

## **Rapid Multiplication of Yams (*Dioscorea* spp.)**

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# RAPID MULTIPLICATION OF YAMS

In traditional systems of producing yams (*Dioscorea* spp.), farmers depend on this season's harvest to supply planting material for the following season. To produce yams for eating or marketing, most farmers in the Pacific plant yam setts that weigh 100 to 600 g or more. This means that they must set aside 10 to 30% of their yam harvest for planting material.

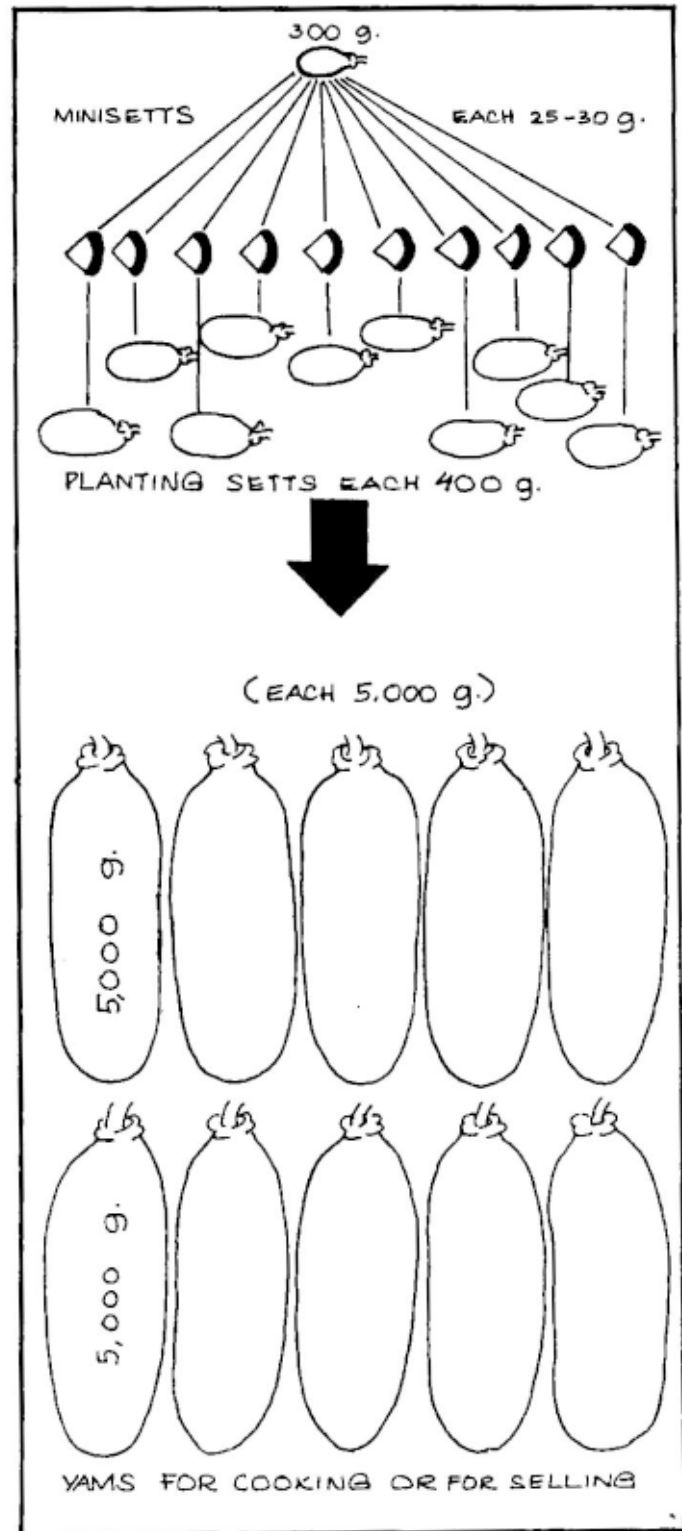
Farmers often encounter shortages of yam planting material, especially following cyclones, droughts, and disease epidemics, or in years when many feasts and celebrations are held.

Research and extension officers may also be faced with the challenge of producing large quantities of yam planting material.

Several methods of rapid multiplication have been developed to speed production of yam planting material. One of these methods is miniset rapid multiplication. This method produces small, whole planting setts, each weighing 200 to 800 g, from minisetts as small as 25 g.

Usually, the aim of miniset rapid multiplication is to produce a large number of small, whole tubers for planting, NOT to produce tubers for eating and marketing.

However, in the Caribbean where small tubers are preferred for export, minisetts are being used to produce high yields of marketable yams.



## Who Can Use Minisett Rapid Multiplication?

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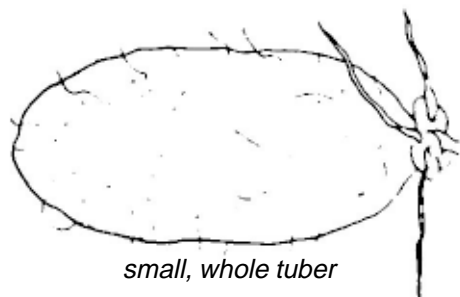
- Farmers can grow their own planting setts.
- Farmers can produce planting setts to sell to other farmers.
- Extension workers can grow large quantities of planting setts to supply farmers after cyclones and other natural disasters.
- Extension and research workers can rapidly multiply new cultivars for distribution to farmers.
- Researchers can rapidly multiply new introductions for evaluation.
- Researchers can use it to produce high-quality, uniform planting material for trials.

For example, when the 1987 drought destroyed most of the planting yams of farmers in the East Sepik Province of Papua New Guinea, the Saramandi Research Station used the minisett technique to rapidly multiply *D. alata* for distribution to these farmers for planting.

## Small Whole Tuber Setts

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The small, whole tuber setts produced by minisett rapid multiplication are excellent planting material for farmers and researchers. Each sett has a head, which means that sprouting is early, strong, and uniform. Also, these small, whole tuber setts have no cut surfaces and therefore rot less easily than cut pieces.



Although small, whole tubers produced from minisetts are excellent planting material, this is NOT true for all small, whole tubers produced in normal yam production. Why? Because in normal yam production, many of the small tubers are produced by weak plants that are infected with nematodes, viruses, and other diseases. Some of these nematodes and diseases are carried in the tuber. So, if you plant small tubers from infected plants, you will spread and multiply these nematodes and diseases and reduce your yields.

## Minisett Rapid Multiplication

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There are 8 steps in minisett rapid multiplication:

- Select tubers for cutting into minisetts.
- Choose minisett size.
- Cut the tubers into minisetts.
- Dry and treat the cut pieces.
- Presprout the minisetts.
- Plant and maintain the minisett crop.
- Rogue diseased plants.
- Harvest and store the planting setts.

## Select Tubers for Cutting

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To avoid spreading tuber-borne diseases, only tubers harvested from **HEALTHY** plants should be cut into minisetts. Select the tubers you will use for minisett multiplication in the field during harvest. Mark weak and diseased plants during the growing season, so that you can recognize them at harvest and avoid using their tubers for minisetts. The most important diseases to watch for are caused by viruses and nematodes.

### **Virus Diseases**

Do not use tubers harvested from plants with virus symptoms. Look for symptoms of virus on the leaves. Symptoms include vein banding, vein clearing, mottling and leaf distortion. If you see leaf distortion or curling, examine the undersides of the leaf for insect damage, which can sometimes be confused with virus symptoms. It is not necessary to avoid tubers from plants with insects on the leaves.



Leaf vein banding is one symptom of virus.

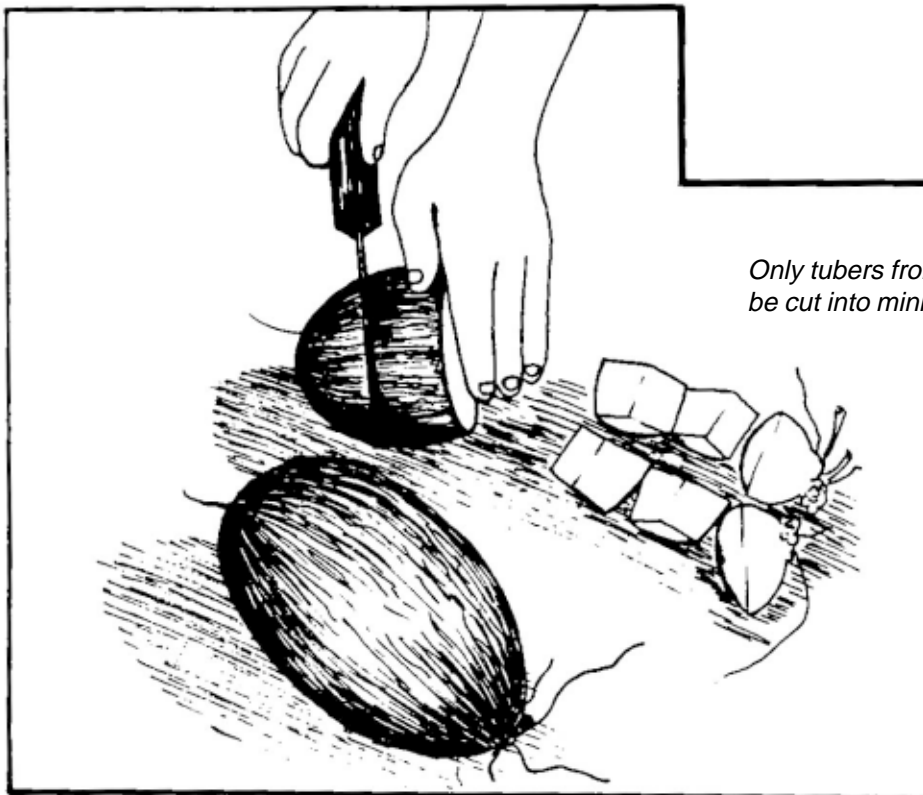
## Nematodes

Do not use tubers infested with nematodes. At harvest, look carefully for the symptoms of root-knot and lesion nematodes.

The symptoms of root-knot nematode (*Meloidogyne incognita*) include bumps and excess hairiness that are not typical of the cultivar.

The external symptoms of the lesion nematode (*Pratylenchus coffeae*) include vertical cracks on the skin of the tuber. The skin of the tuber flakes off easily to expose black-coloured dry rot underneath. This dry rot looks like black fire ash. Also, tubers infested with lesion nematode become soft and wrinkled and feel spongy when you touch them.

While you are cutting minisetts, discard any tubers that show the internal symptoms of lesion nematode. These include yellow, brown, or black areas under the skin that are not typical of the cultivar. Also, discard tubers with slow growing sprouts since this is another symptom of lesion nematode.



Only tubers from healthy plants should be cut into minisetts.

## Choose Minisett Size

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When choosing the size of minisett to use in your location, you must consider:

- The species of yam,
- The spacing at which the minisett will be planted in the field, and
- The size planting setts preferred by farmers.

You can use Table 1 to choose minisett size and plant spacing to produce a desired size of planting sett.

For example, if farmers prefer to plant 500 g setts of *D. alata*, cut minisett that weigh about 25 g and plant them at a spacing of 100 x 25 cm.

*Dioscorea rotundata* usually requires larger minisett than *D. alata*. The minisett technique has not yet been tested on *D. esculenta* or *D. nummularia*.

Large minisett sprout rapidly and grow into vigorous plants that yield large planting setts. In comparison, small minisett are more likely to rot or fail to sprout, and they yield smaller planting setts. But despite these disadvantages, small minisett usually give a more rapid multiplication rate than large minisett.

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**Table 1. For different species of yam (*Dioscorea*), what size planting setts you can expect to harvest from minisett of different weights planted at different spacings?**

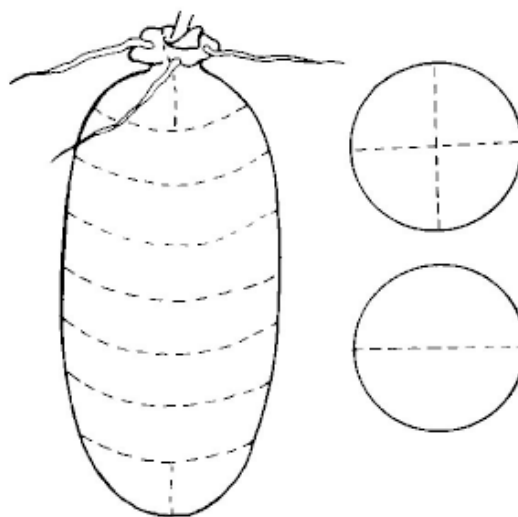
Yam species	Minisett wt (g)	Minisett spacing (cm)	Planting sett produced (g)
<i>D. alata</i>	10-20	100 x 25	100-600
	25-30	100 x 25	200-800
	40-60	100 x 40	400-1800
<i>D. rotundata</i>	25-30	100 x 25	100-300
	45-60	100 x 50	100-400
	70-100	100 x 50	400-500
<i>D. esculenta</i>	No data		
<i>D. nummularia</i>	No data		

## Cut Tubers into Minisettts

You can cut selected tubers into minisettts when they have broken dormancy and begun to sprout. Use a clean, sharp knife to cut each tuber into pieces that are the size you have chosen. First cut off the head and tail, and cut them each into at least 2 pieces. Then cut the rest of the tuber crosswise into disks, and cut each disk into 2, 3, 4 or more pieces. Each piece should have as much skin as possible and enough flesh to support sprouting.

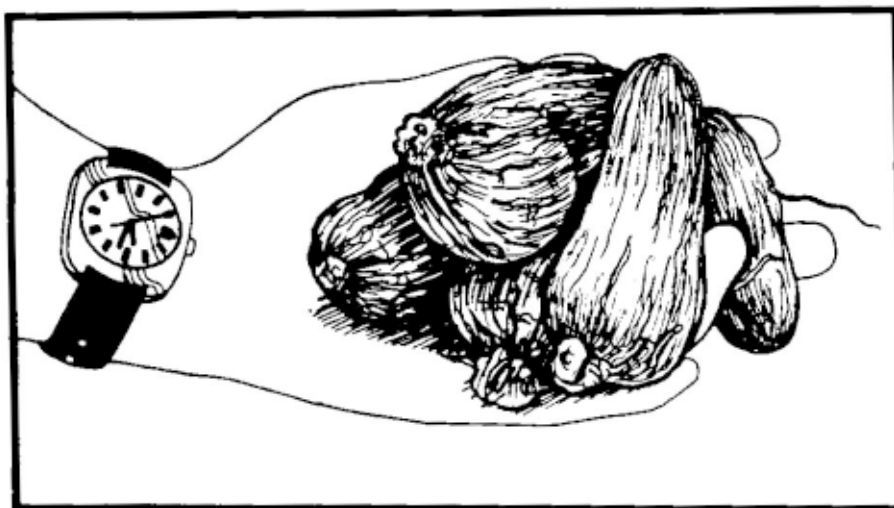
Tubers that are irregular in shape are more of a challenge to cut. But with planning, you can cut them in such a way that you get the most minisettts, each with as much skin as possible. For round yams that have a low ratio of skin to flesh, you can carve out some of the center flesh and use it for cooking.

Very small tubers should be planted whole.



Some cultivars of yam produce aerial tubers, and these can also be used for minisett rapid multiplication. Use small ones whole and cut large ones to the correct size.

There is no evidence that yam viruses can be spread by the cutting knife, but to avoid spreading rot diseases, disinfect cutting knives by dipping frequently in a strong (70%) solution of Clorox (or other household bleach containing SODIUM HYPOCHLORITE).



*Very small tubers would be planted whole.*



## Dry and Treat Cut Piece

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To reduce rotting, minisetts should be treated and dried as soon as possible after cutting.

Dust the cut surfaces with dry, sifted fire ash, or beach sand (well washed or collected from above the high tide mark), or treat with the fungicide and/or insecticide recommended in your country for normal yam planting setts.

Air dry the treated minisetts for 2 days, then plant them. Do NOT dry longer. Minisetts are so small that drying for longer than 2 days reduces sprouting because too much moisture is lost.

Dry the minisetts in a place that is shady, well-ventilated, and protected from rain and sun. Spread them in a thin layer with cut surfaces facing up, so that air can circulate freely around them.



*oil palm*

### Fire Ash

To treat 500 minisetts each weighing 25 to 30 g, you will need about 1 kg (or almost 2 litres) of dry, sifted fire ash.

Fire ash made from burning the inflorescences of oil palm is particularly effective as a treatment for minisetts. This may be related to its high potassium content of 4% or more, compared to 1% for ash made from burning most woods. Oil palm (*Elaeis guineensis*) grows in Solomon Islands and Papua New Guinea. For other countries, alternative high-potassium ashes should be identified.

### Fungicides

If rotting of normal yam planting setts is a serious problem in your location, you can also expect it to be a problem in minisett rapid multiplication. Minisetts can be treated with the same fungicide/insecticide slurry or dust recommended by your Extension Division for treating regular yam planting setts.

For example in one Pacific country the following is recommended: Dust freshly cut pieces with undiluted powder of captafol (Difolatan, 80% WP), then dry and plant.

## Presprout Minisett

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After drying, minisettts can be planted directly into the field. With some yam cultivars, however, better results are obtained if minisettts are presprouted before planting. They can be presprouted in a nursery bed, wooden box, or pit that is well drained. These should be protected from the rain and shaded from the sun.

Place old, rotten sawdust or very light, sandy soil in the nursery bed, box, or pit. These media are better than topsoil because they allow excess water to drain away, and they make it easy for you to remove the minisettts without damaging sprouts and roots.

After burying the minisettts in the sawdust or sandy soil, apply water as necessary to keep damp but NOT wet. This is important, because minisettts that are kept too wet will rot.

NOTE: Do not use fresh saw-dust because it tends to heat up and that can kill young plants.

Not all the minisettts you plant will sprout. Sprouting usually ranges from 60 to 80%, but this varies with species and cultivar. Also, the range in time to sprouting varies with species and cultivar and the variability in time to sprouting among minisettts of one cultivar can sometimes be a problem.

## Plant and Maintain Minisett Crop

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Most operations involved in planting minisettts and maintaining the crop are the same as for normal yam.

**Time of Planting.** The best time of planting will vary with location, but is usually during the normal yam planting season. Your aim is to harvest settts that will break dormancy as close as possible to the time when they are needed for planting.

**Soil.** It is possible to plant minisettts on soils that are too low in fertility or too shallow to grow normal yams for eating and, marketing.

However, remember that your goal is to produce healthy planting settts that are free from soil-borne nematodes and diseases. Therefore, minisettts should NOT be planted on soils infested with lesion or rootknot nematodes or yam diseases. Minisettts should not be planted repeatedly on the same land, and they should not be planted after a crop of normal yam. Newly cleared fallow is the best land for planting minisettts, because nematode populations are low.

Land should be prepared as is customary for growing yam in your location, either by digging holes or by building mounds or ridges.

**Planting.** Plant the mini-setts at a spacing of 1 x 0.25 m or 1 x 0.5 m (see Table 1) and cover with about 5 cm of soil.

**Mechanized land preparation.**

Where fields are flat and soils are free of large stones (like some locations in Tonga, Cook Islands, and Fiji), minisett production can be mechanized to reduce labour costs. The soil can be prepared by ploughing and harrowing. Ridges can then be made mechanically before the minisett are planted by hand.

If yams are usually planted on the flat, as in Tonga, shallow furrows can be made with a chisel plough or subsoiler. The minisett are then placed in the furrow by hand and buried either by hand or by mechanically ridging over the furrow.

If using fertilizer, phosphorous and potassium can be broadcast before ridging or furrowing.

**Staking.** If yams are staked in your location, then your minisett crop should also be staked. However, the stakes can be lighter and shorter. Stakes 1 to 2 m high are adequate. Split bamboo, thin sticks, or other inexpensive local materials can be used. Also, single maize plants spaced at 1 x 2 m can be planted to support the light vines of minisett without significantly reducing the yield of the yams.

Where yams are grown on branches scattered over the soil, as in Tonga, minisett can also be grown this way.

Where yams are traditionally grown without stakes, minisett can also be grown without stakes. In some tropical countries where minisett are being grown without staking, WHITE plastic mulch has been used successfully (not clear or black plastic). This mulch is spread over the ridges, and the minisett are planted through holes cut in it.



*Light stakes 1 to 2 m high are adequate for minisett production.*

**Weed control.** Sprouting of minisett is often delayed, and the young sprouts are weak and tender. Good weeding is therefore critical during the first 12 weeks after planting. If herbicides are recommended for normal yam production in your location, they can also be used for minisett production.

**Fertilizer application.** If fertilizer is recommended for yam production in your location, it should also be applied for minisett production.

**Pest control.** To protect your minisett production from diseases, insects, and nematodes, use the methods recommended by your Extension Division for normal yam production.

## **Rogue Diseased Plants**

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Virus diseases can be carried in the yam setts you grow and distribute. To avoid spreading virus diseases, you should reduce the incidence of virus in your minisett production as much as possible by roguing.

Roguing is the process of inspecting the crop and eliminating unwanted plants.

Walk your minisett multiplication plots regularly, and pull out all plants with virus symptoms on their leaves. Burn these plants, or bury them very deep. Also eliminate plants that are weak and grow slowly. Start roguing early in the growing season and rogue frequently to prevent insects from spreading virus from infected plants to other plants.

## **Harvest and Store Planting Setts**

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Harvesting must be done carefully so that yam tubers are not cut, scraped, bruised, or sunburned. Immediately after digging, tubers should be moved out of the sun, cleaned, sorted, and placed in storage. Damaged tubers and tubers showing symptoms of nematodes should be eaten or fed to livestock, not stored.

Storage areas must have adequate shade, good ventilation, and security against pests, especially rodents. Regular inspection and disposal of rotting tubers is recommended. Sprouts should be kept pruned.

## Curing

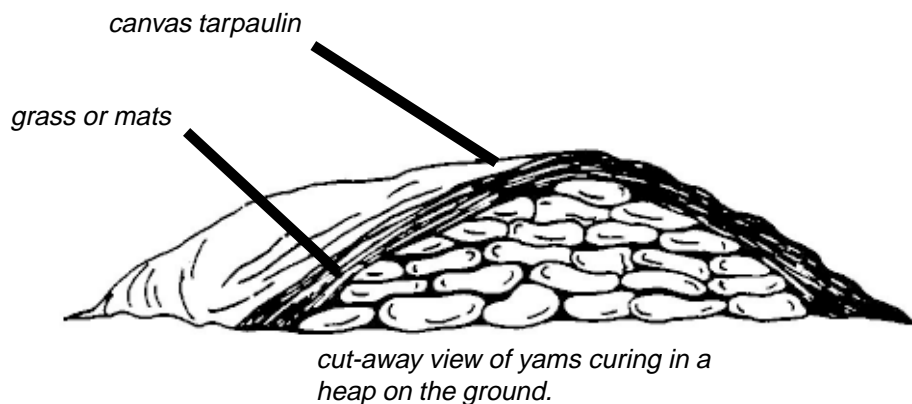
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Planting setts will store longer if they are cured before they are placed in storage. Curing helps to heal wounds and toughen the skins.

Curing should be carried out IMMEDIATELY after harvesting and transporting yam setts to the storage area. Curing requires high temperatures (32 to 40°C) and high humidity (95%) for 2 to 4 days. It is done under a cover that traps self-generated heat and moisture.

One way of curing is to heap the tubers in a lightly-shaded area and cover them, first with grass or mats and then with a CANVAS tarpaulin. Do not use plastic sheets for curing. Plastic will make the yams too hot. If you do not have a canvas tarpaulin, you can use several layers of sacks or mats. Leave the yams to cure for 2 to 4 days - NO LONGER. Check to be sure temperatures do not get higher than 40°C.

For more information on storing yams see: “Agro-Facts, Careful Storage of Yams” by Jill E. Wilson, IRETA Publication No. 15/87.



## Distribution of Minisetts

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The small, whole tubers produced by the minisett rapid multiplication are easily transported and distributed to farmers.

Tubers that are smaller than desired for planting setts can be used for another cycle of minisett rapid multiplication.