intercultural operations and earthing up.

Irrigation: To ensure proper sprouting and establishment of vines, a moist seed bed is required for 4-5 days. Tuber initiation phase which falls between 8 and 20 days after planting is very critical and maintenance of soil moisture during this period is essential to obtain economic yield.

Plant protection

Sweet potato weevil is the most destructive pest causing very severe damage to the crop. Adult weevil punctures the vines and tubers. The grubs bore and feed by making tunnels. The weevil infestation is high during dry seasons especially when farmers delay the harvesting of tubers. Average yield loss is 20-55% which may go up to 100 % in severe cases.

Management

- Select weevil free healthy planting materials
- Dip the vine cuttings in Fenthion (0.05 %) or Fenitrothion (0.05 %) solution for 10 minutes before planting
- Remove and destruct all alternate hosts
- Earthing up at 30 and 60 days after planting
- Install the sex pheromone trap @ one trap 100 m^{-2} for mass trapping of the male insects
- Timely harvest of the tubers and destruction of crop residues by burning

Sweet potato weevil (*Cylas formicarius*)

Sweet potato weevil is the most important pest causing very severe damage to the crop.

Adult weevil punctures the vines and tubers. The grubs bore and feed the stem and tubers by making tunnels. Attack is high during dry seasons or when farmers delay in harvesting of tubers. Yield loss may go up to 100%. On average 20 to 55% tuber loss occurs.

IPM for Sweet Potato Weevil

Select weevil free healthy planting material.

Dip the vine cutting with an insecticide with the active ingredient Imidacloprid (3 ml in 10 liters of water) for 10 minutes before planting.

Reridge the crop at 30 and 60 Days after planting.

Install the sex pheromone trap @one trap/100 m2 for mass trapping the male weevils.

Harvest at 105-110 days.

Destroy the crop residues after harvest by burning.

Sweet potato feathery mottle virus: Among the different viruses, sweet potato feathery mottle virus is widely observed in sweet potato which causes crop loss upto 50 % . Feathery and purple pattern in the leaves are the common symptoms and the primary spread is through planting materials.Among the 12 viruses, sweet potato feathery mottle virus (SPFMV) is widely observed. The most common symptom of SPFMV is a feathery, purple pattern in the leaves.

Primary spread is through planting material and also by aphids. The SPFMV causes up to 50% yield loss.The SPFMV can be managed through field tolerant varieties like Sree Vardhini, and the use of virus free planting materials as well as meristem culture plants.

Management

The disease can be managed through field tolerant varieties like Sree Vardhini and use of virus free quality planting materials as well as meristem culture plants.

Harvesting:

Harvesting is done at crop maturity depending on the duration of the cultivated varieties

Remove the vines and dig out the tubers without making injury. Good quality, well shaped and pest and disease-free tubers are selected for planting materials

Apical vines produced from healthy tubers without pests and diseases are selected as planting materials

Vine cuttings are to be stored upright side under shade for two days before planting

All tubers and vines for planting materials purpose are to be transported in net bags or well aerated containers to avoid excess heat damage Sweet potato is ready for harvest when the leaves turn yellow and begin to drop. Maturity can also be assessed by cutting sample tubers in the field and examining the color of the latex exudation. Latex from mature tubers remains creamy white, while in immature tubers when cut, the latex turns black.

Harvesting must be timely. If the crop is left too long in the ground the tubers can become prone to rotting and weevil attack

The field is irrigated two to three days prior to harvesting to facilitate easy lifting of the tubers. After removing the vines the tubers are dug out without causing injury.

Yield : 20 to 25 t/hectare.

Curing For successful storage and marketing, it is necessary to cure the harvested tubers. Covering the freshly harvested tubers with a polythene sheet (6" – 8" height above the tubers) spread open in a well-ventilated place can help in reducing fungal infection by over 10% thereby increasing shelf life by 60%. Curing facilitates toughening of the skin and healing of wounds thereby reducing the risk of shrinkage, post-harvest infection, and decay. Curing enhances the culinary quality of the sweet potato tubers.

Washing: The cured tubers should be washed in water using a sponge to remove all soil particles Care must be taken to minimize the removal of surface skin. This operation can be done by hand or by a specialized washing machine.

Storage of tubers:

Sweet potatoes are often consumed within 2-3 weeks without storing. However, storage often becomes necessary to extend the availability of fresh roots throughout the year and also fetch a good market price. In general, the cured sweet potatoes can be stored for 6-8 months at ambient temperature.

The rotting of sweet potatoes in storage is closely related to injury during harvest and subsequent handling. This can be prevented by prompt curing, careful handling, and discarding of infected tubers before storage Problems associated with improper storage conditions - Dry matter loss and pithiness, sprouting in storage, excessive shrinkage and development of fungal diseases during storage.

Ideal storage method - Storing tubers in pits and covered with paddy straw, will result in only less than 20% loss when stored for six months.

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Agro techniques for cultivation of orange fleshed sweet potato

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Agro techniques for cultivation of orange fleshed sweet potato

Sweet potato (*Ipomoea batatas* L. Lam.) is one of the important tropical tuber crops in terms of production, economic value, contribution to calories and protein. Sweet potato is a native of South America and is the seventh most important staple food of many developing nations. It is cultivated for human food, animal feed and raw materials in industries. It is grown in several agro ecological zones and plays a vital role in the farming and food systems in southern and eastern regions of India. Sweet potato is a herbaceous perennial plant and produces edible tubers. However, it is grown as an annual plant by vegetative propagation using either storage roots or vine cuttings. Sweet potato matures in 3-5 months, and stores well in soil as a famine reserve crop, has high productivity per unit area and performs relatively well in marginal soils, which makes it as an ideal crop for food security.

In India, sweet potato is one of the important staple food crops among tribals, which are consumed as snack and also used to a limited extent as animal feed.

The total area under sweet potato cultivation in India (including orange- fleshed sweet potato) was about 130.6 thousand hectares during 2017-18 with a production of about 1500 thousand tons The orange-fleshed varieties of sweet potato contain high levels of beta-carotene, a precursor of Vitamin A.

Sweet potato plants

Consumption of orange- fleshed sweet potato when they are available builds up the human body's stores of vitamin A. The unutilized vitamin A is stored in the liver for several months. This enables the body to build up a reserve to avoid vitamin A deficiency during the times when access to vitamin A-rich foods is limited.

Sweet potato tubers

The orange-fleshed sweet potato (OFSP) helps in combating Night blindness and Bitot Spot diseases caused by Vitamin A deficiency. The orange- fleshed sweet potato (OFSP) tubers have high carbohydrate content, allowing them to produce more edible energy per hectare per day than other common sources of carbohydrates such as rice and wheat. Sweet potato leaves and vines are excellent sources of vitamins A, B (thiamine, niacin, and pyridoxine) and C and contain comparatively high levels of protein, calcium and antioxidants.

Improved varieties

The ICAR-CTCRI has released 21 improved varieties in sweet potato with various quality traits for food and nutritional security and income generation. The details of the varieties are given in the table 1.

Climate

Sweet potato is grown in tropical, sub-tropical and warmer temperature regions. It can be grown in elevations from sea level up to 2000 m above mean seal level. Warm sunny days and cool nights are very much favourable for storage root formation. Short days with a low light intensity promote root development and it requires a day length below 11.5 hours to promote flowering. Root formation requires cool temperature while the weather should be warm for root bulking.

The sweet potato plant requires a temperature range of 21 to 26°C, well-distributed rainfall of 75 to 150 cm along with adequate sunshine for profitable production.

Soil

Sweet potato can be grown on a wide range of soils but sandy loams reasonably high in organic matter with a permeable sub soil are ideal for cultivation. A well-drained sandy and clay loam soils with reasonably high organic matter with permeable sub-soils are ideal for sweet potato cultivation.

Sweet potato is an acid-tolerant crop and yields are usually high in acidic soils (pH - 5.5 to 6.5).

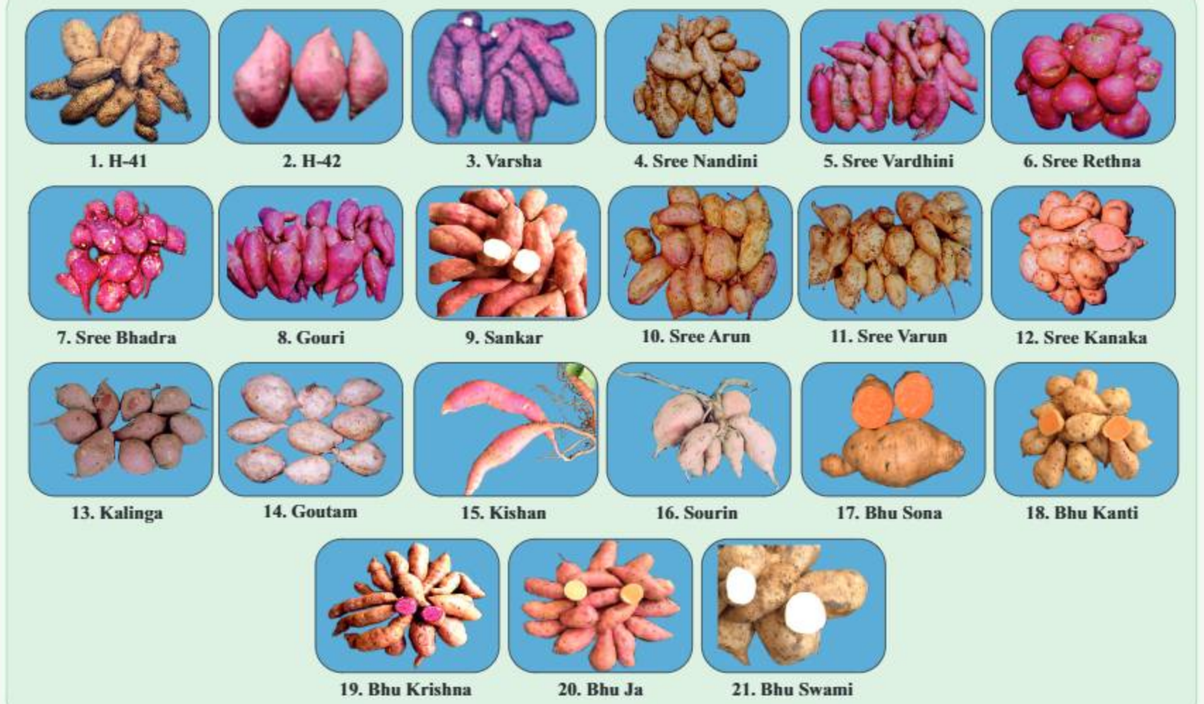
Planting Season

Sweet potato can be cultivated as rainfed crop during Kharif season (June-August), and with supplemental irrigation during Rabi season (October-December). A Rabi planted sweet potato produces higher tuber yield under warm sunny days, cool nights with moderate rainfall. It can also be grown in summer season (February-May) with irrigation in lowlands.

Table 1. Details of improved varieties of sweet potato

Variety	Duration (days)	Yield (t ha^{-1})	Year of release	Important features
1. H-41	120	20-25	1971	Semi spreading, reddish purple skin and white flesh with excellent cooking quality
2. H-42	120	22-25	1971	Semi spreading, greenish vine with pink tinge, emerging leaf light purple, storage root fusiform with pink skin and cream flesh
3. Varsha	120	17-22	1983	Semi spreading, reddish purple skin, light yellow flesh, good cooking quality, drought tolerant, susceptible to sweet potato weevil
4. Sree Nandini	100-105	20-25	1987	Spreading, light cream skin, white flesh, good cooking quality, drought tolerant, suitable for paddy fallows as a catch crop
5. Sree Vardhini	100-105	20-25	1987	Semi spreading, purple skin, light yellow flesh, good cooking quality, susceptible to sweet potato weevil, suitable for both rainfed and irrigated conditions
6. Sree Rethna	90-105	20-22	1996	Spreading, purple skin, orange flesh, excellent cooking quality
7. Sree Bhadra	90	20-22	1996	Semi spreading, early maturing variety, light pink skin, cream flesh, good cooking quality, trap crop for root knot nematode, susceptible to sweet potato weevil
8. Gouri	110-120	19	1998	Medium duration variety, reddish purple skin, orange flesh, suitable for *Kharif* and *Rabi* seasons, susceptible to sweet potato weevil, tolerant to mid-season moisture stress
9. Sankar	120	13.7	1998	Medium duration variety, spreading type, excellent cooking quality, susceptible to sweet potato weevil
10. Sree Arun	90	20-28	2002	Spreading, pink skin, cream flesh, good cooking quality, early maturing type

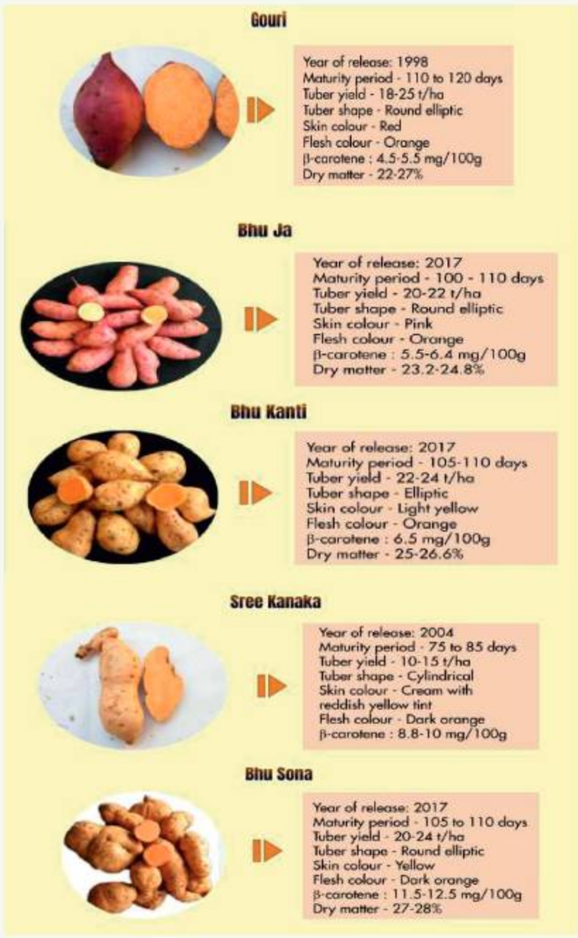
Variety	Duration (days)	Yield (t ha^{-1})	Year of release	Important features
11. Sree Varun	90	20-28	2002	Spreading, cream skin, cream flesh, good cooking quality
12. Sree Kanaka	75-85	10-15	2004	Short duration hybrid, rich in b carotene (8.8-10 mg/100 g), good cooking quality with a soft texture
13. Kalinga	105-110	17.2	2004	Spreading type, open pollinated selection, suitable for food and fodder, starch extraction, susceptible to sweet potato weevil
14. Goutam	105-110	18.9	2005	Spreading type, clonal selection, suitable for both *Kharif* and *Rabi* seasons, good cooking quality, tolerant to sweet potato weevil
15. Kishan	110-120	17	2005	Semi compact with greenish purple vine, suitable for food and fodder, high starch content, tolerant to mid-season drought, tolerant to sweet potato weevil
16. Sourin	105-110	16.2	2005	Spreading type, clonal selection, suitable for *Kharif* and *Rabi* seasons, tolerant to sweet potato weevil, withstand mid-season drought
17. Bhu Sona	105-110	20-24	2017	Dark orange with b carotene (13.2-14.4 mg/100g), good cooking quality, field tolerant to weevil (<10% infestation), suitable for processing
18. Bhu Kanti	105-110	22-24	2017	Orange fleshed (b carotene 6.2-7.8 mg/100 g), good cooking quality, tolerant to mid-season drought and salt stress
19. Bhu Krishna	100-120	18-22	2017	Anthocyanin rich variety (85-90 mg/100 g), highly tolerant to weevil (<5% incidence) and salt, suitable for processing
20. Bhu Ja	100-110	20-22	2017	Orange fleshed with b carotene (5.5-6.4 mg/100 g), good cooking quality, tolerant to salt stress
21. Bhu Swami	105-110	20-24	2017	Tuber with white skin and white flesh, excellent cooking quality, tolerant to mid-season drought, suitable for food and processing, tolerant to weevil



Orange fleshed Sweet potato Varieties

The biofortification work conducted at ICAR-Central Tuber Crops Research Institute (ICAR-CTCRI), Thiruvananthapuram and its Regional Centre at Bhubaneswar, Odisha, has resulted in the release of six orange-fleshed varieties - *Bhu Sona,* Sree *Kanaka, Bhu Kanti, Bhu Ja, Gouri*, and Sree *Rethna*.

Among the released varieties, the Beta (β)- Carotene content ranged from 3.2 - 3.5 mg/100g (Sree *Rethna*) to 11.5 - 12.5 mg/100g (*Bhu Sona*).



Planting material production

Nursery Preparation:

Sweet potato is propagated through vine cuttings obtained either from freshly harvested plants from the field or from the nursery.

Vines obtained from the nursery should be healthy and vigorous for maximum tuber production. If tubers are used, raise the nursery in two stages – primary and secondary.

Primary nursery:

Raise nursery three months prior to planting in the main field. For planting one hectare of land, about 100 m^2 of primary area and about 100 kg of medium sized weevil free seed tubers (125-150 g each) are required. Make ridges of 60 cm apart and plant healthy tubers on ridges giving a spacing of 20 cm. In water scarce areas, plant the tubers in rows. To ensure quick growth of vines, it is top dressed with 1.5 kg urea / 100 m^2 at 15 days after planting. The nursery is irrigated whenever required. After 45 to 50 days, the vines are cut to a length of 20 to 30 cm for further multiplication in the secondary nursery.

Secondary nursery: Vines collected from the primary nursery are further multiplied in the secondary nursery in an area of 500 m^2 to produce enough vines for planting in one hectare of land. Farmyard manure or compost is applied @1 kg m-2 and ridges are formed at a spacing of 60 cm. Vines obtained from the primary nursery or from freshly harvested crop are planted in the secondary nursery at a spacing of 20 cm on the ridges. To ensure enough vegetative growth, 5 kg urea is applied in two splits at 15 days and 30 days after planting. Irrigate first three days and thereafter on alternate days for one week. Thereafter irrigation may be restricted at once in three days. After 45 days, vines are cut to a length of 20-30cm for planting in main field.

Selection of vines for planting in the main field

After 45 -50 days in the secondary nursery, the vine cuttings of 20 to 30 cm long from the middle and top portions are harvested for planting in the main field.

Cut vines with intact leaves are stored under damp/shaded conditions for two days prior to planting in the main field to promote better root initiation, easy establishment of vines and higher tuber yield.

The leaves of the vines can be removed when the vines are to be transported to distant places to reduce the bulkiness.

Preparation of vines: The apical vine cuttings are found to be the best for high yield. A vine length of 20-30 cm with atleast 3-5 nodes is ideal for planting. The cut vines with intact leaves when stored under shade for two days prior to planting in the main field promote better root initiation, early establishment of vines and high tuber yield. The leaves can be removed when the vines are to be transported to distant places to reduce bulkiness.


Planting materials of sweet potato

Planting materials of sweet potato

Land preparation

The land is ploughed or dug to a depth of about 20 cm and harrowed to pulverize the soil.

In general, mounds, ridge and furrows, and flat bed methods are practiced in sweet potato cultivation. When the sweet potato is cultivated in areas experiencing drainage problems, mounds are ideal while ridges and furrows are suitable for sloppy lands.

In case of ridge planting, prepare ridges of 90 cm apart having 45 cm ridge height. When sweet potato is planted on mounds, no specific spacing is followed.

1. Advantages of growing sweet potato in ridges
2. When cultivated in sloppy land, it prevents soil erosion
3. Efficient pest management
4. Easier harvesting
5. Less possibility of deformed tubers
6. Produces larger size tubers
7. Provides Higher and better quality tubers

Land preparation and planting: Plough the soil to a fine tilth. Mounds, ridges and furrows and flat bed methods are recommended at different places. Make ridges at 60 cm apart having 25-30 cm height, plant the vine cuttings in the soil at a spacing of 60 x 20 cm with both the ends exposed and middle portion buried in the soil.

Time of planting

Under rain-fed conditions, it is best to plant sweet potatoes early in the rainy season so that establishment can take place quickly.

In areas where the rainy season is prolonged, planting may be timed so that the crop matures just as the rainfall begins

Planting method

Plant two cuttings per hill on the ridges either horizontally/ inclined/ vertically and place them 20 cm apart in ridges with minimum of two to three nodes placed inside the soil.

If there is no rain, sprinkle water immediately after planting the vines and continue watering for first 10 days for better establishment

Nutrient management: Apply farmyard manure @ 5 t ha-1 prior to planting and N, P_2O_5, K_2O fertilizers @ 50:25:50 kg ha^{-1}. (Apply urea (55 kg) or ammonium sulphate (125 kg), rock phosphate (125 kg) and muriate of potash (85 kg) per hectare at the time of planting. Top dress with 55 kg urea or 125 kg ammonium sulphate at 30 days after planting along with