

## Slide 1 **Cauliflower and Broccoli Seed Production**

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Cauliflower and broccoli are vegetable crops belonging to the family Brassicaceae. They are grown commercially in many countries. Both crops are found in the same species, *Brassica oleracea*, and are known by common names such as cabbage (3), brussel sprouts (4), kohlrabi (5), and collards as shown in the slide. Broccoli and cauliflower are grown for their “Curd” which is an inflorescence primordium and a young inflorescence in cauliflower and broccoli, respectively,

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Cauliflower and broccoli can be annual or biennial crops. The juvenile stage ends when the plant has developed 6 to 19 leaves depending on cultivar. There is a relationship between earliness to flower and the length of the juvenile period. Sensitivity to vernalization varies according to plant size. Larger plants are more sensitive than smaller plants and require a shorter period of low temperature exposure.

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Cauliflower has a pre-floral structure that possesses characteristics of both a vegetative and reproductive apex. Morphologically, it is an early stage of inflorescence development, since its formation takes place before floral initiation. It is a curd with tightly branched peduncles containing thousands of meristems at an early floral stage. The inflorescence is a raceme, and flowering starts from the bottom to the top of the inflorescence.

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During the development of the reproductive structures, the inflorescence begins to elongate from the outer flowers of the curd and can be as large as 60 to 75 cm.

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The curd in broccoli corresponds morphologically to a young inflorescence. As in cauliflower, temperatures greater than 20°C stimulate seed stalk elongation.

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Broccoli, like cauliflower, has yellow flowers with 4 petals, 4 sepals, 6 stamens, one pistil containing two carpels with 10 to 15 ovules inside each carpel.

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After fertilization of the ovules, seeds form inside a pod called a silique. This structure is highly dehiscent. Thus, harvest must be done before the siliques shatter. Seeds are round and reddish brown to black in color.

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There are different pollination mechanisms for cauliflower and broccoli hybrid seed production. For example, sporophytic-self-incompatibility (SSI) and male sterility are useful production systems in commercial hybrid seed production of these crops, but the main mechanism of pollination control is SSI.

This phenomenon occurs when the ovule can not be fertilized by pollen grains from the same or another plant which carry the same alleles of compatability. This causes the absence or a drastic reduction in seed number per silique

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SSI avoids inbreeding thus favoring genetic variability. This mechanism permits easier hybridization. Nevertheless, the maintenance of parental lines is not easy.

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These self-incompatible lines can be maintained through hand pollination accomplished at the bud stage. Seeds are obtained by emasculating the anthers of the parental line before the pollen is viable. Later, this parental line is hand-pollinated using pollen collected from the same line. After pollination, the branches are covered with paraffin bags to avoid contamination.

For the propagation of inbred lines, self-incompatibility may be overcome by several methods such as CO<sub>2</sub> enrichment, electricity-aided pollination, wire brush pollination, temperature-aided pollination or spraying the plants with a NaCl solution. Each of these methods has limitations and requires sophisticated techniques and highly trained workers. Thus, their use remains difficult on a commercial scale.

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Cauliflower and broccoli seeds germinate optimally between 27 and 29°C. As a result, the seeds are planted in greenhouses during the summer. At the 3 to 4 real (true) leaf stage, seedlings are transplanted in early autumn to obtain the high- to mid-temperatures necessary for rapid vegetative growth. This allows the plants to be large enough in the winter to ensure successful vernalization. When severe frost injured and rain damaged curds are encountered, a cross cut is made on the curd to allow rainwater to drain from the curd and avoid disease development. In spring, moderate temperatures of 20°C promote bolting followed by flowering. During seed maturation and at harvest, higher temperatures of 25-30°C and the absence of rainfall promote high seed quality.

When using chemical weed control, it is important that the potential phytotoxic effect on the parental lines be avoided. Even during pre-planting, herbicides should be used with special care. There should be at least two days between application of the chemical and the planting date.

Crop rotation is important in brassicas because siliques are dehiscent and have a high rate of shattering. This causes volunteer plants to appear that potentially reduce the genetic purity of the desired seed lot.

*Sclerotinia esclerotium* is a common fungal disease in this crop. Sclerotia may remain viable in the soil for at least two years and can cause devastating attacks of Sclerotinia in cauliflower and broccoli seed crops.

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Seeds are planted in seed beds. At the expanded cotyledon stage, seedlings are transplanted with tweezers to multi-cell trays. Seedlings are selected for uniformity in order to make later work such as roguing and harvesting easier.

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At the 3 to 4 true leaf stage, seedlings are transplanted to mounded beds to permit good drainage in the winter and avoid diseases. The planting holes for the seedlings are hand made with a planting frame.

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Some beds are not planted in order that tractors can enter the fields in winter to provide chemical disease control for Downy mildew (*Peronospora parasitica*) and Sclerotinia (*Sclerotinia sclerotiorum*, *S. minor*)

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To achieve synchronous nicking of inbred parent lines, especially for broccoli, it is necessary to use at least three different planting dates in the male parent line. The first male is planted a week before the female, the second male is planted at the same time as the female line and the third male planted a week after the female line. The environment does not affect plant growth of the parental lines in the same way. As a result, even using different planting dates does not always assure a successful nick. When this is the case, the curds must be cut.

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Each male is cut after flowering. (18) Sometimes, both parent lines are harvested as hybrid seed.

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Since broccoli and cauliflower require cross pollination and are insect pollinated, the isolation distance is 1500 m between fields for hybrid seed production of both crops.

Selection of curds is done when the curds are well developed. Off-type plants and those forming poor curds should be removed at this stage.

Subsequent roguing for off-types and diseased plants is done from time to time as required.

Harvesting can be problematic due to the uneven maturation of siliques and their readiness to dehisce. Harvest is done by hand. The entire plant is cut early in the morning to minimize shattering. The plants are dried in rows for 10 - 14 days in the field and later the crop is threshed in a combine.

The seed is cleaned on an air-screen cleaner. A spiral separator is used to separate splits from whole seeds.