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Improved Practices for Harnessing the Potential of Tree Spices

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Abstract

India is known as 'land of spices'. Tree spices are an important group among spices and about 17 tree spices are grown in India. There is need to harness yield potential of tree spices owing to its economic importance and demand. The improved varieties with good yield capacity and quality are developed in some tree spices viz. Nutmeg- Konakn Swad, Konkan Sungadha, Konkan Sanyukta, Keralashree, Viswashree; Cinnamon- Konkan Tej, Konkan Tejpatta, Navashree, Nithyashree; Kokum-Konkan Hatis, Konkan Amrita. Remarkable quality planting material of tree spices is being supplied to the stakeholders due to standardization of nursery and propagation techniques such as soft wood grafting in nutmeg and kokum; air layering in cinnamon etc. The tree spices are best suited mixed and inter crops for coconut, arecanut plantations as well as in kitchen garden. These crops are important component of agro and eco tourism. Developments of appropriate practices of post harvest management are important for marketing of tree spices. The various processed products adds the value of tree spices and some of them are nutmeg- pickle, candy, sweet chutney, powder; cinnamon - powder, quills, bark oil, leaf oil, bark oleoresin; kokum- kokum syrup, RTS, amsul, seed oil, butter, agal etc. The effective production technology must be coupled with proper dissemination technology. The initiative of Government of India through Mission for Integrated Development of Horticulture (MIDH) has helped for remarkable impact for area expansion under tree spices. Total 7 accredited and 15 implementing centers are participating in MIDH on Spices under jurisdiction of Dr. Balasabeb Sawant Konkan Krishi Vidyapeeth, Dapoli for catering the objectives to produce genuine and quality planting material of tree spices recommended by university, front line demonstrations and transfer of technology through farmer training programmes in entire Konkan region.

Key words: *Nutmeg- Konakn Swad, Konkan Sungadha, Konkan Sanyukta, Keralashree, Viswashree; Cinnamon- Konkan Tej, Konkan Tejpatta, Navashree, Nithyashree; Kokum-Konkan Hatis, Konkan Amrita, Improved tree species*

Introduction

India is known as 'land of spices' and history of Indian spices dates back to the beginning of human civilization. Among the various groups of spices, tree spices are unique owing to their nature. As the name indicates, tree spices are tall plants with more canopy compared to other spices like rhizome, seed and herbal spices, seed spices, bulbous spices, aromatic spices, leafy spices. There are different tree spices are grown in different parts of India shown in Table 1. They are the best components for intercropping systems particularly those of coconut and arecanut. Among the tree spices clove, cinnamon and tamarind are relatively more important and they are grown on area of 67304 with a production of 176136 tonnes (Table 2).

Table 1. Tree spices grown in India.

Sr. No.	Botanical Name	Family	Common Name	Part used as spice
1.	*Averrhoa bilimbi* L.	Averrhoaceae	Bilimbi	Fruit
2.	*A. carambola* L.	Averrhoaceae	Carambola	Fruit
3.	*Cinnamomum aromaticum* Nees	Lauraceae	Chinese cassia	Bark, leaf
4.	*C. tamala* Nees	Lauraceae	Tejpat, Indian cassia	Leaf, bark
5.	*C.verum* Bercht & Pres l.	Lauraceae	Cinnamon	Bark, leaf
6.	*Garcina gummi-gutta* (L.) Robs.	Clusiaceae	Garcinia, Cambogia	Pericarp of fruit
7.	*G. indica* (Thouars) Choisy	Clusiaceae	Garcinia, kokum	Pericarp of fruit
8.	*Illicum verum* Hook	Illiciaceae	Star anise	Fruit
9.	*Juniperus communis* L.	Cupressaceae	Juniper	Fruit
10.	*Laurus nobillis* L.	Lauraceae	Bay leaf	Leaf
11.	*Mangifera indica* L.	Anacardiaceae	Mango	Rind of immature fruit
12.	Mu*rraya koenigii* (L.) Sprengel	Rutaceae	Curry leaf	Leaf
13.	*Myristica fragrans* Houtt.	Myristicaceae	Nutmeg	Kernel, Aril
14.	*Pimenta dioica* (L.) Merr.	Myrtaceae	Allspice, Jamaica pepper	Immature fruit, leaf
15.	*Punica granatum* (L.)	Punicaceae	Pomegranate	Dried seed (with flesh)
16.	*Syzigium aromaticum* (L.)	Myrtaceae	Clove	Flower bud
17.	*Tamarindus indica* L.	Fabaceae	Tamarind	Fruit

(Haldankar *et al.* 2013)

2. Area, production and productivity of tree spices in India

Table 2. Area, Production and Productivity of tree spices in India 2021-22

Sr. No.	Crop	Area (ha.)	Production (toones)	Yield (kg/ha)
1.	Tejpatta	1682	4089	2432
2.	Nutmeg	23353	18429	789
3.	Clove	1924	1209	628
4.	Tamarind	40345	152409	3778

(Source-DASD, Calicut, 2023)

Table 3. Area and Production of Nutmeg in India 2021-22

Sr. No.	States	Area (ha.)	Production (toones)
1.	Kerala	22152	17435
2.	Karnataka	490	619
3.	Andaman & Nicobar	4	1
4.	**Total including other states**	**23353**	**18429**

(Source-Spices Board, Government of India)

Table 4. Area and Production of Clove in India 2021-22

Sr. No.	States	Area (ha.)	Production (toones)
1.	Tamilnadu	1085	1049
2.	Karnataka	115	86
3.	Kerala	715	53
4.	Andaman & Nicobar	9	21
5.	**Total including other states**	**1924**	**1209**

(Source-Spices Board, Government of India)

Table 5. Area and Production of Tamarind in India 2021-22

Sr. No.	States	Area (ha.)	Production (toones)
1.	Tamilnadu	14395	44415
2.	Karnataka	11012	41877
3.	Kerala	8232	28317
4.	Andhra Pradesh	3810	13811
5.	Telagana	54	147
6.	Maharshtra	1652	12592
7.	**Total including other states**	**40345**	**152409**

(Source-Spice Board, Government of India, 2023)

3. Improved varieties of tree spices in India

Various research institutes, Agricultural Universities are involved on improvement for tree spices and few varieties are released for commercial production of tree spices in India. The detail of the varieties along with their characteristics is given in Table. 6.

Table 6. Improved Varieties of Tree Spices in India

Variety	Characters	Developed by
Nutmeg		
Konkan Sanyukta (2018)	Monoecious nutmeg bearing 500 fruits per plant per year with bold nuts (9.20 g), high nut oil (27%) and mace oil (17.75%). Recommended for release during 2018-2019.	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli
Keralashree (2013)	1. First nutmeg variety developed by Farmers participatory breeding 2. Very bold nut with thick and entire mace 3. Wide adaptability. 4. The mace and nut oils are rich in sabinene and myrcene with low myristicin and elemicin.	ICAR - Indian Institute Of Spices Research, Kozhikode, Kerala
Viswashree (2001)	A high yielding, high quality variety with bushy and compact plant type.	ICAR - Indian Institute Of Spices Research, Kozhikode, Kerala
Konkan Shrimanti (Konkan Chaul) (2005)	A high yielding variety of nutmeg having bold nut and thick mace.	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli
Konkan Swad (2003)	A high yielding female variety with medium size fruits.	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli

Konkan Sugandha (1998)	First variety of nutmeg released in India. High yielding and hermaphrodite	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli
KAU Mundathan	Single mace weight (dry)-2.5 g, SingL nut weight (dry)-l2.6 g, Average no. fruits per tree: 1800	Kerala Agricultural University
KAU, Punnathanam	Single mace weight (dry)3.02 g, Single nut weight (dry)-13.9 g, Average no. fruits per tree: 1500	Kerala Agricultural University
KAU Pullan	Single mace weight (dry)1.4 g, Single nut weight (dry)-10.9 g, Average no. fruits per tree: 2100	Kerala Agricultural University
KAU Poothara	Single mace weight (dry) 2.1 g, Single nut weight (dry)-10.0 g, Average no. fruits per tree: 2000	Kerala Agricultural University
KAU Kochukudy	Single mace weight (dry)2.5 g, Single nut weight (dry)-11.6 g, Average no. fruits per tree: 1800	Kerala Agricultural University
Cinnamon		
PPI (Ci) 1 (2003)	It is a selection from the germplasm of open pollinated seedlings maintained at HRS, Pechiparai. The tree can be retained upto 50 years. It is tolerant to drought and resistant to pest and diseases. It is suitable for coppicing at an interval of 18 – 24 months and has good regeneration capacity. June – July is found to be the best season. It yields about 980 kg bark / ha (248.42 kg of quills and 731.58 kg of chips and dust) which is 25 percent higher than Pechiparai local. It is well adopted at lower elevation (100 – 500m), high rainfall with wide range of soil.	Tamil Nadu Agricultural University, Coimbatore
Sugandhini (2001)	Selection from germplasm maintained at AMPRS Odakkali	Kerala Agricultural University
Navashree (1996)	A selection with high shoot regeneration capacity. Higher cinnamaldehyde and oleoresin in bark.	ICAR - Indian Institute Of Spices Research, Kozhikode, Kerala
Nithyashree (1996)	A selection with high shoot regeneration capacity. Gives quality quills. Bark oil, leaf oil and oleoresin contents are high giving good aroma and taste.	ICAR - Indian Institute Of Spices Research, Kozhikode, Kerala
YCD 1 (1995)	It is a selection from the germplasm of open pollinated seedlings from Yercaud. It come to harvest from third year and can be maintained economically for 20 years. High dry bark yield of 359.75 quills and 3800 kg of dried leaves /ha with high bark recovery (35.3%). It has a 2.8 % volatile oil and in 3% quills and leaves. High regeneration capacity of 19.2 harvestable shoots in a harvest. The quills are sweet and light pungent. It is well adapted under 500m to 1000m above MSL and areas receiving 1000 to 2000 mm rainfall.	Tamil Nadu Agricultural University, Coimbatore
Konkan Tej (1993)	A high quality and high yielding variety of Cinnamon (*Cinnamomum verum* Presl.).	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth
KonkanTejpatta (1993)	High yielding cinnamon variety for leaves	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth

Kokum		
Konkan Hatis (2006)	A high yielding kokum variety having very bold fruits.	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth
Konkan Amrita (1997)	A variety of Kokum released for the first time in India. It is early, high yielding and fruits have long shelf life.	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth
Clove		
PPI (CL) 1-	First clove variety with dry flower bud yield of 5.2 kg/ tree, 6% oil content and 34.22% bark recovery. It is suitable for Tamil Nadu conditions. Recommended for release during 2012-2013.	Tamil Nadu Agricultural University, Coimbatore
Cassia		
Konkan Cassia	First cassia variety with low coumarin content and dry bark yield is 262.94 kg ha-1. Suitable for cassia growing regions of the country. Recommended for release during 2017-2018.	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth
Curry leaf		
Suwasini Dharwad-1	The leaves are dark green (0.1629 mg of chlorophyll/ gram of fresh leaf), shiny and highly aromatic. It is sensitive to low temperature in winter season and hence the bud burst is poor. The leaves have oil content of 5.22 % and can be dehydrated at 50°C without loss of quality and made into powder.	University of Agricultural Sciences, Dharwad
Dharwad-2	The leaves are slightly pale green and less aromatic. It is not very sensitive to low temperature and much superior in number of bud burst, inter nodal length and 8 times higher in growth of shoot than DWD-1	University of Agricultural Sciences, Dharwad
Tamarind		
Shiwai (2018)	1. TSS-41.6% 2. Acidity of fruits-31.2% 3. Regular bearer	Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani
Goma Prateek (2013)	It is an early with spreading growth habit, regular bearer, semi-dwarf and starts flowering in 4th year. Fruit shape is slightly curved with reddish pulp, suitable for processing.	ICAR-CHES, Godhra, Gujarat
Ajintha (2006)	1. Sweet tamarind 2. Acidity-5.19% 3. Regular bearer	Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani
No.263 (1987)	1. Acidity-18% 2. Regular bearer	Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani
Prathistan (1985)	1. Acidity-18% 2. Regular bearer	Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani
PKM 1	Grafts come to flowering three years after planting and give commercial yield from fifth year. Nine year old trees give a mean yield of 263 kg. It has 35% pulp, 17.10 % and 3.90 mg/100 g ascorbic acid.	Tamil Nadu Agricultural University, Coimbatore
DTS 1	The pods are straight having semi-curved shape, 23.6 cm length, 3cm width, 19.5 gm weight, 51.00 % pulp and 13.60 % acidity. It is a late variety and takes 310 days from fruit set to maturity	University of Agricultural Sciences, Dharwad

DTS 2	This is a selection made at College of Horticulture, Arabhavi, UAS, Dharwad.The pods are straight having semi- curved shape, 17.60 cm length, 2.60 cm width, 18.00 gm weight, 53.00 % pulp and 12.20 % acidity. It is an early variety and the pods mature in 280 days after fruit set.	University of Agricultural Sciences, Dharwad
Malbar Tamarind Garcinia Cambogia		
Nithya (2018)	Acidity 53.67 %; tannin 520 mg/100 g; driage 9.76 %, intensive branching with spreading canopy; 740 fruits/tree/ year. Average fruit weight 88.25 g. Suitable for loamy to laterite soil. Dry Rind – 10.11 kg/tree; HCA -16.96 %	Kerala Agricultural University
Haritham (2015)	A HY Malabar tamarind ; spreading trees; golden yellow oblate fruits; good quality fruit rind; dry rind yield of 9.91 kg/ tree/ year; HCA content 52.99%	Kerala Agricultural University
Amrutham (2015)	Compact res , golden yellow colored global shaped fruits, average yield of 16.38 kg dry ring/ tree/year; mean HCA content 51.58%	Kerala Agricultural University

4. Propagation technologies for tree spice-

Propagation methods are standardized in some tree spices which resulted in to rapid multiplication and increase in the area of tree spice. For seedling production seeds are used for raising rootstock. However, scions of desired varieties are procured from mother orchard which gives true to type variety. The details propagation methods are given in Table. 7.

Table 7. Propagation techniques of Tree Spices in India

Sr. No.	Tree Spice	Propagation method	Advantages
1.	Nutmeg	Epicotyl grafting, Softwood grafting, top working	Female plants are propagated conservation of male plants to female plants. Rapid multiplication of elite plants per unit area.
2.	Cinnamon	Cottage, air layering (rapid multiplication techniques)	Earliness, More plants per unit area
3.	Cassia	Air layering, cutting	True to type plants
4.	Allspice	Cutting, layering	Management of rhizome rot
5.	Kokum	Soft wood grafting	True to type plants, early bearing
6	Clove	Seed, Inarching on clove seedling	Earliness, dwarfness and high productivity
7.	Tamarind	veneer grafting, Softwood grafting	Earliness, dwarfness

(Haldankar *et al*., 1999; Varghese and Jose, 2019)

Nutmeg-

It is a dioeciously in nature, therefore sexual propagation may lead to male plants and these male plants are unproductive. Commercial plantations are raised mostly using grafts or buds to circumvent the sex problem. A ratio of 1:10 male: female trees are recommended in the plantations. Currently, femaleness is ensured by grafting or budding, which needs good skill and experience for reasonable success. The dimorphic branching pattern of the tree is another issue of relevance in case of vegetative propagation. The scions or buds extracted from the orthotropic shoots only exhibit vigorous erect growth and canopy development similar to the seedling trees and the availability of such scions from mother trees is limited. Hence, commercial nurseries generally propagate nutmeg

through budding rather than grafting as the bud-wood provides maximum numbers of orthotropic propagules. However, the success rate in budding is a matter of skill, experience and season and hence budded plants are priced very high by the nurseries.

Softwood grafting is possible in nutmeg (*Myritica Fragrans* Houtt.) it was revealed that may was the best season for softwood grafting with maximum success (80.00%) followed by June (54.00%) and July (50.00%). were preferred for softwood grafting. Retention of one terminal leaf on except the terminal leaf, for apical bud swelling was advantageous and recorded 70.00 per cent success. The retention of the leaves on rootstocks did not influence the success of softwood grafting (Haldankar *et al*., 1997).

Nissar *et al*. (2019) reported air layering in nutmeg and attempted in matured trees for the first time in the India. They reported that, Air layering was successful in plagiotropic and orthotropic shoots with 100 per cent survival. This method is cost effective and is easy for adoption.

5. Planting systems for tree spice-

Tree spices are with compact canopy and tall in nature, so they are the best component for intercropping and can be utilized for planting with various crops as a intercrop. Nutmeg, Clove, Cinnamon are the best intercrop tree spices with coconut and arecanut. 'Laki Baug' at Dr. BSKKV, Dapoli is the best example for the same. 'Laki Baug' techniques utilize the potential of tree spices, land, resources etc. which resulted in improvement in economy of farmers.

Mixed cropping of spices in coconut

The excellent growth and good bearing capacity of cinnamon, nutmeg, black pepper and clove planted in coconut as intercrops proved that these crops can be cultivated on commercial scale in the Konkan region of Maharashtra.

Multi-storeyed Cropping of Tree Spices in Coconut

Among the various spices the tree spices are highly remunerable crops. These crops can sustain the climatic changes experienced in the region. Tree spices viz., nutmeg (*Myristica fragrans* Houtt.), cinnamon (*Cinnamomum verum* Bercht. and Presl.), clove (*Syzygium aromaticum* (L.) merr. and Perry), kokum (*Garcinia indica* Thouars), and all spice (*Pimenta dioica* (L.) Merr.) are suitable intercrops in coconut plantation. The air space, partial shade, solar radiation and available irrigation water in the plantation provide scope of growing intercrops. The multi-storeyed cropping with tree spices in coconut is a solution for sustainability with greater income to counter the climatic fluctuations. Various production models of multi-storeyed mixed cropping are developed for small farmers through rigorous research for suitable varieties, propagation protocols, densities of various spices in the coastal region of Maharashtra. The integrated multi-storeyed cropping system with tree spices continuously for ten years contributed higher returns per hectare elevated the nut productivity from 6300 to 9800 nuts acre^{-1} which helped for the sustainability of coconut plantations under aberrant climate of coastal region.

The planting of cinnamon, nutmeg, black pepper, kokum and clove under coconut as mixed crops were recorded excellent growth and bearing under coastal conditions (Patil *et al*. 1991, Nagwekar *et al*. 2014). The mixed cropping of tree spices resulted in increase of the average yield of coconut palm from 23 to 96 per cent at the end of 26th year as compared to the average yield of previous years (Table 8). Nutmeg proved to be the best intercrop in coconut plantation. (Nagwekar *et al*. 2014).

Table 8. Average yield of coconut per palm before and after planting spice crops and per cent increase in different blocks of spices crops.

Block Particulars	Cinnamon Block	Nutmeg Block	Black Pepper	Allspice Block	Clove Block	Garcinia Block	Control Block
Average yield before planting spices	69	71	83	49	47	64	77 Average yield of 26 years
Average yield after planting spices 1982 to 2003	118	119	102	93	92	96	
Percent increase (%)	71	69	23	90	96	50	-

(Anonymous 2015)

High density multistoried system in coconut plantation with nutmeg, cinnamon, banana, black pepper and pineapple contributed very high returns (Table 9 and Figure 1) (Anonymous 2005). The yield of coconut before planting with different component crops was 5,320 nuts acre-1 which was increased to 6,300 to 9,800 nuts acre^{-1} after planting of component crops. Whereas, nutmeg yield commenced from 4th year and it was 15,000 nuts and 7.5 kg mace (aril) per acre respectively from 10th year onwards (Anonymous 2005). The cinnamon started yielding from 3rd year and it was 50 kg dried bark acre-1 and 370 kg dried leaves acre-1 at 10th year whereas black pepper recorded 105 kg dried black pepper yield at the age of 10th year (Table 10). Inter cropping with nutmeg, kokum, black pepper, cinnamon and clove in the coconut plantations proved beneficial in Konkan region of Maharashtra (Table 11).

Table 9. Plant population in one acre of coconut plantation.

Name of crops	Variety	No. of plants
Coconut	D X T	70
Nutmeg	Konkan Swad	54
Cinnamon	Konkan Tej	246
Banana	Safed Velachi	246
Black pepper	Panniyur-1	140
Pineapple	Kew	4320

(Source: Nagwekar *et al.* 2014)

Table 10. Yield of coconut and different components crops in Lakhi Baug (in one acre).

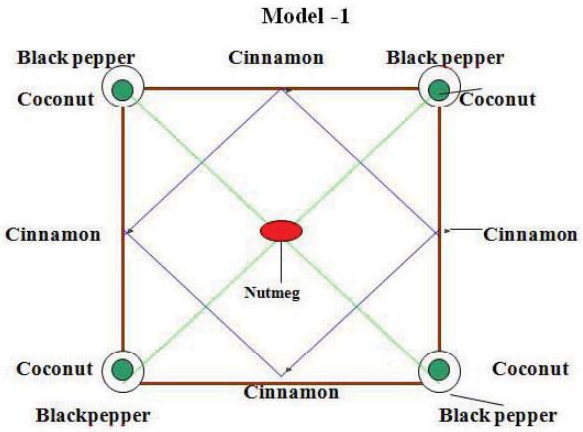
Name of the crop	Year									
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Coconuts (no.)	6300	7000	8400	8400	9100	9100	9100	9100	9100	9800
Nutmeg										
i) No. of Nuts	-	-	-	250	500	1000	2500	5000	10000	15000
ii) Mace (kg)	-	-	-	0.100	0.200	0.500	1.250	2.500	5.000	7.500
Cinnamon										
i) Dried bark (kg)	-	-	-	12.3	-	24.6	24.6	37	37	49
ii)Dried leaves (kg)	-	-	-	196	-	370	370	370	370	370
Banana (t)	-	2.2	1.76	2.2	1.76	2.2	1.76	2.2	1.76	2.2
Pineapple (t)	-	6.4	4.0	-	6.4	4.0	-	6.4	4.0	-
Black pepper (kg)	-	-	-	-	14	70	70	70	70	105

Source: Nagwekar *et al.* 2014.

Table 11. Economics of Coconut-based high density multi species cropping system (per hectare average of 5 years: 1999-2004).

Block	Total Cost ₹	Total Returns ₹	Net Profit ₹	B:C Ratio
Cinnamon	83449	137877	54428	1.65
Nutmeg	86417	179995	93578	2.08
Black Pepper	79313	130213	50900	1.64
All spice	68087	105952	37865	1.55
Clove	77017	109496	32479	1.42
Garcinia	81483	136976	55493	1.68
Control	55207	81194	25987	1.47

Lakhi Baug



Plant population

Coconut: 70; Cinnamon: 123; Nutmeg: 54; Black pepper: 140

Lakhi Baug Model - 2

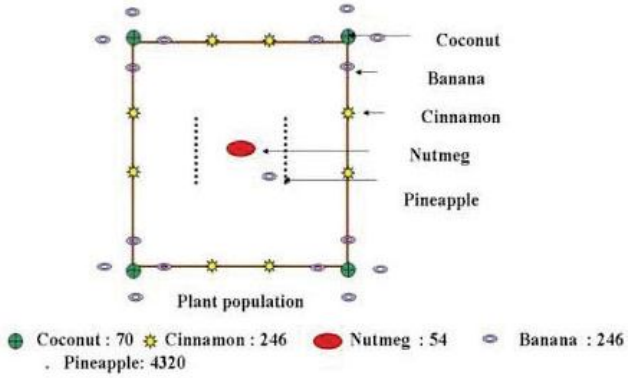


Fig. 1. High density multispecies cropping system model in coconut.

Expected Expenditure/Acre	**Rs. 2,30,000/-**
Expected Incomer/Acre	**Rs. 3,75,000/-**

Success Stories for Tree Spices as a mixed crop

The various farmers from Konkan region of Maharashtra adapted mixed cropping of tree spices instead of monocropping and successful in production of tree spice.

Mrs. Priyanka Nagwekar (34), a resident of Hatis village in Ratnagiri Tahsil of Ratnagiri District ventured into family farming. She was cultivating subsistence crops like rice, finger millet, vegetables, etc. in the traditional way in her 22 ha farm. Her farm income was very limited. Under the guidance of RCRS, Bhatye started to cultivate spice as mixed crops in coconut garden and successfully planted the spices Nutmeg, and Arecanut as mixed crop in their coconut garden which could get her additional income. Mrs. Priyanka Nagwekar received net profit Rs. 87860/- due to mixed cropping of coconut and Cinnamon (Indian Coconut Journal, May, June, July 2021). The few other success stories are enlisted in Table 12.

Table 12. Success story for mixed cropping of Tree spices in coconut garden

Sr. No.	Name of Farmer	Address	Crops grown
1.	Mr. Raja Bhargav Padhye	Nate, Tal. Rajapur, Dist. Ratnagiri.	Coconut, Nutmeg, Cinnamon
2.	Mr. Hemant Phatak	At-Someshwar, Post- Chinchkhari, Dist. Ratnagiri.	Coconut, Areacnut, Cinnamon
3.	Mr. Mahadev Naravane	Post- Nakhare, Tal. & Dist. Ratnagiri.	Coconut, Nutmeg, Cinnamon, black pepper, Banana
4	Mr.Abdul Majgaonkar	A/P- Karla, Tal. & Dist. Ratnagiri.	Coconut, spices
5	Mr. Amrut Ravji Desai	A/P- Kudase, Tal. Dodamarg, Dist. Sindhudurg.	Coconut, Arecanut, Kokum, spices, Coffee, Cashewnut, Pineapple
6	Mr. Vivekanand H. Naik	A/P- Dodamarg, Dist. Sindhudurg.	Mango, Coconut, Arecanut, Kokum, balck pepper, Coffee, Cashewnut, Pineapple
7	Mr. Raghunath V. Naik	A/P- Oros, Tal. Sawantwadi, Dist. Sindhudurg.	Coconut, Arecanut, Kokum, Clove
8	Mr. Vijay Waman Gogate	A/P- Mavlange, Tal. & Dist. Ratnagiri.	Coconut, Arecanut, Spice
9	Dr. Vivek Y. Bhide	A/P- Malgund, Tal. & Dist. Ratnagiri.	Coconut, Arecanut, clove

(Source- Success stories, Dr. BSKKV, Dapoli, 2009)

6. Post harvest of tree spice-

Tree spices in addition to adding taste, flavour, scent, and colour, also serve as preservatives by preventing food and beverage goods from getting deteriorated. There is a vast source of aromatic compounds and essential oils, which are in high demand in the pharmaceutical and cosmetics industries in both domestic and international trade. They are recognized as one of the most functionally significant food ingredients since; they also have nutritional, antibacterial, antioxidant, and medicinal qualities. Therefore, efforts are to be focused on post harvest management of tree spices in view of minimizing their losses along with the upgrading the area, raising productivity, and enhancing tree spice quality.

Nutmeg-Fruits of nutmeg are harvested when they split open on ripening. Fruits of nutmeg ripen 6 to 9 months after blossoming. (Nazeem, 1979)

The split fruits are either plucked from the tree with a hook or collected soon after they drop onto the ground. Since this crop is harvested during rainy season in Kerala, sun drying is difficult resulting in improper drying of nutmeg and mace. Drying of medium to large quantities of nutmeg is done in drying rooms. The harvested nutmeg is spread on raised wire mesh floor and heated air is passed through pipes inside the drying room. Continuous drying of nutmeg is not recommended as the oil oozes out without proper drying. The local practice of drying nutmeg at Kalady, a prominent nutmeg growing area is to pass the hot air for one or two days (8 hours each) and then allow to dry at ambient conditions for one week. The heated air is again passed for a day or two and then dried for aweek or 10 days. The nutmegs are dried until the seeds inside rattle on shaking. This takes about 15 days or more. The seed cover is removed by breaking the hard seed coat manually or mechanically.Some of the nutmegs are dried improperly by this process have lot of fungal infections and the problems of aflatoxins are also reported by the exporters. Nutmeg samples dried in solar tunnel drier showed a higher reduction in drying time. It took about 8 hours for drying from an initial moisture content of 42.6% to 7.2%, while the conventional drying practice took about 13 days (Joy etal. 2000). Nutmeg is usually packed in double layered jute or polythene bags. If other packing materials are used, care must be taken to avoid materials, which might lead to 'sweating' and mould development. Powdered nutmeg is prepared by grinding at ambient temperature. Mace is detached from the nut carefully soon after harvest, washed, flattened by hand or between boards and then sun dried until they become brittle. Hot air ovens can be used for drying and the colour retention is much better than sun dried mace. Studies conducted at IISR, Calicut showed that blanching of mace in hot water at 75oC for two minutes preserved the qualities of mace during drying (Amaladhas etal., 2002). Dried mace is graded and packed.

Kokum- Fruit is mature when its colour changes from green to light green and from red to purplish red. Kokum fruit has a shelf life of 4-5 days when stored at room temperature. It can be extended to 15 days with application of waxol 12 percent and stored in a cool environment. Paddy straw and CFB boxes are the excellent kokum packaging materials. (Shirke and Pinjarkar, 2023)

Cinnamon-Cinnamon is harvested twice a year. Due to the high humidity during the monsoon makes it easier to peel the bark. It attains maturity after three years. The side stems are cut off by removing the bark. Bark with a diameter of between 1.2 and 5 cm is preferred for cinnamon. Cinnamon quills are dried in the shade on coir rope racks. The quills are rolled on a board to tighten the bark after 4-5 days of drying, and then placed in gentle sunshine to continue drying. Since, the weather is humid during the rainy season; a mechanical dryer is required to dry the cinnamon. Different dryers are used, which includes those are powered by electricity, gas, biomass, etc. Cinnamon quills are divided into pieces up to 10 cm long and placed in moisture-proof polypropylene bags before sold. Bag sealing is crucial to preventing moisture gain. Product labels must be visually appealing. The label should include all necessary product and legal information, including the product's name, brand, manufacturer's contact information (including name and address), date of manufacture, expiry date, weight of the contents, and any additional ingredients that may be needed (a barcode, producer code and packer code are all extra information that is required in some countries for traceability).

7. VALUE ADDITION OF TREE SPICES

Nowadays, many value-added spices are used and they impart a special taste to food preparations. Value addition has several plus points, viz. the value added products are simple to carry, having long-lasting flavours, with low bacterial contamination, having higher income from food industry, used as preservatives and also in pharmaceutical industry. Some prominent value-added products accredited globally are black pepper powder, pepper oleoresin, cardamom oil, curcumin, turmeric oleoresin, bleached ginger, garlic paste, onion powder, coriander oleoresin, etc. Big entrepreneurship to be

developed in large scale, and year round production of the value-added product for meeting the international demand is feasible (Mani and Kabiraj, 2019).

Some value-added products of tree spices

A. Ready-made spice powder and paste

Powdered spice is air tight packaging material is of enormous demand. Increasing urbanization paired with a rise in number of working women has reduced the time of cooking. Consequently, home-makers have started demanding readymade spice powder that includes chilli powder, cumin powder, fennel powder, black pepper powder, turmeric powder. Also popular are ready made paste of onion, garlic, ginger in packet form. An official report from Everest Spices Ltd. Reveals their exports about 10 per cent of its products to the US, West Asia, Singapore, Australia, New Zealand and East Africa, said: "The total market size of branded spices is estimated at 6,600 crore, and is growing at 14 per cent annually

B. Spices extractives.

Essential oil

Essential oils are major flavouring constituents of spices, highly concentrated about 75-100 times than the fresh spice.

Crop wise Value added products of major tree spices

A. Nutmeg and mace - Nutmeg oil and mace oil, Nutmeg oleoresin, Nutmeg butter are the main value added products. By utilizing nutmeg pericarp (rind), many value added products have been developed viz., Nutmeg (rind) pickle, Nutmeg(rind) preserve from slices, and Nutmeg (rind) preserve from shreds, Nutmeg (rind) candy, Nutmeg (rind) sweet chutney and Nutmeg (rind) powder.

B. Cinnamon - In addition to cinnamon bark, various other products are obtained from the tree namely, powder, quills, bark oil, leaf oil, bark oleoresin etc.

C. Clove - Clove oil, ground clove, oleoresins, clove-stem oil, clove-leaf oil, oil of mother of cloves and clove-root oil are some of the value-added products of clove.

D. Allspice - Pimenta berry oil, Pimenta leaf oil, Pimenta oleoresin, Pimenta bark and wood.

E. Kokum- Kokum Syrup, RTS, Amsul, seed oil, butter, agal etc.

8. Challenges and threats to Indian spice and its value added product export -

Production of spices pay important role in Indian economy. Following the challenges and threats to Indian spice and its value added product export:

i. Lack of planting material -

In India (other than south India), the availability of quality planting material is always an issue. Even though planting material is available they are not that superior in quality as that of the elite one. Hence the production is quite low.

ii. Small size of spice growing farms -

India is a nation with several small land holdings. This is the main reason why the production is scattered and hard to be computed and estimated in a single platform.

iii. Lack of technical skills -

In India, it is very tough to ensure that the spice growers in every corner are trained with the latest skills needed for optimum cultivation, management and processing of spice. In India, farming as a profession is accepted by the least educated section. Hence, the best technologies are hard to be transmitted at grass root level.

iv. Residual toxicity of chemicals-

Usually the developed qualities which are the potential market of spice and value-added products of spice are very much aware and concerned about residual toxicity in the food product they import. Quality of spice crops are ensured by proper PGR applications. Pest management seldom needs spraying of chemicals. These agro-chemicals have residual effects. Due to lack of proper organic practice and absence of Organic certification, export is limited to organic spices only.

v. Lack of value addition and quality upgradation –

Developed countries do import spices at a decent rate and extract the oil and oleoresins to obtain a huge margin of profit. Spices produced in India are rarely value added in India due to lack of proper platforms and little MNC/s intervention. They are imported and value added in different country. As soon as bigger companies and MNC's start investing on spice value added products, spice industry would show an upsurge.

vi. Adoption of improper post-harvest practices –

Some spice growers do not follow proper post-harvest practices for their spice crop. This includes right from the optimum stage of harvesting to proper handling, storage packaging, etc. Proper packaging is also necessary for ensuring optimum quality after harvest. Rough handling during interstitial stages can endure rottenness to tree spices. Improper drying of cinnamon and nutmeg could lead to loss of flavor and destruction of oil glands.

9. Impact of MIDH (Spices) for sustainable agriculture

The effective production technology must be coupled with valid dissemination technology. It helps to improve the impact of production technology. The initiate of Government of India through Mission for Integrated Development of Horticulture (MIDH) has created excellent impact as per as the spices production technology is concern.

Mission for Integrated Development of Horticulture (MIDH) is a Centrally Sponsored Scheme for the holistic growth of the horticulture sector and also covering spices. Under MIDH, Government of India (GOI) contributes 60%, of total outlay for developmental programmes in all the states except states in North East and Himalayas, 40% share is contributed by State Governments. In the case of North Eastern States and Himalayan States, GOI contributes 90%. MIDH also provides technical advice and administrative support to State Governments/ State Horticulture Missions (SHMs) for the Saffron Mission and other horticulture related activities Rashtriya Krishi Vikas Yojana (RKVY)/NMSA.

Main objectives of the Mission for Integrated Development of Horticulture (MIDH) are: a) Promote holistic growth of horticulture sector, including bamboo and coconut through area based regionally differentiated strategies, which includes research, technology promotion, extension, post harvest management, processing and marketing, in consonance with comparative advantage of each State/region and its diverse agro-climatic features; b) Encourage aggregation of farmers into farmer groups like FIGs/FPOs and FPCs to bring economy of scale and scope. c) Enhance horticulture production, augment farmers, income and strengthen nutritional security; d) Improve productivity by way of quality germplasm, planting material and water use efficiency through Micro Irrigation. e) Support skill development and create employment generation opportunities for rural youth in horticulture and post harvest management, especially in the cold chain sector. (Operational guidelines, Horticulture Division Department of Agriculture & Cooperation Ministry of Agriculture Krishi Bhavan, New Delhi. www.midh.gov.in, April, 2014).

MIDH (Spices) at Dr. BSKKV, Dapoli

In 2014, the MIDH (Spices) scheme under Directorate of Arecanut and Spices Development, Calicut was established at Department of Horticulture under the aegis of Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli. The objective of scheme was to produce genuine and quality planting material of tree spices recommended by university, establishment of nursery centre, transfer of technology through farmer training programme, seminars and front line demonstrations in entire Konkan region. There are 7 accredited and 15 implementing centers under the jurisdiction of Dr. BSKKV, Dapoli which are participating to fulfill these objectives,.

Accordingly the following tree spices planting material was distributed among the farmers.

Table 13. Tree spices planting material distributed by MIDH (Spices), DBSKKV, Dapoli

Sr. No.	Name of tree spices	Planting material	Estimated area covered (ha)
1	Nutmeg grafts	36,000	202
2	Cinnamon layers	57,000	8
3	Kokum grafts	96,000	345
	Total	1,89,000	555

About 2515 farmers have been trained for various technologies on package of practices like propagation techniques, nutrient management, integrated pest and disease management, harvesting techniques and value addition on tree spices through above centers of Dr. BSKKV, Dapoli in entire Konkan region. Also, new initiatives like participatory demonstration of cinnamon on farmers' field has initiated through this scheme to develop cinnamon tree spice village. Therefore, this scheme has help the farmers for area expansion of tree spices like nutmeg, cinnamon and kokum in entire Konkan region about 1.62 lakh ha with 40 lakh MT (fnbnews.com, 2023) and many entrepreneurs, nursery growers and processors on small scale has established.

The area under tree spices in Kokan region is expanded due to distribution of quality planting material, transfer of technology, farmers training. The mixed cropping of tree spices resulted in double the farmers income which resulted in sustainability of the coconut and arecanut growers. The tree spices also gaining the popularity through agro tourism. Similarly; the tourist from the city area are demanding more and more spices grown in Konkan region. New varieties, advanced propagation and production technologies, expansion in area, mixed intercrops of tree spices, MIDH initiatives, agro-tourism aspects are fruitful in to rural employment which diverted the flow of youth towards sustainable agriculture. The new variety, propagation techniques, mixed cropping, lakhibaug model, post harvest handling, value added products and MIDH is privilege for tree spices.

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