

***Brassica oleracea*, taxonomy, wild cabbage and its decendants: cabbage, kale, broccoli, cauliflower, etc.**

- **Taxonomy**
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Brief facts

- Cabbage is an important vegetable known to mankind for over 4,000 years. It is a member of the mustard or cruciferous family (*Brassicaceae*), which includes mustard, rape, turnip, wasabi (*Eutrema wasabi*), radish, watercress, many Oriental vegetables, and a very important model plant *Arabidopsis thaliana*.
- The wild cabbage (*Brassica oleracea* L.), called **colewort** or **field cabbage**, is native to the coasts to Western Europe and the Western Mediterranean. It occupies rather harsh niche growing on ledges of chalky cliffs and even on nearly vertical rocky surfaces where no other plant can take a foothold. Wild cabbage plant has tall, stout, green, hairless stem, and large, fleshy leaves. The growing habit is biennial when the rosette of leaves is formed in the

first year, and stem with leaves and flowers up to 2-4 ft. tall, in the second year. When grown on rich garden soils, the wild plants exhibit striking gigantism thus presenting an immediate effect of cultivation on biomass production. The plants are self-sterile and require cross-pollination to bear seeds. This correlates with striking variability of individual plants. The wild plants were probably collected for food since Neolithic, long before they were taken into cultivation.

- Domesticated *Brassica oleracea* variants (collectively called **cole crops**) are widely cultivated for food. To name just a few:
 - *B. oleracea* var. *capitata* (cabbage);
 - *B. oleracea* var. *acephala* (kale);
 - *B. oleracea* var. *gongylodes* (kohlrabi);
 - *B. oleracea* var. *botrytis* (cauliflower);
 - *B. oleracea* var. *italica* (asparagus broccoli).

If all these cultivated forms have been derived from the single species, then no other cultivated plant has shown such tremendous diversity of its vegetative form in its cultivated descendants.

- Plants were selected for the following features: loss of pungent flavors produced by the mustard oils; enlargements of certain parts for eating; loss of toughness; growth in cool climates with long growing seasons.
- The shape of the cabbage head can be classified in three groups:
 - **Ballhead (round head)**. This is most common type. It has a round 6-7 in. (15-17 cm) in diameter. It has smooth white-veined leaves forming firm head.
 - **Conical head (oxheart, sugar loaf)**. This type has a smaller pointed head.
 - **Drumhead**. This type has large flat head.
- The cabbage has remarkable healing properties. Hippocrates prescribed a dish of boiled salted cabbage from violent colic. Ancient Romans and Greeks used cabbage to alleviate headaches, gout, and ingestion of poisonous mushrooms. Roman soldiers applied cabbage leaves to their wounds. There are many anecdotal observations of cabbage leaves to be effective in curing severe inflammations and infections. Cancer preventive properties of cabbage include antioxidant, anti-mutagenic, and detoxification

activities exhibited by substances and enzymes contained in cabbage juice.

List of pests (non-exhaustive)

• Insects

- **Cabbage Root Maggot** (*Delia brassicae*). Larvae borrow into lower stems and roots. Adults are small grey bristly flies laying eggs three times a year. One generation overwinters as pupae. The spring generation of the pest incurs most damage when plants are young.
- **Imported Cabbage Worm (ICW)** (*Pieris rapae*). Larvae (velvety green caterpillars) can cause a loss in the quality (100%) and the quantity (25-50%) of cabbage crops by eating big holes in leaves, leaving large amount of debris on the leaves, and consuming whole young plants. Adults are white medium-sized butterflies. Up to three generations can be produced annually.
- **Cabbage Looper (CL)** (*Trichoplusia ni*). Adults are gray-brown night moth. Larvae are light green, with a white stripe on each side, about 1 in. long, that move by humping their back like and inch-worm. They cause damage similar to ICW.
- **Diamondback Moth (DBM)** (*Plutella maculipennis*). The larvae eat numerous small holes in the leaves, and sometimes leave fine webbing in the center of the plant. The larvae can contaminate final product. Four to six generations can occur per season. Adults are brownish small (~0.5 in.) moths with narrow fore and hind wings. Forewings have light yellowish-white stripe with wavy edge. Of the three lepidopteran pests of cabbage, DBM is most difficult to control.
- **Onion thrips** (*Thrips tabaci*). Onion thrips are very small (1/16 in. or 1.5-2 mm) yellow or brown sap-sucking insects. Injury looks like constellations of tiny, raised, roughened white to yellowish spots (intumescences). Females do not require males for reproduction during summer. Thrips damage usually increases during hot, dry weather. The selection of resistant varieties is one of the most important control measures available for thrips control.
- **Flea beetle** (*Phyllotreta striolata* and (*Phyllotreta cruciferae*).

These small shiny black insects chew tiny holes in foliage of young plants weakening them. Damage to mature plants is more cosmetic but can render heads unmarketable. There are 2-3 generations per year.

- **Beet Armyworm** (*Spodoptera exigua*). Early instars damage terminal bud of young plants, causing abnormal head formation. Large late larvae feed in the center of the head. Adults are medium-sized (1-1.2 in. or 2-3 cm) gray-brownish moths with narrow wings. The larvae are smooth pale green or yellow in color during the first and second instars. Later instars are darker and striped.

• Fungi

- **Alternaria leaf spot** (*Alternaria spp.*). The fungus causes dark round spots on leaves and head. Rotting primarily occurs in storage cabbage and cauliflower. Flea beetles can spread the disease through a field. Typical losses are 1-5% (up to 40%) for cabbage and up to 100% for cauliflower and broccoli.
- **Black Leg and Seed Decay** (*Phoma lingam*). Nowadays, this devastating disease is almost eradicated. Black leg causes dark, sunken cankers at the base of the stem or light brown leaf spots. The fungus can destroy the root system, cause wilting and result in plant death. The infection can occur through the seed or from soil where the pathogen can survive for at least three years.
- **Downy Mildew** (*Peronospora parasitica*). Downy mildew thrives under cool moist conditions. The initial sign of the disease is an appearance of small irregular grayish-purple spots on stems and undersides of leaves. The spots enlarge and become covered with grayish mycelia. The upper surface of the heavily affected leaf turns yellow and dries out. The leaf eventually drops off. The disease can move systemically causing internal darkening of cauliflower and cabbage heads.
- **Clubroot** (*Plasmodiophora brassicae*). The fungus' rapid growth causes swelling of the roots hampering water and nutrient supply to aboveground parts of the plants. Plants turn yellow, wilt and often die. Typical yield losses are 1-15%.
- **Root Rot, Wirestem, and Head Rot** (*Rhizoctonia solani*). The fungus causes root rot in young plants resulting in death. In older plants the disease destroys the center of the stem while outer layers provide restricted nutrient supply for the plant.

Stems turn black or brown and become thin and pliable like a wire. The fungus also attacks lower leaves causing reddish brown lesions that progress to inner leaves and eventually can affect the whole head.

- **Bacteria**

- **Black Rot** (*Xanthomonas campestris*). The Black Rot is a seed-borne bacterial disease. The pathogen moves through the leaf into the vascular system where it multiplies quickly causing blackening of the leaves and plugging of the veins. Losses of 100% are not uncommon. Cultural practices are the primary method of control. These include mandatory crop rotation, control of cruciferous weeds; use of varieties with some black rot resistance; using treated or certified seeds.
- **Bacterial Soft Rots** (*Pseudomonas spp.* and *Erwinia carotovora*). The bacteria cause watery, soft, messy, foul-smelling rot of cabbage crops. It flourishes under warm wet conditions and is facilitated by injury and external or internal tipburn. Typical losses are less than 5% (up to 50% in severely affected fields).

- **Viruses**

- *Turnip Mosaic Virus* and *Cauliflower Mosaic Virus*. The viruses cause various symptoms including spotting, mosaic coloration, necrosis, stunting, and weakening of the plants. The viruses are spread by aphids. The most important viral reservoir is wild cruciferous weeds. The losses are usually not significant, but some Oriental crops can suffer as much as 100% of damage.

Developmental stages (life cycle)

Life Cycle Stages

The plant is short-lived perennial, usually biennial. Cabbage grows best on well-drained fertilized soils with constant availability of adequate moisture and under moderate temperatures and pH in the range 6.0-6.5. It is essential not to grow cabbage on the same field years after years because of accumulation of various pathogens, to which the crop is highly susceptible.

- seed stage MeSH

- dormant seed

there are about 100 seeds per gram; cabbage seeds lose their viability quickly, and should be used within next year

- germination **MeSH**

stage 0; germinating seed; do not sow seed deeper than 0.7-0.8 in (~2 cm)

- vegetative

- seedling **MeSH**

stage 1; young plant (3-5 weeks); it takes 4 -5 weeks to grow plants suitable for transplantation (4-5 true leaves); hardened plants are frost tolerant and can be among the earliest planted garden vegetables; however, plants that were exposed to low (35 to 45 degrees F) temperatures for extended periods can bolt prematurely without producing a firm head

- rosette stage

stage 2; growth of rosette leaves; at end of this stage *B. oleracea* var. *capitata* forms firm head; cabbage heads can be harvested any time when firm head develops (60 - 90 days after transplantation); the farther seedlings were spaced, the bigger their heads grow; usual spacing is 10-14 inches for fresh market cabbage and 14-24 for kraut and storage cabbage; to prevent heads from splitting, twist stalk or prune roots with a shovel to reduce the water intake

- bud stage

stage 3; plants reach their maximum leaf area index

- bolting

rapid growth of stem

- reproductive

- flowering

stage 4

- ripening

stage 5; seeds are mature and attain best germinability and growth vigor in ~60 days after flowering

- senescent

***Brassica oleracea* variants**

Brassica oleracea var. *capitata*, cabbage



Brassica oleracea var. *botrytis*, cauliflower



Brassica oleracea var. *italica*, broccoli





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