



Recommended Sweetpotato Farming Practices in Quang Binh, Vietnam: A Way to Promote Sustainable Rural Development and Food Security under a Changing Climate

A TRAINING GUIDE



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in Quang Binh, Vietnam:
A Way to Promote Sustainable Rural Development
and Food Security under a Changing Climate**

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**Food Resilience Through Root and Tuber Crops in Upland
and Coastal Communities of the Asia-Pacific
(FoodSTART+)**

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International Potato Centre (CIP)
CIP Philippines, PCAARRD, Los Baños, Laguna
4030 Philippines
Tel +63 49 536 8185 | Fax + 63 49 536 1662
E-mail: cip-manila@cgiar.org | Website: cipotato.org

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ABOUT FOODSTART+

Food Resilience Through Root and Tuber Crops in Upland and Coastal Communities of the Asia-Pacific (FoodSTART+) is a three-year project (2015-2018) that builds on and expands the scope of the recently-concluded IFAD-supported Food Security Through Asian Root and Tuber Crops (FoodSTART) project. It is coordinated by the International Potato Center (CIP), in collaboration with the International Center for Tropical Agriculture (CIAT) in Asia. The project is also working closely with the CGIAR Research Program on Roots, Tubers and Bananas (RTB); and the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). It is funded by the International Fund for Agricultural Development (IFAD) and the European Union (EU).

The project aims to enhance food resilience among poor households in upland and coastal communities of the Asia-Pacific region through introducing root and tuber crops (RTC) innovations. To achieve this goal at scale, the project will develop, validate and implement effective partnership strategies with IFAD investment projects to promote RTCs for food security.

FoodSTART+ is being implemented in four primary beneficiary countries; specifically Meghalaya State in India, Maluku Islands in Indonesia, Eastern and Central Visayas Regions in the Philippines, and Quảng Bình Province in Central Vietnam. Supplementary beneficiary countries are China and Myanmar.

INTRODUCTION

Sweetpotato (*Ipomoea batatas*) is the world's second most economically important root crop after potato and is an important food security crop in many countries in Asia. Throughout history, this crop has played an important role during disasters. For instance, in Japan, people rely on sweetpotato when typhoons demolish their rice fields. Similarly, in the immediate aftermath of Typhoon Haiyan in the Philippines when food supply was most difficult, affected families harvested sweetpotato for food. It kept millions from starvation in famine-plagued China in the early 1960s, and in Uganda, where a virus ravaged cassava crops in the 1990s, rural communities depended on sweetpotato to keep hunger at bay.

In Vietnam, sweetpotato is an important crop for small scale farmers not just during disasters. It is also frequently consumed as an alternative food source during seasonal shortage, substituting for rice, and diversifying diets and income of local people. Sweetpotato is a climate-resilient crop because of its short growing cycle of three to four months, its high tolerance to increased soil salinity, and because it grows underground, it is less affected by typhoons. Sweetpotato helps farmers combat the effects of climate changes, especially in areas like Central Regions of Vietnam which are most vulnerable to extreme weather events.

However, after a few years of cropping rootcrops such as sweetpotato without adequate practice, farmers' yield decline as well as income. Poor tuber quality and quantity of sweetpotato eventually deter them from expanding production. Although the exact cause of the problems is not clearly identified yet, the study 'Assessing Gaps Between Existing Cassava and Sweetpotato Farming and Climate Smart Agriculture Practices in Quang Binh Province, Vietnam' jointly conducted by

FoodSTART+ and the IFAD-supported Sustainable Rural Development Project (SRDP) found that farmers face erosion and degradation of soils, as well as widespread use of poor-yielding planting material and the lack of pest management practices (Wilkins, 2017). Farmers do not always take into account proper soil management practices to maintain fertility. The farmers are also either not aware of any alternative or better management techniques or believe that there is nothing that can be done to improve their current practice. With this situation, the study recommended the adoption of Climate Smart Agriculture (CSA) strategies to help farmers improve their cropping practices. CSA practices entail effective and smart use of inputs and natural resources toward increased yields with reduced impacts on land, water and forest.

This training manual describes CSA practices for sweetpotato, which aim to transform sweetpotato cultivation practice to sustainably support development and food security under a changing climate. This is a valuable resource for those involved in training extension workers, village leaders, and SRDP staff, among others; who will, in turn, will train farmers and help them build their problem solving and decision-making skills so they can continue to learn, question, test and address different opportunities and challenges relevant to their livelihoods.

This training manual is divided into three key parts: namely production and management, pest and disease management, and soil conservation. It discusses the recommended practices and its benefits or advantages, based on the most recent literature on CSA practices for sweet potato in Quang Binh Province, Vietnam.

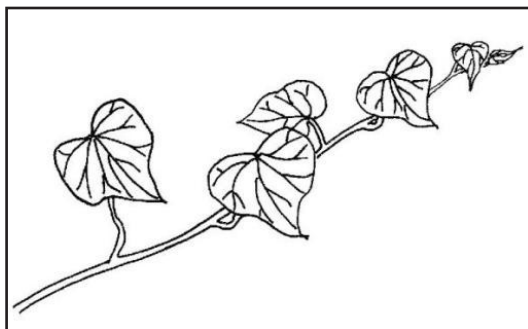
SWEETPOTATO PRODUCTION AND MANAGEMENT

Planting Material

Recommended practices:

Use clean and good quality vine cuttings that are:

- of medium age or 50-60 days after multiplication in nursery;
- from vigorous seed stocks or mother plant;
- cut from the first section (apical cutting) and the second section;
- 25-35 cm in length and bear 6-8 nodes;
- with thick, strong, and short internodes, thick leaf, and short petiole; and
- free of disease and pests, adventitious roots and/or flowers at the nod



Internode lengths may differ between varieties (3 nodes = 30 cm length).

Healthy and clean apical (tip) cuttings.



Advantages:

- It recovers most easily from cutting and planting shock.
- It grows faster than the lower part

Field Selection and Preparation

Select a field that is not previously planted with sweet potato. Fields should be located at least 100 m away from previous sweetpotato fields to avoid spread of pests and diseases. It will be very good if a field previously planted with rice or other irrigated crops will be used, so as to minimize disease and pest infection. It should also be close or accessible to water sources for later irrigation.

Sandy loam, loamy sand and well drained soils are ideal for sweetpotato, such as alluvium deposited soil on a river band, rice-based cropping land in the delta, low elevation hilly land after spring-summer maize or summer-autumn soybean, and sloping hilly land after summer-autumn soybean. Good soil drainage is essential for sweetpotato production.

Recommended practices:

Plowing should be done two times with one week interval between plowings. Second plowing must cross the direction of the first plowing together Apply organic fertilizer at the rate of 600 -900 kg per 1,000 m² or 9,000 kg per hectare evenly over the field and then mix with the soil. Plowing depth should be about 20 cm. Treatment of plants residues on the soil can be rich in mineral could support sweetpotato growth.



Buffalo-driven plowing.



Spreading out the organic fertilizer and mixing in the soil.

Harrowing is done to break soil clods and remove large plant debris. It should be done after second plowing. The field should be passed with harrow two times, with the second crossing the direction of the first.

Furrowing is to construct the ridges for the sweetpotato plants. Any residue of plants should be buried.

Advantages:

- Break soil clods and remove large plant debris.
- To loosen the soil and kill weeds.
- A loose rooting zone for sweetpotato.
- Ridges keep them from being submerged in water during heavy rains.
- Release nutrients from decomposed the plants residues.

Planting

Recommended practices:

Planting on ridges is needed for storage root initiation and growth, and so the height of the mound or ridge is important. Sweetpotato vine cuttings with at least 3 nodes (about 20-30 cm) long are usually planted at a spacing of 25-30 cm between plants and 60-100 cm between ridges.

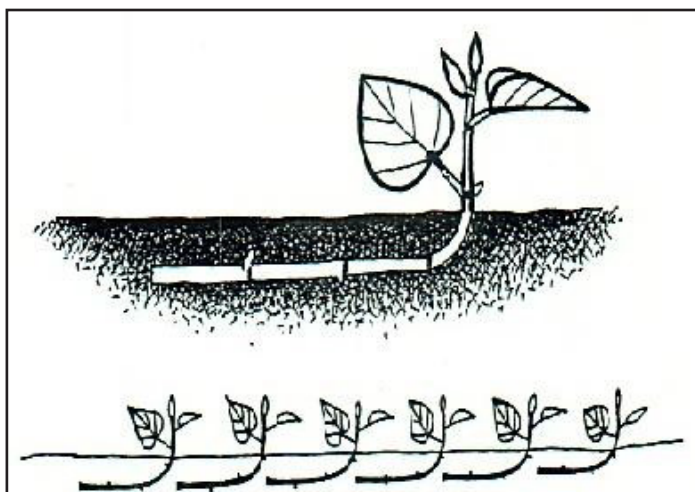
Flat planting gives better shaped roots and were straighter than other method. A stick, machete. or hoe is used to make a hole at least two nodes should be under the soil to enhance establishment and increase the number of roots that form. With the flat planting method, cuttings are placed into the soil, leaving only the tip exposed. The soil should be wet and the whole amount of nitrogen (N) and phosphorous (P) and half of potassium (K) as basal at planting (150 kg Urea, 133 kg TSP, and 75 kg K₂O) should be applied. The remaining amount of K should be side dressed at 4 weeks after planting.



Sweetpotato being planted on ridges.



Planting sweetpotato cuttings on mounds.



Recommended sweetpotato vine placing.

Advantages:

- Ridges facilitate good soil aeration which is needed for storage root initiation and growth.
- Flat planting gives better shaped roots because they have more room for growth.
- Sweetpotato requires certain amount of nutrients in order to produce optimum yield.

Fertilizer Application

The most common commercial fertilizer used in the Cao Quảng villages is Kali (P-based) and Đạm (N-based). In Quảng Thạch, farmers apply urea and/or phosphorus amendments. Most farmers add supplemental fertilizer of urea or Kali, one month after planting or after the first weeding. Sometimes, additional fertilizer use is dependent on the type and amount of amendment left from other crops.

Recommended practices:

Sweetpotato, as with most root crops, absorbs more potassium (K) but less nitrogen (N) and phosphorous (P) than maize does. Potassium is the most important element for storage root development. However, it is not only the amount of potassium that is important, but also the ratio between the supplied potassium and nitrogen. The best bulking of storage roots occurs when the nitrogen and potassium are present in the soil at a ratio of about 1:3. Applying potassium during the second half of the crop's growth cycle helps promote development of a strong skin. Nitrogen (N) can result in abundant vine growth but poor root development if present in too high concentrations.

Therefore, balanced fertilizer regimes should be used, such as 60 kg N, 60 kg P_2O_5 , 90 kg K_2O per hectare. The remaining amount of potassium (K), or 45 kg K_2O , should be side dressed at four weeks after planting. The recommended fertilizer rates for a sweet potato crop in the Central Region of Vietnam is presented in Table 1. If a complete fertilizer of NPK is used, the applied dose is calculated in equivalence to the mentioned recommended rates.

Table 1. Recommended fertilizer rates for a sweet potato crop in the Central Region of Vietnam (FCRI, 2011).

Application & Timing	Amount (kg/500 m2/crop)			
	Manure	Urea	Super phosphate	Kalyclorua
Basal	500 - 750	2.5	10 - 15	2.0
Side dressing 1 (20-25 DAP)	-	3.5 - 4.5	-	2.5 - 3.5
Side dressing 2 (45-60 DAP)	-	2.5 - 3.5	-	5.0 - 6.0
Total	500 - 750	8.5 - 9.5	10 - 15	9.5 - 11.5



Example of fertilizer mixtures (NPK 20-10-10) available in the market.

Advantages:

- The best bulking of storage roots occurs when the nitrogen and potassium are present in the soil at a ratio of about 1:3.
- The crop's growth cycle helps promote development of a strong skin.

Weeding

Weeding is an important step in sweetpotato production during plant establishment and within the first two months after planting. It is done to avoid competition with the sweetpotato plants for nutrients and water, and to reduce pests and diseases infection.

Advantages:

- Allows optimal growth of sweetpotato and absorption of nutrients and water without any competition.

Off-barring

Recommended practices:

The soil on the sides of the ridges are plowed out into the middle of the furrow. In the process, the weeds are removed from the sides of the ridges and at the same time the soil covers the weeds that are in the middle of the furrows. Off-barring is done 3-4 weeks after planting.

Advantages:

- Loosening of the soil, facilitate weed control done during the crop establishment.
- Spreading the cut weeds on the field as mulch can improve soil health by increasing organic matter inputs.



***Sweetpotato plots where cut weeds are covered
to the middle of the furrow.***

Hilling-up

Recommended practices:

The soil thrown off the sides of the ridges during off-barring is plowed back to the sides. At the same time, the weeds in the plow path are disturbed and those in the plots are covered. Hilling-up is done 2-3 weeks after the off-barring operation. It is important to allow the base of the sweetpotato plants to be covered and to prevent exposed the roots.

Advantages:

- Control weeds.
- The base of sweetpotato is covered to prevent sweetpotato weevil attacks at the roots.



Hilling up to plow back the soil to the sides to cover cracked soil.



Cracked soil and exposed roots are easier for weevils to attack.

Lifting Vines

Recommended practices:

Lift the sweetpotato vine at four weeks after planting and continue once in every two weeks. Lifting vines could also be done while weeding. If the soil is moist and the stem of a vine touches it, roots will grow from the nodes. Some producers lift these vines to prevent roots forming into small non-marketable storage roots.

Advantages:

- Produce high marketable storage root yield.
- Exposes soil that is always covered with stems, leaves, or bulbs that can become hiding places for rats.

Irrigations of sweetpotato crops

There is relatively limited information about the water requirements of sweetpotato, though it is recognized that adequate moisture is important during the first month of the crop. It is generally agreed that the crop requires between 450 and 650 mm of water, including rain, well-distributed throughout the growing season. The soil should be kept moist enough, ideally at 70-80% of soil water holding capacity throughout cropping season. Saturated water should also be avoided for at most a half of day, especially at critical stages during four to eight weeks after planting.

Recommended practices:

Irrigation twice a week is recommended up to 20 days after planting (DAP), once a week from 20 to 40 DAP, and once every two weeks from 40 DAP until harvesting. During irrigation, the soil should only become wet to the depth of the crop root zone, and not further.

Stop watering one month before harvesting to allow the storage roots to mature physiologically and for root skins and appearance to become firm and attractive.

Advantages:

- High yield and the best quality can be expected if sweetpotato plants are established in moist soil and sufficient water is available to the crops throughout the growing season.



Furrow irrigation is suitable for sweetpotato planted on ridges.

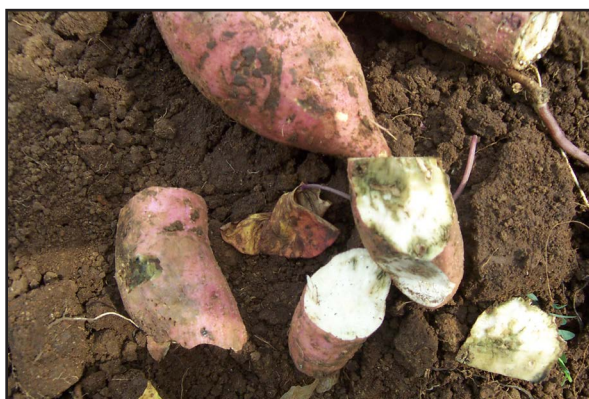
SWEETPOTATO PEST AND DISEASE MANAGEMENT

Integrated Pest Management

Several Cao Quảng and a few Quang Thach farmers reported sweetpotato pest issues, specifically leaf and root eating bugs, which caused a drastic decline in yield in their area. Crop damage from stem borers were also reported by some farmers, as well as a variety of other insects which cause more damage the longer the crop remains unharvested. Despite this, very few in both communes use pesticides to control pests because they are either unaware of applicable pesticides or were hesitant to spray because of the perceived negative health implications. In terms of diseases, some reported that their sweetpotatoes have crinkled or yellowed leaves, but do not know its cause. Other farmers also experienced diseases but could not describe specific symptoms, but they do not do anything to prevent or treat the symptoms.



Stemborer feeding damage on the vine causes wilting, poor growth, and even plant death.



Weevil-infested storage roots emit offensive odors due to the presence of terpenes produced by the insect.

Recommended practices:

Integrated Pest Management (IPM) integrates an understanding of the ecology of the pest organism with a variety of tactics that prevent, avoid or reduce the crop losses caused by the pest. It refers to the application of combined control approaches use to reduce pest or disease damage to tolerable levels and not aiming at complete elimination. The techniques include use of crop sanitation and rotation, and cultural, mechanical, biological, and non-chemical pest control. The choice of control components depends on the key pest to control, part of the plant attacked, the kind of loss caused, and control measures available.

Crop sanitation aims to prevent or eradicate sources and vectors of pests and disease. Crop rotation can help prevent the buildup of crop specific pest and disease in one area of field. Cultural control includes using pest and diseases-free planting materials since a healthy plant may be more resistant to attack by pest or diseases. High plant densities should be avoided. Meanwhile, mechanical control involves the use of physical measures. For example, flying insects can be kept away from planting materials and nurseries with the help of net tunnels. Biological control methods use natural/beneficial enemies to control pest and diseases and use of extract plants as pesticide and other safer and more affordable non-chemical pest management practices

Some examples of extract plants as natural and homemade pesticides are: chilli for ants, aphids, caterpillars, mealybugs; tobacco for caterpillars, aphids, etc., soap for scale insects and mealybugs; garlic for caterpillars, thrips, and possibly some fungal diseases; gliricidia for aphids, caterpillars, whitefly; derris for caterpillars, grasshoppers, aphids, spider mites, plant hoppers; and ash against grasshoppers.

Advantages:

- Provide farmers with practical guidelines and alternatives to eliminate their dependence on synthetic pesticides for the management of sweetpotato pests.
- Safe and non-poisonous.
- Reduce the pollution of air, water, and soil resources.



Common insect pests of sweetpotato:



Armyworms (*Spodoptera litura*)

Biological damage: The larvae can eat the entire leaves of field crops and grasses. When feeding, they chew from the leaf edges until only the midrib is left.

Natural enemies: Predatory ants, earwig, and bugs

Control measures: Weedy hosts should be eliminated. *Ipomoea reptans* (kankung) and several weeds (*Amaranthus sp.*, *Passiflora foetida*, *Ageratum sp.*) are common alternate hosts in Asia.



Grasshopper (*Attractomorpha psitaccina*)

Biological damage: The feeding damage includes leaf notching and stripping, but as they mature they can consume an entire plant.

Control measure: Not necessary due to their status as minor pests.



Tortoise beetles (*Aspidomorpha* spp.)

Biological damage: The larvae and adult feed on the leaves producing rounded holes on the leaf blades.

Natural enemies: Pupal parasitoid, praying mantis

Control measures: Control of alternate hosts like weeds. Several natural enemies including egg and larval parasites (*Tetrastichus* sp., *Eulophidae*; *Chalcidae*) and predators (*Stalilia* sp., *Mantidae*) have been reported.



Weevil (*Cylas formicarius*)

Biological damage: Larvae feed and tunnel into vines and storage roots. Larvae tunnel filled with frass. Adults feed on tender buds, leaves, stems and storage roots.

Natural enemies: Ground beetles, spiders, big headed ants

Control measure: Field sanitation, use of clean planting material, hilling-up, crop rotation, flooding the field, and mulching.



Stemborers (*Omphisa anastomosalis*)

Biological damage: Larval feeding produces large tunnels causing hollow cavities in the stem. Seriously affected plants may wilt and die.

Natural enemies: Earwigs, ladybird beetles, ground beetles, ants, and spiders

Control measures: Use of clean planting material, destruction of infested crop residues after harvesting, crop rotation, use of light trap, hilling-up.



Bug (*Physomerus grossipes*)

Biological damage: Nymphs and adult pierce stems and petioles and suck plant sap, causing stunting and wilting.

Control measure: Control weeds from fields. Weeds serve as the pests' alternate hosts. Plant small flowering plants to attract native parasitic wasps and flies. Plow-under all plant debris after harvesting to destroy all possible breeding sites.



Whiteflies (*Homoptera: Aleyrodidae*)

Biological damage: Yellowing and necrosis of infected leaf.

Natural enemies: Aphelinid wasps (*prospatella clypealis* Silvestra and *crospatella* sp.)

Control measures: Field sanitation and use of insect-free planting material. Planting non-host crops after sweet potato, Garlic oil spray, Soap spray.



Aphids (*Aphis gossypii*)

Biological damage: The direct damage is typically distortion of young leaves and shoot. Excessive damage leaf leads to leaf curling.

Natural enemies: Lynx spider (*Oxyopes javanus* Thorell), crab spider (*Thomisus* sp), lady birds beetle (*Menochilus sexmaculatus*)

Control measure: Predators such as ladybeetles, chrysopids and syrphids, prey on nymphs and adults.

Natural enemies to common sweetpotato insect pests:

Natural enemies are beneficial insects that can contribute to the control of pests. Helping natural enemies to thrive can help reduce pest problems. One method is to provide hiding sites and alternative habitats such as mulches and other ground covers, as well as to plant small flowering plants on borders, hedges, and other perennial habitats as source of food and shelter.



Damsel Bug



Diadegma



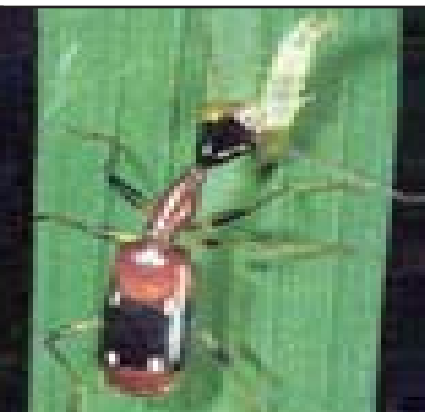
Lacewings



Spider



Hoverflies



Groundflies



Ladybirds Beetle



Thacididflies



Rove Beetles

Common sweetpotato diseases:

The most widespread and destructive diseases that contribute to degeneration in sweetpotato planting material are the Sweetpotato Feathery Mottle Virus (SPFMV) and the Sweetpotato Chlorotic Stunt Virus (SPCSV). These viruses are much smaller than any other creature and can only live and multiply inside their host or victim. It then takes over the management of the cell's processes, causing severe and irreparable damage to the host plant. Fungal disease such as scabs are also common to sweetpotato plants in Vietnam.



Sweetpotato Feathery Mottle Virus (SPFMV)

Biological damage: Vein clearing, pale areas/spots on leaves sometimes with purple edges. Russet cracking and internal cork caused by SPFMV can also reduce storage root quality.

Spreader: Aphids (inset image)

Control measure: Start with clean planting material, remove and burn any diseased plants as soon as they appear in young crops, avoid planting new sweetpotato crops where grew sweetpotato last season. wasps and flies. Plow-under all plant debris after harvesting to destroy all possible breeding sites.



Sweetpotato Chlorotic Stunt Virus (SPCSV)

Biological damage: Diminished growth or stunting causing the plant and leaves to remain small. Chlorosis the leaf tissue so that the diseased plants stand out from the rest of the crop.

Spreader: White flies (inset image)

Control measure: Always use planting materials cut from healthy-looking plants, Plant sweet potato varieties that are resistant to the disease.



Scab (*Elsinoe batatas*)

Biological damage: Brown to tan raised corky lesions with purple to brown centers appear along the stems. Humid weather favors the disease.

Control measure: Use resistant varieties and use healthy planting materials.

SOIL CONSERVATION TO MANAGE SOIL FERTILITY

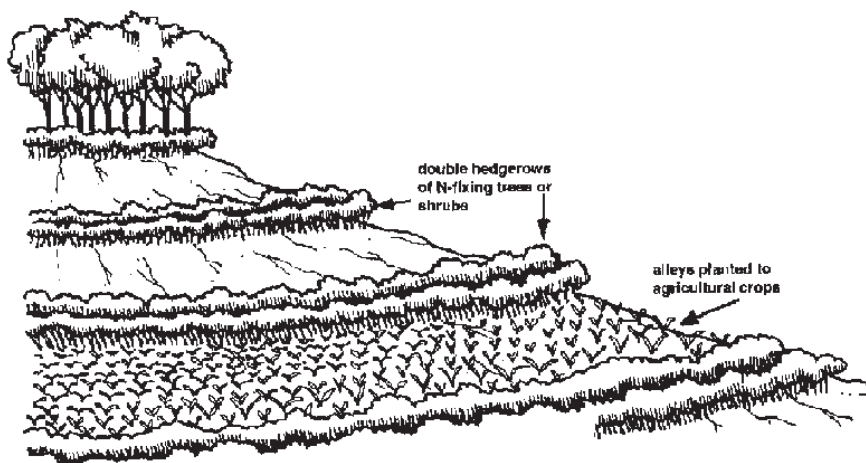
Recommended practices:

Some of measures to avoid degrading the soil and to make them productive for sweetpotato includes: plowing and orienting the ridges for the plants across the contour, planting sweetpotato between established hedgerow of vetiver grass, and incorporation of high amount of organic matter into the soil.

Intercropping of sweetpotato is easier when it is grown on ridges. As with all intercropping, the cropping pattern should try and minimize the competition for light and nutrients between crops.

Advantages:

- Maintain the good quality of soil and crops in the long term.
- Alley cropping can reduce nutrient losses due to erosion, amounting to USD 4,10 to 85,5/ha/year (Irawan, 2003).
- Intercropping contributes to improving crop and food diversity, increasing soil fertility if nitrogen fixing intercrops are used, and reducing weed growth.



Alley cropping with double hedgerows.

Contour Strip Cropping

Advantages:

- Cheap and effective conservation technique.
- Controls erosion and surface flow.
- Maintain soil productivity.



Contour strip cropping with maize.

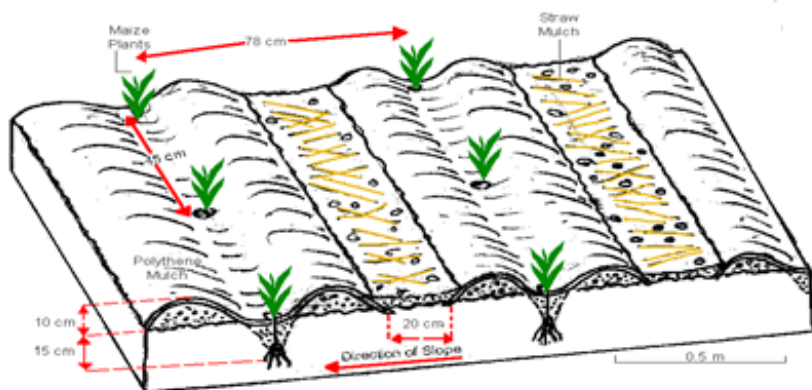
Mulching and Minimum Tillage

Advantages:

- Reducing nitrogen and phosphorus movement off-field and into surface water.
- Legume cover crops, like crimson clover, add nitrogen to the soil.
- Cover crops also provide soil erosion control, which limits runoff-associated losses of nitrogen and phosphorus.
- Cover crops also can improve soil health by increasing organic matter inputs.



Vetiver and mulch strips to prevent erosion in maize croplands.



Rice straw mulch placed between the rows of plants.

Cover Crop

Advantages:

- Crop residue mulch and cover cropping can increase earthworm activity.
- Improves structural properties.
- Improves activity and species diversity of soil fauna and flora.
- Improves soil quality and reduces risks of soil degradation.



Soil cover crops such as legume creeps are planted among the previous crop residues.

Relay Cropping

Advantages:

- The rotation of crops is not only necessary to offer a diverse “diet” to the soil microorganisms, but as the roots are at different soil depths, they are capable of exploring different soil layers for nutrients.
- A diversity of crops in rotation leads to a diverse soil flora and fauna as the roots excrete different organic substances that attract different types of bacteria and fungi, which in turn, play an important role in the transformation of these substances into plant available nutrients
- In proper rotation, sweetpotato can follow either cereals such as maize, sorghum, rice, finger millet, or legumes such as beans, cow peas, soybean and sesame.
- Sweetpotato should never follow root (cassava, yam) or tuber (potato) crops because these have almost similar nutrient requirement.



Relay cropping with papaya and legumes.

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The International Potato Center (known by its Spanish acronym CIP) is a research and development organization with a focus on potato, sweetpotato, Andean roots and tubers. CIP is dedicated to delivering sustainable science-based solutions to the pressing world issues of hunger, poverty, gender equity, climate change, and the preservation of our Earth's fragile biodiversity and natural resources.

CIP Philippines
PCAARRD, Los Banos, Laguna 4030 Philippines
Tel +63 49 536 8185 | Fax + 63 49 536 1662
E-mail: cip-manila@cgiar.org
www.cipotato.org



The International Center for Tropical Agriculture (CIAT) develops technologies, methods, and knowledge that better enable farmers, mainly smallholders, to enhance eco-efficiency in agriculture by making production more competitive and profitable as well as sustainable and resilient through economically and ecologically sound use of natural resources and purchased inputs.

CIAT Regional Office for Asia
Km2, Pham Van Dong Street, Bac Tu Liem District,
Hanoi, Vietnam
Phone: +844 3757 6969 | Telefax: +844 3757 0999
Email: d.campilan@cgiar.org
www.ciat.cgiar.org



The CGIAR Research Program on Roots, Tubers and Bananas (RTB) is a broad alliance led by the International Potato Center (CIP) jointly with Bioversity International, the International Center for Tropical Agriculture (CIAT), the International Institute for Tropical Agriculture (IITA), and CIRAD in collaboration with research and development partners. The shared purpose is to tap the underutilized potential of root, tuber and banana crops for improving nutrition and food security, increasing incomes and fostering greater gender equity, especially among the world's poorest and most vulnerable populations

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