop-protection chemicals as a substitute for costly hand labor.”

ATTRA Publ. #IP138
Onion

Aspects of Market Garden Production

Green bunching onions are excellent subjects for direct sales.

Bulbing onions produced for sale from storage are much more difficult to manage under small-scale, market garden conditions.
Onion

Aspects of Market Garden Production

Major issues in market garden production include:

Weed control (season-long)

Insect control (especially onion maggot)

Storage rot diseases (pink root, neck rot)
Onion

Aspects of Market Garden Production

Weed control

Select fields free of perennial weeds

Rotate with cover crops and green manures

Eliminate early weeds before planting

Hand weeding (careful to avoid damage)
Onion

Aspects of Market Garden Production

Insect control (onion maggots)

Fall plowing

Long-term crop rotation

Isolation (1 mile) from previous production fields

Sanitation (eliminate all crop waste)
Onion

Aspects of Market Garden Production

Disease Control (storage rots)

- Long-term rotation
- Resistant cultivars
- Furrow or drip irrigation
- Sanitation (elimination of crop waste)
Onion

Major Problems in Subsistence Production

Lack of suitable varieties

Lack of high quality seed

Premature bolting

Need for high levels of fertilizer & irrigation

Poor storage potential
Garlic
Garlic

Taxonomy

Monocotyledon
Family: Amaryllidaceae (Alliaceae)
Genus and species: *Allium sativum* L.
Related species: onion, leek, ramps members of the lily family
Garlic

Domestication

Originated around Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan (Central Asia)

Parental wild types unknown

Records of use in Babylon ~4,500 BC & China ~4,000 BC

Bulbs from around 1,500 BC were found in King Tut’s tomb

USDA says garlic was truly domesticated in 1980s, when “routine seed production became possible”
Garlic

Use and importance

Minor crop with respect to production

Used primarily as a condiment and flavor additive

Historically used to mask flavor and odor of aged and salted meats

Long history of medicinal and religious uses
Garlic

Major producing countries

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<tr>
<th>Country</th>
<th>Production (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>13,664,069</td>
</tr>
<tr>
<td>India</td>
<td>833,970</td>
</tr>
<tr>
<td>South Korea</td>
<td>271,560</td>
</tr>
<tr>
<td>Egypt</td>
<td>244,626</td>
</tr>
<tr>
<td>Russia</td>
<td>213,480</td>
</tr>
<tr>
<td>Burma</td>
<td>185,900</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>180,300</td>
</tr>
<tr>
<td>United States</td>
<td>169,510</td>
</tr>
</tbody>
</table>
Garlic

Varieties

Many varieties. Adapted to localized conditions, regionalized preferences for size, color, flavor

Two types:

- Hardneck or bolting: closely related to wild garlic, do not store as well, hot and spicy flavor
- Softneck or non-bolting: store well, mild flavor, most U.S. production (California Late, California Early)
Garlic

**Hardneck Garlic**
- spathe
- umbel
- scape
- clove arrangement
- bulb neck
- bulb
- stalk
- v-keeled leaf

**Softneck Garlic**
- v-keeled leaf
- bulb neck
- bulb
- stalk
- roots
- clove

Diagram courtesy of Jim Anderson, Filaree Farms, Okanogan, WA
Garlic

Propagation

Vegetatively propagated from cloves

Seed cloves stored over-winter at 45 degrees

Seed clove size regulated using close spacing

Usually planted in the fall (vernalization)
Garlic

Seed cloves
Garlic

Adaptation to Production and Marketing Systems

Garlic has few of the disease and insect problems of onions

Good subject for market garden and subsistence agriculture

Market base tends to be ethnic in nature
Which vegetable did Noah refuse to take on the ark?

Leeks
Leek

Taxonomy

Monocotyledon

Family: Amaryllidaceae (Alliaceae)

Genus and species: *Allium ampeloprasum* L.

Related species: onion, garlic, ramps, members of the lily family
Leek

Botany

Differs from onion in 3 significant ways:

Limited ability to form bulbs

Has flattened rather than rounded leaves

Leaves are not hollow

Tops are much larger than those of onions
Leek

Production

Planting practices depend on market preference for blanching

Blanched:
   Labor intensive (appropriate for market gardens)
   Transplant into trenches 10-15 in deep
   In-row spacing of 2-4 in

Non-blanched:
   Seed (1/4 in deep) or transplant in 15 in rows
Leek

Blanching

Used to lengthen and whiten the lower stem

Accomplished by filling planting trenches or hilling around plants when fully grown
Planting blanched leeks
Hilling of leek for blanching
Trimmed & bunched leeks
Shallot

Taxonomy, Origin, and Botany

Species: *Allium cepa* var. aggregatum

Same species as onion and thought to be a genetic variant of the cultivated onion

Also known as (or similar to) the multiplier onion

Originated in western Asia, known from antiquity

Produces clusters of bulblets, but no common membrane
Shallot
Shallot production in Malaysia
Chive

Taxonomy, Origin, and Description

Species: *Allium schoenoprasum*

Perennial (not evergreen) relative of onion

Used by the ancient Greeks and Romans

Clump growth habit with numerous thin, hollow leaves 6-10 in long

Only leaves are used – as an herb for flavoring many foods
Chive
Chive
Chive

Production

Amenable to container and greenhouse production
Treated as a perennial
Planted in the fall for spring production
Continuous harvest essential to maintain vigor

Varieties:
  Common – mild flavor
  Garlic – stronger, garlic-type flavor
Other minor Alliums

Chinese chive

Species: *Allium tuberosum*

Has flat, gray leaves, the edible portion (which includes the flowers)

Used as a seasoning for meat, stir-fry

Production systems similar to chives
Other minor Alliums

Japanese bunching onion

Species: *Allium fistulosum*

Important in China, Japan and Korea

Very similar to leek in growth, use, and production (round leafed)

Often produced with blanched stems
Other minor Alliums

**Rakkyo** - *Allium chinense*
  Similar to shallots in growth habit (clusters)

**Egyptian onion** - *Allium cepa*
  similar to multiplier onion

**Kurrat** - *Allium ampeloprasum*
  similar to leek but smaller

**Elephant garlic** – *Allium ampeloprasum*
  Leek-like plant produces bulb similar to garlic

**Pearl onion** – *Allium ampeloprasum*
  leek-like plant that produces a small garlic type bulb