Coconut Based Banana Production System

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Coconut (*Cocos nucifera* L.) the versatile palm with multifarious uses, is cultivated in the country predominantly by small holders in tropical regions in 1.93 million ha with a production of 12832 million nuts and productivity of 6632 nuts per hectare. Kerala, Tamil Nadu, Karnataka and Andhra Pradesh are the four major coconut producing states accounting for more than 90 per cent of the share in area and production.

Monocropping of coconut is unsustainable as it utilizes only 45-50% of solar radiation and 21 % of land area and the income derived from such a system is not sufficient to sustain even the small families. Coconut based cropping/farming systems, involving cultivation of compatible crops in the interspaces of coconut and integration with other enterprises like dairying offer considerable scope for increasing production and productivity per unit area, time and inputs by more efficient utilization of resources like sunlight, soil, water and labour.

Resource use in coconut

A spacing of 7.5 m x 7.5 m in the square system is recommended for coconut (175 palms/ha) but in the homestead gardens of Kerala, the density is much higher (200 to 250 palms/ha) whereas in the malnad region of Karnataka state much wider spacing are adopted with densities as low as 120 palms/ha. Experimental evidences have shown that a sole crop of coconut, at the recommended spacing of 7.5 x 7.5 m does not fully utilize the available resources such as land space, aerial space, water and nutrients.

Rooting pattern

Coconut palm like all monocots has a typical adventitious root system and about 74 per cent of the roots produced by a palm under good management did not go beyond 2 m lateral distance and 82 per cent of the roots were confined to the 31 to 120 cm depth of soil (Kushwah *et. al.* 1973 and Maheswarappa *et al.* 2000).

Canopy structure and light utilization

The venetian structure of the coconut crown and the orientation of leaves allow part of the incident solar radiation to pass through the canopy and fall on the ground. The leaves in a coconut palm crown are not randomly distributed, but clumped around few widely spaced growing points. This non-random distribution will also lead to low extention coefficient of around 0.65 for PAR. Age, spacing, soil fertility, varietal characteristics, leaf area and time of the day influence the light penetration through the canopy. The nature and amount of sunlight transmitted through coconut canopy and falling on the ground shows temporal as well as spatial variations. Nair and Balakrishnan (1976) estimated that as much as 56 per cent of the sunlight was transmitted through the canopy during the peak hours (10-16 hours) in palms aged around 25 years. The angle of the sun rays (and thus the time of the day) influences the amount of light passing through the coconut canopy. With the movement of the sun and the movement of coconut fronds in the wind, the light and shade patterns under the palms are constantly changing. The distribution of light at different positions in the canopy zone of coconut varies very much because of the non-random distribution of leaves. This causes differences in the growth and yield of intercrops at different positions of the plantation floor.

Based on the growth habit of the palm and the amount of light transmitted through its canopy, the life span of coconut palm could be divided into three distinct phases from the point of view of intercropping.

1. Planting till full development of canopy (about 8 years): Good transmission initially, but decreasing with age suitable for growing annuals/biennials.
2. Young palms (8 to 25 years): Maximum ground coverage and low canopy- poor light availability- not suitable for multiple cropping.
3. Mature trees (more than 25 years): Increase in trunk height; reduction in crown size - light transmission increasing with age - ideal for raising annual and /or perennial crops.

It is not very necessary always to fulfil all these exacting requirements to have successful crop combinations. But one must ensure that the correct crop is chosen. In most cases failure of inter/mixed cropping is due to the wrong choice of the crop(s).

In the present paper, performance of banana as mixed crop in coconut garden are described:

Banana prefers tropical humid climate. For planting banana, select 3-4 months old disease-free sword suckers from healthy clumps. The rhizomes are to be smeared with cowdung solution and ash, and dried in the sun for about 3-4 days and stored in shade up to 15 days before planting. Planting should be done in a pit of 50 cm x 50 cm x 50 cm at a spacing of 2.5 m x 2.5 m. Apply compost/farm yard manure @10 kg /plant in the pit and plant the suckers upright in the centre of pits with 5 cm of pseudostem remaining above the ground level. The recommended dose of N:P:K for banana is 100:200:400 g/plant/ annum to be applied in equal 2 splits during May-June and Sept.-October.

Impact of banana as mixed crop in coconut garden

Banana is a highly profitable intercrop in areas with good irrigation facilities. Experiments were conducted at CPCRI, Kasaragod to screen and find out the banana varieties best suited for intercropping. Varieties like Grosmichel and Peda pacha were the highest yielders followed by Dwarf Cavendish (Gopalasundaram and Nelliat, 1979). Studies conducted by Suma *et al.* (1989) indicated that, palayamkodan, robusta, BB Batheesa, karpooravally and poovan were identified as suitable varieties for intercropping in coconut garden. Under high density multispecies cropping system model at different level of recommended fertilizer doses, banana (Kadali) has performed well and yielded on an average of 8-10 kg fruit per bunch (Reddy *et al.*, 2002). Under the same system, there was increase in the population of bacteria where as count of fungi and actinomycetes was low and population of 'P' solubilisers was maximum in the banana root rhizosphere (CPCRI, 2004). Microbial biomass and Phosphatase activity was higher at 2/3rd of recommended fertilizer and full dose of fertilizer in the rhizosphere of banana (CPCRI, 2001). Under root (wilt) affected coconut garden, among banana varieties studied as mixed crop in high density multi-species cropping system, palayankodan and karpooravalli varieties produced highest per plant yield followed by poovan, Njalipoovan, nendran and robusta at CPCRI (RS), Kayamkulam, Kerala (Table 1) (Maheswarappa *et al.*, 2003). Under this system, banana crop alone could contribute on an average gross return of Rs. 10,000 to Rs. 15,000/ per year in one ha of coconut garden. There was increase in the nutrient status of the soil and crop over the years and increase in the nut yield of coconut (Maheswarappa *et al.*, 2005). In the farmers garden, Nendran banana could be profitably cultivated as an intercrop in coconut garden in early phase of coconut garden, and yield obtained was 10-12 kg/plant and provided net profit of Rs. 6,400/- from 0.1 ha coconut garden in Pallikkara, Kasaragod (Thamban and Arulraj, 2007).

It is reported that in Godavari delta of Andhra Pradesh, banana was the best intercrop with complementary effect on coconut yield (Reddy *et al.*, 1980). They have also reported that the increase in yield of coconuts by 145.4 per cent and 400 per cent over pre-intercropping period with banana during the first and second year of post intercropping, respectively. Rao *et al.* (2004) have studied the influence of two cropping system models involving cocoa, banana, elephant foot yam, pineapple, colocasia and turmeric on productivity, economics over the years. Results revealed that, above crops found to be productive and remunerative for the coastal ecosystem of Andhra Pradesh. The nut yield increased by 18 to 27% under cropping system models over 4 years (compared to pre-experimental yield), whereas increase in yield over the same period was to the tune of 3.6% under coconut monocrop. The economic analysis and employment generation was higher in cropping system models (Rs.39496 to Rs.47589/ha, 569 to 680 mandays) compared to coconut monocrop (Rs.9477/ha and 166 mandays). The cropping systems also enhanced the population of beneficial bacteria and fungi in the rhizosphere of coconut including phosphate solubilising bacteria and *Trichoderma viridae*, a bioagent against basal stem rot. Thus the soil fertility in cropping systems created a more favourable environment for sustained crop production. Srinivasulu *et al.* (2004) have studied the population dynamics of *Trichoderma* spp. (biocontrol agent) in different crops existed in coconut ecosystem of Andhra Pradesh. The investigation has indicated that although coconut supported a reasonably good population density of *Trichoderma* spp. in its rhizosphere, it is not free from the most dreaded basal stem rot disease. Crops like mango-ginger, coffee, cocoa, banana and lemongrass supported growth of *Trichoderma* reasonably well and hence can be grown as intercrops in coconut ecosystem.

At Veppankulam (Tamil Nadu), banana varieties such as poovan, rastali, karpuravalli and jurmony performed well as an intercrop (Ramanathan *et al.*,1982). Under high density multispecies cropping system, banana variety, Monthan has performed better by yielding 17-20 kg per plant at Veppankulam (AICRP on Palms, 2006).

Under All India Co-ordinated Project on Palms, studies indicated that, banana performed better and provided additional income to coconut farmer in different regions (AICRP on Palms, 2006). Mixed cropping with different crops along with banana has resulted in increase in nut yield of coconut and increase in NPK status of soil over the years under different regions.

In Sri Lanka, banana, pineapple, passion fruit and papaya are common fruit crops grown in coconut garden. The beneficial interactions of mixed cropping of coconut with cocoa, coffee, pepper, clove, banana, cinnamon in terms of improvement in physical characters of soil has been reported by Liyanage and Dassanayake, (1993).

In Tonga and Western Samoa, intercropping with banana and passion fruit has given 20-30 per cent increase in nut yield of coconut (Opio, 1990).

Table 1: Yield of banana in various coconut based cropping system

Cropping system/variety	Yield per plant
Coconut based high density multispecies cropping system at Kasaragod, Kerala (Kadali)	8-10 kg
Coconut based high density multispecies cropping system at Kayamkulam,Kerala:	
Poovan	15-20 kg
Njalipoovan	14-19 kg
Robusta	12-17 kg
Nendaran	13-18 kg
Palayankodan	20-24 kg
Karpooravalli	22-25 kg
Coconut based high density multispecies cropping system at Kahikuchi, Assam (Chenichampa)	13-15 kg
Coconut based high density multispecies cropping system at Veppankulam, TN (Monthan)	17.5 kg