BEET ROOT

BOTANICAL NAME : *Beta vulgaris* L
COMMON NAME : Chukander
CHROMOSOME NUMBER : 2n=18
FAMILY : Chenopodiaceae
ORIGIN : Mediterranean region

Introduction: Beet root or garden beet or table beet is an important home and market garden crop of India grown during winter season for its fleshy enlarged roots. It can be eaten raw as salad, cooked with other vegetables and with meat and is also grown for processing. Beet root is rich in minerals and vitamin-C. The garden beet, sugar beet, swiss chard, mangel and palak, all belong to the same genus and species *Beta vulgaris*.

USES

- Beet root (Chukandar) is not so popular vegetable crop in India.
- Its root contain high percentage of sugar. It is also rich in protein, Ca, P, Fe & vitamin C.
- It is mainly used as salad in five star hotels in India, and also cooked as vegetable preferably mixed with other vegetables.
- Beet root is also suitable for pickling.
- Beet root is short stem plant, the simple leaves bear close spiral arrangement of leaves at the crown.
- Large sized beets are used for canning.
- The colour of the leaves may vary from dark red to light green.

PIGMENTATION

- Red colour of table beets is due to *betacynin*, a nitrogen containing compound, with chemical properties similar to anthocynins. Also contains a yellow pigment betaranthin.

AREA AND PRODUCTION

- Though, the exact area in beet root is not available, however in 2008, the area under root and tuber crops (combined) was 2.18 million hectares with an annual production of 44.6million tones (NHB, 2010).

CLIMATIC REQUIREMENTS

- It is essentially a cool weather crops, hence it grows best in winters in plains of India.
- It is rich in sugar and intense red in colour.
- High sugar content is accumulated under cool weather.
- High temperature for root growth result in poor colour development of the root.
- The optimum temperature for root growth is 18-21oC obtained always in cool climate and at a temperature below 10oC for couple of week's results in bolting which affects root development.
- Mild climatic conditions are suitable for beet growing under warmer conditions.

- Beet root shows alternate white and coloured circles when sliced.
- Excessive hot weather causes "zoning" – the appearance of alternating light and dark red concentric circles in the rot.
- It is a direct sown crop and can be harvested in 120-130days, whereas, transplanted crop comes to harvest in 135 to 150days.

SOIL

- Soil should be rich in organic matter.
- Preparation of land should be done by ploughing deeply and harrowing till it becomes well pulverized and finally prepared seed bed retains adequate soil moisture which induces early germination and provides favourable conditions for root development.
- Beet root is sensitive to high acidity as it is slightly tolerant to acidity (pH as low as 6.0 only).
- This is only vegetable which can successfully be grown is saline and alkaline soils up to 9 to 10 pH.

VARIETIES

Beet cultivars are usually classified on the basis of shape of roots.

1. Flat: Flat-Egyptean
2. Short-top shape: Flattened at top and bottom with rounded sides and conical or tapered base, e.g. Crosby Egyptian, Early Wonder, Asgrow Wonder
3. Round or globular: Roots are round or globular in shape, e.g. Detroit dark Red, Crimson Globe.
4. Half-long: Length is short than long types, e.g. Half-Long Blood, Winter Keeper.
5. Long: Roots are long, may grow as much as 40 cm, quite popular in Europe, e.g., Long Dark Blood.

Characters of some of the varieties are explained as under:

Crimson Globe:

- Top of this variety is medium to small.
- Leaves are large, bright green with coppery shade, prominent venation and younger red veins.
- Roots are round to flat round and medium red, small shoulders, dark crimson red with indistinct zones.
- It is non corrosive in taste when taken raw.
- It gets ready for harvesting in 80-90 days after maturity.

Crosby Egyptian:

- Roots are flat globes with a small tap root and a smooth exterior.

- The internal colour is dark purplish red with some indistinct zoning.
- The top is medium tall green with red veins.
- It reaches edible maturity in 55-60days after sowing and shows pronounced white zoning, when grown in warm weather.

Detroit Dark Red:

- Top is small with dark green glossy foliage having maroon tinge.
- Prominent venation of maroon colour is found in this variety.
- Mid rib is thin from dorsal side but looks broad because of spreading maroon shade to its nearby areas.
- Older leaves are prominently maroon shaded.
- Roots are smooth, uniform, and attractive with small collar and perfectly round with deep red skin.
- Flesh is very dark, blood red with light zoning, tender, round, fine grains and corrosive in taste when taken raw.
- It is a heavy yielding cultivar maturing in 80-100days.

Early Wonder:

- The roots are flattened globe with rounded shoulders and skin is smooth and dark red.
- The interior is dark red with lighter red zoning.
- The top is heavy, green with red veins.
- It takes about 55-60 days after sowing to reach edible maturity.

Ooty-1:

- It is a selection from the local type and released from TNAU, Coimbatore in 1992.
- It can grow up to 40 to 52cm in height.
- The roots are blood red in colour with thin skin and good quality.
- It contains 1.52 per cent protein, 10.25per cent carbohydrate and 6mg/100g vitamin C.
- It can be used as a salad.
- It yields on an average 310-450q/ha of roots.
- It can be grown throughout South Indian hills.

SOWING TIME

Plains

Northern plains : September – November.

Southern plains : July – November.

Hills

March- July.

The seed is sown in raised beds or furrows and before sowing seeds are soaked in water over night for better germination.

SEED RATE

It requires about 8-10 kg of seed for cultivation in one hectare.

SPACING

30-45 x 8-10 cm at a depth of 2-3 cm on ridges

NUTRIENT MANAGEMENT

- For getting good yield, 200-250 quintals of well rotten farmyard manure should be applied during field preparation.
- Besides, 200-250q Farm Yard Manure, 60-70 kg nitrogen, 100-20kg phosphorus and 60-70kg potash per hectare should also be applied.
- Application of half to two third of total nitrogen along with whole quantity each of Farm Yard Manure, phosphorous and potash is given as basal dose.
- The remaining half-to-one third quantity of nitrogen is applied after three to four weeks of sowing.
- Further, light sandy soils require more nitrogen and potassium.

IRRIGATION

- Irrigate the field immediately after seed sowing. Light but regular irrigations should be given to maintain the optimum level of moisture in the field for better germination.
- The crop requires 300 mm of water which should be supplied through 4-6 irrigations.
- Stagnation of water is harmful.

INTERCULTURAL OPERATIONS

- Earthing up is essential to cover the exposed root.
- One or two hoeings should be done.
- Pre-emergence application of pyrazone at 1.5-2.0 kg a.i. /ha or Pendimethan at 1.0 kg a.i. /ha is recommended for effective weed control.

THINNING

- The seed of beet root is multigerm which produce 3-4 seedlings per seed ball.
- Hence, thinning is an important operation. Remove extra seedlings leaving a single robust plant per seed ball.
- The thinning should be done n the seedlings attain 3-4 leaves.
- Also remove weak, diseased and insect attacked plants to maintain the distance of 8-10cmbween the plants in a row.

HARVESTING

- The crop is ready for harvesting in 55-70 days after sowing.

- Harvest the roots when they attain the size of 3-5 cm in diameter.

YIELD

- 250-300q/ha

DISEASES & PESTS

Damping off: (*Pythium spp. and Rhizoctonia solani*)

- Affected seedlings collapse at the ground level and die.
- Affected roots are usually discoloured and often become reddish brown.
- Excessive moisture is favourable for damping off disease.

Control measures:

- Provide good drainage, treat the seed with ceresan (2g/kg seed), avoid overcrowding of the seedlings, thin out seedlings which are large enough to handle and remove all affected seedlings and destroy them.

Sclerotium root rot: (*Sclerotium rolfsii*)

- Affected leaves become yellow and wilt.
- The roots start to decay.
- Presence of strands of fungal mycelium and brown sclerotia on the decaying roots is often seen.

Control measures:

- Collect the crop residue and destroy it.
- Uproot the affected plants and destroy them.
- Drench the plants with carbendazim (0.1%) around the roots.

Downy mildew: (*Peronospora schachtii*)

- It may occur at any stage of growth.
- All above grounds parts may be affected.
- On the leaves, spots of different sizes up to 4 cm in diameter appear.
- The affected portions become light green on the upper surface, while on the under surface the mildew (fungal growth) is noticed.
- The infected leaves may become small and thicker than normal, and are often curled downward at the edges.

Control measures:

- Control measures include field sanitation, crop rotation, use of resistant cultivars and seed treatment with fungicides.
- Spray with 0.3 percent Zineb thrice at an interval of 15 days is also an effective control measures.

BACTERIAL DISEASES

Bacterial blight: (*Pseudomonas syringae pv. aptata*)

- Leaves show circular to irregular leaf spots, which have a tan center with a dark margin.
- Disease also shows symptoms on leaf edges.
- These spots later coalesce causing the leaves to have a ragged appearance.

Control measures:

- Follow proper sanitation and crop rotation.

VIRAL DISEASES

Beet yellowing virus:

- It is sometimes serious.
- It is a viral disease and transmitted by aphids.
- Conspicuous mottling with chlorotic zonate ring spots are common symptoms.
- These may become necrotic with age.
- Virus infected plants remain stunted and may loose some leaves.

Control measures:

- Follow proper crop rotation and sanitation practices.
- Isolate the healthy plants which may act as secondary hosts.
- Control the insects and destruction of infected plants also prevent the spread of the disease.

PESTS

Beet leaf miner: (*Pegomyia sp.*)

- It makes tunnels inside the leaves.
- The larva feeds on the tissues between the upper and the lower layer of leaf, thus causing serious injury to the leaves making it unfit for manufacture of food, consequently the plant growth is checked.

Control measures:

- Destroy all fallen leaves and other plants refuse after harvesting of roots.
- Spray systemic insecticides like oxy-demeton methyl (0.025%) on underside of leaves.

Beet web worm: (*Hymenia sp., Loxostege sp.*)

- The caterpillar sometimes causes very serious damage.
- The adults lay eggs on the leaves and the larvae attack the foliage, either by spinning small webs among the tender leaves or feeding on the underside, protected by small webs.

Control measures:

- Manage the insect by spraying malathion (0.05%).

Physiological Disorders:

Heart rot or Crown rot

- The disorder is caused by boron deficiency.

- The leaves die in the crown which is covered with small deformed leaves.
- The older leaves wilt and become necrotic.
- The entire crown becomes necrotic and starts to decay.
- The inner portion of affected roots turns black and become unfit for consumption.

Correction:

- Soil application of borax (10-15 kg/ha) or foliar spray of boric acid (0.2%), 2-3 times at vegetative stage can check it.
- Avoid the sowing of beet in acidic soils.
- Avoid drought conditions by supplying reduced irrigation.

Speckled yellows

- It is due to the deficiency of manganese.
- The leaves of the affected plants show yellowish-green chloratic mottled areas which become necrotic resulting into breaking of lamina.
- The leaf margins roll upward and turn into an arrow-shaped outline which remains upright.

Correction:

- Apply manganese sulphate @ 5-10 kg/ha or foliar spray of manganese sulphate (0.2%) 2 to 3 times.
- Avoid planting on very sandy and alkaline soils.

SEED PRODUCTION

Methods of Seed Production

- Both seed to seed and root to seed methods can be employed for raising seeds of beet root.
- However, the usual method of production of beet seed is by root to seed method.

Root to seed method

First season

- Raising of roots- as discussed for table crop

Time of Sowing

- Unlike other crops, garden beet does not have any tropical type. Hence their seeds can only be produced in the hills of India.
- Like carrot, beet requires exposure to low temperature of 4.4 -7.7oC for 6-8 weeks for initiation of flower stalks.
- In hills, the best time is from mid July to the end of July.
- Late varieties can be sown from last week of June to mid July.

Roguing

- Before uprooting, the standing crop is examined for foliage according to varietal characteristics in the field.

- The crop is in full bloom from mid May to mid June.
- One roguing during this period should be done to remove early bolters, off type plants and diseased plants.

Flowering

- The inflorescence, which normally develops in second year, is botanically a large spike.
- The flowers are almost sessile; these arise in clusters of 3-4 in axils of bracts of the inflorescence axis and its secondary branches.
- The flowers are small inconspicuous without corolla, but with green calyx which become thicker towards base as the fruit ripens.
- Fruits are aggregate formed by the cohesion of two or more fruits and held together by swollen perianth (calyx) base and thus forming an irregular dry cork-like body, known as seed ball or so called seed, if there is a single flower, a single germ seed will develop.

Pollination

- Beet root is highly cross pollinated crop.
- Flower produce abundant small and light pollen grains which are carried by wind leading to wind pollination.
- The whole face of flower bud development takes 35 days to become in bloom, there are 6 development stages through which bud passes before it opens into a flowers.
- Anthesis takes place between 7 am to 5 pm with peak period between 11am to 1pm. The flower opens mostly during mid-day.
- In the individual flowers, anthesis is completed within two hours and hastened by high temperature and low humidity.
- Another dehiscence takes place between 8.30 am to 6.30 pm with peak period between 12.30 pm to 2.30 pm depending upon the temperature and humidity.

Isolation

- Seed fields must be isolated from fields of other varieties and fields of same variety not confirming to varietal purity requirement of seed certification by five meters at mother root production stage and by 3000 meters for foundation seed production and 1000 meters for certified seed production.

Inspections

i) Mother root production stage

- A minimum of two inspection shall be made as follows:
- The first inspection should be done after 20-30days of sowing in order to determine isolation, off types and other relevant factors.
- The second inspection should be done after the roots have been lifted to verify the true characteristics of roots.

ii) Seed production stage

- A minimum of two inspection shall be made as follows:
- The first inspection should be done at pre-uprooting stage.
- Other two inspections should be done one at uprooting and replanting stage and the final at pre-flowering stage in order to determine isolation and other relevant factors.

Seed Yield

- Seed yield is 800-1000 kg/ha.

SEED CERTIFICATION STANDARDS

A. Fields Standards

a. General requirements

Isolation

- Seed fields should be isolated from the contaminants as shown in the table given below:

Contaminants	Minimum Distance (meters)			
	Mother Root production stage		Seed production stage	
	Foundation	Certified	Foundation	Certified
Fields of other Varieties	5	5	3000	1000
Fields of the same variety not conforming to varietal purity requirements for certification and fields of the Swiss chard and Spanish beet	5	5	3000	1000
Fields of garden beet, sugar beet etc.	5	5	3000	1000

b. Specific Requirements

Factor	Maximum permitted (per cent)	
	Foundation	Certified
*Roots of other varieties not conforming to Varietal Characteristics	0.10	0.20
** Off types	0.10	0.20
Objectionable weed plants	-	-
Diseased plants	0.10	0.50

* Maximum permitted a second inspection at mother root production stage.
** Maximum permitted at and after flowering at second production stage.

B. Seed Standards

Factor	Standards for each class	
	Foundation	Certified
Pure seed (minimum) %	96	96
Inert matter (maximum) %	4	4
Other crop seeds (maximum) Number/ kg	5	10
Weed seeds (maximum) Number/ kg	5	10
Germination (minimum) %	60	60
Moisture (maximum) %	9	9
For vapour proof containers (maximum)%	8	8