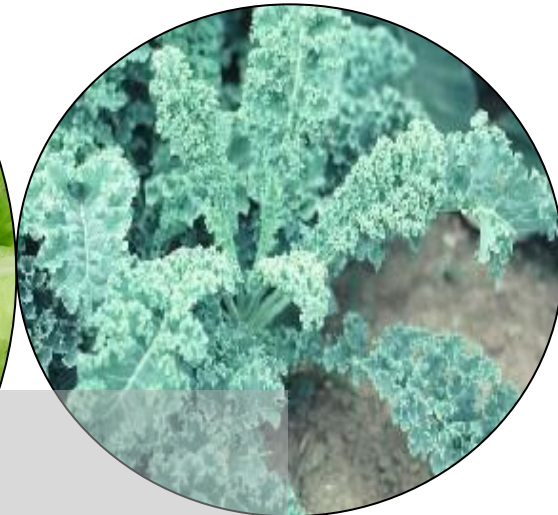


COOL SEASON VEGETABLE CROPS



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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



Broad Bean



Broccoli



Brussels Sprouts



Cabbage



Collard



Garlic



Horseradish



Kale



Kohlrabi



Leek



Onion



Pea



Radish



Rhubarb



Shallot



Spinach



Turnip

Introduction

Cool season crops affected by frost



Beets



Chard



Mustard



Carrots



Chinese Cabbage



Parsnip

No
Image
Available



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 (*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 2nd 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

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

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



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 (*Brassica oleracea*, Capitata)

- Planting can be started from either **transplanting** or **direct seeding**.
- Processing cabbage is usually 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 (*Brassica oleracea*, Capitata)

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 (*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 (*Brassica oleracea*, Capitata)

Thrips:

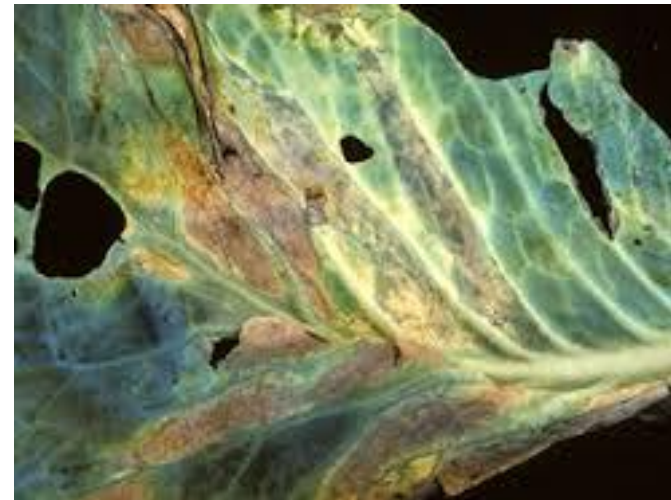
- These are small, wingless insects that are a serious pests especially in northern growing areas.
- The damage is by their rasping feeding habits on the leaves.
- Chemical control is not very effective.
- Available options include the use of resistance cultivars.



Cabbage (*Brassica oleracea*, Capitata)

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.



Cabbage (*Brassica oleracea*, Capitata)

- 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)

-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

Variety	Days to Maturity	Plants/100 ft of row	Disease resistance or Tolerance	Remarks All American Selection (AAS)
Stonehead Hybrid	60	63 – 125	Fusarium yellows	AAS, very compact, solid head
Emerald Cross Hybrid	63	63 – 125		AAS, vigorous and well adapted
Savoy King Hybrid	82	63 – 125		AAS, vigorous and excellent quality
Resistant Golden Acre	64	63 – 125	Fusarium yellows	Widely adapted

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 (*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 (*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

Variety	Color	Remarks
White cloud	White curd	Tolerant of frost
Cheddar	Orange curd	Hold well without flowering
Purple head	Purple curd	Smaller

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, *Chenopodiaceae*.
- 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

Types of spinach	Varieties	Remarks
Savoy	Regiment, Spinner	Resistant to blue mold and bolting
Semi-Savoy	Teton	Slow to bolt and resist down mildew
Smooth	Space	Moderate bolt resistance, resist down mildew

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 (*Pegomya 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 fungicides.



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. $>72^{\circ}\text{F}$ or soil temp. $>70^{\circ}\text{F}$ 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% CO₂ and 10% O₂ 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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