COOL SEASON VEGETABLE CROPS

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Introduction

- Cool season crops are plants that have adapted to cool climates.

- They prefer the temperature to stay below 70°F.

- They generally thrive at temperatures of 15°F lower than that required by warm season crops.

- Most cool season crops will germinate in soils with temperature of 40 to 45°F.
Introduction

• **Bolting**: When the temperature starts to climb over the comfort zone of the cool season crops they tend to produce a seed stalk.

• When this happens the plant becomes too woody or bitter for us to eat.
Introduction

• Grow cool season vegetables in the spring for an early start or in the late summer for a fall harvest.

• They can withstand light to moderate frost, but are intolerant of high summer temperatures.

• The best way to grow cool season crops in the summer is to shade them to keep them cooler.

• Most cool-season vegetables are grown for one season as annuals, and are mainly root or leaf crops.
Introduction

Cool season crops not affected by frost

- Asparagus
- Cabbage
- Kale
- Pea
- Spinach
- Broad Bean
- Collard
- Kohlrabi
- Radish
- Turnip
- Broccoli
- Garlic
- Leek
- Rhubarb
- Brussels Sprouts
- Horseradish
- Onion
- Shallot
Introduction

Cool season crops affected by frost

- Beets
- Chard
- Mustard
- Carrots
- Chinese Cabbage
- Parsnip
- Cauliflower
- Endive
- Potato
- Celery
- Lettuce
- Swiss Chard
Asparagus
Asparagus (*Asparagus officinalis altilis*)

- A **perennial** temperate vegetable that can last up to 30 years.

- Plant one-year-old crowns as seeds may take 1 to 2 years longer.

- Spacing: 12 to 18 inches wide trench, 9 to 12 inches deep, crowns spaced 18 to 24 inches apart.

- Cover crowns with 1 to 2 inches of soil.
Asparagus (Asparagus officinalis altilis)

• Plants are **dioecious** which means male and female flowers are borne on different plants.

• In general, male plants have a number of advantages over the female plants:
  
  ❖ Male plants live longer than the female plants;
  
  ❖ Male plants emerge earlier in spring than female;
Asparagus \textit{(Asparagus officinalis altilis)}

- Male plants do not produce fruits, which will compete with the crowns and roots for nutrients.

- Male plant has no seeds that can produce unwanted volunteer seedlings.

- Female plant has a tendency to lodge in heavy rain and strong wind as its fruits increase the weight of the plant.
Asparagus \((Asparagus\ officinalis\ altilis)\)

- Fertilizer: 10 to 12 lbs per 100 ft row of 13-13-13 incorporated with cultivation.

- Harvest starts the 2\textsuperscript{nd} year after planting crowns. Stop harvesting when spears are less than pencil thick.

- Pests: asparagus beetle and cutworms.

- Storage: refrigerate immediately, can or freeze.
## Asparagus Varieties

<table>
<thead>
<tr>
<th>Variety</th>
<th>Hybrid or open pollinated</th>
<th>Disease resistance / tolerance</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mary Washington</td>
<td>Open pollinated variety</td>
<td>Rust</td>
<td>Good quality</td>
</tr>
<tr>
<td>Atlas</td>
<td>Ordinary F1 Hybrids</td>
<td>Rust, Fusarium rot, and Cercospora</td>
<td>Heavy spears with tight heads</td>
</tr>
<tr>
<td>Jersey Giant</td>
<td>All male (androecious) F1 Hybrid</td>
<td>Rust, Fusarium rot</td>
<td>Large uniform spears</td>
</tr>
</tbody>
</table>
Cole crops

-Cole crops include cabbage, broccoli, cauliflower, collards, kale.

-The group of vegetables collectively known as **Cole crops** are all members of the species *Brassica oleracea*.

-The term cole is derived from the Latin *caulis*, meaning “stem” or “stalk”.

-They are similar culturally and taxonomically, belonging to the **mustard family** *Cruciferae*. 
Cole crops

-The flowers have 4 petals and 4 sepals shaped like a cross (cruciform) hence the family name Cruciferae.

-Cole crops are cool-season, hardy, dicotyledonous plants.

-The have received attention as “functional crops” due to production of mustard oils used for cancer chemoprotection.
Cabbage *(Brassica oleracea, Capitata)*

- Cabbage is one of the most important member of the **cole crops**.
- It’s grown for fleshy leaves which may be served:
  - Boiled,
  - Raw (coleslaw), or
  - Fermented (sauerkraut).
Cabbage \((Brassica\ oleracea,\ Capitata)\)

- It is fairly nutritious, ranking higher than tomatoes in mineral content.
- A good source of vitamin A and C and calcium.
- There are several types: pointed, flat, green, red or savoy.
Cabbage \textit{(Brassica oleracea, Capitata)}

- Planting can be started from either \textcolor{green}{transplanting} or \textcolor{green}{direct seeding}.

- Processing cabbage is usually \textcolor{green}{direct seeded}.

- Direct seeding is less expensive and permits higher populations than transplanting, but requires more expertise.
Cabbage  (*Brassica oleracea*, Capitata)

- Spacing: 15 to 18 inches between plants and 30 to 36 inches between rows – depending on variety and size of head needed.

- Cabbage respond well to starter fertilizers high in phosphorus.

- Develops head during the cool weather.
Cabbage (Brassica oleracea, Capitata)

Cabbage Insects

-Cabbage worms: Include cabbage looper, imported cabbage worm, and larvae of diamondback moth.

-Cause considerable damage by chewing holes in the leaves and heads of cole crops.

-The worms are light to dark green in color and feed from the undersides of the leaves.
Cabbage Worms

-The adults are gray, brown, and white moths.

-Control is by chemical and biological \((Bacillus thuringiensis)\) measures.
Cabbage  *(Brassica oleracea, Capitata)*

**Aphids**

-Cabbage aphids (*Brevicoryne brassicae*) are small, green, sucking insects that have waxy covering similar to cabbage leaves.
Cabbage \textit{(Brassica oleracea, Capitata)}

**Aphids**

- Aphids damage causes leaves to curl or cup.

- Cultural practices and biological control agents can reduce aphid infestations.

- Plants should be treated before the insects are established and before the leaves start to cup.
Cabbage (Brassica oleracea, Capitata)

Cabbage Maggots:

Cabbage maggots (Hylemya brassicae) are white larvae that feed on the roots, severely limiting water uptake.

-Plants will wilt during the day but return to normal over the night.

-Damage is more severe when the soil is cool and moist, providing conducive conditions for egg laying by adult fly.
Cabbage (Brassica oleracea, Capitata)

Cabbage Maggots:

-Effective control can be achieved using insecticides or drenching the soil with water.
Cabbage \textit{(Brassica oleracea, Capitata)}

**Thrips:**
- These are small, wingless insects that are a serious pests especially in northern growing areas.
- The damage is by their rasping feeding habits on the leaves.
- Chemical control is not very effective.
- Available options include the use of resistance cultivars.
Cabbage Diseases

- **Black rot**: Caused by a bacterium *Xanthomonas campestris*.
- The diseases can appear at any stage.
- First indicated by yellowing of leaves and blackening of veins.
- If diseases attack early, no head will form.
- Control the disease by practicing crop rotation and sanitation measures.
Black leg:
-Caused by fungus *Phoma lingam*.
-It is a dry rot, that attacks the stem of young plants.
-Causes dark, sunken areas and the entire plant wilts.
-It is more active at lower temp. than black rot.
-Control measures similar to those of black rot.

Cabbage (*Brassica oleracea, Capitata*)
Cabbage  (*Brassica oleracea, Capitata*)

- **Alternaria:**
  - Caused by several fungi species.
  - Black spot is caused by *Alternaria brassicicola*.
  - Characterized by dark black spots.
  - Consist of concentric rings.
  - Control is by seed treatment and fungicide application.
Cabbage (Brassica oleracea, Capitata)

Club root:
-Caused by a fungus *Plasmodiophora brassicae*.
-It attacks the roots causing swelling.
-Most prevalent in high moisture, acid pH, and warm temp.
-Control is by crop rotation and raising pH to around 7.2.
# Cabbage - Varieties

<table>
<thead>
<tr>
<th>Variety</th>
<th>Days to Maturity</th>
<th>Plants/100 ft of row</th>
<th>Disease resistance or Tolerance</th>
<th>Remarks All American Selection (AAS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stonehead Hybrid</td>
<td>60</td>
<td>63 – 125</td>
<td>Fusarium yellows</td>
<td>AAS, very compact, solid head</td>
</tr>
<tr>
<td>Emerald Cross Hybrid</td>
<td>63</td>
<td>63 – 125</td>
<td></td>
<td>AAS, vigorous and well adapted</td>
</tr>
<tr>
<td>Savoy King Hybrid</td>
<td>82</td>
<td>63 – 125</td>
<td></td>
<td>AAS, vigorous and excellent quality</td>
</tr>
<tr>
<td>Resistant Golden Acre</td>
<td>64</td>
<td>63 – 125</td>
<td>Fusarium yellows</td>
<td>Widely adapted</td>
</tr>
</tbody>
</table>
Broccoli
Broccoli  (*Brassica oleracea, Italica*)

- High in vitamins A and D.

- Optimum temperature – 57°F to 68°F – warmer temperatures result in poor quality and heads may not form above 77°F.

- Transplants are recommended – plant in early spring (February – March) or early September for fall.
Broccoli - Harvesting

- Cut the central head with 5 or 6 inches of stem while the inflorescence is immature and compact, before individual flowers open.

- Side shoots (secondary heads) will develop for later harvesting.
Broccoli - Varieties

• **Spartan Early** – 55 days, short, good yields and quality and medium-sized head.

• **Premium Crop Hybrid** – 75 days, all-American winner, good yield and quality and large, tight head.

• **Green Comet Hybrid** – 68 days, good yield and quality and large, tight head.

• **Packman Hybrid** – 50 days, high yield, large head.
Brussels sprouts
Brussels Sprouts (*Brassica oleracea*, gemmifera)

- Very hardy and withstands light freeze.

- Require a longer growing season – use transplants to shorten the growing season.

- Cool temperatures are important for development of compact quality buds.

- They are susceptible to all pests and physiological disorders that affect other cole crops.
Brussels Sprouts  \((Brassica oleracea,\) gemmifera)\)

- Spacing: 12 to 18 inch between plants and 24 to 30 inch between rows.

- Harvest when sprouts are firm and well developed (1 to 2 inches in diameter).

- Can make several successive harvests by hand from the same plant.
Brussels Sprouts - Harvesting

- Remove the lower leaves below the sprouts.

- Sprouts can be stored for 3 to 5 weeks at 32°F and 95 – 100% humidity
Brussels Sprouts - Varieties

• Jade Cross Hybrid – 95 days, uniform maturity and good yields.

• Long Island Improved – 95 days, good yields.
Cauliflower
Cauliflower  \textit{(Brassica oleracea, Botrytis)}

- Grown for its white head, the ‘curd’ – a highly branched, prefloral, undifferentiated shoot apices.

- Optimum temperature for curd formation is 57 to 68 °F. Above 77 °F curds may not form.

- At temperatures near 32 °F, freezing injury may result in no curd development.
Cauliflower  *Brassica oleracea, Botrytis*

- Spacing: 15 to 24 inches between plants and 24 to 36 inches between rows.
- The curd matures in 7 to 12 days after blanching.
- Harvest the curds when they grow to 6 to 8 inches in diameter.
Cauliflower \textit{(Brassica oleracea, Botrytis)}

- **Blanching** is the excluding of light from plants or plant parts resulting in loss of color.

- Blanch when the head begins to form (2 to 3 inches of white curd in the leaves).

- Some snowball varieties are self blanching.
# Cauliflower - Varieties

<table>
<thead>
<tr>
<th>Variety</th>
<th>Color</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>White cloud</td>
<td>White curd</td>
<td>Tolerant of frost</td>
</tr>
<tr>
<td>Cheddar</td>
<td>Orange curd</td>
<td>Hold well without flowering</td>
</tr>
<tr>
<td>Purple head</td>
<td>Purple curd</td>
<td>Smaller</td>
</tr>
</tbody>
</table>
Collards
Collards (*Brassica oleracea, Acephala*)

- Leafy, non-heading cabbages.
- Rich in vitamins and minerals.
- Grow better in warm weather but can tolerate frost unlike other members of the family.
Collards (*Brassica oleracea, Acephala*)

- Spacing: 6 to 12 inches between plants and at least 3 feet between rows.

- Harvesting may include whole rosettes or individual leaves.
Collards - Varieties

- **Georgia** – 75 days, large crumpled blue-green leaves, good yield, tolerant to heat and cold.

- **Vates** – 75 days, large crumpled dark-green leaves, holds color in cold weather, resistant to bolting, good yield.
Collards - Varieties

• **Georgia** – 75 days, large crumpled blue-green leaves, good yield, tolerant to heat and cold.

• **Vates** – 75 days, large crumpled dark-green leaves, holds color in cold weather, resistant to bolting, good yield.
Kale
Kale  (*Brassica oleracea*, Acephala)

- Rich in vitamin A and C.
- Also called non-heading cabbage.
- Plants biennials, but grown as annuals for their curled and succulent leaves.
- Cultural practices much similar to collards.
Kale - Varieties

- **Scotch** – 40 to 50 days, much curled, crumpled foliage of greyish-green color.

- **Siberian** – 40 to 50 days, less crinkled, bluish-green.

- Both varieties have dwarf and tall forms.
Spinach (*Spinacia oleracea*)

- Spinach belongs to the goosefoot family, *Chenopodiacea*.

- This family also includes beets and chard.

- Spinach is the most important vegetable green grown in the US.

- Due to its recent use as a functional food, the demand and production of fresh spinach has increased markedly.
Spinach (*Spinacia oleracea*)

- Spinach requires less labor than many other crops except green peas and sweet corn for processing.

- Spinach occupies the land for only a short time.

- The growth to maturity is about 30 to 50 days.

- Spinach plant is usually *dioecious*, producing male and female flowers on separate plants.
Spinach (*Spinacia oleracea*)

- Some *monoecious* plants may develop in certain cultivars, although rarely.

- Long days and high temperature causes *bolting*, marking the end of productive life.

- Since bolting is in response to *photoperiod* and warm temperature, fall production is important when days are short and cool.

- Cultivar selection is important as varieties differ in their resistance to bolting.
Spinach (*Spinacia oleracea*)

- Spinach grows best on a fertile sandy loam well supplied with organic matter.

- It requires a high level of fertility especially nitrogen. Also very responsive to boron.

- It is very sensitive to acidic conditions. But high pH can cause manganese deficiency.
Spinach (*Spinacia oleracea*)

- Spinach cultivars are classified as:
  
  ➢ Prickly-seeded or smooth-seeded types; and
  
  ➢ Savoy-leaved or smooth-leaved

- Commercial cultivars are of the smooth-seeded type, which are much easier to handle and plant accurately.
Spinach (*Spinacia oleracea*)

- The savoy types tend to be larger and are preferred for fresh market.

- The smooth-leaved cultivars are used for processing, because the leaves are easier to wash.

- Cultivars vary in their resistance to bolting or longstanding characteristics.
# Spinach (Spinacia oleracea)

## Varieties

<table>
<thead>
<tr>
<th>Types of spinach</th>
<th>Varieties</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savoy</td>
<td>Regiment, Spinner</td>
<td>Resistant to blue mold and bolting</td>
</tr>
<tr>
<td>Semi-Savoy</td>
<td>Teton</td>
<td>Slow to bolt and resist down mildew</td>
</tr>
<tr>
<td>Smooth</td>
<td>Space</td>
<td>Moderate bolt resistance, resist down mildew</td>
</tr>
</tbody>
</table>
Spinach (*Spinacia oleracea*)

**Insect Pests**

- **Aphids (*Myzus persicae*)**. Cause damage by sucking the juice from foliage and by transmitting mosaic disease.
Spinach (Spinacia oleracea)

Insect Pests

- Spinach Leaf miners (Pegomyia hyoscyami). Damage the crop by feeding inside the leaves between the leaf surfaces.
Spinach (*Spinacia oleracea*)

**Diseases**

**Damping-off (*Pythium*).**

- Fungal disease
  - Affects germinating seeds causing poor stand.
  - Can be controlled by treating seeds with appropriate fungicidal treatments.
Spinach (*Spinacia oleracea*)

**Diseases**

**Mosaic**

- Commonly known as **blight**. It is a **virus complex** caused by **cucumber mosaic virus (CMV)**.
- Plant leaves develop mosaics and eventually die.
- Disease is transmitted by insects, especially aphids.
Spinach (Spinacia oleracea)

Diseases

Downy Mildew or blue mold (Peronospora effusa)
- Can cause serious losses in cool, wet weather.
- Disease start as irregular patches on underside of leaves.
- Can ruin whole spinach field.
- Use resistant cultivars and fungicides to suppress the disease.
Spinach (*Spinacia oleracea*)

**Diseases**

**Fusarium Wilt** (*Fusarium salani*)
- Causes young plants to appear yellow and stunted and older leaves may wilt and fail to recover.
- Air temp. >72°F or soil temp. >70°F conducive to disease development.
- Use crop rotation and grow spinach during cold weather to control the disease.
Spinach (*Spinacia oleracea*)

**Harvesting**

- Spinach is ready for harvest when it has reached edible size.

Spinach is very perishable and can be stored no more than 10 to 14 days.

- The crop should be cooled as rapidly as possible to 32°F and place under RH of 95-100 percent.

- Controlled atmospheres of 10-40% CO\(_2\) and 10% O\(_2\) can reduce yellowing and improve quality.
Beet
Beet  (*Beta vulgaris*)

- Tops are a good source of vitamin A and roots are rich in vitamin C.

- Seedlings establish better under cool, moist conditions (65 – 75 °F).

- Spacing: 2 to 3 inches apart and 12 to 18 inches between rows.
Beet - Harvesting

- Beet need fertile soils that are high in potassium (K).
- They grow best in loose, well-drained soils.
- Consider raised beds to enhance drainage, and make sure soils are free from large stones that could hinder growth.
- In soils with high clay content, make sure to incorporate organic matter to improve drainage.
Beet - Harvesting

• The soil should remain moist, but not saturated.

• Harvest when they grow to desired size (about 1.5 inches in diameter in about 60 days).

• For storage, cut off the top one inch above the root.

• They store best at 32 °F and 95% humidity.
Beet - Varieties

• **Ruby Queen** – 54 days to maturity, round, deep red color, good quality and yield.

• **Detroit Dark Red** – 68 days to maturity, globe, dark red, good yield and quality.
Please contact me for more information

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