SATNET ASIA
Innovation network for food security and poverty reduction

'Mukibat' Grafting System in Cassava Production

Technology fact sheet

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Key facts

- Higher yielding cassava cropping method
- Grafted cassava can be grown in shady areas where cassava usually fails
- Increased labour requirements

What is 'Mukibat' grafting system in cassava production?

'Mukibat' is a grafting system for cassava seedling production. It uses rubber cassava (*Manihot glaziovii*), a perennial tree cassava as a scion and a superior or local cassava variety (*M. esculenta*) as the rootstock. The technology has a potential to yield 80-100 tonnes per hectare. Returns can be increased despite higher production costs.

Figure 1. Researcher from ILETRI and farmer harvesting Mukibat cassava

Photo: Ministry of Agriculture, Indonesia

History

- The technology was developed in 1952 by a farmer named Mukibat in Kediri District, East Java, Indonesia (IDRC, 1978) to increase productivity.
- The development of the technology and its diffusion was very slow. Experimentation was mainly by farmers with little extension and research support.
- Recent studies show that some farmers still plant Mukibat cassava because of the growing cassava industry in Indonesia.

Where it works

- Mukibat cassava grows well in medium-shaded environments where normal cassava would not produce tubers.
- Climatic requirements:
  - Latitude: 10-700 m above sea level
  - Rain: 1,500–2,500 mm/year
  - Minimum temperature: 10°C
  - Humidity: 60-65 per cent
  - Sunshine: 10 hours/day
- Most soils can be used for production, but should be crumbly with a pH level between 5.5 and 7.
- Mukibat cassava cultivation is successful in several districts of Indonesia.
- Successful adopters are farmers with sufficient capital to continue planting cassava and living close to markets.

Technological aspects[1]

- Technology includes:
  - Scion – tree cassava, Ceara rubber tree (*Manihot glaziovii)*
  - Rootstock – superior or local cassava variety of *M. esculenta*
  - Bamboo stick to strengthen the grafting
  - Plastic to wrap the connection
  - Seedlings shelter
- Planting material should be prepared during the dry season and be ready for planting when the rainy season starts.
- A scion of tree cassava of about 10-30 cm length is grafted on a 20-70 cm long piece of stem of ordinary cassava (*M. esculenta*). When the rootstocks are long (>40 cm), they can be directly replanted for a second or third cropping season after harvest (de Foresta *et al.*, 1994). The diameter of both the scion and rootstock should be exactly the same at about 2-4 cm. Cut the scion and stock, slantwise.
- Place a thin piece of bamboo in the pith of both the scion and the stock to facilitate the connection, and connect both stem pieces. Then wrap a plastic or banana leaf fibre around the joined stems to stabilize them.

[1] If not otherwise mentioned, this description is based on de Bruin and Guritno (1988).

- Keep the cuttings in the shade, watering them daily. After about eight days, sprouts start to grow. Remove the sprouts from the stock but let sprouts grow on the scion.
- Plant grafted cuttings in the field when sprouts from the scion are about 2 cm long.
- Prepare a 0.5 m-deep hole (1 x 1 m) and fill this with a mixture of soil and organic matter comprising 5-25 kg of banana leaves, kitchen waste or the like. Place the cutting vertically – one per hole – and fill the hole with soil, making a hill around the cutting.
- Take care of the plants. Plants can be supported with bamboo.
- Plants are usually spaced 1.25 x 1.50 m but spacing can vary, especially with intercropping.
- The cropping period can vary from 8 to 18 months; most farmers harvest about 11-12 months after planting, once a year. Older roots may become too fibrous and woody for human consumption.
- Grafted plants can be used again for a second and third year. The technology is expected to last for 36 months with 3 harvests.
- The second and third planting will reduce the cost of seedlings as these can be obtained from harvests 1 and 2 (Randan seed).

Economic aspects

- Investment per hectare is approximately Rp 12,000,000 ($1,232). Conventional cassava cultivation requires almost the same investment ($1,100-$1,200)[2], but yields less.
- In a recent experiment in Indonesia, Mukibat yielded 90-100 t/ha, compared to 54-62 t/ha for ordinary cassava (Radjit and Prasetiaswati, 2011).
- Average yield in Mulia Bakti (Indonesia) was reported to be 30 kg of edible tuber per grafted cutting as compared to 5-10 kg for ungrafted cassava (de Foresta *et al.*, 1994). De Foresta *et al.* (1994) estimate a yield of 60-150 t/ha from Mukibat cassava in home gardens against 3-15 t/ha of normal cassava in smallholder plantations.
- Starch content in Mukibat cassava was reduced by 0.7-2.2 per cent compared to normal cassava (Radjit and Prasetiaswati, 2011).
- The technology is recommended for use on not less than one hectare of open field or home garden.

Enviromental aspects

- Cassava usually does not need irrigation and can be a rain-fed crop.
- Mukibat cassava needs sufficient water during the first growth so the planting should be done at the beginning of the rainy season.

Social aspects

- Cultivation of grafted cassava requires more work than un-grafted plants. This offers a potential for employment in areas with a high demand for grafted cassava. The work requirement is two weeks for preparation of seedlings and one day for planting.
- Seedlings preparation requires two people (men or women).
- Usually, 10 people have to work for 3-4 days during planting and harvesting of 1 ha of land. The work is normally done by men.
- In Indonesia, the labour force for Mukibat cassava cultivation is composed of 30 per cent women and 70 per cent men.

Table 1. Gross margin per hectare at 4,000-4,500 plants/hectare

District	Gross value in Rp (000) ($) A	Variable cost in Rp (000) ($) B	Gross Margin in Rp (000) ($) A-B	Benefit/ Cost Ratio B/C
Banyuwangi	32.450 *(3.33)*	8.116 *(0.83)*	24.334 *(2.50)*	3.00
Trenggalek-1	24.264 *(2.49)*	4.720 *(0.48)*	19.544 *(2.00)*	4.10
Trenggalek-2	28.080 *(2.88)*	5.471 *(0.56)*	22.609 *(2.32)*	4.13
Pacitan	10.292 *(1.06)*	2.803 *(0.29)*	7.489 *(0.77)*	2.67
Wonogiri	14.400 *(1.48)*	6.373 *(0.65)*	8.027 *(0.82)*	1.26
East Lampung	11.760 *(1.21)*	5.703 *(0.59)*	6.057 *(0.62)*	1.06
Central Lampung	32.472 *(3.33)*	12.776 *(1.31)*	19.694 *(2.02)*	1.54

Note: Variable costs include: land, seedlings, fertilizer (organic and inorganic), tillage, planting, ridging and weeding, harvesting and transportation. Labour cost is included and estimated at Rp 40,000/person/day ($4.11/person/day)
Source: Prasetiaswati *et al.* (2008 and 2009)

[2] Conversions based on OANDA currency converter rate of 31.03.2013.

Issues for replication

- Need for grafting skills.
- Lack of capital for purchasing the rootstock for grafting.
- Labour bottlenecks as grafting and planting time coincide.

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Useful links

Indonesian Legumes and Tuber Crops Research Institute (ILETRI) (2012). Yield performance of cassava grown using Mukibat system. Available from:

- http://balitkabi.litbang.deptan.go.id/en/index.php/research-highlight/cassava/968-cassava-cultivation-technology
- http://balitkabi.litbang.deptan.go.id/info-teknologi/834-potensi-peningkatan-hasil-ubikayu-melalui-sistem-sambung-mukibat.html

SATNET Asia agriculture technology fact sheets

This fact sheet provides information of a sustainable agriculture technology or good practice that has shown its potential to enhance resource efficiency, provide economic benefits, and has a low risk of societal disturbance. The fact sheet is a result of the analytical work conducted by the Network for Knowledge Transfer on Sustainable Agricultural Technologies and Improved Market Linkages in South and South-East Asia (SATNET Asia). In consultation with SATNET Asia participants, the Food Security Center (FSC) of the University of Hohenheim in Germany has led the development of an analytical framework to assess the sustainability- and productivity- enhancing potential of agricultural technology options based on an extensive review of scientific literature. Examples of technology options are collected from various sources, including SATNET participants, experts from outside the region and online knowledge portals and literature. For technologies where sufficient information is available, the analytical framework is used to calculate a sustainability indicator for the technology.

About SATNET Asia

SATNET Asia is a network funded by the European Union. It is implemented by the Centre for Alleviation of Poverty through Sustainable Agriculture (CAPSA) of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) in collaboration with the Asian and Pacific Centre for Transfer of Technology (APCTT), AVRDC - The World Vegetable Center, the Food Security Center of the University of Hohenheim and the Trade and Investment Division of UNESCAP.

SATNET Asia was launched in 2012 to support innovation for sustainable agriculture by strengthening South-South dialogue and intraregional learning. Operating in 10 countries of South and South-East Asia, SATNET facilitates knowledge transfer through the development of a portfolio of best practices on sustainable agriculture, trade facilitation and innovative knowledge sharing. Based on this documented knowledge, it delivers a range of capacity-building programmes to network participants who play roles as change agents and innovators, such as farmer organizations, traders, the private sector, the public sector and policymakers. This will enable network participants to transfer this knowledge to those who need it most – smallholder farmers and small-scale entrepreneurs.

Because the public sector no longer predominates agricultural development, SATNET explicitly aims to include the following groups in the innovation process: universities, private companies that develop and sell technology products or provide trade facilitation services, agricultural foundations, farmer organizations and NGOs. For, and together with, these target groups, the project aims to create a knowledge environment that is focused on poverty reduction and conducive to continuous and sustainable innovation.

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