

Recent technologies for cashew production

towards zero hunger

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At global scenario, though India occupied largest area under cashew cultivation (20.30%), but contributes only 16.10% in production. India has low productivity of raw cashew nuts (782 kg/ha) when compared with other cashew growing countries. The research programmes on crop improvement resulted in identification of 43 varieties in our country by different cashew research centers. The performance of varieties vary from region to region, therefore, the varieties having more yield potential the varieties should be selected based on its suitability to the region.

Key words: Cashew, Production, Technologies, Zero hunger

CASHEW (*Anacardium occidentale*), is one of the important nut crop which is native to eastern Brazil and since last five centuries as it was introduced in India by Portuguese traders. Our country is the pioneer in cashew trade and processing in the world. India, Ivory-cost, Vietnam and Nigeria are the major producers and exporters of cashew, India and Vietnam accounting for 40% and 33% market shares, respectively, Brazil is another major exporter that supplies to the United States of America. India is exporting cashew kernels to over 60 countries. The major importers of cashew are United States of America, Netherlands, Japan, Spain, France, Germany, United Kingdom as well as Middle-East countries such as the United Arab Emirate and Saudi Arabia. India accounts for about 65% of global cashew exports. During financial year 2016-17 the total export earnings from cashew and allied products were ` 5,077 crore (US \$780.41 million). Among this, cashew nut shell liquid/cardanol accounts for 11,422 million tonne

valued at ` 44 crore (US \$6.75 million) and cashew kernels accounts for 82,302 million tonne (provisional) in financial year 2016-17, valued at ` 5,168.78 crore (US \$793.91 million).

Factors for low productivity

The main reasons associated with low productivity are non-uniform seedling progenies, cultivation under degraded sites, improper management of soil, water and canopy management, senile orchards, low density planting, severe infestation of cashew stem and root borer (CSRB) and tea mosquito bug.

CASHEW PRODUCTION

The new varieties have an important role in increasing the productivity. Same of these are discussed here.

BPP-10: The cashlow variety was selected by clonal selection at Cashew Research Station, Bapatla. The variety is of extensive branching type with compact canopy. It bears an average of 28.5 flowering laterals/m². This has mid-season flowering from February to April, with 85 days' duration. An early bisexual phase, cluster bearing (5.35 nuts/panicle), regular bearing, bold nut type with average nut weight of 8 to

Table 1. Cashew varieties recommended for different states

States	Suitable varieties
Tamil Nadu	VRI-3, and VRI-5
Kerala	Dhana, Kanaka, Madakkathara-2, Priyanka, and VRI-3
Andhra Pradesh	BPP-4, BPP-8, Dhana, and VRI-3
Karnataka	Chintamani-NRCC-2, Ullal-1, Ullal-3, Ullal-4, UN-50, Bhaskara, Vengurla-4, Vengurla-7, and VRI-3, Madakkathara-2
Maharashtra	Vengurla-4, Vengurla-7, and Vengurla-9
Goa	Goa-1, Goa-2, Goa-3, Goa-4, Vengurla-4, and Vengurla-7
Odisha	Bhubaneswar-1, Bhubaneswar-2, Dhana, BPP-8, and Jagannath BH-6
West Bengal	Jhargram-1, Jhargram-2, and BPP-8
North-eastern hills region	Priyanka, Ullal-4, NRC Selection-2, and Vengurla-4



Fig. 1. Precociousness and fruiting bunches of H-130

10 g with harvesting between April and June. The apple is yellow and nut yield was 14.9 kg/tree. The shelling percentage was 29.3% with export grade kernels of W210. This variety showed high yield potential of about 2,200 kg/ha.

BPP-11: It had extensive and intensive branching of 27.5 branches per m² with upright compact canopy. Early flowering variety (January to March) with flowering duration of 89 days, cluster bearing, regular bearing, medium nut size with nut weight of 6.80 g. Harvesting takes place between April and May. Apple is yellow with average nut yield of 14.7 kg/tree. The shelling percentage was 28% with export grade kernels of W 240. This variety showed high yield potential of 1,600 to 2,000 kg/ha under normal conditions of planting. This variety is also suitable for high density planting.

H 130: The recent hybrid H-130 of Directorate of Cashew Research, Puttur is having high precocity and good response to pruning (Fig. 1). It has bold nuts (13 g) and long flowering duration. The complete allotted space in ultra density plots can be covered in third year of planting and potential yield of the unit land can be realized from 3rd to 4th year of orchard life onwards. The hybrid has early bearing in the season and bearing remains for longer period of 3 to 4 months. The apple is yellow with weight of around 100 g. The nuts have shelling of 29.5% and kernel grade of W110 to 150. The yield in farmers plot harvested with variety under ultra density planting method was

up to 3 kg/plant after 3 years of planting.

Jhargram 2: Its selection was made from seedling plantation of H-2/15 of Regional Research Station, Bidhan Chandra Krishi Viswavidyalaya, Jhargram, West Bengal. The variety has mid-season flowering habit with 3-4 fruits/panicle. Apple is golden yellow with a weight of 63 g and a mean juice content of 68.9%. The average nut weight is 9.2 g with a kernel weight of 2.85 g and high shelling (32%). The kernel grade is W 180. The variety can yield 13.5 kg/tree in 7th harvest

Vengurla 9 (V-9): This is a hybrid cross between Vengurla 4 × Vridhachalam 1. It is mid-to-late variety with 111 days of flowering duration and is bunch bearing variety with intensive branching. It has bold nut with average nut weight of 8.9 g with a shelling 29.35 % and kernel weight of an average 2.2 g. The average yield per tree is 15.98 kg and has moderate resistance to insect pests. The apple is reddish yellow with average weight of 69.71 g.

Use of quality planting materials

Majority of existing old orchards are developed from seedling progenies of non-descript origin, which is one of the major factors for erratic and low productivity in cashew because of their high degree of heterozygosity. The seedling plants will also grow more vigorously and remain vegetative for longer time. Hence, the use quality planting material (vegetatively propagated) will help to develop uniform orchards attracted with higher early yields. Presently, farmers are using grafts for development of orchards. As a result the demand for quality planting material is gaining in linear phase which require immediate attention. The Directorate of Cashew Research has a tremendous role in production and supply of elite planting material. Every year around 2 to 5 lakh cashew grafts are produced and distributed to different cashew growers in the country. The present requirement of cashew planting material in the country is around 75 to 80 lakh grafts/annum.

Table 2. Differences between Rejuvenation and Top working in cashew

Rejuvenation	Top working
Main objective of rejuvenation is to improve the productivity	Main objective of top working is to convert inferior genotype to superior genotype
Mainly old, senile, overcrowded and low yielding trees are preferred	Young to medium-aged plants are used
Maintain same genotype but other techniques are imposed to improve the productivity	Genotype will be changed by grafting to improve productivity
Pruning of primary branches at the 1.0 to 1.5 m	Pruning of primary branches at the height of 1.0 to 1.5 m
All the sprouted shoots were retained on branch	After sprouting 4-6 shoots/branch were grafted and remaining were removed
Trees starts bearing one year after rejuvenation	Trees starts bearing two year after top working



Fig. 2. General view of planting material available at Directorate of Cashew Research, Puttur



Fig. 3. Successful top worked plants of cashew



Rejuvenation and top working

Cashew is more vigorously growing tree and without proper canopy management. The canopy of plants become over crowded in 15 to 20 years of planting. The main aim of rejuvenation is to improve the productivity of existing old, senile cashew plantations by adopting horticultural and agro-technique practices such as pruning of branches including de-topping, removal of unproductive shoots/branches, soil and water conservation techniques, application of recommended doses of organic and inorganic manures, mulching, irrigation, intercropping and pesticide application *etc.* Top working is a type of rejuvenation which can be done on young to medium-aged plants to convert inferior genotypes in to superior genotypes by grafting.

High and ultra density planting systems in cashew

High density planting is a new technique which can enhance the productivity per unit area on accommodation of more number of plants per unit area. Conventionally cashew was planted at 8 m × 8 m which accommodated 150 to 160 plants/ha and the plants take 7 to 8 years to cover the allotted space and to give potential yield upto 10 to 15 q/ha with best management practices. Therefore, high density or ultra density planting appears to be the most appropriate solution to overcome low productivity and initial long waiting period for early returns. To meet the challenge of high productivity, optimization of growth and parameters, and minimization of the unproductive components of trees without sacrificing the overall health of the tree and quality of the product are required. The control of

excessive vegetative growth and induction of productive growth in the tree for increased productivity is the major principle of ultra density planting. In ultra density system, yields are improved in early years of planting. Ultra density helps to increase the productivity by 2- to 3-fold.

Advantages of high and ultra density planting in cashew

- More number of plants can be accommodated per unit area
- Plants are maintained at lesser space and lower canopy head by regular training and pruning methods.
- Helps to facilitate better utilization of solar radiation and increase the photosynthetic efficiency of the plant.
- Precocious cashew varieties can bring early yields in 1st or 2nd year of planting.
- Due to more number of plants the productivity/unit area will increase.
- The yield increase of 2-3 times higher than the normal planting.
- Effective utilization of land and resources.
- Higher yield per unit area with quality fruits and nuts.
- Easy to carry out cultural operations viz., spraying and harvesting of fruits and nuts.
- Cost of spraying and picking of nuts will be reduced.

- The number of flowering shoots will increase than vegetative shoots.

Pruning and training

The grafts are allowed to grow straight without any side sprouts up to 0.25 to 0.50 m height from the ground level. Thereafter terminal bud can be pinched off to force frame work of primary branches and subsequent lateral branches from them. Highly precocious types will flower and fruit during the year of planting and in certain other varieties may be from second season onwards. Once the first harvest is completed (during May-June) first pruning at 1 m height from ground level be taken up subsequently every year at same height. After pruning a spray of Bordeaux mixture (1%) is given to prevent the entry of fungal pathogens.

Use of growth regulators

Growth regulators and retardants play an important role in improving yields of cashew. Soil application of Paclobutrazol PBZ @ 2 g a.i./plant at pre-flushing stage was found to be effective in reducing the plant height, canopy spread, intermodal length and it also helps to increase the yield (51.78 %) per plant over the control. Foliar application of Ethrel @ 50 ppm at 20 days before blossoming and 20 days after full bloom in cashew cv. Vengurla 4 resulted the

Table 3. Comparison of planting density at different methods of planting

Methods of planting	Recommended spacing	Accommodation of number of plants/ha	Expected yield/ha
Conventional method/ low density planting	8 m × 8 m or 7 m × 7 m	156 or 204	1-1.5 tonne/ha (at the age of 8 years)
High density planting of age	5 m × 5 m or 4 m × 4 m	400 or 625	2-2.5 tonne/ha (at the age of 5-6 years)
Ultra High Density planting	3 m × 3 m or 2.5 m × 2.5 m	1111 or 1,600	3-4 tonne/ha (at the age of 3-4 years)



Fig. 4. General view of ultra density planting



Fig. 5. Pruning and training under Ultra Density Planting (UDP) system of cashew



highest number of panicles m^{-2} (13.09), number of perfect flowers (87.11) per panicle and the highest sex ratio (0.24), highest fruit set m^{-2} (19.44), number of nuts per panicle at peanut stage (76.41), number of nuts per panicle at marble stage (33.82) and fruit retention (9.61%), nut weight (7.36 g), nut yield (3.11 kg/tree and 634.73 kg/ha), shelling (27.37 %) and kernel weight (1.87 g). GA_3 at 50 $mg\ L^{-1}$ will enhance flowering precocity, shorten flowering duration, increase production of hermaphrodite flowers and fruit set significantly, and resultant nuts develop optimally with high percentage retention. Thus, it suggested cashew yield could be increased by exogenous foliar application of GA_3 at 50 to 100 $mg/litre$ at pre-blooming stage.

Pest and disease management

The major damaging pests of cashew are tea mosquito bug, cashew stem and root borer and some other minor pests are mealy bugs, leaf minors, leaf eating caterpillars and leaf and blossom Webbers.

The tea mosquito bug is considered to be the most serious pest of cashew in India, and causes more economic loss to the crop than any other pest. Tea mosquito causes crop loss to the extent of 30 to 40% and in severe cases it may go up to 70 to 80%. The tea mosquito bug can be controlled by spraying 0.06% Λ cyhalothrin, 0.05% Monocrotophos, 0.1% Carbaryl, 0.15% profenophos. For better management three sprays are required one at the vegetative

flush, the second when the panicle emergence and third at the time of fruit set.

Cashew stem and root borer is another major pest which is causing death of the affected tree. The incidence of the pest was about 10%. It affects both young and old trees and the more infestation will be seen on neglected old plants than young trees. For control of stem and root borer early detection of incidence is important. Dead trees and those which are beyond recovery should be removed from the plantation. The affected bark should be removed along with the grubs and then swabbing with chlorpyrifos 2 ml/litre, the other minor pests like mealy bugs, leaf minors, leaf eating caterpillars and leaf and blossom Webbers can be controlled by spraying 0.06% Λ cyhalothrin or 0.05% Monocrotophos or Profemophos 50 EC @ 2 ml/lit

Diseases of cashew

These diseases are controlled by spraying fungicides like copper oxychloride 2 g/lit or Diathane - M-45 2.5 g/lit or Bordeaux mixture 1%.

Value added products

These are as follows:

Cashew nut nutritive status: The cashew nut kernel contributes as an important source of invisible fat in the diet, being widely used in a variety of ways. Cashew kernel contains proteins (21%), carbohydrates (22%), fat (47%), sizable quantity of minerals and

vitamins. Cashew not kernel proteins contain essential amino acid and are comparable with other nuts like almond. Cashew kernel proteins are rich in acidic amino acids (38.78%) particularly, leucine and arginine to extent of 22.23%.

Cashew apple: Cashew apple is rich source of vitamins, polyphenols, sugars, minerals, amino acids and dietary fibers. Despite being more nutritious, the utilization of cashew apple was meager use in India due to few disadvantages like less shelf life and more astringent taste. Alternately a total of 5,73,000 million tonne of cashew apples go waste after taking the nuts. There is need for creating awareness among people about nutritional status of apple and it can be potentially utilized by processing purpose for the preparation of value added products like cashew apple juice, RTS, cashew apple jelly and cashew apple jam. Cashew apple can also be used for preparation of alcoholic beverages like cider, wine and fenny. The processed products help to earn additional income from crop.

SUMMARY

Cashew has concurred the highest status in global market because of its countable nutritive status. Low productivity reflected with high cost makes cashew nuts not available for middle and lower class of people. The improved productivity will increase the per caput consumption and best solution to overcome malnutrition. The above techniques are found suitable to increase cashew productivity two-to three-fold and considered as superlative solution for food security.

Table 4. Fertilizers recommendation for different aged plants under ultra density planting

Age of plants	Urea (N)	Rock phosphate (P)	Muriate of potash (K)	Organic manure
One	100 g	150 g	50 g	4-5 kg
Two	250 g	200 g	100 g	5-10 kg
Three and above	400 g	300 g	200 g	10-20 kg

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