Money spinning mixed croppping for the bright future of coconut sector

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Coconut is a small holder's crop with the average size of holdings being 0.22 ha. To stabilize the coconut based economy of the small and marginal farmers it is essential to make use of the land under coconut for generating additional income source for realizing maximum return from unit area. Mixed cropping system is one way to do this. Many crops annuals, biennials and perennials can be grown under coconut. Growing of perennials in the interspaces of coconut is called coconut based mixed cropping.

More than 90% of the five million holdings in the country are less than one ha in size. To generate sufficient employment and income, farmers traditionally raise a variety of annual and perennial crops in the interspaces of coconut. In India, a spacing of 7.5 x 7.5 m is recommended for tall varieties of coconut. The lifespan of coconut palms may be divided into three phases namely, pre-bearing trees up to eight years, young palms of 8-25 years and mature trees of over 25 years. It is estimated that as much as 56 % of the sunlight is transmitted through the canopy during peak hours(10-16 hours) in palms aged around 25 years. All these features suggest the possibility of growing several crops of compatible nature in the interspaces of coconut grooves, during the initial stages and again after 25 years of age.

High value crops like pepper, cocoa, nutmeg and clove are perennial and most profitable mixed crops that can grow in partial shade in coconut garden as companion crops. In view of the increasing demand of these crops in the international and domestic market there is wide scope for large scale cultivation of these crops in coconut gardens for future.

A spacing of 7.5x7.5 m is recommended for coconut (175 palm/ha) but in the homestead gardens of Kerala, the density is much higher (200 to 250 palm/ha) where as in Karnataka state, much wider spacings are adopted with densities as low as 120 palm/ha. Experimental evidences have shown that a sole crop of coconut, at the recommended spacing of 7.5x7.5 m does not fully utilize the available resource. The active root zone of coconut utilizes only 25% of the available land area and the remaining area could be profitably exploited by raising subsidiary crops. Coconut palm like all monocots has a typical adventitious root system. Under favourable conditions as many as 4000 to 7000 roots are found in the middle aged palms. It is reported that about 74% of the roots produced by a palm under good management did not go beyond 2m lateral distance and 82% of the roots were confined to 31 to 120 cm depth of soil and more than 80% of the root activity was confined to a lateral distance of 2m from the trunk Thus the active root zone of coconut is confined to 25% of the available land area and remaining area could be profitably exploited for raising subsidiary crops. The venation structure of 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 apparent coverage of ground and shade cast by the canopy, and the magnitude of radiation transmitted through the canopy vary accordingly to the age of palms. Besides age, spacing, soil fertility, varietal characteristics and time of the day influence the light penetration. The diffused sunlight facilitate growing the high value crops like pepper, cocoa, nutmeg and clove as companion crops in the interspaces.

Cocoa - The Cocolate tree

A shade loving plant, cocoa an ideal, mutually beneficial mixed crop for coconut garden has been proved highly remunerative with less cost. There is no serious competition for

nutrients and moisture between the crops because of the mutually exclusive rooting zone. For better performance regular pruning should be done form the second year onwards which gives better shape to the canopy.

Cocoa has proved to be an ideal mixed crop for coconut gardens. Four to six month old F1 hybrid or one year old cocoa grafts are planted at a spacing of 3m between plants in single row system in between two rows of palms. The rows should have to be aligned north-south. One ha of coconut garden planted at a spacing of 7.5 X 7.5m in the square system will accommodate about 500 cocoa plants. Pits of 45 X 45 X 45cm size may be opened and filled with a mixture of FYM or compost (15Kg) and top soil to a depth of 20 cm from the surface. Fertilizers @ 100 g N, 40gP2O5 and 140 g K2O are to be supplied to an adult tree in equal splits in May and September. One third of the adult dose is to be given in the first year, two third in the second year and full dose from the third year onwards. The fertilizers may be broadcast in a circular area of 75cm radius and forked into the soil.

The unrestricted height of cocoa is around 6-8m, but it has to be pruned and shaped to get the canopy at a height of 1.8 to 2m allowing only a single storey of fan branch or double story. Cocoa plants flower from the second year onwards and stabilized yield is obtained from the seventh year. It bears round the year though two peaks are seen in June and December. It takes six months from flowering to maturity of pods. Harvesting is to be done with a sharp knife with out damaging the cushions when the pod colour starts changes to yellow. On an average 10-15 kg of pods per tree are produced every year. 10-12 kg pods give one kg of wet beans and three kg of wet beans give one kg of dry beans. On an average 60 fresh pods per tree are obtained every year. 30 pods give three kg wet beans and three kg of wet beans give one kg of dry beans.ie on an average two kg. dry bean per plant. With the present market price an additional income of Rs.80,000/-per acre can be obtained from this crop.

Pepper - King of Spices

Black pepper is raised as a mixed crop in coconut plantations in the west coast of India and SriLanka. It can be raised successfully using coconut trunk itself as the standard and also on live standards. Rooted cuttings may be planted at a distance of 1m from the bole of the palm in the northern side in pits of 50 X 50 X 50cm size. The pits are filled with a mixture of 10kg FYM or compost and topsoil. The vines may be trained along the ground and then on the palms by tying to the trunk during the first two years.Application of neem cake @ 1kg/vine will help to suppress the nematodes which are serious pests of the crop. As the crop has a very fine root system it is desirable to broadcast the fertilizers in a circular area of 45cm radius and earth up without disturbing the root system.

The height of the vines is restricted to 4m by pruning. Pepper begins to yield in the third year and comes to full bearing by 7th or 8th year. The yield declines after about 15 years but vines have been found to yield even upto 60 years. It flowers during April-May and comes to maturity after eight months. Harvesting of spikes is done when two or three berries in a spike turns red in colour. The berries are separated manually and dried in the sun for 7-10 days, till they turn black in colour. On an average 1kg of dry black pepper can be obtained from a vine. It is reported that Panniyur-1 variety pepper vines trained on palms aged over 25 years gave a mean yield of 2 kg pepper/vine/year, maximum being 5.5kg vine/year. An additional income of Rs. 70,000 per acre can be obtained by raising pepper as a mixed crop.

Clove - The Flower Spice

Clove can be raised as mixed crop in fertile, well drained soils with assured irrigation facilities. Generally it is planted at the centre of four palms.Two year old clove plants in 60 X 60 X 60 cm pits filled with a mixture of top soil and of Farmyard manure or compost(15kg). The population of clove trees in a hectare will be around 1550. During the first year, fertilizers @ 20gN, 18g P2O5 and 50g K2O per tree is to be applied, the dose is increased gradually so as to reach the adult dose by the 5th year. An adult clove tree is to be manured with 300g N, 250g P2O5 and 750gK2O every year. This may be given in two equal splits in May and September. The fertilizers may be broadcast around the drip circle and a light earthling up is given.

The clove tree attains a height of 10 to 12m. It flowers at the age of six years and full bearing comes at 20 years. Thereafter the production is sustained for 60 to 80 years. Flowering starts in September and continues till January (at high altitudes). The buds are ready to harvest in about four months. The flower buds are harvested when they turn light pink from green by hand-picking with the help of platform ladders. Drying has to be done in sun for 4-5 days, till they turn brown in colour. An average yield of 3kg is obtained from a tree under favourable conditions. An additional income of Rs. 80,000 to Rs. One lakh per acre can be obtained by raising clove as a mixed crop.

Nutmeg

Two year old nutmeg grafts are planted in the centre of four palms in order to accommodate 150 trees/ha. It is preferable to use grafts prepared from high yielding female trees because of the dioecious nature of the plant. While planting, the ratio

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the thermal efficiency of CME during the performance of the vehicle. Precisely the important technical advantages of using CME as fuel in diesel engines can be listed out as follows.

CME can be used straight away as fuel in any diesel engine. All that is required is a thorough cleaning of the fuel system including fuel lines and fresh fuel filters.

No modification is required in the engine components and in the fuel lines. CME need not be blended with any other fuel for use in diesel engines. Emission is negligible. All vital engine parameters like temperature, oil pressure, fuel consumption, power and torque are within the limits or slightly better than the specification of the vehicle manufacturer.

The results of the present study demonstrate a new trend in the field of renewable energy source and in the area of biofuel production. The distinct and unique features of the coconut oil and the CME compared to other vegetable oil esters were supported by the functional test of CME in diesel vehicle. Based on the standardized parameters of CME production and the functional properties of CME, the data has been filed for getting Indian patent. The functional effectiveness of CME as biofuel in diesel vehicle without any technical modification of the engine further demands more trial runs in diesel vehicles using CME under varied conditions and parameters for confirming the efficiency of CME. Plot plant trials for scale up the production of CME and more extensive functional runs using CME are warranted to establish the efficacy of CME in Combustion Ignition Engines (CIE) as a primary substitute of fuel energy source in near future. As a potential oleaginous crop with nutritional, therapeutic and industrial advantages, the commercial feasibility of CME as biofuel can be evaluated only through an integrated approach of CME production initiated from mature coconuts.

Table 7 Computerized pollution under control certificate using CME as fuel

Free Acceleration	K Value (1/m)	Actual RPM
T1	0.53	3500
T2	0.51	3500
T3	0.51	3640
T4	0.51	3750

(contd from page 7)

between male and female grafts is to be kept at 10:1. Pits of 60 X 60 X 60cm size may be taken and filled wit a mixture of FYM/compost and topsoil. Manuring at the rate of 20gN, 18g P2O5 and 50gK2o/year has to be done in the first year. Gradually the dose is to be increased so as to reach 500g N, 250g P2O5 and 1000g K2O/ tree/year by the 5th year. The fertilizers may be applied in the drip area of the tree and forked into the soil. The nutmeg tree grows to a height of 5-13m and sometimes as tall as 20m. It flowers at 5-8 years of age, full bearing reaches at 15-20 years and continues for 30 to 40 years or more. Flowering season is from June to August and the fruit takes six months to ripen. Fruits are to be harvested when they have split and the aril turns bright red in colour. The mace is dried in the sun for 10 – 15 days, till they become brittle and turn yellowish brown from the initial red colour. The nuts are dried till the kernel rattles within the shell. A tree produces 1500-2000 fruits per year which comes to 8 – 12 kg nuts. (100-250 nuts/kg) and 1.5 to 2kg mace. An average yield of 3 kg is obtained from a tree per year. An additional income of Rs1.20 lakh can be obtained from one acre coconut–clove system with the present market price of Rs.700/- per kg.

The above crops under coconut based farming system render enhanced employment opportunities, make available multiple farm produce and ensure ecological sustainability. The beneficial effects include improvement in soil fertility status, increased microbial activities, higher interception of sunlight, better micro-climate and reduced weed growth. Deleterious effects of surface run off and soil erosion will also be reduced in this system. The litters from the falling leaves and other plant parts have a salutary effect on the properties of soil through the degradation process and related activities undergoing in the soil. Experimental results from various coconut based cropping systems show that the high level of productivity could be sustained with lower level of fertilizer input which is one of the most costly input for farming. Coconut based integrated farming system with the above four money spinning cash crops as mixed crops not only provide additional income but also would help achieve higher productivity of coconut on a sustainable basis in future.