Field view of quality planting material production of tannia

Planting material corms

Planting material cormels

Conclusion

Tannia is a crop with immense applications in food, feed and industrial sector. This versatile crop is cherished for both its leaves and subterranean corms and cormels although the latter is the preferred part of consumption. Tannia crop have emerged as a potential enterprise for many, providing opportunities for employment, effective land use besides ensuring increased production, productivity, availability and export. However, availability of certified quality seed/planting material of tuber crops continues to be a constraint. To ensure the quality of planting material for farmers, a plan is required well in advance so that seed chain could be maintained for ensuring the timely availability of the desired planting material. The functional properties of its components, particularly starch, mucilage and powders have paved the way for their incorporation into a range of food products including baked goods, food pastes and beverages, as thickening and gelling agents. Cultivation of tannia by adopting high yielding varieties with proper seed certification standards is the need of the hour for achieving sustainability in the sector.

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Seed Certification Standards For Tannia (*Xanthosoma sagittifolium* (L.) Schott)

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Seed Certification Standards for Tannia (*Xanthosoma sagittifolium* (L.) Schott)

Introduction

Tannia (*Xanthosoma sagittifolium* (L.) Schott) is an edible aroid known by many names like elephant ear, arrow leaf elephant ear, cocoyam etc. It is one of the most important edible corm and leaf crop for millions of people in the tropics and sub-tropics. Tannia is a member of the Araceae family and sub family Aroideae. It is one of the six most important root and tuber crops in the world, next to cassava, potato, sweet potato, yam, and taro in area planted and its production. Although the species *Xanthosoma sagittifolium* is a crop of south tropical American origin domesticated by the tropical American-Indians and people of the Caribbean, it is being cultivated as a food plant in several developing countries for the reason that it is high yielding and also highly resistant to pests and diseases. It is known to be more protein-rich than the traditionally cultivated taro (*Colocasia esculenta* L. Schott) and probably easier to digest (Giacometti and Leon, 1994). Tannia's high calorific corms are rich in carbohydrates and are nutritionally superior to other roots and tubers in terms of digestible crude protein and minerals such as calcium, magnesium, and phosphorus. Natural flowering is rare in tannia and hence it is cultivated through vegetative propagation. Consequently, most cultivars do not exhibit much variability.

There is often confusion between the genus *Xanthosoma* and *Colocasia* since superficially tannia appear to be a rather large type of taro. Tannia plants can reach a height of about 2 m and have a short erect stem and large, long-stalked sagittate or hastate leaves, which differ from those of *Colocasia* in that the leaf stalk joins the blade at the margin between the lobes and the tips of the lobes are pointed, and not rounded. The leaves have a prominent marginal vein, and are 50-75 cm long, occasionally more in length; the petioles are about 1 m long. The inflorescence is borne below the leaves, with a pale green spathe about 20 cm long; some cultivars never flower and seed is rarely produced. Surrounding the spadix, the inflorescence is an erect spathe with the basal area forming a tube. The spadix comprises of female flowers at the base, male flowers near the tip, and sterile flowers in the middle, in the region compressed by the neck of the spathe. Flowers are probably pollinated by beetles, euglossine bees and flies (Gibernau, 2003). A corm is produced at the base of the plant and this bears several (usually 10 or more) lateral corms (cormels), each 10-25 cm long (Blazek, 2006–2025). The shape of the cormels varies from ovate, cylindrical, elliptical and elongate (Krishnaveni, 2021). The chromosome number of *X. sagittifolium* is 2n = 26 (Kuruvilla *et al.,* 1989). A study by Das *et. al.* (2020) also confirmed this chromosome number. *Xanthosoma* is a genus belonging to tribe Caladieae with about 38 species. *Xanthosoma sagittifolium* otherwise known as tannia is an important edible aroid ranking next to taro. Tannia originated in tropical America and was first brought under cultivation there (Onwueme, 1978). It is known to early Spanish and Portuguese explorers but spread of this species is rather ambiguous and is supposed to have reached Southeast Asia much before reaching Pacific Islands and Africa probably in the nineteenth century. The crop was introduced into Ghana from West Indies by missionaries in1941. In India, it is quite a popular vegetable crop in many parts of South India, Andhra Pradesh, Maharashtra, Gujarat, Orissa, Bihar, Eastern Utter Pradesh, West Bengal and the North Eastern States. It is locally called Vadiche aaloo in Marathi, Rikawatch in Hindi, Manakachu in Bengala, Palchaembu in Malayalam and Chaembu in Tamil.

Tannia is often grown as a subsistence crop mostly grown as an intercrop. Portions of the central corm, with three or four buds weighing 100 to 150 g are the most commonly used planting material. They give better yields than the cormels which are also used at times as planting material. Primary plant growth is characterized by the growth of the root system and foliage growth. The growth rate of corm and cormel fastens once the peak plant leaf area is attained, which is well into the production period. This goes on for about 2 or more months and when the corm or cormel production phase is complete, some plant species go dormant, while others must be harvested to avoid unwarranted amounts of sprouting and a drop in the starch content and quality of the produce (Maynard and O'Hair, 2003). Tannia grows best in tropical conditions, it could be cultivated over a fairly wide range of temperatures and conditions. The mean temperature for their optimum growth must exceed 20°C.

Tannia can be grown in a wide variety of soils, except hard clays or pure sands. However, for optimum yields they require a deep, well-drained, rich soil, planting is usually done in the month of April-May, loamy soil with slight acidic pH of 5.5-6.5. Unlike taro, tannia is not adapted to water logged conditions. Planting of setts or cormels is done on the ridges and furrows 90 cm apart. Either corms or cormels could be used as planting material. If corms are used, it should be cut in to small setts of 50-80 g weight, whoever, if cormels are used, whole tubers of same size would be ideal. The use of corm is better than cormels because the latter is less fibrous and normally preferred for consumption more than the former. A corm weight of 150-200 g and cormel weight of 50-75 g are found to be ideal as planting material. For planting one hectare, 1800-2000 kg of corms or 600-1000 kg of cormels are required and usually the seed materials are planted 6-7 cm deep. While planting the cut pieces of the main corm or suckers, it is advisable to keep the apical portion above ground level (Asha *et al*., 2024). Application of 25 t ha^{-1} of FYM and NPK is recommended @ 80:50:150 kg ha^{-1}. Full dose of phosphorus and half dose of nitrogen and potash are applied as basal, a week after sprouting, and the remaining half dose, a month after the first. The general maturation time is considered to be 9-10 months after planting and average yield is 25- 30 ton ha^{-1}. They are often harvested as and when required in homesteads since the mature corms rarely deteriorate if left in the ground. The older leaves begin to yellow at maturation which is an indication of the plant attaining maturity. The cormels are detached from the main corm after the whole plant is dug up. In order to prevent spoilage of tubers, care must be taken to avoid bruising the cormels during harvest, as otherwise they are liable to develop rots during storage.

Seed is an important input for any crop. The seed requirement is mainly met through traditional seed system where farmers keep a portion of their produce as seed for next season. As a result of continuous use of

same planting material year after year, the quality of seed/planting materials get deteriorated due to degeneration and lack of proper knowledge by farmers about the seed production technique. Inadequate availability of quality planting material of tuber crops continues to remain as a major stumbling block in the faster spread of high yielding varieties and their adoption by the farming community (James *et al*., 2004). Rapid propagation of tannia is limited by the lack of improved varieties, high bulkiness and low multiplication rate. These reasons along with requirements of huge quantity of planting materials attribute for the newly released varieties of tannia to take long time in reaching farmers' fields. Unlike other horticulture crops such as potato, banana, citrus, grapes etc., which have a well established system of seed production (Singh, 2011), the Indian minimum seed certification standards are not followed for quality planting material production of tannia.

Importance of using quality planting material of tuber crops:

Quality planting material is the propagation material of tuber crops which have i) Genetic purity- true-to type variety; ii) physical quality-free from debris, inert matter, diseased and insect-damaged planting material, iii) healthy- free from diseases, insects, pests (planting material health) and iv) Possess good physiological quality-high germination percentage and viability.

These planting materials are produced through a systematic and supervised process and are considered as standardized form of planting materials to produce consistent yield.

Why do farmers need quality planting materials?

The quality planting material is one of the critical aspects of profitable cultivation of tuber crops, which consumes over 30-40% of the production cost. Though farmers keep their planting materials they look for planting materials from other sources due to the following reasons.

Farmers have lost most or all of their planting materials due to natural calamities, diseases, pests, labour issues, or inadequate storage. Farmers have consumed or sold all of their planting materials. Farmers wish to expand the area under a particular crop or variety in the current season but do not have enough planting materials. Farmers want to try a new variety due to low yielding of current variety or try new high yielding or high-quality variety released by Research Institutes or Universities. They want to get additional income by producing planting materials by enrolling in a quality planting material production scheme of Research Institutes or Universities or Central/State Departments.

Current state of quality planting material production of tuber crops

In India, the quality planting materials of tuber crops are produced mostly by public sector agencies like ICAR-Central Tuber Crop Research Institute (ICAR-CTCRI), Thiruvananthapuram, Kerala and its All India Coordinated Research Project on Tuber Crops (AICRPTC) Centres, few Krishi Vigyan Kendras (KVK) and NGOs. Limited quantities of planting materials are produced through designated seed villages and also Decentralised Seed Multipliers.

Though the Seed certification standards are available, only a few state governments have a formal system of certifying tuber crops planting materials. In the absence of a regular course, the planting material producers and farmers face problems in mass multiplication of planting materials.

Realising the need for facilitating mass multiplication of tuber crops planting materials, the ICAR-Central Tuber Crops Research Institute has developed guidelines for producing quality planting materials of tuber crops (Muthuraj *et al*., 2018) following minimum seed certification standards of Govt of India, research works of ICAR-CTCRI as well as the FAO guidelines (Fajardo *et al*., 2010).

Importance of seed certification standards

The purpose of seed certification is to maintain and make available to the public, through certification, high quality seeds and propagating materials of notified kind and varieties so grown and distributed so as to ensure genetic identity and genetic purity. Seed certification is also designed to achieve prescribed standards. Certification shall be conducted by the certification agency notified under section 8 of the Seed Acts, 1966. Seed of only those varieties which are notified under section 5 of the Seed Act, 1966 shall be eligible for certification (Tanwar and Singh, 1988). As per the national policy of seed multiplication phases, seeds have been grouped into three categories i.e. i) Breeder or basic seed; ii) Foundation Seed I and Foundation Seed II and iii) Certified Seed.

Breeder Seed/Basic Seed: Breeder seed is a seed or vegetatively propagating material directly controlled by the originating or sponsoring plant breeder of the breeding progamme or institute and/ or seed whose production is personally supervised by a qualified plant breeder and which provides the source for the initial and recurring increase of foundation seed. Breeder seed shall be genetically so pure as to guarantee that in the subsequent generation i.e. foundation seed and certified seed class shall conform to the prescribed standards of genetic purity. The other quality factors of breeder seed such as physical purity, inert matter, germination etc. shall be indicated on the label on actual basis. Breeder seeds are considered to be pure, disease free and no tolerance limit is fixed, while for foundation (FS I and FS II) and certified seed the tolerance limits for viruses off-type, tuber-borne diseases and grades have been fixed by Government of India. Breeder seed is only being monitored by the certification agency but it is not certified by them.

Foundation Seed: Foundation seed shall be the progeny of breeder seed, or be produced from foundation seed which can be clearly traced to breeder seed. Foundation seed produced directly from breeder seed shall be designated as foundation seed stage-I. whereas foundation seed produced from foundation seed stage-I shall be designated as foundation seed stage -II. May be adopted mostly by crops having low rate of multiplication therefore, planting material production in tropical tuber crops is refered to as foundation seed stage-II.

Certified Seed: Certified seed shall be the progeny of foundation seed and its production shall be so handled as to maintain specific genetic identity and purity. Certified seed shall be the seed certified by certification Agency notified under section 8 of the seed Act, 1966 or seed certified by any certification agency established in any foreign country provided the certification Agency has been reorganized by the Central Government through notification in the official Gazette.

In India, there are 19 state seed certification agencies in different states certifying the seed of different crops. The states in which seed certification is in operation are Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal and Delhi.

Seed certification standards for quality planting material production of tannia *Xanthosoma sagittifolium* (L.)

I. Application and amplification of general seed certification standards

A. The General Seed Certification Standards are basic and together with the following specific standards constitute the certification standards for tannia.

B. The General Standards are amplified as follows to apply specifically to tannia

All certified classes shall be produced from planting material (corms) from the seed field (field where tannia is cultivated for the purpose of planting material) whose source and identity may be assured and approved by the Certification Agency.

II. Land Requirements

1. Land to be used for seed production of tannia shall be free from volunteer plants. Avoid swampy, low lying and over shaded conditions.

2. Avoid tannia residue and drainage from other tannia fields.

3. Well drained loamy soil is best suited. The optimum soil pH preferred is between 5.5 and 6.8

III. Field Inspection

A minimum of four inspections shall be made for the standing tannia crop. The first inspection shall be made prior to planting. The second inspection shall be made at 75 days after planting to verify the isolation and off-type plants. The third inspection shall be made at 160 days after planting to verify off-types and extent of disease infected plants. The fourth inspection shall be made prior to harvesting or at appropriate growth stage depending on the crop duration of the variety concerned to check isolation, off-types and other relevant factors.

IV. Field Standards

A. General requirements

1. Isolation

Seed fields shall maintain minimum isolation distance for foundation seed and certified seed. The isolation distance should be maintained from fields of other varieties as well as fields of the same variety not conforming to varietal purity requirements for certification. The details of maximum permissible limits of off types for foundation seed and certified seed are given in Table 1.

Table 1. The details of isolation distance for foundation seed and certified seed

Contaminants	Minimum distances (meters)	
	Foundation Seed	Certified Seed
Fields of other varieties	5	5
Fields of the same variety not conforming to varietal purity requirements for certificate	5	5

B. Specific requirements:

The details of maximum permissible limits for off types, pest and diseases in foundation seed and certified seed are given in Table 2.

Table 2. The details of maximum permissible limits: off-types, disease and pest in foundation seed and certified seed

Factor	Maximum permitted (%)*	
	Foundation Seed	Certified Seed
Off-types	0.10	0.50
Plants showing symptoms of Dasheen Mosaic	0.50	1.00
Plants infected by leaf blight (*Phytophthora sp*.) disease	None	None
Plants infected by root rot (*Pythium myriotylum*) disease	None	None
Plants infested with root weevil (*Diaprepes abbreviatus*)	None	None
Plants infested with root-knot nematode (*Meloidogyne* spp.)	None	None

*Standards for off-types shall be met at final inspection and for mosaic, designated disease and insects at each inspection.

Note: 1. All off-types, diseased and insect infested plants shall be rogued out along with corms, suckers and is to be destroyed.

2. Gaps in the seed field shall not be more than 10 %

V. Seed standards

Specifications in respect of size and weight of the planting material for foundation and certified classes shall be as follows

For foundation and certified classes seed standards for corm setts weight ranging between 150-200 g, corm setts size 6-8 cm length and breadth 5-6 cm and cormels weight 50-80 g

Note:

1. In a seed lot, corms not conforming to specific size of seed shall not exceed more than 5.0% (by number).
2. The seed material shall be reasonably clean, healthy, firm and shall conform to the characteristics of the variety. The corms not conforming to varietal characteristics shall not exceed 0.10% and 0.50% (by number) for Foundation and Certified seed classes, respectively.
3. Cut, bruised, cracked corms or those damaged by insects, slugs or worms shall not exceed more than 1.0% (by weight).
4. There should not be any visible symptoms of insect infestation on the corms for foundation seed and certified seed.

Storage standards: The planting material of tannia corm/cormels are to be stored in a dry, well-ventilated area.

Ideal condition for storage:

Ideally with controlled storage temperature and relative humidity.

Temperature**:** 7°C (45°F) is a good target temperature for long-term storage.

Humidity: Aim for a relative humidity of around 80%.

Ventilation: Ensure good air circulation to prevent moisture buildup.

Duration: Tannia can be stored for up to 6 months under these conditions.

Pre-storage: Consider curing the corms before storage to improve shelf life.

Monitoring: Regularly check for signs of spoilage, such as rotting or sprouting.

Avoid: Do not store in damp, poorly ventilated areas, as this can lead to spoilage.