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Cashworthy Companion of Konkan Farmers: Cashewnut

R. C. Gajbhiye[1]*, R. Gavit[1], B. R. Salvi[2], R. S. Varadkar[1], V. K. Patil[3], A. D. Rane[3], A. A. K. Dosani[4], P. M. Haldankar[4] and T. Bhattacharyya[4]

[1]Regional Fruit Research Station (DBSKKV), Vengurle, Maharashtra (India) 416516
[2]College of Agriculture (DBSKKV), Dapoli, Maharashtra (India) 415712
[3]College of Forestry (DBSKKV), Dapoli, Maharashtra (India) 415712
[4]Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra (India) 415712

Abstract

Under changing climatic conditions of Konkan region when mango crop find very difficult to record sustainable production and productivity Cashew offers sustainable production. Though the comparative returns are less but surety gives promise to the farmers. If cashew is cultivated to rainfed without any management production the productivity is hardly 647 kg ha^{-1}. However, it is cultivated as per the recommended technologies of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli like improved varieties V-4,V-7,V-9; fertilizes application, irrigation, canopy management, intercropping with tuber crops and proper plant protection measures the cashew records average productivity of 1,378 kg ha^{-1}. which is more than double. This is proven fact in Konkan region with more than 1.7 lakh hectare area. This all has helped to Doubling Farmers Income.

Keywords: Doubling Farmers' Income, DFI, cashew, yield, area, production.

Introduction

Cashew (*Anacardium occidentale* L.) a native of Brazil, was introduced in India during 16th century for the purpose of soil conservation, as cashew is hardy crop. It ranks second among horticultural commodities contributing 1.5 per cent of the total export earning of the country. India has an area of 10.41 lakh ha under cashew with production of 7.79 lakh tones during 2016-17. India is the second largest exporter of cashew in the world. The current production accounts for nearly 25% of the global production.Maharashtra ranks first in cashew area (1.86 lakh ha) and production (2.56 lakh tonnes) with productivity (1,378 kg ha^{-1}) in the country and contributing 17.90% in terms of overall area and 32.92% of total cashew nut production in the country (2016-17 season). In Maharashtra, 90% of cashew plantation is in Konkan region.

In Konkan region, initially cashew was introduced as a soil conservation crop on marginal land. However, after realization of its potential, it was promoted as a commercial plantation crop to strengthen the economy of marginal farmers of the region. Assured rainfall, hot and humid climate and well-drained soil, undulating and sloping terrain of the Konkan region is very much conducive for its cultivation in the region. Cashew gives four to five times more returns per unit area than the traditional cereal crops in the Konkan. The Government of Maharashtra launched an ambitious Employment Guarantee Scheme linked with horticultural plantation in state from 1990-1991 which resulted in an exponential increase of area under cashewnut in the Konkan region. The cashewnut produced in Konkan region possess great demand from processors and fetch premium price in the market. It is estimated that Konkan region of Maharashtra exports about 15% of Indian cashew export worth ₹ 370 crores.

The cashew kernels are used in confectionery and dessert. The shells contain high quality oil known as cashewnut shell liquid (CSNL) which has got wide industrial uses. Cashew apple is eaten fresh or mixed in fruit salads and a drink is prepared from the juice. Cashew apple can be distilled to produce alcoholic drinks (*Fenni*). Seed coats (testa) are used as poultry feed. The residue of the shell after the extraction of CNSL is used as fuel. Cashew wood is used as fuel or a low quality timber. Wounded trees exude a gum which is used as an adhesive.

Need to enhance cashew nut production

There is an ever-increasing demand for cashew kernel both in international and domestic market. Countries such as Vietnam and Brazil are giving tough competition

***Corresponding author**: rcgajbhiye@yahoo.com
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to India in the international market, as exporters of kernel. Since African countries have started processing their raw nut themselves, its availability in global market will gradually decline. Hence, there is an urgent need to increase the domestic raw cashewnut production. The increase in raw nut production is essential to meet the present and future demand of cashew industries in order to feed its large number of cashew processing industries and to keep them running for most period of the year. Further, the raw cashewnuts have to be produced at cheaper rate in order to compete with other cashew growing countries of the world. It is also important to develop and expand domestic market for cashew kernels so that there will be continued good price for the nuts and there by farmers would be encouraged to grow cashew. Unless good price is offered to the raw cashewnuts, farmers may switch over to other crops.

The compound annual growth rate in area under cashew was the highest in Maharashtra (7.54%) followed by Andhra Pradesh (5.26%) and Orissa (4.20%). In India, cultivation of cashew is confined to Kerala, Karnataka, Goa and Maharashtra along the west coast and Tamil Nadu, Andhra Pradesh, Orissa and West Bengal along the east coast. To a limited extent it is being cultivated in Chattisgarh, North Eastern states and Andaman and Nicobar Islands. Area under cashewnuts in India increased by 53 per cent from 5.65 lakh ha during 1993-94 to 9.23 lakh ha during 2009-10. The compound annual growth rate in production was the maximum in Maharashtra (10.81%) followed by Tamil Nadu (7.30%) and Orissa (6.24%). The yield of cashewnut in India increased from 694 kg ha^{-1} during 1993-94 to 695 kg ha^{-1} during 2009-10. Cashew prices in Goa are higher as compared to other states because of the large size of nuts as compared to the nuts of other states (Kulkarni *et al.* 2012).

Reasons of low productivity in cashew

- Most cashew plantations are being seedling in origin of non descript types and senile in condition.
- Planted under degraded lands and are in neglected conditions.
- Non-adoption of package of practices. However, some farmers adopted the technologies to some extent only.
- Often heavy yield loss due to tea mosquito bug (TMB) and tree death due to cashew stem and root borer (CSRB).
- Absence of dwarf and compact high yielding varieties suitable for high density planting.
- Inadequate transfer of technology.

Cashew Technologies Developed by Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli for Konkan region:

High yielding varieties

In view of the need for stepping up the production and maintain permanent position in the global market, it felt necessary to develop varieties either through selection or breeding which could produce high yield per unit tree canopy, bold nut size with high shelling conforming the requirement of internal market.With the efforts of different Cashew Research Centres in the country, a total of 43 cashew varieties (28 selections and 15 hybrids) have been released for commercial cultivation in India (Bhat *et al*. 2016).

AICRP, RFRS, Vengurle released 9 varieties out of which Vengurla 1 and Vengurla 2 are selections and Vengurle 3 to Vengurle 9 are hybrids (Table 1).

However, the varieties Vengurla-2 and Vengurla- 5 (small sized nut) and Vengurla-3 (low shelling percentage) are not recommended by university.

The varieties Vengurla-4 and Vengurla-7 have more wide adaptability and more demand in almost all the cashew growing states in India. The variety Vengurla-8

Table 1. Varieties of cashew released by Regional Fruit Research Station, Vengurle and their yield

Variety	Apple weight (g)	Nut weight (g)	Yield (kg $tree^{-1}$)	Shelling %
Vengurla 1	60	6.25	16	31
Vengurla 2	37	4.35	23	32
Vengurla 3	78	9.09	17	27
Vengurla 4	46	7.69	19	31
Vengurla 5		4.50	25-26	30
Vengurla 6	70	8.90	17	29
Vengurla 7		10.00	18-20	30
Vengurla 8	100	11.50	17	28
Vengurla 9	72.9	8.90	16	29.5

has demand mostly from Goa state due to large sized cashew apple having 86% juice recovery and it is widely used for fenny making.

Availability of planting material

The large number of cashew nurseries (Government and Private) were established in Maharashtra after 1990. For rapid multiplication of the improved varieties an exhaustive work on standardization of vegetative propagation technique was undertaken and softwood grafting technique was standardized for propagation on commercial scale (Fig. 1). In Konkan region, nurserymen have extensively adopted this easy, cheap and rapid softwood grafting method and are raising 50,000-1,00,000 cashew nut grafts annually valued ₹ 200-400 lakh in every nursery.

However, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli every year supplies about 5,00,000 genuine quality grafts of high yielding cashew varieties.

Total 25.87 lakh grafts of high yielding cashew varieties (V-4, V-6, V-7, V-8 & V-9) have been supplied by Regional Fruit Research Station, Vengurle during 1992 to 2015 to cashew growers.

Integrated nutrient management

Cashew responds very well to fertilizer application. About 50 to 100 per cent increase in nut yield is commonly observed in this crop. Nitrogen is the key nutrient element for cashew nutrition followed by potassium. Fertilizers and manures promote growth of the plants and advance the onset of flowering in young trees. Application of 10-15 kg of farm yard manure or compost per plant is beneficial. The fertilizer recommendation for Maharashtra for high

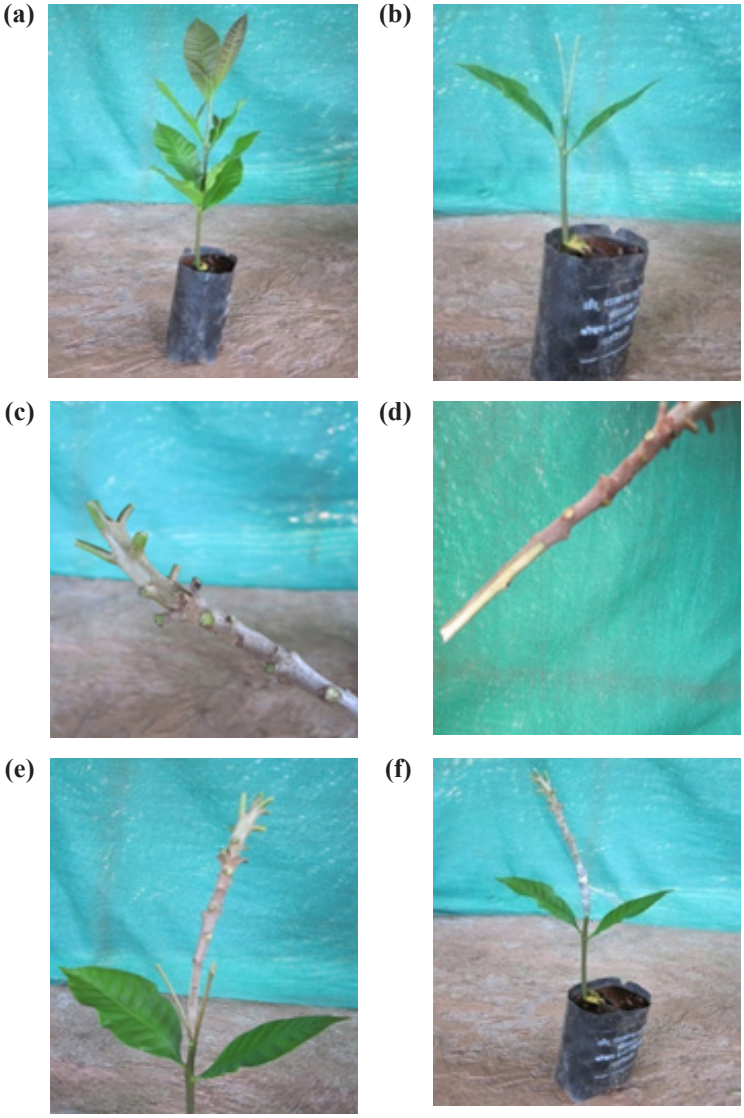

Fig. 1. Process of cashew graft preparation: (a) cashew seedling, (b) vertical cut on the stock, (c) mature scion stick, (d) V-shaped cut on scion stick, (e) scion grafted on rootstock, and (f) ready cashew graft.

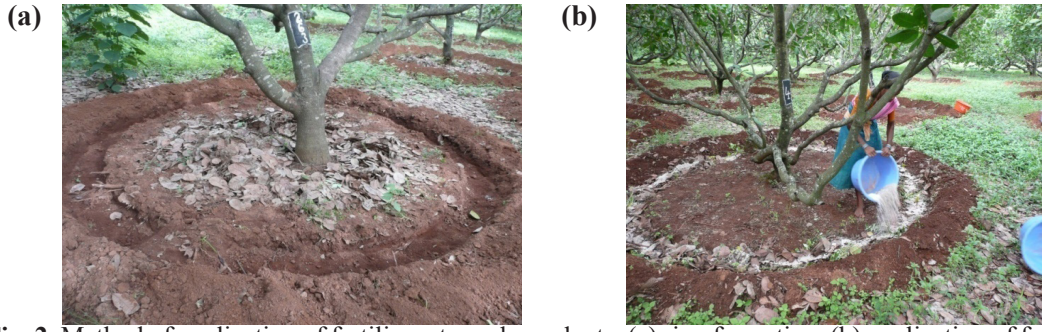

Fig. 2. Method of application of fertilizers to cashew plants: (a) ring formation, (b) application of fertilizer.

yielding cashew varieties is 1000 g N (2.2 kg urea), 250 g P_2O_5 (1.5 kg SSP) and 250 g K_2O (400 g MOP) for adult plant (4th year onward) per year (Table 2). It is always advisable to use straight fertilizers instead of complex fertilizers.

The ideal period for fertilizer application is immediately after the cessation of heavy rains, in a circular trench. While applying the fertilizers, it should be ensured that adequate moisture is available in the soil, so that the applied fertilizers are taken up by the plant. It is also suggested that fertilizers should be applied in two split doses during June-July and post monsoon (September-October) periods.

Placing of fertilizers at 1.5 m away from the trunk in the trenches of 25 cm width and 15 cm depth is suitable in high rainfall areas while in low rainfall area application in circular bands in 1.5 m width between 1.5 and 3 m distance from the trunk and incorporating in the soil was beneficial.

Table 2. Recommended doses of NPK fertilizers for cashew.

Year(s) after planting	FYM (Basket)	Recommended dose (g plant^{-1})					
		N	Urea	P_2O_5	SSP	K_2O	MOP
I	1	250	500	63	400	63	100
II	2	520	1000	125	800	125	200
III	3	750	1725	188	1250	188	300
IV	4	1000	2200	250	1500	250	400

Table 3. Yield of cashewnuts at different plant densities at two centres Vengurle and Jhargram centres of AICRP on Cashew Source: (Yadukumar *et al*. 2001)

Centres	Variety used	Duration	Tree density (trees ha^{-1})	Cumulative yield (t ha^{-1})
Vengurle (West Coast)	V-4	1990-2001	400 (5m x 5m)	5.142
		1990-2001	156 (8m x 8m)	2.116
Jhargram (East Coast)	Jhargram-1	1982-2001	400 (5m x 5m)	9.00
		1982-2001	352 (6m x 6m)	8.620
		1982-2001	156 (8m x 8m)	2.589

High density planting

High density planting (HDP) was found to be one of the efficient technique useful for enhancing the production, productivity and better economic returns per unit area in the initial years and also helped more efficient use of inputs in cashew plantations. This involves planting number of grafts per unit area and thinning out at later stages by selective felling during later years. The success in HDP depends on the decision making regarding the initial spacing and the time of thinning at later stages (Salam 1997).

In Maharashtra, the field experiment was conducted at Wakawali, Ratnagiri (Maharashtra) with cashew grafts of V-4 planted in 1990. The experiment included various tree densities with 50 % and 75 % thinning at various growth stages. High density planting at 5m x 5m (400 plants ha^{-1}) and normal planting systems at 10 m x 10 m (100 plants ha^{-1}) and 8 m x 8 m (156 plants ha^{-1}) were included. Similar planting density trials were conducted in Jhargram of West Bengal under AICRP coordinated project in 1982 by using seedling progeny of high yielding variety (Table 1). The yield obtained in density

Table 4. Effect of drip irrigation on growth and yield attributing characters of cashew at Vengurle (Gajbhiye *et al.* 2017)

Treatment	Plant height (m)	Stem girth (m)	Yield (kg tree^{-1})	Apple weight (g)	Nut weight (g)	Shelling (%)
T1 no irrigation	7.60	89.70	5.90	61.0	8.2	31.5
T2 irrigation 20% CPE	7.53	97.68	7.12	64.5	8.4	31.28
T3 irrigation 40% CPE	7.85	96.93	8.84	65.1	8.5	31.13
T4 irrigation 60% CPE	7.78	90.08	10.53	66.2	8.6	31.0
T5 irrigation 80% CPE	7.43	97.10	13.49	72.1	9.0	30.88
Mean	7.64	94.30	9.18	65.78	8.54	31.13
SEM	0.26	4.85	0.64	1.60	0.09	0.32
CD(5%)	0.82	14.96	1.99	4.93	0.28	NS

of 400 plants ha^{-1} was remarkably higher over low tree density treatments at both the locations (Yadukumar *et al*. 2001).

Irrigation

Cashew cultivated mostly under rainfed conditions. However, trials conducted at RFRS, Vengurle and DCR, Puttur by adopting various irrigation methods indicated that nut retention and yield was better in the irrigated plots.

Yield can be doubled through provision of protective irrigation of 200 l of water per tree once in 15 days from January to March during the summer season.

The experiment was carried out at RFRS Vengurle to see the effect of drip irrigation on the yield attributing characters of cashew. It is observed that application of 80% of CPE (T5) recorded that maximum yield (13.49 kg tree^{-1}), apple weight (72.10 g) and nut weight (9.0 g) was found superior over rest of the treatments.

It is seen from data, as the irrigation level increased, the yield levels also increased. The present result may be due to maximum water availability of water to the tree, particularly during the critical stage that also increased the availability of nutrients to the plants.

Foliar spray

Low productivity in cashewnut is closely associated with nutrient management. The foliar application of Amrashakti (multi-nutrient spray) is advised for obtaining higher yield in cashew. Low fruit set is one of the important factor for low yield, use of 100 ppm ethrel, and 5 % dry fish extract has been advised by the Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. For increasing the yield, spraying of 2 per cent urea is recommended along with insecticide solution at the time of emergence of vegetative flush (before flowering), flowering and fruit set.

A field trial was conducted at Regional Fruit Research Station, Vengurle to assess the efficiency of Ethrel in relation to flowering behavior and yield enhancement in seven year old cashew trees of V-7 during 2008-09. Three sprays of Ethrel 100 ppm, 200 ppm, 400 ppm along with water spray and control (no spray) were given before flushing, after flushing and during fruit set. Among the treatments, Ethrel @ 100 ppm significantly increased number of flowering panicles per meter square (12.0), number of perfect flowers per panicle (52.8), fruit

Table 5. Effect of Ethrel spray on growth and flowering in cashew

Treatment	No. of laterals before spray	No. of laterals after spray	Increase (%)	Flowering (panicles m^2)	Flowering duration (days)
T1 control	27.0	28.0	3.7	7.3	102.5
T2 water spray	26.0	32.0	23.1	7.3	101.3
T3 Ethrel 100 ppm	18.8	19.3	5.5	12.0	101.0
T4 Ethrel 200 ppm	20.3	20.5	1.0	10.0	104.0
T5 Ethrel 400 ppm	26.2	26.5	1.1	11.0	102.5
SEM	0.8	0.6		0.8	1.9
CD (0.05)	2.4	1.9		2.4	NS

Table 6. Effect of Ethrel spray on sex expression and yield in cashew (Gawankar *et al.* 2010).

Treatment	Staminate flowers (%)	Perfect flowers (%)	Fruit set (numbers m^{-2})	Yield (kg tree^{-1})	Weight of nut (g)
T1 control	96.4	3.6	17.3	0.88	8.2
T2 water spray	98.3	2.0	23.8	0.93	8.3
T3 Ethrel 100 ppm	82.0	18.0	28.8	1.51	8.5
T4 Ethrel 200 ppm	94.6	5.4	18.0	0.95	7.0
T5 Ethrel 400 ppm	88.4	11.6	18.0	0.88	8.2
SEM	1.5	1.4	1.4	0.06	0.4
CD (0.05)	4.7	4.2	4.3	0.19	NS

set per meter square (28.8), number of nuts per panicle (2.9) and yield per tree (1.51kg) than control and water spray. Thus, lower concentration of Ethrel had beneficial effect on cashew.

Intercropping

Cashewnut is a perennial crop and farmers earn money only once in year. Further, the land and other resources are being utilized only for sole crop of cashewnut. Farmers need the additional income from the same land with growing suitable intercrops without hampering the yield of cashewnut. It also helps as an insurance against main crop failure under adverse condition. Intercrop system utilizes resources efficiently to increase the productivity. Intercropping of vegetables like, cucumber, ridge guard, bitter guard, snake guard and sponge guard in the initial non-bearing period of orchard during *kharif* season is recommended. However, feasibility of intercropping in well grown cashew orchard has not been studied so far in the Konkan region.

An experiment was conducted to study intercropping in well grown cashewnut plantation at Cashew Farm, Regional Fruit Research Station, Vengurle in Sindhudurg district by using different tuber crops.

The experiment on Intercropping in cashew was conducted during 2015-16 and five different intercrops such as Lesser Yam, Greater Yam, Aerial Yam, Elephant foot Yam and Tapioca were tested in old cashew plantation. On the basis of six years pooled data it is revealed that the Elephant foot yam intercropping system in cashew nut plantation produced significantly the highest total yield of 4.05 t ha^{-1} and followed by Greater yam (3.63 t ha^{-1}). Economics of different intercropping systems in cashewnut revealed that the Elephant foot yam intercropping noticed highest net returns of ₹ 3,75,003 ha^{-1} with B:C ratio of 4.38, followed by Cashew + Greater yam intercropping with net return of ₹ 3,25,462 ha^{-1} and B:C ratio 3.95. The highest additional net returns (realization over control) of ₹ 2,49,273 ha^{-1} was obtained from Elephant foot yam (T_4) and it was followed by Greater yam (₹ 1,99,732 ha^{-1}) (Table 7). It is recommended to grow elephant foot yam or greater yam as an intercrop in well grown cashewnut plantation for getting the higher returns during *kharif* season in Konkan region.

Intercrops like cowpea, french bean, cluster bean, rice bean, red bean, mung bean, soybean and groundnut could be grown along with cashew to get additional profit (Gupta 1999). Maize and groundnut can be grown successfully as intercrops in newly-planted and two year-old cashew orchards (Abeysinghe *et al.* 2003). Intercropping cashew with pineapple, turmeric or elephant foot yam under normal density planting system during the first five years increased net benefit from cashew gardens (Yadukumar *et al*. 2003; Fig. 3). Weed suppression was best in plots carrying cashew / cassava and cashew / plantation / cassava mixtures with 50-60% reduction in frequency of weeding per annum (Adeyemi 1998).

Training and pruning

Training during the first two years is essential for better scion growth and for better canopy development. During the initial phase, shoots arising on the rootstock have to be regularly removed to promote better scion growth. Scion rejection could occur if rootstock shoots are left unchecked. Training in the juvenile phase comprises of

Table 7. Economics of different intercropping systems in cashewnut plantation. (Selling prices: Lesser Yam ₹ 60 kg^{-1}; Greater Yam ₹ 60 kg^{-1}; Aerial Yam ₹ 80 kg^{-1}; Elephant Foot Yam ₹ 60 kg^{-1}; Tapioca ₹ 10 kg^{-1}; Cashew ₹ 120 kg^{-1})

Treatment	Total yield (t ha^{-1})	Cashew COC (Rs ha^{-1})	Intercrop COC (Rs ha^{-1})	Total COC (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	Add. Net returns from intercrop (Rs ha^{-1})	B: C ratio
T_1 C + LY	2.27	48,960	59,521	1,08,481	2,72,400	1,63,919	38,189	2.51
T_2 C + GY	3.63	48,960	61,178	1,10,138	4,35,600	3,25,462	1,99,732	3.95
T_3 C + AY	2.66	48,960	40,669	89,629	3,19,200	2,29,571	1,03,841	3.56
T_4 C + EFY	4.05	48,960	62,037	1,10,997	4,86,000	3,75,003	2,49,273	4.38
T_5 C + T	1.49	48,960	33,922	82,882	1,78,800	95,918	-29,812	2.15
T_6 Cashew alone	1.46	48,960	0	48,960	1,74,690	1,25,730	0	3.57

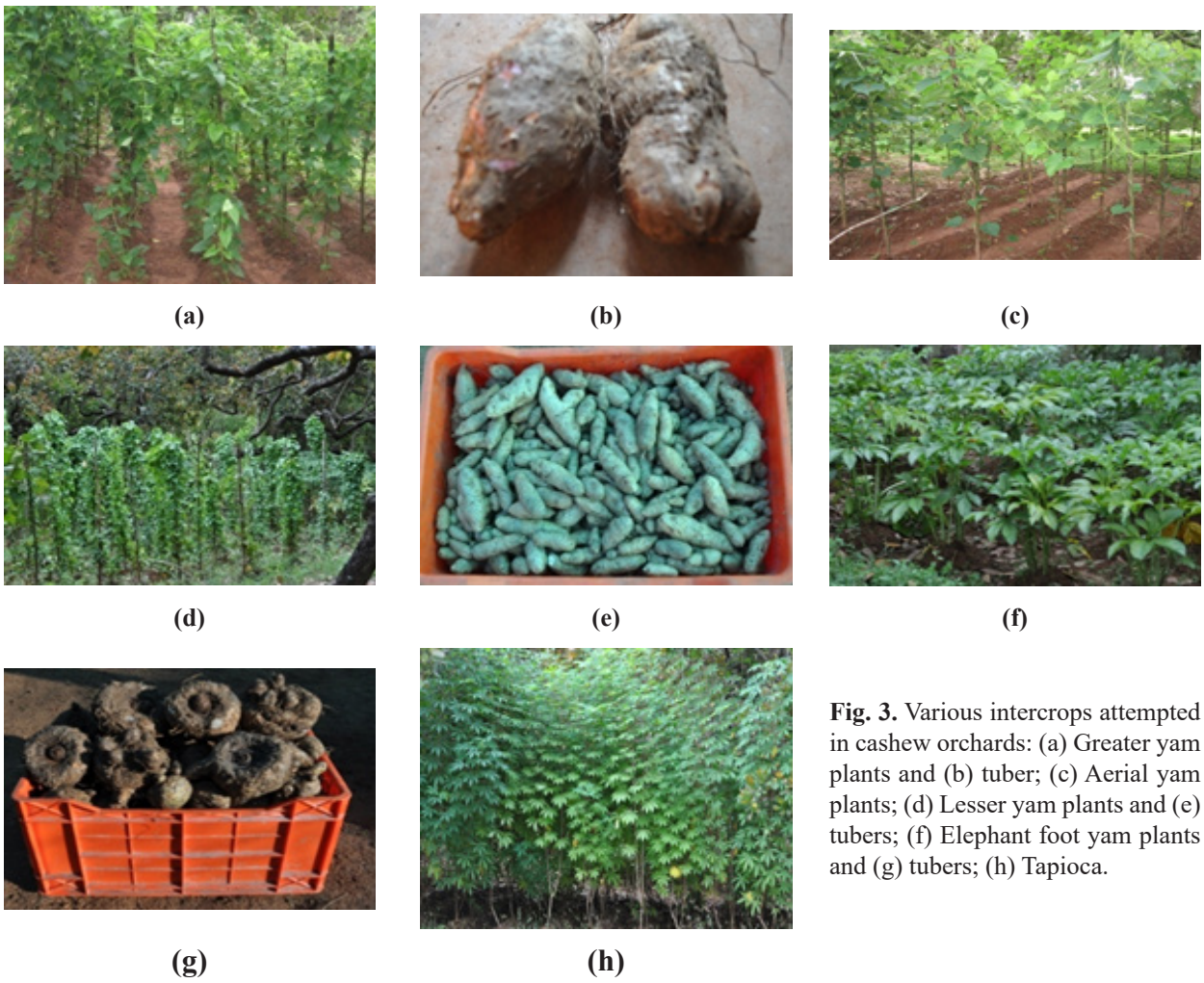

Fig. 3. Various intercrops attempted in cashew orchards: (a) Greater yam plants and (b) tuber; (c) Aerial yam plants; (d) Lesser yam plants and (e) tubers; (f) Elephant foot yam plants and (g) tubers; (h) Tapioca.

removing basal branches and water shoots. The plants are trained as single stem by removing all side shoots up to the height of 0.75 to 1 m from ground level and then 3-4 branches are allowed to grow and attention should be given for canopy become umbrella shape.

Soil and water conservation measures

Use of staggered trenches for cashew plantation on sloping land of Southern Konkan for soil and water conservation. Keep 4.5 m long trenches having top-width of 0.6 m and bottom width of 0.3 m with depth of 0.3 m. There should be 230 trenches per hectare.

Rejuvenation of old senile orchard by top working

Generally the old cashew trees are of seedling origin and non descript having very low productivity and to convert these trees in to high yielding varieties rejuvenation is carried out. Old and very low yielding trees of elite varieties are selected and their major branches are detopped to 1.00-1.50 m height from the ground. The stump should be sprayed with 0.2% Chlorpyriphos to prevent the egg laying by CSRB.

If the old trees have gone senile due to their origin from poor performing trees, then such trees can be rejuvenated by heading back and then top grafting with elite scion shoots on the new sprouts, arising from the remaining portion of the trunk which is called as “Top working”.It is done in 2-3 months, about 15-20 sprouts on different branches at different directions may be grafted with the required variety of scion sticks. Sprouts are grafted by employing softwood grafting.

Plant protection

Tea mosquito bug (TMB)

Incidence of Tea mosquito bug on cashew occurs at new flushing, flowering and fruitingstages during September to April and causes crop losses ranging from 20-60 per cent.

Symptoms: the tissues around the attacked portion develop necrotic patches and the necrotic patches coalesce resulting in drying up of shoots. Severely affected branches may leads to fungal infection causing "die back" disease.

Control : Endosulphan or monocrotophos @ 0.05% or carbaryl @ 0.1% at the time of emergence of new flushes, panicles and fruit set, was effective in controlling tea mosquito bug.

Cashew stem and root borer

The stem borer of cashew is capable of killing the tree outright.

Symptoms: presence of small holes in the collar regions, gummomsis, extrusion of frass through holes, yellowing and shedding of leaves, drying of twigs and final death of the tree.

Control: mechanical removal of grub and pupa during initial stages of infestation and swabbing of the trunk and exposed roots with carbaryl @ 0.2% or drenching the soil around the trunk with 0.2% carbaryl solution. Application of phorate granules 10 g tree^{-1}.

Value addition

Cashew is commercially grown for its kernels; although cashew nut shell liquid (CNSL) and apple are also valuable byproducts and can be used.

Value addition in kernel

Commercial processing of cashew either by steam roasting or drum roasting results in kernels of different grades such as wholes, bits, pieces, etc. Cashew kernel baby bits are obtained to an extent of 0.5 to 1 per cent when nuts are processed by steam roasting. Attempts have been made at National Research Centre for Cashew, Puttur, Karnataka to develop value added products from the cashew kennel baby bits. Milk and spread could be prepared from cashew kernel baby bits. Cocoa flavoured and sweetened milk could be reconstituted from the cashew kernel paste prepared and storage of this paste up to 34 days at <0 °C had no effect on organoleptic quality and composition of the milk prepared

Value addition in Cashew apple

Beverages

i) Fresh apple beverages

Several nutritious and refreshing beverages like clarified and cloudy juice, juice concentrate, squash and syrup can be made from the unfermented juice of cashew apple by adding varying concentrations of sugar, citric acid and preservative. Kerala Agricultural University has standardized the technique for the preparation of juice, syrup and ready to serve drink. The Cashew Research Station, Madakkathara is manufacturing cashew apple syrup and a ready to drink form "cashew apple drink" on a commercial scale and selling through the sales outlets of the university. Sri Lankan Cashew Corporation has standardized an RTS beverage named 'Cashola' (Mathew *et al*. 2010).

ii) Fermented beverage

Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli have standardized technologies for utilization of cashew apple for the manufacture of the fermented products like wine.

Cashew apple vinegar can be prepared by alcoholic and subsequent acetic fermentation of juice, which is perhaps the oldest known fermentation product. Cashew liquor is not made by blending of spirits, as done in case of foreign liquor, but distilled exclusively from the pure juice of cashew apple without addition of any extraneous matter.

Goa is the only place in India where cashew apples are utilized widely for the preparation of the liquor "*fenny*" by distillation mostly through crude country methods on cottage industry basis in almost all plantations.

iii) Pulp products

The most important pulp product of cashew is jam. It can be prepared by boiling the cashew fruit pulp with a sufficient quality of sugar and a pinch of citric acid to a reasonably thick consistency, firm enough to hold fruit tissues in position. Mixed fruit jam can also be prepared by mixing cashew apple pulp with equal quantity of banana pulp or pineapple pulp. The Madakkathara Centre is commercially producing Cashew apple-Mango Mixed jam named Cashewman (Mathew *et al*. 2010). Fruit bar having 80° Brix can be prepared by heating layers of fruit pulp mixed with pectin, sugar, glucose and potassium met bisulphate to 90° C and drying to 15% moisture. Different layers of cashew apple paste mixed with 1% citric acid are sun dried and cut into required size after placing one on top of the other to

form leather. The layers, after smearing sugar syrup and pressed together, can be eaten like fruit wafers. The cashew apple pulp, cooked in to thick jam like typical sweet (doce) and cooked pulp formed into balls and coated with sugar (cajucristalizado), are used in Brazil for serving as dessert (Mathew *et al*. 2010).

iv) Confectioneries

Cashew apple impregnated with cane sugar and subsequently drained and dried is called a candied fruit. One kilogram of cashew apple on processing gives 745 g candies (Mathew *et al*. 2010). The syrup left over from the candying process can be used for sweetening chutneys, in vinegar making or for candying another batch of fruits. Cashew apple can also be utilized for the preparation of tutty fruity. One kilogram of cashew apple on processing gives 715 g totty fruity. The whole fruit can also be processed in to nutritious toffee, a feasible dessert item with extended shelf life (Mathew *et al*. 2010).

Frozen desserts and dairy confectionery items could be prepared from cashew apple juice by optimization of juice concentration and spray drying. The only constraint here is the large capital investment required for spray drier equipment. Different dairy products involving cashew apple have been prepared on a laboratory scale by the University of Agricultural Sciences, Bangalore (Mathew *et al*. 2010).

Dehydrated cashew apple products can be prepared from dehydrated powder. Clarified juice is prepared from steam blanched, sulphur dioxide treated fruits and spray dried for preparation of cashew apple powder with juice. The pulp or the residue of apple can also be dried, powdered and sieved for use as cashew apple powder without juice. 10 to 30% dehydrated cashew apple powder can be used in various value added products like wheat laddu, masala biscuits, sweet and masala doughnuts, sponge cake, steamed kabadu, tomato cashew apple powder soup, powder koftas, chocolates, sweet and hot bread products and cashew apple blended chocolates. Nutri-Cashew, a ready mix have already been prepared using cashew apple powder for the elderly as high fibre fruit (drink) float mix for instant use (Mathew *et al*. 2010). 10% to 15% clear and cool cashew juice mixed with skim milk powder can be spray dried for the production of cashew milk powder and can be utilized for the preparation of products like milk shakes, ice creams and ice candy. A ready- to- serve beverage mix, fruit-milk/lassi mix has been prepared from clarified juice by homogenization, spray drying and mixing with milk/ lassi powder.

Culinary preparations

Pickle can be prepared from sliced raw green fruit using chilli powder, gingelly oil, fenugreek powder, asafoetida, turmeric powder, garlic, mustard powder, a pinch of sodium benzoate and salt to taste.

Cashe Nut Shell Liquid (CNSL)

Processing of the raw nuts releases the by-product CNSL that has industrial and medicinal applications. CNSL is one of the few natural resins that is highly heat resistant and is used in braking systems and in paint manufacture. Distillation of CNSL under reduced pressure gives cardanol.

The remaining cashew apples after processing are used in vermicompost, biogas etc.

Organic cashew certification and marketing

Presently most of the cashew cultivation in Konkan region is organic though not certified. It can be done through any organization or Agriculture Department of Government of Maharashtra. All suchcashew nut can be purchased at a pre-decided fair price for further trading or marketing.

Conclusion

The farmer’s income can be doubled by following ways:

- Adoption of recommended package of practices like, use of high yielding varieties and grafts, integrated nutrient management, integrated pest and disease management, high density planting, irrigation, application of foliar spray, intercropping, soil and warer conservation measures, rejuvenation by top working etc.
- Promoting post harvest value addition including cashew apple.
- Transfer of technology: The popular technologies are spread through electronic media, Doordarshan, AIR, Video conferencing etc. Success stories of farmers will motivate other farmers.
- Training programmes related to spraying, pest and disease management, canopy management and rejuvenation, value addition. Various types of exhibitions provide information about the technology related to cashew cultivation.

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