Organic Cultivation of Coconut in India : Concepts, Present Scenario, Constraints and Recommendations

K.U.K. Nampoothiri, R. K. Singh, C.C. Bidappa, George V. Thomas, S. R. Prabhu and P. Subramanian**

Central Plantation Crops Research Institute, Kasaragod 671 124, Kerala

Introduction

a is one of the major coconut ducing countries. Coconut ibutes 6 per cent to the national able oil pool and about 10 million es depend on coconut for their hood. Most of the production es from small and marginal ngs. More than 90 percent of ngs are below one hectare with erage of 0.22 hectare. Despite the tial for impressive high yields, the nal average is only 40 nuts per per year, which is only half of is realized in experimental fields under rainfed conditions. A ber of high production nologies suitable for coconut are able (Nair *et al.*, 1995) and it is n that nutrients and moisture ly regulate coconut productivity to ent of 80 per cent. But coconut is grown predominantly in acidic nutrient-poor laterite, sandy loam coastal sandy soils deficient in st one macronutrient or the other. these impoverished soils, tall ars planted in one hectare exports 50 Kg N, 4.5 Kg P and 62.5 kg K ear. As coconut is a perennial palm continuous flowering habit, it is that unless these nutrients are ed continuously, the productivity e seriously affected.

here is evidence that chemical izers can increase coconut yields n et *al.*, 1997). But unfortunately, limited number of farmers use ical fertilizers and even among , a very few apply the mended dose (Shehana *et al.*, 1995), leaving a vast majority of palms under-fertilized and unfertilized. Increasing the area under chemical fertilizer use may not be the answer to the problem. Fertilizers especially, nitrogen are getting costlier every year and emphasis now has to be on low cost production technologies that can enhance yields enabling competition in the international market. Again, large scale use of high analysis fertilizers are known to mediate a number of environmental hazard such as eutrophication, enhanced nitrate content in drinking water, etc. (Smil, 1997). Continuous use of chemical fertilizers also results in soil acidity, imbalances in soil nutrient levels and decrease in availability of micronutrients. Already, boron deficiency has become a serious problem in many coconut-growing tracts.

Even if efforts are made to use chemical fertilizers in all coconut plantations, it would be difficult to bridge the gap between the present use of 36 kg NPK/ha and the recommended use of 353 kg NPK/ha. This calls for attention towards other sources of nutrients to meet the crop needs and at the same time maintaining/improving native soil fertility and productivity. This is much relevant today, as maintaining and improving soil quality for sustaining crop productivity is gaining importance (Papendick and Parr, 1992). Development and use of ecologically designed agrotechnologies that integrate ecological principles into intensification process can contribute to sustainable production and reduce environmental problems (Paul and Robertson, 1989).

The use of pesticides to control pests and diseases in coconut cultivation is yet another concern. Development of pesticide resistance, destruction of natural enemies and environmental pollution are some of the immediately known consequences of chemical pest control. A number of minor pests and diseases of coconut have attained serious proportions in many parts of India which is related to the destruction of natural enemies. One of the solutions to this problems is adoption of eco-friendly pest control methods and fortunately a number of technologies using natural enemies of pests and disease causing microorganisms are now available for use in coconut plantations.

There is worldwide growing demand for organic agriculture products (Geier, 1998). There is also growing demand for organic coconut products and spices (which are usually grown in coconut gardens as mixed crops) in the western world. This trend is likely to spread to India in future and farmers who produce organic tender nuts and mature nuts may get a premium price.

Relevance and Suitability of Organic Farming in Coconut Cultivation

Coconut exports nutrients to the above ground parts continuously from a limited volume of soil throughout its

Coconut Development Officer, Coconut Development Board, Kera Bhavan, Kochi - 682 011

existence. Unlike other field crops, there is no critical stage of nutrient requirement for coconut palm. Since it produces flowers every month, nutrition is important throughout the year. It is, therefore essential that a nutritionally rich environment is provided in the feeding zone (root zone) of coconut throughout the year to realise adequate yields. Straight fertilizers can supply only NPK and do not have an impact on soil physical properties. The nutrients supplied from organic manures is slow and steady and therefore the nutrient loss is less. The nutrients held in organic combinations become available to the plants slowly over many cropping seasons and is very beneficial in perennial crops, like coconut.

Coconut is one of the most amenable crops for organic farming and a number of agrotechnologies are now available for organic cultivation which are detailed by Prabhu *et al.* (2000) and Thomas *et al.* (2001). Studies conducted at CPCRI have revealed the possibility of supplying a major portion of nutrient needs of the palm through organics. From a well-managed coconut garden about 6-8 tonnes/ha/year of dry material becomes available in the form of leaves, spathe, bunch waste and husk. In fact, a total of 14 million tonnes of organic materials (including coir pith) is available for recycling in the country. If fully utilized, it can meet the requirement of a major portion of nitrogen and a part of other nutrients. Technology for large scale vermicomposting of these wastes using *Eudrilus* spp. is now available (Prabhu *et al.*, 1998).

Huge quantities of organic materials also become available from intercrops commonly grown in coconut garden. It has been observed that 818 and 1785 kg/ha/year of dry cocoa litter become available from single and double hedge systems of planting respectively. About 50 kg N, 12 kg P_2O_5, and 35 kg K_2O could be returned to the soil every year under double hedge system of mixed cropping with cocoa (Varghese *et al.*, 1978).

Growing green manure cover crops such as *Mimosa invisa, Calapogonium* and *Pueraria* in coconut basins can provide 15-20 kg green manure per basin and can meet about 50% of nitrogen requirement of the palm (Thomas *et al.*, 1991). An agrotechnique for generating green manures by alley cropping of *Glyricidia* in coconut plantation has also been standardised (Subramanian *et al.*, 2000).

In an ongoing experiment on coconut based mixed farming of 1.2 ha involving coconut, grasses, dairy, poultry and rabbitry, 15 tonnes of farm yard manure, 2 tonnes of poultry manure as well as 50,000 litres of cow urine and cowshed washings were obtained annually. If effectively recycled, these can supply 125 kg N, 78 kg P_2O_5 and 115 kg K_2O (Maheshwarappa *et. al.*, 1998).

Biofertilizers based on nitrogen fixers such as *Beijerinckia, Azospirillum Bacillus, Arthrobacter, Azoarcus, Burkholderia* and *Pseudomonas* have been found effective at nursery stage and may have beneficial effects on mature palms as well.

Similarly, a number of eco-friendly technologies are available for pest and disease control (Nair *et al.*, 1998, Rohini Iyer and Nambiar, 1998) in coconut gardens. Rhinoceros beetle can be managed through the microbial agents such as Baculovirus and *Metarrhizium anisopliae. Clerodendron infortunatum,* a commonly found weed in Kerala is another promising biocontrol agent. Grubs of black beetle become deformed and sterile when fed on feed containing this plant. This plant with root, shoot, leaves and flowers can be incorporated in the composting material and the larvae that hatch out in such pits shall be affected by the contaminated feed.

The parasitoids *Bracon brevicornis,* and, *Apantilis taragamae* are used for the effective control of coconut leaf eating caterpillar. These egg and larval parasitoids are being multiplied and distributed in large numbers for release in affected gardens.

Neem oil - garlic - soap emulsion has emerged as on of the potent means for the control of the eriophyid mite *Aceria guerreronis. Hirsutella thompsonii,* a fungus has been reported to be an effective microbial agent for annihilating this pest.

Increased use of organic amendments like neem and mahua *(Hydnocarpus)* oil cakes and farm yard manure helped in the integrated management of burrowing nematode *Radopholus similis* in coconut.

Biocontrol measures have been formulated for stem bleeding disease. Research is in progress in formulating similar measures for bud rot and Ganoderma wilt disease. *Gliocladium virens, Trichoderma hamatum* and *T. harzianum* have been found to be very effective in reducing the population of *Thielaviopsis paradoxa* in the soil.

Case studies of a few farmers in Andhra Pradesh, Karnataka, Kerala, Gujarat and West Bengal who grow coconuts organically and get good yields are discussed.

Organically Grown Coconut Gardens in Different States

a) Andhra Pradesh

The size of holdings of the coconut plantations in the districts of Krishna, East Godavari, West Godavari and Srikakulam districts of Andhra Pradesh are comparatively large varying from 5 to 50 ha. The prominent coconut variety is East Coast Tall. In these gardens coconut is grown both as a monocrop and under coconut based cropping system. In the inter spaces of coconut palms, perennial trees like cocoa, spices, arecanut, pepper, coffee etc are grown, thereby efficiently utilizing the solar energy and other natural resources for crop production.

The organic sources were farm

ure and green leaves. A few rers apply oil cakes and nicompost prepared using farm te in their own garden. nicomposting is adopted in the n of the coconut palms using the waste available in the garden. In e of the gardens, cocoa is a mixed which produces large amount of ass in the form of litter fall adding e organic matter. The quantity of nic manure application varies from den to garden ranging from 25 kg kg per palm per year.

hough organic carbon content as as other plant nutrients in the soil uite high to support good plant th, widespread potassium iciency is observed, which is ably due to imbalances of N:K and atio in the coconut leaves.

n order to get the full benefits of nic farming, assured irrigation is red in this area due to prolonged spell and high temperatures ailing from December to May. All growers irrigate the gardens owing different methods of gation viz., flood, drip or micro nkler system.

he stand of coconut groves is llent with satisfactory crown size h 34-40 functional leaves and ise bearing. The pest and disease idence is less. The present level of ductivity is comparable and even her than that achieved in the ghbouring gardens where entional agriculture is practised. yield ranged from 50 to 200 nuts/ /year, which is comparable with earch station yield.

Among the organic farms, Prakash Organic Farm situated in ayawada deserves a special tion. In this garden, 2,500 coconut ms and 2000 mango trees are ercropped with 2000 guava and 600 ta plants. The average yield of the ms was 150 nuts/palm/year. Apart n these crops, drumstick, cashew, undnut, ginger, turmeric, watermelon, papaya, banana, chilli and a host of vegetables are also grown, A one hectare lake in the farm is used to develop pisciculture.

Liberal dose of farm yard manure (FYM) is applied in the basins, mulching is done with the organic matter available in the farm. Large scale vermicomposting using burrowing and non-burrowing earthworms is done and this meets the manure requirement of the farm to a very great extent. Cow dung, goat dung, poultry manure, press mud and fly ash are used as manure sources. These are all indigenous and available as farm resources.

Vermiwash prepared from vermicompost is sprayed periodically to control pests. Marigold plants grown all over the farm is claimed to aid in nematode control. Neem trees are allowed to grow freely on the farm in view of its pest control properties. Neem cake is applied in the basins and neem oil is applied as foliar spray. Garlic extract is also applied as foliar spray to control pests. Marigold and Tulasi plants are grown across the available spaces of the farms which are believed to be in control of nematodes and pests. Cows are being reared to collect the dung and the urine, which are also sprayed on to the trees for pest control. Poultry is also being raised and the birds eat away some undesirable insects apart form good manure. In this farm all the essential integrated farm components are being effectively harnessed to attain sustainability in the farm.

b) Karnataka State

In Karnataka state, the information has been derived from farmers belonging to Mandya, Shimoga, Mysore, Tumkur, Dakshin Kannada and Mangalore districts. In majority of the cases, coconut is planted at a wider spacing of over 9 m x 9 m to facilitate growing of intercrops in between coconut palms. Field crops like banana, tapioca, turmeric, beans, vegetables, and perennials like sapota, nutme black pepper, lemon, coffee an arecanut are preferred as intercrop The size of the holdings ranged fro one to 20 ha. Most of the farme maintain a dairy nut, which provide cow dung for biogas productio Installation of biogas plant is found t be useful in the on farm organi recycling by utilizing the biogas slurr Poultry and apiary are also min components of the farming system.

In general, these coconut growe do not apply chemical fertilizers and a far as possible maintain their grove organically. The locally availabl organic manures are also used. Th sources of organic manures are nee cake, fish manure, vermicompost, far yard manure and green leave depending on the locality. In the cas of maidan tract of Karnataka the majo sources of organic manures are co dung, farmyard manure and oil cake However, in the coastal region it i poultry manure followed by oil cak The availability of cowdung is scarc in this zone. Many farmers use gree leaves collected from the Western gha forest as well as organic waste available in their farm. The quantity organic manure application varied fro farm to farm and ranging from 25 to 6 kg per palm per year. The frequency application varied from six moths t two years. The gardens were irrigate either by drip or basin method.

From the assessment of soil fertilit status of organic coconut gardens, it observed that almost all the so samples had high organic carbo content build up due to continuou application of organic manur Consequently, the plant nutrie content is also high. Majority of th soils had high amount of availabl phosphorus (more than 20 ppm). Th available nitrogen is medium to hig and the available potassium is in som cases very low whereas in others it high. Coconut palms show yellowin of leaves due to potassium deficienc where the K status is unsatisfactor

When the garden is maintained organically, the entire K requirement of coconut palm is not met because of the of low K content of the organic manures. Under this condition, requirement of K should be met through organic manures with high K content.

The coconut palms are found all healthy and robust without either stress symptoms or major pest or disease problems. The palms have 35-40 leaves and showed heavy bearing. The combined effect of irrigation and organic manures results in an average yield ranging from 100-200 nuts per palm per year. In the madian tract of Karntaka, profused bearing is noticed in all the palms. The garden belonging to Mr. Margret D'Souza has about 3000 coconut palms organically maintained and all the palms are high yielders, the average yield being 250 nuts per palm per year.

From the observations, it is noted that organic farming is practically viable when Coconut based cropping system is adopted. This system with assured irrigation favours better microclimate, more biomass production and ultimately more organic matter build up.

c) Gujarat

Sanghvi farm and Save's farm located in Umbergan, Valsad District of Gujarat adopt organic farming for coconut cultivation.

Sanghvi Farm

In this farm, natural farming of coconut cultivation is practised rather than organic farming. Banana, sugarcane, custard apple, guava, etc., are grown as intercrops and channel irrigation is adopted. Cattle is allowed to graze freely and no attempt is made to collect and apply the cow dung. Instead, cowdung is left as it is where it laid. Zero tillage is the general rule and no pesticides, fungicides or weedicides are used. All the organic wastes are available in the garden are dumped along the irrigation channels. The soil is found to be very fertile and there is abundance of natural flora and fauna. The estimated average coconut yield from the 1500 palms is about 200 nuts per palm per year. Unfortunately, no records are being maintained on the performance of the crop.

Save farm

In this farm, WCT and dwarf varieties are maintained and curry leaf plants, arecanut, banana etc., are the intercrops. The crops are irrigated from November to May. The farm is not tilled and no fertilizers and pesticides are used. Organic manure is applied as in the case of Sanghavi farm. In addition to this, the farmer procures areca and cotton waste-based manures and applied to the garden. The natural fauna and flora including earthworms, micro-organisms and weeds are allowed to co-exist without any disturbance. This reduced drastically the labour requirement. However the yields are not satisfactory (less than 80 nuts/palm/year) because of poor soil type.

According to Mr. Save and Mr. Sanghvi, the principle of natural farming adopted by them for coconut cultivation not only produces healthy food, and maintains proper soil health but also keeps environment free from pollution. In addition to this, cost of production is minimised. As per their estimate the cost of inputs was less than 15 per cent of the income as against 60 to 80 per cent in the case of conventional farming.

d) West Bengal

Eight coconut gardens in Malda district of West Bengal where the coconut groves are maintained purely under organic culture are found to be in a neglected condition. The size of the holdings were less when compared to those in states like A. P and Karnataka. Most of them are homestead gardens and the palms are planted without giving proper spacing. Irrigation practices are not adopted scientifically and the intercrultural operations are not regularly undertaken. Eve... the agroclimatic condi... favourable for coconut cultiva... yield level is not satisfacto... probably due to the lack of awa... about scientific cultivation ... palms. Most of the farmers d... to incur expenditure on fert... are satisfied with applica... whatever organics available. Almost all the growers use ... manures such as cowdu... farmyard manure and at ... cakes. They also cultivate ... manure crops and apply ... coconut. However, the quantity ... organics used for coconut is ... sufficient to meet the entire ... nutrition, reflecting badly on yi... could be overcome by effe... utilising the biomass availabl... coconut garden.

Soil sample analysis revea... the organic carbon content ... cases is low when compared ... in other states. This is obv... because of low amount of ... manure application. The pH of ... ranges from 5.51 to 8.26. Th... status is low to medium while P... is satisfactory. The N content ... from 46 to 183 ppm and K conte... 33 to 783 ppm. Majority of the ... show the deficiency of nitroge... potassium. The palms are not ha... and bearing is not very good ... compared to Andhra Prades... Karnataka states. There is onl... garden with an average of 10... palm/year. Irrigation facilities s... be provided to realise the full ben... of organic farming. They have ... least double the quantity of org... manure application and irrig... facilities should be provided to re... the full benefits of organic farmi...

e) Kerala state

A number of farmers practise ... organic cultivation of coconut ... reported to get a minimum of 90 ... palm/year. All of them follow crop ... systems with a variety of crops ... as arecanut, cocoa, banana, ...

ugh vegetables, cassava, ginger and are trees. In addition, most of them the dairy, poultry, apiary and s is ture enterprises. Those who do ess dopt proper spacing face nut ns of low yield in the long run.

ant
ind
of
ily.
nic
nd
oil
en
to
al
ot
ut
is
y

Need for Inspection and ification in Organic Coconut Cultivation

n though a number of farmers wing coconut organically, they get any financial benefits for or getting premium price in ational markets, the produce d be certified as organic. tion and certification of organic ns and the products are the only a for the authentication of a t as organic. India does not have onal Inspection and certification m for organic products. The y is loosing potential agricultural due to the absence of a National cation scheme and Accreditation y to certify the produce of the r. Certification is a system by the conformity of the products plicable standards is determined. dvantages of certification are that s as a trust building system een farmers and consumers, helps e authentication of organic ucts, enables transparency and gthens the position of primary ducer and helps in market otion of products.

he concept of organic agriculture organic food processing is based ertain specific norms or standards, ch varies from country to country. mber of organizations in the world promoting organic concept. The rnational Federation of Organic culture Movements (IFOAM) has ed certain basic standards. They de a framework for certification grammes world wide to develop r own national or regional ndards. The IFOAM-India has pared and adopted the Basic ndards as applicable to Indian ditions, which were drafted by the onal Standards Committee (Anonymous, 1997). The use of **chemical fertilizers, pesticides and** sewage sludge are totally banned in organic farming. All organic manures and mulches produced from organic materials produced in the farm are **permitted. These include farm yard** manure, slurry, urine, poulty manure, vermicompost, composts, green manures, azolla, crop residues, coir pith, biodynamic preparations, etc. The use of many other organic materials such as human excrement, oil cakes, biofertilizers, saw dust, blood and bone meal, fish and fish products, gypsum, lime stone, magnesium sulphate, trace elements and organic manures produced in other farms are restricted.

The use of materials such as nicotine, mercurial seed dressings, methyl bromide, formaldehyde and phenols for soil sterilization are prohibited for use in plant protection. Mechanical traps, plant-based repellents, silicates, soft soaps, gelatines, etc. are permitted in plant protection. Pheromones, plant and animal oils, predators, microbial pesticides, sulphur, copper salts, mineral oils, botanical insecticides, etc are restricted for use in organic cultivation. Non-mercurial seed dressing, traps containing prohibited insecticides, slug killers based on aluminium sulphate, formaldehyde and phenols for sterilization of equipments are allowed with council's approval.

India has bright prospects for organic agriculture exports if it sets up its own certifying agencies conforming to the standards of EEC. It is very essential to evolve a National Organic Certification Scheme and set up an Accreditation Agency to certify the produce of the farmer. Strategy needs to be developed for special drives for marketing of organic products inside and outside the country.

[APEDA, Coffee Board, Tea Board, Spices Board, Coconut Development Board and Directorate of Cashew and Cocoa Development have been recognized by the Govt. of India as accreditation agencies. The accreditation agencies have drawn up the guidelines/procedures for evaluation and accreditation of inspection and certification programmes and these have been approved by the Steering Committee contributed by the Ministry of Commerce and are being implemented presently under the National Organic Programme. APEDA has further accredited three certification agencies namely Skal (Netherland), Ecoert (Germany) and IMO (Switzerland), and this will be simultaneously applicable in the other accreditation agencies.

- Editor]

Constraints in Adopting Organic Farming

- The organic manures contain less amount of potassium. Some manures may be rich in nitrogen but low in K for example oil cakes contain upto 7.8% N whereas K content is only 1.6%. The potassium requirement for coconut is high (1200 gm K_2 O/palm/year or more). This necessitates application of large quantities of organic manures causing practical problems. There is a general lack of awareness among the consumers about the quality aspects of organically produced coconut. Lack of research activities on organic farming is also a major constraint. So sincere efforts should be made in this direction to conduct more research on organic farming in view of its feasibility and viability.
- Organic manures are expensive especially when it involves huge transportation costs from production site to users site.
- Lack of premium market price for organically grown products. The legislation EEC No 2092/91 for organic production and marketing adopted on 24th June 1991 by European community is still followed by most of the countries.
- Absence of accreditation for certification.

Conclusion and Recommendations

Based on the information available at CPCRI Kasaragod and those gathered from organically managed coconut gardens in five states of India, and discussion with authorities on the subject the following conclusions have been drawn :

- Farmers are very much aware about the benefits of organic farming and ill effects of chemical fertilizers.
- Irrigation plays a major role in deriving full benefits of organic farming. Though drip, sprinkler, basin or flood methods of irrigation can be adopted, drip irrigation is preferable. Moisture stress is lessened and water use efficiency can be increased through organic mulching.
- Farmers correctly believe that coconut based cropping system, use of organic manures, mulching and protective irrigation would keep the soil and crops in good health. This is supported by the healthy and vigorous condition of the palms in many of the gardens.
- The research information available clearly indicates that there is enough waste biomass available in coconut garden especially in a coconut based farming system to meet full requirement of nitrogen and phosphorus as well as 50% of potassium requirement.
- The application of organics helps to improve physical characters and microbial properties of the soil.
- Coconut productivity can be maintained through organic culture. This is especially so because of the fact that coconut palms permit adequate sunlight and offer less root competition allowing very successful inter/mixed cropping system. 19 to 27 MT of organic matter is produced per hectare of coconut based high density multispecies cropping system. In view of costly nature of chemical fertilizer input and deleterious effect of pesticides and fungicides on the ecosystem, it is advisable to go in for organically cultivated coconut which should include use of biopesticides and biofertilizers.

How to Grow Coconut Organically

Based on the research results and farmers' experience, a package of recommendations could be made for organic cultivation of coconut palms.

Selection of seed gardens and seed nuts

- Select seeds from palms in an organically grown plantation having high proportion of heavy yielders without the incidence of diseases and pests
- Select regular bearers in the age group of 20-50 years with annual yield of greater than 80 nuts/palm under rainfed conditions and 120 nuts under irrigated conditions. The copra content should not be less than 150 g per nut.
- Collect fully mature (12 months old) nuts as seed nuts from January to April (under west coast conditions).

Raising of nursery

- Raise nursery by sowing seed nuts at a spacing of 40 x 30 cm during May-June, either vertically or horizontally in 20-25 cm depth trenches in nursery beds.
- Grow green manure crops in between rows.
- Reject all nuts which do not germinate within five months.
- Vigorous seedlings can be raised in black poly bags of 60 x 45 cm size of 500 gauge thickness using soil + coir pith mixture in 1:1 ratio. Inoculation of biofertilizers of *Azospirillum, Beijerinckia* and phosphobacteria will result in production of vigorous seedlings.

Field planting

- Planting in square system at a spacing of 7.5 x 7.5 m will accommodate 175 palms in a hectare. Wider spacing can be adopted to accommodate perennial mixed crops.
- The recommended pit size in soil is 1m x 1m x 1m. Plant seed during May-June after filling pits upto 60 cm with top amended with FYM/compost biofertilizers. Coconut husks buried on the sides.
- For planting, select one year seedlings having at least six leaves and girth of 10 cm at collar.

Care of young gardens

- During summer, provide shade irrigate with 45 lit. of water on four days for the young seedl Weeding to be done when req
- Apply 3 kg vermicompost in the year, 5 kg in the second year in the third year and 15 kg fro fourth year onwards.
- Raise cover crops such as *Pue phaseoloides, Mimosa calapognoium mucunoides* interspaces.

Maintenance of adult plantation

- Provide drip irrigation at the 32 lit./palm/day with 4 emitte laterite and sandy loam soil emitters in sandy soil du summer months.
- Recycle the waste bio available in coconut plante including leaves, bunch waste by vermicomposting in con basins or in pits or in cement using earthworm belongin *Eudrilus* sp.
- Raise cover crops in the bas palms and the perennial leg *Glyricidia sepium* in the interspa or in the border areas.
- Apply 15 kg of vermicompost, of green manures, biofertilizers g each) of N_2 fixers phosphobacteria and 2kg co husk ash per palm per year.
- Bury husks in the interspac trenches of 2m wide and 0.5m between rows of palms for moi conservation.
- Do not adopt control meas against pests unless it assu serious proportions. A

ntrol measures against pests
d diseases.

farming in coconut garden

se fodder crops such as guinea
ss or hybrid napier and mulberry
he interspace.

t black pepper and trail on the
m. Grow other compatible crops

ntain milch cows (5Nos/ha) and
tablish biogas plants using cow
g produced in the system to
erate gas for cooking and
hting purpose.

tegrate enterprises such as
ltry, rabbitry, pisciculture and
riculture to enhance income from
e system.

ecycle cattle manure, urine, biogas
rry and wastes from poultry,
bbitry and sericulture as manure
coconut and fodder crops.

re strategies

ependence on high inputs to get
gher productivity and production
as lessened enthusiasm in
esearch activities on organic
rming. Research on organic
rming in crops like coconut is now
ghly necessary.

ong term benefits of organic
rming need to be assessed
alistically.

ore effective ways of converting
rganic bio wastes into eco-friendly
rganic manures are to be evolved
pecially since this will also help
reducing the pollution problems
reated by the biowastes.

conomic viability of adopting
rganic farming system should be
lucidated.

here should be encouragement for
rganic coconuts' by way of
creased price.

ncentives are necessary in the
itial years for farmers interested
converting conventional farmers
organic farmers in a phased
manner.

onvincing the larger sector of
rmers about the benefits of organic farming. Popularizing the success stories on organic farming in India.

- Popularising cropping system approach with the inclusion of compatible crops, animal husbandry, poultry and fisheries depending on the situation.
- Promotion of biofertilizer, biopesticides and recycling of wastes as ecofriendly inputs.

References

Anonymous (1997) Concepts, principles and basic standards of organic agriculture. National Standards Committee of IFOAM, India, Aurangabd, Maharashtra. pp. 60.

Geier, B. (1998) The organic market : opportunities and challenges. *ILEIA News letter.* **14** (4) : 6-7.

Khan, H.H., Biddappa, C.C. and Cecil, S.R. (1997) Nutrition of coconut. *In :* Chadha, K. L. and Rethinam, P. (eds.) *Advances in Horticulture Vol. 9-Plantation and spices crops part 1.* Malhotra Publishing House, New Delhi, pp. 375-394.

Maheshwarappa, H. P., Dhanapal, R., Singh, T.V. and Hegde, M.R. (1998) Integrated coconut based farming system for sustainable agriculture. *Indian Coconut J.* XXIX(7) : 1-4.

Nair, M. K., Khan, H. H. and Gopalasundaram, P. (1995) High production technology in coconut. *Indian Coconut J.* XXV (9) : 3-19.

Nair, C.P.R., Sathiamma, B., Chandrika Mohan and Murali Gopal (1998) Newer approaches in the integrated pest management. *Indian Coconut J.* XXIX (4) : 99-103.

Papendick, R. I. and Parr, J. F. (1992) Soil quality - the key to a sustainable agriculture. *American J. Altern. Agric.* **7** (1-2) : 2.

Paul, E. A. and Robertson, G. P. (1989) Ecology and the agricultural sciences : a false dichotomy ? *Ecology* **70** : 1594-1597.

Prabhu, S. R., Subramanian, P., Biddappa, C.C. and Bopaiah, BM. (1998) Prospects of improving coconut productivity through vermiculture technology. *Indian Coconut J.* XXIXX : 79-84.

Prabhu, S. R., Subramanian, P. and Thomas, G. V. (2000) Opportunities for organic cultivation of coconut palms. *In :* Souvenir of XXXVII COCOTECH meeting, 24-28 July 2000, Chennai, India pp. 37-45.

Rohini Iyer and Nambiar, K.K.N. (1998) Integrated disease management in coconut. *Indian Coconut J.* XXIX (4) : 90-94.

Shehana, R. S., Meera Bai, M. and Gokulapalan, C. (1995) Fertilizer use pattern in coconut by the farmers in the homesteads of Kollam district. *Indian Coconut J.* XXV (11) : 4-11.

Smil. V. (1997) Global population and the nitrogen cycle. *Scientific American.* July 1997 : 56-63.

Subramanian, P., Biddappa, C.C., Maheshwarappa, H. P., Dhanapal, R. and Palaniswamy. C. (2000) Coastal sandy soil management through alley cropping of *Glyricidia* in coconut gardens. *SAIC Newsletter.* **10** (1) 7-8.

Thomas, G.V., Iyer, R. and Bopaiah, B.M. (1991) Beneficial microbes in the nutrition of coconut. *J. Plantation Crops* **19** : 127-138.

Thomas, G. V., Prabhu, S.R., Subramanian, P. and Rohini Iyer (2001) Organic farming technologies in coconut. *ATIC Series Publication No-4,* CPCRI, Kasaragod, p.14.

Varghese, P.T., Nelliat, E.V., and Balakrishnan, T. K. (1978) Beneficial interactions of coconut-cacao crop combination. pp. 283-292. *In : Proc. PLACROSYM-I* (ed. Nelliat, E.V. *et. al.),* Indian Society for Plantation Crops, Kerala, India.