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Directorate of Arecanut and Spices Development
Department of Agriculture, Co-operation & Farmers Welfare
Ministry of Agriculture & Farmers Welfare, Government of India
Calicut - 673005, Kerala, India



Use Quality Planting Materials from Accredited Cashew/Cocoa nurseries

Quality standards-Cashew Grafts



Characters	Standards
Age of the graft	6 months
Number of leaves	5-7 functional leaves
Height of the graft	30-45 cm
Height of the graft Joint	15 -20 cm from collar region.
Growth	Healthy and vertical growing
Graft joint	Perfect without any girdling or constriction.
Nature of Polythene bag	Intact and not torn
Side sprout	Free from side sprout from the root stock

Quality standards - Cocoa hybrid seedlings

Characters	Standards
Age of the seedling	5-6 months
Number of leaves	5-6 pairs
Height of the graft	45-50 cm
Growth	Vigorous seedlings growing straight at the middle of the poly-bag.
Jorquetting	No jorquetting



Directorate of Cashewnut and Cocoa Development (DCCD) Kochi is the national agency approved by Government of India for accreditation of cashew/cocoa nurseries.

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ARTICLES INVITED FOR INDIAN JOURNAL OF ARECANUT, SPICES AND MEDICINAL PLANTS

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TRADITIONAL CHEWING OF ARECANUT/BETEL QUID AND HUMAN HEALTH - A SURVEY REPORT

C.T. Jose¹, S. Keshava Bhat², K.P. Chandran³, S. Jayasekhar³ and Ananda Gowda¹

Abstract

Arecanut is the fruit or seed (endosperm) of an oriental palm called *Areca catechu* L. Though this palm is cultivated in several tropical and subtropical countries such as India, Indonesia, China, Myanmar, Bangladesh, Sri Lanka, Thailand, Bhutan, Malaysia, etc., India is the largest cultivator of this crop. This nut is the most common masticatory in the world especially in South and South East Asian Countries. The history of arecanut chewing is not of recent origin but goes back to thousands of years. Traditionally, arecanut is chewed along with the leaf of *Piper betle* and lime (calcium hydroxide). This mixture is commonly called as pan or betel quid. Later on, several other ingredients including tobacco are added and made into different forms of chewing mixtures and marketed in different trade names where neither the quality of the ingredients is known nor their names are properly disclosed. In the present study, a survey was conducted in certain arecanut growing districts of Karnataka and Kerala targeting only the traditional arecanut or betel quid chewers to find out the health effects of such chewing. Of the 917 people surveyed, 232 people were non chewers, 292 were chewers of betel quid without tobacco and 393 were chewers of betel quid with tobacco. Not much

health variations were noticed except for tooth problems which were much less in betel quid (both without and with tobacco) chewers when compared to non chewers.

Introduction

Arecanut, an important commercial agricultural produce of India, is the seed or endosperm of a slender and tall oriental palm, *Areca catechu* L. of Palmaceae family (Ananda, 2004). This palm is also cultivated in several other South Asian and South East Asian Countries such as Indonesia, Myanmar, China, Bangladesh, Thailand, Malaysia, Vietnam, Philippines, etc. (Cheriyann and Manojkumar, 2014). In some regions of the world arecanut is also called as 'betel nut' as this nut is commonly chewed along with the leaf of *Piper betle* L., a tropical, evergreen, perennial vine of Piperaceae family. Arecanut chewing is an indigenous habit notably in Central, South, and South East Asia, and some South Pacific Islands. World Health Organization estimated that around 600 million people chew betel nut around the globe in some form or the other. It is an essential cultural and social tradition in several countries. It is perceived to have medicinal values; including oral hygiene, appetite as well as saliva production. It is a common practice to offer arecanut along with

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betel leaf to guests in important social gatherings, weddings and other religious events. This habit is widely accepted among all strata of society, including women and children.

There are differences of opinion on the risk/benefits associated with arecanut chewing. India has the largest arecanut consuming population in the world. Arecanut chewing has wide-ranging social and cultural influences. Traditionally, betel chewing consists of arecanut wrapped with the leaf of *P. betle* smeared with slaked lime (calcium hydroxide). This mixture is called as betel quid. Although major contents of this quid are almost same in all preparations, the ingredients may vary according to the local customs and individual preferences. Tobacco is often added to the betel quid and sometimes other ingredients like cardamom, clove, menthol, aniseed, grated coconut, coriander, saffron, extracts of rose and jasmine are also added (IARC, 2004).

Since time immemorial, arecanut along with other products is being used for chewing throughout the world especially in Indian sub-continent and several parts of South East Asia as it is believed to be stimulatory and to have lots of medicinal properties (Aman, 1969). In India the use of arecanut has been quoted as early as 1300 BC by Sisumayana in 'Anjana Chaitra' (Bhat and Rao, 1962) and the practice of its chewing to 650 BC as mentioned by Magha in 'Shishupala Vadha' (Rao, 1982). In other countries such as Vietnam, the antiquity of arecanut goes back to Bronze Age (Oxenham *et al.*, 2002).

Arecanut has an important place in the ancient system of medicines in several countries such as India (Kirtikar *et al.*, 1918), China (Peng *et al.*, 2015), Bangladesh (Rahmathullah *et al.*, 2009), Philippines (Tavera, 1901), etc. The World Health Organization (2009) has included areca palm as one of the medicinal plants of Philippines. Most of the folklore medicinal properties of arecanut are now validated with proper scientific data (Rashid *et al.*, 2015). It has antioxidant, anti-inflammatory and analgesic (Bhandare *et al.*, 2010), anti-diabetic (Anthikat *et al.*, 2014), hypolipidemic (Park *et al.*, 2002), antibacterial (Hazarika and Sood, 2015), anti-fungal (Anthikat *et al.*, 2014) anti-malarial (Jiang *et al.*, 2009), anti-viral (Anthikat and Michael, 2009), anti-HIV (Kusumoto *et al.*, 1995), treatment for AIDS (Vermani and Garg, 2002), anti-aging (Lee and Choi, 1999) treatment for Alzheimer's (Joshi *et al.*, 2012) and Schizophrenic patients (Sullivan *et al.*, 2000) wound healing (Azeez *et al.*, 2007), anti-ulcer (Anthikat and Michael 2011; Senthil and Hazeena, 2008), anti-migraine (Bhandare *et al.*, 2011), antihypertensive (Inokuchi *et al.*, 1986) antidepressant (Khan *et al.*, 2014), anti-allergic (Lee *et al.*, 2004), anthelmintic (Valenciano and Cotiwan, 1980), aphrodisiac (Anthikat *et al.*, 2012), anti-venom (Gupta and Gupta, 2013) hepatoprotective (Pithayanukul *et al.*, 2009), cytoprotective (Sazwi *et al.*, 2013), antitumorogenic (Kumari *et al.*, 1974) properties, etc. In China, as many as 30 medicines are being prepared using arecanut as one of the ingredients (Peng *et al.*, 2015).

Though arecanut has got all these beneficial properties, several researchers projected arecanut chewing as dangerous and even cause

cancer (IARC, 2004). Almost all studies were mostly based on the survey data considering several chewing products where arecanut is one of the components, but blamed only arecanut for all the ill effects. The adverse effects reported in association with arecanut chewing may be due to several other factors such as small sample size, the role of other ingredients used in the preparations of chewing products (especially in packed products such as pan masala, gutkha, khaine, etc.), the cumulative effects of all the ingredients, unusual methods of application, the quality (including contaminations and adulterations) of arecanut used etc. Most of the research publications which projected arecanut chewing as dangerous did not check for these factors (Keshava Bhat *et al.*, 2018).

In order to find out the effect of arecanut chewing on human health, perceptions about health benefits and risks, a house to house survey was conducted in certain major arecanut chewing areas of Kasaragod District in Kerala and Dakshina Kannada, Shivamogga and Uttara Kannada Districts in Karnataka, India during May-June, 2018 and the data are presented in this report. Only the traditional chewers who chewed betel quid without or with tobacco and the non-chewers were included in this observation.

Methods

A population survey was conducted, especially in villages, with the help of local people who were familiar with the area and families of that locality. The houses were selected at random and the family members were interviewed and data collected on the following aspects:

1. Number of persons in the family (above 15 years), their age and gender.
2. Number of people in the family chewing arecanut alone or betel quid (arecanut, betel leaf and calcium hydroxide) with or without tobacco.
3. Number of times chewing per day.
4. Whether they spit out the liquid or swallow
5. Since how many years they were chewing
6. The reasons for developing this chewing habit
7. Whether they had developed any major health problems after starting chewing
8. Whether they noticed any perceived benefits from chewing

Persons who chewed the packaged chewing products such as pan masala, gutkha, khaine, etc., where the actual contents and the quality of such products were not known were not included in the study. Those people who indulged in smoking tobacco and drinking alcohol were also excluded. Infrequent or occasional (not daily) chewers were recorded as non-chewers. The non-chewers were considered as control and the data were compared with those of chewers.

Results

Chewing data: Data were collected from 917 people from 412 families and classified into four age groups (15-39 years, 40-59 years, 60-79 years and 80 and more years) and three chewing types (Non Chewers, Betel Quid without tobacco (BQ) chewers and Betel Quid with tobacco (BQT) chewers). Among the 917 respondents, 232 (25%) were non chewers. People chewing

arecanut alone were very rare with only four (0.44%) persons indulged in that habit. Hence such people were included in the group of betel quid chewers without tobacco. Hence, there were 292 (32%) BQ chewers and 393 (43%) BQT chewers (Fig 1). All the chewing people used to chew for 10 to 30 minutes and spit out the remaining quid.

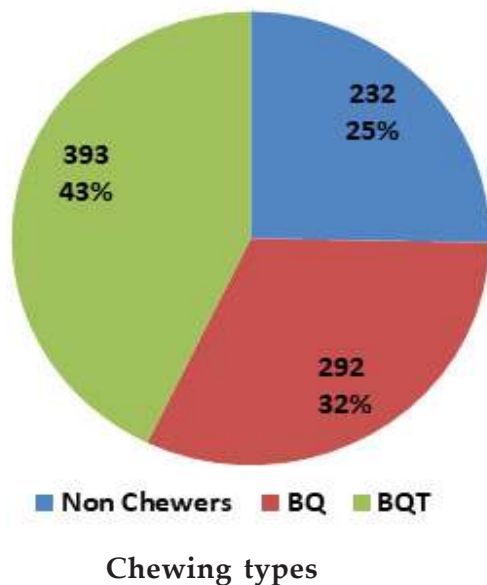


Fig. 1. Number/Percentage of people with different types of chewing (N=917)

Age criteria: Among the 917 respondents, 163 (18%) were in the age group of 15-39, 399 (43%) were in the age group of 40-59, 287 (31%) were in the age group of 60-79 and the remaining 68 (7%) were 80 or more years of

age (Fig 2). When we observe for different chewing types and the age of people it is seen that in non- chewers, the percentage of people in the age group of 60 and above category was only 31%, whereas it was 43% and 41% in BQ and BQT chewing people, respectively (Fig 3). Further, it is seen that super seniors (80 years and above) were also found more in BQ (10%) and BQT (9%) chewers when compared to that of non chewers (3%). Interesting observation was that in non-chewers the maximum age noticed was 85 years, whereas it was 103 years in BQ and 102 years in BQT chewers.

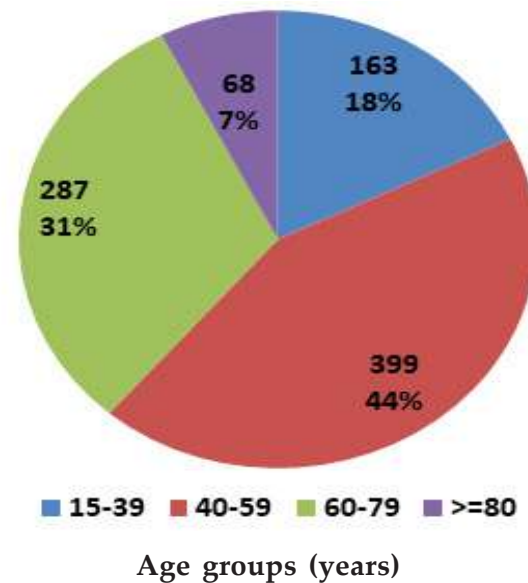


Fig 2. Total number/Percentage of people in different age groups (N=917)

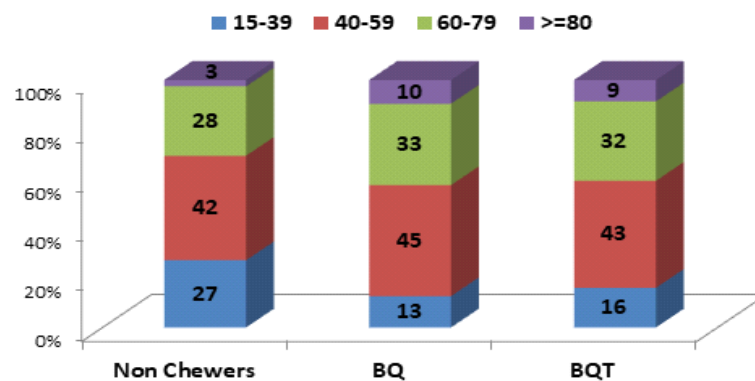


Fig 3. Percentage distribution of chewing types in different age groups

Frequency of chewing: Among the 232 respondents from the BQ chewers, 171 (58.56%) were chewing less than 5 times per day and only 4 (1.37%) were chewing 25 or more times in a day, whereas among the 392 respondents from the BQT chewers only 51 (12.98%) were chewing less than 5 times per day and 55 (14%) were chewing 25 or more times in a day. Nearly 84% of BQ chewers chewed less than 10 times / day, whereas in BQT chewers, as many as 55% of them chewed more than 10 times / day (Fig

4 & 5). This shows that BQ chewers are not as much addictive as that of BQT.

Period of chewing: Chewing for very long period of more than 50 years without any visible health problems was noticed in both BQ and BQT chewers. Twenty four (8%) people in BQ chewing group and 54 (14%) persons in BQT chewing group were having these habits for 50 years and even more (Fig 6 & 7). Only 15% of BQ and 10% BQT chewers chewed less than 10 years.

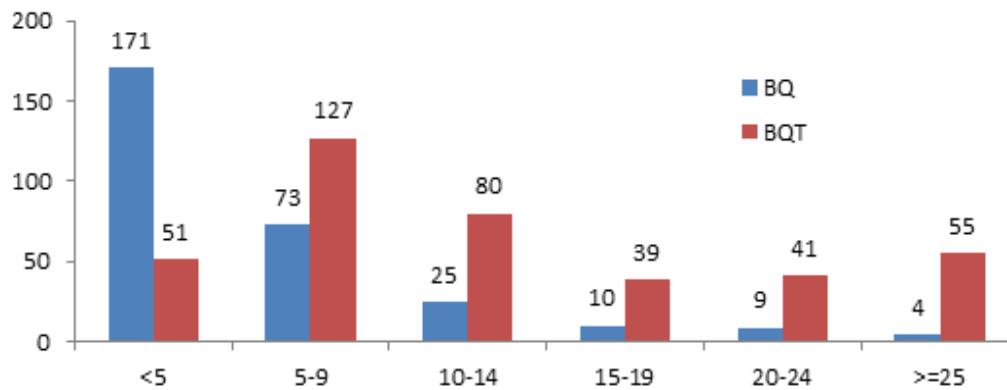


Fig4: Number of respondents (Y-axis) in different chewing frequency (X-axis)

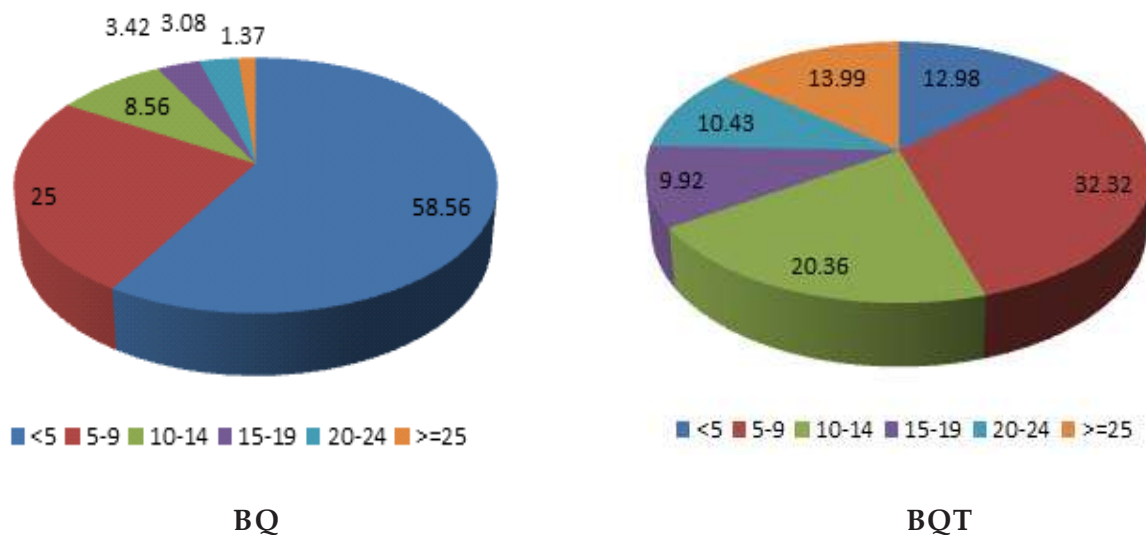


Fig.5: Percentage of respondents under different level of chewing frequency

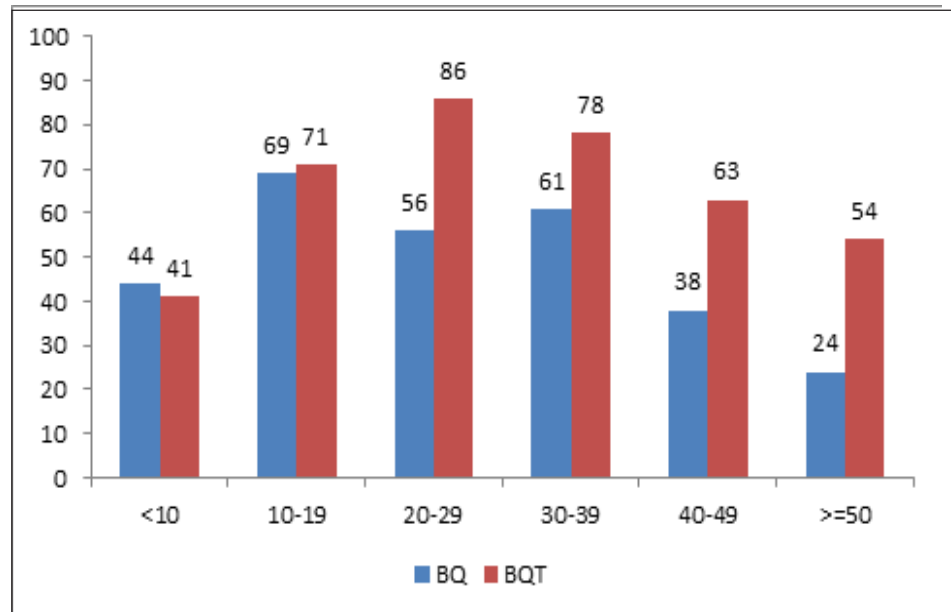


Fig 6: Period of chewing (X-axis) under two types of chewing BQ and BQT

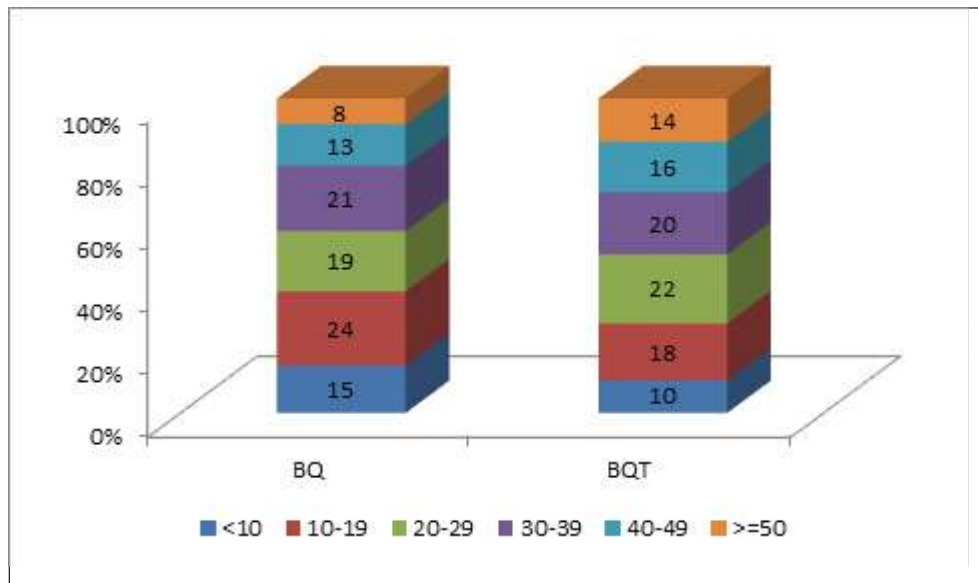


Fig 7: Percentage of respondents under different period of chewing

Perception of chewers on health issues: Of the total 685 chewing people surveyed, 256 gave their opinion on the health issues of chewing arecanut, BQ or BQT. None gave any adverse remark on such chewing habits on their health, but gave several beneficial effects on their health.

Most of the people said that BQ chewing helped in digestion and reduced tooth pain. BQT chewing helped in keeping them active, reduced tooth pain and helped in digestion (Table 1).

Table 1: Perception of chewers on health issues of chewing

Perception	Chewing habits			
	BQ (N=292)		BQT (N=393)	
	No.	%	No.	%
Reduces tooth problems	28	9.59	48	12.21
Helps in digestion	58	19.86	24	6.11
Helps to remain active	14	4.79	64	16.28
Good for general health	4	1.37	8	2.04
As mouth freshener	3	1.03	2	0.51
Good for diabetes	1	0.34	1	0.25
Reduces hunger	Nil	--	1	0.25

Health status of chewing and non-chewing people: Of the 232 people surveyed in non-chewing group 72 (31.03%) people reported certain health problems, whereas, in BQ chewing group, out of 292 people only 40 (13.70%) and in BQT chewing group out of 393 people 71 (18.07%) reported such problems

(Table 2). There is no significant difference between non-chewers and chewers with regard to various health issues except for tooth problem. It is interesting to note that the tooth problem was significantly more in non-chewers when compared to BQ and BQT chewers.

Table 2: Number of people with various health problems in non-chewers and chewers

Health Problems	Chewing habits					
	Non chewers (control) (N=232)		BQ only (N=292)		BQT (N=393)	
	No.	%	No.	%	No.	%
Cancer	2	0.86	Nil	--	1	0.25
BP	16	6.90	20	6.85	27	6.87
Diabetic	6	2.59	2	0.68	18	4.58
Tooth problem	42	18.10	6	2.05	15	3.82
Asthma/respiration	2	0.86	4	1.37	3	0.76
Heart problem	2	0.86	2	0.68	3	0.76
Any other	2	0.86	6	2.05	4	1.02
Total	72	31.03	40	13.70	71	18.07

Discussion

The present study clearly shows that chewing arecanut or betel quid without tobacco are beneficial and not harmful as far as their health effects on humans are concerned. Several other reports are also in conformity with this. In a study carried out by Shrihari *et al.* (2010) on a similar community in Dakshina Kannada District, it was reported that chewing arecanut or BQ had several beneficial effects. They did not notice any cancer or even pre-cancerous lesions in the oral cavity of such areca or BQ chewing people. In another study conducted on pan chewing people in Bangalore, India, Nandakumar *et al.* (1990) reported the relative risk of such habits for the occurrence of oral cancers as non-significant ($p=0.36$ for males and 0.17 for females). Chewing BQ without tobacco is also reported to be not harmful to pregnant women (Chue *et al.*, 2012). In a very large cohort study conducted by them on 7,685 BQ chewing women no adverse pregnancy effects were observed. They further reported that chewing BQ even reduced the bad effects of smoking on birth weight.

The contents of the betel quid are very important as far as its health effects are concerned. In countries such as Taiwan, Philippines, Papua New Guinea, etc., people mostly use the inflorescence of *P. betle* instead of its leaf (Wong *et al.*, 1992). The chemical constituents of each biological entity differ significantly. The inflorescence of *P. betle* contains good amount of safrol, a carcinogenic compound, whereas the leaf of that vine does not contain that chemical but contains hydroxichavicol, an anticancer drug (Wu *et al.*, 2004). This might be the reason why oral cancer

is more prevalent in such countries where the people use the inflorescence of *P. betle*. In India the betel quid chewers use only the leaf of *P. betle* and not its inflorescence. The results of the present study are in conformity with this. There was no incidence of cancer in arecanut or BQ chewers but there were two cancer patients in non-chewers. Five BQ chewing people and 13 BQT chewing persons crossed 90 years and two BQ chewing people and one BQT chewing person crossed even 100 years by chewing 10 - 30 times per day for nearly 70 years. In non chewing group none was there in the very old age of 90 years and above.

Several animal studies also reported that arecanut and BQ are not carcinogenic. In a study conducted on hamsters by exposing their cheek pouches to the ingredients of BQ for several weeks no cancer was noticed (Dunham and Herrold, 1962). In a study conducted on rats by feeding individual components of BQ (20% arecanut powder, 20% betel leaf powder, 20% arecanut powder mixed with 1% lime) separately for 480 days, none of the animals fed with such diet mixed food showed any carcinogenic symptoms (Mori *et al.*, 1979). In another study carried out on both normal as well as immune suppressed mice for two years using the extracts of arecanut (from 100g arecanut) and BQ without tobacco (50g of arecanut + 100g of betel leaf + 4g of lime) no tumour growth was noticed, but there was a reduction in the incidence of tumours (Kumari *et al.*, 1974). The inhibitory action of arecoline hydrobromide, the major active principle of arecanut, on the growth and proliferation of cancer cells is reported by Fan *et al.* (2016). The results of the present study are also in

conformity with these observations. There was no incidence of cancer either in arecanut or in BQ chewing people. However, there was one (0.23%) incidence of cancer in BQT chewing group whereas there were two (0.87%) cases of cancers in non chewing group as well. The anti cancer principles present in arecanut and betel leaf might have reduced the cancerous effects of tobacco in BQT, thereby reducing the incidence of cancer in such chewers.

Tooth problem was significantly less in BQ and BQT chewing people when compared to non-chewers of arecanut. This is in conformity with the observations of Shrihari *et al.* (2010) who have reported that nearly 19% of BQ chewers perceived that chewing arecanut reduced tooth ache and prevented tooth decay. The antibacterial properties of arecanut on several oral microorganisms are well documented in the literature (Chin *et al.*, 2013). Several scientific observations revealed that chewing arecanut protected teeth against dental caries (Howden, 1984; Nigam and Srivastava, 1990). The procyanidines found in arecanuts were reported to be the antibacterial principles against the primary cariogenic bacteria, *Streptococcus mutans* (Hada *et al.*, 1989). It was also reported that the anaerobic bacteria such as *Enterococcus faecalis*, which is responsible for endodontic infections in human teeth was susceptible for arecanut extract and the extract was found even better than that of Chlorhexidine, the chemical disinfectant presently used during root canal treatment (Arathi *et al.*, 2015).

Conclusion

The present study clearly indicates that the traditional chewing of arecanut (without any

additives) or betel quid with or without tobacco is not harmful to humans. There was no significant difference between non-chewers and chewers in health issues except for tooth problem where, it is observed that the tooth problem was significantly more in non-chewers compared to the traditional chewers with or without tobacco.

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Shri K.Krishnankutty, Hon'ble Minister for Water Resources of Kerala state visiting the stall.

ANTIOXIDANT POTENTIAL OF MEDICINAL HERBS

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Abstract

In the present study, 59 herbal extracts were comparatively evaluated using different *in vitro* assay techniques to identify novel and better sources of antioxidant activity for use in medicines and functional foods. The shade dried powders were extracted with 10% aqueous methanol and antioxidant capacity was estimated by DPPH, ABTS, FRAP, TAOC and TRC methods and total polyphenols by Folin-Ciocalteu method. Among these tested extracts, highest activity was observed in leaves of *Piper chaba* (Bangla thippali) and seeds of *Mucuna pruriens*. Seeds of *Embelia ribes* and *Vitis vinifera*, aerial parts of *Phyllanthus amarus*, roots of *Salacia reticulata* and leaves of *Mimosa pudica*, *Ensete superbum*, *Kaempferia rotunda*, *Indigofera tinctoria* and *Curculigo orchioides* showed high antioxidant activity.

Introduction

Natural antioxidants play an important role in balancing the pro-oxidant and the antioxidant homeostatic phenomenon in the body and delaying degenerative diseases. Pro-oxidant condition dominates in the body due to increased generation of free radicals or its poor scavenging. Reactive oxygen species, such as superoxide O_2^- , hydroxyl (OH^\cdot), and peroxy ($^{\cdot}OOH$, ROO^\cdot) radicals produced under oxidative stress is one of the major causes of diseases like atherosclerosis, ischemic heart

disease, ageing, diabetes mellitus, cancer, immunosuppression etc. (Young *et al.*, 2001). Reactive oxygen species, generated extracellular and intracellular, also promotes neurodegenerative disorders like Alzheimer's and Parkinson's diseases. Therefore, it is imperative to search for novel sources of antioxidant phyto-constituents which can annihilate free radicals, and retard associated degenerative diseases in biological systems (Cao *et al.*, 1996). The emerging sector of nutraceuticals is also stimulating the search for better sources of antioxidant phyto-constituents. Plants are generally rich in low molecular mass dietary antioxidant compounds that can keep oxidative stress under control. Although there are synthetic antioxidant compounds in use, some of them are reported to have significant side effects such as liver damage and carcinogenesis. Therefore, comparative evaluation of antioxidant capacity of selected herbs were undertaken.

Materials and Methods

The plant parts were shade dried, finely powdered and extracted with 10% aqueous methanol. The samples were analyzed for polyphenol content by Folin-Ciocalteu method and *in vitro* antioxidant capacity was estimated by DPPH (2,2-diphenyl-1-picrylhydrazyl), ABTS (2,2'-azinobis[3-ethylbenzo-thiazoline-6-sulfonate]), FRAP (Ferric Reducing Antioxidant

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Power), TAOC (Total Antioxidant Capacity) and TRC (Total Reducing Capacity) and expressed on dry weight basis. The total phenol content and antioxidant activity were recorded for mature seeds, rhizomes, roots and mature leaves.

Results and discussion

The results showed significant variation among plant extracts in antioxidant capacity and total phenol content. The antioxidant activity might be attributed to its polyphenolic content and other phytochemicals constituents. Phenolics, the most wide spread secondary metabolites in plants; act as radical scavengers and metal chelators. Their antioxidant activity is mainly due to their hydroxyl groups. Therefore, in the present study, total phenolic content present in extracts was also estimated and expressed as Gallic acid equivalents percentage of dried extract. The phenol content of herbal extracts ranged from 0.37 GAE % in *Aconitum ferox* leaves to 12.82 GAE % in *Ensete superbum* leaves.

Lower DPPH and ABTS values and higher FRAP values denote higher antioxidant activity. Further comparative evaluation on antioxidant capacity of tested herbal extracts is made based on the EC_{50} values of DPPH assay with Ascorbic acid ($EC_{50} = 1.89$ ppm) and Trolox ($EC_{50} = 6.95$ ppm) as reference.

The DPPH EC_{50} values of test extracts ranged from 10.65 in *Piper chaba* leaves to 4466 ppm in *Allium sativum* cloves. Plants with EC_{50} values up to 30 ppm were rated to possess very high, 31 to 80 ppm high, 81 ppm to 150 ppm medium and above 150 ppm, low antioxidant capacity (Table1).

Though *Piper chaba* leaves exhibited highest antioxidant activity in *in vitro* DPPH assay, it recorded low phenol content (1.33 % Gallic acid equivalents). Its berries showed significantly low antioxidant activity with mean EC_{50} value of 404.07 μ g/ml but had phenol content of 2.27 % Gallic acid equivalents. *Piper chaba* is used as a substitute for *Piper longum* in Ayurveda. Leaves and berries of *Piper longum* had considerably low activity (598.78 ppm and 1071.99 ppm) compared to the respective parts of *Piper chaba* but had higher phenol content (3.05 & 4.58 % GAE). The fruits, stem, stem bark and also root of *P. chaba* are reported to have medicinal properties and use. The present study indicated that its leaves have higher potential to serve as a source of antioxidant activity.

Seeds of *Mucuna pruriens* (Fabaceae) also showed high antioxidant activity (EC_{50} 25.01ppm) and high phenol content also (9.45 % GAE). The drug is used in Ayurveda from ancient times for the management of male infertility, nervous disorders such as Parkinson's disease and has neuroprotective and aphrodisiac effects (Lampariello *et al.*, 2012). It also possess anti-diabetic property (Suresh and Prakash, 2011).

Phyllanthus amarus aerial parts (EC_{50} 33.53 ppm) *Salacia reticulata* root (35.12 ppm), *Mimosa pudica* leaves (39.44ppm), *Ensete superba* leaves (39.49 ppm), *Embelia ribes* seeds (55.6 ppm), *Kaempferia rotunda* leaves (64.96 ppm), grape seed (67.1 ppm), *Indigofera tinctoria* leaves (69.25 ppm) and *Curculigo orchiodes* leaves (73.93 ppm) also showed fairly high antioxidant activity. Among these highly antioxidant extracts, *Phyllanthus amarus* aerial parts (9.20% GAE) *Salacia reticulata* root (7.87

Table 1- Polyphenol content and in vitro antioxidant capacity of selected medicinal plants.

No.	Name of plant	Plant part	Total Poly-Phenols*	Antioxidant capacity				
				DPPH* EC ₅₀	ABTS*	FRAP*	TAOC*	TRC*
1.	<i>Acanthus ilicifolius</i> (Vayal chulli)	Seeds	2.55	176.87	23.57	160.9	1.69	2.10
2.	<i>Aconitum ferox</i>	Leaves	0.37	591.87	24.07	13.88	0.55	0.20
3.	<i>Adenanthera pavonina</i> (Manchadi)	Leaves	1.73	712.6	40.14	65.51	2.50	1.21
4.	<i>Adhatoda beddomei</i> (Adalodakam)	Leaves	2.20	591.87	24.07	56.33	1.20	0.62
5.	<i>Aerva lanata</i> (Cheroola)	Plant tops	1.74	856.71	50.17	50.69	1.37	0.69
6.	<i>Allium sativum</i> (Garlic)	Cloves	0.60	4466.08	159.63	5.69	0.68	0.29
7.	<i>Andrographis paniculata</i> (Kalmegh)	Leaves	2.21	248.76	33.18	112.63	1.40	1.33
8.	<i>Asparagus racemosus</i> (Satavari)	Rhizome	0.72	614.83	75.68	50.64	0.58	0.70
		Leaves	2.92	81.37	13.8	10.53	1.51	0.45
9.	<i>Bacopa monnieri</i> (Brahmi)	Tops	6.06	81.37	13.80	482.80	3.87	4.00
10.	<i>Boerhaavia diffusa</i> (Punarnava)	Root	1.17	401.29	21.33	47.38	0.49	0.90
11.	<i>Calotropis gigantea</i> (Erukku)	Leaves	1.94	712.21	23.25	84.51	2.16	0.84
12.	<i>Catharanthus roseus</i> (Periwinkle)	Plant tops	4.41	200.81	31.71	153.83	1.53	1.97

13.	<i>Celastrus paniculatus</i> (Jyothishmathi)	Seeds	2.27	229.28	22.42	96.24	1.85	1.62
14.	<i>Centella asiatica</i> (Gotu Kola)	Leaves	2.35	182.34	53.05	165.99	0.53	1.57
15.	<i>Eleutherine bulbosa</i> (Chenthallir)	Bulb	1.67	758.06	119.65	68.8	0.59	1.28
16.	<i>Clitoria ternatea</i> (White Sankupushpam)	Whole plant	2.43	833.11	19.11	92.61	0.31	0.71
17.	<i>Coccinia grandis</i> (Kovakka)	Fruit	1.48	1968.24	59.77	19.65	0.86	1.29
18.	<i>Costus igneus</i> (Insulin plant)	Plant tops	2.43	1390.02	15.48	76.41	1.70	
19.	<i>Curculigo orchitoides</i> (Nilappana)	Rhizome Leaves	2.41 3.37	205.27 73.93	28.37 12.69	185.99 48.41	0.37 0.51	1.64 0.53
20.	<i>Curcuma longa</i> (Turmeric)	Rhizome	5.30	123.05	13.93	178.32	0.93	1.94
21.	<i>Cyperus rotundus</i> (nut sedge)	Rhizome	3.28	140.8	30.1	149.62	0.65	1.66
22.	<i>Elettaria cardamomum</i> (Cardamom)	Fruit	0.49	948.45	197.91	22.34	0.53	0.53
23.	<i>Embelia ribes</i> (vizhaal)	Seeds	3.96	55.6	22	175.26	0.87	1.55
24.	<i>Ensete superbum</i> (Kalluvaazha)	Leaves Seeds	12.82 3.35	39.49 146.19	5.89 10.76	485.52 121.82	3.85 1.21	3.45 1.78
25.	<i>Gynemema sylvestre</i> (Chakkara kolli)	Leaves	3.69	498.11	20.72	130.6	1.75	1.80
26.	<i>Hemidesmus indicus</i> (Sarsaparilla)	Root	4.05	106.93	20.82	184.99	0.50	2.01

27. <i>Hibiscus rosa-sinensis</i>	Leaves	1.53	1534.71	135.6	35.5	1.79	0.55
28. <i>Holostema adakodien</i> (Adapathayan)	Rhizome	0.62	1705.92	107.29	29.01	0.19	0.49
	Leaves	2.29	180.32	19.08	18.05	0.69	0.29
29. <i>Indogofera tinctoria</i> (Nili)	Leaves	6.92	69.25	11.56	346.05	4.02	3.17
	Tuber	4.03	769.56	38.94	126.91	1.84	1.22
31. <i>Kaempferia rotunda</i> (Chengazhineer kizhangu)	Rhizome	1.10	1092.12	52.84	49.92	0.67	0.95
	Leaves	0.49	64.96	16.99	8.75	0.41	0.16
	Leaves	7.22	39.44	4.45	533.98	5.25	3.28
32. <i>Mimosa pudica</i> (Touch-me-not)	Fruit	1.44	1079.49	366.06	29.55	2.38	0.90
34. <i>Mucuna pruriens</i> (Kapikachu)	Seeds	9.45	25.01	4.12	855.41	3.62	3.41
	Leaves (fresh)	2.90	313.63	18.9	96.58	1.31	0.95
35. <i>Musa paradisiaca</i> (banana) nendran	Leaves (dry)	1.12	1176.45	69.13	21.97	0.82	0.26
	Plant tops	2.38	233.56	40.52	128.28	1.44	1.65
36. <i>Ocimum sanctum</i> (Tulsi)	Aerial parts	9.20	33.53	5.94	374	2.87	2.70
38. <i>Piper betle</i> (Taambuul, vettila)	Leaves	1.20	579.24	53.07	66.29	1.26	1.10
	Leaves	1.33	10.65	5.09	41.63	1.61	0.88
39. <i>Piper chaba</i> (bangla Pippal)	Berries	2.27	404.07	27.14	90.15	1.73	1.27

40.	<i>Piper longum</i> (Thippali)	Leaves Fruit	3.05 4.58	598.78 1071.99	16.16 110.24	50.84 24.78	2.34 1.13	1.00 0.70
41.	<i>Pogostemon</i> patchouli (Patcholi)	Leaves	2.64	225.92	28.55	137.47	1.17	1.81
42.	<i>Rubia cordifolia</i> (Manjishtha)	Stem Leaves	2.21 1.23	247.27 669.51	41.48 47.62	85.54 60.25	0.38 1.04	0.99 0.67
43.	<i>Ruta graveolens</i> (Arutha)	Leaves	3.34	387.13	14.99	117.9	2.62	1.72
44.	<i>Salacia reticulata</i> (Ponkoranti)	Root	7.87	35.12	6.52	424.33	1.29	2.99
45.	<i>Sida rhombifolia</i> (Kurunthotty)	Root	1.14	738.24	38.93	66.72	1.50	0.92
46.	<i>Sida rhombifolia</i> (Kurunthotty)	Root	0.58	1558.25	158.51	34.87	0.14	0.28
47.	<i>Solanum melongena</i> var. <i>indicum</i> (Putharichunda)	Root	1.22	1360.75	43.08	30.9	0.65	0.58
48.	<i>Solanum melongena</i> (Brinjal)	Root	1.02	1531	41.13	29.12	0.56	0.60
49.	<i>Solanum melongena</i> var. <i>insanum</i> (Cheruvazhuthina)	Root	0.78	1329.18	42.1	28.44	0.54	0.45
50.	<i>Solanum torvum</i> (Kaattuchunda)	Root	0.70	1360.75	44.17	30.3	0.85	0.56
51.	<i>Solanum xanthocarpum</i> (Kantakarichunda)	Roots	1.28	995.84	57.79	54.07	0.68	1.01
52.	<i>Tinospora cordifolia</i> (Chittamruth)	Stem	1.74	769.56	38.94	103.16	1.84	0.96

53.	<i>Tinospora cordifolia</i> (Chittamruth)	Stem	0.72	1186.37	109.32	42.08	0.33	0.50
54.	<i>Tribulus terrestris</i> (Njeringil)	Fruit	0.83	1686.79	101.68	47.69	0.22	0.45
55.	<i>Trigonella foenumgraecum</i> (Fenugreek)	Fruit	1.22	826.54	32.34	29.52	1.55	0.57
56.	<i>Vitex negundo</i> (Nirgundi)	Leaves	5.55	108.49	22.36	248.78	4.86	2.71
57.	<i>Vitis vinifera</i> (Grapes- red)	Fruit peel	3.74	236.88	17.29	191.42	1.45	2.26
		Seeds	8.65	67.1	5.72	423.35	1.94	3.37
58.	<i>Withania somnifera</i> (Amukkuram)	Root	0.56	1207.24	132.3	29.27	0.23	0.77
59.	<i>Zingiber officinale</i> (Ginger)	Rhizome, dry	1.97	400.18	34.69	145.3	1.01	1.48

*Total polyphenols (Gallic acid equivalents, %), *DPPH method - EC₅₀ ppm, *ABTS method (Trolox Equivalent, ppm), *FRAP (Ascorbic acid equivalents, %), *TAOC (Ascorbic acid equivalents, ppm), *TRC (Ascorbic acid equivalents, ppm)

% GAE), *Mimosa pudica* leaves (7.22% GAE), *Ensete superba* leaves (12.82 % GAE), grape seed (8.65 % GAE) and *Indigofera tinctoria* leaves (6.92% GAE) showed high phenol contents but extracts from *Embelia ribes* seeds (3.96) and *Kaempferia rotunda* leaves (0.49) and *Curculigo orchoides* leaves (3.37) had fairly low phenol content.

The rhizomes of *Kaempferia rotunda* and seeds of *Ensete superba* showed much lower activity compared to their leaves indicating that their leaves could serve as better source of natural antioxidants.

Rhizomes of *Kaempferia rotunda* rich in essential oil and some important epoxides is the officinal part used in ayurvedic and allopathic systems of medicine. In traditional medicine, its leaves are also used for healing wounds which indicates its antioxidant and anti-inflammatory property. In the present comparative evaluation, leaves of *K. rotunda* showed higher antioxidant activity compared to rhizomes.

Grapes seeds were richer in antioxidants (EC₅₀ 67.1 ppm) and phenol content (8.65% GAE) compared to fruit peel (EC₅₀ 236.88 ppm and 3.74% Gallic acid equivalents). Its antioxidant contents are primarily responsible for its health benefits. The extract of *Vitis vinifera* seeds has been in use as adjuvant therapy in wide range of pathological conditions (Sevastre *et al.* , 2014.)

Curculigo orchoides leaves showed high free radical scavenging activity. Its rhizomes are traditionally used for their adaptogenic, aphrodisiac, antiasthmatic, estrogenic and anti-osteoporotic activity. Recent reports showed some additional beneficial effects including

antihepatotoxic, immunomodulatory, immunoadjuvant and antilithiatic effects (Shashi Alok *et al.*,2013). Present study affirmed higher antioxidant activity to otherwise its discarded plant parts.

Indigofera tinctoria is considered as a plant of great economic value from ancient times because of its use in textile industry and medicinal activity. It is being used for the treatment of epilepsy, nervous and brain disorders in traditional Indian and Chinese systems of medicine.

The aerial parts of *Bacopa monnieri*, commonly known as Brahmi also showed moderate antioxidant activity. This creeping herb is used in many memory enhancing drug formulations and also as nerve tonic and antiepileptic agent. The neuroprotective effects of Brahmi could be attributed to its power to suppress neuronal oxidative stress. Therefore, treating patients with Brahmi extract may be an alternative option for ameliorating neurodegenerative disorders as well as Alzheimer's disease (Limpeanchob *et al.*, 2008).

Hemidesmus indicus root have shown medium antioxidant activity in the comparative evaluation. *Hemidesmus indicus* is important as a rasayana plant in Ayurveda. It is one of the key ingredients in refreshing, pressure lowering syrup of south India. Among various protective activities of herbal infusions, the antioxidant and antimicrobial activity of *H. indicus* was well documented (Das and Bisht ., 2013). It is used traditionally to treat a wide variety of illnesses including rheumatism, leprosy, impotence, urinary tract and skin infections. *Vitex negundo* leaves also showed medium antioxidant activity.

It is reported to have analgesic, anti-inflammatory, anticonvulsant, antioxidant, bronchial relaxant and hepatoprotective activities.

Conclusion

The present study has led to identification of superior sources among the extracts studied. A few novel sources of antioxidant activity also have been identified. Among 59 herbal extracts, 11 extracts showed high antioxidant activity with DPPH EC₅₀ below 80 ppm. In some herbs, plant part other than officinal medicinal part in Ayurveda or traditional medicine system have shown higher antioxidant activity and they are not yet recognized for their significant antioxidant attribute. These superior sources identified through comparative evaluation could be further explored for isolation of antioxidant phyto-constituents and development as therapeutic agents for use against complications arising out of oxidative stress.

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PROSPERITY THROUGH SATAVARI (*Asparagus racemosus*) CULTIVATION IN STONY SOILS: A CASE STUDY OF GUJARAT

Parmeshwar L. Saran and Ram P. Meena*

Satavari is an important perennial medicinal herb and a profitable venture for growing in stony or culturable wasteland. Integration of this crop into existing farming systems could be considered as high returns per rupee investment, potential crop as compared to cumin, gram, cotton and groundnut. Front line demonstration of elite DAR-26 on farmers field was successfully conducted and agro-economics worked out. On an average, a grower can get an approximately, Rs. 4,86,940/ha/year net return with 3.66 B:C ratio over net return from this crop. Satavari growers not only fetching remunerative income, additionally generating employment throughout the year, especially for family members through primary processing (root peeling & drying). This was also observed that cultivation is a profitable venture due to perennial nature of crop and not preferred as a feed by wild animals. To attract the other farmers having culturable wasteland, trainings and field days were conducted.

Introduction

In the changing food habits in the metropolitan cities, herbal medicines are in great demand. These plants products play crucial role in primary health care because they are inexpensive, better cultural acceptability, compatibility with the human body and minimal side effects. The cultivation of many Medicinal and Aromatic Plants (MAPs) has been

established, for performing well in degraded lands. Cultivation of medicinal plants carrying minimal risk in terms of the damage by wild animals, incidence of pest and diseases and have better potential to grow in stony fields of foot hills (Saran et al., 2019). The Directorate of Medicinal and Aromatic Plants Research, Anand had been continuously tried to explore new research areas for improving livelihood supports to growers. Gujarat state is known for some traditional crops such as cotton, groundnut, tobacco, banana, potato, etc. Under such circumstances, they were in the need of suitable crops for livelihood of marginal farmers (Saran and Manivel, 2018). Being a pioneer research organization of medicinal crops, ICAR-DMAPR, Boriavi suggested satavari in the problematic stony soils. For better acceptability, front line demonstration (FLD) were conducted with the financial support of CSS, DASD, Calicut and fruitful results were accomplished. Satavari was selected decisively due to rich in saponins, high in demand (better returns), almost free from pest and diseases. It is a story of Mr. Vipulbhai R. Hariyani and Shri Kantibhai have been emerged as a satavari growers of village Bhadravadi, Botad, Bhavnagar, Gujarat (Figure 1). During 2016-17, they started cultivation with 2.5 ha area (Saran et al., 2019). Earlier they were growing cotton, groundnut, cumin, gram and earning approximately Rs. 1.6 Lakhs /ha/year . With the intervention of

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Fig. 1: FLDs of satavari cultivation at progressive farmers' fields

DMAPR trainings, they decide to replace these crops by satavari. The supply elite QPM of DAR-26 suitable for shallow, steep and stony soil instead of traditional crops under high density plantation with plant to plant and row to row spacing (45 × 60 cm) under micro irrigation system with the financial support of NMPB, New Delhi. Generally, it is transplanted at 60 × 90 cm plant to plant and row to row spacing as a perennial crop. The ridge method of transplanting was found to be superior in comparison to flat method in terms of root harvesting based on the previous observation. Satavari, generally propagated by seeds and rhizomatous discs. Commercially, it was multiplied through seeds but due to having the cross-pollination tendency, seeds are not always true to type. To retrieve the true to type plants, vegetative propagules were used. Seeds were

sown in nursery during rainy season on raised beds 5-10 cm apart. About 5.0-6.0 kg of healthy seeds required to raise the seedlings for one-hectare land. Seeds were soaked in cow urine mixed with fresh water for 48 hours performed better for survival, plant height and number of branches as compared to control (Figure 2). Seedling emergence takes place after four weeks and ready for transplanting after 13-14 weeks (Figure 3). Satavari is a perennial root crop and hence requires different forms of intercultural operations. For initial 60 days crop grows slowly, which keeps inter-row space virtually vacant, allowing easy weed growth. It is necessary to carry out weeding and shallow hoeing operations to keep the field weeds free. To overcome weeding cost, this farmer developed hand driven, mechanical driven (cycle and motorcycle based) weed remover, because

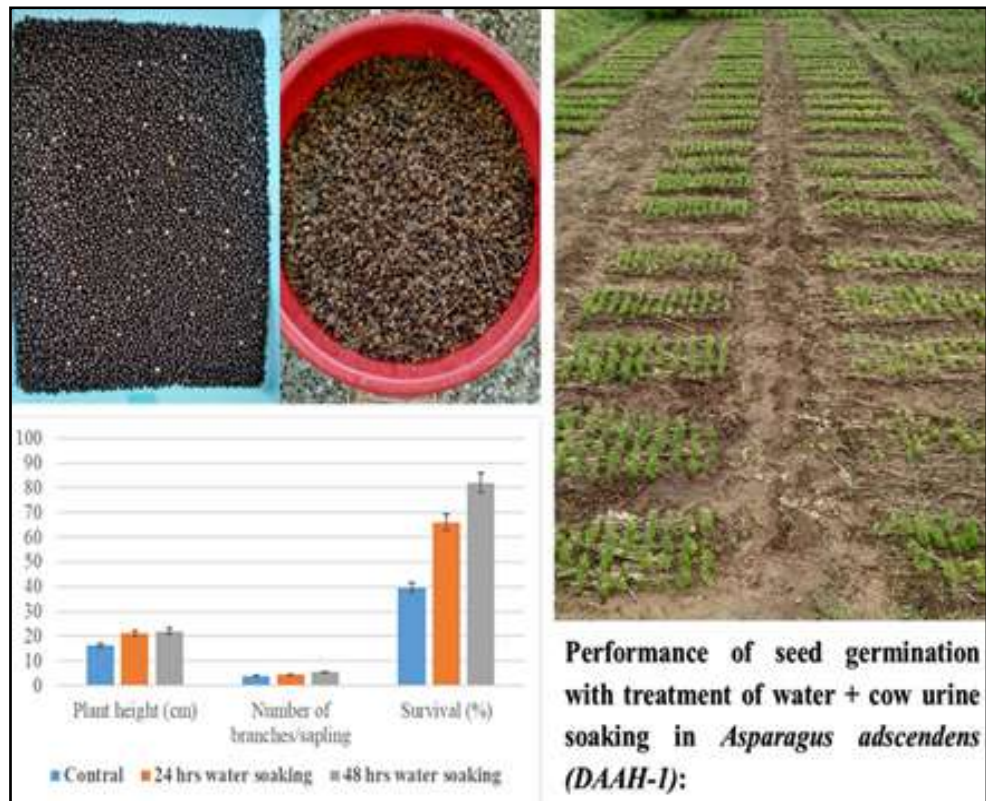


Fig. 2: Performance of seed germination under different seed soaking



Fig. 3: Activities from QPM preparation to root harvesting at farmers' fields



Fig. 4: Different weed remover developed by progressive farmer and drip irrigation system installed in stony fields

manual hand weeding involved heavy cost and unavailability of labourers (Figure 4). Farmers applied well decomposed FYM approximately 8-10 t ha⁻¹ during field preparation and did not use any chemical based fertilizers and pesticides in fields. Satavari is a perennial root herb in nature and time span of root harvesting after plantation plays major role in quantity and quality of the produce, therefore, roots were harvested after 24 months of transplanting at colour turning stage of above ground parts from green to pale yellow. Most of the farmers harvested about 70-80 kg seeds from one hectare, only in biennial crop harvesting. The crop roots were harvested after 24 months of transplanting with deep plough. The fresh roots yield was 41 t ha⁻¹ achieved after 24 months of

harvesting and on an average, farmers fetches Rs. 4,86,940 net returns per hectare (Table 1).

The harvested roots were peeled manually by pulling their outer thin rinds and central thread. Post-harvested materials required proper drying to maintain the quality and for that alternate day turning required. After drying, the dried material was packed in waterproof bags and stored in a cool dry room. The tuberous root contains saponin as the main active constituent, which is very hygroscopic, therefore, roots were dried before storage up to stage breaks with a cracking sound, it means that it has completely dried. The dry roots and powder produced by farmers faces problem in marketing due to lack of information and skills.

Table 1: Average economic parameters of satavari cultivation in Gujarat

Sr. No.	Particulars	Value
1.	Fresh root yield after two years (q ha ⁻¹)	408
2.	Dry root yield after two years (q ha ⁻¹)	41.33
3.	Gross return after two years from dry roots (@ Rs. 30000 q ⁻¹)	Rs. 12,39,950
4.	Gross return per year	Rs. 6,19,950
5.	Total cost per year	Rs. 1,33,010
6.	Net return (ha ⁻¹ year ⁻¹)	Rs. 4,86,940*
7.	B:C ratio over net return	3.66

* Based on market availability



Fig. 5: Satavari FLDs at other farmers field

Contractual farming or buy back system is the primary need of hours for MAPs growers, therefore, attempts were made to establish the linkage between growers and the market personals (Khari baoli market (Asia's largest spice market), New Delhi and Shatras Agri. Pvt. Ltd. Surat, Gujrat) for earning virtuous profit

(Figure 5) under this case study. After four years of cultivation, farmer achieved good amount of profit. Keeping in the view of doubling the farmers income, satavari considered as a high remunerative crop. The Directorate promoted and trained several other farmers (Kalpesh R. Patel, Malataj; Chetanbhai G. Prajapati, Mogar)



Fig. 6: Stake holder meet cum farmers training by ICAR-DMAPR for market linkage

and were convinced for satavari cultivation (Figure 6).

Acknowledgment

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YEAR ROUND ORGANIC PRODUCTION OF CORIANDER FOR GREENS IN SHADENET HOUSE

S. Balakrishnan*

Abstract

Coriander [CO(CR) 4 variety] seeds were sown for organic production in every month throughout the year during 2018-19 in shadenet house. The results revealed that October sown crop recorded early germination, vigorous growth, the highest plant height, number of primary branches per plant, number of leaves per plant, leaf area, leaf area index, total chlorophyll content and yield of greens per unit area. The technology of year round organic production of coriander in shadenet house can be adopted by the farmers. Though the initial cost of establishment of shadenet house is slightly high, but the farmers can get high yield of coriander greens with good quality favouring for getting sustainable income not only during main season but also in off season / summer season.

Introduction

Coriander is valued for its tender leaves and grains, coriander greens are used for seasoning of curries, salads, soups, preparation of chutney etc. Throughout the year, there is demand for organically produced coriander greens that are free from toxicity and heavy metals. In order to meet the demand for organically produced coriander greens, cultural methods are to be modified to increase the productivity. Solar radiation is one of the primary factors governing

the ultimate yield and productivity of any crop. The growth, yield and quality of crops are influenced by shade at various stages of crop growth and development. Hence, an attempt is made for year round organic production of coriander for greens in shade net house.

Materials and methods

The study was conducted during September, 2018 to August, 2019 at Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. Seeds of coriander variety CO(CR)4 were used for this study and were sown from the month of September, 2018 to August, 2019 in plots of 2 m² size formed inside the shadenet house (cladding material 50% shadenet) for organic production. Observations like days taken for germination, plant height, number of primary branches per plant, number of leaves per plant, leaf area, leaf area index, total chlorophyll content and herbage yield per plot were recorded and benefit cost ratio were worked out.

Results and discussion

Days taken for germination was significantly affected by time of sowing. Early germination was observed in the month of October followed by November. Generally, Coriander seeds can germinate and establish well in the temperature range of 22-27°C. The

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Fig. 1: Production of coriander for greens in shade net house

optimum temperature range of 21-32°C prevailed during October month under

Table 1. Benefit : Cost ratio for year round organic production of Coriander for greens in Shadenet house

Shade net condition	
Month	B:C ratio
September, 2018	2.38
October, 2018	2.80
November, 2018	2.32
December, 2018	2.28
January, 2019	1.95
February, 2019	1.65
March, 2019	1.55
April, 2019	1.58
May, 2019	1.70
June, 2019	2.00
July, 2019	2.20
August, 2019	2.30

shadenet may be the reason for the early germination in that particular month. High temperature is the main limiting factor for the germination and growth of coriander (Sarada *et al.*, 2011). The highest plant height, number of primary branches per plant, number of leaves per plant, the highest leaf area and leaf area index were observed in plants derived from October month sown seeds.

It is due to the reason that coriander plants had optimum climate which delayed the reproductive stage and plants with prolonged vegetative phase gave higher fresh green leaf yield. The maximum biological yield in October sown crop can be attributed to greater leaf area. Vegetative growth parameters were found to be better in shadenet condition which might be due to favourable growing condition. Under shadenet house, the temperature is reduced up

Table 2: Performance of coriander (Co(CR)4) for year round organic production for greens in Shadenet house

Month of Sowing	Days taken for germination	Plant height (cm)	Primary branches (per plant)	Number of leaves (per plant)	Leaf area (cm ²)	Leaf area index	Total chlorophyll content (SPAD value)	Single plant weight (g)	Yield (Kg/plot)
September 2018	8.33	28.81	4.00	38.67	40.29	0.134	42.81	7.23	5.21
October 2018	7.67	29.88	4.50	39.56	40.84	0.136	43.64	7.49	5.69
November 2018	8.00	27.90	4.00	37.91	39.87	0.133	43.29	7.02	5.14
December 2018	8.67	27.26	3.50	36.92	39.01	0.130	42.16	6.28	5.09
January 2019	10.00	27.26	4.50	34.81	37.12	0.124	43.02	6.02	4.67
February 2019	10.33	24.44	4.00	33.03	34.68	0.116	42.91	5.84	4.29
March 2019	11.33	24.07	3.50	28.98	30.34	0.101	42.70	4.41	4.08
April 2019	11.67	23.54	3.00	26.33	28.90	0.096	42.09	3.89	3.89
May 2019	9.33	23.39	4.00	33.70	38.67	0.129	42.24	5.11	4.39
June 2019	8.30	24.20	3.50	35.50	38.70	0.122	42.70	5.90	4.55
July 2019	8.90	25.50	3.80	36.80	39.20	0.128	42.85	6.10	4.75
August 2019	9.10	25.80	4.00	37.20	39.80	0.130	42.98	6.60	5.10
CD at 5% level	0.70	1.45	0.20	1.42	1.50	0.007	NS	0.21	0.15

to 5°C and the relative humidity is also increased. Thereby, with the available optimum environmental conditions, the production of coriander is success during summer months/ off season (Shoba and Rajamani, 2009). Coriander plants under shade produced more number of leaves which had increased photosynthetic area through the action of cell division and cell enlargement. The greater leaf number might have helped in the production of more metabolites and consequent growth accumulation of total solids which ultimately resulted in the production of larger amount of green leaf yield. Similar results of significant differences in these characters due to date of sowing were reported in coriander (Choudhari *et. al.*, 1995).

Conclusion

From the foregoing results, it is pertinent that coriander greens can be produced organically throughout the year in shadenet house by the farmers. By sale of organically

grown coriander greens of good quality, the farmers can get sustainable income, not only during main season but also in off season / summer season.

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FENNEL: AN IMPORTANT SEED SPICE OF RAJASTHAN

Abhay Dashora, Deeksha Chauhan, Jyotsana Rathore and Neetu Yadav*

Introduction

Fennel (*Foeniculum vulgare* Mill) belongs to the family Apiaceae, is one of the important seed spice crop mainly grown for its seeds. It is originated in Southern Europe and Mediterranean region and widely cultivated in Romania, Russia, Germany, France, Italy, India, Argentina and USA. In India fennel is mainly cultivated in states of Gujarat, Rajasthan, Karnataka, Maharashtra, U.P., Punjab and Bihar. Among them, Gujarat and Rajasthan is the major fennel producing states. In Rajasthan, it is mainly cultivated in the districts of Sirohi, Jodhpur, Nagaur with an area and production of 21,236 hectare and 20,274 MT, respectively (2017-18).

Economic Importance

Fennel seeds alone or in combination with sugar are used as a mouth freshener in India. In foods and beverages, fennel oil and fennel seed are used as flavoring agents. It is widely used both raw and cooked in side dishes, salads, pastas, vegetable preparations, sausages, etc. The bulb and green 'herb' fennel are used to flavour food during cooking or as a garnish prior to serving.

Fennel is a traditional and popular herb with a long history of use as a medicine. A series of studies showed that *F. vulgare* effectively controls numerous infectious disorders of bacterial, fungal and viral origin. It has

antioxidant, antitumor, chemopreventive, cytoprotective, hepatoprotective, hypoglycemic, and oestrogenic activities. Some of the publications stated that *F. vulgare* has a special kind of memory-enhancing effect and can reduce stress. Fennel is used for various digestive problems including heartburn, intestinal gas, bloating, loss of appetite, and colic in infants among others. It is also used to prevent sunburn. Essential oil extracted from fennel seeds is used for manufacturing cordials and as a fragrant agent in toiletries such as soaps and shampoos. Fennel oil is extensively used as a flavoring agent in baking and confectionary industries.

The essential oil in fennel is in a range of 0.7-6.0 %, yellowish green liquid, which having main constituents are anethole and fenchone. The oil of good quality contains 50-60 % anethole. The higher percentage of anethole and absence of fenchone are responsible for the delicate sweet odour. Indian fennel contains about 70 % anethole and 6 % fenchone. However, European fennel contains up to 90 % anethole and absence of fenchone, which is responsible for its delicate sweet odour and flavor.

Fennels cultivated for seed are of two types: sweet fennel (*F. vulgare* Miller var. *dulce*) and bitter fennel (*F. vulgare* Miller var. *vulgare*) or common fennel. Bitter fennel is grown for its fruits and essential oil and is grown in India, Argentina, Czech Republic, France, Germany,

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Hungary, Italy, Japan, Romania and Southern Russia. Sweet fennel is cultivated for its enlarged leaf base, for its fruits and for the essential oil taken from its fruits. It is not found wild; it is grown in Bulgaria, France, Italy and Macedonia.

Plant description

It is a biennial, aromatic, stout, glabrous, 1.5 to 1.8 m height. Stem erect and profusely branched. Leaves alternate, sheathed, lower leaves largest; margins white scariosus. Inflorescence is a terminal, compound umbel which bears peduncle, primary rays, secondary rays (pedicels), calyx (vestigial), petals 5, stamens 5, pistil with inferior, bilocular ovary, 2 styles, each with a stylopodium at base and a stigma at top. The ripe fruit (seed) is small, oblong, cylindrical, 6.8 mm long, straight or slightly curved, greenish yellow, deeply furrowed, 5 ridged and having agreeable aroma.

Breeding objectives and breeding methods:

Currently, the main objectives of fennel breeding are short duration, smaller height, size of umbels (large), resistance to blight and gummosis, high yield and volatile oil content.

Fennel is a cross pollinated crop. Breeding methodologies depend upon the pollination behavior of the crop. Different breeding methods are used in fennel improvement for development of high yielding and disease resistant varieties. Some of the methods used for fennel improvement are as under :

*** Germplasm Collection, Maintenance and Evaluation**

At present, a large number of germplasm of fennel have been maintained at different AICRP centres. However, the variability

assembled in these collections is low particularly for reaction to diseases and the volatile oil content. It is, therefore, an urgent need to enrich the collection by introducing varieties particularly from the Mediterranean region, Southern Europe, Egypt etc. where diversity exists.

*** Population Improvement vis-à-vis selection:**

Population improvement is the process of pyramiding of the positive genes for desirable characters in a variable population through selection or half-sib or recurrent selection. Different methods of selection have been followed to develop the varieties in fennel. Mass selection and single plant selection based on the progeny are used to develop varieties in fennel.

*** Hybridization:**

In fennel, hybrid vigour to the extent of 24.6 to 108.9 per cent increase over the best pure line was observed when hybrids were produced through crossing elite males with a cytoplasmic male sterile female parent. Exploitation of heterosis breeding through use of hybrid varieties, therefore, may be a successful proposition if cytoplasmic male sterile is discovered and utilized in the production of hybrid seeds.

Selection of improved varieties:

For successful crop production, selection of a variety is a very important step. Although there are a number of high yielding varieties under cultivation in the state as well country as a whole but only few are popular and adopted for cultivation by many farmers in the state.

Some of the popular high yielding varieties of fennel developed for different regions are RF-101, RF-125, RF-143, AF-1, AF-2, Gujarat Fennel-1, Gujarat Fennel-2, Gujarat Fennel-11 and Hisar Swarup

Crop Husbandry:

*** Climate and Soil:**

A dry and moderately cold weather is favourable. High humidity and cloudy weather favour diseases and pests and the crop is highly susceptible to frost.

Fennel can be successfully cultivated on all types of soil except sandy soil. A well drained loamy or black or sandy loam soils is better suited for fennel cultivation.

*** Seed and Sowing:**

A seed rate of 10-12 kg/ha is sufficient for direct sowing and for transplanted crop, a seed rate of 3-4 kg/100 m² in nursery is sufficient for transplanting the plants in one hectare. The optimum sowing time of fennel is first fortnight of October to mid November for direct sowing. Delayed sowing reduces the yield. In transplanted crop, nursery is raised in the month of June and transplanted in the month of August. For getting desired population, sowing should be done in rows of 50-60 cm apart with plant to plant distance of 25-30 cm.

*** Manures and Fertilizers:**

Apply 10-15 tones/ha FYM to the soil before planting at the time of field preparation. A proper fertilizer schedule should be followed which includes 90 kg N/ha in three equal splits-first as basal dose along with 40 kg/ha P₂O₅, second and third applications at 30 and 60 days

after sowing with irrigation to obtain good yield.

*** Weed Management:**

Weed infestation is a serious problem in commercial cultivation of fennel crop. At the time of thinning at 30 days after sowing, first hoeing and weeding is recommended. Second weeding depends on weed growth in the field. Integrated weed management with pre-emergence application of pendimethalin at the rate of 1.0 kg/ ha, supplemented with one hand-weeding 50 days after sowing controls weeds effectively.

*** Irrigation:**

Fennel is a long duration crop and has high water requirement. One or two light irrigations immediately after sowing is essential to facilitate germination, subsequently irrigate at interval of 15-20 days depending upon crop stages and weather condition and water holding capacity of soil. Water stress must be avoided during flowering and seed formation stages to get good seed formation and grain yield.

*** Plant protection measures:**

Alternaria blight, *Ramularia* blight, powdery mildew, leaf spot, gummosis are the major diseases and aphid is the important insect-pest that adversely affects the yield as well as quality of fennel. Effective control measures should be followed as per the suggestions of concerned experts to control these diseases and insect-pests.

Fennel crop is vulnerable to frost damage which can be minimized by spraying 0.1% solution of sulphuric acid prior to the incidence of frost.

* **Harvesting, Threshing and Storage:**

The crop is ready for harvest 180-200 days after sowing, when umbels turns yellow in the whole plant. Picking of umbels is done when seeds are fully developed but still green. After harvesting, umbels should be dried in sunlight for 1-2 days and then in shade for 8-10 days. Care must be taken not to sun-dry the umbels too long as long exposure of seeds to the sun reduces the quality of the produce. For producing chewing type (Lukhnavi) fennel, umbels are harvested at 30-40 days after pollination when seed size is just half of fully developed seeds and then dried in shade. Threshing should be done on hard threshing

floor.

Fennel should be stored after proper drying. At the time of storage moisture content should not be more than 8-9 %. After drying, fennel seeds are cleaned with the help of vacuum gravity separator or spiral gravity separator. Cleaned seeds are then graded based on its quality and then packed in polythene lined gunny bags in humidity free stores.

* **Yield:**

The average yield of fennel is about 12-13 q/ha. However, when improved varieties and package of practices are properly adopted, yield as high as 20-25 q/ha can be obtained.

The Directorate had participated in the Calicut Flower Show-2019 held at Marine Ground, Calicut, Kerala from 10th to 19th January, 2020 organized by Calicut Agri Horti Society.



PROSPERITY THROUGH BRAHMI CULTIVATION: A CASE STUDY OF GUJARAT

Parmeshwar L. Saran, Ram P. Meena and Kuldeepsing A. Kalariya*

Jal brahmi (*Bacopa monnieri*) plays an important role in low laying area especially in central Gujarat for livelihoods. Integration of such crop into existing farming systems was thought to be one of the viable options for farmers. Even, jal brahmi could be considered as high returns per rupee investment and better system productivity crops as compared to rice. The agri-economics of this crop (DBM-2) have been worked out to attract rice growers, and generated an average of Rs. 2,86,728/ha net returns with 3.14 B:C ratio. Jal brahmi growers not only getting the fair remunerative income by cultivating this crop, but also provided an employment opportunity to the local workers. Hence, introduction of this crop instead of traditional rice-wheat cropping system, is a profitable venture under low lying area of central Gujarat.

Introduction

Herbal medicines are now in great demand in the developing world for primary health care not because they are inexpensive but also for better cultural acceptability, compatibility with the human body and minimal side effects. Entire biomass of the plant is used in indigenous system of medicine as a nerve tonic, curing from epilepsy and insanity. Several medicinal plants have been identified to perform well in degraded land for cultivation. ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand

has been continuously trying to explore the thrust research areas to improve the livelihood supports of the stakeholders. Medicinal and aromatic plants are gradually recognized as a source of livelihood upliftment, besides sustaining the soil as well as human health. The cultivation of jal brahmi is lesser prone to damage by wild animals, incidence of pest and diseases. Farmers of central Gujarat faced water logging problems, especially during the rainy season which limits the cultivation of conventional crops. Consequently, they need a substantial option of crops and being a pioneer research organization in the country, ICAR-DMAPR, Boriavi, suggested a medicinal crop which found to be sustainable in such troublesome lands (Saran *et al.*, 2017). Innovative farmer interested in jal brahmi cultivation were provided the quality planting material and technical support through a field level demonstration with the financial support of CSS, DASD, Calicut and got fruitful results.

Mr. Vimalkumar K. Patel, an innovative farmer from village Isnav, Anand of Gujarat, emerged as a successful brahmi cultivator, who adopted the suggested technology in low laying rice fields for last three years (Fig.1). He started jal brahmi cultivation especially elite DBM-2 from 2016-17, in a rice field without using any inorganic inputs, which was an extension of earlier success story (Saran, 2017). He is also

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Figure 1: Jal brahmi FLD at our progressive farmer field at Isnava, Petlad

rearing 10-12 cows for milk production. Further, cow dung is used in Gobar gas plant to produce biogas for his own consumption and

remaining by-product of process is used as an organic manure (digestate), a substitute fertilizer used in jal brahmi field (Fig. 2). He is



Figure 2: Different interlinked farm enterprises with Jal Brahmi cultivation at progressive farmer (Shri Vimalkumar K. Patel) field.

also preparing decoction from leaves of five-six toxic herbs for management of sucking pests. The progressive farmer also generating income from subsidised solar system from state government. In this direction, ICAR-DMAPR demonstrate the successful cultivation of jal brahmi in the low-lying area of village Pandori, Anand and conducted field days/farmers trainings for the farmers of neighbouring villages to convince the profitability of the crop. The story starts with the plantation of this crop (DBM-2) in one *bigha* area by a farmer, Sh. Neil Shah in consultation with ICAR-DMAPR, Boriavi and he collected about 10 kg cuttings as planting material during 2015-16 (Saran and Kumar, 2017; Saran, 2017).

The whole plant is cut into small divisions to about 4-5 cm long, each with two-three nodes are transplanted directly in the field using

plastering method to get maximum herbage yield (Fig. 3; Saran and Patel, 2019). The plants then transplanted in fields in the month of May were grown and proliferated through the hot and humid months of monsoon till September. The growers of this crop should have an assured irrigation source even in monsoon season for successful cultivation. The plants maintained in a perennial state gave three harvests in a year with the first regular harvest in September followed by two ratoons, first in February and second in or before June. The progressive farmer (Sh. Vimalkumar K. Patel) harvested the crop at flowering stage or at maturity symptoms, by using petrol driving cutter (Fig. 2). It saved the labour cost, uniformity in herbage as well as time of harvesting. On an average, a yield of 179 q/ha dry herbage obtained from all three harvests of elite DBM-2. After first harvest, about 10-20 q/ha additional dry herbage yield



Fig. 3: QPM prepared for plastering method, crop at vegetative phase and packaging of dry jal brahmi for marketing.

can be obtained from the ratoon crops. Growers may get good returns from cultivation of this crop per unit area, which field is normally not appropriate for conventional crops.

Marketing is major issue for MAPs cultivator; therefore, this farmer has buyback contract with an earlier progressive farmer (Shri Neil Shah) for two years. Now he has contract with Fresh Mantra Organics LLP, Ahmedabad and ZFHC, Ambach with the interventions of DMAPR, Anand. Drying is determinantal factor for desired colour retaining, therefore, produce dried under the partial shade using tarpoline sheets. The harvested material turned over in alternate days. Further, the dried material was packed in waterproof bags and stored in a cool dry room. After three years of cultivation, farmer achieved good amount of profit. Previously, the farmer was cultivating traditional crops such as wheat, rice, etc., but after getting profit, he switched over to this crop in his rice field. On an average, a farmer can get approximately Rs. 2,86,728/ha net returns from the cultivation of brahmi as a sole crop under low lying field. The B:C ratio over cost C_2 was 3.14 (Table 1). It proven that brahmi cultivation is a profitable venture under low lying areas. Based on the performance and economics under marginal land, brahmi gradually recognized as source of income.

When he explained his profitability of brahmi cultivation, some farmers of nearby villages also decided to cultivate this crop. Brahmi growers are not only fetching the remunerative income from enterprise, but also providing the employment opportunities to the rural unemployed people. Previously, the

farmers of nearby villages were growing traditional crops (Rice and Wheat) but after

Table 1: Economics of brahmi cultivation under rice field of central Gujarat

Sl. No.	Particulars	Value (Rs.)
1.	Dry herbage from three cuts (q/ha)	179
2.	Gross return @ Rs. 2350/q	4,20,650
3.	Total cost (C_2)	1,33,922
4.	Net return over cost C_2 (ha^{-1})	2,86,728
5.	Input-output ratio over cost C_2	1:3.14
6.	B:C ratio	3.14

seeing the good income from brahmi cultivation, farmers were impressed and motivated with this crop (Fig. 4 and 5).

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Fig. 4: Stake holder meet-cum-farmers training by ICAR-DMAPR Scientists for convincing farmers



Fig. 5: Jal brahmi harvesting and post-harvest drying at Isnav FLDs

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सौंफ में समन्वित नाशीजीव प्रबंधन

डॉ. अभिषेक शुक्ला*

सौंफ का मसालों में मुख्य स्थान है। इसके दानों में पाये जाने वाले वाष्पशील तेल के कारण इसमें जायकेदार सुगंध आती है। इसी सुगंध के कारण सौंफ का मसाले के रूप में उपयोग होता है। मसाले के रूप में सौंफ का प्रयोग हर प्रकार की सब्जियों, आचार व सूप के सुगन्धित करने के लिये किया जाता है। खाने के बाद भी सौंफ का प्रयोग मुखवास के तौर पर प्रयुक्त होता है। साथ ही साथ इसका प्रयोग कई देशी तथा आयुर्वेदिक दवाओं में भी होता है, इन्हीं सभी गुणों के कारण से सौंफ को एक महत्वपूर्ण मसाला फसल माना जाता है, सौंफ के सफलतापूर्वक उत्पादन करने में अनेक कारक बाधा पैदा करते हैं इन्हीं में समय समय पर कीटों तथा रोगों का प्रकोप भी बहुत ही महत्वपूर्ण है। इससे न केवल सौंफ का उत्पादन प्रभावित होता है वरन उसकी गुणवत्ता (Quality) पर भी प्रतिकूल असर पड़ता है जिससे अंततः हमारे किसान भाईयों को भारी आर्थिक नुकसान उठाना पड़ता है। प्रस्तुत लेख में सौंफ को ग्रसित करने वाले इन्हीं कीटों तथा रोगों तथा उनके समन्वित प्रबंधन के विषय में सविस्तार जानकारी दी जा रही है जो कि हमारे सौंफ उत्पादक किसानों के लिये उपयोगी सिद्ध होगी।

मुख्य नाशीजीव

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कटुआ सूंडी – एग्रोटीस प्रजाति

फुदका – एमरास्का बिगटूला

सिगरेट भृंग : लेसोडर्मा सिरेटस

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जड़गाठ सूत्रकृमि : मेलेडोगायनी प्रजाति

नाशीजीव की निगरानी :

नाशीजीवों की निगरानी का प्रमुख उद्देश्य खेतों में नाशीजीवों के प्रारंभिक विकास के बारे में, उनकी उपस्थिति तथा भविष्य में होने वाले नुकसान का अनुमान लगाने से है, इसी के साथ खेत में जैविक नियंत्रण कारकों की उपस्थिति का पता लगाना तथा उनका उपयोग नाशीजीवों के नियंत्रण में भली-भंति करने से भी है। इसका प्रमुख उद्देश्य खेत में नाशीकीट और प्राकृतिक शत्रुओं के अनुपात पर नज़र रखना है नाशीकीटों

की निगरानी निम्नानुसार कर सकते हैं:

(अ) **रेपिड-रोविग सर्वे** : इसमें एक निश्चित रास्ते पर सर्वे दल को कीटों व रोगों की साप्ताहिक हिक निगरानी रखनी चाहिए। कीट रोगों की उपस्थिति के साथ-साथ प्राकृतिक शत्रुओं की उपस्थिति पर भी कड़ी नज़र रखनी चाहिए। इससे कीटों-रोगों का पूर्वानुमान लगाने में बहुत मदद मिलती है। इसके पश्चात कीटों तथा रोगों और उनके प्राकृतिक शत्रुओं की उपस्थिति के सभी आँकड़े रखने बहुत आवश्यक है। इससे भविष्य में कीटों के प्रकोप के पूर्वानुमान में काफी मदद मिलती है। यहाँ पर एफिड की जनसंख्या को 30 पौधे (100 पत्तियों) पर रिकार्ड करनी चाहिए। प्रत्येक 10 कि.मी. के बाद खेतों का चयन करके अवलोकन लेने चाहिए।

(आ) **फील्ड स्काउटिंग** : कीटों के आर्थिक क्षम्य मान (ETL) का ज्ञात करने के लिये साप्ताहिक अन्तराल पर फील्ड-स्काउटिंग करनी भी अत्यंत ही आवश्यक होती है। रस चूसने वाले कीटों की संख्या ज्ञात करने के लिये प्रति पौधा तीन पत्तियों (ऊपरी , मध्य तथा नीचे वाली) का अवलोकन करना चाहिये। इसी प्रकार से बटुआ सुँडी तथा पत्तियों को खाने वाले कीटों द्वारा होने वाले नुकसान को ज्ञात करने हेतु कुल पौधे तथा क्षतिग्रस्त पौधों की गिनती करके प्रतिशत नुकसान का अनुमान लगाया जा सकता है। जब वातावरणीय अवस्थाओं जैसे कि अधिक नमी, रूक-रूक कर बरसात होना आदि हो तब खेतों में कीट संख्या की निगरानी करना अत्यंत ही आवश्यक होता है।

(इ) **एग्रो-इकोसिस्टम एनेलेसिस (AES)**: साप्ताहिक सर्वेक्षण के आधार पर कीटों का आर्थिक

क्षम्य मान तथा प्राकृतिक शत्रुओं की संख्या का सही-सही अनुमान लगाया जा सकता है। इसी आधार पर प्रसार कार्यकर्ता किसानों को इन नाशीकीटों और रोगों के सही नियंत्रण हेतु आवश्यक जानकारी दे सकते हैं और बड़े पैमाने पर नियंत्रण की कार्यवाही शुरू कर सकते हैं।

(ई) **पीले चिपचिपे ट्रेप से कीट निगरानी** :

मोयला अथवा सफ़ेद मक्खी जैसे कीटों की निगरानी के लिये पीले चिपचिपे ट्रेप @ 10 ट्रेप प्रतिहेक्टेयर के दर से लगाने चाहिए। इसके लिये स्थानिक तौर पर उपल्ब्ध पीले टीन पर ग्रीस अथवा वेसलीन का लेप लगा कर उन्हें खेतों में लगाना चाहिए। इससे भी रस चूसने वाले कीटों की निगरानी में काफी मदद मिलती है।

सौंफ में समन्वित नाशीजीव प्रबंधन रणनीति :

सौंफ में विभिन्न तरीकों को समन्वित तथा समग्र तौर पर अपनाने से नाशीकीटों का भली भॉति प्रबंधन किया जा सकता है जो निम्नानुसार है:

(1) **कर्षण(पारंपरिक) क्रियाएँ** :

(क) गर्मी के मौसम में खेत की गहरी जुताई करनी चाहिए, इससे कीटों/बीमारियों की अलग-अलग अवस्थाएँ जमीन के ऊपर आ जाती है तथा सूर्य की तेज़ रोशनी तथा गर्मी से साथ ही साथ परभक्षी जीवों द्वारा नष्ट हो जाती है।

(ख) भूमि का प्लास्टिक की शीट से सौरीकरण (सॉइल सोलराईजेशन) करने से भूमि में उपस्थित कीट उनकी अपरिपक्व अवस्थाएँ, रोग तथा सूत्रकृमि आदि का भी नाश हो जाता है।

- (ग) सही फसल-चक्र अपनाना चाहिए तथा इसमें चवला-सौंफ, चवला-गेहूँ-सौंफ, तथा चवला-सरसों-सरसों-सौंफ अथवा बाजरा/ज्वार जैसी फसलों को फसल चक्र में आवश्यक तौर पर सम्मिलित करना चाहिये जिससे कीटों तथा रोगों के प्रकोप में कमी लाई जा सके।
- (घ) हमेशा सौंफ के रोगरहित स्वस्थ बीजों को बुवाई के लिये काम में लेना चाहिए।
- (ङ) हमेशा सौंफ की कीट तथा रोग सहिष्णु/प्रतिरोधक किस्मों का प्रयोग करें (तालिका-क)
- (च) पाउडरी मिल्ड्यू रोग की तीव्रता को कम करने के लिये हमेशा फसल को सही समय पर बोना चाहिये तथा फसल की देरी से बुवाई से हमेशा बचना चाहिये।
- (छ) सौंफ की खेती हमेशा ऐसी जमीन में करनी चाहिए जहां पर जल निकासी की उचित व्यवस्था हो।
- (ज) आवश्यकता से अधिक सिंचाई नहीं करनी चाहिए क्योंकि इससे उखटा (विल्ट) जैसे रोग के प्रकोप में कमी लाई जा सकती है अर्थात् सिंचाई जल प्रबंधन की व्यवस्था होनी जरूरी है।
- (झ) सौंफ में बीज बनते समय खेतों की सिंचाई नहीं करनी चाहिए।
- (त्र) बादल तथा अधिक नमी वाले मौसम में खेतों की सिंचाई नहीं करनी चाहिये।
- (ट) खेतों में जैविक पदार्थ जैसे अरंडी या नीम की खली को 2 से 3 टन-हेक्टेयर की दर से जमीन में मिलानी चाहिए।
- (ठ) जब सौंफ की फसल पूर्ण रूप से परिपक्व हो जाए तो फसल की काटाई में बिल्कुल भी देरी नहीं करनी चाहिए।
- (ड) भंडारण के दौरान सिगरेट भृंग तथा औषधीय भृंग के प्रकोप को रोकने के लिये सौंफ का भण्डारण उसमें पायी जाने वाली नमी को उसकी गुणवत्ता को प्रभावित किए बिना करना चाहिये।

(2) यांत्रिक नियन्त्रण :

- (अ) कीट-रोग ग्रस्त पौधों तथा उनके भागों को उनसे अलग करके उनका नाश कर देना चाहिए।
- (ब) जमीन से काटने वाले कीटों जैसे कटुआ कीट तथा पत्तियों को खाने वाली सूंडीयों को सुबह के समय हाथों से एकत्र करके उनका नाश कर देना चाहिए।

(3) जैविक नियंत्रण :

- (अ) बीजों को बुवाई से पूर्व ट्राईकोडर्मा हर्जेनियम या ट्राईकोडर्मा विरीडी / 3 से 4 ग्राम/कि.

तालिका 1 : सौंफ की कीट रोग प्रतिरोधक किस्मे

क्रम संख्या	रोग / कीट	किस्म
1.	मोयला	एस-16, ई-58, यूएफ-132
2.	उखटा और पाउडरी मिल्ड्यू	आरएफ-101, आरढफ-125
3.	पर्ण झुलसा और पर्ण धब्बा	गुजरात सौंफ-1, पीएफ-35, एस-7-9

ग्रा. बीज की दर से उपचारित करके बुवाई करनी चाहिए।

- (ब) खेतों में परभक्षी कीटों जैसे लेडी बर्ड भृंग, क्रायसोपा तथा सिर्फिड मक्खी व परजीवी ट्राईकोग्रामा आदि की पहचान करके उनका संरक्षण और संवर्धन करना चाहिए तथा उनकी कीटनाशी दवाओं से सुरक्षा करनी चाहिए।
- (स) मोयला तथा अन्य रस चूषक कीटों के नियंत्रण के लिये कोव्सीनेला सेप्टमपकटाटा @ 5000 भृंग प्रति हेक्टेयर की दर से मोयलाग्रस्त फसल में छोड़ना चाहिये।
- (द) नुकसानदायक कीटों की सुंड़ीयों तथा पतंगों का शिकार करने के लिये परभक्षी पक्षियों को खेतों में बैठने की व्यवस्था के लिए खेतों में टी आकार के लकड़ी के डंडे लगाने चाहिए इन हेतु 10 से 15 डंडे प्रति हेक्टेयर की दर से लगाने चाहिये।
- (य) शाम के समय पर एचएनपीवी @ 250 एलई/है. की दर से छिडकाव करना चाहिये जिससे की हेलीकोवर्पा की संख्या में कमी

लाई जा सकती है। इस घोल में कुछ गुड़ मिलाने से इसकी कार्य क्षमता बढ़ जाती है।

(4) रासायनिक नियंत्रण :

- (अ) बीज को बोने से पूर्व उनको फफूंदनाशी दवा जैसे कार्बेन्डाजिम @ 2 ग्राम/कि.ग्रा. की दर से उपचारित करके उनकी बुवाई करनी चाहिये।
- (ब) खेतों में रस चूषक कीटों के प्रबंधन के लिये डाई मिथेएट (0.03%) का छिडकाव करना चाहिये।
- (स) यदि खेतों में पत्ती खाने वाले कीटों की संख्या अधिक होने पर ही दवाओं का छिडकाव करना चाहिये।
- (द) नीम बीज सत 5% का छिडकाव करके भी कीटों की संख्या में कमी लाई जा सकती है।
- (य) कीटनाशकों का घोल बनाते समय इसमें स्प्रेडर अथवा चिपकने वाले पदार्थ की 2 से 3 बूंद मिलानी चाहिये।

तालिका 2 : सौंफ में फसल की अवस्था के मुताबिक समन्वित नाशीजीव प्रबंधन

अवस्था	नाशीजीव	नाशीजीव प्रबंधन युक्ति
बुवाई से पूर्व	मृदाजन्य बीमारियां	<ul style="list-style-type: none"> — ग्रीष्म कालीन गहरी जुताई — जमीन का सौलरीकरण — फसल चक्र अपनाना
बुवाई के समय	जमीन तथा बीजजन्य रोग, कीट तथा सूत्रकृमि	<ul style="list-style-type: none"> — सदैव स्वस्थ तथा बढ़िया बीज का चुनाव करें — जमीन में कार्बनिक सुधारकों को मिलावें जैसे सरसों, नीम अथावा अरंडी की खली @2.0 से 2.5 टन/है

		<ul style="list-style-type: none"> – कीट तथा रोगप्रतिरोधक किस्मों को बोने के लिये चुनना चाहिये – सही समय पर सौंफ की फसल की बुवाई करनी चाहिये – बीज को बोने से पूर्व कार्बेन्डाजिम @ 2 ग्राम/कि.ग्रा. बीज की दर से उपचारित करें
वनस्पतिक (Vegetative) वृद्धि अवस्था के दौरान	रोगों का प्रकोप	<ul style="list-style-type: none"> – आवश्यकता से अधिक सिचाई से बचें – फसलों पर रोग के प्रकोप दिखने पर बुवाई के 30–40 दिनों बाद मेन्कोजेब 2% या कोपर ओक्सीक्लोराईड @ 0.2% + नीम आधारित कीटनाशक दवा का छिडकाव करें
	मोयले तथा अन्य रस चुसक कीट	<ul style="list-style-type: none"> – परभक्षी कीटों जैसे लेडी बर्ड भृंग, क्रायसोपा तथा सिर्फिड मक्खी व परजीवी ट्राईकोग्रामा आदि से संरक्षण करना चाहिये – कोक्सीनेला सेप्टमपकटाटा @ 5000 भृंग प्रति हेक्टेयर की दर से छोड़े – नीम बीज सत 5% का छिडकाव करना चाहिये – यदि जरूरत पड़े तो दवा डाईमिथेएट (0.03%) का छिडकाव करना चाहिये
प्रजनन (Reproduction) अवस्था के दौरान	रोगों का प्रकोप	<ul style="list-style-type: none"> – आवश्यकता से अधिक सिचाई से बचना चाहिये – फसलों पर रोग के प्रकोप दिखने पर बुवाई के 30–40 दिनों बाद मेन्कोजेब 2% या कॉपर ओक्सीक्लोराई @ 0.2% + नीम आधारित कीटनाशक दवा का छिडकाव करें
	मोयले तथा अन्य रस चुसक कीट	<ul style="list-style-type: none"> – परभक्षी कीटों जैसे लेडी बर्ड भृंग, क्ररसोपा तथा सिर्फिड मक्खी व परजीवी ट्राईकोग्रामा आदि से संरक्षण करना चाहिए – कोक्सीनेला सेप्टमपकटाटा @ 5000 भृंग प्रति हेक्टेयर की दर से छोड़े

		<ul style="list-style-type: none"> – नीम बीज सत 5% का छिडकाव करना चाहिए – यदि जरूरत पड़े तो दवा डाईमिथेएट (0.03%) का छिडकाव करना चाहिये
भंडारण के दौरान	कीट तथा रोग	<ul style="list-style-type: none"> – हमेशा सौंफ का भंडारण उसमें नमी का ध्यान रख कर जूट के बोरो में करना चाहिये

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सुपारी और मसाले के लिए अप्रैल-जून, 2020 के कृषि कार्य

सुपारी

पौधशाला

- * रोज होस / स्प्रिंगलर / फाइन मिस्टिंग से सिंचाई करें।
- * पर्णदाग का नियंत्रण करें।
- * एक या दो गर्मकालीन वर्षा मिलने पर पौधशाला में छॉव कम करें।
- * अनंकुरित बैगों को छोड़ दें।
- * नियमित रूप से निराई करें।
- * डाइ बैक और अन्य किसी प्रकार के रोगों का प्रबंधन करें।
- * चानलों की सफाई करके पर्याप्त जल निकासी का बंदोबस्त करें।
- * कॉलर सड़न और पर्णदाग का नियंत्रण करें।

नया बाग

- * निराई जारी रखा जाए।
- * मई महीने के दौरान स्थल चुनकर नए बागान बनाना शुरू करें। जमीन की गर्मी कम करने के लिए रोपाई के 2-3 हते पहले 60 घन सेंटी मीटर के आकार वाले गड्ढे खोदकर रखना चाहिए। खोदते समय सतही मिट्टी और नीचे की मिट्टी अलग से रखें। रोपाई के 1 हते पहले 5-10 कि. ग्रा. गोबर की खाद और आधे भाग तक सतही मिट्टी भरा दें। पौदों को गड्ढे के मध्य में रोपाई करके चारों ओर दबाकर पलवार करके छॉव दें।
- * जून में अच्छी तरह जल निकासित मिट्टी में बागों को तैयार करना शुरू करें।
- * दक्षिण-पश्चिम मानसून की शुरुआत से या जून के प्रथम सप्ताह में प्रतिरोपाई करें।
- * गड्ढे खोदते समय कतारें उत्तर-दक्षिण दिशा में

बनाया जाए क्योंकि उत्तर-दक्षिण लाइन में पश्चिम की ओर 35° कोण में करने से सूर्याघात कम हो जाता है।

- * दक्षिण और दक्षिण-पश्चिम भाग में पर्याप्त छॉव पेड़ों की रोपाई करें।
- * रोपाई के बाद हरे पत्तों से गड्ढों का पलवार करें।
- * नारियल के पत्तों से पौदों को छॉव दें और अंतरासस्य के रूप में केले की रोपाई करें।
- * सनहेंप (हरे खाद सस्य) के बीज 20 कि.ग्रा. एकड की दर से रोपाई करके खरपतवार बढ़ने से रोका जा सकता है।

पुराना बागान

- * सिंचित बागों में अप्रैल के अंत में मिट्टी खोदकर उर्वरकों की पहली मात्रा का प्रयोग करें।
- * बढ़िया अवशोषण के लिए उर्वरकों के प्रयोग के बाद अच्छी तरह सिंचाई करें।
- * माइट, पेंटाटोमिड बग और स्केल प्राणियों का नियंत्रण करें।
- * सिंचित बागों में यदि अप्रैल में उर्वरकों की पहली मात्रा का प्रयोग नहीं किया जाए तो मई में कर सकता है।
- * वर्षा सिंचित बागों में काफी वर्षा मिलने के बाद 35ग्राम नत्रजन, 15 ग्राम फोसफोरस और 750 ग्राम पोटेश प्रति पेड़ की दर से उर्वरक दें।
- * सूखे मौसम, मिट्टि के प्रकार और पानी की लभ्यता के अनुसार 3-5 दिनों के अंतराल में सिंचाई करें।
- * आवरण फसल के रूप में *माइमोसा इन्विसा*, *स्टाइलोसान्तस ग्रेसिल्लस*, *कालप्पोगोनियम*

- मुकुनोइडस,प्युरेरिया जावानिका आदि का बीजारोपण अप्रैल-मई में वर्षा के प्रारंभ में किया जा सकता है। इस के लिए प्रति हेक्टर क्रमशः 15 कि.ग्रा 9 कि.ग्रा.11 कि.ग्रा. और 11 कि.ग्रा. बीज आवश्यक है। अक्तूबर में इसको काटकर मिट्टी में शामिल करें।
- * दक्षिण-पश्चिम मानसून शुरू होने से पहले सूखे पत्ते और रोग संक्रमित पेड़ों को हटाना चाहिए। अच्छी तरह वर्षा मिलने वाले इलाकों में फाइटोथोरा से संबंधित समस्याओं (कलिका गलन, मुकुट सड़न, फल सड़न और पाद गलन) के समाधान के लिए रोग निवारक उपाय के रूप में 1% बोर्डोक्स मिश्रण छिड़का दें।
 - * जड़ सूँडियों का नियंत्रण करने के लिए पौधों के आधार भाग की मिट्टि को 10-15 से.मी. की गहराई में ढीला करके वहाँ पर 0.04% क्लोरपाइरीफोस का घोल से दो बार उपचारित करें, पहला मई में, दक्षिण-पश्चिम मानसून की शुरुआत से ठीक पहीले और फिर से मानसून के अंत में करें। कीट का पूर्ण उन्मूलन के लिए 2-3 वर्षों तक लगातार इसका प्रयोग करें।
 - * जून में टपक सिंचाई की सामग्रियाँ बाग से हटाकर मानसून समाप्त होने के बाद प्रयोग करने के लिए सुरक्षित रखें। इससे पाइप / नालों को मिट्टी भरकर जाम होने की स्थिति से रोका जा सकता है।
 - * वर्षा मौसम में सुपारी के बागों में जल निकास की पर्याप्त सुविधाएँ करें। इसके लिए नए नालियाँ बनाया जाए यो पुराने नालियों को गहरी साफ करके रखा जाए। ये नालियाँ पौधों के आधार से 25-30 से.मी.गहरी होनी चाहिए।
 - * पुराने बागों को पुनरुज्जीवित करने के लिए 3-4 वर्ष के दौरान चरणबद्ध तरीके से प्रतिरोपाई /

पुन:रोपाई करें। यदि बागों में पेड़ों को अनियमित तौर से लगाया गया है तो पुराने अनुत्पादक पेड़ों को काट लें।

- * उच्च आर्द्रता के साथ अच्छी धूप एवं बारिश है तो फल सड़न होने की संभावना है। गुच्छों को इससे बचाने के लिए रोग निवारक उपाय के रूप में 1% बोर्डोक्स मिश्रण छिड़का दें। गुच्छों में पूरी तरह से फफूँदनाशियों का संरक्षण मिलने के लिए छिड़काव अच्छी धूप वाले दिनों में करना चाहिए।
- * रासायनिक नियंत्रण के अलावा यांत्रिक तरीके से इस रोग के नियंत्रण के लिए गुच्छों को पॉलिथीन कवरिंग करने पर अन्य पौधों में रोग फैलने से रोका जा सकता है।

काली मिर्च

पौधशाला

- * आवश्यक मात्रा में सिंचाई करें।
- * पाक्षिक अंतराल में पौधों को स्यूडोमोनास फ्लूरोसेंस रोसेंस P1(2%) से उपचार करें।
- * यदि फाइटोफथोरा रोग तीव्र है तो 0.03% पोटोसियम फोस्फोनेट या मेटालाक्सिल 0.02% का छिड़काव करें।
- * मीली बग का संक्रमण है तो 0.075% क्लोरपाइरीफोस से उपचार करें।
- * गाल थ्रिप्य या स्केल कीट के नियंत्रण के लिए 0.2% डिमिथोएट का छिड़काव करें।
- * जून में पौधे मुख्य बागों में रोपाई के लिए तैयार हो जाएगा। इसके लिए वाइरस रहित स्वस्थ रोपण सामग्रियाँ चुन लें।

नया बाग

- * आधारी पेड़ों की रोपाई करें। मुरुक्कु (एरिथीना इंडिका) कारयम या किलिंजिल (गरुगा पिन्नेट्टा),

एलान्थस वर्ग, ग्लिरिसिडिया वर्ग आदि आधार पेड़ों के लिए उपयुक्त है। उच्च ऊँचाई वाले इलाकों में दलाप (लिथोस्पेर्मा) और सिल्वर ओक (ग्रेविलियो रोबस्टा) आधार पेड़ों के रूप में सफलतापूर्वक प्रयोग किया जाता है। काली मिर्च लगाने से 2-3 वर्ष पूर्व सिल्वर ओक के पौद लगाना चाहिए।

- * मैदानी इलाकों में पौधों के बीच 3x3 मीटर और ढलान में 2 मीटर की जगह छोड़ना चाहिए एवं कतारों के बीच 4 मीटर ।
- * मानसून प्रारंभ होने तक आधारों की सिंचाई करें।
- * आधारों से 15 से.मी. की दूरी पर इसके उत्तरी भाग में 50 x 50 x 50 से.मी. आकार के गड्ढे खोद लें। गड्ढों को ऊपर मिट्टी और कंपोस्ट या अच्छी तरह सड़े हुए गोबर 5 कि.ग्रा. की दर से ढेर बनाकर रखना चाहिए।
- * जड़कलमों की बढ़ती के अनुसार बेलों को आधार से बांध लें।
- * यदि खुले बाग है तो या बारिश नहीं है तो पौधों को छॉव दें।

उर्वरक

- * सिफारिश के अनुसार उर्वरकों की मात्रा NPK 50:50:50 ग्राम प्रति बेल की दर पर प्रति वर्ष देना चाहिए।
- * आधी मात्रा जून में दें।
- * दूसरे वर्ष में दो तिहाई मात्रा और तीसरे वर्ष से लोकर पूरी मात्रा दें।
- * जहाँ मिट्टी में जिंक या मग्नीशियम की मात्रा कम है, वहाँ 0.25 जिंक सल्फेट और मग्नीशियम सल्फेट 150 ग्राम प्रति बेल की दर पर मिट्टी में प्रयोग करें।

बाग

- * अप्रैल में तुड़ाई के बाद मानसून प्रारंभ होने तक

हफ्ते में एक बार के क्रम में 40-50 लीटर पानी प्रति बेल की दर पर सिंचाई करें।

- * बेलों के आधार में आवश्यक पलवार करें।

फाइटो सानिटेशन

- * रोग संक्रमित सभी मृत बोलों को जड़ तंत्र के साथ हटाकर जला दें।
- * भूस्तारियों को मानसून के प्रारंभ से काट-छाँट करके बेलों से बाँध लें।
- * आधारी पेड़ों की शाखाएँ काटकर काफी धूप प्रदान करें और नमी बनने से बचा लें।
- * जहाँ पानी के जमाव की समस्या है, वहाँ सतह में निम्न भागों में जल निकास का प्रबंधन करें।

उर्वरक

- * कुछ मानसून पूर्व वर्षा मिलने पर खाद एवं उर्वरक देना शुरू करें।
- * जैवीक खाद के रूप में गोबर या कंपोस्ट 10 कि. ग्रा.प्रति बेल की दर पर प्रयोग करें।
- * नीम खली 1 कि.ग्रा. प्रति बेल की दर पर प्रयोग करें।
- * एकांतर वर्ष में चूने का प्रयोग 500 ग्राम प्रति बेल की दर पर करें।
- * एसोस्पोरिलम 100 ग्राम प्रति बेल की दर पर करें।

पौध संरक्षण

- * मानसून वर्षा मिलने के बाद सभी बेलों के आधार से 45-50 से.मी.की दूरी पर चारों ओर 0.2% कोप्पर ओक्सीक्लोराइड 5-10 लिटर प्रति बेल की दर पर उपचार करें।
- * पत्तों में 1% बोर्डोक्स मिश्रण छिड़का दें या 0.3% पोटाशियम फोस्फोनेट से मिट्टि और पत्तों को उपचार करें।
- * फल गलन रोग के नियंत्रण के लिए मानसून के पहले जहाँ पोटाशियम फोस्फोनेट का प्रयोग

करता है, वहाँ काली मिर्च के बेलों को VAM(AMF) ट्राइकोडेर्मा और स्यूडोमोनास फ्लूरोसेंस P1 से उपचार करके रखें।

सिंचाई

- * मानसून शुरू होने तक हफते में एक बार 40–50 लिटर प्रति बेल की दर पर सिंचाई करें।

अदरक और हल्दी

अप्रैल–मई में वर्षा मिलने के बाद अदरक और हल्दी की रोपाई की जाए। अदरक के लिए मूल मात्रा के रूप में गोबर की खाद 25–30 टन और उर्वरक 50कि.ग्रा.फोस्फोरस और 25 कि.ग्रा.पोटाश तथा हल्दी के लिए 30कि.ग्रा.फोस्फोरस और 30 कि.ग्रा.पोटाश प्रति हेक्टेयर की दर पर प्रयोग करें। हल्दी के मामले में रोपाई के समय जिंक 5 कि.ग्रा. प्रति हेक्टेयर और तेल खली जैसे जैविक खाद भी 2 टन प्रति हेक्टेयर की दर पर प्रयोग करें। ऐसी स्थिति में फार्म यार्ड खाद की मात्रा कम कर सकता है। कॉयर खाद 2.5 टन प्रति हेक्टेयर के साथ गोबर, जैविक खाद (एसोस्परिलम) और NPK की आधी मात्रा का एकीकृत अनुप्रयोग भी किया जाए।

अदरक बीज 1200–1800 कि.ग्रा. प्रति हेक्टेयर और हल्दी के बीज 2500 कि.ग्रा. प्रति हेक्टेयर की दर पर प्रयोग करें।

अदरक के बीज प्रकंदों को 0.3% मान्कोजेब (3 ग्राम प्रति लिटर पानी) में 30 मिनट तक उपचारित करके 3–4 घंटे तक छाया में सुखाने के बाद रोपाई करें। कतारों के बीच 20–25 से.मी. की दूरी छोड़कर रोपाई करना चाहिए। बीज प्रकंदों को हाथ–कुदाली से बनाए गए छोटे गड्डों में सड़े गोबर और मिट्टी के हल्के परत भरकर रोपित करके मिट्टी से ढँक लें। रोपाई के समय नीमखली 2 टन प्रति हेक्टेयर की दर पर प्रयोग करने पर अदरक कंद को गलन रोग से बचा सकता है और उपज में वृद्धि भी होती है। रोपाई के तुरंत बाद

15 टन प्रति हेक्टेयर की दर पर हरे पत्तों से पलवार करना अनिवार्य है और यदि आवश्यक है तो 40–50दिनों के बाद 7.5 टन प्रति हेक्टेयर की दर पर दुबारा पलवार करें।

प्रो–ट्रे तरीके के द्वारा अदरक के स्वस्थ रोपण सामग्रियों का उत्पादन

अदरक के अच्छे रोपण सामग्रियों के उत्पादन के लिए कम लागत और व्यय पर अदरक के एकल कली मुकुल (लगभग 5ग्राम) के प्रयोग करके प्रतिरोपाई तकनीक विकसित किया गया। इस प्रकार विकसित अदरक के पौधों की पैदावार परंपरागत खेती तरीके के बराबर है। इस तरीके में प्रो–ट्रे में एकल कली मुकुल बीज प्रकंदों की रोपाई करके 30–40 दिनों के बाद बागों में प्रतिरोपाई करता है।

तकनीकी

- * बीज के लिए अदरक के स्वस्थ बीज प्रकंदों को चुन लें।
- * चयनित बीज प्रकंदों को मेंकोजेब (0.3%) और क्विनालफोस (0.075%)में 30 मिनट तक भिगोकर अच्छे वायु संचार वाले स्थानों में रखें।
- * रोपाई के एक महीने पहले बीज प्रकंदों को एकल कली मुकुल वाले 4–6 ग्राम के प्रकंदों के रूप में काटता है।
- * रोपाई के 30 मिनट पहले इन एकल कली अंकुरणों को मेंकोजेब (0.3%) से उपचारित करें।
- * प्रो–ट्रे में पीजीपीआर (PGPR)/ ट्राइकोडेर्मा 10 ग्राम प्रति कि.ग्रा. मिश्रण की दर से परिपोषित आंशिक रूप से सड़े हुए कॉयर पित्त (coir pith) और केंचुआ खाद (75:25) से भरा दें।
- * अदरक के एकल कली अंकुरणों को प्रो–ट्रे में रोपाई करें।
- * प्रो–ट्रे को छॉव–जाल–गृह में रखना चाहिए।

- * आवश्यकतानुसार रोस क्यान से या उचित स्प्रिंगलर से सिंचाई करें।
- * 30-40 दिनों से पौदे बागों में प्रतिरोपाई के लिए तैयार हो जाता है।

इस तकनीकी से लाभ

- * रोपण सेमग्रियाँ कम मात्रा में प्रयोग करने के कारण बीज पर होने वाले व्यय कम हो जाता है।
- * 98-100 पौधे बागों में अच्छी तरह बढ़ जाते हैं।

वृक्ष मसाले

नए पौधों की रोपाई के लिए दक्षिण-पश्चिम मानसून की शुरुआत से 90 से.मी. की गहरी गड्ढे खोदना चाहिए। रोपाई के समय लौंग पौधों के बीच में 6 x 6 मीटर, जायफल में 8 x 8 मीटर, दालचीनी में 2 x 2 मीटर की जगह छोड़ना चाहिए। गड्ढों में सतही मिट्टी और कंपोस्ट या अच्छी तरह सड़े हुए गोबर से भर देना चाहिए। पर्याप्त मात्रा में वर्षा मिलने पर रोपाई करें।

मिर्च

मिर्च एक प्रतिरोपित फसल है। पौधशालाओं में बीजों की बुआई करके एक माह के बाद पौधों को मुख्य बागों में प्रतिरोपित किया जाता है। बुआई के लिए 90-100 से.मी. चौड़ी और सुविधानुसार लंबी ऊँची क्यारियाँ तैयार करके अच्छी तरह सड़े हुए कार्बनिक खाद मिला देता है। प्रमाणित एवं स्वस्थ बीजों को चुनकर एक हेक्टेयर के लिए 1.0-1.5 कि.ग्रा. बीजों को कप्तान, थीरम या कार्बेन्डाजिम 2-3 ग्राम प्रति कि.ग्रा. बीज की दर से उपचार करके एक हेक्टेयर में प्रतिरोपण के लिए बुआई की जाती है। बुआई के बाद, हरे पत्तों से पळ्वार करके रोज सुबह रोस-क्यान से सिंचाई करें। बीजों के अंकुरण के तुरंत बाद पळ्वार को हटाना चाहिए। प्रतिरोपण के एक हफ्ता पहले सिंचाई कम करना चाहिए और प्रतिरोपण के एक दिन पहले अच्छी तरह सिंचाई करें। प्रधान खेतों में 75:40:25 कि.ग्राम नत्रजन, फॉसफोरस और पोटाश प्रति हेक्टेयर की दर से उर्वरकों का प्रयोग करें। प्रतिरोपण के पूर्व नत्रजन और पोटाश की आधी मात्रा और फॉसफोरस की पूरी मात्रा मूल खुराक के रूप में प्रयोग करें।

	नत्रजन ग्राम	फॉसफोरस ग्राम	पोटाश ग्राम	
लौंग	150	125	375	15 वर्ष पुराने पोडों को (प्रति पेड़)
जायफल	250	125	500	15 वर्ष पुराने पोडों को (प्रति पेड़)
दालचीनी	100	90	100	10 वर्ष पुराने पोडों को (प्रति पेड़)

तरुण पौधों को उर्वरकों का प्रयोग क्रमिक मात्रा में करें।

पेड़ के आधार तने से उपयुक्त दूरी पर बनाए गए गड्ढे में उर्वरकों का प्रयोग करें।

FARM OPERATIONS FOR ARECANUT AND SPICES FROM APRIL TO JUNE, 2020

ARECANUT

Nursery

- * Daily watering- hose/sprinkler/fine misting.
- * Control leaf spot disease.
- * Shade may be reduced in the nursery on receipt of one to two good summer showers.
- * Discard the ungerminated bags.
- * Regular removal of weeds.
- * Monitoring for incidence of any diseases especially die back disease.
- * Providing sufficient drainage and cleaning of channels.
- * Control of collar rot and leaf blight

Young garden

- * Weeding may be continued.
- * During May, Selection of site and laying out for new plantation to be done. Pits of 60 cm³ should be taken 2-3 weeks before planting to ward off the field heat. While digging top and bottom soils should be heaped separately. Pit should be half filled with top soil and 5-10 kg Farm Yard Manure (FYM) one week before planting. Seedlings should be planted in the centre of the pit, pressed around, mulched and shaded.
- * Establishment of garden in well drained soil during the month of June.
- * Take up transplanting in the beginning of south-west monsoon or the first week of June.
- * While digging the pits, the rows may be aligned in north-south direction by

deflecting the north-south line at an angle of 35° towards west to minimize sun scorching.

- * Suitable shade trees may be planted on southern and south-west side.
- * After planting, pit should be mulched with green leaves.
- * Cover the seedlings with plaited coconut leaves and grow shade crops like banana in the interspaces.
- * Sunhemp (green manure crop) seeds @ 20 kg/acre may also be sown in the interspaces as a soil reclamation measure and to avoid weed growth especially in the gardens without much overhead shade.

Old garden

- * Forking and application of first dose of fertilizers at the end of April in the irrigated garden.
- * Irrigate sufficiently after fertilizer application for efficient absorption.
- * Control mites, pentatomid bugs and scale insects.
- * If first dose of fertilizers were not given during April, it can be given in May in irrigated arecanut gardens.
- * Application of first dose of fertilizers to supply 35g N, 15g P₂O₅ and 50g K₂O per palm can be taken up in rainfed gardens after receipt of sufficient showers.
- * Irrigate palms during hot and dry periods at regular intervals of 3-5 days depending upon the soil type and availability of water for irrigation.

- * Sow seeds of green manure cover crops such as *Mimosa inuisia*, *Stylosanthes gracilles*, *Calapagonium muconoides* and *Pueraria javanica*, in April-May with onset of pre-monsoon rains. The seed rate required per hectare is 15 kg, 9 kg, 11 kg and 11 kg respectively. These crops may be cut and incorporated during October.
- * Before the onset of south-west monsoon, dried leaves and diseased palms should be removed. 1% Bordeaux mixture may be sprayed as a prophylactic measure to avoid Phytophthora related problems (bud rot, crown rot, fruit rot and foot rot) in high rainfall areas.
- * For Management of rootgrubs, loosen soil around the base of palms to a depth of 10-15cm and drench with chlorpyrifos 0.04 per cent suspension twice, one in May just before the onset of southwest monsoon and again in September- October towards the end of the monsoon. Repeat application for 2 or 3 years consecutively to secure a complete eradication of the pest.
- * During the month of June remove drip lines from the garden, roll back and keep safely for use during post monsoon season. This will prevent the pipes/tubes from soiling and clogging.
- * Adequate drainage should be provided in the arecanut gardens during the rainy season. Open new drains or deepen and clean the existing ones so that the channel should be 25-30 cm deeper than the bottom of the plant base.
- * To rejuvenate old gardens, underplanting/replanting may be taken up in a phased manner over a period of 3 to 4 years. If the existing garden is irregularly spaced, thin out old, unproductive palms.
- * High humidity alternating with bright sunshine and rain favour the incidence of Fruit rot. Prophylactic spraying with 1% Bordeaux mixture will provide adequate protection to the bunches against disease incidence. Spraying operations may be undertaken on clear sunny days with a very fine spray so as to give a protective coverage on the entire nut surface with fungicide.
- * Besides the chemical control, mechanical method of control of the disease by protecting the bunches through polythene covering is found to be very much effective in checking the incidence and spread of the disease.

Black Pepper

Nursery

- * Continue watering at the required frequency
- * Spray and drench the plants with *Pseudomonas fluorescens* P1 (2%) at fortnightly interval.
- * In case of a Phytophthora disease outbreak, spray with 0.3% Potassium Phosphonate or Metalaxyl 0.2% at fortnightly interval. Alternatively spray with 1% Bordeaux mixture and drench with 0.2% Copper Oxychloride.
- * In case of an incidence of mealy bugs drench with 0.075% of Chlorpyrifos.
- * In case of the incidence of gall thrips or scale insects spray 0.2% Dimethoate
- * During the month of June the plants will be ready for planting in the main field. Select only virus free healthy planting material.

New plantation

- * Standards may be planted. Murukku (*Erythrina indica*), Karayam or Kilingil (*Garuga pinnata*), *Ailanthus* sp., *Glyricidia* sp.etc. are suitable standards for growing pepper. In high altitude areas, Dadap (*E. lithosperma*) and silver oak (*Grevillea robusta*) can be successfully used as standards for pepper. Seedlings of silver oak are to be planted 2-3 years before planting pepper.
- * The spacing recommended is 3 x 3 m on plain lands. On sloppy land 2m between plants in rows across the slope and 4 m between rows.
- * Irrigate the standards till the monsoon starts.
- * Prepare pits on the northern side of standards, 15 cm away from it. The pit size should be 50 x 50 x 50 cm. Fill the pits with a mixture of topsoil and compost or well rotten cattle manure @ 5 kg/pit mixed with above mentioned biocontrol agents.
- * Plant 2-3 rooted cuttings in the pits at a distance of about 30 cm away from the standards.
- * Press the soil around the cuttings to form a small mound slopping outward and away from the cuttings to prevent water stagnation around the plants.
- * The growing portions of the cuttings are to be trailed and tied to the standards.
- * Provide shade to the plants if the land is exposed and if there is a break in the rainfall.

Manuring

- * Apply recommended dose of fertilizer at the rate of NPK 50:50:150 g/vine/year. Half

of the dose to be given during June.

- * Second year plants to be given only two-third of the dose, and full dose of fertilizers from 3rd year onwards.
- * In soil that are deficient in Zinc or magnesium foliar spray of 0.25% Zinc Sulphate and soil application of 150 g/vine of magnesium sulphate is recommended.

Plantation

- * During the month of April after harvest, start irrigating the vines @ 40-50 litres of water per vine once in a week till monsoon starts.
- * Ensure proper mulch at the base of the vine.

Phytosanitation

- * Remove all infected or dead vines along with the root system, and burnt off.
- * Runner shoots are to be pruned or tied back to vines before the onset of monsoon.
- * The branches of support trees may be lopped off to allow penetration of sunlight and avoid build up of humidity.
- * Wherever water stagnation is a problem, effective drainage of both surface and sub-surface to be ensured

Manuring

- * Manuring and fertilization to be done with the receipt of few pre-monsoon showers
- * Organic manures in the form of cattle manure or compost @ 10kg/vine may be applied
- * Neem cake @ 1 kg/vine is also recommended.
- * Lime applied @ 500 g / vine in alternate years
- * Apply *Azospirillum* @ 100 g/vine

Plant protection

- * After receipt of monsoon showers basins of all vines are to be drenched over radius of 45-50 cm with 0.2% copper oxychloride (COC) at the rate 5-10 litres per vines. A foliar spray with 1% Bordeaux mixture is also given or Drenching the soil and foliar spray with 0.3% Potassium phosphonate.
- * When potassium phosphonate is used pepper vine can be inoculated with VAM (AMF), *Trichoderma* and *Pseudomonas fluorescens* P1 during pre-monsoon period to control foot rot disease.

Irrigation

- * Continue irrigation @ 40-50 litres/vine once in a week, till the monsoon starts.

Ginger and Turmeric

Planting of Ginger and Turmeric may be taken up with the receipt of showers in April-May. Basal application of cattle manure @ 25 to 30 tonnes and fertilizers to supply 50 kg P₂O₅ and 25 kg K₂O for Ginger and 30 kg each of P₂O₅ and K₂O for Turmeric per hectare may be done. In the case of Turmeric, Zinc @ 5 kg/ha may also be applied at the time of planting and organic manures like oil cakes can also be applied @ 2 t/ha. In such case, the dosage of FYM can be reduced. Integrated application of coir compost (@ 2.5 t/ha) combined with FYM, biofertilizer (*Azospirillum*) and half recommended dose of NPK is also recommended.

A seed rate of 1200-1800 kg per ha for Ginger and 2500 kg per ha for Turmeric may be adopted.

The Ginger seed rhizomes are treated with mancozeb 0.3% (3 g/L of water) for 30 minutes, shade dried for 3-4 hours and planted at a spacing of 20-25 cm along the rows and 20-25 cm between the rows. The seed rhizome bits are placed in shallow pits prepared with a hand hoe and covered with well decomposed farm yard manure and a thin layer of soil and levelled. Application of neem cake @ 2 tonnes/ha at the time of planting helps in reducing the incidence of rhizome rot disease/ nematode of Ginger to a certain extent and increasing the yield. Mulching with green leaves @ 15 tonnes per ha immediately after planting and @7.5 tonnes per ha again 40 to 50 days after planting is necessary.

For healthy planting material of Ginger using pro-tray method

A transplanting technique in ginger using single bud sprouts (about 5 g) has been standardized to produce good quality planting material with reduced cost. The yield level of ginger transplants is on-par with conventional planting system. The technique involves raising transplants from single sprout seed rhizomes in the pro-tray and planted in the field after 30-40 days.

Technology

- * Select healthy ginger rhizomes for seed purpose
- * Treat the selected rhizomes with mancozeb (0.3%) and quinalphos (0.075%) for 30 min and store in well ventilated place
- * One month before planting, the seed rhizomes are cut into single buds with small piece of rhizomes weighing 4-6 g.

- * Treat the single bud sprouts (mancozeb 0.3%) for 30 min before planting
- * Fill the pro-trays (98 well) with nursery medium containing partially decomposed coir pith and vermicompost (75:25), enriched with PGPR/Trichoderma 10g/kg of mixture
- * Plant the ginger bud sprouts in pro-trays
- * Maintain the pro-trays under shade net house
- * Adopt need based irrigation with rose can or by using suitable sprinklers
- * Seedlings will be ready within 30-40 days for transplanting

Advantages of protray method

- * Less planting material requirement (500-750 Kg/ha), hence savings on seed cost
- * 98-100 % field establishment

Tree Spices

Pits of 90 cm cube may be dug with the onset of South-West monsoon for fresh planting. A spacing of 6 m x 6 m for Clove, 8 m x 8 m for Nutmeg and 2 m x 2 m for Cinnamon may be adopted. The pits may be filled with top soil and compost or well decomposed cattle manure. Planting may be done after the receipt of sufficient rains.

Irrigation may continue till the receipt of regular rains. With the receipt of sufficient

summer showers, 40 to 50 kg cattle manure or compost and fertilizers to supply N, P₂O₅ and K₂O at the following rates may be applied.

Fertilizers may be applied in graded doses for young plants. The manures may be applied in shallow trenches dug sufficiently away from the base of the tree.

Chilli

Chilli is a transplanted crop. Seeds are sown in the nursery and one month old seedlings are transplanted in the main field. For sowing the seeds, raised seed beds of 90 to 100 cm width and of convenient length are prepared to which well decomposed organic matter has to be incorporated. Certified and healthy seeds of selected varieties about 1.0 -1.5 kg treated with Captan or Thiram or Carbendazim @ 2-3 gm/kg seed should be sown for transplanting of seedlings in 1 ha. After sowing the seeds, mulch the beds with green leaves and irrigate with a rose-can carefully daily in the morning as well as evening. Remove the mulch immediately after germination of the seeds. Restrict irrigation one week before transplanting and irrigate heavily on previous day of transplanting. A fertilizer dose of 75:40:25 kg N, P₂O₅, K₂O/ha may be given in the main field. Half of Nitrogen, full Phosphorous and half Potash may be applied as basal dose before transplanting.

	N gm	P ₂ O ₅ gm	K ₂ O gm	
Clove	150	125	375	per plant of 15 years old
Nutmeg	250	125	500	-do-
Cinnamon	100	90	100	per plant of 10 years old

बाज़ार समीक्षा (अक्टूबर – दिसंबर, 2019)

सुपारी

समीक्षाधीन तिमाही के दौरान लगभग सभी बाज़ारों में सूखी सुपारी के मूल्य में मिश्रित प्रवृत्ति देखी गई। कोची में इस अवधि के दौरान सुपारी के मूल्य में स्थिरता एवं मजबूती की रुख दिखाई पड़ी। कोषिकोड में दिसंबर, 2019 के अंत में सूखी सुपारी के मूल्य में 22,500 रुपए प्रति क्विंटल से 20,000 रुपए प्रति क्विंटल की गिरावट हुई। इसी अवधि के दौरान मैंगलोर में चोल सुपारी और नई सुपारी की कीमत में वृद्धि की प्रवृत्ति दर्ज किया गया और इनकी औसत कीमत क्रमशः 26,385 रुपए तथा 19,808 रुपए प्रति क्विंटल था। समीक्षाधीन तिमाही के दौरान गोवा में चाली (पुरानी) के मूल्य में 4,000 रुपए प्रति क्विंटल की वृद्धि हुई।

काली मिर्च

बाज़ारों में काली मिर्च के मूल्य में वृद्धि की प्रवृत्ति दिखाई पड़ी। कोची बाज़ार में अनगारबल्ड काली मिर्च का भाव, जो अक्टूबर, 2019 के प्रथम सप्ताहांत के दौरान 32,300 रुपए प्रति क्विंटल था, ह दिसंबर, 2019 के अंतिम सप्ताहांत के दौरान बढ़कर 33,300 रुपए प्रति क्विंटल हो गया। कोषिकोड बाज़ार में नाडन और वयनाडन काली मिर्च के भाव में वृद्धि की प्रवृत्ति दिखाई पड़ी। इस अवधि के दौरान कोट्टयम में काली मिर्च की कीमतों में उतार-चढ़ाव की प्रवृत्ति देखी गई।

अदरक

प्रायः सभी बाज़ारों में अदरक की कीमत

MARKET REVIEW (October to December, 2019)

ARECANUT

Arecanut (dry) price has expressed a mixed trend in almost all the markets during the quarter under review. In Kochi, the price of arecanut showed a steady to firm trend during the period under review. In Kozhikode, arecanut (dry) prices decreased from Rs. 22,500/quintal to Rs. 20,000/quintal by the end of December, 2019. In Mangalore, the prices of choll supari and new supari registered an increasing trend and ruled at an average of Rs.26,385/quintal and Rs.19,808/quintal respectively during the same period. In Goa also the price of Chali(old) increased by Rs.4,000/quintal in the period under review.

BLACK PEPPER

Pepper market witnessed an increasing trend in prices. The price of ungarbled black pepper in Cochin market, which was Rs. 32,300/quintal during the first weekend of October, 2019, had increased to Rs. 33,300/quintal during the last weekend of December, 2019. In Kozhikode market, the prices of both Nadan and Wayanadan pepper showed an increasing trend. In Kottayam, the pepper prices showed a fluctuating trend during the period under review.

GINGER

Ginger prices displayed a mixed trend in almost

में मिश्रित प्रवृत्ति दिखाई पड़ी। समीक्षाधीन अवधि के दौरान कोची में सूखे अदरक के दाम में 500 रूपए प्रति क्विंटल वृद्धि हुई। कोषिककोड में भी इसी अवधि के दौरान सूखे अदरक की कीमत स्थिर रहा और ताजे अदरक में गिरावट हुई। समीक्षाधीन तिमाही के दौरान बेंगलुरु बाज़ार में ताजे अदरक के दाम में गिरावट हुई।

मिर्च

समीक्षाधीन अवधि के दौरान टूटिकोरिन और बेंगलुरु बाज़ार में मिर्च के मूल्य में वृद्धि की प्रवृत्ति देखी गई। दिसंबर, 2019 के अंत में चेन्नै बाज़ार में मिर्च (रामनाड किस्म) का मूल्य स्थिर रहा और सम्बा- II किस्म के मूल्य में 2,800 रूपए प्रति क्विंटल की वृद्धि हुई।

हल्दी

समीक्षाधीन अवधि के दौरान कोची बाज़ार में हल्दी की कीमत में स्थिरता एवं मजबूती की रुख देखी गई और इसकी कीमत 11,000 रूपए प्रति क्विंटल थी। तिमाही अंत के दौरान चेन्नै बाज़ार में ईरोड एवं। सेलम हल्दी के भाव में गिरावट हुई।

लहसुन

समीक्षाधीन अवधि के दौरान बेंगलुरु बाज़ार में लहसुन के भाव में 4,650 रूपए प्रति क्विंटल की वृद्धि दर्ज की गई।

बीजीय मसाले

अक्टूबर से दिसंबर, 2019 के दौरान जीरा के दाम में मिश्रित प्रवृत्ति देखी गई। इसी अवधि के दौरान धनिया की कीमत में गिरावट

all the markets. The price of dry ginger in Kochi increased by Rs.500/quintal for the period under review. In Kozhikode, the prices of dry ginger remained stable but that of fresh ginger registered a decreasing trend during the same period. Fresh ginger prices in Bangalore market also showed a declining trend during the period under review.

CHILLI

Chilli prices in Tuticorin and Bangalore markets showed an increasing trend during the period under review. In Chennai market, chilli prices (Ramnad variety) remained stable and that of Samba- II variety increased by Rs.2,800/quintal by the end of December, 2019.

TURMERIC

Turmeric prices in Cochin market showed a steady to firm trend and the price ruled at Rs.11,000/quintal during the period under review. In Chennai market, the price of Erode and Salem Turmeric has decreased towards the end of the quarter.

GARLIC

Garlic prices showed an increasing trend in Bangalore market and the price registered an increase of Rs. 4,650/quintal during the period under review.

SEED SPICES

The market witnessed a mixed trend in Cumin prices in Chennai market during October to December, 2019. Coriander price

हुई। धनिया की कीमत 10,000 से 9,650 रूपए प्रति क्विंटल तक घट गई।

displayed a decreasing trend. The price of coriander decreased from Rs. 10,000/quintal to Rs. 9,650/quintal during the period.

जायफल / जावित्री और लौंग

समीक्षाधीन अवधि के दौरान (छिल्का सहित और छिल्का रहित) जायफल के दाम में मिश्रित प्रवृत्ति देखी गई। लेकिन अक्टूबर से दिसंबर, 2019 के दौरान जावित्री की कीमत 10,000 रूपए प्रति क्विंटल में घट गई।

NUTMEG, MACE & CLOVES

The prices of Nutmeg (with shell and without shell) showed mixed trend during the period under review. But the prices of Mace decreased by Rs.10,000/quintal during the time period from October to December, 2019.

भारत तथा विदेश के प्रमुख बाज़ार केन्द्रों में सुपारी और मसाले के साप्ताहिक थोक भाव नीचे तालिका में दिया गया है।

Week-end wholesale prices of arecanut and spices recorded in the major market centers of India are appended in the following tables.

WEEKLY WHOLESALE PRICES OF ARECANUT

KERALA		(Rs./quintal)		
Month	Week	Kochi Dry	Thalassery New	Kozhikode Dry (Old)
Oct-19	1 st	19500	22000	22500
	2 nd	19500	22000	22700
	3 rd	19500	22800	22800
	4 th	19500	23200	23000
Nov-19	1 st	19500	23200	19200
	2 nd	19500	23200	19200
	3 rd	19500	25000	21000
	4 th	19500	25200	21000
	5 th	19500	26000	22000
Dec-19	1 st	19500	27800	23500
	2 nd	19500	27500	22500
	3 rd	19500	24700	20000
	4 th	19500	24500	20000

Source : District Economics and Statistics Office, Ernakulam; Regional Statistical Office, Kozhikode.

KARNATAKA, TAMIL NADU & GOA

(Rs./quintal)

Month	Week	Mangalore		Chennai Rashi	Goa Chali (Old)
		Choll Supari	New Supari		
Oct-19	1 st	25000	19500	21800	23200
	2 nd	25000	19500	22500	23500
	3 rd	25000	19500	22500	23500
	4 th	25000	19500	22500	23600
Nov-19	1 st	27000	19500	22500	23600
	2 nd	27000	20000	22500	24300
	3 rd	27000	20000	22500	24900
	4 th	27000	20000	23500	24900
	5 th	27000	20000	23500	24900
Dec-19	1 st	27000	20000	23500	26700
	2 nd	27000	20000	23500	27200
	3 rd	27000	20000	23500	27200
	4 th	27000	20000	22500	27200

Source: Agricultural Produce & Marketing Committees (APMC), Mangalore, Economics & Statistics, Chennai, Directorate of Marketing, Goa.

WEEKLY WHOLESALE PRICES OF BLACK PEPPER (Rs./Quintal)

Month	Week	Kochi Ungarbled	Kozhikode		Kottayam
			Nadan	Wayanadan	
Oct-19	1 st	32300	29000	31000	35000
	2 nd	32100	29000	31000	35000
	3 rd	31400	28500	30500	34500
	4 th	29900	28500	30500	34500
Nov-19	1 st	29800	28000	30000	34000
	2 nd	30800	28000	31500	34500
	3 rd	31900	30000	31500	35000
	4 th	32700	30000	33000	35000
	5 th	32300	31000	33000	37000
Dec-19	1 st	33300	30000	32000	35000
	2 nd	33600	31000	33000	36000
	3 rd	33700	31000	33000	35000
	4 th	33300	30000	32000	35000

Source: District Economics & Statistics, Ernakulam & Kottayam, Regional Statistical Office, Kozhikode .

WEEKLY WHOLESALE PRICES OF GINGER (DRY) (Rs./Quintal)

Month	Week	Kozhikode		Kochi	Chennai	Bangalore
		Dry	Fresh	Dry	Dry (white)	Fresh
Oct-19	1 st	22000	10000	26000	31500	5350
	2 nd	22000	14000	26000	29500	5350
	3 rd	22000	12000	26000	29000	5350
	4 th	22000	9000	26000	29000	5350
Nov-19	1 st	22000	10000	26000	30500	3100
	2 nd	22000	4200	26000	30500	3100
	3 rd	22000	4500	26000	30500	3100
	4 th	22000	4500	26000	31500	3100
	5 th	22000	4500	26000	33500	3100
Dec-19	1 st	22000	5500	26000	32500	3000
	2 nd	22000	5000	26500	32000	3000
	3 rd	22000	5500	26500	32000	3000
	4 th	22000	6000	26500	32000	3000

Source: Regional Statistical Office, Kozhikode; Economics & Statistics, Ernakulam; Department of Economics and Statistics, Chennai, APMC, Bangalore.

WEEKLY WHOLESALE PRICES OF CHILLI (Rs./Quintal)

Month	Week	Tuticorin Samba - I	Bangalore	Chennai	
				Ramnad	Samba-II
Oct-19	1 st	14000	15000	13500	13500
	2 nd	14000	15000	13500	13500
	3 rd	14000	15250	13500	14000
	4 th	14000	15250	13500	14000
Nov-19	1 st	14000	15200	13500	9500
	2 nd	14000	15250	13500	9500
	3 rd	14000	15250	13500	9500
	4 th	14000	15250	13500	9500
	5 th	14000	15000	13500	9500
Dec-19	1 st	14000	15650	13500	15000
	2 nd	14500	15650	13500	15400
	3 rd	14500	15650	13500	15800
	4 th	17000	15650	13500	16300

Source: Directorate of Marketing, Tuticorin; APMC, Bangalore; Dept. of Economics and Statistics, Chennai.

WEEKLY WHOLESALE PRICES OF TURMERIC					(Rs./Quintal)
Month	Week	Chennai		Kochi	Bangalore
		Erode	Salem	Dry	
Oct-19	1 st	11000	10500	11000	10500
	2 nd	10000	10500	11000	10500
	3 rd	10000	10500	11000	10500
	4 th	9500	10000	11000	10500
Nov-19	1 st	9500	10000	11000	10150
	2 nd	9500	10000	11000	10150
	3 rd	9500	10000	11000	10150
	4 th	9500	10000	11000	10150
	5 th	9500	10000	11000	10150
Dec-19	1 st	9500	10000	11000	10400
	2 nd	9500	10000	11000	10400
	3 rd	9500	10000	11000	10500
	4 th	9500	10000	11000	10500

Source: Dept. of Economics and Statistics, Chennai; Economics and Statistics, Kochi; APMC, Bangalore.

WEEKLY WHOLESALE PRICES OF MAJOR SEED SPICES & GARLIC (Rs./Quintal)

Month	Week	Coriander	Cumin	Garlic
		Rajasthan Green Bangalore	No.1 Chennai	Medium Bangalore
Oct-19	1 st	10000	19000	7850
	2 nd	6850	19000	7850
	3 rd	10000	18500	8800
	4 th	10000	18500	9250
Nov-19	1 st	9650	18000	9250
	2 nd	9650	18500	9250
	3 rd	9650	18000	9250
	4 th	9650	16500	9250
	5 th	9650	18000	9250
Dec-19	1 st	9650	18500	9750
	2 nd	9650	19000	12500
	3 rd	9650	19000	12500
	4 th	9650	19000	NT

NT - No Trade

Source: APMC, Bangalore & Dept. of Economics & Statistics, Chennai.

WEEKLY WHOLESALE PRICES OF NUTMEG & CLOVE (Rs./Quintal)

Month	Week	Thrissur			
		Nutmeg		Mace	Clove
		with shell	without Shell	Yellow	
Oct-19	1 st	28000	42000	180000	66000
	2 nd	28000	42000	170000	63000
	3 rd	25000	46000	170000	62000
	4 th	25000	46000	170000	61000
Nov-19	1 st	26000	43000	175000	62000
	2 nd	26000	45000	175000	64000
	3 rd	27000	47000	180000	65000
	4 th	26000	45500	180000	64000
	5 th	26500	45500	175000	63000
Dec-19	1 st	25000	44000	170000	61000
	2 nd	26000	44000	175000	63000
	3 rd	26000	44000	170000	62000
	4 th	26000	46000	170000	63000

Source: Economics and Statistics, Thrissur.

**STATEMENT OF OWNERSHIP AND OTHER PARTICULARS ABOUT THE JOURNAL
“INDIAN JOURNAL OF ARECANUT, SPICES AND MEDICINAL PLANTS”**

**FORM IV
(See Rule 8)**

1. Place of Publication : Calicut, Kerala State
2. Periodicity of its Publication : Quarterly (January-March, April-June,
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I, Homey Cheriyan, hereby declare that the particulars given above are true to the best of my knowledge and belief.

(Sd/-)
(Homey Cheriyan)
(Publisher)

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