SPROUTING BROCCOLI

BOTANICAL NAME : *Brassica oleracea var. italica*
COMMON NAME : Broccoli
FAMILY : Cruciferae
CHROMOSOME NUMBER : 2n=18
ORIGIN : East Mediterranean and Italy (Main center of diversification)

- The word broccoli is derived from the Latin word Brachium meaning an arm or branch. Broccoli contains 3.3per cent protein, high content of vitamin A and C and appreciable quantities of thiamine, riboflavin, niacin, calcium and iron.
- Broccoli refers to green buds and thick fleshy floral stalks arising from the main stem.
- In Italy, these have been used as a vegetable from early times but their economic importance become appreciable only since thirties of last century when this vegetable became popular in the U.S.A.
- A larger part of the produce in the U.S.A. goes to the freezing industry.
- It is also becoming popular in other parts of the country very rapidly.
- Sprouting broccoli is sometimes briefly called as broccoli though this name is also used for broccoli rape (the sprouts which develop on turnips) and for winter cauliflower (winter broccoli or heading broccoli).
- In U.S.A., it is also known as Italian broccoli pointing to its Italian origin.
- Morphologically, sprouting broccoli resembles cauliflower.
- The plant forms a kind of head, consisting of green buds and thick fleshy flower stalks.
- A main head is produced terminally and comparatively smaller heads in the shoots arise from axils of leaves laterally.
- The terminal head is rather loose, green in colour and the flower stalks are longer than cauliflower.
- The sprouts in the axils of leaves develop strongly, especially after the removal of terminal bud or head.
- Both terminal head and the sprouts with bud clusters are consumed as human food.

CLIMATE

- Brocooli is a cool season crop.
- Seed germination takes place at 12-16^{o}C and optimum temperature for growth is 16-20^{o}C.
- Hot weather results in development of small and thin leaves in the head. Generally, the plants of broccoli are hardy, can withstand fairly heavy frosts.
- It is generally biennial, while the annual cultivars are slightly sensitive to frost.

SOIL

- The requirement of broccoli is not that specific as in other cole crops though the soil should be sufficiently fertile and rich in organic matter for the development of seedlings after transplanting.
- Brocooli is slightly tolerant to acidic soils (pH 5.5-6.5).
- Soil should be well cultivated so that it becomes friable and suitable for planting.

CULTIVARS
Different Types of Broccoli

Purple sprouting broccoli	Biennials, branched, purple spears, variable
Purple cape broccoli	Biennials, single purple heads, variable
White sprouting broccoli	Biennials, branched, white spears
Purple Sicilian broccoli	Single heading pale-purple heads also known in horticulture as purple cauliflower
Couve broccoli	„Roxo de Cabeca" Tall purple heading, sprouting type from Portgal
Calabrese	Green sprouting broccoli from Calabrian region. Now a world wide crop and virtually single heading
Black broccoli	Highly branched annual with dark green spears and sickle shaped leaves, from Rome area

- In Brocooli, purple and green variants occurs though in U.S.A, only the green types are grown.
- The purple types are fairly hardy and can be harvested during winter.
- The green sprouting broccoli is classified in accordance to their maturity i.e. early, medium and late cultivars.
- Though a very sharp distinction is not possible but the cultivars may differ in the size of plant, size of clusters and buds, firmness of heads, colour of heads and foliage.
- The demand is more for a firm head with small dark green buds while demand for the side shoots have decreased in recent years possibly due to difficulty in harvesting.
- Cultivars like De Cicco, Green Bud, Spartan Early etc. are early types and can be harvested in 6-7weeks after transplanting.
- These cultivars may not perform well under unfavourable conditions especially at lower temperature.
- Cultivars like Waltham 29, Green Mountain, Coastal Atlantic etc. are sensitive to buttoning and can be grown as an early or late crop.
- The medium strains like Green Sprouting Medium take about 100days to maturity, while the late strains like Green Sprouting Late are biennials and may be harvested on the onset of winter or after its end.

- At present a large number of F1 hybrid cultivars are being marketed by the different seed companies of Japan, U.S.A. and Europe.

Some of F1 hybrids are

- **Extra Early and Early :** Southern Comet, Premium Crop and Laser
- **Mid season :** Cosair, Excalibur and Emerald Corona
- **Late :** Late corona, stiff, kayak and Green surf

Some of the important varieties grown in Northern India are

Pusa Broccoli Kt. Sel. 1:

- Developed through selection at IARI, Regional Station Katrain (Kullu Valley).
- Compact light green heads, weighing around 250-400g, plant height 40-50cm and ready for harvesting in 85-95days after transplanting.

Palam Samridhi (DPGB I):

- Sprouting broccoli having compact green heads, free from yellow eyes and bracts, average head weight is 300-400g, plant branched.
- It also bears sprouts in the axil of leaves which adds to the total yield, ready for harvest in 85-90days after transplanting, average yield 150-200q/ha.

Palam Haritika:

- Sprouting broccoli having dark green straight leaves, the main head formed deep inside the leaves.
- Late in maturity and gets 150 days for harvesting, free from yellow eyes, average yield 200-250q/ha

Palam Kanchan:

- Yellow coloured heading type broccoli, leaves are large, green and straight with white midrib.
- Gets ready for harvesting in 140days, average yield 250-300q/ha.

Palam Vichitra:

- Purple coloured heading type broccoli, medium foliage, open green leaves having green tinge, heads are firm and solid.
- Gets ready for harvesting in 115-120days, average yield 225-250q/ha

Punjab Broccoli 1:

- This variety is developed by PAU, Ludhiana, matures in 65-70days, bears large number of spears, foliage dark green with smooth leaf surface, heads and spears are dark green with bluish tinge.

NURSERY MANAGEMENT

- Same as for cabbage

SEED RATE

- The seed rate for raising seedlings to plant in one hectare area is about 300-400g.

SPACING

- 45 x 45 or 60 x 45 cm

SOWING TIME

- It varies in different parts of the country.
- In plains, sowing is done in October whereas in mid hills it is done in September.
- In high hills, seeds are sown in month of May-June.
- The time of transplanting depends upon the climatic condition and the kind of variety.
- The sowing of an autumn crop is limited and sowing is undertaken in autumn to harvest them in late spring or early summer by over wintering them.

NUTRIENT MANAGEMENT

- Light soils should be supplied with heavy quantity (200-250q/ha) of organic matter either through incorporation of farmyard manure or compost or through green manuring.
- Requirements of manures and fertilizers depend upon soil fertility, soil status and cultivar.
- Besides this, apply 100-125kg N, 60-80kg P2O5 and 25-50kg K2O per ha should be applied depending
- It is better to apply nitrogen in split doses.
- It has been reported that warm weather, heavy fertilization and wide spacing results in hollowness of main stem.
- Besides macro nutrients, broccoli has light requirement for molybdenum and boron.
- The deficiency symptoms are likely to appear if fertilizers are not applied.

IRRIGATION

- Broccoli requires more water than cauliflower however, care should be taken that light irrigation at regular intervals is done.
- After transplanting irrigation are done at 10-15days interval.
- Uneven moisture after the heads have formed, cause head splitting or head bursting.

HARVESTING

- The broccoli heads resembles with cauliflower consisting of clusters of green flower buds.
- Early types mature in 45-50days, mid in 60-100days and late after 100days of transplanting.
- The head is cut along with a few leaves and stem (10-15cm).
- From the remaining main stem, lateral shoots are formed and these produce comparatively small heads.
- Usually only the central head is harvested.
- It is very important that broccoli is harvested at the correct time i.e. it is picked up before the buds open and when the bud clusters are compact.
- The heads are cut-off long with 15cm of the stem attached.
- The head may be 15-25cm in diameter and weigh about 200-600g.

YIELD

- The yield of broccoli ranges from 50-150q/ha depending on variety, time of planting and length of harvesting period.

PACKING AND STORAGE

- Broccoli is more perishable than cauliflower.
- Just after harvesting, heads and shoots are kept in cold storage until they are sold.
- Otherwise the buds and leaves became yellowish and give an unattractive appearance.
- The yellowing could be avoided by storing the broccoli in a oxygen free atmosphere. Broccoli emits ethylene in storage.
- For freezing, stems are cut to 10-15cm in length.
- The shelf life of broccoli heads & sprouts is significantly affected by temperature and not much influenced by relative humidity. Broccoli can be stored at 320F for 8-10days.
- At temperature 12–17oC and RH between 75%. It can be easily stored for 3days. Under cool storage (3oC & 88% RH) the shelf life of heads can be extended upto 31days.
- Packaging in LDPE (Low density polyethylene) bags helps in keeping the broccoli more fresh and green under low temperature.

SEED PRODUCTION

Seed Production Methods

- Methods of seed production is exactly the same as in cauliflower since the transplanting method is not successful because there is practically no rest period between the sprouts/curds stage and flowering in broccoli.
- It is easier to grow sprouting broccoli for seed than cauliflower because it can tolerate other climatic conditions and takes lesser duration than cauliflower for seed production.
- Transplanted seedlings are allowed to grow, over winter, flower and produce seed at the same place i.e. *in-situ* method.
- Besides all cultural practices required for head production of broccoli, the following essential points should be taken care of while the broccoli is grown for seed production purpose.
- Maintain proper isolation distances between two varieties.
- Raise seeds either by

i. Stump method or
ii. Seed to seed method or
iii. Head to seed method

Stump method (Rarely followed)

- The stump to seed method gives the lowest seed yield.
- Seed to seed method is used for the production of market seed.
- For stocks/breeder's seed, it is better to use head to seed method.
- For both foundation and certified seed, use seed to seed method.

Seed to seed method (Generally followed/Recommended)

- The plants are allowed to over winter in their original position where they are first planted in the seedlings stage (*in-situ*).
- The seed crop matures 10-15days before or earlier than that of head to head method.
- The most essential requirement of this method is the high quality foundation seed required for raising head crop.

Head to seed method (Generally not followed/ not recommended)

- It is followed for breeder/nucleus seed only but otherwise not remunerative.

Cultural Practices for Seed Production

- Apply 100kg of nitrogen/ha in two equal splits, first at seed stalks emergence and second at flowering and seed setting stage. Apply whole quantity of phosphorus and potassium @ 60-80kg/ha depending upon soil test at planting time.

- Optimum time for raising nursery is May-June for the production of head crop and March-April for replanting heads for the seed crop.
- Do hoeing, if required.
- Do earthing up at head formation stage.
- Be particular about irrigation. Maintain uniform moisture through irrigation at regular intervals.
- Rogue out all off types and diseased plants.
- The heads with more number of non-wrapper leaves, less loose and with heavy frames should be eliminated.
- The colour of leaves, head size, shape and maturity of the crop may also form basis of an effective selection.
- Harvest seed crop in 2-3 lots to avoid shattering of seeds.
- Thrash the seeds with the help of wooden sticks, clean the seeds and allow drying and grading for small, light, ill developed rotten and split seeds.
- Store the seeds in air tight containers under well ventilated dry and cool places.
- Under proper storage condition broccoli seeds remain viable for about 4 years.

Seed Yield

- Seed yield of sprouting broccoli is about 5-6 q/ha.

SEED CERTIFICATION STANDARDS

A. Field Standards

a. General requirements

Isolation

- Isolation is very important for the maintenance of purity of different cultivars.
- In *Brassicas,* there are two distinct groups which do not inter-cross with each other.
- Isolation is necessary when two crops of the same group are grown at the same locations.
- It would always be better to avoid more than one crop at a particular location.
- Maintain at least 1600m isolation distance for the production of breeder's seed while 1000m for certified seed.
- Seed fields should be isolated from the contaminants.

Contaminants	Minimum distance (Meters)	
	Foundation	Certified
Fields of other varieties	1600	1000
Fields of the same variety not conforming to varietal purity	1600	1000

B. Specific requirements

Factors	Maximum Permitted (Per cent)	
	Foundation	Certified
Off types	0.10	0.20
Plants affected by seed borne diseases	0.10	0.50

C. Seed Standards

Factors	Standards for each class	
	Foundation	Certified
Pure seed (minimum) %	98	98
Inert matter (maximum) %	2	2
Other crop seeds (maximum) Number/kg	0.05	0.20
Weed seeds (maximum) Number/kg	0.05	0.20
Objectionable weed seeds (maximum) number/kg	-	-
Germination (minimum) %	70	70
Moisture (maximum) %	7	7