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VEGETABLESCIENCE

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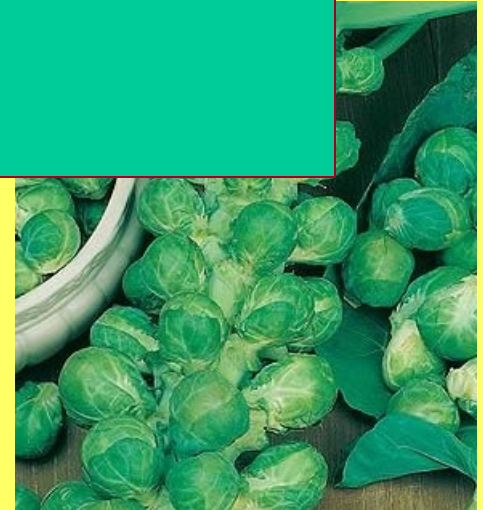
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Cauliflower



Cole Crops

Origin


Mediterranean Region



The word “cole” seems to have come from the abbreviation of the word “caulis” meaning stem.



A group of highly differentiated plants originated from a single wild ancestor *Brassica oleracea* var. *oleracea* (*sylvestris*), commonly known as wild cabbage.



The most popular vegetables grown during winter season



Cauliflower and cabbage are the most important



Broccoli is also gaining popularity due to its high medicinal and nutritive value.

Uses

- ☐ **These are eaten in the raw state as well as cooked.**
- ☐ **Rich source of vitamin A and C. Also, contains minerals including P, K, Ca, Na and Fe.**
- ☐ **Some protective properties against human bowel cancer.**
- ☐ **Used against ailments such as gout, diarrhea, colic trouble, stomach trouble, deafness and headache.**
- ☐ **Leaves are used to cover wounds and ulcers and also recommended against a hangover.**
- ☐ **Cabbage juice is said to be a remedy against poisonous mushrooms and also used as a gargle against hoarseness.**

Cauliflower

Botanical Name: *Brassica oleracea* var. *botrytis* L.
Family: Brassicaceae
Chromosome number $2n=18$



☺ A cool season vegetable grown for its white and tender curd formed of undifferentiated flower parts or pre-floral apical fleshy meristem.

☺ India commands the largest area and production under cauliflower in the world.

☺ Physiologically different from other cole crops as possesses an intermediate stage of curding between the vegetative and generative phase.

☺ Cauliflower cultivars grown in India can be classified in two broad groups:

▶ Indian Cauliflower/tropical/hot weather/heat tolerant

✓ result of crossing between Cornish and European types.

▶ European types/Early temperate type/Snowball/late

Difference between Indian Type and European type

Indian Type	European Type
Tolerant to heat	Not tolerant to heat
Curd formation at and above 20 °C.	Curd formation at 5-20 °C
Annual	Biennial
Yellow to creamish curds, loose with strong flavour.	Snow white curds with very mild or no flavour (better quality curds).
Plants are short having long stalk and loosely arranged leaves.	Steady plants and long leaves giving protective jacket to curd.
Early	Late
More variable (heterozygous)	Less variable (homozygous)
More self-incompatible.	Less self incompatible.
Small juvenile phase.	Long juvenile phase.
No need of vernalization but needs cold treatment at 10-13 °C.	Needs vernalization at 7 °C for 8-10 weeks.

Soils

- ♠ Grown in all types of soils with good fertility and good water regime.
- ♠ Mid season and late crop will grow very well in medium, medium heavy and heavy soils.
- ♠ A light to light medium soil should be preferred for early crop to have easy drainage in rainy season.
- ♠ Water stagnation checks the growth.
- ♠ Prefers pH ranging from 6 to 6.5.
- ♠ Deficiency symptoms of Mg may quickly appear in acidic soils while pH higher than 7 reduce availability of B causing Browning

CLIMATE

- ♥ Climatic factors play important role during transformation from vegetative to curding and curd development stages.
- ♥ Temperature 10-21°C is good for germination.
- ♥ Thermo-sensitive i.e. temp influences growth stages from vegetative to reproductive.
- ♥ Transformation from vegetative to curding take place from 5°C to nearly 28-30°C, depending on the cultivar of a particular maturity group.
- ♥ Certain amount of vegetative growth is necessary to pass over juvenile phase of plant.
- ♥ 4 weeks in Mid-Late group and 5-6 weeks in late group would be sufficient for transformation from vegetative to curding phase.
- ♥ Optimum temperature for growth of young plant is 23°C in initial stages while growth in later stages is more favourable at 17-20°C.
- ♥ The tropical cultivars can grow even at 35 °C or more.
- ♥ Plant will go on putting vegetative growth without forming any curd if temperature remains higher than optimum for curding .
- ♥ Late group cultivars require 15-20 °C for optimum growth but the same temperature would cause curd formation in the early cultivars.
- ♥ Therefore, when tropical cultivars are grown at lower temperature, they form button and show severe riceyness to typical green bud formation.
- ♥ Temperature should not fluctuate too much during curd initiation phase, otherwise curd quality deteriorates.

Conclusion: Temperature higher or lower than optimum for curding results in physiological disorders like riceyness, leafyness, blindness, loose and yellow curd.

Four different maturity groups (I-IV)

Maturity group	Nursery sowing	Transplanting time	Opt. temp. for curding	Varieties
Extra Early: May maturity (May-June)	End of February	March	24°C-30°C	Pusa Meghna, DC 23, Pusa Kartik Sankar
Early I (A) Sept. maturity (mid Sept-mid Nov.)	Mid May	July beginning	20-27 °C	Early Kunwari, Pusa Early Synthetic, Pant Gobhi-3, Pusa Meghna, Pusa Kartik Sankar
I (B) Oct. maturity (Mid Oct-mid Nov)	May end to Mid June	Mid July	20-25 °C	Pusa Katki, Pusa Deepali, Pant Gobhi-2
Mid Early (II) Nov. maturity (Mid Nov-mid Dec)	July end	Sept beginning	16-20 °C	Improved Japanese, 12-C, Pusa hybrid-2, Pusa Sharad, Pant Gobhi-4
Mid late (III) Dec maturity (mid Dec-mid Jan)	Aug end	Sept end	12-16 °C	Pusa Synthetic, Pusa Subhra, Pusa Paushja, Pusa Shukti, Palam Uphar, KT-25, Pant Subhra, Pusa HimJyoti, Pb Giant 35
Late (IV) Snowball (Jan-March)	Sept end to mid Oct	Oct end-mid Nov	10-16 °C	Snowball 16, Pusa Snowball-I, Pusa Snowball K-1, Dania, Ooty-1,

Varieties recommended for Himachal Pradesh

Early varieties	Early Kunwari, Pusa Deepali
Mid-early Group	Improved Japanese,
Mid-late	Pusa HimJyoti, Palam Uphar, Pusa Subhra
Late season	Pusa Snowball 1, Pusa Snowball K1

Soil preparation and transplanting

- ♣ Soil should be well prepared by ploughing first with soil turning plough and afterwards with 4 to 5 ploughings with country plough.
- ♣ Ploughing should be followed by leveling and bring it to a fine tilth.
- ♣ The manure should be applied while preparing the field.
- ♣ Drainage is a problem for early and some times in mid season crop when the rains prolong.
- ♣ Transplant early crop (MG II & I) on ridges or raised beds while mid and late (MG III & IV) cultivars on flat beds.
- ♣ Transplanting should be done during late afternoon

Nursery Sowing Time

Zone	Early group	Mid group	Late group
Low Hills	June-July	August-September	October-November
Mid Hills	April-May	July-August	September
High Hills	-	-	April

Seed Rate

Early varieties	600-750g
Mid-Early season varieties	500g
Mid-late varieties	400 g
Late varieties	300g

Spacing

Early varieties	45cm X 30cm
Mid and Late season varieties	60cm X 45cm

Manures and Fertilizers

Open pollinated varieties

Farmyard manure (q/ha)	N	P ₂ O ₅	K ₂ O
	(Kg/ha)		
250	125	75	60

- ☺ Apply full dose of FYM and P and one-third of N and half of K at time of transplanting.
- ☺ Remaining part of N should be top dressed at an interval of one month each while half of potassium is to be applied alongwith N during second top dressing.
- ☺ Sulphur application @ 20-40kg/ha and Mo @ 80-160g/ha helped in increasing cauliflower yield under Palampur conditions.

Interculture and weed control

- ▶ **A shallow rooted crop, so do shallow hoeing to remove weeds and to avoid any injury to the roots.**
- ▶ **Regular hoeing operation keep crop weed free and provide aeration to the root system.**
- ▶ **Crust formation in medium heavy and clay soils hinder water and air penetration in root system and should be broken otherwise adversely affect plant growth.**
- ▶ **Earthing up is important in rainy season as roots get exposed after every shower and should be done 4-5 weeks after transplanting.**
- ▶ **Critical period for crop- weed competition is between 30-50 days after transplanting.**
- ▶ **Use herbicides in initial stages followed by hand weeding in later stages of plant growth along with fertilizer top dressings.**
- ▶ **Application of Alachlor (Lasso) @ 2kg a.i./ha before transplanting is beneficial for controlling annual and broad leaved weeds.**
- ▶ **Pendimethalin (Stomp) @1.2 kg a.i./ha or Oxyflurofen (Gol) @ 600 ml/ha) can also be used before transplanting if there is problem of annual weeds only.**

Irrigation

- First light irrigation just after transplantation of the seedlings.
- Needs very careful irrigation which should be sufficient at right time.
- Over-watering and insufficient irrigation is harmful.
- Regular maintenance of optimum moisture supply is essential during growth and curd development.

Use of growth hormones

- ☺ Treat cauliflower seedlings with NAA (10 ppm) as starter solution effective in enhancing plant stand in the field and vegetative growth.
- ☺ Application of $GA_4 + GA_7$ @ 80 mg/l of water shortened the period from transplanting to the harvest.

Blanching

- ❑ An important operation to protect the curds from yellowing to direct exposure to sun.
- ❑ The curds may also lose some of their flavour because of this exposure.
- ❑ This problem generally occurs in varieties of early and mid maturity group which have spreading and open plant type.
- ❑ In Snowball group and some of hybrids of early and mid maturity groups, curds remain naturally protected and surrounded by inner whorls of leaves.
- ❑ This may be done by drawing and tying of leaves when curds are fully developed.
- ❑ Sometimes, a leaf of cauliflower is kept over the curd 4-5 days prior to harvesting.

Harvesting

- ☺ The harvesting of curds is to be done as soon as the curds attain prime maturity and compactness.
- ☺ It is better to harvest little early than late if there is any doubt about the maturity.
- ☺ Delayed harvesting leads to the elongation of flower stalk and curds become over-matured, deterioration of quality and turns into loose, leafy, ricey and fuzzy.
- ☺ Such curds should be eliminated from the consignment to be sent to the market as they wilt rapidly and spoil the appearance of the consignment.
- ☺ The curd should be cut-off with stalk along with sufficient number of jacket leaves to protect the curd.
- ☺ Severe trimming of leaves is to be done after unloading or before marketing.

Yield (q/ha)

- ♠ Early varieties 100-150
- ♠ Mid and Late season varieties 150-225.
- ♠ Snowball group may produce upto 500 q/ha.

Pre and post harvest handling

- ⇒ Harvesting should be done preferably in the late evening or early morning so that the product remains turgid and fresh
- ⇒ The freshly harvested plants should be put in the truck or cart in such a way that the bruising of the curd is minimum.
- ⇒ These bruised portion of the curd becomes blackish and unattractive for the fresh market

Storage

- ☉ Most of cauliflower grown in India is harvested and used for fresh consumption
- ☉ In general, it is not stored in the cold storage because of lack of capital to erect and run the cold storage by farmers.
- ☉ Snowball cauliflower can be stored for 7 days at 0°C-1.7°C and RH between 85-95%.
- ☉ Cauliflower with intact leaves and head size 25-30cm dia are the most suitable for long term storage.

Packing and Packaging Material

- ♣ Packages protect the contents against undue damage during distribution.
- ♣ Maintain the shape and strength often for long periods at a relative humidity near saturation.
- ♣ Generally packaging material is not used for transportation or storage of cauliflower in India.
- ♣ Freshly harvested plants with most of the leaves intact are loaded in cart/truck keeping the curd downward so that they are not exposed to the sun and the leaves protect the curd from bruising and impact damage. This practice is for the market situated nearby.
- ♣ They are sent in gunny bag packings or in crates to distant market.
- ♣ Cling wraps may be used for packing in which only the curd portion is kept.

Value added products

- 😊 In India, cauliflower is mainly dried or processed into mixed vegetable pickles.
- 😊 In the glut season, cauliflower can also be preserved in chemical solution containing 3% salt + 0.3% Potassium metabisulphate + 0.8% glacial acetic acid in glass jars for 6-8 months for culinary purpose and for pickling.

Frozen cauliflower

The curds are washed, cut into pieces, blanched, packed in polybags of the desired size and then marketed in the lean period.

Dehydrated Cauliflower

- ❖ **Cauliflower buttons are separated and cut into small pieces.**
- ❖ **These pieces are blanched for 4-5 minutes in boiling water, steeped in 0.5% SO₂ solution for about an hour, then drained and washed.**
- ❖ **These are then dried at 60°C for about 10-12 hours.**
- ❖ **The dry matter content is 7 and 8-10% in snowball and tropical cauliflower, respectively.**

Canning

- **Canning is also done on limited scale in India.**
- **Compact curds are cut into small pieces of suitable size.**
- **These are then blanched for 5-6 minutes in boiling solution of 0.1% citric acid or tartaric acid and subsequently cooled in 2% brine to prevent discolouration.**
- **Blanched material is filled in plain cans containing 2% brine, then they are sealed and sterilized .**
- **Pink colouration in the canned product is a problem.**

PHYSIOLOGICAL DISORDERS

1. Buttoning

- ☺ It means development of small curds or buttons.
- ☺ The general basis is that any check in the vegetative growth of the seedlings may induce buttoning.

Possible Reasons

- Planting of over aged seedlings, which do not get sufficient time to initiate growth before transformation to curding.
- Selection of wrong cultivars means planting early variety late
- Root injury by insects or diseases.



2. Riceyness

- ☺ A premature initiation of floral buds or elongation of peduncle stalk of inflorescence is characterized by riceyness.
- ☺ The curds are considered to be of poor quality for marketing

Possible Reasons

- ⇒ Temperature higher or lower than the optimum required for curding in a particular cultivar
- ⇒ High N and high temperature favour rapid growth and development of curd also causes riceyness

Management

- 🕒 Proper management of soil moisture and fertility during the development of head or curd.

3. Fuzzyness

- ❖ It is the elongation of pedicels of the individual flower.
- ❖ Almost all the prefloral bud which develops precociously on the curd surface give the fuzzy appearance.

Possible Reasons

- ⇒ Temperature higher or lower than the optimum required for curding in a particular cultivar
- ⇒ High N and high temperature favour rapid growth and development of curd also causes riceyness

Management

- Proper management of soil moisture and fertility during the development of head or curd.



4. Blindness

- ❖ **Blind plants are those which are without terminal bud.**
- ❖ **The leaves of the blind plants are large, thick, leathery and dark green.**

Possible Reasons

- **Poor fertility of the soil.**
- **Damage by insects, diseases etc.**
- **Genetic irregularity.**
- **Cold temperature.**
- **Damage to the terminal portion during handling at the time of planting**



Management

- **Healthy and vigorous seedlings with terminal portion intact should be planted.**

5. Bracting

- ▶ The bracts are underneath the prefloral meristem which corresponds to axillary buds.
- ▶ These bracts or leaves come out of the curd resulted in poor quality of curds for marketing as they turn green or purple in colour on receiving the direct sunlight at the surface of the curd.

Possible Reasons

- ♣ Temperature higher than the optimum during curding

6. Purple colouring

☀ Some time various pigmentations are occurred on the curd



Possible Reasons

😊 Fluctuation in temperature.

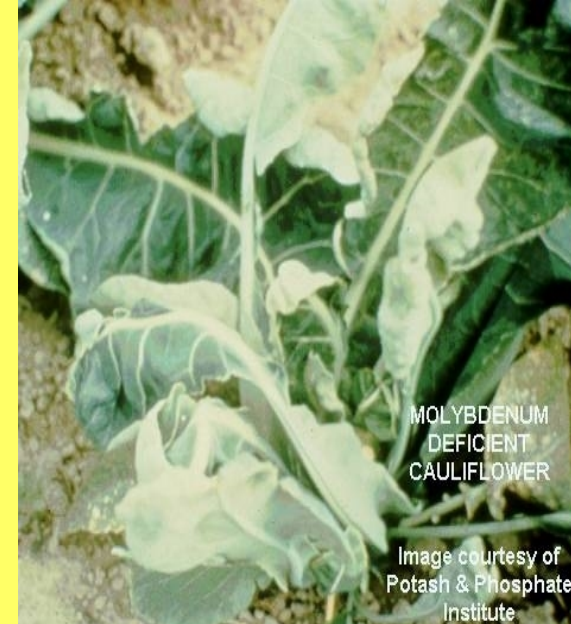


7. Whip tail

- ◆ It is caused by the deficiency of Molybdenum (Mo).
- ◆ Young plants become chlorotic and turn white particularly along the leaf margins.
- ◆ They also become cupped and wither and eventually the leaf dies and the growing point also collapses.
- ◆ In older plants, the lamina of the newly formed leaves is irregular in shape, frequently consisting of only a large bare midrib and hence the common name “Whip tail”.

Management

➤ Application of Mo @ 1kg/ha.



8. Browning (Red or Brown rot)

- ▶ It is caused by boron deficiency.
- ▶ Smaller water soaked areas in the centre of the curd is the first sign of appearance.
- ▶ In later stages, the stem become hollow with water soaked tissues surrounding the walls of the cavity.
- ▶ In more advance stages, a pinkish or rusty brown area develops on the surface of the curd and hence is known as red or brown rot.

Management

- ▶ Application of borax @20kg/ha



9. Blackspeck

A physiological disorder in cauliflower common with the popular snowball cultivar. Blackspeck could be due to nutrient imbalance. Tip burn and internal browning in cabbage and Chinese cabbage is due to the inadequate transport of calcium to rapidly growing tissues.



Management

Foliar spray, with calcium nitrate may control the problem or alternatively by a reduction in nitrogen fertilizer

