

Intercropping tuber crops in root (wilt)-affected coconut garden is remunerative

Cassava, edible yams, elephant-foot yam and colocasia grow well under coconut-based high-density multi-species cropping system in root (wilt)-affected area. Intercropping these crops provide additional yield and income without affecting the main crop (coconut) yield to a coconut farmer.

COCONUT-based high-density multi-species cropping system involves growing different annual, biennial and perennial crops as inter/mixed crops in coconut garden to utilize natural resources to maximum possible extent. Such system was initiated in 1.0 ha of coconut root (wilt)-affected garden during 1993-94 at Kayagulam. The coconut palms of different age groups; 10-20 years: 46 palms, >20 years: 79 palms were studied. The crops involved as inter/mixed crops in the system were: black pepper, nutmeg, banana, pineapple and tuber crops. The agro-techniques for raising tuber crops and their performance are explained. The recommended cultural practices for tuber crops have been adopted.

HIGH-DENSITY MULTI-SPECIES CROPPING SYSTEM

Cassava

Before planting, plough the field 2-3 times or dig to a depth of 25-30 cm depending upon soil type to establish a deep porous field in which the setts are to be planted. Cassava is propagated from cuttings and select mature healthy stems free from diseases and pests. Harvested stems meant for planting material are to be stored vertically in shaded and well-aerated places. Discard about 10 cm from the lower mature and about 30 cm from the upper immature end. Stems should be cut into setts of 15-20 cm length using a sharp knife. For maximum

tuber production, April-May planting is preferred because the crop can effectively utilize both the monsoons.

Adopt square method of planting at a spacing of 90 cm × 90 cm and one cutting/pit. Apply 12.5 tonnes/ha of farmyard manure or compost during preparation of land. Apply fertilizers N : P₂O₅ : K₂O at the rate of 100 : 50 : 100 kg/ha for high-yielding varieties and 50 : 25 : 50 for local varieties. The N and K₂O should be applied in 3 split doses, i.e. one-third each as basal, two months after planting and three months after planting. Retain two shoots on each plant in opposite directions and remove excess shoots 30 days after planting. Cassava becomes ready 9-10 months after planting.



Cassava growing in a coconut garden

Edible Yams

Dig pits of 45 cm × 45 cm × 45 cm size at a distance of 1 m × 1 m and fill three-fourths of pits with FYM/compost and mix with top soil. Plant cut tubers pieces and cover the pit with leafy materials to conserve

soil moisture and maintain optimum temperature. Apply FYM/compost at 10-15 tonnes/ha as a basal dressing. A fertilizer dose of N, full of P and half of K should be applied within a week after sprouting and remaining dose should be applied one month after the first dose along with weeding and earthing-up.

Trailing is essential to expose the leaves to sunlight. Trailing has to be done within 15 days after sprouting by

coir rope. Greater yam is ready for harvesting 8–9 months after planting when vines are completely dried up. Lesser yam becomes ready for harvesting 7–8 months after planting while white yam 9 months after planting.

Elephant-foot Yam

Elephant-foot yam requires warm humid climate. Seed corm size of 0.5 kg is ideal for planting. Dig pits of 60 cm × 60 cm × 45 cm size 90 cm apart and plant the seed tuber and cover with soil and dried leaves. Apply full dose of P_2O_5 and half of N and K_2O @ 50 : 50 : 75 kg/ha 45 days after planting. Second dose of fertilizer N and K_2O @ 50 : 75 kg/ha one month after first application along with weeding and earthing-up. The crop is ready for harvesting 8–9 months after planting.

Colocasia

Colocasia is a crop of tropical and subtropical regions and requires warm humid climate and particularly grown in eastern parts of India. Use side tubers (25–35 g) for planting. Make ridges 60 cm apart and plant the side corms at a spacing of 45 cm on ridges during April–May.

Apply farmyard manure or compost @ 12 tonnes/ha as a basal dressing, a fertilizer dose of 80 : 60 : 80 kg N, P_2O_5 and K_2O /ha is recommended. Full dose of P and half of N and K should be applied within a week after sprouting and the remaining half dose of N and K should be applied one month after first application. Colocasia crop is ready



Dioscorea species growing in a coconut garden

Table 1. Yield of different tuber crops in coconut-based HDMSCS model in root (wilt)-affected garden

Crop/variety	Yield (average of 6 years, kg/plant)
Elephant-foot yam (local)	7.5–9.0
Dioscorea (local)	5.0–6.5
Colocasia (local)	3.0–4.0
Cassava (M4)	7.0–9.0

5–6 months after planting.

All these crops are grown in available space in high-density multi-species cropping system in root (wilt)-affected coconut garden. The performance of elephant-foot yam, *Dioscorea*, cassava and colocasia is very good. The cultivation of these crops do not affect the yield of main crop (coconut). Six years' average yield of tuber crops grown in the system is given in Table 1.

SUMMARY

Intercropping tuber crops in root wilt-affected coconut garden is remunerative if grown scientifically. The multicropping practice is quite

economical to growers.

For further interaction, please write to:

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Table 6. Important diseases and their distribution

Disease	Symptoms	Susceptible cultivars
Fusarium wilt (Panama wilt) <i>Fusarium oxysporum</i> f.sp. <i>cubense</i>	Symptoms appear 5-6 months after planting, yellowing of older leaves. Splitting of pseudostem at base	Silk, Ney Poovan, Pisang Awak, Pome, Bluggoe and Monthan
Sigatoka leaf spot (<i>Mycosphaerella</i> sp.)	At earlier stage, small lesions appear on leaves which become pale yellow or greenish yellow streaks	Cavendish and Mysore group
Heart rot (<i>Erwinia carotovora</i>)	Planted suckers start rotting and emit off-odour. In older plants rotting appears at collar regions and leaf base. Base of pseudostem gets swollen and split at later stages	Tissue cultured Cavendish, Robusta, Grand Naine
Cigar-end rot <i>Verticillium theobromae</i> , <i>Gloeosporium musarum</i>	Black necrotic rot appears at the tip of fingers and extends towards whole arrears of fruits	Bluggoe group, Nendran, Ney Poovan
Anthracoise <i>Colletotrichum musae</i>	Black lesions on fruit skin	Cavendish and all varieties

Banana Streak Virus (BSV) in Poovan cultivar is found to be present in all the banana-growing regions with varied degrees of symptoms. This is becoming serious in other cultivars also. BBrMV is also observed to be widespread and causes considerable damage. BBrMV is serious in Plantain, Robusta and Ney Poovan varieties and spreading fast through infected suckers. CMV or variegated chlorosis is also found in many banana-growing regions, which spread through infected planting material.

Since, there is no control measure for viral diseases, selection of disease-free planting material and mother plants for micropropagation is very important. The planting material and micropropagated planting material should be diagnosed for the presence of viruses. Accordingly effective molecular diagnostic techniques like ELISA, PCR and RTPCR have been developed at NRC for Banana and are being used for simultaneous detection of 2-3 viruses.

Post-harvest Management

Banana is highly perishable, post-harvest losses being 25-30 %. At ambient temperature, banana has an average shelf-life of 1-5 days. The short storage life of banana is worsened by the marketing system. The marketing system in Indian usually involves several retailers. Buying and selling takes time and leads to increased crop damage. Transport is often delayed, and can fail altogether, because of poor conditions of vehicles and roads. A combination of high perishability, high ambient temperatures, slow marketing systems, and poor market conditions leads to losses in fruit quality, and ultimately to post-harvest losses. Shelf-life could be extended by appropriate storage at 13-14°C. Effective pre- and post-harvest management

technology is available to extend the storage life and also export of banana. To maintain product quality throughout the market chain, the whole system, from the farm to the consumer, should be considered. Banana and plantain can be processed into different byproducts as value-addition to tide over the glut and to get maximum profitability to banana producers. NRC for Banana has developed technology for 12-value added products and has commercialised four products which are available in the market.

Improvements in one area may be ineffective if other areas of retail system are not considered. Cultural practices also affect post-harvest quality of banana. Timely cultivation, moderate use of nitrogen fertilizer, avoidance of drought, and control of fungal infection, all increase the storage potential. Fruits harvested at the appropriate maturity ensure the highest quality. In commercial production of dessert banana, the date of harvesting is based on size rather than maturity, because the fruit can be ripen as required by exposure to ethylene. Market standards dictate the size at harvesting. It is essential to ensure the exact time for harvesting and for this, maturity indices could be followed. In banana, maturity indices for harvesting are degree of fullness of fingers, i.e. disappearance of angularity in a cross section. Banana is harvested mature-green and ripen upon arrival at destination markets since fruits ripen on plant often split and have poor quality. Post-harvest management is essentially required to improve better return and to reduce losses.

MARKETING AND SUPPLY OF BANANA IN INDIA

Banana supply and marketing are mainly governed by private sector except in some cases where cooperatives

handle the marketing. Unlike other commodities, cash marketing is most common, where money payment is done immediately after every transaction. Banana markets are specialized markets located in all big cities, and most of the marketing functions are followed. Primary wholesale market is major marketing yard for all commercial clones in the country. Irrespective of the location of the farm, bunches are transported by growers to the nearest town. In some cases, bunches are sold by farmers to the pre-harvest contractors even before harvesting, as 50% of the cost in advance. After harvesting, bunches are transported to primary wholesale market by growers or by pre-harvest contractors.

Secondary wholesale markets are located at a distant place from the major area of production. Grading and sorting are mainly done in marketing yard for the convenience of price fixing. Though there is no definite yardstick for grading and sorting, size of bunch and external fruit appearance determine the quality of the produce. In last 10 year, average price of banana has shown increasing trend while seasonal fluctuation is very wide, pre-winter and summer prices are generally high while prices comes down during October-December.

Banana Export

Bananas are fifth most important agricultural commodity in world trade after cereals, sugar, coffee and cocoa. Out of the 97 million tonnes of banana and plantain produced annually, only 14% are traded globally. The world's buyers of banana purchased a total volume of 14.65 million tonnes valued at US\$ 4.41 billion in 2000. United States of America remains the major importer of banana with a share of 30% of global import. USA imports banana worth US \$ 1.50 billion. The other major importing countries of banana and plantain are Germany, Japan, Belgium and United Kingdom. The Latin American countries dominate the US export market for banana. Costa Rica and Ecuador are top exporters capturing half of the US market for banana at a combined volume of 1.8 million tonnes.

World exports of bananas also show a high level of concentration, with developing countries accounting for bulk of exports. Only Latin America and the Caribbean supplied about 70% of total exports in 2004. The four leading banana exporter countries in 2004 (Ecuador, Costa Rica, Philippines and Colombia) accounted for 63% of world exports. Ecuador alone provided more than 30% of global banana exports. Nevertheless, the participation of Latin American and Caribbean supply has been slightly reduced during the nineties, while participation of Asian exports has increase.

The analysis of export income dependence on bananas provides also interesting results. For major exporting countries like Ecuador or Costa Rica, exports of bananas

represented 16.7 and 23.1% of the total value of exports in 2000. The highest levels of dependence on banana exports can be found in the Windward Islands countries: Saint Lucia, St. Vincent and Grenadines, Dominica and Grenada (in case of Saint Lucia, for example, the proportion of banana exports over total exports was 49.6%).

Banana Imports

Bananas are imported mainly by the European Union, USA and Japan, accounting for 67% of world total imports in 2004, while first 10 banana-importing countries represented more than 80% of total imports (considering the EU as a whole). Although geographical concentration of imports remains high, analysis of import data shows a tendency towards diversification of destination markets for bananas, particularly during the nineties. This is shown by the evolution of imports by the rest of the world group of countries. It would reflect the increasing importance of emerging markets as the Russian Federation, China or Easter European countries as destinations for banana exports. While during the last decades all importing areas have increased their banana imports, it is possible to appreciate certain stagnation in the volume of imports of the European Union during the nineties.

Trends of Banana Prices in Major Markets

In general, banana market prices at the international level are determined by demand and supply availability. Supply factors would include weather conditions, diversification of supply sources, area available for banana production, yields, etc. Demand from banana consumers would depend on income growth and economic evolution in different countries, population growth, consumer preferences, banana import regimes, etc.

Although the banana market presents an oligopolistic structure, this does not actually mean that transnationals marketing companies have a great power to set selling prices for bananas, particularly during the nineties with increasing competition exiting among them. In addition, the dominant position of these large banana marketing companies has been challenged by some other importing groups that have appeared as a result of efforts of producers to directly market their bananas outside the multinational channels. Therefore, banana price formation is most determinant at the retail stage, particularly due to the increasing dominant position of distributors (supermarket chains).

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