

Scientific Cultivation of Cabbage

Cabbage (*Brassica oleracea* var. *capitata*) is one of the most important winter vegetables grown in India and has high nutritive value. 100 g of green edible portion of cabbage contains 92% water, 1.5 g of protein, 4.8 g of carbohydrate, 40 mg of calcium, 0.6 mg of iron, 600 IU of carotene and 60 mg of vitamin C. Due to its wide adaptively, resistance to disease and stress, high yield and



good transportation potential, it is cultivated worldwide. Area and production of cabbage in West Bengal is 0.79 lakh hectare and 22.88 lakh tonnes, respectively. Murshidabad district of West Bengal occupies highest area (0.1 lakh hectare) and production of 3.72 lakh tonnes under cabbage.

Climate

Cabbage can tolerate extreme cold weather and is hardy than cauliflower. It performs well in cool and moist climate. Optimum temperature for seed germination is 20- 25°C and for head formation is 15-20°C. At low temperature of 2-7°C for an extended period, the plants develop seed stalks instead of heads. Optimum temperature for growth and development is 25-30 °C. Splitting of heads may occur due to heavy rains after prolonged drought. Early maturing varieties are more prone to head splitting than the late maturing ones.

Soil

Well drained loam to sandy loam soil with high organic matter and pH of 6.0-6.5 is ideal for cabbage production. In heavy soils, growth and development of the plants is slow but the developed heads have better keeping quality. Light soils tend to produce early with loose heads.

Seed rate

Seed rate of cabbage varies from 500-600 gram per hectare. However, for hybrid varieties seed requirement is 400-450 gram per hectare.

Varieties

Cabbage cultivars are broadly classified into three groups viz. white cabbage (*Brassica oleracea* L. var. *capitata* f. *alba*), red cabbage (*Brassica oleracea* L. var. *capitata* f. *rubra*), and savoy cabbage (*Brassica oleracea* L. var. *capitata* f. *sabauda*). Commonly grown varieties of cabbage in India belong to the white cabbage group. Commonly grown varieties are listed below.

Golden Acre (Introduction, USA)

Early maturing variety with small round heads, colour of the leaves is light green from outside and dark green from inside. Individual head weight is 1-1.5 kg, harvested within 60-65 days after transplanting. Late harvesting leads to heads cracking. Average yield is 200-240 q/ha.

Pusa Mukta (IARI, Katrain)

It is an early maturing variety and takes 70-80 days after transplanting to maturity. Heads are medium sized, compact and round each weighing 1.5-2.0 kg. Average yield is 250-300 q/ha. It is resistant to black rot.

Pride of India (IARI, Katrain)

Early maturing variety, medium-large head weighing 1-1.5 kg, harvested within 70-80 days after transplanting, Average yield is 200-280q/ha.

Pusa Drumhead (IARI, Katrain)

It is a late maturing variety developed by selection from the material introduced from Japan. It takes about 90 days to reach maturity. The heads are pale green, flat, compact and large, each weighing 3.0-3.5 kg. The yield varies from 250-350 q/ha.

Pusa Synthetic

It is a mid season high yielding variety. Heads are medium in size, round and weigh 2-4 kg. Harvesting can be done within 80-90 days after transplanting. Average yield is 350-460q/ha.

Hybrid Cultivars

There are a large number of hybrid cultivars of cabbage, most of them developed by the private seed companies. Some of these hybrids are:

Bajrang F1 (Beejo Sheetal): It is early maturing hybrid and takes 65 days to reach maturity. Its heads are dark green, small and compact weighing about 1.0 kg. Outer leaves are upright. It is tolerant to high temperature and resistant to *Fusarium* wilt.

Swarna (Beejo Sheetal): It is a late maturing hybrid and takes 110 days from sowing to reach maturity. Its heads are round and large weighing about 3.0 kg.

Sri Ganesh Gol (Mahyco): It takes from 90-95 days from sowing to reach maturity. The heads are bluish-green, round and compact. Average yield is 500-700 q/ha. It is resistant to yellowing disease.

Red Cabbage

There are different varieties of red cabbage viz. Ruby Ball, Scarlet O Hara, Ruby Perfection grown in India. All the red cabbage cultivars are tolerant to diamond back moth insect which is a

serious pest of cabbage. It has distinct coat of wax and produces a head of 1-2 kg in about 90 days from transplanting.

Sowing Time

The time of sowing the cabbage seeds varies with different locations. In the plains of northern India, sowing in seed bed starts from early August and continue till November for the late cultivars. In eastern India, sowing is generally done from mid to late September.

Nursery Management

The soil of nursery bed should be well prepared and free from disease organisms. For raising healthy seedlings, nursery beds should be of 1 meter width, length should be 3-5 meter and 10-15 cm high. 60-70 numbers of beds of size 3m² will be required for raising seedlings for one hectare. Fertilizers should be incorporated @ 100g SSP & 50g MOP per bed. Sieved well rotten farmyard manure or compost @ 2-3 kg/m² must be added in the seedbed. Before sowing, the seed should be treated with any one of fungicides like Thiram, Cerasan, Agrosan or Bavistin @ 2 g/kg seeds. The optimum spacing between rows in the nursery bed is 10 cm and the depth of sowing should be 1.5-2.5 cm. After sowing, the seed is properly covered with a thin layer of mixture of fine manure and soil. The seedbed is covered with dry paddy straw or gunny bags so as to retain moisture and also increases the temperature. Proper watering should be done for rapid germination of seed and for optimum growth of seedlings. As soon as the seedlings emerges, the cover should be removed. At 2-3 leaf stage urea should be applied @ 1g/litre of water. As a preventive measure, spraying for Metalaxyl + Mancozeb @ 0.2% should be done.

Attention should also be given for control of diseases and insect pests in the nursery. “Damping off” caused by different fungi viz. *Pythium spp.* *Rhizoctonia spp.* is common and severe disease in nursery. Spraying of Blitox-50 @ 0.3% is effective against the disease.

Manures and Fertilizers

Cabbage is a shallow-rooted crop and requires high amount of nutrient. The fertilizer dose depends upon the fertility status of the soil. For an optimum yield, 15-20 t/ha of well-decomposed FYM is incorporated into the soil during land preparation. Generally, application of 80-120 kg N, 60-100kg P₂O₅ and 60-120 kg K₂O is recommended for optimum yield. Entire amount of P and K is applied at the time land preparation. Half dose of N is applied after 7 days of transplanting and the remaining half of N is applied at 30-35 days after transplanting.

Land Preparation

The land should be well prepared by four to five ploughing. Planking should be done for proper leveling. The transplanting is done on the raised beds, ridges or in furrows depending on climate and soil conditions. For early planting, ridge method is suitable especially in areas where the rains occur at the time of planting. The manure and fertilizer should be applied as a basal dose while preparing the field.

Transplanting of Seedlings

Transplanting should be done preferably in the morning or late evening. Seedlings are ready for transplanting at 25-30 days after sowing. Before transplanting, the roots of the seedlings are dipped in a solution of Bavistin (2 g/litre of water). Immediately after transplanting, watering should be done using can. For better seedling establishment beds may be first irrigated and then the seedlings are transplanted. Proper spacing should be maintained between row to row and plant to plant. For early varieties spacing should be 45x45 cm, mid-season varieties 60x45 cm and for late varieties 60x60 cm. Grow two rows of mustard or marigold as a trap crop after every 25 rows of cabbage.

Irrigation

Cabbage is shallow rooted crop hence frequent light irrigation should be given especially in light soil. The first irrigation using watering can should be given immediately after transplanting for seedling establishment and subsequent irrigations are given at an interval of 10-15 days depending upon the season. Prolonged water stress followed by irrigation results in splitting of head.

Integrated Weed Management

Normally, the crop is kept free of weeds by 2-3 hand weeding and 1-2 hoeing. Earthing-up helps in supporting the plants and avoid toppling of the plants during head formation. Weed control is most critical for the first 25 days after transplanting. Among the herbicides, pre-emergence application of Fluchloralin (1-2 kg a.i. per ha in 600-700 litres of water) or Nitrofen (2 kg a.i. per ha) followed by a hand weeding at 45 days after transplanting effectively checks the weed population.

Major Insect-pests

Cabbage butterfly (*Pieris brassicae*)

The caterpillars feed gregariously during the early instars and disperse as they approach maturity. The first instar caterpillars just scrape the leaf surface, whereas the subsequent instars eat up leaves from the margins inwards, leaving intact the main veins. Often, entire plants are eaten up. The adult is a common white butterfly with black spots. The larva also feed on the head and deposit excreta which make the head unmarketable.

Management

- Spray Nuclear Polyhedrosis Virus (NPV) @ 250 LE/ha in evenings at 30, 35 and 45 days after transplanting.
- Spray BT formulations (Dipel) @ 2 g/l of water for Cabbage Butterfly and Diamond Back Moth.
- Install pheromone traps @ 4-5/acre for monitoring of the adult insects.

Leaf webber (*Crociodolomia binotalis*)

The moths lays eggs in clusters of 40-100 on leaf surface, which hatch in 5-7 days. Young larvae feed gregariously and later web the leaves together and feed within. This results in rotting of cabbage head. The larval period lasts for 25-20 days while pupation occurs in soil, which varies from 15-40 days.

Management

- Collect and destroy egg masses and gregarious larvae.
- Spray any contact insecticide on the foliage when the larvae are observed.
- Spray neem seed kernel extract 4% or pulverized neem seed powder extract (NSPE) 4%.

Aphids (*Brevicoryne brassicae*)

Aphids are green tiny insect mostly found on the underside of the leaves. They suck the sap, devitalize the plants affecting the quality of head. Direct feeding on young growth leads to wilting of plants. Early attack may lead to stunted growth. Symptoms of virus transmitted diseases by *B. brassicae* include mosaic, chlorotic and necrotic lesion on leaves. *M. persicae* is the most important aphid virus vector.

Management

- Spray any systemic insecticide like Dimethoate 3 EC @ 2ml/litre of water when the aphids are observed.
- Spray pulverized neem seed powder extract (NSPE) 4%.

- Grow two rows of mustard as a trap crop after every 25 rows of cabbage/cauliflower.
- Select resistant varieties like All season, Red Drum Head.

Major Diseases

Alternaria leaf spot (Alternaria brassicicola)

Tiny black spots appear on the leaves which enlarge in concentric circles with yellow halos. Severe infection on leaves can cause leaves to fall away from plant. Black shooty spores are produced on the leaf surface under high humidity and affect the head at the later stage. The disease may be seed-borne, soil-borne, and wind-borne.

Management

- Alternaria leaf spot of cole crops is effectively managed by detaching all the infected lower leaves in morning and then burning.
- Spray of Chlorothalonil @ 0.2% along with sticker @ 0.1% in evening hour. Adopt crop rotation (a minimum two year crop with non-crucifers)
- Use disease free seeds.
- Hot water seed treatment (50 °C for 20 to 30 min)
- Spray Mancozeb (0.2%) or Blitox (0.20%) at 7-10 days interval.

Damping-Off (*Pythium spp*)

One of the most damaging diseases of vegetables at seedling stage is caused by soil borne fungi such as *Pythium*, *Fusarium* and *Rhizoctonia spp*. Presence of fungus in the soil results in poor germination, infection after seed germination causes the seedling to rot and fall off, also termed as “damping-off”. Cool, cloudy weather, high humidity, wet & compact soil and overcrowding of seedlings increases the incidence of the diseases.

Management

- Soil solarization or soil treatment with formaldehyde (1.5-2%) in nursery beds.
- Soil drenching with Thiram and Dithane M-45 (0.2%) or bavistin (0.1%).
- Seed treatment with fungicides like Thiram, Captan, Ceresan or Bavistin 3gm per kg of seeds before sowing.
- Regulate watering/irrigation carefully to avoid excess soil moisture.
- Provide good drainage.
- Destroy the infected plant debris after harvesting.

- Plants should be thoroughly inspected for black rot symptoms and the affected plants should be removed and destroyed.

Downy Mildew (*Peronospora parasitica*)

Disease is observed on the leaves. Fine hair like downy growth of fungus is observed on the lower surface of leaves. Corresponding of the fungal growth there is minute pinhead brown necrotic spots visible on the upper surface of leaves, which later on coalesce to each other. It may appear from nursery to head formation stage.

Management

- Field sanitation, disease-free seed and crop rotation reduce pathogen inoculums.
- Foliar spray of Mancozeb @ 0.25% at disease initiation stage and repeat next spray at 6-8 days interval.
- One spray of Metalaxyl + Mancozeb @ 0.2% in severe case may be given.
- Use sticker @ 0.1% with fungicide to avoid runoff of droplets

Black leg (*Phoma lingam*)

The disease occurs in areas with high rainfall during the growing period. The fungus is carried by the seed and hence it may occur from the early stage. The stem of the affected plant when split vertically, shows severe black discoloration of sap stream. Whole root system decays from the bottom upwards.

Management

- Seed treatment with Captan or Thiram 4g/kg of seed, followed by seed treatment with *Trichoderma viride* 4g/kg.
- Pusa Drumhead, a cabbage cultivar has been reported to be tolerant under field condition.

Root rot (*Rhizoctonia solani*)

Young plants show soft, water soaked lesion on the stem near soil level, the cotyledons wither and the plant eventually falls over and perishes. When infection occurs at a later stage of growth, the lower part shows discoloration and becomes thin wire like stem.

Management

- Remove and destroy the affected plants.

- Seed treatment with Captan/Thiram @ 4g/kg, followed by seed treatment with *Trichoderma viride* @ 4g/kg.

Harvesting

The right time to harvest cabbage is when the heads are firm and mature. It is ready for harvest at 90-120 days after planting. Delayed harvest, even few days beyond maturity can result in splitting of heads and high incidence of disease. Harvesting of immature heads results in yield reduction and the soft tissue of heads cannot resist handling damage. Harvesting should be done by bending it to one side and cutting it with a knife. The stalk should be cut flat and 3-4 leaves should be retained for better cushioning.

Yield and Income

Yield of cabbage varies from 125-150 quintals per hectare in early season varieties and 200-300 quintals per hectare in main and late season varieties. Cost of cultivation of Cabbage is approx. Rs. 1,38,354/- per hectare and the net return is Rs. 85,646/- per hectare.