Indian Farming 75 (08): 45-49; August 2025

Quality cashew production techniques in Garo hills, Meghalaya

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Despite the high economic potential of cashew as a valuable trade commodity, its widespread low yields remain a major challenge, requiring urgent and effective solutions. Despite numerous research initiatives aimed at enhancing cashew production and productivity, the crop has yet to realize its maximum potential. Adopting improved production practices could lead to higher crop yields, increased foreign exchange earnings, better livelihoods for growers, and enhanced consumer health through more nutritious products. It would also drive industrial growth through the production of processed nuts and elevate overall output across the production value chain. This article focuses on the improved production techniques of cashew for quality production and productivity in Garo Hills, Meghalaya.

Keywords: Consumer health, Foreign exchange earnings, Processed nuts

CASHEW *(Anacardium occidentale* L.) commonly known as 'gold mine of wasteland' and'poor man`s crop, rich mans food. Cashew nuts are a rich source of nutrients, containing approximately 21% protein, 47% fat, 22% carbohydrates, 0.45% phosphorus, 0.05% calcium, and 5 mg of iron per 100 grams. The lipids in cashew kernels are particularly high in unsaturated fatty acids, including oleic acid (73.7%), linoleic acid (7.67%), and stearic acid (11.2%). Cashew kernels are considered cholesterol-free, largely due to their high content of mono-unsaturated fatty acids, particularly oleic acid, which is known to help lower blood cholesterol levels. Thiamine, niacin, and vitamin E are among the few vitamins found in cashew kernels. This crop has its origin in Brazil and it was brought to India by the adventurous Portuguese travelers when they came sailing down the Indian coasts in the 16th century to control soil erosion on the coasts. Cashew has adapted well to Indian agro-climatic conditions and is now widely cultivated along the coastal regions on the east coast in Andhra Pradesh, Odisha, Tamil Nadu, and West Bengal, and on the west coast in Maharashtra, Goa, Karnataka, and Kerala. It is believed that cashew was introduced to the north eastern states particularly Meghalaya, parts of Assam, Mizoram, and Tripura during the 1950s as part of efforts to reclaim land previously used for shifting cultivation. Cashew has become one of the most popular commercial horticultural crops globally. Its consumption continues to grow worldwide and is expected to maintain a positive trend. Beyond its economic value, cashew industry in India supports livelihoods of over 1.5 million people, primarily women, working in both farms and processing units located in rural areas. This highlights the crucial role of cashew sector in promoting social and economic security in rural India.

Area and production

Though cashew was introduced as a soil binding crop, it has now proved to be a high-income generating crop in degraded and marginal land. In the year 2022–23, cashew cultivation in Meghalaya covered an area of 10,616 hectares, yielding a total production of 18,363 metric tonnes.

Table 1. Status of cashew in Meghalaya (2022–23)

District	Area (ha)	Production (MT)	Productivity (kg/ha)
East Garo Hills	235.0	294.0	1251.0
North Garo Hills	129.0	145.0	1124.0
West Garo Hills	4013.0	7578.0	1888.0
South West Garo Hills	1663.0	3233.0	1944.0

South Garo Hills	4576.0	7113.0	1554.0
Total	10616.0	18363.0	1552.2

Source:https://megagriculture.gov.in/PUBLIC/dwd_docs/ApprovedSLCSR2022_23.pdf

Cashew varieties suitable for Meghalaya

Cashew varieties are broadly categorized into three flowering types based on their blooming period viz. early varieties (Flower during December–January), mid-season varieties (Flower in February) and late varieties (Flower in March). Since cashew is typically harvested 60–70 days after fertilization, early and mid-season varieties are more suitable for the Garo Hills region of Meghalaya. These varieties help farmers avoid the early onset of rains, which can negatively affect both the yield and quality of the nuts.

VRI-3: This is an early-flowering cashew variety, blooming during December-January in the eastern regions of India. It features a compact canopy and an intensive flowering habit, with approximately 12.1% perfect flowers. This variety is highly responsive to pruning and is well-suited for high-density planting systems. Apple colour: Red, juice content: 72.8%, yield: 11.68 kg/tree, nut size: 7.2 g, kernel weight: 2.16 g, shelling percentage: 29.1%, kernel grade: w 210 export standard.

Vengurla-1: This early-flowering cashew variety blooms in December–January and features a compact canopy with a very intensive flowering habit. Apple colour: Yellow with 65.0% juice content, nut yield: 19 kg/tree, nut weight: 6.2 g, kernel weight: 1.39 g, shelling percentage: 31%, kernel grade: W 240.

Vengurla–4: This mid-season cashew variety flowers in February. Branching habit: extensive, canopy type: open, bearing habit: cluster with a high sex ratio, apple colour : red with 76% juice content, nut yield: 17.2 kg/tree, nut weight: 7.7 g, kernel weight: 1.91 g, shelling percentage: 31%, kernel grade: w 210 (export grade).

BPP 8: This cashew variety is a mid-season hybrid, known for its compact canopy and intensive branching habit. Flowering season: February–April, apple colour: Yellow, juice content: 64%, nut yield: 14.5 kg/tree, nut weight: 8.2 g, kernel weight: 1.89 g, shelling percentage: 29%, kernel grade: w 210 (export grade).

Bidhan Jhargram-2: Flowering Season: January–February, Canopy: Compact and erect, leaf colour: massive bottle-green, flowering density: intensive, with 12.8 inflorescences/m², fruit colour: Golden yellow, average apple weight: 63 g, juice content: 68.9%, nut weight: 9.2 g, kernel weight: 2.85 g, shelling percentage: 32%, kernel grade: w180 (export grade), average yield: Consistently over 11 kg/tree from 10 years onward.

Bidhan bonsai kaju: It is a very early variety. The variety is a highly pruning responsive which can be accommodated in high density, ultra-high density planting systems. It is a cluster bearer with average of 21.50 no. of nuts/tree and yield is 14.60 kg/tree. Apple colour: Red, apple weight: 34.5g with 71.3% juice content. Nut weight: 4.80 g, kernel weight: 1.5 g, shelling percentage: 33.06%, kernel grade: W320 (export grade).

Jhargram-1: It is an early variety flowers in January-February. The tree exhibits a medium-compact canopy with a vigorous branching pattern. Apple colour: Yellow with 65.5% juice content, nut yield: 8.5 kg/tree, nut weight: 5 g, kernel weight: 1.5 g, shelling percentage: 30%, kernel grade: W 320.

Bhubaneswar-1: This variety is noted for its cluster-bearing habit, producing approximately 12 fruits per bunch. The flowering season lasts for around 70 days, from January to March. Nuts weight: 4.6 g, nut yield: 10.5 kg/tree, kernel weight: 1.47 g, shelling percentage: 32%, kernel grade: W 320.

Balabhadra: This variety flowers early (December-February). Apple colour: yellow, apple weight: 56 g with 78.33% juice recovery. Nut weight: 7.4 g, nut yield: 10.0 kg/tree, shelling percentage: 33%.

Madakkathara-1: It has an intensive branching habit with compact canopy. Apple colour: yellow, apple weight: 56 g with 72% juice recovery. Nut weight: 6.2 g, yield: 13.8 kg/tree, kernel weight: 1.64 g, shelling percentage: 26.8%, kernel grade: W 280.

Poornima: Nut weight: 7.8 g, shelling percentage: 31%, kernel weight: 2.6 g, kernel grade: W 210, nut yield: 14.1 kg/tree, apple colour: Yellow weighing 77.96 g.

Ullal-3: This variety is recognized for its early

flowering and high yield potential. Fruiting period: Short duration of 50–60 days, from January to February, branching type: Intensive, canopy type: open, apple colour: red, apple weight: 63 g, juice content: 66.1%, nut yield: 14.7 kg/tree, nut weight: 7 g, kernel weight: 2.1 g, shelling percentage: 30%, kernel grade: w210 (export grade).

NRCC selection-2: It exhibits a mid-season flowering habit in February, with a flowering duration of 74 days. Apple colour: pink, apple weight: 51 g, juice recovery: 76.0%, nut yield: 9 kg/tree, nut weight: 9.2g, shelling percentage: 28.6%, kernel grade: Export grade W 210.

Netra ganga: It is an extremely valuable variety that blooms early and bears fruit for a long time. It adapts well to ultra-density planting systems and responds well to thinning. Bearing habit: Cluster (10–20 nuts per panicle) and nut size: Jumbo (12–13 g), kernels weight: 3.5–5.0g, shelling percentage: 29.9%, kernel grade: W-130–150.

Chintamani–2: It is dense and has many branches. The blooming period occurs in December or January. Apple colour: Red purple, apple weight: 70g, juice content: 60%, yield: 12.4 kg/tree, nut weight: 7.9g, shelling percentage: 30%, kernel weight: 2.35 g, kernel grade: W 210.

Soils and climate

Cashew can be cultivated in various soil types, but it performs best in well-drained brown forest soils, red sandy loam, and light coastal soils that retain moisture well and are rich in organic matter. The ideal soil pH ranges between 5.5 and 7.5, and the water table should be deeper than 1800 mm. Soils with a pH above 8 are unsuitable for large-scale cashew farming. Cashew trees are adaptable to diverse environmental conditions and have become naturalized across vast tropical regions, with their geographic range extending between latitudes 27° N and 28° S. While optimal growth occurs at elevations below 700 m where temperatures consistently remain above 20°C, cashews can also be found growing at altitudes up to 1200 m.

Propagation

As a cross-pollinated crop, seedlings in cashew orchards exhibit variation in yield, nut size, apple colour, and several other traits. Therefore, vegetative propagation is practiced, since clonal progenies are genetically identical to the mother plant, producing more uniform yields and reaching fruiting earlier. Softwood grafting is considered the most effective vegetative propagation method and has been shown to greatly enhance cashew productivity.

Planting

Before planting, chosen site should be cleared of shrubs and other vegetation. Planting pits measuring 1m x 1m x 1m should be dug, spaced either 7.5 m × 7.5 m or 8 m × 8 m apart, allowing for approximately 175 or 156 trees per hectare, respectively. On sloped terrain, pits should be aligned along contour lines to minimize soil erosion. Each pit should be filled with a mix of topsoil, 10 kg of compost, 2 kg of poultry manure, and 200 g of rock phosphate. Grafted cashew seedlings are typically planted during June-July. When planting, ensure the graft union remains above the soil surface. After planting, apply light irrigation, making sure the pits are not waterlogged, especially during the rainy season.

Canopy management

Cashew canopy if not properly shaped and managed from the early stages of orchard development, can grow irregularly, become difficult to control, and lead to reduced yields. A modified leader system or open centre system may be followed for widely spaced plants. It is important to regularly remove sprouts that emerge from the rootstock at consistent intervals. The graft's growth should be encouraged by maintaining a single stem up to a height of 0.75–1 m, achieved by eliminating sprouts or suckers not only below the graft union (stock portion) but also above it. During the first two years of graft growth, it is advisable to remove flower panicles emerging later in the season. This facilitates proper vegetative growth, ensuring the attainment of the appropriate height with robust canopy development. Starting from the third year, plants can be allowed to flower and fruit. To achieve better fruiting, it is important to permit well-spaced branches (4–6) in all directions. Regular pruning, adjusted according to the plant's variety and growth vigor, is crucial for encouraging optimal fruit production.

Nutrient management

Annually, cashew trees take up a significant quantity of nutrients. A 30-year-old tree reportedly removes 2.8 kg N, 0.75 kg P_2O_5, and 1.265 kg K_2O. Nutrient management is very important to get early and high yields in new plantations and to get regular high yields in mature plantations. ICAR-Directorate of Cashew Research, Puttur recommended applying organic manure at 10 kg/tree along with in organic fertilizers i.e. NPK at 500 g + 125g + 125g/tree in two splits during June-July and September-October for optimizing the yield of cashew under normal density planting system. The foliar application of 0.25 % Urea + SOP + SSP each) + 0.25 % ($ZnSO_4$ + Borax + $CuSO_4$ each) + 0.01 % Ammo. molybdenum increased the cashew yield (3.50 kg/plants) significantly over control (2.15 kg/plant). Further, 2% foliar spray of 19:19:19 (complex nutrients available in the market) produced significantly greater fruit set and yield (kg/tree) over control.

Soil and moisture conservation

Cashew is often grown in poor soils, making proper soil management essential to improve nutrient levels. In case of lands owing to frequent exposure to weather conditions, particularly heavy rainfall, top soil is almost completely eroded and the subsoil with poor nutrient reserve is exposed in elevated areas. When the crop is planted in such soils, the yield per tree is generally poor. *In situ* soil and water conservation practices are therefore crucial for harvesting rainwater and ensuring its availability to cashew plants during critical growth stages. This can be achieved through appropriate agronomic measures such as crop spacing, intercropping, and mulching, as well as by enhancing moisture retention using mechanical methods like trenching, bunding, terracing, basin construction, micro-catchments, or contour furrows, with trenching being the most effective. Methods like modified crescent bunds and use of coconut husks have proven effective in reducing annual runoff, soil and nutrient loss, while also improving average soil moisture, plant growth, cashew yield, and overall profitability showing a 40% increase in net profit compared to untreated areas. With proper soil and water conservation, the soil loss can be minimized; runoff water from post-monsoon and pre-monsoon rainfall can be harvested and made available to the plant during the critical period.

Irrigation

Cashew with an extensive root system is generally rain-fed and not irrigated. However, during the initial stages, especially in sandy soils, light irrigation may be provided for better growth and development. Irrigation should be applied only after flowering, starting one or two weeks post-flowering, depending on the specific characteristics of the variety. Therefore, in areas with irrigation facilities, providing water to cashew crops can enhance yield and profitability. It's crucial to note that cashew can not tolerate waterstagnation, flooding, orimpeded drainage, necessitating proper drainage wherever there is a risk of water stagnation.

Intercropping

Inter-cropping has gained popularity with the systemic development of large-scale orchards. It is commonly practiced during the initial years when there is enough space between the cashew rows, aiming to generate income before the cashew trees become productive, control weed growth, minimize nutrient loss, and make efficient use of sunlight and soil resources. Intercropping with vegetable crops such as yardlong bean, okra, cowpea, turmeric, ginger or short-stature fruit crops such as pineapple during early years can provide subsidiary income to growers. Among fruit crops, pineapple has proven to be the most suitable for intercropping or mixed cultivation with cashew plantations during the first seven years. Cultivating tuber crops in the spaces between 15-year-old cashew trees, without disrupting their root systems, provides cashew growers with an extra source of income such as ₹ 84,440/ha (Greater yam) followed by lesser yam (Rs. 66,440) and ₹ 65,350 from elephant foot yam.

After care

Staking the young plant with strong stick is necessary because when the plant grows to a height of 0.75 to 1 m with single stem, the graft is likely to lodge due to wind blow. Cashew plantations must be maintained free of weeds through manual, mechanical, or chemical methods. Mulching the tree basins with organic materials or residues helps control weed growth, deters soil-dwelling insects and disease-causing pathogens, reduces surface evaporation in the summer, and helps regulate soil temperature. Black/silver colour polythene mulch was helpful to conserve soil moisture and to repel sucking insects due to reflections of sun rays by the mulch sheet. The mulching of coir-pith (7.5 cm thickness) has reduced weed growth to the extent of 73.2 per cent in propagation plot followed by 46.00 and 45.16 per cent in top worked trees and nursery plot, respectively.

Pest and disease management

Tea mosquito bug (TMB): It is a major pest of cashew that causes significant damage in many regions worldwide. Of the four species that attack cashew, *Helopeltis antonii* is the most prevalent. Both nymphs and adults feed by sucking sap from leaves and flower clusters. This feeding results in leaf deformation and angular lesions, especially along the veins, which can cause leaves to fall off. During the flowering stage, it leads to inflorescence blight. When the bugs feed on the stalks of young shoots, they create elongated green lesions, sometimes accompanied by gum exudation. Severe damage causes shoot dieback due to the combined effect of bug saliva and fungi entering through the feeding wounds. This stimulates the growth of numerous side buds, producing a dense cluster of growth known as 'witches broom.' In heavy infestations, the trees may appear scorched as if burnt by fire. Bug feeding on developing apples and nuts causes brown sunken spots. The growth of trees is seriously retarded and fruit formation of attacking flowering shoots is reduced. The water based emulsions of pongamia oil (3%) resulted in high mortality of TMB up to 7 days after application, followed by neem oil (3%). Additionally, neem seed extract caused TMB mortality, but at levels below 50%. Likewise, seed extracts of *Annona reticulata* and *A. squamosa* induced less than 50% mortality of TMB.

Cashew stem and root borer: The Cashew Stem and Root Borer (CSRB), *Plocaederus ferrugineus* L., is a major pest attacking cashew trees. Its small larvae bore into fresh tissue, feeding on the phloem and xylem of the trunk and roots, creating irregular tunnels. This extensive tunneling damages the vascular tissues, disrupts the movement of plant sap, and ultimately causes the death of the tree. To manage CSRB, the most effective treatment was applying 250g of *M. anisopliae* spawn per tree combined with 500g of neem cake, resulting in the lowest infestation rate of 7.40%. This was followed by the application of 250g of *B. bassiana* spawn

per tree along with 500g of neem cake, which reduced infestation to 11.11%.

Gummosis: The disease is caused by the fungus, *Ceratocystis* species. It is identified by the oozing of a reddish-brown liquid from the main stem and branches, which eventually darkens to black. Longitudinal cracks develop in the infected areas, releasing gum. The inner tissues of the affected parts appear reddish-brown and contain small cavities filled with this reddish fluid. To manage the disease, remove the infected sections by chiseling them out and treat the exposed area by applying Bordeaux paste or wiping it with a copper oxychloride suspension.

Harvesting and yield

Cashew plants start bearing 3 years after planting, however, it is advisable to take the crop from the fourth year onward to encourage proper vegetative growth. Harvesting commences from February and continues till May depending on the varieties. Harvesting is usually carried out manually by picking up the nuts from the ground, which is highly labour-intensive. Alternatively, it is done by using a small basket or sack attached to a ring at the end of a long stick. The highest quality nuts are obtained when freshly fallen fruits are harvested. The area beneath the trees should be kept free of weeds and cleared regularly to ease nut collection.The average yield is about 10–15 kg/tree of raw nut and 80–100 kg/tree of cashew apple from the 10th year onward with proper management practices being followed.

Post-harvest management

After harvesting, cashew apple and nut should be separated using a nylon thread or sharp knife. The nuts should be air dried on concrete floors, drying mats or tarpaulins under shade for 3–4 days. While drying, the nuts should be turn frequently to ensure uniform drying. Well-dried nuts produce a rattling sound when turned on the drying floor. Dried nuts should be kept in gunny bags, safeguarded from rodents, and placed on a platform raised above the ground, ensuring there is space around all sides of the storage area. Properly dried raw nuts with a moisture content of 8–9% can be stored for up to one year without losing quality. Similarly cashew apple should be cleaned and kept for preparation of cashew apple products. Cashew apples can be maintained for 4–6 days by dipping with 1% mustard oil, 3 weeks by dipping with 0.25% citric acid and 500 ppm SO2, 4–5 weeks at 0–1.5°C and relative humidity 85–90% and 4–5 months with deep freezing.

SUMMARY

Lately, cashew cultivation has gained more attention across India because of the numerous benefits the crop offers. It was introduced to India as a soil binding crop but has now proved to be a high-income generating crop in degraded and marginal land. Its climate resilience provides an additional advantage compared to other perennial crops. Reliable markets and processing infrastructure in India have given farmers greater confidence. Currently, there is a strong demand for cashew both in domestic and international markets. Considering the growing demands, it is imperative to enhance the production of cashew by increasing productivity through adoption of scientific management practices, development of new plantation and replanting of old senile and uneconomical cashew gardens with high yielding varieties.

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