Dr. K.U.K. Nampoothiri

Dr. K. Unni Krishnan Nampoothiri was born in December, 1940. He graduated from College of Agriculture, Vellayani, under the University of Kerala and passed the M.Sc. (Ag.) examination with distinction in 1963 from Agricultural college and Research Institute, Coimbatore under the University of Madras. He was awarded Ph.D. degree in Genetics by the Indian Agricultural Research Institute, New Delhi, for his work on coconut genetics under the guidance of Dr. M.S.Swaminathan, FRS.

Dr. Nampoothiri has adorned various positions during his 36 years of service such as Principal Scientist and Head, Division of Genetics, Project Co-ordinator, Scientist-in-charge and finally retired as Director, CPCRI, Kasaragod.

He worked as Head, Plant Breeding Division at the Nigerian Institute for Oil Palm Research, from 1975 to 1981 on deputation from Govt. of India. He initiated coconut research in Nigeria, undertook prospection for coconut genetic resources, described floral biology in coconut cultivars and worked out the trend in yield and bunch characters in oil palm. Besides he also established a hybrid seed garden and implemented coconut schemes in five southern states in that country.

Dr. K.U.K. Nampoothiri's contributions include identification of prepotent West Coast Tall coconuts, genotypic and phenotypic correlations with yield in coconut, investigations in *pisifera* and its implications in oil palm improvement, production of indigenous hybrid seeds for the first time in India, initiating an oil palm breeding programme and releasing two high yielding *tenera* oil palm hybrids. He was associated with designing a small scale palm-oil processing unit, evaluating unrefined palm oil for edible purpose, release of Palode-I variety of black pepper, and breeding root (wilt) tolerant coconuts.

He has made significant contributions as member of various professional bodies like Coconut Development Board, General Council of Kerala Agricultural University, Task Forces of Department of Biotechnology and Oil Palm India, and conducted National and International symposia under different banners. As a part of research work on Coconut and Oil Palm he has visited many countries such as Sri Lanka, France, Cote'd Ivoire, Republic of Benin, Nigeria, Papua New Guinea, Malaysia, England, USA, Costa Rica, Indonesia and Vietnam. He was also the country co-ordinator for the International Project on Coconut Genetic Resources Net Work (COGENT)

Dr. Nampoothiri has to his credit over 130 scientific articles in Indian and international journals. As a professional recognition he was honoured with the Platinum Jubilee award for outstanding contributions to coconut breeding by the Indian Society for Plantation crops. He is also a recipient of Dr. C. S. Venkata Ram Memorial Award.

Dr. Nampoothiri is a founder member of the Indian Society for Plantation Crops and he was the President of the Society for two years, 1999-2000. He is a member of various other professional societies and helps many of them as referee and editorial member.

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Organic Farming - Its relevance to plantation crops*

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Organic agriculture is a production system, which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, fungicides, growth regulators and livestock feed additives (Lampkin, 1990). In organic farming, chemical inputs are replaced with the organic inputs and biologically active formulations. It envisages a comprehensive agronomic management to improve the health and underlying productivity of the soil.

Principal Aims of Organic Farming

The main goals of organic farming are to produce food of high nutritional quality, to interact in a constructive and life enhancing way with natural systems, to encourage and enhance biological cycles, to maintain long term fertility of soils, to use renewable on-farm resources in locally organized agricultural systems, to work with materials which can be recycled, to minimize all forms of pollutants which may affect the farm environment including plant, livestock and wild-life habitats, to preserve and enhance 'traditional and indigenous knowledge and to allow everyone involved in organic production and processing to cover their basic needs and obtain an adequate return and satisfaction from their work keeping in view the wider social and ecological impact of the farming system.

Soils is not an inert material, but a medium supporting the growth of a large variety of macro and micro flora and fauna. Large scale use of high analysis fertilizers are known to mediate a number of environmental hazards such as eutrophication, enhanced nitrate content in drinking water, increased soil acidity, imbalances in soil nutrient levels and decreased availability of micronutrients. Biologically mediated processes form the key to the ecological functioning of soils and soil biological activity is the driving force in the decomposition of organic matter, formation of humus, nutrient transformations, evolution and maintenance of stable soil structure, biological fixation and solubilisation of nutrients and biological control of soil-borne diseases. Only those soils with high diversity of flora and fauna can continuously support the growth of healthy crops and are termed *living soils* which is the basis of organic farming.

By supplying the soils with required amounts of organic wastes, nature is encouraged to build up soil biodiversity and thus develop its own capabilities and mechanisms to support plant growth by supplying nutrients and preventing nutrient loss. The fertility of the soil is maintained by using farmyard manure, decomposed organic matter, vermicompost, rhizobium cultures and the like. We can control pests through biological means and use of biopesticides. Diseases are also controllable by prophylactic measures including crop rotation, growing trap crops and use of bioagents.

Relevance of Organic Farming in Plantation Crops

Unlike other field crops, plantation crops export nutrients to the above ground parts continuously from a limited volume of soil throughout its existence. It is therefore, important that a nutritionally rich environment is provided in the root zone throughout the year to realise adequate yields. The nutrient supply from organic manures is slow and steady apart form very low nutrient

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loss. The availability of micro nutrients and effect on soil physical properties are additional advantages. The nutrients held in organic combinations become available to the plants slowly over many cropping seasons as a result of natural control over nitrification effected by the heterotrophic organisms through nutrient immobilisation, which is very beneficial in perennial crops. It is in this background that interest generated in organic farming is considered as a welcome sign in the context of sustainable plantation crop production. Moreover, these crops are most amenable for organic farming since they produce huge amounts of waste biomass for recycling (Table 1).

Table 1. Biomass available for recyling in plantations

Crop	Biomass (kg/ha/year)
Coconut	8000-12,000
Arecanut	8000
Cocoa	5000
Oil palm	15,000
Rubber	6000
Cardamom	5500
Cashew	1500
Tea	1400 - 23,000

If the available biomass is fully utilized, it can meet the requirement of a major portion of the nitrogen requirement and a part of other nutrients. Huge quantities of organic materials also become available from intercrops commonly grown in some of these plantation crops.

Coconut is one of the plantation crops on which extensive studies have been made on organic recycling, in India. It is therefore, taken as a case study to bring home the possibility of organic farming in plantation crops (Nampoothiri *et al.,* 2001).

Organic Farming in Coconut

From a well managed coconut garden 6 to 8 tonnes of organic matter/ha/year becomes available in the form of leaves, spathe, bunch waste and husk (Biddappa *et al.,* 1996). When intercropped with cocoa, 818 and 1785 kg/ha/yr of dry matter is additionally obtained from single and double hedge systems of planting respectively. This means that 50 kg N, 12 kg P_2O_5 and 35 kg K_2O could be returned to the farm every year under double hedge system of intercropping with cocoa. Growing green manure crops like *Mimosa invisa, Calapogonium* and *Pueraria* in the basins can provide 15 to 28 kg green manure per basin (during a growth period of 140-150 days) which can meet 50% of the nitrogen requirement of coconut (Table 2)

Table 2. Biomass and nitrogen contribution of green manure legumes in coconut basins

Legume species	Laterite soil		Sandy soil	
	Biomass kg/basin	Nitrogen g/basin	Biomass kg/basin	Nitrogen g/basin
Calapogonium mucunoides	27.21	186.53	14.71	102.61
Mimosa invisa	24.97	197.55	17.00	153.19
Pueraria phaseoloides	28.45	196.19	19.43	121.29

Mixed farming : In an ongoing experiment at C.P.C.R.I. Kasaragod on coconut based mixed farming of 1.2 ha involving coconut, grasses, dairy, poultry and rabbitry, 15 tonnes of farmyard manure, 2 tonnes of poultry manure as well as 50,000 litres of cow urine and cow shed washings were obtained annually. If judiciously recycled, these can supply 125 kg N, 78 kg P_2O_5 and 115 kg K_2O (Table 3). There was effective build up of organic carbon, N,P,K and Fe status in the soil (Maheshwarappa *et al.,* 1998).

Table 3. Nutrient recyling from the byproducts in mixed farming (per year)

Byproducts/year	N(kg)	P(kg)	K (kg)
FYM-15 MT	75	40	75
Poultry manure - 2MT	20	38	12
Cow's urine and cowshed washings- 50,000 litres	30	-	28
Total	**125**	**78**	**115**

Management of coastal sandy soil : Apart from supplying plant nutrients, organic manures also have profound impact on moisture retention, root growth and nutrient conservation. When organic manures are applied to coarse textured soils, there is a decrease in the bulk density due to better aggregation properties. The available soil moisture of 0.78% for plots treated with NPK alone increased to 1.94,0.87, 1.39 and 1.13% respectively when coir dust, coconut shedding, forest leaves and cattle manure were incorporated along with NPK. The values for organic carbon, available N,Fe,Mn and exchangeable Ca and Mg were higher for soils receiving organic manures (Biddappa *et al.,* 1996).

To mitigate the poor physicochemical properties of coastal sandy soil, investigations have been conducted on the effect of growing *Glyricidia* in between the coconut rows with different planting densities and pruning intensities (Subramanian *et al.* 2000). Coconut growth was not adversely affected when intercropped with *Glyricidia.* A high biomass yield of 8000 kg/ha was obtained with three prunings per year from three rows of

Glyricidia grown in between two rows of coconut palms. These prunings could meet 90% of nitrogen, 25% of phosphorus and 15% of potassium requirement.

Recycling of Organic Wastes from Plantations

i) Direct utilization as mulch : Mulches can reduce the loss of soil moisture and create good microclimate in soil for the proper growth of plant roots and soil flora and fauna. Since most of the organic wastes from the plantations have high moisture holding capacity, spreading these in the basins is of obvious advantage. This gains more practical significance considering the complementary roles of soil organic matter, nutrient availability and moisture conservation. In addition, mulches will decompose over a period of time and add to the soil organic reserves.

ii) Composted biomass as a nutrient source :

Composting is one of the most popular methods of recycling the organic residues back to the soil. Compost is biologically decayed organic refuse and the process of composting leads to the production of brown and dark coloured humified material which is valuable for supplementing plant nutrients. The time taken for completing the process of composting depends upon C:N ratio of the organic material. A C:N ratio of 30:1 in raw materials is most desirable for efficient composting. For materials with a high C:N ratio, an external nutrient source, especially nitrogen must be added. Use of microorganisms capable of producing cellulase and ligninase can enhance the degradation of organic wastes. Similarly, use of soil macrofauna such as earthworms capable of shredding the organic wastes and enhancing the surface area, can reduce the composting period.

Vermicomposting : Decomposition of dry leaves and other organic biomass is rather slow because of their high lignin content. Earthworms can mediate decomposition of lignin and thus accelerate the humification process. A locally isolated strain of *Eudrilus,* for example, is capable of fully converting the coconut wastes (including the thick petioles) into vermicasts, leaving behind only midribs of the leaves. On an average 70% recovery can be obtained (Prabhu *et al.,* 1998). Vermicomposting can be done in cement tanks, heaps or in large pits. If the composting is done in the plantation itself, lot of labour required for transportation of the biomass and compost can be saved. Under irrigated situations vermicomposting in the basins or interspaces are advocated.

There are materials like coir pith which are available in large quantities but are rather resistant to decomposition. The main problem encountered while vermicomposting coir pith is that after a few days of composting, a hard layer is formed preventing the activity of the earthworms. A three-tier composting system was found effective when soil as bottom layer, coir pith as middle layer and coconut leaves as top layer were composted using *Amynthas alexandri, Lampino mauritii* and the local strain of *Eudrilus* sp. Use of *Pleurotus* and biopolymer degrading fungi like *Marasmiellus troyanus* are also useful in composting lignin-rich materials.

Recycling of spent mushroom substrate : Mushroom cultivation is an ecofirendly and economically profitable biotechnology process for the production of high quality protein from plantation crop wastes (Thomas *et al.,* 1998). Leaves and bunch wastes of oil palm, arecanut and coconut and coffee husk have been found to be giving a very high bioconversion efficiency. The spent mushroom substrate (SMS) has many positive attributes still left for potential use as good nutrient source for agricultural use. The nutrient status of SMS is higher than that of the original material, which can further be enhanced by composting after amendment with cow dung.

Biofertilizers : Several groups of micro-organisms have been found to possess the potential to enhance the growth and health of agricultural crops, which was previously confined to inoculation of legume seeds with *Rhizobium.* These include a large array of bacteria that are now known as plant growth promoting rhizobacteria (PGPR). These are naturally occurring, free-living soil microorganisms which are capable of colonizing roots. PGPRs influence plant growth by producing and secreting plant growth promoting substances, by stimulating root metabolic activities, by simulation of phytoalexins in roots, by phosphate solubilization, by reducing the soil pH, and (or) by supplying biologically fixed nitrogen. PGPRs also influence plant growth by indirect mechanisms such as suppression of bacterial, fungal and nematode pathogens. These characters differentiate them from the many other microorganisms found in the rhizosphere of plantation crops. Among the microorganisms that are promising enough in the plantation crop production system are the mycorrhizal fungi and certain other free-living microorganisms with specific functions. Situations where the plantations are irrigated are ideally suited for easy application of PGPRs.

The nitrogen fixing bacteria associated with the roots of plantation crops include, *Azospirillum amazonense, A. lipoferum, A. brasilense, Herbaspirillum frisingense, Bacillus* sp., *Burkholderia* sp., *Azoarcus* sp., *Arthrobacter* sp., and many others awaiting identification

(Prabhu and Thomas, 1998). Soil amendments as well as farming practices also bring about a protracted change in rhizosphere microflora, which favour the growth of specific microorganisms, thus leading to better growth and yield. Addition of cow dung, for example, increases VA-mycorrhizal colonization as well as the population of P-solubilizing bacteria in the root zone. Other organic amendments such as farmyard manure, coir pith, neem cake, green manures, etc. can be combined with microbial inoculants like *Beijerinckia indica* for improving the nitrogen fixation by indigenous diazotrophs in plantation soils.

The positive effects of these microorganisms become more pronounced under inter-cropping and mixed farming situations, as the component crops continuously add plant residues to the soil which undergo organic recycling. In mixed cropping, nitrogen fixing bacteria dominated by the *Beijerinckia* group and phosphate solubilizers are higher in number. Moreover, higher inhibition potential of resident soil bacteria to phytopathogens is observed as compared to monocropping. Some of the microorganisms generally used in plantation crops are indicated in Table 4 below :

Table 4. Biofertilizers in plantation crops

Crop	Micro-organisms used
Coconut	*Beijerinckia, Azospirillum, Burkholderia Azoarcus, Arthrobacter, Herbaspirillum* and phosphobacteria
Rubber	*Azotobacter,* phosphobacteria and VAM
Black Pepper	*Azospirillum, VAM* and phosphobacteria
Tea	*Azospirillum,* phosphobacteria and VAM

Biopesticides

The serious deleterious effects of pesticides in polluting the environment and affecting human health directly is now well understood. The awareness to this problem has made everyone think of alternatives. Use of pesticides is to be completely avoided in organic farming system. Ecofriendly methods of pest and disease control involve use of biopesticides. Biopesticides are of biological origin, as against the chemical or synthesised compounds. These include, microbes like *Trichoderma, Bacillus thuringiensis* (*Bt* toxin), microbial products like aureofungin, antagonistic endophytic bacteria, larval and egg parasitoids, predatory insects, plant products like neem oil, pheromones etc. Fortunately in most of the plantation crops, we have success stories in the field of ecofriendly pest and disease control as discussed briefly below :

Coconut : Rhinoceros beetle can be controlled by releasing Baculovirus-infected beetles (Mohan *et al.,* 1989). The release initiates a self-perpetuating disease in the beetles through copulation, contamination through excreta etc. The virus can infect all stages of the pest and the infection is passed on to the progeny also. However, re-release should be ensured when the virus load diminishes, usually after 3-5 years. Another biocontrol agent which can infect all stages of rhinoceros beetle is the green muscardine fungus (*Metarrhizium anisopliae*). On inoculating the fungus in decaying organic matter, they thrive well and cause good degree of mycosis of the grubs resulting in reduction in the beetle population. *Clerodendron infortunatum,* a weed commonly found in Kerala, is a very cheap and convenient biocontrol material. Grubs of black beetle become deformed and sterile when fed on feed containing this plant. Parts of this plant can be incorporated in cow dung or compost pits where the grubs are found and the larvae that hatch out in such pits shall be affected by the contaminated feed (Chandrika Mohan and Nair, 2001).

Pyrecon-E (derivative from Pyrethrum) is a time tested effective preparation for the control of red palm weevil, *Rhyncophorus ferrugineus.*Pheromones are behaviour modifying chemicals aiding in attraction of the beetles/weevils. The pheromones secreted by the rhinoceros beetle and red palm weevil have been found to be very effective. These commercially available pheromones are being now used in the control of the above referred pests in coconut and date palm. Effective control of leaf-eating caterpillar (*Opisina arenosella*), another serious pest of coconut, using the larval parasitoids *Apanteles teragamae* and *Goniozus nephantidis* as well as pupal parasitoid, *Brachymeria nosatoi* is a well demonstrated technology (Sathiamma *et al.,* 1996).

The eriophyid mite, *Aceria guerreronis,* is a hitherto unknown insect which caused panic among Indian coconut farmers in 1998 and 1999. The control measures adopted using dicophol as well as systemic insecticides like monocrotophos resulted in hue and cry due to the environmental hazards. Neem oil-garlic-soap emulsion then emerged as an acceptable potential measure. Incresased use of organic amendments like neem and marotti (*Hydnocarpus*) oil cakes helped in the integrated management of the burrowing nematode, *Radopholus similis* in coconut.

Coffee : In *arabica* coffee, white stem borer attack can be effectively checked through cultural measures like providing optimum shade, regular tracing, burning of affected parts and bark scrubbing to remove crevices on the main stem and thick primaries. If required, spraying neem oil based formulations on to the main stem may be taken up coinciding with the flight period of adult beetles. Removal of off-season berries, timely and clean harvesting, prevention of gleanings using harvesting mats, collection and burning of affected gleanings and timely sprays of entomopathogenic fungus *Beauveria bassiana* will bring down the incidence of coffee berry borer well within the economic threshold levels. *Cephalonomia stephanodermis* and *Phymasticus coffeae* are promising exotic parasitoids against this pest. Similar ecofriendly measures can be adopted against shoot-hole borer and mealy bugs. To tackle the problem of root-lesion nematode, planting grafts with tolerant rootstocks like robusta, excelsa, abeokutae and arnoldiana, and application of neem cake can be adopted.

In coffee, the four types of root diseases (brown, red, black, and Santavery) can be contained by making a proper ring around the affected coffee bushes, uprooting and burning the affected bushes, application of 1-2 kg of lime to the uprooted pit and exposing the spot to *T. harzianum* is recommended @ 2.5kg per plant in May-June and August-September months.

Tea : In tea, formulations containing azadiractins have been found effective against pink (*Acaphylla theae*) and purple (*Calacarus carinatus)* mites, and caterpillar pests such as flushworm (*Cydia leucostoma*) and leaf roller (*Caloptilia theivora*). Certain microbial formulations containing the entomogenous fungal pathogens, *Beauveria bassiana, Paecilomyces fumoso-roseus* and *Verticillium lecanii* have been found effective against shoot hole borer as well as pink and purple mites. Certain pheromones have also been tested with success against flush worm.

Dipel, a commercial formulation of *B. thuringiensis* has been recommended for the management of ginger and turmeric shoot borer. It has been shown that pepper pollu beetle can be managed with neem based insecticides. For control of cardamom white flies installation of yellow sticky traps in the plantation is advocated. Application of neem oil + triton (500 ml each) is recommended for the control of nymphs of this pest. Beetles of root grub are found to be susceptible to the fungus *Beauveria bassiana* and their grubs to another fungus *Metarrhizium anisopliae* as well as the nematode *Heterorhabditis* sp.

Now let us examine the status of organic farming in some of the other important plantation crops.

Arecanut

Application of organics as farm yard manure or green leaf is an age old practice among arecanut farmers. In traditional areas inter-cropping is also generally practised. The organic wastes from these along with 0.43 mt of organic matter available from the areca palms can meet 50% N, 75% P and 26% K requirement taking into account the presently recommended fertilizer dose of 100 g N, 40 g P_2O_5 and 140 g K_2O. It has been found that 50% of chemical fertilizers can be substituted through application of composted coir pith. Initial observations for three years have shown that vermicompost application to replace the entire chemical fertilizers is superior in terms of growth parameters (Chowdappa *et al.,* 1999).

Rubber

Very few farmers adopt organic farming in rubber and there has been no extensive study on the aspect. A case study by Jessey *et al* (1996) indicated that application of organic matter along with chemical fertilizers improved the soil physical properties, microbial population and cation exchange capacity. The present recommendation is application of FYM or compost @ 2550 kg/ha for seedlings, 12 kg / pit while planting and 6 tonnes / ha for mature plantations. Krishnakumar and Potty (1992) calculated that 6 tonnes/ha of leaf litter falls in a mature rubber plantation. Growing of leguminous cover crops is an accepted practice, especially in young rubber plantations, from which 3-5 tonnes of crop residues/ha are added in a period of 4 years (Kothandaraman *et al.,* 1989).

Coffee

In India, coffee is traditionally grown as a silvi-horticultural crop under the shade of natural forests mainly in the Western and Eastern ghats. Mexico and Nicaragua are reported to be the leaders in organic coffee production (Anon., 1991). Organic coffee which fetches a premium price of 10-33% over other mild coffees in the world market could be considered as one of India's best options for competing in the global market as well as to improve export earnings. The share of organic coffee in the markets is expected to touch one percent (Anon., 1998). Some of the advantages Indian planters have are that coffee is cultivated here in fertile jungle soils under a two-tier mixed shade canopy; recycling of organic wastes is already in vogue in vast majority of small holdings, and manpower is available at a cheaper rate. Majority of coffee holders belong to small and tribal sectors who do not use much of chemical inputs. These sectors can be successfully brought into organic farming methods by providing proper guidance without much change in the existing practices.

The production technology for organic coffee would consist of selecting plant varieties which are as much as possible resistant/tolerant to as many pests and diseases so that use of pesticides and fungicides are avoided. At lower elevations of less than 1000' MSL *robusta* coffee sould be the best option. In the case of *arabica*, which is basically grown at higher elevations, varieties with wider adaptability such as S 795, Sln. 5 B, 6 and 9 may be preferred. Application of compost (prepared in the farm) @ 1125 kg/ha is recommended. The by-products of coffee processing namely coffee pulp and cherry husk are rated higher than catle manure in terms of their manurial value and soil conditioning properties. For every tonne of clean coffee produced in the estate, around one tonne of dry coffee pulp or cherry husk is produced. These when composted would contribute approximately 17 kg N, 1 kg P_2O_5, 52 kg K_2O, 1kg S, 5 kg Mg. The micronutrient requirement will also be taken care of. Mulching with weed slashings and shade tree leaf litter etc. would be beneficial in suppressing the weed growth. Pepper, origanum, cardamom, vegetables, pineapple, banana, etc. are commonly grown in coffee gardens. This offers ample scope for recycling of crop residues.

Tea

In tea gardens, the main sources of organic matter are shade tree litters and loppings, tea litters, tea prunings and weeds. The annual average addition of organic matter by these sources is as much as 23 t/ha at mid elevation and reduces to 14 t/ha at high elevations. In the integrated nutrient management system, the nitrogen dose varies with the organic matter status of the soil and on the yield level. A proper N : K_2O ratio is maintained depending on the height of pruning in the pruned year and on the sources of N in other years of pruning (Verma and Palani, 1997). Compost, oil cakes and wood ash are the main substitutes recommended to substitute the nutrients removed by the crop. The minimum quantity of OM recommended is 5 t/ha and the maximum rate is 25 t/ha. This is to be applied in two spilts in the staggered trenches of 2m x 0.3m. It is stipulated that organic matter should not contain more than 25% moisture, should not have pathogens, pH should be neutral and the C:N ratio should be 10:1 to 15:1.

An experiment was conducted at UPASI on the management of tea prunings in relation to yield and organic matter status in the marginal rainfall area of Nilgiris. A nine percent yield increase was recorded in plots where the prunings were buried and a three percent increase when it was spread on the surface. A gradual decrease in the OM status was noticed in the control plots whereas the OM status improved with pruning burial (Pandiaraj, 1991). The details are given in Table 5.

Table 5. Effect of management of tea pruning on productivity and soil OM status

Treatment	Average made tea yield (kg/ha)		Organic matter (%)			
			1st cycle		IInd Cycle	
	1st cycle	IInd cycle	Surface soil	Sub soil	Surface soil	Sub soil
Prunings removed (control)	3105	2980	4.1	2.7	3.6	2.3
Burial of prunings	3287 (+5.9%)	3248 (+9.0)	5.4	3.6	5.9	4.0
Chopping and spreading of prunings on the surface	3234 (+4.1%)	3068 (+3.0%)	5.0	2.9	4.9	3.0

Spices

Unlike in many other plantation crops there is an increasing demand for organic spices especially pepper and cardamom. The demand is expected to go up by 25% in a few years time. In reality, our farmers are practising organic spices cultivation since they seldom use any chemical fertilizers for one reason or the other. What is now required is to induce them to go into organic farming in a systematic manner, especially by avoiding chemicals for control of pests and diseases. Repeated and indiscriminate use of chemical fungicides in pepper has increased the level of soil copper to an alarming extent of upto 77 ppm and the berry status to more than 12 ppm as against the international standard of permissible copper level in the harvested produce of 2 ppm.

The present recommendation of nutrients for pepper is : 10 t FYM + NPK @ 100 : 40:140 kg/ha/year. Leads obtained from preliminary studies are that application of compost viz, leaf, vermicompost or FYM improves the soil physico-chemical properties and nutrient availability, supports significantly higher population of free-living N-fixing bacteria, phosphate solubilizing bacteria, as well as fungal population. Uptake of major nutrients is increased; there is an yield increase of 119%, and the oleoresin content also goes up.

The nutrient requirement of cardamom is 75:75:150 kg NPK/ha/year under rainfed conditions and 125:250 kg under irrigated situations. It is now recommended that FYM @ 5kg or neemcake @ 1kg/ plant may be applied. In fact, on an average, 5.5 tonnes of organic matter per hectare becomes available in a cardamom plantation as leaf litter, weeds and pruned plant parts which is sufficient to meet around 50% of the nutrient requirement.

Encouraging results have also been obtained at Indian Cardamom Research Institute from application of organic matter in ginger and turmeric. In turmeric, for example application of organic matter favoured increase in yield and dry recovery as well as in curcumin (C) and oleoresin (O) contents (Table 6).

Table 6. Effect of organic matter application in turmeric

Year	Fresh yield (t/ha)		Curcumin (%)		Oleoresin (%)		Dry recovery (%)	
	C	O	C	O	C	O	C	O
1998	21.0	24.0	5.39	5.60	-	-	20.8	21.0
1999	12.5	14.0	4.34	4.44	-	-	20.8	21.2
2000	11.5	13.5	3.85	4.03	9.5	10.1	20.4	21.4

Cashew

The fertilzer recommendation for cashew is 750 g N, and 150 g each of P_2O_5 and K_2O/tree/year along with 10 kg poultry manure. Nearly 1.5 tonnes of cashew leaf litter and apples are available per hectare for recycling.Though these wastes are not generally removed from the plantations, there is no deliberate attempt to use them by composting etc. which if done is sufficient to meet 15% of total nutrient requirement. The cashew waste compost contains 1.59% N, 0.53% P, 0.33% K, 0.94% Ca, 0.56% Mg, 0.60 ppm Zn, 4.02 ppm Cu, 74.5 ppm Mn and 86 ppm Fe. An experiment conducted at the National Research Centre for cashew, Puttur, indicated that trees which received full dose as well as halt dose of NPK + 10 kg poultry manure gave 50% more yield than those receiving full dose of NPK alone.

Oil Palm

Oil palm is another crop which offers tremendous scope for organic farming, since 18-20 tonnes of organic wastes become available annually per hectare of plantation mainly from leaves and empty bunches. Mill effluent is another source which has not been fully utilized. The nutrient requirement of oil palm is 1200 g N, 600 g P_2O_5 and 1200g K_2O/palm/year. Application of 100 kg FYM or green manure is also recommended. Although much information is not available from Indian work, researches done abroad especially in Malaysia and Nigeria have shown that cocoa is an ideal intercrop in oil palm plantations. Additional biomass becomes available in these gardens, as in the case of coconut + cocoa system discussed earlier. Cocoa leaves contain 2.84% N, 0.26% P_2O_5 and 1.73% K_2O. Continuous addition of its leaves increases the organic carbon content to the extent of 9-25% at 15 cm depth. Many other annuals can be grown under oil palm, the most comparable ones being vegetables, banana, ornamentals, tobacco, chillies, turmeric, ginger and pineapple under Indian conditions. All these make oil palm plantations very much suitable for organic cultivation.

Thus, it is clear from the foregoing discussion that there is ample scope for organic cultivation in plantation crops. However, there is need for systematizing the efforts especially in recycling the available biomass within the plantation to derive the full benefit. The other important general aspects in this regard are discussed further.

Certification in Organic Farming

Inspection and certification of organic gardens and the products are the only ways for the authentication of a product. Due to the lack of a national certification scheme and accreditation agency to certify the produce of the farmer, India is losing potential agricultural export. Serious efforts are understood to be made to create such a facility in the country. The advantages of certification agency are that it acts as a trust building system between farmers and customers, helps in authentication of the products, enables transparency and strengthens the position of the primary producer and helps in market promotion of products. A number of organizations in the world are promoting organic concept. The aims and activities of the prominent organizations are given below:

1. *The California Certified Organic Farmers (CCOF) in U.S.A.* The purpose of CCOF is to promote and support a healthy, ecologically accountable and permanent agriculture in California and elsewhere, to develop standards and certification programmes for organic farming and processing organic foods. It provides verification of adherence to those standards for distributors, retailers and consumers as well as provides educational forums and materials relating to sustainable agriculture, apiculture and shares ideas and information on the subject.

2. *The Soil Association in U.K.* In Britain, the standards set by the association are well accepted. Its approach is based on creating a fertile soil by returning animal manures and crop wastes to the land.

3. *The United Kingdom Register of Organic Food Standards (UKROFS).* In order to reduce confusion and to unify standards, UKROFS was established in the year 1987. All the associations/ organizations in Britain have to register with UKROFS for approval of their standards.

4. *Register Member Grower (RMG).* It is a system devised by Magon exports through which it pooled together the organic farmers and got their farms certified. Many RMGs have opted for growing required items on a long term basis.

5. *The International Federation of Organic Agriculture Movements (IFOAM)* in Germany. The IFOAM technical committe has established basic standards of organic agriculture and food processing. It does not operate an inspection or regulatory procedure. Therefore, individual nations frame their own certification programme, certify organic products and label them.

The IFOAM provides a frame-work for certification programmes world wide to develop their own national or regional standards. The IFOAM-India has prepared and adopted the basic standards as applicable to Indian conditions which were drafted by the National Standards Committee. Nine major aspects are dealt with in these standards besides defining terminologies and providing details of various inputs and practices.

The certification includes inspection at all stages of production and marketing. The producer and the inspection agency should prepare the details of areas earmarked for organic cultivation. Production details and the details pertaining to storage, processing, transportation and marketing arrangements are to be recorded. The organic inputs such as FYM, poultry manure, slurry, straw and plant residues should be well composted before use. Basic slag, natural rock phosphate, limestone, chalk, gypsum etc. can be used only with the approval of the inspection body. Plant diseases and pests have to be controlled through approved plant extract preparations. Farm animals also should be raised as per standards. Detailed lists are available on standards set for organic farming, products which can be and which should not be used for fertilization, soil conditioning and disease and pest control. These conditions are to be strictly followed.

Constraints in Adopting Organic Farming

Organic manures contain less amount of potassium. Some manures may be rich in nitrogen but low in K. For example, some of the oil cakes contain 7.3% N whereas K content is only 1.3%. This necessitates application of large quantities of organic manures causing practical problems. Please see Table 7 for nutrient content of some of the organic manures.

Table 7. Nutrient content of organic manures

Source	Nutrient content (%) on dry weight basis		
	N	P_2O_5	K_2O
Sunn hemp	2.30	0.50	1.8
Glyricidia	2.76	0.28	2.6
Groundnut cake	7.30	1.50	1.3
Raw bone meal	3.50	22.50	-

- There is a general lack of awareness among the consumers about the quality advantage of organic plantation products.
- Lack of research results on various aspects of organic farming in plantation crops.
- Organic manures are quite expensive especially when it involves transportation from production site to the farm site.
- Lack of premium market price for organically grown products. Even when there is a higher price it does not commensurate with the additional expenditure.
- Absence of a national certification scheme.

Future Strategies

Modern agriculture is highly dependent upon high inputs, using high analysis chemicals to get higher productivity and production, which has lessened the enthusiasm in research activities on organic farming. It should now be realized that emphasis should be given to conduct research on organic farming in plantation crops.

- The direct and indirect effects of organic farming on a long term basis need to be quantified.
- More effective ways of converting organic biowastes into ecofriendly organic manures, with least pollution are to be evolved.
- Information on economic viability of adopting organic farming systems should be explicitly elucidated.
- There should be special encouragement for organic products by way of adequate premium price incentives.
- Incentives are necessary in the initial years for farmers interested in converting conventional farms to organic farms in a phased manner.
- Creating awareness among the larger sector of farmers about the special benefits of organic farming in India.
- Promoting cropping system approach with the inclusion of comparable crops, animal husbandry, poultry, and fisheries depending on the locality and facilities.
- Promotion of biofertilisers, biopesticides and recycling of wastes as ecofriendly inputs in plantations.
- Setting up of a national certification scheme and accreditation agency to certify organic products in the country.

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