



Review Article

Technologies for Cashew productivity enhancement in Maharashtra

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Abstract

Cashew (*Anacardium occidentale* L.) is a native of Brazil and was introduced into India by Portuguese during the 16th century with the objective of soil conservation and forestation. However, India is the first country in the world to exploit the international trade of Cashew kernels. Today India is the largest producer, processor, consumer, and exporter of the cashew in the world with 8.55 lakh hectares, and total production of 6.20 lakh MT of raw nuts with the productivity of 800 kg per hectare.

Diverse agro-climatic conditions, increasing irrigation potential, progressive research, and innovative farmers receptive to new ideas and technologies are all the factors that combined to offer tremendous scope for commercial horticulture in the Maharashtra state. The ambitious horticulture development program linked with the employment guarantee scheme by the Government of Maharashtra resulted in a substantial increase in the area under various fruit crops. Before the inception of massive horticulture development program in 1990-91, the area under cashew was only 40,000 hectares which has now crossed a level of 1.83 lakh hectares. The average productivity in the state of Maharashtra is 1.5 t/ha. This is due to strong research backup from the State Agriculture University and efforts taken by the extension officers for the transfer of technologies and popularizing the high yielding bold type hybrid varieties developed by Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli.

However, still there is a scope for increasing the productivity to the tune of 2 t/ha with little refinements in the management practices, adoption process, and creating awareness among the farmers.

Keywords cashew, high yielding varieties, processing, technology

Introduction

Cashew (*Anacardium occidentale* L.) is hardy and drought-resistant tropical crop grows best in warm, humid, and typically tropical climate with a well-defined dry season of at least 4-5 months, followed by the rainy season. The Portuguese introduced cashew in India during the sixteenth century and it was mainly exploited for soil conservation and afforestation purposes in the coastal region.

At present, Maharashtra ranks first in area (1.86 lakh ha), production (2.48 lakh tonnes), and productivity (1367kg ha⁻¹) in the country contributing 28% area and 31.49 percent total cashew nut production in the country [1]. In India cashew occupies an area of 10.27 lakh ha, with the production of 7.25 lakh MT and productivity of 706 kg ha⁻¹. However, due to low productivity, the demand in India cannot be met from the processing industry [2]. Well-drained lateritic and sandy soils along the coastal belt with undulating topography and climatic conditions

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like modest temperature, high humidity and high rainfall in Konkan region of Maharashtra are considered as the most favorable for cashew plantation. The maximum cashew plantations in the Konkan region are concentrated in Sindhudurg and Ratnagiri districts.

Technologies developed for increasing productivity of Cashew in Maharashtra

To improve the productivity of the existing cashew plantation, there is an urgent need to motivate the farmers to adopt the recommended good agricultural practices in the already established and the newly establishing orchards. Some of the technologies developed by Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli for improving the productivity of cashew in Maharashtra are summarised below.

Establishment of cashew orchard

Cashew is grown in almost all types of soils nevertheless it performs better in well-drained, forest soils, red sandy loam, and light coastal soil with high water-holding capacity and rich in organic matter. Its active roots are concentrated in the first 1 m depth of the soil and 2 m radius around the trunk of the tree. Therefore, the soil should be a minimum of 1.5 m deep without any hardpan.

In Konkan conditions, planting of cashew at 7 m x 7 m or 8 m x 8 m in the square system is recommended for availing maximum sunlight which is prerequisite in the yield maximization in cashew [3]. The research carried out regarding high-density planting indicated that cashew could be planted at a closer spacing of 5 m X 5 m accommodating 400 trees ha⁻¹ with the removal of one alternate line after 8 to 10 years [4].

Improved varieties

The first cashew variety in India, Vengurla-1 was released by Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli in the year 1974 which was a selection. Further, the cashew hybridization program was initiated by Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli, and released six hybrid varieties of which V-4, V-7, V-8, and V-9 are high yielding, bold types prepared by farmers and industry and therefore, 80 percent of the area is covered by these types in Maharashtra (Table 1).

Table 1. Peculiar characters of different cashew varieties

Sr. No.	Varieties	Varieties recommended for State	Nut yield kg/tree	Specific Characters		
				No. of nuts/kg	Shelling %	Colour of Apple
1	Vengurla-4	Karnataka Uttara, Maharashtra and Goa	15-20	140	31	Red
2	Vengurla-7		15-20	100	31	Yellow
3	Vengurla-8		15-20	87	28	Orange
4	Vengurla-9		7.59	112	29.35	Reddish yellow

Further studies on the survey, germplasm collection, evaluation of high yielding varieties, and hybridization with special reference to the compact canopy, bold nuts, high shelling percentage, greater kernel count per pound, resistant to pest and diseases are under progress which will produce new high yielding varieties in future.

Production of quality planting material

The seedling raised orchards to show variation in yield, nut size, apple color and several other characters due to cross-pollination. Hence, vegetative propagation is recommended in cashew. Vegetatively propagated clonal progenies are genetically identical to the mother plant and give relatively more uniform yield. Softwood grafting method was developed and standardized which is an easy, cheap, and rapid technique for raising large scale planting material of desired variety on commercial scale [5]. With this method 5-10 lakhs of cashew grafts are being produced and sold throughout the country by the University,



nurseries of State Agricultural Department, and private nurseries. This method has a long span of operation and can be practiced throughout the year (except December) with a high degree of success under warm and humid climate.

For appropriate scion production irrigation at 30 mm, Cashew productivity enhancement (CPE) is most effective (86.63) followed by 60 mm CPE (80.43 scions). A package of 30mm CPE irrigation and 750 g N/tree resulted in a maximum of 111 scions against 54.64 scions under zero irrigation and zero nitrogen level. May was the most favorable month for grafting V-4 and V-6 varieties of cashew. The most appropriate age of rootstock for cashew grafting is 45 days [6].

Nutrient management

Cashew responds well to fertilizer application. About 50 to 100 percent increase in nut yield is commonly observed in this crop. Manures and fertilizers promote the growth of the plants and flowering in young trees.

A result of the manure trial revealed that application of 40 kg F.Y.M. along with 1kg N, 250g P₂O₅ and 250g of K₂O / plant /year from the 4th year onwards by circular ring method in August have proved beneficial effect on yield of cashew [7]. 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 is beneficial.

Generally, fertilizers are applied to cashew nut during monsoon season but due to heavy rainfall, severe nutrient leaching losses occur through the runoff and deep percolation in monsoon. A study conducted by Sawke et al., [8] revealed that the post-monsoon fertilizer application using the diffuser applicator help to minimize the nutrient losses and increase the efficiency of applied nutrients and are beneficial for the yield and quality of cashew nut. Nitrogen applied @ 200 kg/ha through diffuser had the maximum cashew nut yield (1.91 t/ha) followed by Nitrogen applied @ 100 kg/ha (1.44 t/ ha).

Irrigation requirement

Protective irrigation after planting with 15 liters water at 15 days interval during winter and at 8 days interval during the summer season is recommended. The yield of cashew can be doubled through the provision of protective irrigation during flowering. Application of 200 liters of water at 15 days interval from January to March at a time of fruit and nut development for adult trees resulted in two-fold increase in the yield. Similarly, irrigating 80 L / tree once in four days through drippers from December to March (total irrigation of 2400 L/tree/season) can also increase the yield substantially [9]. For newly planted grafts, protective irrigation after planting with 15 L water at 15 days interval during winter and at 8 days interval during the summer season is advised. The use of black polythene mulch with irrigation at the fortnightly interval (60 lit./tree/ irrigation) increased the fruit retention (66.15 %) over control (44.98%). Similarly, irrigation with 75 percent P.E. (polyethylene) produced the highest yield of nuts (1.44 t/ha) and was at par with irrigation at 50 percent P.E. (1.43 t/ha) through subsurface irrigation by diffuser [8].

Soil and water conservation measures

The Konkan region comprises of lateritic soil and undulating hilly terrain. The intensity of rainfall creates the problem of runoff and soil erosion. Average topsoil loss as reported by Badhe and Magar [10] was 16 t ha⁻¹ which was nearly four times above the permissible limit. Use of staggered trenches is the best option for reducing runoff, soil loss, and nutrient loss and for obtaining a better yield of cashew plantation on the sloping land of Southern Konkan for soil and water conservation. Mane et al., [11] suggested to keep 4.5 m long trenches having top-width of 0.6 m and bottom width of 0.3 m with a depth of 0.3 m with 230 trenches per hectare.



The performance of cashew in stone bunding, staggered trenches, and Continuous Contour Trench (CCT) of 0.60 m depth were superior over the rest of the treatments. CCT of 0.60 m depth was the best soil conservation practice on the area having 7 to 8 percent slope [10].

Use of mulch

Nawale. et al., [12] reported that the use of black polythene as a mulch with irrigation at the fortnightly interval (60 lit./tree/irrigation) increased the fruit retention (66.15 %) over control (44.98%).

Foliar spray

There is great scope for improving the productivity through supplementary foliar sprays with major and micronutrients and growth regulators. Foliar spray of 3 percent urea help to produce the highest nut yield (5.987 kg tree⁻¹), as well as total Ca and Mg content in cashew kernel [13]. Foliar application of 3 % Urea along with insecticidal spray scheduled thrice, coinciding with the vegetative flush, flowering, and fruit set increased the yield to the extent of 60-65 % (Anonymous, 1990). For increasing the fruit set and yield of cashewnut, Haldankar et al., [9] recommended two sprays of an extract of low cost dried fish @ 500 g/10 liters of water, first at the time of flowering and second at 15 days after the first spray. Similarly, Gajbhiye et al., [14] recommended two sprays of 10 ppm Ethrel during the flushing and flowering stage for increasing yield of cashew.

In another experiment Gawankar et al., [15] observed Ethrel @ 100 ppm significantly increased number of flowering panicles per m² (12.0), number of perfect flowers per panicle (52.8), fruit-set per M² (28.8), number of nuts per panicle (2.9) and yield (1.51 kg tree⁻¹) over control.

The feasibility of different major and micronutrients as a supplement in the form of foliar sprays for boosting the yield of cashew was also evaluated by Patil et al., [16]. They observed that the foliar application of 0.25 % Urea + SOP + SSP each) + 0.25 % (ZnSO₄ + Borax + CuSO₄ each) + 0.01 % Ammo. Molybdenum increased the cashew yield (3.50 kg/plants) significantly over control (2.15 kg/plant). The feasibility of different complex nutrients available in the market for sex expression, fruit set and its relevance with nut yield of cashew through foliar sprays was assessed by Gawankar et al., [17] and reported that the foliar spray of 19:19:19 (2 %) produced significantly greater fruit set and yield kg tree⁻¹ over control. Foliar application of N in the form of Urea 3 % mixed with endosulfan 0.05, thrice a year, coinciding with new vegetative flushing, flowering, and fruit set improved cashew yield [18].

Rejuvenation of inferior quality low yielding seedling trees

Cashew plantations of seedling origin are less productive such inferior quality, a low yielding local seedling of 5 to 15 years age can be top worked with high yielding and superior type cashew variety. May-Jun is the right time for beheading and July-August is suitable for grafting [9]. However, precautions should be taken to control the attack of cashew stem and root borer by continuous monitoring each top worked plant.

Intercropping

Intercropping in cashew plantation helps to obtain additional returns during the initial years of establishment. The main objective of intercropping in cashew plantation is to obtain additional returns during the initial years of establishment till the cashew trees start bearing sustainable yield. Intercropping in cashew was not paid attention in earlier days as cashew was grown on marginal soils on hill slopes with low water availability and fertility. However, with the adoption of a systematic package of practices, large scale plantations were established during the last decade which forced to pay attention to intercropping in cashew for getting fair returns during the initial years of cultivation. The canopy of cashew covers the entire area in about 8 to 10 years when grown under normal spacing of 8m x 8m in fertile soil. However, in marginal lands, it takes 10 to 12 years for the canopy to cover the entire area. Gawankar and Pawar [19] tuber crops in the available interspace under cashew plantation of more than 15 years old without disturbing the root system, Greater yam was the most remunerative intercrop in cashew V1 which contributed Rs. 84,440 per ha followed by lesser yam (Rs. 66,440) and Rs. 65,350 from elephant foot yam. Jadhav et al., [20] reported



the sole cashew yield of 1120 kg nut/ha realizing Rs. 89600/ha but when it was integrated with back yard poultry (Giriraja Breed), an additional income of Rs. 1,75,000 were obtained.

Plant protection

Among the various production constraints, the insect pest is one of the major limiting factors causing a crop loss of 30 to 40 percent as stated by Thirumalaraju [21]. Under Konkan condition, Tea mosquito Bug (T.M.B.) Stem and Root borer and Flower thrips are the major pests causing economic losses in cashew. For effective control of Tea mosquito Bug and flower thrips, the spray schedule recommended by the university is given below.

Table 2. Cashew blossom protection schedule

Sprays	Chemicals	Stages
1st	Monocrotophus (0.05%) or Profenophos (0.05%) or Cyhalothrin (0.03%)	Vegetable flush
2nd	Endosulphan	Flowering stage
3rd	Dimethoate (0.05%) or Phasalone (0.07%) or Carbaryl (0.01%) or Cyhalothrin (0.03%)	Fruiting stage

Out of three, the second spray at the flowering stage plays a major role in Tea Mosquito Bug's control. The third spray plays a major role in the management of flower thrips. The Stem and Root Borer is a destructive pest. The pest prefers old trees however damage is seen in young trees below five years also. Effective orchard management, sanitation at the base of a tree, and regular inspection of the trees are prerequisite as preventive measures for managing this pest. Swabbing tree trunk up to 1 m height with Carbaryl or with mud slurry containing Carbaryl 50 W.P. (0.2 %) or Lindane (0.2 %) or its quarterly soil application around the trunk and expose roots is essential. Swabbing and drenching of Chlorpyriphos 40 E.C. @ 10 ml/liter (5 liters/ tree) at the early stage of an infestation is recommended as a curative treatment for the management of this pest.

Value addition

Apart from the cashew kernel, the cashew apple is the most important fruit part which can also increase the income of the farmer. Except for Goa where it is utilized commercially for making the alcoholic beverage "Fenni" in the rest of the country it remains unutilized. Considerable research work was done by Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli and technology have been developed for utilization of cashew apple for preparation of nonalcoholic beverages like ready to serve drinks (R.T.S.), squash, syrup and semi-solid Chutney and Jams.

The above discussed technologies have been disseminated to the farmers through the strong support of extension workers from State Agri. Department. Nevertheless, the adoption is slow; there is a scope for making awareness among the farmers who treat cashew orchard as a secondary income source. However, cashew apple processing will lead to a substantial increase in income generation. Further, it will be a source of employment generation. There is also scope for the preparation of Wine from cashew. The research work is in progress at Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli.

Strategies for area expansion and yield maximization

Though cashew covers 1.73 lakh hectare area in Maharashtra still systematic efforts can be able to cover another 3 lakh ha area in Konkan region which is fallow due to absentee land lordship and non-fragmentation of revenue documents (7/12). Haldankar et al., [9] reported that from such area yield of about



5.46 lakh tons can be expected in 2020, which will further increase to. It will lead to a generation of Rs. 2,457 Crores in 2020 and will be able to employ 2.73 lakh personnel.

Utilization of cultivable waste and fallow land

There is about 3 lakh ha cultivable wasteland available in the Konkan region for plantation. It is remained fallow due to absentee land lordships and non-splitting of revenue documents made the farmer unable to take advantage of the Government of Maharashtra's ambitious program for horticulture development through the Employment Guarantee Scheme. Therefore, Govt. of Maharashtra should take suitable steps in this matter.

Development of cashew estates

Efforts should be taken to form the Self Help Groups (SHG) for the development of cashew estate in the Konkan region of Maharashtra. At list 100 ha fallow land may be allotted to each group. This will help in the upliftment of poor rural folk above the poverty line. It will have the potential for employment generation if the processing is combined with these estates. To overcome the difficulties in land acquisition the Government should make a special resolution in this case.

Productivity enhancement through awareness programmed

Organizing awareness programmers regarding crop management during offseason, timely application of fertilizer, irrigation and plant protection, etc., at the village level through unemployed agricultural graduates will engage the youth and awareness can be created among the farmers who consider the cashew as a secondary crop in Konkan region.

At present cashew is grown on poor soils and as a rainfed crop. It has been observed that cashew responds well for N, P, and K fertilizers and irrigation if given in such soils. So awareness campaigns should be organized to demonstrate the effects of such technology.

Organic cashew certification

Most of the cashew orchards in Konkan are left natural. Most of the farmers do not use pesticides and fertilizers. Therefore, efforts should be made to treat such orchards as organic, and accordingly, the arrangement should be made for certification, suitable support price should be fixed for organic raw material.

Creation of irrigation facilities

Though it is taken as a rainfed crop, trials conducted at various research stations indicated that nut retention and yield can be improved through irrigation. Yield can be doubled by providing protective irrigations. Most of the plantations are on hilly areas and therefore creating water sources at each site is a crucial factor. Hence, financial support should be given by the Govt. for creating water sources, soil conservation structures like Nala-bunding, terracing, etc., irrespective of landholding, or financial condition of the farmers. Subsidy for establishing micro-irrigation facilities in cashew orchards may be given up to 75 %.

Planting of cashew in the catchment area of the minor and medium irrigation project

Planting of cashew in the catchment area of minor and medium irrigation projects should be encouraged. Further, the cashew farmers may be allowed to lift irrigation water for cashew orchards. This will help in checking soil erosion and increasing the productivity of cashew. Similarly, while designing irrigation project provision for providing irrigation to cashew orchards may be considered.

Establishment of processing units

Being a plantation crop, it requires processing before consumption. It allows establishing a network of cashew processing industries in the Konkan region. It is projected that in 2015 to process 4.66 lakh tons of raw cashew, about 600 large processing units (capacity 300 t/year) and 14,392 small units (capacity 20 t/year) will be required and from this 1.17 tons of cashew kernels will be available which will be valued of



Rs. 2,906 Crores and will generate 1.89 lakh manpower per year. There is also a great scope for the establishment of cashew nut shell oil (CNSL) extraction units. Nearly 3.25 lakh tons of cashew nutshell be available after processing of 4.66 lakh tons of cashew. For the processing of 3.25 lakh tons of cashew shell about 300 factories with a capacity of 1000 tons/year will be required. It will produce 0.81 lakh tons of cashew nut shell oil of Rs. 0.179 Crores and it will generate employment for 6000 people per year. To have efficient and sustainable processing the Government should provide the following facilities.

- (a) Provision of Godown facility to the processing units
- (b) Providing loan facilities for the purchase of raw cashew nut at low-interest rate
- (c) Financial assistance for modernization of old processing units

Conclusion

To enhance the productivity of cashew in Maharashtra state Dr. B. S. K. K.V., Dapoli developed several technologies. The important among these are 7 hybrid cashew varieties, softwood grafting method, integrated nutrient management, foliar application of nutrient for fruit set and yield maximization, soil and water management, rejuvenation of unproductive plants, intercropping plant protection and development of post-harvest technologies. The package of practices given by the University has helped in improving the socioeconomic status of the farmer in the region.

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