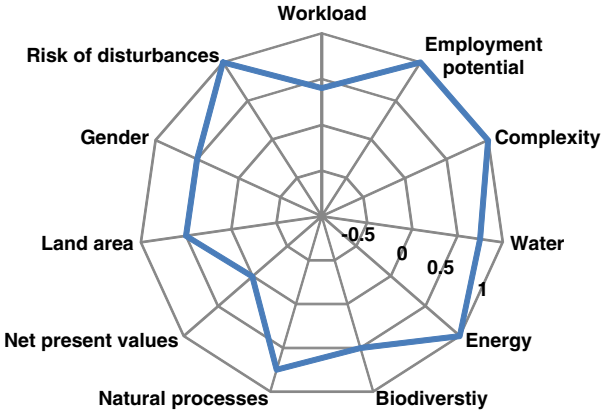
SATNET ASIA
Innovation network for food security and poverty reduction

Crotalaria is Effective Against Nematode Damage of Chili in South-East Asia

Technology fact sheet | 01 / October 2014

Key facts

- Uses natural properties of crotalaria to control nematode infestation in chili production.
- Reduces reliance on and use of synthetic pesticides.



This graph summarizes the results of a sustainability assessment conducted for this technology. The closer the line is to the outer edge of the diagram, the better the technology performs in terms of the particular criterion.

Description

- Nematodes (*Phylum nematoda*), called roundworms, are the most abundant and genetically diverse multicellular organisms. Most are beneficial members of their ecosystems.
- A few nematode species are parasites of humans, livestock or agricultural crops. Root-knot, cyst and lesion nematodes are pests of a wide variety of crops and are annually responsible for billions of dollars of crop losses.
- Crotalaria (a genus of herbaceous plants and woody shrubs in the family Fabaceae commonly known as rattlepods) works as a trap crop to reduce the nematode population in soils.
- The planting and incorporating of crotalaria biomass in the soil before chili production can control nematode damage in tropical areas as proven in north-east Thailand.

Figure 1. Crotalaria (*Crotalaria juncea*) in the field[1]

Figure 2. Crotalaria (*C. juncea*) flower[2]

[1] Photo: A16898. http://commons.wikimedia.org/wiki/File:Crotalaria_juncea_D9991.jpg
[2] Photo: A16898. http://commons.wikimedia.org/wiki/File:Crotalaria_juncea_Da220020.JPG

History of the technology

- In north-east Thailand, farmers suffer considerable reduction of yield in chili crops (*Capsicum spp.*) due to damage by nematodes (*Meloidogyne incognita*), forcing them to plant other crops or stop growing chili.
- Crotalaria has been proven to be effective in controlling nematodes in temperate areas, but there was not enough evidence to show its effectiveness in tropical areas.
- The Japan International Research Center for Agricultural Sciences (JIRCAS) evaluated the effectiveness of crotalaria to formulate practical measures to mitigate damage from nematodes in tropical areas[3].
- Sunn hemp (*Crotalaria juncea*) was highly effective in controlling nematode infection in chili in field experiments.

Where it works

- The technology can work well in chili production areas in tropical regions with a problem of nematode damage such as north-east Thailand.
- Successful adopters were chili farmers in north-east Thailand who joined a seminar organized by the Government of Thailand and had access to crotalaria seeds. Non-adopters did not join the seminar and did not have access to the seeds.
- In Thailand, adopters learned about the technology from the Department of Agriculture, Ministry of Agriculture and Cooperatives.

Technological aspects

- Crotalaria is sown after soil preparation and at least two months before chili transplanting, at a density of at least 31 kg/ha, depending on site conditions. It is important to sow sufficient seeds to ensure optimal soil coverage by crotalaria.
- At the end of the flowering stage, usually 50 to 60 days after seeding, the crop is incorporated into the soil mechanically or manually. The field is left to rest for two weeks to allow further decomposition of crotalaria in the soil.
- After the two weeks, one-month-old chili seedlings can be planted and cultivated as usual.
- The time frame of a production cycle is six months.
- In north-east Thailand, one production cycle (crotalaria - chili crop rotation) can be operated in one year; the land remains fallow during the dry season.
- It is necessary to seed crotalaria in a relatively high density and grow it until the flowering stage to secure sufficient biomass.

Figure 3. Chili root system infected by the southern root knot nematode[4]

Figure 4. Root system of infected (left) and healthy (right) plant[5]

[3] Kushida *et al.* (2003). Effects of *Crotalaria juncea* and *C. spectabilis* on hatching and population density of the soybean cyst nematode, Heterodera glycines (Tylenchida: Heteroderidae). Applied Entomology and Zoology. 38 (3):393-399. Available from https://www.jstage.jst.go.jp/article/aez/38/3/38_3_393/_pdf

[4] Photo: JIRCAS (2008). Research Highlights 2008. Crotalaria is effective against nematode damage of chili in Southeast Asia. Available from http://www.jircas.affrc.go.jp/english/publication/highlights/2008/2008_11.html

[5] Photo: A.M. Varela, icipe

Economic aspects

- In a recent study[6], adopters had a net income of THB214,437.50 ($7,265.14). Non-adopters' net income was THB117,878.13 ($3,993.71).

Table 1. Comparison of costs and yields for adopters and non-adopters

	Adopters	Non-adopters
Cost (THB/ha)	134 903.13 ($4 570.52)	119 134.38 ($4 036.27)
Yield (kg/ha)	11 972	7 759
Gross income (THB/ha)	352 465.63 ($11 941.54)	228 900 ($7 755.132)
Net income (THB/ha)	214 437.50 ($7 265.14)	117 878.13 ($3 993.71)

- Since farmers cannot plant marketable crops during crotalaria production, some income opportunities will be lost. However, the loss is more than offset by the increase in that season's chili harvest and sales.

Environmental aspects

- Improvement of soil fertility through nitrogen fixation by crotalaria and through nutrients from the decomposition of crotalaria residues.
- The technology does not use water resources, except during the dry season when irrigation is necessary. No wastewater is produced.
- Reduced pesticide use.
- The technology does not use any energy.
- Before the first cultivation, crotalaria seeds have to be procured externally. Farmers can then multiply and keep their own seeds for the following seasons.

Social aspects

- One production cycle involves one household member and five paid workers from outside.
- Farmers using this technology have a higher labour requirement than farmers who cultivate chili using chemical pesticides.
- The technology is suitable for women: in Thailand, the share of women adopting the technology is 50 per cent.
- The technology can be operated on any size of agricultural land.

Issues for replication

- Mixed cropping of chili with Crotalaria sp. did not control nematode infestation sufficiently and is, therefore, not recommended.
- Although *Crotalaria juncea* is generally used as a green manure crop in Thailand, it is sometimes hard to obtain its seeds because of insect damage in the flowering stage.
- Because crotalaria has high efficiency as a green manure, it is expected to reduce the use of chemical fertilizer and mitigate nematode infection.
- In Japan, crotalaria was shown to be more effective under field conditions than in the laboratory.

Experts

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Related topics

- Pepper grafting
- Tomato grafting

[6] Phompanjai, P. *et al.* (2012). Control of root gall disease in chilis caused by root-knot nematodes. In: High value vegetables in southeast Asia: production, supply and demand. Proceedings, Seaveg 2012.104-108, p.107f.

SATNET Asia agriculture technology factsheets

This factsheet 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 factsheet 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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