BRUSSELS SPROUT

BOTANICAL NAME : *Brassica oleracea* var. *gemmifera*
CHROMOSOME NO : 2n=2x=18
FAMILY : Cruciferae
ORIGIN **:** Belgium

DISTRIBUTION

- It is an important vegetable in European countries.
- This vegetable, although a popular vegetable in England and its continents, is sparingly cultivated in the United States of America.
- From Belgium it has been introduced to England (1810).
- Some parts of Long Islands in New York are also well known for Brussels Sprouts production.
- In India, it is widely grown in Kodai kanal and Nilgiris hills of Tamil Nadu and Maharashtra.
- Exact statistics regarding area, production and productivity are not available.

CLIMATIC REQUIREMENTS

- Brussel‟s sprout requires a cool climate.
- It is somewhat sensitive to temperature.
- In warm weather, bud clusters become loose quickly.
- It can tolerate frosty conditions.
- However, the best quality sprouts are produced in the sunny weather and light frost during nights.
- Suitable temperature for seed germination is 12-16^{o}C and for optimum growth is 16-20^{o}C.

SOIL

- Sandy and silt loam soils are most suited for Brussels sprouts.
- It grows well in drained upland soil.
- Soils must have capability for retention of good moisture.
- Soil pH should be 5.8 to7.2 for better growth.

VARIETIES / HYBRIDS

Two types of varieties are there on the basis of growth of the plant

1. Dwarf
2. Tall

Hilds Ideal:

- It is an introduction and recommended by IARI, Regional Station, Katrain (Kullu Valley).
- Plant height varies from 60-65cm with 45-55sprouts/plant and number of leaves varies from 45-55.
- Average diameter of sprouts is 7.0-8.0cm and each sprout weighs about 7-8g.
- Sprouts are compact with good flavour.
- It takes about 115days for first picking after transplanting..

- Average yield per plant varies from 250-400 .
- Picking at 10days interval is recommended to get the higher quality sprouts, as they start bursting if not harvested at time.

Jade Cross:

- It is an early hybrid which matures in 90days after transplanting.
- Sprouts are firm, dark green, closely packed on long stems.
- It can be grown under wide range of growing conditions.
- Some other important varieties are Improved Long Island, Danish Prize, Early Morn, Amager Market and Frontier Zuerg.

SOWING TIME

- Brussels sprout is sown in June-July and seedlings are transplanted from July to September (for early crop) and October to middle November (for the late crop) in northern parts of the India.
- In eastern India, sowing is generally started from mid to late September.
- Sowing is delayed further in the southern hills except in the western and southern peninsular, where this crop can be grown almost round the year by selecting proper cultivar.
- In hills, especially in high hills, seeds are sown in April-June for summer/autumn crop.
- In the hilly areas which receive heavy rains, the summer and autumn crops are rather limited and sowing is done in autumn to harvest them in later spring on in early summer by over watering them.

SEED RATE

- About 200-500g seed/ha is required for raising the seedlings.

Methods and Management

METHODS OF TRANSPLANTING

- The seedlings are transplanted when they are 6 to 8weeks old.
- The planting is done on the flat land, ridges or in furrows depending upon climate and soil condition.
- For early planting, ridge method will be more suitable, especially, in areas where the rains occur at the time of planting.
- In saline soils, planting should be done in furrows.

SPACING

- Generally, recommended on the basis of maturity of cultivars, optimum planting distance for early cultivars is 45 x 45cm or 60 x 30cm. For mid maturity group, the distance is 60 x 45cm and for late maturity group, the planting distance is 60 x 60cm.
- For tall varieties and places having longer growing periods, spacing is 90 x 90cm.

NUTRIENT MANAGEMENT

- Brussel‟s sprout require more manures and fertilizers than cauliflower and cabbage because of comparatively longer growing period.

- FYM @20-25 tonnes/ha,
- Nitrogen @200kg/ha,
- Phosphorous @100kg/ha and
- Potassium @100kg/ha should be provided for getting higher yields.
- Whole quantities of FYM, phosphorus and potassium and one third quantity of nitrogen should be applied in the soil at the time of field preparation. It is advisable to top dress the remaining two doses of nitrogen after a gap of one month.

WATER MANAGEMENT

- First irrigation should be given just after transplanting of seedlings.
- The first irrigation should be very light.
- As Brussel"s sprouts require moist conditions, subsequent irrigations should be given at frequent intervals

INTERCULTURAL OPERATIONS

- In order to provide good aeration to the root zone, one or two hoeing may be done.
- Hoeing will also help in keeping down weeds, if any.
- However, if growing weeds are very close to the plants, they should be pulled out by the hands.
- Sometimes, removal of terminal buds and lower leaves may results in early and good sprouts.

TOPPING

- Removal of apical point is done in order to harvest the whole crop at one time.
- In normal crop also, it is done in some regions after Ist or IInd picking when the temperature is low.

HARVESTING

- The sprouts are harvested when they are firm and well developed, usually 1-2inch in diameter.
- The sprouts become ready for harvesting in approximately 120days after transplanting in north Indian conditions.
- Regular harvesting at right stage enhances further growth of the plants and formation of new more heads.
- The sprouts are picked by cutting leaving a short stalk on the main stem, rather than to break them off for the formation of new more sprouts/heads.
- A total of 3-5pickings are obtained in a common cultivar.
- Sprouts should be solid, dark or at least light green.
- Sprouts with small, loose leaves at the base are considered poor in quality.
- Loose sprouts are sometimes marketed as “Blowers”.
- The freezing industry requires a sprout less than 3cm in diameter.

YIELD

- The average yield is about 60-80q/ha.

STORAGE

- The recommended storage condition for Brussel‟s sprouts is 0-1oC with 90-95 per cent RH for about 3-5weeks.
- CA storage at 5-7per cent CO2 and 2-5 per cent O2 helps to maintain quality at 4 or 10oC during storage.

SEED PRODUCTION

Land requirements

- Land to be used for seed production of Brussel‟s sprouts should be free from volunteer plants.

Climatic Requirements

- Brussel‟s sprout thrives best in a relatively cool, moist climate with moderate rainfall, well distributed during the growing season.
- It can withstand frost in the head stage.
- It requires a dormant period of cool temperature for initiation of seed stalks and flowers.
- Cool temperature, however, is effective only after stem has attained at least 1cm diameter. In temperate climates, this occurs during the winter after the first season growth.
- Flowering and seed production follow in the second year.
- Headed plants form seed stalks when exposed to mean temperature of about 2.22°C to 10°C for 42-56days to eight week.
- In India, seed production of Brussel's Sprout is possible only in hilly areas.

Isolation Distance

- Foundation seed :1600m
- Certified seed :1000m

Methods of Seed Production

- Being a biennial, Brussel‟s sprouts require two seasons to produce seed.
- In the first season, the heads are produced and in the following season seed production follows.
- The seed crop can be left in-situ or replanted during autumn.
- In-situ method is usually followed for certified seed and the latter for nucleus seed production.
- In In-situ method, the crop is allowed to over winter and produce seed in their original position i.e. where they are first planted in the seedling stage.
- In the transplanting method, the mature plants are uprooted.
- After uprooting, the plants are immediately reset in a well prepared new field.

Methods to produce seeds of Brussel's sprouts:

- Seed production of Brussel's sprout is same as that of cabbage except that *in-situ* (seed-to-seed) method is followed since the plant does not withstand planting.

- However the plant with earthen ball may withstand planting well.
- After transplanting, the crop is allowed to over winter in the field.
- Flowering and seed- setting take place in spring-summer (from mid march to mid may).
- The plants after receiving the vernalization stimulus bolt and flower in the spring when the temperature rises.
- The flower stalk arises from the terminal growing point and also from some of the upper sprouts.
- First the main flowering stalk with branches develops from the terminal bud and the other flowering branches come from the axillary buds i.e. sprouts.
- Therefore, do not harvest the upper sprouts to allow more number of flowering branches. Flowering takes place from April to May.
- The ways and means to enhance seed set are similar to those followed for other crops.

Roguing

- The first roguing is done at the time of handling of mature crop.
- All off type plants, diseased, or otherwise undesirable types are removed at this stage.
- The second roguing is done before the heads start bursting.
- The loose leaves, poorly heading plants and those having a long stem with heavy frame must be rogued out at this stage.
- It is highly undesirable to keep such poor plants in the seed plots.
- Subsequent roguing for off-types, diseased plants, plants affected by phyllody, black leg, soft rot or leaf spots should be done from time to time as required.

Brief Cultural Practices (*In-situ* method)

Time of Sowing and Transplanting

- The sowing time of different varieties should be so adjusted as to complete head formation by the end of October or first week of November, when the mean temperature falls to 10oC or below, at this temperature, the heads stand best for over wintering.
- Early varieties should be sown from mid July onwards and transplanted when the seedlings are four to six weeks old, during the second fortnight of August.
- This sowing time must be strictly adhered to, as the crop from early sowing has matured heads during September (20oC).
- The heads sometimes get infected with bacterial stalk rot, which is very severe.
- The late crop, planted during September does not form heads and bolts directly during spring and the seed grower is not able to ascertain purity of the crop.
- The mean temperature of 22.5oC, 20oC and 14oC of August, September and October, respectively afford optimum requirements for growth and head formation.

- The late transplanted crop starts head formation during spring and continues up to June and usually does not produce seed stalks.

Preparation of land for transplanting

- Prepare the land to a fine tilth by repeated ploughing and harrowing followed by levelling.

Source of seed and seed rate

- Obtain nucleus/breeder/foundation seed from source approved by a seed certification agency.
- For main season and late varieties take 375-400g seed/ha and for early varieties, 600-750g seed/ha.

Method of raising nursery

- The seeds are sown in raised nursery beds in a similar manner as described earlier in commercial production of Brusse'ls sprouts.

Transplanting

- Four to six weeks old seedlings are transplanted.
- Transplanting should preferably be done in the evening and the field irrigated immediately afterwards.

Spacing

- For late varieties 60 x 60cm, medium varieties 60 x 45cm and for early varieties 45 x 45cm spacing should be followed.

Nutrient management

- Brussel's sprouts grow satisfactorily only when the supply of organic matter is liberal.
- For good crop, apply 20 to 25tonnes of farmyard manure per hectare at the time of land preparation.
- Apply half dose nitrogen (50 kg/ha), 200kg/ha phosphorous and 100kg/ha of potash by drilling, or by broadcasting, sufficiently before transplanting the seedlings.
- Give another dose of 50kg/ha nitrogen as surface application at the time of seed stalk emergence during April.
- Extra application of nitrogen may be given as and when there is a need before flowering starts, depending upon the condition of the crop.

Irrigation

- Brussels's sprout requires a regular supply of moisture.
- Irrigate the crop as frequently as required.
- Heavy irrigation should, however be avoided when the heads have formed.
- A sudden heavy irrigation after a dry spell may cause bursting of head.

Hoeing and weeding

- At least three weddings and hoeings till the end of October are essential.
- One weeding and earthing up during November-December and the second during March when seed stalks have emerged, control weeds and also help in proper drainage during winter and thereafter.

Staking

- After the flower stalks are sufficiently developed, staking is necessary to keep the plants in an upright position.

Handling the mature head

- After the planted crop has fully developed, crop with good heads is selected at the end of autumn and these plants are marked for seed production.
- Handling of plants can also be done carefully so that good and true to type plants are selected for seed production.

Harvesting and threshing

- Brussels sprout starts seed stalk elongation by the end of March when the mean temperature rises to 10-13^{o}C.
- Flowering and pod formation starts during the last week of April at mean temperature of 13-18^{o}C.
- By last week of May, the crop is in full flush of flowering and fruiting.
- The ripening of pod commences at the temperatures below 20^{o}C during June and July, the maturity of crop is delayed at least by a fortnight and the harvesting may continue up to July end.
- To avoid shattering of seeds, the whole crop is harvested in two or three lots with sickles.
- Generally, the plants are harvested first by hand when the pod colour is brown and about 60-70per cent of the rest of the crop changes to yellowish brown, it is harvested completely and piled up for curing.
- After 4-5 days of curing, is then threshed with sticks and sifted with hand sifters.
- After thoroughly drying seeds are cleaned and stored.

SEED YIELD

- 300-400kg per hectare.

SEED CERTIFICATION STANDARDS

Field Inspection

- A minimum of three inspections should be done first before the marketable stage, the second at the marketable stage and the third at flowering stage.

A. Field standards

A. General requirements

Isolation:

- Seed fields should be isolated from the contaminants shown below:

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	5	5
Weed seeds (maximum) Number/kg	5	5
Germination (minimum) %	65	65
Moisture (maximum) %	7	7
For vapour proof containers (Maximum %)	5	5