Journal of Root Crops, 2016, Vol. 42 No. 1, pp. 3-8
Indian Society for Root Crops
ISSN 0378-2409, ISSN 2454-9053 (online)

Seed Certification Standards for Quality Planting Material Production of Cassava, Sweet Potato, Lesser Yam and Taro

R. Muthuraj, James George and V. Ravi

ICAR-Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram, 695 017, Kerala, India
Corresponding author: R. Muthuraj; e-mail: drmuthuraj29@yahoo.co.in
Received: 10 June 2016; Accepted: 28 June 2016

Abstract

Tropical tuber crops are propagated through vegetative method of propagation. This method of propagation includes micropropagation which facilitates faster multiplication of true to type clones. High yielding clones can be propagated faster using vegetative method of propagation without going for generation to achieve stabilization. However, due to the presence of large number of viruses and virus like organisms, there are all possibilities for transmission of diseases through clonal propagation, many of will be lethal. Furthermore, tuber crops have long duration and any mistake done in the choice of cultivar, quality of planting material and seed may invite more risks to the farmers. Quality seed/planting material therefore is one of the most important determinants of tuber crop production, which influences the output apart from other inputs like fertilizer, water management, pesticide etc. The efforts taken for several years may become futile, if true to type, healthy and disease- free planting material is not used. Therefore, quality of planting material of tuber crops with minimum seed certification standards assumes greater significance in the development and production of tuber crops.

Key words: Cassava, sweet potato, yams, taro, quality planting material, seed certification standards

Introduction

Tropical tuber crops are important food crops after cereal and constitute the stable food for a large population in many parts of the world. Tropical root and tuber crops comprising cassava, sweet potato, yams, aroids and other minor tuber crops are the third most important source of food crops for the mankind after cereals and grain legumes (James, 2011). With their versatility to adapt to varying soil, climate and edaphic conditions these crops stand out as unique to meet the food and fuel requirements of ever increasing population. The ability to yield reasonably well under adverse climatic conditions makes them as "Future Crops" (Krishnakumar, 2013). In India, Cassava is cultivated in an area of 0.2 million ha with a production of 8.5 million tonnes during 2014-15 with a productivity of 35.7 t ha^{-1}. The major states cultivating cassava are Tamil Nadu, Kerala and Andhra Pradesh. Sweet potato is cultivated in an area of 0.1 million ha with a production of 1.0 million tonnes. The major sweet potato growing states are Odisha, West Bengal and Uttar Pradesh. The major states cultivating yams and taro are Andhra Pradesh, Bihar, Gujarat, Kerala, Odisha, West Bengal, Uttar Pradesh and North-Eastern States.

Major constraints in quality planting material production of tuber crops

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). The tropical tuber crops being vegetatively propagated have low multiplication ratio of 1:10 in cassava, 1:4 in elephant foot yam, 1:6 in yams and 1:20 in taro. The propagation materials used are the stem in cassava, vine in sweet potato, tuber in lesser yam and corms, cormels in taro (CTCRI, 2004). Rapid propagation of tropical

tuber crops is limited by the incidence of pests and diseases, very high bulkiness and low multiplication rate. These reasons along with requirements of huge quantity of planting materials attribute for the newly released varieties of tropical tubers to take a long time to reach the farmers field. Unlike other horticultural crops such as potato, banana, citrus, grapes etc., which have a well established system of seed production (Singh, 2011), the formal procedure mentioned in Indian minimum seed certification standards are not followed for quality planting material production of tropical tuber crops. Clonal propagation practised in tropical tuber crops facilitates transmission of diseases as the propagation material may contain pathogens within them. This review attempts to sensitise and implement the Indian minimum seed certification standards for quality planting material production of tropical tuber crops.

Importance of seed certification standards

The purpose of seed certification is to maintain and make available to public, through certification, high quality seeds/ propagating materials of notified kind and varieties grown and distributed to ensure genetic identity and genetic purity. The minimum seed certification standards are the standards required for the certification of seeds by the certification agencies. In a seed /propagating materials quality control programme through seed certification, the minimum seed certification standards must be met. The certification standards followed in India are called the Indian minimum seed certification standards. These were published by the Central Seed Certification Board. The seed control order issued in 1983 established a regulatory framework for controlling the distribution and supply of seeds to the farmers. In October, 1988, Government of India announced the New Seed Policy with the objective of availability of best quality planting material of improved varieties to farmers from anywhere in the world for increasing the productivity and export of the seed. An important aspect of new seed policy is the creation of awareness for quality seeds and plants which resulted in the growth of several seed companies and many scientific nurseries. In India, there are nineteen State Seed Certification Agencies in different states certifying the seed of different crops.

Classes and sources of seed

Government of India enacted the Central Seed Act in the year 1966 in which different categories of seeds were defined. As per the national policy of seed multiplication, the multiplication phases of seed have been grouped into three categories i.e. (i) Breeder Seed/Basic Seed (ii) Foundation Seed -I and Foundation Seed –II and (iii) Certified Seed (Tunwar and Singh, 1988).

Breeder Seed

Breeder Seed is the seed or vegetative propagation material directly controlled by the originating or sponsoring plant breeder of the breeding programme or institution or seed whose production is personally supervised by a qualified plant breeder. Breeder seed provides the source for the initial and recurring increase of foundation seed. The breeder seed is considered to be pure, disease free without fixed tolerance limits where as for Foundation (FS- I and FS- II) and Certified Seeds the tolerance limits for viruses off type, tuber-borne diseases and grades have been fixed by the Government of India. Breeder Seed is only monitored by the certification agency but it is not certified by them.

Foundation Seed

Foundation Seed may 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. Production of Foundation Seed stage-II may be adopted mostly by crops having low rate of multiplication. Therefore, planting material production in tropical tuber crops refers to Foundation Seed stage-II.

Certified Seed

Certified Seed shall be the progeny of Foundation Seed and its production has to maintain specific genetic identity and purity.

Seed certification standards for the production of quality planting materials in cassava (*Manihot esculenta* Crantz)

I. Application and amplification of general seed certification standards

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

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

II. Land requirements

(a) Land to be used for seed production of cassava shall be free from volunteer plants. Swampy and shaded conditions might be avoided (b) Avoid cassava residue and drainage from other cassava fields.

III. Field inspection

A minimum of four inspections shall be made for the standing cassava crop. The first inspection shall be made at 60 days after planting to verify the isolation and off-type plants. The second inspection shall be made at 120 days after planting to verify off-types and extent of disease infected plants. The third inspection shall be made at 180 days after planting or at appropriate growth stage depending on the crop duration of the variety concerned and extent of disease infected plants. The fourth inspection shall be made prior to cutting of planting stakes to verify isolation, off-types and other relevant factors.

IV. Field standards

A. General requirements

1. Isolation

Seed fields shall provide minimum isolation distance of 5 meters for foundation seed-I, foundation seed -II 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, pest and disease are given in Table 1.

V. Seed standards

1. The planting stakes for foundation and certified classes shall be collected from a seed crop which is 7 to 12 months old and grown under the above conditions. Approximate length of planting stake should be 20 cm with five number of nodes in the planting stake and diameter of the planting stake should be 1.5 to 2.5 cm. Presence of latex at the cut end of the planting stake is the indication of good quality planting material.
2. Maximum tolerance limit of planting stakes for infestation caused by scale insect is very crucial for seed standards. There should not be any visible symptoms of scale insects infestation on the planting stakes for Foundation Seed and Certified Seed.

Seed certification standards for the production of quality planting material in sweet potato (*Ipomoea batatas* (L.) Schott.)

I. Application and amplification of general seed certification standards

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

All certified classes shall be produced from either apical vine cuttings or from sprouts cut from the field bed whose source and identity may be assured and approved by the Certification Agency.

II. Land requirements

Land to be used for planting material (vine cuttings) production of sweet potatoes shall be free of volunteer plants. Avoid sweet potato residue and drainage from other sweet potato fields.

Table 1. Details of maximum permissible limits off-types, disease and pest in foundation seed and certified seed in cassava.

Factor	Maximum permitted (%)*	
	Foundation Seed	Certified Seed
*Off-types	0.10	0.20
Plants showing symptoms of mosaic	0.10	0.50
Plants infested with scale insects	None	None

*Standards for off-types shall be met at final inspection and for mosaic and plants infested with scale insects at each inspection.

Note: All off-types, diseased plants and plants infested with scale insects must be rouged out along with tubers.

III. Field inspection

A minimum of two inspections shall be made in the standing sweet potato field. The first field inspection shall be made in the planting material production field (plant bed) when plants are nearly large enough to transplant. The second field inspection shall be made shortly after transplanting in the seed field.

IV. Field standards

A. General requirements

1. Isolation

Seed fields shall provide minimum isolation distance of 5 meter 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, pest and disease for Foundation Seed and Certified Seed are given in Table 2.

V. Seed standards

1. The seed material shall be reasonably clean, healthy, firm and shall confirm to the characteristics of the variety.
2. Cut, bruised, unshaped, cracked, root or those damaged by insects (except sweet potato weevil), slugs or worms shall not exceed more than 1.0% (by weight.). The details of maximum permissible limit of roots showing visible symptoms caused by the diseases, sweet potato weevil and other factors are given in Table 3.

Seed certification standards for the production of quality planting material in lesser yam (*Dioscorea esculenta* (Lour.) Burkill)

I. Application and amplification of general seed certification standards

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

Table 2. Details of maximum permissible limits off-types, disease and pest in foundation seed and certified seed in sweet potato.

Factor	Maximum permitted (%)*	
	Foundation Seed	Certified Seed
Plant bed		
Plant infected by		
Black rot (*Ceratostomella fimbriata* (EII.& Halst) J.A. Elliot.)	None	None
Wilt (*Fusarium oxysporum* f. *batatas* (Wr.) Snyder & Hanson)	None	None
Scurf (*Monilochaetes infuscans* (EII. & Halst) Ex. Harter	None	None
Off-types	None	None
Seed field		
Plant infected by		
Wilt (*Fusarium oxysporum* f. *batatas* (Wr.) Snyder & Hanson)	None	None
Mosaic	0.05	0.10
Off-types	0.05	0.10

*Maximum permitted at any one inspection.
Note:1. All off-types and diseased plants should be rouged out along with root and destroyed.

Table 3. Details of maximum permissible limits off-types, disease and pest in Foundation Seed and Certified Seed in sweet potato.

Factor	Maximum permissible limit (by number)	
	Foundation Seed	Certified Seed
Storage rot	None	None
Black rot (*Ceratostomella fimbriata* (EII.& Halst) J.A. Elliott.)	None	None
*Scurf (*Monilochaetes infuscans* (EII. & Halst) Ex. Harter	None	None
Wilt (*Fusarium oxysporum* f. *batatas* (Wr.) Snyder & Hanson)	None	None
Internal cork	5.00%	5.00%
Nematode	None	1.00%
Wire worm	1.00%	5.00%
Other distinguishable varieties	0.10%	0.20%
Sweet potato weevil (*Cylas formicaris* Fab.)	None	None

* A root carrying 10.0% or above scurfed surface would be considered as one infected unit.

II. Land requirements

Land to be used for seed tuber production of lesser yam shall be free from volunteer plants. Swampy and shaded conditions may be avoided.

III. Field inspection

A minimum of three inspections shall be made, the first field inspection at 90 days, the second inspection at 150 days and the third inspection at 200 days of planting or at appropriate growth stage depending on the crop duration of the variety concerned to verify 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 details of isolation distance and maximum permissible limits of off types, pest and disease for Foundation Seed and Certified Seed are given in Table 4.

V. Seed standards

1. The tuber seed size 100-150 g. 2. In a seed lot, tubers not conforming to specific size shall not exceed more than 5.0% (by number). 3. The seed material shall be reasonably clean, healthy and shall conform to the characteristics of the variety. The tubers not conforming to the varietal characteristics shall not exceed 0.050% and 0.10% (by number) for Foundation and Certified Seed classes respectively. 4. Cut, bruised, irregular shape, cracked tubers or tubers damaged by insects (other than scale insects) slugs or worms shall not exceed more than 1.0% (by weight). 5.There should not be any visible symptoms of tuber infested with scale insects on the tuber of planting material for Foundation Seed and Certified Seed.

Seed certification standards for the production of quality planting materials in taro (*Arvi) Colocasia esculenta* (L.)

I. Application and amplification of general seed certification standards

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

II. Land Requirements

1. Land to be used for seed production of taro shall be free from volunteer plants. Avoid swampy, low lying and over shaded conditions. 2. Avoid taro residue and drainage from other taro fields.

III. Field Inspection

A minimum of three inspection shall be made, the first and second inspection at 60 and 90 days after planting respectively and the third at 160 days of planting and 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 provide minimum isolation distance of 5 meters 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

Table 4. Details of isolation distance and maximum permissible limits off-types, disease and pest in lesser yam.

Contaminants	Minimum distances (meters)	
	Foundation Seed	Certified Seed
Fields of other varieties	5.00	5.00
Fields of the same variety not conforming to varietal purity requirements for certification	5.00	5.00
Factor	Maximum permitted (%)*	
Off-types	0.05	0.10
Plants infested with scale insects	None	None

*Standards for Off-types shall be met at final inspection and for the designated insects at each inspection.

Note: 1. All Off-types and plants infested with scale insects shall be rogued out alongwith the tubers and destroyed 2. Gaps in the seed field shall not be more than 10.0%

Table 5. Details of maximum permissible limits off-types, disease and pest in Foundation Seed and Certified Seed in lesser yam.

Factor	Maximum permitted (%)*	
	Foundation	Certified
Off-types	0.1	0.5
Plants showing symptoms of dasheen mosaic	0.5	1
Plants infected by Phytophthora (*Phytophthora colocasiae* (Rac.) disease	None	None
Plants infested with scale insects and mealy bugs	None	None

*Standards for Off-types shall be met at final inspection and for designated disease and insects at each inspection.
Note: 1. All Off-types, diseased and insect infested plants shall be rogued out alongwith corms, cormels and destroyed.
2. Gaps in the seed field shall not be more than 10.0%

certification. The details of maximum permissible limits of off types, pest and disease for Foundation Seed and Certified Seed are given in Table 5.

V. Seed standards

For Foundation and Certified classes seed standards for seed corms are 4-6 cm x 2.5 to 3.5 cm with weight ranging between 20-40 g.

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 (other than scale insects and mealy bugs), slugs or worms shall not exceed more than 1.0% (by weight). 4. There should not be any visible symptoms of scale insects and mealy bug infestation on the corms for foundation seed and certified seed.

Conclusion

Tropical tuber crops have emerged as 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 continue to be a constraint. There are many success stories for enhanced profitability of farmers with the use of certified quality seed/planting materials for improved varieties. 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 availaility the desired propagating material. Interaction between the research institutions and public and private enterprises for mass multiplication of certified, quality planting materials would enhance production of tropical tuber crops.

References

CTCRI. 2004. Agro-Techniques of tuber crops. *Technical Bulletin*, CTCRI, Trivandrum, India. p. 32.

James, G. 2011. Production techniques in tuber crops for production of disease free quality planting materials. In *National consultation on production of disease free quality planting material propagated through tubers and rhizomes* (Singh, B.P. Dua V.K. and Brajesh Singh Eds.) Malhotra Publishing House New Delhi, India. p. 85-92.

James, G., Shyam S., Nair and Sreekumari, M. T. 2004. Rapid multiplication of planting materials in tuber crops. NATP Booklet, CTCRI, Sreekariyam, Trivandrum. p. 40.

Krishnakumar N. K. 2013.Tropical root and tuber crops: Key issues of research and development. In: *Souvenir-International conference on Tropical Roots and Tubers for Sustainable livelihood under changing Agro-Climate*, 9-12 July 2013, CTCRI, Thiruvananthapuram, pp. 15-17.

Singh, H.P., 2011. Quality planting material production rhizomes and Tubers. In *National consultation on production of disease free quality planting material propagated through tubers and rhizomes* (Singh, B.P., Dua, V. K. and Brajesh Singh Eds.) pp. ix-xvi. Malhotra Publishing House New Delhi, India.

Tanwar, N. S. and Singh, S.V. 1988. Indian Minimum Seed Certification Standards.The Central Seed Certification Board, Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi p. 388.