

Propagation and planting techniques

for commercial cultivation of tropical tubers

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Tuber vegetables are potential functional food, primarily acting as staple carbohydrate source, second to cereals, basically in tropical regions in the world and are vital elements in human diet. They contribute a considerable share of world's food supply and are important source of both fodder and industrial product particularly in the developing countries. From farmers point of view the cultivation process of these kinds of vegetables is not so much intensive and difficult. The vital factor to consider is propagation since they are commercially vegetatively propagated. Healthy planting material, devoid of biotic stresses (most importantly virus), selection of proper matured planting material from a healthy mother plant, storage of propagules, seed treatment before planting and planting method are the critical factors that directly affect the yield and quality of harvest. In this article we shall try to discuss the typical techniques of propagation and planting of commercial tubers like cassava, sweet potato, elephant foot yam, colocasia and greater yam in a practical way specifically for the tuber growers in India.

Keywords: Cultivation, Planting, Propagation, Tubers

UNDERGROUND modified stem and root tuber vegetables are major components of subsistence agriculture in many parts of the world including India. Africa, Asia and Southern America are the reservoir for the diversity of tuberous vegetables and supply these crops to whole world. India is home for many of these tropical vegetable crops from ancient time. Cassava, sweet potato, elephant foot yam, colocasia, alocasia, tannia, greater yam, lesser yam, white Guinea yam, bitter yam, aerial yam and yellow yam are the crops which are grown in tropical tracts of our country and found wild in nature too. Comparatively tuber vegetables provide high energy and nutrition per unit area and time, require less-intensive management systems even under climatically marginal and risky conditions, and can be processed into a variety of food, feed and industrial products. These facts are the reasons behind the shifting of their subsistence cultivation

to commercialization. Farmers in different parts of India cultivate cassava, sweet potato, elephant foot yam, colocasia and greater yam on commercial scale. Every crop is commercially propagated by vegetative means. Proper planting material, propagation technique and planting method directly affect the yield and quality of harvest. Cassava is propagated by mature stem cutting from old mother plant. Miniset technology for quality planting material production in greater yam and elephant foot yam is very popular in India. Sweet potato is chiefly propagated by vine cutting. *Colocasia*, *alocasia* and tannia are propagated by headsett, corm, cormel and sucker. These tuber crops are not so much difficult to take care of unlike other vegetables, but regarding propagation and planting methods are really special as proper technique of propagation and planting is very critical for successful crop production with quality produce.

Cassava

Propagation: It is perennial woody shrub having a height of 3–4 m with erect branching stem and latex in all parts. Modified underground swollen roots are of commercial importance. Mature stem cutting obtained from 8–15 months old disease and insect free plant is treated as ideal planting material. Harvested stem cutting of 1–2 m length should be tied in bunches keeping the apical portion of the stem up and placed vertically on the ground in fully shaded and dry (RH≤80%) area with temperature range 20–30°C. Stored planting materials should be sprayed with insecticide (dimethoate or malathion) and fungicide (cuxochloride) prior to planting. Stem cutting should have 5–7 node and minimum length of 20 cm. Diameter of the pith should be equal to or 50% less than the total diameter of cut stem. Latex exudation up on stem cutting is positively correlated with maturity, thereby, a practical mean



Selection of planting material and their storage in cassava



Mature stem cutting and their planting techniques (vertical, slanting and horizontal) in cassava

to find out the maturity of planting material.

Planting: 3-4 deep ploughing followed by ridge planting is best in Indian condition. Generally flat, ridge and mound plantation are followed in cassava. As a basal fertilizer dose 12.5 tonnes farmyard manure (FYM) along with 50 kg N, 50 kg P and 50 kg K are recommended at land preparation. Top dressing by 50 kg N and 50 kg K is recommended to apply 45–60 days after planting (DAP) with first intercultural operation. Onset of monsoon is proper time for planting as rainfed crop but best time to plant is April-May. About 10,000-15,000 plants/ha is most common plant population under monocropping. On planting day 1 irrigation followed by 2 irrigations at an interval of 3–5 days are provided till the plants are established. Vertical, slanting (45° angle) and horizontal planting have been adopted according to topographical situation. Vertical planting to a depth of 5 cm into soil is best as per plant health and yield concerned. Top portion of the bud

should be facing sky while planting. Normally the stakes sprouts 15–20 DAP. Removal of excess sprouts by retaining 2/plant at opposite sides is better for getting higher number of tubers per plant. Planting of stem cuttings in light to moderately wet soil is quite effective to protect the planting materials from scorching sun and intolerable field heat in tropical regions.

Sweet potato

Propagation: Sweet potato is a perennial vine crop of light green to dark purple in colour treated as an annual when cultivated having trailing or twining thin stem measuring 1–5 m in length with the presence of latex. Commercially important edible storage roots are rich in carbohydrates, β-carotene and flesh colour varies as white, cream, yellow, purple and orange. It is commercially propagated by stem (vine) cutting. Cuttings obtained from apical and middle portion of vine produce more tuber than bottom vines. A 20–40 cm apical cuttings having 5–7 nodes

are best yielder. Primary and secondary nurseries are required for production of quality planting materials on commercial scale. Planting in nursery is done 3 months ahead of planting in the main field. Storing vine cuttings in shade for at least 2 days prior to planting is also practiced for getting higher tuber yield and faster vine growth.

Planting: Generally flat bed, ridge and furrow, raised bed and mound plantation are followed with 2–3 deep ploughing. As a basal fertilizer dose 10 tonnes FYM along with 40 kg N, 40 kg P and 60 kg K is recommended at land preparation. In tropics and sub tropics regions the crop is planted at beginning or end of rainy (*khari*f) season. In India generally spring (February-March) and Autumn-Winter (September-December) is followed for planting. About 83000 vine cuttings/ha is the most common plant population with spacing of 60 cm × 20 cm. Planting on wet soil followed by 2 irrigations at an interval of 4–6 days should be provided till the plants are established. 35 DAP is



Sweet potato planting materials and its nursery



Planting of vine cuttings in flat bed (trench method), ridge and furrow system and mound plantation in sweet potato

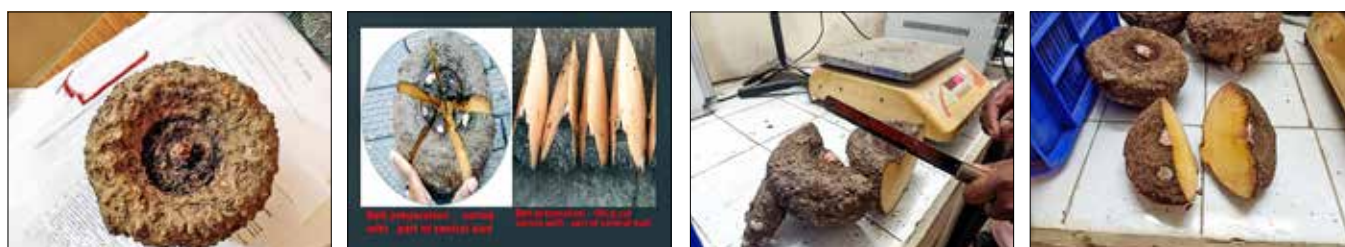
critical stage for earthing up as well as irrigation. Vertical, slanting and horizontal planting with 2 nodes above ground and 3 nodes below ground have mostly been followed with a planting depth of 7–10 cm.

Elephant foot yam

Propagation: This crop is herbaceous perennial and important for its edible underground modified stem known as corm. It

ideal as planting material for higher productivity and greater economic benefit to the farmers. Seed corm treated with fungicides before planting gives better result and the same treated with cow dung slurry and *Trichoderma* results early and better germination with disease avoidance than untreated ones. Mini sett technology in this crop could be adopted by the farmers to generate a greater number of planting materials

dose 25 tonnes FYM along with 40 kg N, 60 kg P and 50 kg K are recommended at land preparation. Rest 40 kg N and 50 kg K should be applied at 60 DAP. Pits (50 cm × 50 cm × 30 cm) are filled up with FYM and soil mixture before planting of seed corm. About 6 tonnes/ha is most common seed rate (seed corm weighing 500 g) with spacing of 90 cm × 90 cm. February to April as planting time recommended



Preparation of seed corm in elephant foot yam



Seed corm treatment with *Trichoderma* and cow dung slurry in elephant foot yam

is commercially propagated by whole or cut piece of corm (must have a part of apical meristem for germination and further growth). Corms exhibit dormancy for about 3–5 months after harvest. Mature healthy corm (8–9 months DAP) is best for seed purpose. Whole or corm cut piece weighing 500 g is

where there is a scarcity. Generally planting of 100 g seed corm at 30 cm × 30 cm spacing is practiced to get ideal size of planting corm.

Planting: 2–3 deep ploughing is required. Generally raised bed method and double row planting on broad ridges are followed for proper drainage. As a basal fertilizer

for most parts of India. Planting should be done keeping the part of apical meristem facing the sky and 1 irrigation immediately after planting is required.

Colocasia

Propagation: This crop is herbaceous perennial, commercially



Raised bed planting: Digging of pits, placing of seed corm and covering with soil slurry in elephant foot yam



Corm



Cormel



Headsett



Sucker

important primarily for its edible underground corm (modified stem). Young leaf blade and petiole are also edible. It grows up to a height of 1.0–2.0 m. The plant consists of a central corm (lying just below the soil surface) from which leaves grow upward, roots grow downwards, while cormels and stolons grow laterally. The root system is fibrous and lies mainly on the top 1 meter of soil. Headsett/Top/Huli (1–2 cm top portion of corm + 15–20 cm basal part of petiole), corm, cormel and side sucker are the planting materials for commercial cultivation. Planting material should be collected from disease and insect free plant and gives better result if treated with fungicides before planting. Headsett (widely adopted propagating material) with 5–6 cm in diameter at petiole base gives highest yield. Corm is used whole or as cut piece. Pre-sprouted corm and cormel are ideal for planting. Medium to large sucker with 3–4 petiole having corm intact is best for planting. Headsett is best adopted in situations where planting occurs shortly after harvesting whereas corm, cormel and suckers can be kept in nursery for better sprouting and used as planting material where there is long gap between harvesting and next season planting. Minisett technology like yam is ideal for rapid seed corm multiplication.

Planting: Wetland/lowland and dryland/upland cultivation are

practised for commercial cultivation. Wetland cultivation is adopted where water is abundant. Soil should be heavy enough to prevent water loss through percolation. Field should be puddled well and flooded just before or after planting. Relatively cool and flowing water is better. Headsett and suckers are preferred for this system. Propagating materials should be planted 10–15 cm deep in soil. Spacing of 45 cm × 45 cm (49,000 plants/ha) is recommended. Staggered planting and throughout year corm production is possible. Fertilizers and organic manures are first applied basal at land preparation and then by split dose 3–4 months after planting. Lowland cultivation with controlled flooding is always desirable. Drip, sprinkler or furrow irrigation are used to supplement the rainfall. Soil should be deep and friable for better corm growth. Crops are grown on flat bed, raised bed and ridge-furrow system. Corm and cormels can be used for planting. Propagating materials should be planted 10–15 cm deep in soil at onset of monsoon. Spacing of 60 cm × 60 cm (28,000 plants/ha) is recommended. Corm yield is lower but maturity is earlier than wetland production. Fertilizers (80:50:100 NPK/ha) and organic manures (FYM 12.5 t/ha) are applied same as wetland method. Mulching (organic and inorganic) should be done to conserve soil moisture and minimize weed growth.

Greater yam

Propagation: The crop is perennial herbaceous climbing deciduous plant having winged spineless vine. Underground stem tuber is edible and commercially important for propagation. Planting material should be collected from disease and insect free plant after getting proper maturity and it performs better when treated with fungicide and soaked overnight before planting. Treatment with cow dung manure before planting hastens germination. Commercially whole small tuber or cut tuber pieces are used as planting material. Bulbils, true seed and vine cutting can also be used for propagation. Sett (tuber pieces) weighing 200–250 g is ideal for optimum yield. Each sett must contain maximum proportion of tuber skin (periderm) for best result. Minisett technology is very popular for this crop. In this technique 20–60 g tuber pieces are planted to produce seed tuber of 250–300g weight. About 30 g and 45 g tuber pieces as minisett have been proven ideal in terms of seed production.

Planting: 2–3 deep ploughing is required. Generally raised bed method, row planting on broad ridges and mound planting over pits are followed. As a basal fertilizer dose 25 tonnes FYM along with 40 kg N, 60 kg P and 40 kg K are recommended at land preparation. Rest 40 kg N and 40 kg K should be



Different planting techniques under wetland and dry land cultivation in *Colocasia*



Preparation of seed tuber and its treatment with fungicide and cow dung slurry before planting



Different planting methods and staking of plant

for successful crop stand in field and results in better yield and best quality of harvest.

SUMMARY

Tropical tuber vegetables are important components of subsistence agriculture throughout the world specifically in developing countries. But the ease of cultivation, ability to grow in different soil and climatic situation, potentiality as functional food, being cheap source of energy, several nutrients, mineral compounds, different important bioactive compounds (vitamins, phenols and antioxidants), high processing value, industrial usage, great fodder value and use in different culinary dishes make these an important ingredient in mainstream agriculture and its trade. These tuberous vegetables do not require attention and intensive agricultural practices unlike other group of vegetables. Therefore, use of disease free planting material, selection of mother plants to collect propagules, proper propagation technique and treatment of the propagules before planting and using appropriate planting methods are the prime aspects of successful crop yield and quality produce of these tuberous tropical vegetable crops.

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applied at 60 DAP. Pits (50 cm × 50 cm × 50 cm) are filled up with FYM and soil mixture before planting of seed tuber. Planting depth should be maintained 10–15 cm in the soil. About 3 tonne/ha is most common seed rate (Seed tuber weighing 250 g) with spacing of 90 cm × 90 cm. March to May as planting time recommended for most parts of India. Planting should be done keeping the brown skin (periderm) facing the sky. One irrigation is needed immediately after planting. Mulching after planting with paddy straw or saw dust or any organic cover results better germination and total yield. The crop has a

vine system and produces profuse vegetative growth, thereby requires support for its climbing growth and development. Thus staking is must within one month of planting to avoid contact of vegetation with soil for protection against several soil born diseases.

These tropical tuber vegetables are important ingredient in diet and commercially cultivated in different parts of India. Being a cheap source of nutrients these have become a much needed component in daily diet specifically for several tribal communities. Proper propagation techniques and planting methods are the key factors to be considered

Water

Even though households are relatively low consumers of water, population growth and expanded water use have outweighed the effect of water saving technology and behavior.

- Less than 3% of the world's water is fresh (drinkable), of which 2.5% is frozen in the Antarctica, Arctic and glaciers. Humanity must therefore rely on 0.5% for all of man's ecosystem's and fresh water needs.
- Man is polluting water faster than nature can recycle and purify water in rivers and lakes. More than one billion people still do not have access to fresh water.
- Excessive use of water contributes to the global water stress. Water is free from nature but the infrastructure needed to deliver it is expensive.

- See more at: <http://www.unep.org/wed/theme/water.asp#sthash.ki5vg3lB.dpuf>
Courtesy: United Nations Environment Programme website - <http://www.unep.org/wed>