TB Basavaraju, HP Maheswarappa,
JC Nath, RG Khandekhar,
D Rajkumar and T Janakiram

# Coconut-based cropping system keeps farmers cheerful

**The coconut palms are generally planted at a wider spacing due to their morphological features. The crop does not fully utilize the basic natural resources such as soil and sunlight available in the garden due to its rooting pattern and canopy structure. The effective root zone of the adult bearing palm is confined laterally within a radius of 2 m around the base of the palm and majority of the roots are found between 30 and 120 cm depth from the surface. The structure and orientation of coconut leaves permit more than 50 per cent of solar radiation incident on crown to penetrate to lower levels. The under-utilized soil space and solar radiation in monocrop stands can be utilized by growing crops having different stature, canopy shape and size, and rooting habits. Such crop combinations intercept and utilize light at different vertical intervals and forage soil at different layers maximizing biomass production per unit area of land, time and inputs. Recently, farmers are experiencing the non-profitability of coconut cultivation due to fluctuating prices of coconut and increasing incidence of pests and diseases in addition to low/erratic rainfall. Hence, there is a need for crop diversification and intensification with compatible crops to increase the productivity and income by effective and efficient utilization of soil space and solar radiation.**

A large variety of annual/ biennial food crops, fruit crops, tuber crops, vegetable crops, spice crops, flower crops and medicinal and aromatic crops can be grown as intercrops in coconut garden depending on the agroclimatic condition. The crops selected for intercropping should be shade-loving or shade tolerant and offers minimum competition for light, water and nutrients by utilizing these resources from different layers of atmosphere and soil.

Garden rue as intercrop in coconut garden

Lemon grass as intercrop in coconut garden

## COCONUT-BASED INTERCROPPING

### Banana, Redgram and Vegetables

Intercropping in coconut garden increases the productivity of land due to yield of intercrops in addition to coconut yield. The studies at Arsikere (Karnataka) showed improvement in nut yield of coconut due to intercropping of banana, drumstick, french bean, okra, and redgram. The mean nut yield is higher with intercropping of banana followed by french bean, okra, drumstick and redgram. On an average, banana produces 11,117 kg fruits/ha/year, drumstick: 3145 kg green pods/ ha/year, french bean: 2189 kg green pods/ha/year, okra, 1,706 kg green pods/ha/year and redgram: 855 kg grain/ha/year. The soil fertility and uptake of nutrients by coconut is also improved. The irrigation requirement of intercrops varies with the crop. The irrigation requirement of banana is higher with 34 irrigations/year (170 ha-cm), followed by 14 irrigations for french bean, okra (70 ha-cm) and 10 irrigations for drumstick (50 ha-cm). Redgram requires two protective irrigations (10 ha-cm) during dry spells at flowering and pod filling stage as the crop can be raised under rainfed conditions.

Intercropping with coconut increases the net returns and benefit:cost ratio as compared

Gladiolus in coconut garden

Crossandra in coconut garden

to coconut alone. The net returns and B:C ratio are higher with intercropping of banana (₹ 76494/ha/year and 2.70), followed by drumstick (₹ 43936/ha/year and 2.49), french bean- okra (₹ 39002/ha/year and 1.94) and redgram (₹ 25839/ha/year and 2.01). The crops are to be selected depending on the availability of irrigation water. When there is a good source of irrigation water, high water requirement crop like banana or medium water requirement crops like drumstick, french bean and okra can be grown. Under limited source of irrigation water, redgram can be grown as a rainfed crop with need based protective irrigation.

**Medicinal and Aromatic Plants**

Intercropping system of medicinal and aromatic plants in coconut garden increases the land productivity and income. In semi-arid regions of Karnataka, lemon grass (*Cymbopogon flexuosus*), garden rue (*Ruta graveolens*), tulsi (*Ocimum sanctum*), kalmegh (*Andrographis paniculata*), arrow root (*Maranta arundinaceae*) and makoi (*Solanum nigrum*) are used as intercrops in coconut garden under irrigated conditions. The nut yield of coconut is also increases from 71 nuts/palm to 97 nuts/palm due to continuous intercropping of medicinal aromatic crops for three years. The intercropping system of coconut + lemon grass recorded highest net income (₹ 91561/ha) and B:C ratio (2.89) followed by coconut + garden rue (₹ 81865/ha and 2.79), coconut + tulsi (₹ 77472/ha and 2.71), coconut + kalmegh (₹ 75163/ha and 2.56), coconut + arrow root (₹ 72211/ha and 2.28) and coconut + makoi (₹ 67058/ha and 2.68). Growing of medicinal and aromatic plants in coconut garden favours the nutrient uptake by coconut palms.

Shatavari (*Asparagus racemosus*), adulasa (*Adhatoda vasica*), arrow root (*Maranta arundincea*), lemon grass (*Cymbopogon citratus*) and citronella (*Cymbopogon winterianus*) are ideal for Konkan region of Maharashtra. The net returns and B:C ratio are highest in coconut + lemon grass system (₹ 96,200 and 2.13), followed by coconut + arrow root (₹ 93,200 and 2.10), coconut + shatavari (₹ 83,300 and 2.09), coconut + adulasa (₹ 78,300 and 1.96) and coconut + citronella (₹ 73,800 and 1.75). The monocrop of coconut recorded lowest net income and B:C ratio (₹ 48500 and 1.73). Soil nutrient status and uptake of nutrients by coconut is not affected by medicinal and aromatic plants in coconut garden.

There is better performance of sarpagandha (*Rauvolfia serpentina*), pipali (*Piper longum*), vedailota (*Paederia foetida*), citronella (*Cymbopogon winterianus*) and patchouli (*Pogostemon cablin*). The nut yield of coconut increases in intercropping system (74.9 nuts/ha) compared to sole crop (58.0 nuts/ha). The intercropping system of coconut + patchouli gives highest net income (₹ 1,78,089/ha) and B: C ratio (3.26), followed by coconut + sarpagandha (₹

Tulsi as intercrop in coconut garden

Gomphrena flower crop

Heliconia in coconut garden

1,57,484/ha and 3.09), coconut + pipali (₹ 113,118 and 2.62), coconut + citronella (₹ 107,432 and 2.40) and coconut + vedailota (₹ 100382 and 2.36). The net income (₹ 52,750/ha) and B:C ratio (1.85) are lowest in sole crop of coconut.

### Flowering Crops

Flower crops can also be grown as intercrops in coconut gardens. Shade tolerant flower crops having good market are to be selected for intercropping in coconut garden. Growing of flower crops in coconut garden increases the land productivity and income due to additional yield and income obtained from flower crops. The flower crops are suitable for intercropping in coconut vary with agroclimatic condition. Chrysanthemum, marigold, and Gomphrena (*Gompherena globosa*) in coastal Tamil Nadu, Crossandra, Chrysanthemum, China aster and marigold in semi-arid Karnataka, Gerbera, gladiolus, Tuberose and marigold in Asom and gerbera, gladiolus, tuberose, marigold and Heliconia in West Bengal.

CBCS at Aliyarnagar

At Aliyarnagar, Tamil Nadu, marigold yields 5,948 kg flowers/ha with a net income of ₹77,710/ha and B:C ratio of 2.88, followed by Gomphrena with a flower yield of 5074 kg/ha, net income of ₹60,230/ha and B:C ratio of 2.46 and Chrysanthemum with a flower yield of 4,912 kg/ha, net income of ₹56,990/ha and a B:C ratio of 2.38. At Arsikere, Karnataka, the flower yield recorded in different crops is 3009 kg/ha in chrysanthemum, 1582 kg/ha in China aster, 1210 kg/ha in crossandra and 4991 kg/ha in marigold.

Crossandra gives highest net income (₹121250/ha), followed by chrysanthemum (₹90250/ha), China aster (₹43200) and marigold (₹d higher net returns (₹72078) and B:C ratio (1.93) followed by gladiolus (₹70573 and 1.97), tube rose (₹63175 and 1.91), marigold (₹58673 and 1.87) and heliconia (₹48065 and 1.75). The growth and yield of coconut was unaffected by the flower crops grown in the coconut garden.

### High-Density Cropping System

The high-density multispecies cropping system involves growing of a number of compatible crops in a unit area to meet the diverse needs of a farmer such as food, fuel, timber, fodder and cash. The productivity of land increases in high density multispecies cropping system due crop diversification and intensification. The cropping systems of coconut + cocoa + lime + drumstick at Arsikere (Karnataka), coconut + cocoa + banana + pineapple + drumstick at Aliyarnagar (Tamil Nadu), coconut + nutmeg + cinnamon + banana + pineapple at Ratnagiri (Maharashtra) and coconut + turmeric + pineapple + lemon + banana + elephant-foot yam at Kahikuchi (Asom) are highly productive than monocrop of coconut.

### SUMMARY

Growing of compatible intercrops with coconut improves the productivity of palms as well as the productivity per unit area through efficient utilization of soil, space and solar radiation. The selection of intercrops should be made looking to their suitability to agroclimatic condition of locality and its compatibility with coconut. The biomass produced in cropping system can be recycled through vermicomposting. Improvement in soil fertility of coconut garden, enhanced nutrient uptake by coconut palms and increase in earthworm and microbial population can be achieved through intercropping in coconut gardens. Sustainability of production and income can be obtained with intercropping in coconut compared to monocropping.

*For further interaction, please write to:*
Dr TB Basavaraju (Scientist), HRS, Arsikere, Karnataka, Dr HP Maheswarappa, Project Coordinator (Palms), ICAR-AICRP on Palms, ICAR-CPCRI, Kasaragod, Dr JC Nath (Scientist), HRS, Kahikuchi, Dr RG Khandekhar (Scientist) RCRS, Ratnagiri and Dr D Rajkumar (Scientist), CRS, Aliyarnagar, Tamil Nadu. Dr T Janakiram, Assistant Director-General (Horticultural Science), Division of Horticultural Science, Krishi Anusandhan Bhawan II, New Delhi 110 012