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United Nations



Ministry of Agriculture
& Fisheries



Guidelines for seed rhizome production

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by

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Food and Agriculture Organization of the United Nations
Kingston, 2021

Required citation:

Saravanakumar, D. 2021. *Guidelines for seed rhizome production*. Kingston. FAO.

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Foreword

The certification of ginger production in Jamaica is geared towards establishing a system of standardized protocols. These protocols can assist stakeholders in the ginger value chain in achieving optimal levels of production through the provision of healthy planting material. This is in an effort to address the production constraints now being experienced due to the “ginger rhizome rot” disease.

The material contained in this manual describes the processes involved in the production of disease-free healthy seed rhizomes utilizing tissue culture sources of planting material and the single bud technology. The manual provides information on the certification process for persons desirous of becoming certified “seed rhizome producers” and the production practices which should result in the multiplication of limitedly available planting material and a better-quality product for field production. The details of the steps to be taken towards becoming a certified producer of ginger planting material are clearly outlined and provide an opportunity for persons engaged in commercial production of ginger planting material to increase their levels of production and productivity. It must be noted that the information contained herein is a guide that will evolve over time as more information becomes readily available.

Dr. Lisa Myers Morgan

Acknowledgements

The Research and Development Division in the Ministry of Agriculture and Fisheries (MoAF) extends its heartfelt thanks and appreciation to the Food and Agriculture Organization of the United Nations (FAO) for funding the project “Support for the development of the Ginger Value Chain in Jamaica” TCP/JAM/3602 (D) valued at USD 212 000. Secondly, Dr. Duraisamy Saravanakumar, FAO International Consultant, who provided technical support to improve systems for producing certified ginger.

Many thanks to Dr. Saravanakumar for his relentless efforts to put this manual together, Dr. Vyjayanthi Lopez, FAO Plant Production and Protection Officer, Mr. Alfred Barrett, Mrs. Michelle Sherwood, Deputy Research Director, Crop & Plant Protection Unit, Research and Development Division, and Dr. Lisa Myers Morgan, Principal Research Director, Research and Development Division, for providing technical feedback in editing this document.

It is anticipated that this document will prove useful to Quarantine Officers who will monitor the future certified ginger nurseries and Jamaica Agricultural Commodities Regulatory Authority (JACRA) over the next few years in the development of the ginger subsector and creating that paradigm shift needed in how ginger is grown in Jamaica which can match the quality of ginger produced in other countries such as China and India.

Acronyms

FAO - Food and Agriculture Organization of the United Nations

GAP - good agricultural practices

JACRA - Jamaica Agricultural Commodities Regulatory Authority

MoAF - Ministry of Agriculture and Fisheries

RADA - Rural Agricultural Development Authority

Introduction

The cultivation of ginger is severely affected by rhizome rot disease caused by fungal (Pythium, Fusarium) and bacterial (Ralstonia) pathogens in Jamaica. Infected mother rhizomes serve as source of inoculum for the diseases. Therefore, the production and supply of clean, disease-free rhizome or seedlings are necessary to reduce the losses caused by rhizome rot incidence.

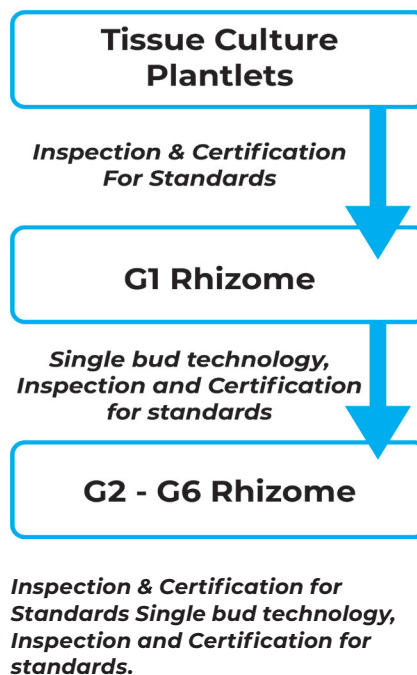
The development of guidelines and certification protocols for the production of quality and disease-free rhizome or seedlings will assist in the supply of quality planting materials for successful cultivation of ginger in Jamaica. This is possible by growing tissue culture plantlets in individual pots or bags under a shade house facility to produce first generation (G1) rhizome. From this G1 rhizome, subsequent rhizome production is carried out using single bud technology to mass multiply the rhizome in a nursery under a seed certification programme to produce quality and disease free planting material.

To ensure the production of disease-free subsequent generations of seed rhizome, a standard shade house with a quality production system and adoption of good management practices are necessary. It is in this context that the present manual has been prepared.



Seed rhizome production for quality and disease free planting material supply

Seed Certification Process



Guidelines for seed rhizome production

Objectives



This manual sets out guidelines for the production of quality disease-free rhizome in shade house facility under a seed certification programme.

The objective of this manual is to provide guidelines for seed rhizome production

Scope

The guidelines presented in this manual are specific to the certification requirements for production of quality seed rhizome under shade house facility for supply of clean planting material.



What is seed certification in ginger?



Seed certification is a quality assurance system whereby ginger rhizome intended for use as planting material is subject to official control and inspection.

This process ensures the production of quality and disease-free ginger planting material, in accordance with the standards and instructions specified by the certifying agency.

What is a seed certifying agency?

- A certifying agency is the official plant regulatory agency that performs a certification function. The standards and procedures it enforces are approved by the relevant Government Agency. The plants are certified against these standards and procedures.

Which agency has the certification function in Jamaica?

- The Plant Quarantine Unit of the Ministry of Agriculture and Fisheries (MAF) functions is the certifying agency in Jamaica.

How does one apply for seed rhizome production?

- The application for production of seed rhizome is provided in Annex 1.
- Fill out the application form and submit it to the Plant Quarantine Unit for further inspection and approval.



Process in seed certification.

Facilities required for seed rhizome production



©C. Mignott

Establish shade house for seed rhizome production.

Shade house

- The shade house is a physical requirement used for production of seed rhizome under a certification programme. Climate requirements

Selection of site for shade house facility

- Select a site where an adequate water source is available.
- The shade house facility must be minimum of 500 m away from the field cultivation of ginger, if any.



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Establish shade house facility.

Size of the shade house

- Shade house facility could be of different sizes based on production capacity of the seed producer / farmer / nursery operator.
- It is economically feasible to have a minimum size of 2500 sq ft shade house facility.

Specific requirements of shade house

- The sourced shade net can provide 60-70% shade for seed rhizome production.
- Shade house must be sealed on all four sides with an insect-proof screen that is of mesh size 40 x 40 or 60 x 60 linear inch.
- The top of the shade house must be covered with polythene sheet to provide protection from rain.
- North-south orientation of shade house is recommended to ensure even light conditions throughout the year.



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Double door system entrance to the shade house.

Sanitation and cleanliness of shade house



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Place a foot bath to sanitize boots before entering shade house

- Use a double door system to prevent entry of insect pests and pathogenic contaminants.
- Keep washing stations for hand washing and foot-bath with bleach solution at the entrance of double door entry of the shade house.
- Renew solution for foot-bath as needed.
- Use gravel flooring in the shade house or lay out the floor with tarpaulin to avoid contamination. When using tarpaulin, ensure that there is no water

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Use gravel for flooring & do not allow weeds inside the shade house.

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Ensure that there are no holes in the shade net



Establish storage facility for inputs

stagnation inside the shade house facility.

- Work on a tarpaulin sheet while preparing potting mix.
- Use nuts and bolts in place of welding, while constructing a shade house to avoid breakage.
- Ensure that the growing structure is completely sealed, and that there are no small openings
- Do not dump waste or dirt near the shade house facility.
- Do not allow weeds to grow outside or inside the shade house facility.
- Ensure that there is a clean storage area for storing of fertilizers, containers, pesticides etc.

Equipment and Inputs for Seed Rhizome Production

Benches

- Terrace, metal or wooden benches made with locally available items (e.g. bamboo) can be used to hold the production bags.
- Disinfect the benches with 1% bleach solution before



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Benches should be at least two feet above the ground.

growing ginger.

- It is recommended that benches are at least two feet above the ground to prevent soil contamination.

Containers or bags for growing ginger

- Bags (24 × 30 inch) are preferred, as they are easier to dispose of after use.
- Containers (24 × 24 inch) can also be used for growing ginger. However, in case these are being reused, they should be washed thoroughly to remove soil particles and plant debris, then treated with a disinfectant even if there is no evidence of disease in the previous crop.
- It is recommended that each bag or container holds two seedlings.



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Use bags for growing of ginger in shade house.

Grow Medium

- Coir or Peat moss or Pro-Mix containing vermiculite could be used for production of rhizomes under shade house conditions.
- However, the use of coconut coir (if available) is preferred due to its water holding capacity and its loose and aerated nature to facilitate the growth and development of rhizome.
- Ensure that growing media is free from rhizome rot pathogen (Pythium, Fusarium, Ralstonia) especially if the growing media package has breaches and the source is unknown or questionable.



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Ensure grow medium is free from pathogen source. Use locally available media to reduce costs.

- If potting media from the previous cycle is re-used, then treat it with chemicals or use solarisation techniques to eliminate pathogens, if any.
- Use of the same grow media is not recommended for more than two cycles, as productivity declines.



Treat media before use, if used for planting in the previous year.

Irrigation facility



Install drip irrigation facility for shade house production of seed rhizome.



Water tank installed for irrigation.

- Install a drip irrigation combined with fertigation system for better water management.
- Ensure that the water source is free from contamination of any pathogenic organisms. In this case, water is a major source of contamination for pathogens like Pythium, which causes rhizome rot.
- Irrigation water should be analyzed for the quality, pH and electrical conductivity (EC).
- Irrigation can be pressurized or gravity fed. The irrigation delivery system can be the conventional drip lines, which is best suited for a gravity fed system.
- After setting up of the irrigation system, it is advisable to turn on the water for about 24 hours to irrigate grow medium before planting. This is to remove any excess salts that may be present in the coir (depending on the source).
- Check Irrigations systems for leakage and damage to prevent excess watering.

Preparation of growing media

- Place grow media (coir) in a sterilized mixing container: this could be half of a 50 gallon drum for small operations, or 200 gallon tank for a larger operation.
- Add clean water (tested for pathogen and hardness) to adequately wet the growing media.
- Treat water for hardness before use. Depending on the pH, the addition of gypsum or acid is recommended.
- Use a clean spade or shovel to mix water into the growing media until its absorption of the water is about 60-70%.
- Use a clean spade or shovel to fill 5 gallon buckets with the moistened growing media, which is then poured into pre-folded 24 × 24" or 24 × 30" grow bags.
- Grow bags are then placed on the benches or tables.
- Grow bags can be placed two-by-two or three-by-three along the benches, depending on the width of the bench.



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Use proper sanitation practices such as clean shovel and container while mixing the grow media.

Nutrient enrichment of coir

- Dissolve calcium nitrate mix in the nutrient tank and feed the grow bags with the coir via the irrigation system.

- This ensures that the plantlets have an immediate source of nutrients after transplant



Application of calcium nitrate to grow medium is recommended.

Planting Material



Prepare single bud rhizomes using sterile sharp knife.



Treat single buds with fungicide before planting.

Preparation of seedlings in nursery

- Tissue culture plantlets should be sourced to produce G1 rhizome. When producing other grades of rhizomes - G2-G6, then G1- G5 rhizomes should be used. Prepare seedlings using single bud technology from certified rhizomes.
- Treat seed rhizomes with a fungicide labelled for use in the control of rhizome rot disease
- Prepare fungicide solution as per recommended dosage.
- Immerse seed rhizomes in fungicide solution for 30 minutes and shade dry in a ventilated place.
- Cut the fungicide-treated rhizomes into single buds of approximately 5 g each, using a sharp, sterilized knife.
- Immerse single buds in fungicide solution once again for 30 minutes.
- Then, plant single buds in nursery trays (pro-tray)



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Plant single buds in trays filled with grow mix/coir and cover the buds with grow mix.



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Place trays in a shaded area and monitor for emergence of seedlings.

filled with partially decomposed coir pith and vermicompost (75:25) or other grow media.

- Apply the recommended dosage of fungicides (do not overdose).
- Check the source and quality of grow mix before use.
- If available, use coir composting technology to prepare grow mix so as to reduce the cost of inputs.
- Treat single bud rhizomes with biopesticides (microbial inoculants), if available, instead of a chemical fungicide.
- Place seedling trays sown with single buds in the shade house facility.
- Apply irrigation with nursery water can or suitable sprinklers when needed.
- Do not overwater and cause dampness in grow media.
- Foliar application of locally available and registered micronutrient is recommended for 20-day-old seedlings.
- Monitor seedlings for uniformity and pest and disease incidence and remove any off-type (abnormal) seedlings from the lot.
- Seedlings should be ready for transplanting at 35-40 days after planting rhizome buds.

Transplanting of seedlings

- Transplant tissue culture plantlets (for G1 rhizome production) or seedlings raised from single bud technology from G1 rhizome (for G2-G6 rhizome production) into bigger pots or bags.
- Plant two seedlings in a bag (24"× 24")
- Use a sterilized piece of $\frac{3}{4}$ -1" diameter PVC pipe to make a hole in the areas of the potting media where the ginger plantlet will be planted.
- Ideally, seedlings should be transplanted from March to late July for seed production in the shade house facility.



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Two seedlings per bag is recommended.

Crop care and fertilization programme



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Integrate application of nutrients with irrigation.

- Immediately after transplanting, an irrigation system or nutrient program of choice should be deployed to properly moisten and add nutrients to the growing media.
- This encourages continued uptake of nutrients by the seedlings.
- Depending on the fertigation and irrigation system employed, plantlets should be fertigated on schedule and regularly watered to prevent drying-out of the media.

Vegetative growth and rhizome development phase



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**Practice hilling for better tillering
rhizome development**

- During the early seedling stage, the plant should be fed with all essential macro and micronutrients.
- At the active vegetative stage, plants demand high volumes of nitrogen, phosphorous and potassium (2-3 months after transplant).
- Plants develop rapidly, as evidenced by the increase in height, number of tillers and leaves.
- At this stage, incremental increase in nitrogen, phosphates and potassium is recommended to match the increasing nutrient requirements of the plants.

Hilling/Earthing up/Moulding

- Hilling (6 inch with potting mix) is recommended at the 4th, 5th and 7th months after planting (mainly during tillering stages)
- At each hilling, the following fertilizer application regime is recommended.

	4 mon	5 mon	7 mon
Gypsum:	1 lb/bag,	1 lb/bag,	30 g/bag
Dolomite:	1 lb/bag,	100 g,	-
CaNo3:	1 lb/bag,	-	25 g/bag
8 8 8 fert:	50 g	-	50g

- Otherwise, equivalent fertilizer should be applied during tillering stages of crop growth.



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Practice hilling for better tillering rhizome development.

Crop protection

- Throughout the growing period, monitor for pests and diseases.

Diseases

Rhizome rot and wilt disease

- Diseases affect ginger plants from 60 days after planting to harvest. Therefore, close monitoring of the crop during rhizome development stage is critical.
- Yellowing and wilting of leaves are the symptoms of rhizome rot disease



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Pythium rot is diagnosed based on the white mycelium on rhizome

- Pathogenic fungi (Pythium, Fusarium) and bacteria (Ralstonia) plus nematode complex are responsible for this disease in ginger.
- A white thread like structure on soft rhizome indicates the fungal infection, while oozing of milky white substance from rot rhizome reveals bacterial infection.



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Bacterial rot infection.

Management of rhizome rot and wilt disease

- Apply biopesticides from 45 days after planting to harvest at 30 day intervals to prevent rhizome rot disease.
- Use locally available and registered biopesticides (Trichoderma, VAM and Bacillus) as a preventive measure for disease management.
- Application of fungicides registered at the 4th, 5th, 6th & 7th months after planting is recommended.
- Diseased rhizome should be carefully disposed of, either by safe burning outside the facility or through sterilization before disposal.
- Remove the diseased plants/bags from the seed production unit.



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Bacterial rot is diagnosed by milky ooze streaming from infected rhizome and streaming test.

Phyllosticta leaf spot

- Be vigilant for the occurrence of Phyllosticta leaf spot disease.
- Look for ash-grey coloured, water soaked lesions, round to spindle shaped: if caused by leaf spot



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Apply fungicide to control leaf spot disease.

disease, these may eventually lead to shot hole symptoms.

- If leaf spot disease severity is more than 3% of the population of the plants in the structure, then application of locally available and registered foliar fungicide is recommended.

Insect pests



Use neem based and BT based biopesticides for the control of caterpillars

Caterpillars & rhizome scale

- Monitor leaves for damage caused by caterpillars.
- Use of neem based and *Bacillus thuringiensis* (BT) based products are recommended for the control of caterpillars.
- In the absence of biopesticides and the event of high infestation, apply suitable insecticides as recommended by the relevant authorities to reduce the damage.
- After harvest during the storage of ginger, monitor infestation by scale insects.

Maintenance of production register

- Prepare a production register with all relevant details of planting and update regularly as given in Annex 2.



Maintain seed production register

Harvesting of ginger



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Senescence of plants indicates maturity



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Wash the harvested rhizome to remove dirt and potting media.

- After 8-9 months of planting, ginger plants experience 'die back' indicating their maturity and readiness for harvest.
- Coir / grow media can be shaken out of the bags to expose the rhizomes, which are then completely removed from the bag and the excess media removed.
- Wash the harvested rhizomes to remove excess coir or solid growing material. Washing ginger rhizomes with a power-hose is ideal to remove any scales, dirt and other insects if present.

Inspection and approval process

- The inspection team visits the site after receiving an application for seed rhizome production in a shade house facility under the certification programme. The producer is required to maintain records as per Annex 3.
- Four site visits are conducted during the different stages of seed production (Annex 4).
- Standards for certifying the seed rhizome during four visits are in Annex 5.
- After the inspection team is satisfied that the standards have been applied, they approve the seed rhizome with a tag and a lot number.
- The producer can sell this seed rhizome for further seed rhizome production (G1-G6) or to produce seedlings (using single bud technology) and to supply disease-free quality seedlings for commercial cultivation of ginger under open field conditions.



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Inspection team visits to assess disease incidence and quality of seedlings at different stages to certify seed rhizome .



Annex 1

**APPLICATION FOR GINGER SEED RHIZOME PRODUCTION
IN SHADE HOUSE FACILITY UNDER
CERTIFICATION PROGRAMME**

1. Applicant details

a. Name and Full Address (with phone/Email):

b. RADA registration number : _____

c. Owner of the land : _____

d. Name of the Nursery (If any):

2. Constitution Individual Partnership Government Co-operative society Private Company Others

3. Location of the nursery :

a. Parish: _____

b. Town or village : _____

4. Year of Establishment : _____

5. Total area of the production facility: _____

6. The details of infrastructure facility

Type of infrastructure	Year of establishment	Number

7. Does the facility have rain protection?

Yes No

8. Does the facility have double door entry?

Yes No

9. Details of production facilities

Grow Medium	Size of the grow container	Source of irrigation	Type of irrigation

10. Details of ginger plants

Ginger variety	Which generation (G1-G6) is being produced during this application?	Source of TC material for G1 production (Enclose the receipt/proof of purchase of TC material) or source of seed rhizome for G2-G6 rhizome production	No. of plants

11. Give details of current and future plan for production of seed rhizome in ginger

	Year I	Year II
Time of planting		
Time of harvesting		

12. Have you undergone any training on the production of seed rhizome (G1-G6)?

Yes No

If Yes, provide the details (Enclose certificate if any)

Name of the training/ workshop	Date	Organizing agency

13. Are you aware of the certification guidelines for seed rhizome production?

Yes No

14. Are you aware of certification standards for seed rhizome production?

Yes No

15. Are you committed to produce seed rhizome under certification protocol?

Yes No

DECLARATION:

I hereby declare that information given above is true to the best of my knowledge and belief.

Signature of the Applicant

Annex 3. Records for certifying quality disease free G1-G6 rhizome

Record maintenance and observation

In addition to the above guidelines, the certification of G1-G6 rhizome strictly requires the maintenance of a nursery register.

The following observation is to be recorded in the nursery register.

<i>Observation</i>	<i>When? How?</i>
<i>Mortality of seedlings</i>	After transplanting of seedlings
<i>Pest & disease</i>	<ul style="list-style-type: none"> • From planting to 3 months of planting, record pest and disease at every 30 days interval • 3 months after transplanting, record disease for every 15 days. • Symptoms
<i>Genetic off type plants</i>	<ul style="list-style-type: none"> • Vegetative phase (2 & 3 month after planting) • Rhizome development phase (5 & 7 month after planting)
<i>Yield</i>	Harvesting

Annex 4. Inspection for certifying seed rhizome

The team consisted of plant pathologist, entomologist, plant breeder and local agricultural extension officer must visit the G1-G6 production site for inspection of quality planting material as prescribed below

<i>Inspection</i>	<i>When</i>	<i>What to look for?</i>
<i>I</i>	At the time of planting	<ul style="list-style-type: none"> • Shade house infrastructure • Material requirements • G1-G6 Register • Seedling health
<i>II</i>	60-125 days	<ul style="list-style-type: none"> • Vigour of plants • Rhizome rot • Phyllosticta leaf spot • Shoot borer infestation • G1-G6 Register
<i>III</i>	180-190 days	<ul style="list-style-type: none"> • Off types • Rhizome rot • Shoot borer infestation • G1-G6 Register
<i>IV</i>	240-250 days (around harvest)	<ul style="list-style-type: none"> • Rhizome rot • scale insect • G1-G6 Register • Any other infestation

Annex 5. Standards for certifying seed rhizome

Following are the standards for certifying quality G1-G6 ginger production.

Criteria	Inspection	Maximum permissible limit
Seedling quality & Plant health	I-IV	Healthy
Rhizome rot disease incidence (fungal and bacterial infection)	I	0
Rhizome rot disease incidence (fungal and bacterial infection)	II-IV	0
Shoot borer incidence	II-III	1%
Off-type plants	III	0.5%
Phyllosticta Leaf spot disease index	II	5.0%
Scale Insect incidence	IV	1.0%

