

Technical Bulletin: 82/2026



# Package of Practices for Cashew Cultivation in Goa



Sanjay M. Bandi  
Akula Chinapolaiah  
Bommayasamy N.  
Omar de Souza  
Parveen Kumar



**ICAR - Central Coastal Agricultural Research Institute**  
(Indian Council of Agricultural Research)

Old Goa 403 402, Goa, India.

Technical Bulletin: 82/2026

# Package of Practices for Cashew Cultivation in Goa

Sanjay M. Bandi  
Akula Chinapolaiah  
Bommayasamy N.  
Omar de Souza  
Parveen Kumar



**ICAR – Central Coastal Agricultural Research Institute**  
(Indian Council of Agricultural Research)  
Old Goa 403 402, Goa, India.

**Compiled and Edited:** Sanjay M. Bandi, Akula Chinapolaiah, Bommayasamy N., Omar de Souza and Parveen Kumar

**Published by**

The Director

ICAR - Central Coastal Agricultural Research Institute

Ela, Old Goa – 403 402

Phone: 0832-2995095, 0832-2993097

E-mail: [director.ccari@gmail.com](mailto:director.ccari@gmail.com)

Website: <https://ccari.res.in>

**Correct Citation:** Sanjay M. Bandi, Akula Chinapolaiah, Bommayasamy N., Omar de Souza and Parveen Kumar (2026) Package of Practices for Cashew Cultivation in Goa. Technical Bulletin No: 82, ICAR-Central Coastal Agricultural Research Institute (CCARI), Ela, Old Goa-403 402, Goa (India). PP. 1-40.

Copyright @ 2021, Indian Council of Agricultural Research (ICAR)

All rights reserved for reproduction of this document or any part thereof, permission of Indian Council of Agricultural Research (ICAR), New Delhi must be obtained.

**ICAR – Central Coastal Agricultural Research Institute**  
**(Indian Council of Agricultural Research)**  
**Old Goa 403 402, Goa (India)**


---

**Preface**

Cashew is an important tropical plantation crop of immense economic value. Cashew is often referred to as ‘wonder nut’ due to its potential to provide sustainable livelihoods to farmers, generate employment opportunities and earn foreign exchange through exports. The cashew kernel, due to its rich combination of fats, proteins, carbohydrates, minerals and vitamins, occupies a unique position among the edible nuts. India is world’s second-largest producer and fourth-largest exporter of shelled cashew nuts, accounting for about 6.6% global market share. Despite the prominent position, low productivity remains to be a major concern in the country. In the state of Goa, cashew is one of the major plantation crops and plays a vital role in the agrarian economy. The hot and humid climate of the Goa, coupled with high rainfall, creates favourable conditions for the build-up of insect-pests and diseases. Biotic stresses during the nursery and reproductive stage severely affect cashew yields. The cashew stem and root borer, tea mosquito bug, die-back disease, inadequate nutrient and orchard management practices are main constraints, leading to substantial economic losses to farmers.



Further, limited awareness regarding biotic and abiotic stresses, inadequate adoption of improved crop management practices, often prevent farmers from realising the optimum productivity of cashew. In this scenario, the ICAR-CCARI, Goa has been at the forefront in creating awareness and disseminating scientific knowledge on early diagnosis and integrated pest and disease management as well as improved production technologies in cashew. I place on record my appreciation for the efforts of our scientists in bringing out the technical bulletin entitled “Package of Practices for Cashew Cultivation in Goa”. This publication describes the major insect-pests, diseases, their field level diagnosis, management strategies and production technologies. I am confident that this technical bulletin will serve as a valuable reference for farmers, extension personnel, and researchers for improving cashew productivity and farmers income.

  
**Parveen Kumar**  
Director, ICAR – CCARI

# CONTENT

1.	Introduction .....	5
2.	Cashew varieties .....	6
3.	Climate and soil type .....	8
4.	Field preparation and planting .....	8
5.	Manures and fertilizers .....	10
6.	Training, pruning and top working.....	11
7.	Harvesting and yield .....	11
8.	Major insect pests .....	12
8.1	Stem and root borer .....	12
8.2	Tea mosquito bug .....	16
9.	Minor insect pests .....	19
9.1	Cashew apple and nut borer .....	19
9.2	Shoot tip caterpillar .....	21
9.3	Leaf and flower thrips .....	22
9.4	Leaf miner.....	24
9.5	Mealybug.....	25
9.6	Aphid.....	26
9.7	Ambrosia beetle.....	28
9.8	Jewel beetle.....	30
9.9	Leaf and blossom webber .....	32
9.10	Leaf beetles .....	33
10.	Major diseases of cashew .....	34
11.	General pest and disease management practices .....	37
12.	References.....	39

## 1. Introduction

Cashew (*Anacardium occidentale* L.) is a tropical evergreen tree native to South America, with Brazil recognized as its centre of origin. The European explorers introduced cashew to Asia and Africa in the 16<sup>th</sup> century. It was brought to India in the latter half of 16<sup>th</sup> Century by Portugal traders for the purpose of afforestation and soil conservation. The major cashew-growing countries include India, Brazil, Vietnam, Côte d'Ivoire, Mozambique, and Tanzania. The cashew fruit consists of a true seed (cashew nut) and a pseudofruit (cashew apple). The kernel is rich in lipids (50%), proteins (21%), and carbohydrates (25%) while the apple is rich in sugars and bioactive compounds. The cashew kernel is one of the most consumed and traded nuts in the global market, contributing substantially to foreign exchange earnings through the exports. In 2024, India emerged as the fourth-largest global exporter of shelled cashew nuts (fresh/dried), accounting for about 6.6% share of the world market. Cashew production in India reached 7.95 lakh tonnes in 2023–24, reflecting a growth of 1.66% over previous year, making the country world's second-largest producer after Côte d'Ivoire (Ivory Coast). India also has world's second-largest area under cashew cultivation, covering 11.84 lakh hectares. Cashew cultivation is primarily concentrated in peninsular region, including Maharashtra, Karnataka, Kerala, and Goa along the west coast, and Andhra Pradesh, Odisha, Tamil Nadu, and West Bengal along the east coast. It is also grown to a limited extent in Chhattisgarh, the north-eastern states (Assam, Manipur, Tripura, Meghalaya, and Nagaland), and Andaman and Nicobar Islands.

Among factors limiting cashew yield, the stem and root borer and tea mosquito bug are causing considerable damage to orchards. On an average, stem and root borers kill about 5–10% of yielding trees each year, while tea mosquito bugs can cause 30–50% yield losses. Among diseases, damping-off, anthracnose, dieback and powdery mildew are most serious, though their impact is generally less severe than that of insect pests. Several abiotic stresses and poor orchard management practices also limit cashew productivity. Drought, salinity, and high temperature adversely affect growth, flowering, and nut yield. Similarly, improper spacing, lack of canopy management, insufficient irrigation, and poor nutrient management further reduce orchard efficiency and yield.

A basic understanding of insect pests and their damage symptoms can enable timely management interventions, helping to realize the full yield potential of cashew. Adoption of appropriate cultivation practices, including proper spacing, canopy management, balanced nutrition, irrigation, and regular orchard monitoring, is essential for maintaining orchard health and enhancing productivity. This technical bulletin provides cashew cultivation practices, descriptions of major insect pests and diseases, damaging symptoms, and integrated management strategies. The bulletin is intended serve as a practical guide for cashew-growers, extension personnel, and researchers.

## 2. Cashew varieties

### Goa Cashew- 1 (Balli-2)

It is the first variety released from the state of Goa developed by ICAR-CCARI.

**Features:** Potential yield: 1.3 t/ha; average yield per tree by 10<sup>th</sup> year: 8.75 kg; number of nuts per kg: 130–137; average nut weight: 7.6 g; shelling percentage: 29.82%; kernel weight: 2.2 g; kernel grade: W210; apple colour and shape: yellow, cylindrical; average apple weight: 66.7 g; average juice content of apple: 66.68%; juice TSS: 12.0° Brix.

### Goa Cashew- 2 (Tiswadi-3)

**Features:** Potential yield: 1.5 t/ha; average yield per tree by 10<sup>th</sup> year: 9 kg; number of nuts per kg: 105-110; average nut weight: 10.2 g; shelling percentage: 29.55%; kernel weight: 2.42 g; kernel grade W180; apple colour and shape: yellowish orange and cylindrical; average weight of apple: 105 g; average juice content of apple: 72.0 %; juice TSS: 12.20° Brix.

### Goa Cashew- 3 (Ganje-2)

**Features:** Potential yield: 1.6 t/ha; average yield per tree by 10<sup>th</sup> year: 12 kg; number of nuts per kg: 130-140; average nut weight: 8.2 g; shelling percentage: 29.5%; kernel weight: 2.282 g; kernel grade W210; apple colour and shape: yellow and round; average weight of apple: 94.0 g; average juice content of apple: 69.17 %; juice TSS: 12.20° Brix.

### Goa Cashew- 4 (KN-2/98)

**Features:** Potential yield: 1.8 t/ha, average yield per tree by 10<sup>th</sup> year: 15 kg; number of nuts per kg: 120-125; average nut weight: 8.2 g; shelling percentage: 29.5%; kernel weight: 2.68 g; kernel grade W210-W240; apple colour and shape: red and conical; average weight of apple: 107.5 g; average juice content of apple: 74.14 %; juice TSS: 13.80° Brix.

### Goa Cashew- 5 (Tudal)

**Features:** Potential yield: 1.85 t/ha; average yield per tree by 10<sup>th</sup> year: 15 kg; number of nuts per kg: 120-125; average nut weight: 9.3 g; shelling percentage: 28.69%; kernel weight: 2.22 g; kernel grade W210-W240; apple colour and shape: yellowish orange and cylindrical; average weight of apple: 90.3 g; average juice content of apple: 71.4%; juice TSS: 13.8° Brix.

### Goa Cashew- 6 (HB-21)

**Features:** Potential yield: 1.8 t/ha; average yield per tree by 10<sup>th</sup> year: 14 kg; number of nuts per kg: 115-120; average nut weight: 8.5 g; shelling percentage: 31.18%; kernel weight: 2.22 g; kernel grade: W210-W240; apple colour and shape: yellow and conical; average weight of apple: 78.0 g; average juice content of apple: 70.4%; juice TSS: 10.8° Brix.



**Goa Cashew -1**



**Goa Cashew -2**



**Goa Cashew -3**



**Goa Cashew -4**



**Goa Cashew -5**



**Goa Cashew -6**

**Fig. 1 Cashew varieties**

### 3. Climate and soil type

Cashew, a tropical nut crop that requires a warm, humid and sunny climate. It thrives at temperatures up to 40°C. Young trees or flowers can be damaged resulting in reduced fruit set, if temperature falls below 7°C or rise above 45°C. Low altitude areas receiving 1,500 to 2,000 mm of rainfall are particularly suitable for cashew cultivation. However, it can also be grown in high-rainfall areas such as the north-eastern hill regions and the west coastal regions, where annual rainfall may exceed 4,500 mm. The high humidity and heavy rainfall during the flowering period can promote disease development. A 4–5 month dry and sunny period is essential for proper fruit development. Cashew grows best from sea level up to 700 meters above mean sea level (MSL). Optimal conditions for better yield include maximum temperatures of 28–32°C, minimum winter temperatures around 19°C and relative humidity of 70–80%. Frost is highly detrimental to the crop.

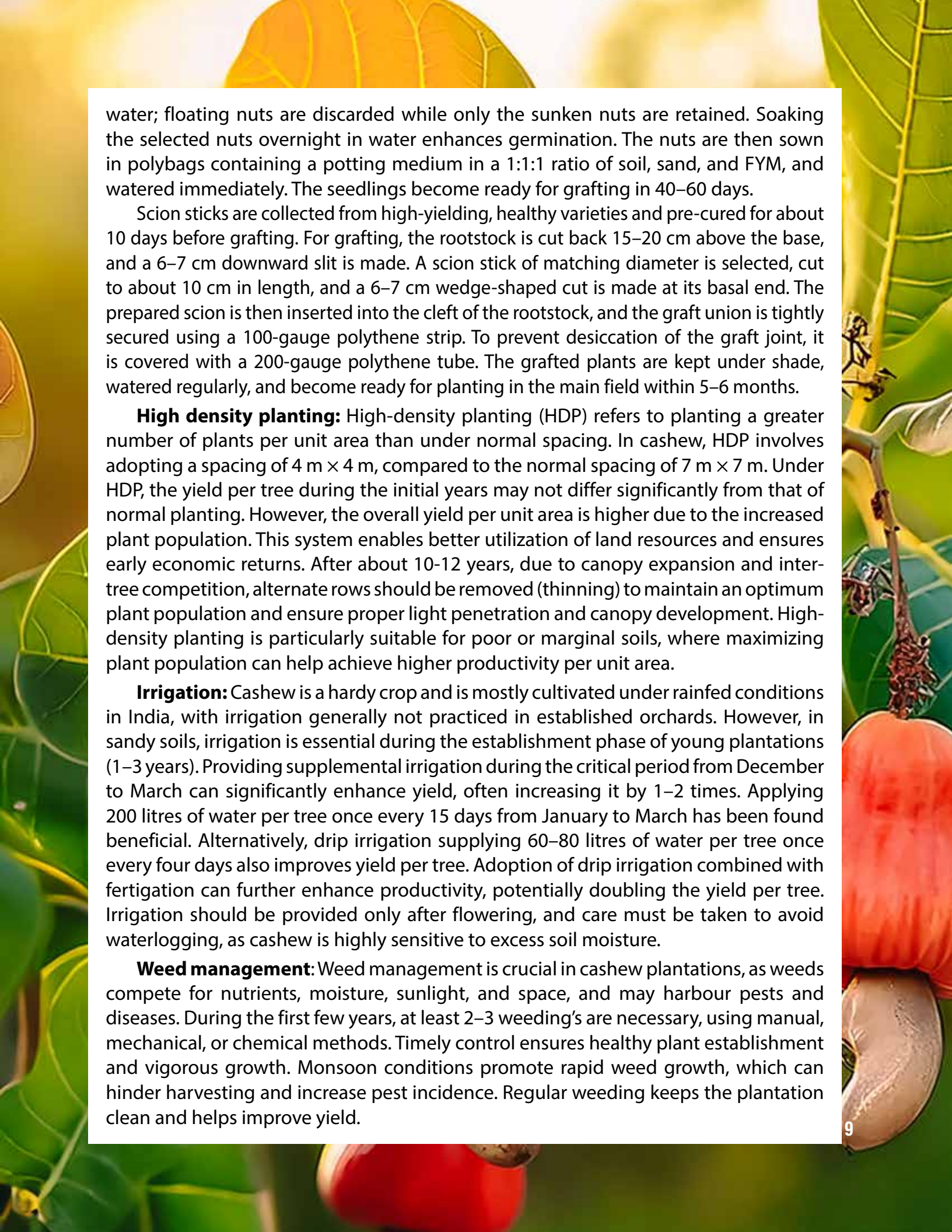
Cashew is a hardy crop that can be grown in a wide range of soils, from sandy to lateritic soils. It can even grow in less fertile and degraded soils. However, it performs best in deep, well-drained sandy loam, red loam, and laterite soils with a pH ranging from 5.5 to 7.5. In poor soils, it is important that the land is free of hardpans. Coastal sandy soils are considered most suitable for cashew cultivation, although nutrient supplementation is necessary in such soils. Cashew is highly sensitive to waterlogging; therefore, heavy clay soils with poor drainage are not suitable. A minimum soil depth of 1.5 meters is essential for successful cultivation.

### 4. Field preparation and planting

For establishing a new plantation, the land should be cleared of all bushes and weeds. In plain agricultural lands, the field should be properly ploughed and levelled. Pits measuring 60 cm<sup>3</sup> or 1 m<sup>3</sup> should be dug during the pre-monsoon period at a spacing of 7 m × 7 m while in high-density planting, a spacing of 4 m × 4 m or 5 m × 5 m may be adopted. The pits should be left open for about 15 days to allow proper curing and solarization. After curing, each pit should be filled up to three-fourth of its depth with top soil mixed with 10 kg of FYM and 200 g of single superphosphate.

The ideal time for planting cashew is during June–July, coinciding with the onset of the monsoon. High-yielding cashew grafts should be planted at the centre of the prepared pit and properly supported with suitable staking to ensure upright growth. Care must be taken at the time of planting to keep the graft union 10–15 cm above ground level to prevent scion rooting and collar rot. Side shoots emerging below the graft union should be removed regularly to promote healthy growth of the scion and maintain varietal purity.

**Propagation:** Cashew is commercially propagated through vegetative means, mainly by softwood grafting, as seed propagation does not produce true-to-type plants due to its cross-pollinated nature and high genetic variability. Seeds are primarily used to raise rootstocks. Fresh, well-matured nuts harvested during February–May are selected. The nuts are sun-dried for 2–3 days, and during selection, they are placed in

The background of the page features a close-up photograph of cashew leaves and a nut. The leaves are vibrant green with prominent yellow veins, and the nut is a rich reddish-brown color. The lighting is bright, creating a natural and healthy atmosphere.

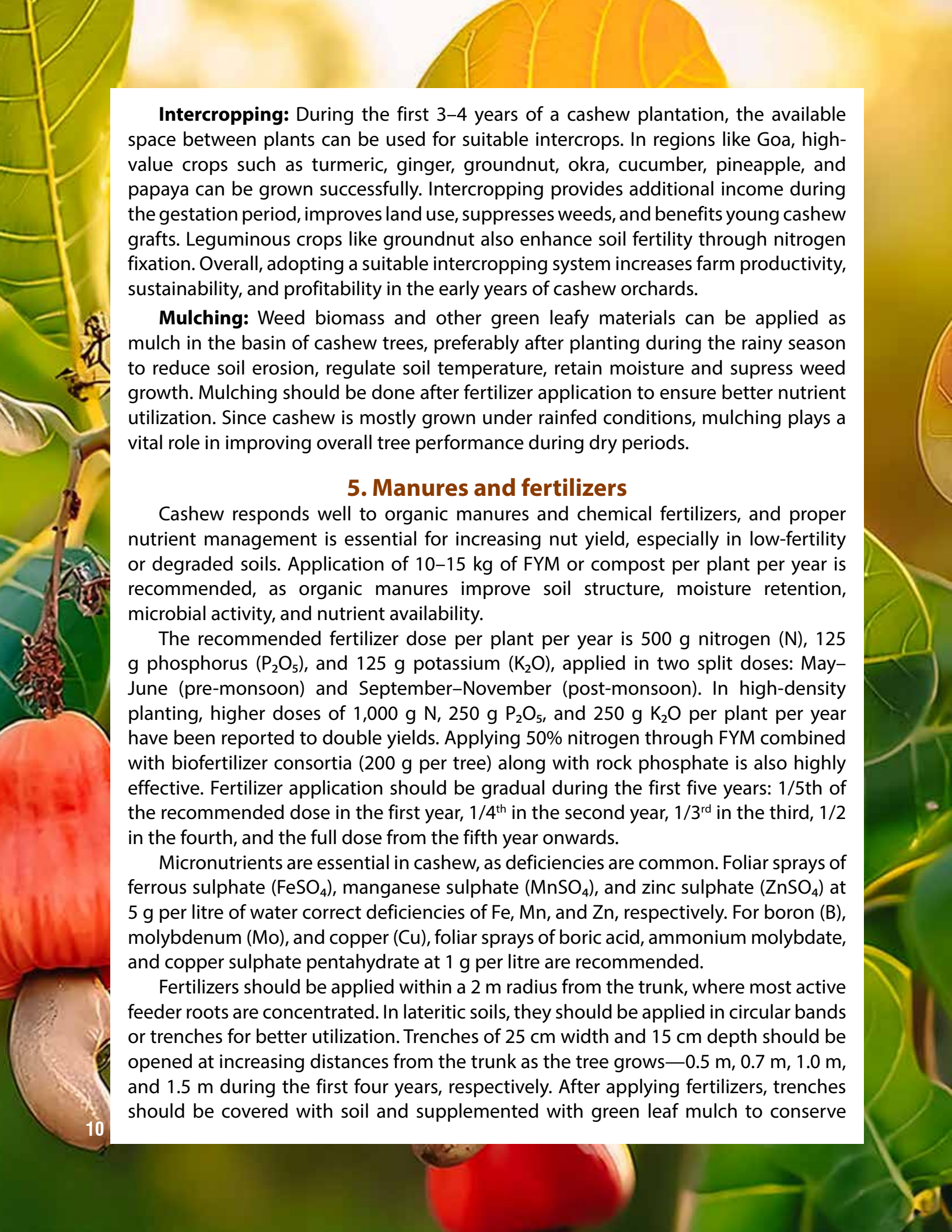
water; floating nuts are discarded while only the sunken nuts are retained. Soaking the selected nuts overnight in water enhances germination. The nuts are then sown in polybags containing a potting medium in a 1:1:1 ratio of soil, sand, and FYM, and watered immediately. The seedlings become ready for grafting in 40–60 days.

Scion sticks are collected from high-yielding, healthy varieties and pre-cured for about 10 days before grafting. For grafting, the rootstock is cut back 15–20 cm above the base, and a 6–7 cm downward slit is made. A scion stick of matching diameter is selected, cut to about 10 cm in length, and a 6–7 cm wedge-shaped cut is made at its basal end. The prepared scion is then inserted into the cleft of the rootstock, and the graft union is tightly secured using a 100-gauge polythene strip. To prevent desiccation of the graft joint, it is covered with a 200-gauge polythene tube. The grafted plants are kept under shade, watered regularly, and become ready for planting in the main field within 5–6 months.

**High density planting:** High-density planting (HDP) refers to planting a greater number of plants per unit area than under normal spacing. In cashew, HDP involves adopting a spacing of 4 m × 4 m, compared to the normal spacing of 7 m × 7 m. Under HDP, the yield per tree during the initial years may not differ significantly from that of normal planting. However, the overall yield per unit area is higher due to the increased plant population. This system enables better utilization of land resources and ensures early economic returns. After about 10–12 years, due to canopy expansion and inter-tree competition, alternate rows should be removed (thinning) to maintain an optimum plant population and ensure proper light penetration and canopy development. High-density planting is particularly suitable for poor or marginal soils, where maximizing plant population can help achieve higher productivity per unit area.

**Irrigation:** Cashew is a hardy crop and is mostly cultivated under rainfed conditions in India, with irrigation generally not practiced in established orchards. However, in sandy soils, irrigation is essential during the establishment phase of young plantations (1–3 years). Providing supplemental irrigation during the critical period from December to March can significantly enhance yield, often increasing it by 1–2 times. Applying 200 litres of water per tree once every 15 days from January to March has been found beneficial. Alternatively, drip irrigation supplying 60–80 litres of water per tree once every four days also improves yield per tree. Adoption of drip irrigation combined with fertigation can further enhance productivity, potentially doubling the yield per tree. Irrigation should be provided only after flowering, and care must be taken to avoid waterlogging, as cashew is highly sensitive to excess soil moisture.

**Weed management:** Weed management is crucial in cashew plantations, as weeds compete for nutrients, moisture, sunlight, and space, and may harbour pests and diseases. During the first few years, at least 2–3 weeding's are necessary, using manual, mechanical, or chemical methods. Timely control ensures healthy plant establishment and vigorous growth. Monsoon conditions promote rapid weed growth, which can hinder harvesting and increase pest incidence. Regular weeding keeps the plantation clean and helps improve yield.



**Intercropping:** During the first 3–4 years of a cashew plantation, the available space between plants can be used for suitable intercrops. In regions like Goa, high-value crops such as turmeric, ginger, groundnut, okra, cucumber, pineapple, and papaya can be grown successfully. Intercropping provides additional income during the gestation period, improves land use, suppresses weeds, and benefits young cashew grafts. Leguminous crops like groundnut also enhance soil fertility through nitrogen fixation. Overall, adopting a suitable intercropping system increases farm productivity, sustainability, and profitability in the early years of cashew orchards.

**Mulching:** Weed biomass and other green leafy materials can be applied as mulch in the basin of cashew trees, preferably after planting during the rainy season to reduce soil erosion, regulate soil temperature, retain moisture and suppress weed growth. Mulching should be done after fertilizer application to ensure better nutrient utilization. Since cashew is mostly grown under rainfed conditions, mulching plays a vital role in improving overall tree performance during dry periods.

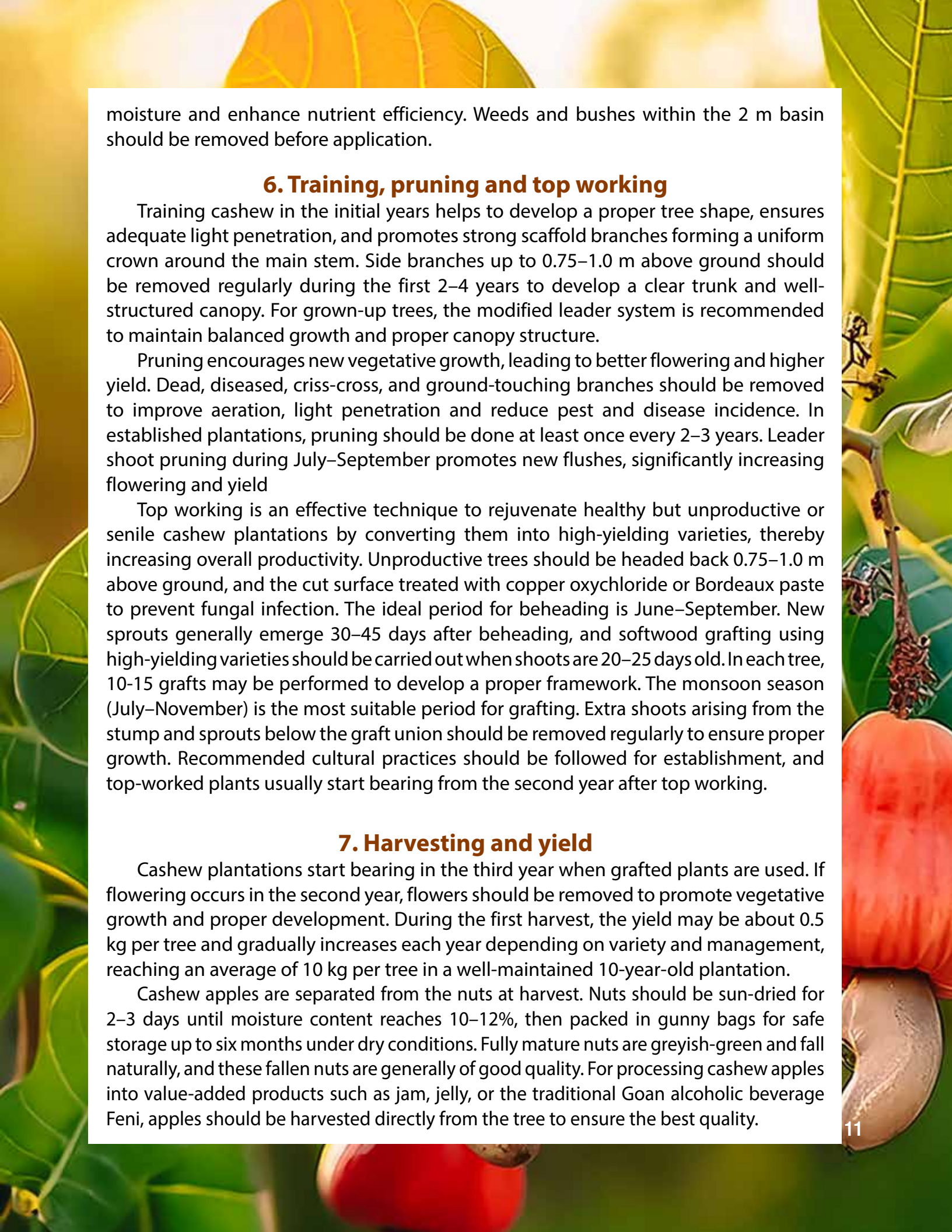
## 5. Manures and fertilizers

Cashew responds well to organic manures and chemical fertilizers, and proper nutrient management is essential for increasing nut yield, especially in low-fertility or degraded soils. Application of 10–15 kg of FYM or compost per plant per year is recommended, as organic manures improve soil structure, moisture retention, microbial activity, and nutrient availability.

The recommended fertilizer dose per plant per year is 500 g nitrogen (N), 125 g phosphorus ( $P_2O_5$ ), and 125 g potassium ( $K_2O$ ), applied in two split doses: May–June (pre-monsoon) and September–November (post-monsoon). In high-density planting, higher doses of 1,000 g N, 250 g  $P_2O_5$ , and 250 g  $K_2O$  per plant per year have been reported to double yields. Applying 50% nitrogen through FYM combined with biofertilizer consortia (200 g per tree) along with rock phosphate is also highly effective. Fertilizer application should be gradual during the first five years: 1/5th of the recommended dose in the first year, 1/4<sup>th</sup> in the second year, 1/3<sup>rd</sup> in the third, 1/2 in the fourth, and the full dose from the fifth year onwards.

Micronutrients are essential in cashew, as deficiencies are common. Foliar sprays of ferrous sulphate ( $FeSO_4$ ), manganese sulphate ( $MnSO_4$ ), and zinc sulphate ( $ZnSO_4$ ) at 5 g per litre of water correct deficiencies of Fe, Mn, and Zn, respectively. For boron (B), molybdenum (Mo), and copper (Cu), foliar sprays of boric acid, ammonium molybdate, and copper sulphate pentahydrate at 1 g per litre are recommended.

Fertilizers should be applied within a 2 m radius from the trunk, where most active feeder roots are concentrated. In lateritic soils, they should be applied in circular bands or trenches for better utilization. Trenches of 25 cm width and 15 cm depth should be opened at increasing distances from the trunk as the tree grows—0.5 m, 0.7 m, 1.0 m, and 1.5 m during the first four years, respectively. After applying fertilizers, trenches should be covered with soil and supplemented with green leaf mulch to conserve

The background of the page is a vibrant collage of cashew-related images. It features large, bright green leaves with prominent veins, some showing signs of aging or damage. Interspersed among the leaves are several red, heart-shaped cashew apples, some still attached to their stems. The overall color palette is dominated by greens and reds, with a soft, natural lighting effect.

moisture and enhance nutrient efficiency. Weeds and bushes within the 2 m basin should be removed before application.

## **6. Training, pruning and top working**

Training cashew in the initial years helps to develop a proper tree shape, ensures adequate light penetration, and promotes strong scaffold branches forming a uniform crown around the main stem. Side branches up to 0.75–1.0 m above ground should be removed regularly during the first 2–4 years to develop a clear trunk and well-structured canopy. For grown-up trees, the modified leader system is recommended to maintain balanced growth and proper canopy structure.

Pruning encourages new vegetative growth, leading to better flowering and higher yield. Dead, diseased, criss-cross, and ground-touching branches should be removed to improve aeration, light penetration and reduce pest and disease incidence. In established plantations, pruning should be done at least once every 2–3 years. Leader shoot pruning during July–September promotes new flushes, significantly increasing flowering and yield

Top working is an effective technique to rejuvenate healthy but unproductive or senile cashew plantations by converting them into high-yielding varieties, thereby increasing overall productivity. Unproductive trees should be headed back 0.75–1.0 m above ground, and the cut surface treated with copper oxychloride or Bordeaux paste to prevent fungal infection. The ideal period for beheading is June–September. New sprouts generally emerge 30–45 days after beheading, and softwood grafting using high-yielding varieties should be carried out when shoots are 20–25 days old. In each tree, 10–15 grafts may be performed to develop a proper framework. The monsoon season (July–November) is the most suitable period for grafting. Extra shoots arising from the stump and sprouts below the graft union should be removed regularly to ensure proper growth. Recommended cultural practices should be followed for establishment, and top-worked plants usually start bearing from the second year after top working.

## **7. Harvesting and yield**

Cashew plantations start bearing in the third year when grafted plants are used. If flowering occurs in the second year, flowers should be removed to promote vegetative growth and proper development. During the first harvest, the yield may be about 0.5 kg per tree and gradually increases each year depending on variety and management, reaching an average of 10 kg per tree in a well-maintained 10-year-old plantation.

Cashew apples are separated from the nuts at harvest. Nuts should be sun-dried for 2–3 days until moisture content reaches 10–12%, then packed in gunny bags for safe storage up to six months under dry conditions. Fully mature nuts are greyish-green and fall naturally, and these fallen nuts are generally of good quality. For processing cashew apples into value-added products such as jam, jelly, or the traditional Goan alcoholic beverage Feni, apples should be harvested directly from the tree to ensure the best quality.

## 8. Major insect pests

### 8.1 Stem and root borer

(*Neoplocaederus* spp., *Batocera rufomaculata* (De Geer); Cerambycidae: Coleoptera)

Stem and root borers are major insect pests of cashew and are capable of killing the trees. Among the three stem borer species infesting cashew, *Neoplocaederus ferrugineus* (L.), and *N. obesus* (Gahan) are recorded as primary pests, while *Batocera rufomaculata* (De Geer) is considered a secondary pest. In India, about 5-10% of yielding trees are lost annually due to stem borer infestation. In addition to these primary borers, the secondary wood borers, including *Coptops aedificator* (Fab.), *Aeolesthes holosericea* (Fab.), *Glenea multiguttata* Guerin-Meneville, *Euplatypus parallelus* (Fab.), and *Belionota prasina* (Thunberg) may further aggravate the infestation. The pests infest several host trees including mango, moringa, fig, guava, chironji, anjan, eucalyptus, mulberry, jackfruit, silk cotton, pomegranate, apple, walnut, sapota and rubber.

### Identification and biology

Adults of *N. ferrugineus* are chestnut-red longicorn beetles, while *N. obesus* adults are dull grey-brown. *Batocera rufomaculata* adults are greyish, with two kidney-shaped orange-yellow spots on the pronotum. The eggs are laid in crevices of loose bark on the trunk and exposed roots. They are creamy-white, oval and resemble rice grains. The incubation period is about 4-8 days. Grubs of *Neoplocaederus* spp. are cream-coloured, with prognathus mouthparts and strong mandibles. A prothoracic shield with two crescent-shaped markings is present. The grub possesses three pairs of prothoracic legs and passed through five instars. In contrast, grubs of *B. rufomaculata* are cream-coloured but apodous. The grubs feed voraciously inside the tree trunk for 4–8 months. The feeding tunnels made by *Neoplocaederus* spp. are broad and irregular, deeper in the middle and shallow at the sides and are fully packed with fibrous tissues and frass. Tunnels made by *B. rufomaculata* are extensive, irregular, deep, and are filled with coarse fibres and scraps of wood and bark. The mature grubs enter the heartwood and forms a calcareous cocoon. Pupal period lasts for 60-90 days. The pest completes its life cycle in about one year. The adults are typically nocturnal. Males have antennae longer than their body, whereas in females have shorter antennae. Pest incidence occurs throughout the year, with peak activity from December to May in major cashew growing regions of India.

### Symptoms of damage

- Small bore holes at the collar region.
- Extrusion of frass (coarse wood dust) through the holes at the collar region. Bore holes and tunnels are filled with chewed fibres, frass and excreta.
- Exudation of gum (gummosis) from the damaged portion at the base of the trunk.
- Grubs bore into and feed on the sub-epidermal and vascular tissues.
- Extensive irregular tunnelling in the stem and root tissues.



(a)



(b)



(c)



(d)



(e)

**Fig 2. Symptoms of CSRB infestation: (a) Bore holes on trunk, (b) Extrusion of frass, (c) Gummosis (d) Yellowing and (e) drying of tree**



**Eggs**



**Grub**



**Cocoon**



***Neoplocaederus ferrugineus***



***Neoplocaederus obesus***



***Batocera rufomaculata***

**Fig 3. Life stages of stem and root borer**

- The sap flow is affected thus disruption of water and nutrient transport, causing yellowing and shedding of leaves, drying of twigs, and eventual death of the tree.
- Affected trees may tilt due to loss of anchorage.

### **Integrated management**

#### **Prophylactic measures**

- 1) Avoid damage to cashew roots while ploughing the interspaces in cashew plantations.
- 2) Avoid injuring cashew trees by garden tools, as wounds attract adult beetles.
- 3) Phytosanitary measure includes removal of alternate host plants and weeds in and around the cashew plantation.
- 4) Regularly examine the trunk portion at monthly interval during April-May and October-November for presence of eggs and grubs of stem borers.
- 5) Periodically monitor the trees for symptoms such as gummosis and presence of frass material near the base of the trunk.
- 6) Remove dead trees and trees beyond recovery, before and after the monsoon period to reduce the spread of stem and root borer infestation.
- 7) Brush the basal trunk region up to 2-meter height using a hard nylon brush to dislodge the eggs present on the surface.
- 8) As a prophylactic measure, swab the trunk with neem seed kernel extract (NSKE) 25% or apply mixture of coal tar and kerosene (1:2) up to 1 meter from ground level, twice a year during March–April and November–December, to prevent egg laying by adult beetles.

#### **Curative measures**

- 1) The trees showing symptoms of sickness or gummosis should be examined critically. Stem borer grubs should be mechanically removed at the initial stages of infestation.
- 2) Insert a flexible clutch-cable or metal wire into the bore holes to kill the grubs mechanically.
- 3) The infested areas of the trunk should be thoroughly swabbed with insecticide. Repeat the treatment after 30–45 days, if fresh infestation symptoms are observed.
- 4) Treat infested trees by applying fipronil 5SC (2 ml per litre water) or Imidacloprid 17.8 SL (2 ml per litre) to the trunk region up to one-meter height from the ground level and to the exposed roots during October-November, January-February and April-May months.
- 5) The entomopathogenic fungi *Metarhizium anisopliae* and *Beauveria bassiana* are known to cause mycosis to grubs. Their spawns may be mixed with farmyard manure (FYM) and neem cake to enhance the spore load of these mycopathogens in the field conditions.
- 6) Entomopathogenic nematodes belonging to the genera *Steinernema* and *Heterorhabditis* have been found effective in managing stem and root borer under laboratory conditions.

## 8.2 Tea mosquito bug

(*Helopeltis* spp., Miridae: Heteroptera)

Tea mosquito bugs (TMBs) are the most serious sucking pests of cashew in India. Four species of TMBs, namely, *Helopeltis antonii* Sign., *H. bradyi* Wat., *H. theivora* Wat., and *Pachypeltis maesarum* Kirk. (Hemiptera: Miridae), have been reported to infest cashew. Among these, *H. antonii* is the dominant species and is prevalent in all major cashew-growing regions of India, followed by *H. bradyi* and *H. theivora*. The pest can multiply rapidly under favourable conditions within a short period, particularly during the emergence of new flushes and flowering. Infestation by TMBs causes yield losses ranging from 30–50%, which may go up to 100% during outbreak situations. The pest feeds on variety of host plants such as tea, neem, guava, cocoa, mahogany, cinchona, cotton, apples, grapes, drumstick, black pepper, jamun, Singapore cherry, henna, eucalyptus, tamarind, weeds like *Chromolaena odorata*, *Terminalia paniculata*, *Getonia floribunda*, *Macaranga peltata*, *Melastoma malabathricum*, *Merremia vitifolia*, *Solanum torvum*, *Cissus repanda*, *Strychnos nux-vomica*, *Ixora* sp., *Lantana camara* and *Leea* sp. But cashew is the most preferred during the cropping season.

### Identification and biology

The adult *H. antonii* is reddish-brown with black head, red thorax and black-and-white abdomen. *H. bradyi* adults closely resembles *H. antonii*, but with distinct colour variation (basal white band) in hind femur and abdomen. *H. theivora* has long antennae with yellowish pronotal ring and greenish patch on the abdomen. All three *Helopeltis* species possess a scutellar process or thoracic knob which is reddish brown, erect, tapering and knobbed with a funnel-shaped tip. This structure is present dorsally in nymphs (except first instar) and adults. However, the thoracic knob is absent in *P. maesarum*. The nymphal stages have long antennae and exhibit varied body colours: brownish in *H. antonii*, greenish-yellow in *H. bradyi* and greenish in *H. theivora*. The nymphs of *H. theivora* are comparatively smaller and slender in appearance. The eggs are elongate and creamy-white, laid in rows deep inside tender shoots or soft tissues of inflorescence stalks. A pair of fine, unequal, thread-like extra-chorionic processes (respiratory filaments) projecting outside indicates the presence of an egg inside the plant tissues. Fecundity ranges from 94-140 eggs per female with incubation period of 6-7 days. Nymph undergo five instars and develop into adults within 10-15 days. The total life cycle is completed in 17-25 days.

Feeding and multiplication of TMBs typically begin during November–December, when cashew trees are in their most active growth phase. Trees with new flushes and tender inflorescences are highly attractive to both nymphs and adults. The pest population usually reaches its peak during January–February, coinciding with the full blossom stage of the trees.



Damaged young leaves



Necrotic spots on shoot stem



Necrotic lesions on fruit peduncle and nuts

**Fig 4. Symptoms of TMB infestation**



**Fig 5. Adult bugs of *Helopeltis* spp.**

### Symptoms of damage

- Both nymphs and adults suck cell sap from tender shoots, leaves, floral branches, developing nuts, fruit peduncle and apples.
- Necrotic lesions develop at the site of stylet insertion on the green tender stems of young shoots and on inflorescence rachis, which are characteristic symptoms of TMB damage.
- The necrotic lesions are elongated on tender shoots and petiole, while they appear as round, sunken spots on fruits.
- Affected shoots and panicles dry up, and developing nuts shrivel and drop prematurely.
- Immature nuts infested by TMB develop characteristic eruptive spots and finally shrivel and fall off.
- During severe outbreaks, heavily infested trees may appear scorched, leading to the death of shoots and growing tips. This condition is also known as “shoot blight” or “blossom blight”.
- Severely affected branches become susceptible to secondary infection by *Lasiodiplodia theobromae* (*Botryodiplodia theobromae*) and *Colletotrichum gloeosporioides* fungus causing die-back disease.

### Integrated management

- 1) The phytosanitary measure includes periodic removal of alternate host plants or weeds in and around the cashew plantations.
- 2) A proper monitoring of pest incidence is highly recommended to rationalize the spray schedule.
- 3) The mid- or late- season flowering varieties of cashews able to escape the severity of TMB infestation to some extent. Cashew variety, *Bhaskara* is reported to escape the TMB damage due to mid-season flowering nature during low to moderate pest incidence.
- 4) The build-up of this pest is naturally regulated by egg parasitoids *Erythmelus helopeltidis* (Mymaridae) and *Telenomus cuspidis* (Platygastridae).
- 5) The presence of red ant (*Oecophylla smaragdina*) colonies on cashew trees has been reported to exert a repellent effect and deter *Helopeltis* from feeding and egg-laying, resulting in reduced pest damage.
- 6) Entomopathogenic fungus, viz., *Beauveria bassiana* and *Metarizhium anisopliae* have been found effective against TMB.
- 7) As an ad-hoc recommendation, 5–10% damaged fresh foliar and floral flushes may be considered the economic threshold level (ETL) for tea mosquito bug to initiate the control measures.

- 8) Need based sprays are advised during the most vulnerable stages, such as new flushing (November- December), flowering (December- January) and initial fruiting stage (February-March).
- 9) A three round of spray schedule is recommended for TMB management. The insecticides like lambda-cyhalothrin 5 EC (0.6 ml/litre), thiamethoxam 25 WG (0.2 gm/litre), acetamiprid 20 SP (0.5 g/litre), beta-cyfluthrin 8.49 + imidacloprid 19.81 OD (0.25-0.5 ml/litre) can be sprayed in rotation.
- 10) The same insecticide should not be repeated in the second round. Avoid indiscriminate use of synthetic pyrethroids as it causes flare-up of sucking pests. The sprayings should be done before 9.00 am or after 4.00 pm in order to save non-target pollinators. Spraying should be avoided during the active foraging period, 10.00 AM–1.00 PM, of the pollinating bees.
- 11) Whenever die-back disease is observed, spray the canopy with 1% Bordeaux mixture.

## 9. Minor insect pests

### 9.1 Cashew apple and nut borer

(*Thylacoptila paurosema* Meyrick, *Hyalospila leuconeurella* Ragonet, *Nephoptyx* spp., Pyralidae: Lepidoptera)

Several lepidopteran larval stages damage the tender nuts and apples of cashew. The pest causes 10% yield loss during severe infestation in certain cashew growing areas.

#### Identification and biology

The adult *T. paurosema* is a medium sized moth with dark forewings and pale hindwings. Eggs are laid on the fruits. The larva is dark pinkish and highly active. It passes through five larval instars over a period of 15-33 days. The fully-grown larvae drop to the ground and pupate in earthen cocoons. The pupal period lasts about 8-10 days. The larvae of *H. leuconeurella* are reddish with light-brown head and adult is dark-brown moth. Eggs are deposited in the grooves near the junction of nut and apple. The full-grown larvae of *Nephoptyx* sp. are pink in colour with short setae. They pupate in earthen cocoon in the soil.

#### Symptoms of damage

- The larvae of *T. paurosema* initially damage flowers by webbing the panicles and feeding on unopened flower buds. They infest fruits at all stages of development and cause shrivelling and premature fruit drop. In the developed apples, the larvae bore near the apple–nut joints and cause premature fruit fall. The affected fruits can be easily identified by bore holes plugged with frass and excreta. The frass is often seen hanging externally at the fruit–nut joints.



**Bore holes plugged with frass**



**Larval stage**

**Fig 6. Apple and nut borer damage**

- The larvae of *H. leuconeurella* bore through apple from one end to other and feed internally while remaining inside the fruit. The infested apples drop pre-maturely, and the nuts become deformed.
- The larvae of *Nephoteryx* sp. scrape the epidermis of fruits and nuts and also bore into apples and tender nuts. The minute entry holes are plugged with excreta. Apples shrivel and drop prematurely while nuts dry up. Full grown caterpillars bore into tender apples and nuts and feed internally. Infested fruits and nuts shrivel up and fall prematurely.

### Management

- 1) Removal and destruction of dead and dried inflorescences during the pre-flowering season is an effective cultural practice to reduce pest population build-up.
- 2) Collection and destruction of infested apples and nuts helps to prevent spread of pest.
- 3) The parasitoids such as *Phanerotoma* spp., (Braconidae) and *Trathala flavoorbitalis* (Ichneumonidae) have been reported to parasitize the larval stages of apple and nut borer under field conditions.
- 4) Spraying of lambda-cyhalothrin 5EC at 0.6 ml per litre during flowering stage has proven effective in controlling apple and nut borers.

### 9.2 Shoot tip caterpillars

(*Anarsia epotias* Meyrick and *Hypatima (Chelaria) haligramma* Meyrick; Gelechiidae: Lepidoptera)

The incidence of these caterpillars is observed from September to December months. The pest is distributed in Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and Odisha. They also infest mango and sapota.

### Identification

- *Anarsia epotias*: Adult moths have dark grey forewings and grey hindwings and the base is thinly scaled. The caterpillars are pale yellowish-green with black heads, later turning pinkish-brown.
- *Hypatima haligramma*: The forewings of adult moths are yellowish-grey with white speckles. The hindwings are grey, thinly scaled and subhyaline anteriorly. The larvae are tiny and yellowish to greenish-brown.

### Symptoms of damage

The pest incidence is seen mostly during flushing stage. The early-stage caterpillars web the tender leaves together and feed within. Later, they bore into terminal shoots,

and tunnelling up to 2-3 cm. A gummy substance exudes from infested tips and the shoots eventually dry up.

Larvae of *H. haligramma* damage shoot tips by folding the fresh leaves and feed internally, tunnelling up to 2 cm. The inflorescences may also be affected. Exudation of gummy web like substances mixed with faecal pellets are visible at injury site. The terminal shoots turn black and die, leading to production of auxiliary shoots.

### Management

- 1) The larval parasitoids such as *Pristomerus* sp. (Ichneumonidae), *Apanteles* sp. (Braconidae), *Elasmus* sp. and *Sympiesis* sp. (Eulophidae) have been recorded, causing parasitism of up to 25 per cent.
- 2) In case of severe infestation, the insecticide spray can be applied to manage this pest effectively.

### 9.3 Leaf and flower thrips

**Foliage thrips:** *Retithrips syriacus* (Mayet) *Rhipiphorothrips cruentatus* Hood and *Selenothrips rubrocinctus* Giard, (Thripidae: Thysanoptera)

**Flower thrips:** *Rhynchothrips raoensis* G., *Scirtothrips dorsalis* H., *Frankliniella schultzei* (Trybom).

Among these *R. cruentatus* and *S. rubrocinctus* cause severe damage to young plantations during summer months. Leaf thrips are prevalent from October to December, while flower thrips occur from January to April. Flower thrips attack buds, flowers, immature apples and nuts.

### Identification and biology

Thrips are minute, slender, soft bodied, fast-moving insects with fringed wings. The eggs are inserted singly into the epidermis of leaves. The nymphs emerge in about 10 days and are wingless. Nymphal period last for 8-10 days, followed by a pupal period of 3-4 days.

### Symptoms of damage

- Nymphs and adults colonise the lower surface of leaves and suck cell sap.
- As a result of feeding, the leaves become pale-brown and slightly crinkled with roughening of the upper surface.
- Scab-like roughening occurs on infested panicles, floral branches, nuts and apples.
- Severe infestation causes premature shedding of flowers, leaves and nuts; formation of corky layers on the affected parts, malformation of nuts and immature fruit drop.
- Young plantations suffer the most during summer months- April-May.



**Fig 7. Thrips damage to apples, nuts and foliage**

### **Management**

- 1) The predators such as coccinellids, syrphids and green lace wing have been found predated on various stages of the thrips.
- 2) Spraying of neem-based insecticide or lambda-cyhalothrin (0.6 ml/ litre) or beta-cyfluthrin 8.49 + imidacloprid 19.81 OD (0.25-0.5 ml/litre) is effective in controlling thrips infestation.

## 9.4 Leaf miner

(*Acrocercops syngamma* M., Gracillariidae: Lepidoptera)

Leaf minors are serious pests of cashew during the post-monsoon period across the country. Nursery seedlings and young plantations are particularly susceptible. The pest has also been reported on mango and jamun.

### Identification and biology

The adult are silver-grey moths which lays eggs on upper surface of tender leaves. Newly hatched larvae are pale white turning reddish-brown when fully-grown. The larval period lasts for 10–15 days. The fully-grown larvae drop to the soil where they pupate and emerge as adult moths after 7-9 days. The life cycle of this pest is around 20-25 days.

### Symptoms of damage

- The young larvae feed on tender leaves and shoots.
- Larvae mine the epidermal layer of leaves with 1-5 larvae often found per leaf.
- Feeding causes white blister-like patches on the leaves.
- Infested leaves dry, turn brown, become distorted and curl.

### Management

- 1) The larval parasitoids; *Chelonus* sp. (Braconidae) and *Sympiesis* sp. (Eulophidae) have been recorded from Kerala and Goa.
- 2) The parasitoids namely, *Chrysocharis* sp., *Aprostocetus* sp. and *Closterocerus* sp. (Eulophidae) have been recorded in Puttur, Karnataka.
- 3) In case of severe incidence in nurseries and young plantations, spray lambda-cyhalothrin 5 EC (0.6 ml/litre) to manage the leaf minors.



Fig 8. Leaf minor damage

## 9.5 Mealybugs

(*Phenacoccus solenopsis* Tinsley, *Pseudococcus longispinus* (Targioni-Tozzetti) and *Ferrisia virgata* Cockrell; Pseudococcidae: Heteroptera)

Mealybugs are emerging as serious insect pests of cashew. *Phenacoccus solenopsis* and *Ferrisia virgata* are particularly damaging across cashew-growing regions, including Karnataka, Kerala, Tamil Nadu, but severe in Konkan region and Goa.

### Identification and biology

Mealybugs are soft-bodied insects, and covered with flocculent, milky-white, waxy threads. They excrete the sticky honeydew that covers the foliage and serves as excellent medium for growth of black sooty mould.

**Solenopsis mealybug** (*P. solenopsis*): Body is oval, covered by white, mealy wax with dark dorsosubmedial bare spots on intersegmental areas of thorax and abdomen. The adult females have two dark stripes on either side and short to medium waxy filaments around the body. The total nymphal development of *P. solenopsis* on cashew ranges from 23– 29 days (average 25.2 days).

**Striped mealybug** (*F. virgata*): These are small, soft bodied insects with numerous glassy filaments over the body. The pair of conspicuous, long, stout, tapering waxy tassels at the posterior end.



Fig 9. Mealybug infestation on panicle and nuts

### Symptoms of damage

- Mealybugs colonies are found on the lower surfaces of tender leaves, twigs, inflorescence panicles and fruit peduncles.
- The nymphs and adults suck the cell sap from tender leaves, twigs, inflorescence, panicles and fruit peduncles, causing withering of growing shoots, inflorescence and developing fruits.
- The honeydew excretion promotes sooty mould growth, reducing photosynthetic activity, thereby reducing nut yield.
- Severe infestation can lead to heavy nut yield loss.

### Management

- 1) Regular monitoring and removal of alternate host plants and weeds to reduce the pest survival.
- 2) Destruction of mealybug infested plant parts like leaves, inflorescence and twigs to reduce infestation and spread.
- 3) Conservation of predators and parasitoids can regulate the mealybug populations.
- 4) The solitary endoparasitoid, *Aenasius bambawalei* Hayat (Encyrtidae) has been recorded as an efficient natural mortality factor of *P. solenopsis*. The *Aenasius advena* Campere (Encyrtidae) is recorded to parasitize *F. virgata*.
- 5) Under severe outbreak conditions, spray thiamethoxam (0.6 g/litre) or imidacloprid (0.6 ml/litre) in combination with fish oil Rosin soap (20 g/litre).

## 9.6 Aphids

(*Aphis odinae* (= *Toxoptera odinae*) van der Goot; Aphididae: Hemiptera)

It is a polyphagous, occasional sucking pest of cashew. It has a broader host range of more than 45 plant families. Some of important host plants include cashew, jack, citrus and mango.

### Identification and biology

Adults are greyish-brown to reddish-brown. They reproduce parthenogenetically throughout the year. These aphids can be easily distinguished by the presence of very small siphunculi, shorter than cauda. Seasonal incidence of aphid noticed from December to April in Goa.

### Symptoms of damage

- Nymphs and adults aggregate in large numbers on the under surface of tender leaves, shoots, inflorescences, apples and nuts, and suck the cell sap. The aphid colonies are often attended by many species of ants.



**Fig 10. Aphid infestation on foliage and nuts**

- Honeydew excretion results in development of sooty mould on leaves and shoots reducing photosynthetic activity.
- The damage is more severe in young plantations.
- Heavy infestation cause shedding and drying of inflorescences and distortion of nuts and apples.
- Populations typically start on young leaves and later migrate to apples and nuts, with the maximum population observed on nuts.

### Management

- 1) Regular monitoring and removal of alternate host plants and weeds and destruction of aphid infested plant parts (leaves, inflorescence and twigs) help to reduce infestation and spread.
- 2) Six aphidophagous predators comprising three species of coccinellids, viz., *Scymnus castaneus* Sicard, *Cheilomenes sexmaculata* (Fabricius) and *Pseudaspidimerus flaviceps* (Walker) and three species of syrphids, viz., *Paragus serratus* (Fabricius), *Dideopsis aegrota* (Fabricius) and *Ischidon scutellaris* (Fabricius) were found preying on *A. odinae* in Goa. The coccinellids and syrphids keep the population of aphid below the ETL.
- 3) Conservation and augmentation of these natural enemies be encouraged to regulate the pest population.

### 9.7 Ambrosia beetle

(*Euplatypus parallelus* Fabricius; Platypodinae: Coleoptera)

Ambrosia beetles, also known as pin-hole borers, are wood-boring insects that live in symbiosis with fungi. They usually attack weakened, dying, and recently cut or killed trees, although some species may infest living trees. The occurrence of *E. parallelus* infestation on cashew has been reported for the first time from Goa, India. Most infested trees were either previously attacked by stem and root borer (*Plocaederus ferrugineus*) or had been pruned.

#### Identification and biology

The larvae are creamy white, curved and legless with 3.0–3.5 mm in length. Pupa is white, 3.7–4 mm in length. Adult beetles are brown, long slender body with yellow hairs, 4.0–4.3 mm in length. They possess a strong apical spine on protibiae but absence of pores on the pronotum which is a characteristic feature. The Male and female beetles can be identified based on the elytral declivity. Elytral striae in male are deeply impressed, subequal in width to interstriae at base of declivity.



**Bore holes with extrusion of dust and frass**



**Adult beetles**

**Fig 11. Ambrosia beetle infestation**

### **Symptoms of damage**

- The numerous round bore-holes appear on the trunk and branches, often accompanied by extrusion of fibrous dust, frass on the trunk and in loose piles at the base of the tree.
- Two types of frass material were observed: powdery frass, and small strings of compacted sawdust (ejected wood fibre) with 1.5-2.8 cm in length protruding from small bore-holes along the tree trunk and limbs.
- The galleries of affected trees contain large numbers of larvae, pupae and adults.
- Gallery length ranges from 1.0 cm to 5.6 cm and the gallery walls are dark stained with fungal mycelia.

### **Management**

- 1) Regularly monitor for the presence of frass at the base of the trunk.
- 2) Brush the basal trunk region up to 2 m height with a hard nylon brush.
- 3) Treat infested trees with fipronil 5 SC (2 ml/litre of water) on the trunk region up to one-meter height from the ground.

## 9.8 Jewel beetle

(*Belionota prasina* (Thunberg, 1789); Buprestidae: Coleoptera)

The jewel beetle, *Belionota prasina* is a polyphagous insect pest, widely distributed in India. It infests several host plants, including *Ceiba pentandra*, *Delonix regia*, *Casuarina* spp., and *Mangifera indica*.

### Identification and biology

Adult beetles are dark greenish-blue in colour and measure about 21–28 mm in length. Adult beetles are very active and walking rapidly over the trunk with interrupted, jerky movements over the trunks. Adults are commonly found on trunk and branches at various heights, usually with their head facing downward. Female beetles are larger than males. Grubs are fleshy, whitish-yellow and measure 9–50 mm in length. Pre-pupa and pupa are yellowish-white, measuring 26–32 mm and 20–23 mm in length.

### Symptoms of damage

- Presence of semi-circular, D-shaped exit holes measuring 7–10 mm in length and 4–7 mm in width on the main trunk and larger branches.
- The cross section of affected trees shows numerous galleries. The galleries measure 3.8 cm in length and 1.9 cm in width and are filled with powdery frass.
- A large number of grubs, pre-pupae, pupae and adults are found within these galleries.
- Early instar grubs are mostly found in smaller galleries within the cambium region of the tree.
- In cashew, most of the infested trees were previously attacked by stem borers.

### Management

- 1) Regularly monitor the activity of adult beetles on the main trunk and branches
- 2) Brush the basal trunk region up to 2m height with a hard nylon brush to remove eggs and early stages.
- 3) Treat infested trees by applying Fipronil 5 SC (2 ml/litre of water) to the trunk region up to one-meter above ground level.



**Bore holes and feeding galleries**



**Grub and pupal stages**



**Fig 12. Jewel beetle damage and life stages**

## 9.9 Leaf and blossom webber

(*Lamida (Macalla) moncusalis* Walker and *Orthaga exvinacea* Hampson; Pyralidae: Lepidoptera)

The pest is prevalent during post-monsoon flushing period (September-October) and the flowering period (February-March). It also infests mango, jamun, and *Semecarpus anacardium* (Indian marking nut tree).

### Identification

Moths of *L. moncusalis* lay eggs either singly or in small groups on leaf surface and on tender shoots. Larvae are initially pale white and later turn light or dark-green, and finally dark brown and pink in colour. Pupation takes place within a leaf fold or inside larval galleries or within a web in a silken cocoon. Pupae are reddish brown in colour. Adult moths have dark brown forewings.

### Symptoms of damage

- Tender flushes and flowers are attacked by both the species of leaf and blossom webbing caterpillars
- The infestation is characterized by the presence of silken webs on terminal shoots. The webbed shoots and inflorescences gradually dry up.
- The caterpillars remain concealed within the web and feed on them.
- The pest generally occurs sporadically in localized pockets.

### Management

Spray of lambda-cyhalothrin 5 EC at 0.6 ml per litre of water during the early stage of infestation.



Fig 13. Leaf and blossom webber damage

## 9.10 Leaf beetles

**Leaf beetle:** (*Monolepta longitarsus* Jac., Chrysomelidae: Coleoptera)

**Leaf twisting weevil (Leaf knot weevil):** (*Apoderus tranquebaricus* Fab., Attelabidae: Coleoptera)

### Symptoms of damage

- The leaf beetle appears in large numbers during south-west monsoon and cause damage to young, tender leaves, flushes and shoots.
- It skeletonises the young leaves and severely affected tender shoots and seedlings may dry up.
- Severe incidence is commonly observed on young trees, where complete defoliation of tender shoots may occur within 2-3 days. The beetle population declines after the monsoon and disappears from cashew trees.
- The leaf twisting weevil is also active during south-west monsoon and feeds on young tender leaves, flushes and stem regions.
- The weevil characteristically folds the leaves along the midrib and feed on the leaf tissues.
- Both species are commonly found occurring together in cashew plantations.

### Management

Spray lambda-cyhalothrin 5 EC at 0.6 ml per litre of water during the early stage of infestation.



Fig 14. Leaf beetle damage

## 10. Major diseases

Cashew is affected by several diseases, including damping-off, anthracnose, inflorescence blight, and powdery mildew, which are important in certain cashew-growing regions.

### Damping-off

Damping-off is the important disease in cashew nurseries, particularly during the rainy season. It is caused by *Pythium* spp., *Phytophthora* spp., *Fusarium* spp., and *Rhizoctonia solani*. The disease commonly associated with poor drainage and excessive soil moisture. The affected seedlings turn pale and develop water-soaked girdles of darkened tissue around the collar region of the stem, which ultimately lead to death of seedlings. In some cases, leaves exhibit discoloured, brownish, water-soaked lesions or patches that gradually enlarge and coalesce. The disease is favoured by close spacing, continuous nursery raising, cool and wet conditions.

### Management

Improve nursery drainage and avoid overcrowding of seedlings. Drenching in nursery bags followed by spraying with Bordeaux mixture at 0.5–1% to effectively reduces the disease incidence.

### Seedling blight

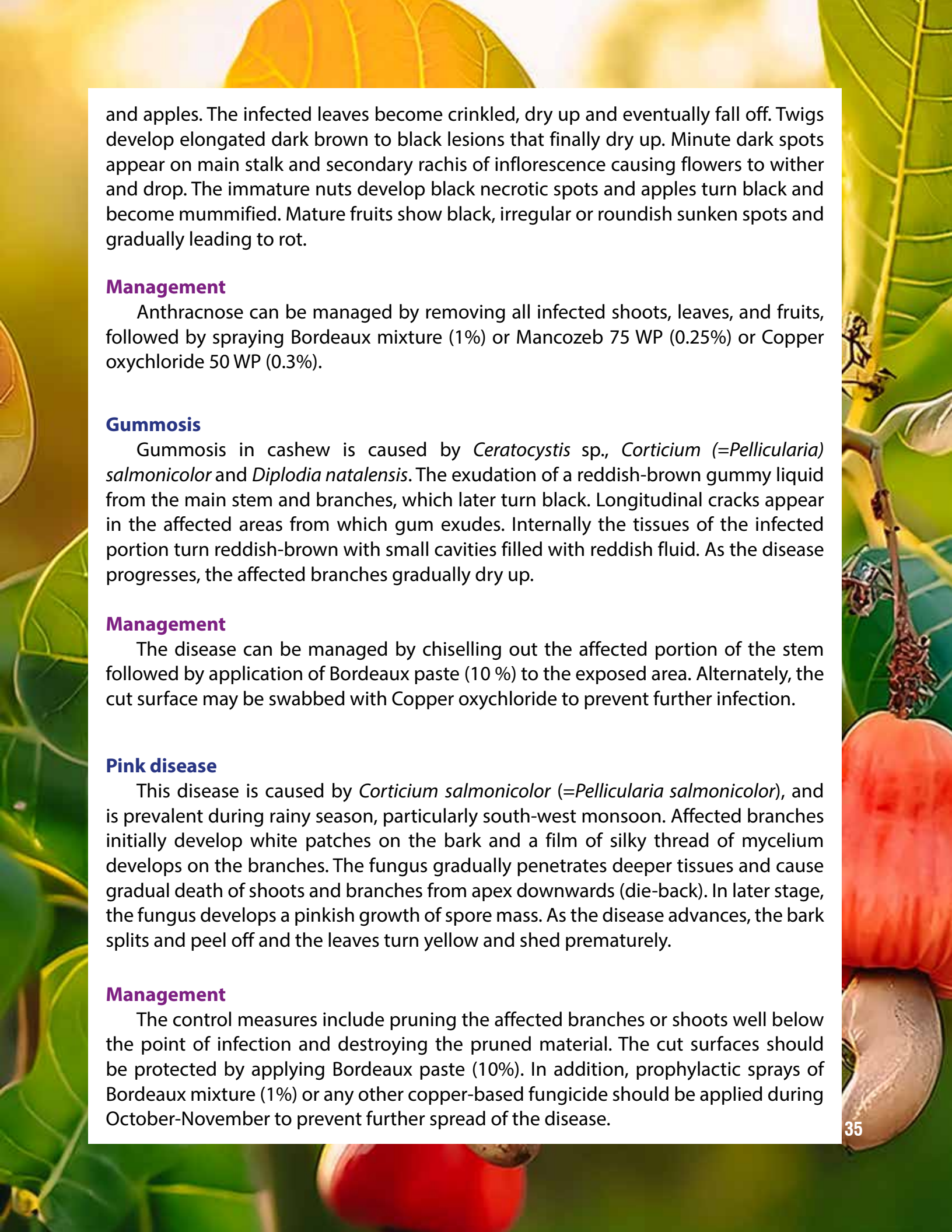
Seedling blight in cashew nurseries is caused by *Fusarium* sp., *Pythium* sp., *Phytophthora palmivora*, *Cylindrocladium scoparium*. The disease is commonly observed in nurseries with poor drainage. The disease is characterized by tiny yellowish spots on leaves of root stocks which gradually enlarge. The surrounding tissues turn brown and eventually turn ash-coloured, while leaf tips dry up. Infected leaves turn yellow, wither and drop. The collar region becomes fibrous and roots show discolouration, decay or shred off. The affected seedlings ultimately wilt and dry up.

### Management

Spraying of Carbendazim 50% WP at 1 gm per litre of water just before the onset of monsoon as a prophylactic measure. Soil drenching with copper oxychloride 50 WP (0.3%) or Bordeaux mixture (1%) or mancozeb 75 WP (0.3 %) is effective in controlling this disease.

### Anthracnose

The young cashew plantations are particularly vulnerable to anthracnose disease, with attack of TMB often predisposing plants to fungal infection. The disease is caused by *Lasiodiplodia theobromae* (*Botryodiplodia theobromae* (Pat.) and *Colletotrichum gleosporioides* Penz., which infect young shoots, tender leaves, panicles, tender nuts



and apples. The infected leaves become crinkled, dry up and eventually fall off. Twigs develop elongated dark brown to black lesions that finally dry up. Minute dark spots appear on main stalk and secondary rachis of inflorescence causing flowers to wither and drop. The immature nuts develop black necrotic spots and apples turn black and become mummified. Mature fruits show black, irregular or roundish sunken spots and gradually leading to rot.

### Management

Anthracnose can be managed by removing all infected shoots, leaves, and fruits, followed by spraying Bordeaux mixture (1%) or Mancozeb 75 WP (0.25%) or Copper oxychloride 50 WP (0.3%).

### Gummosis

Gummosis in cashew is caused by *Ceratocystis* sp., *Corticium* (= *Pellicularia*) *salmonicolor* and *Diplodia natalensis*. The exudation of a reddish-brown gummy liquid from the main stem and branches, which later turn black. Longitudinal cracks appear in the affected areas from which gum exudes. Internally the tissues of the infected portion turn reddish-brown with small cavities filled with reddish fluid. As the disease progresses, the affected branches gradually dry up.

### Management

The disease can be managed by chiselling out the affected portion of the stem followed by application of Bordeaux paste (10 %) to the exposed area. Alternately, the cut surface may be swabbed with Copper oxychloride to prevent further infection.

### Pink disease

This disease is caused by *Corticium salmonicolor* (= *Pellicularia salmonicolor*), and is prevalent during rainy season, particularly south-west monsoon. Affected branches initially develop white patches on the bark and a film of silky thread of mycelium develops on the branches. The fungus gradually penetrates deeper tissues and cause gradual death of shoots and branches from apex downwards (die-back). In later stage, the fungus develops a pinkish growth of spore mass. As the disease advances, the bark splits and peel off and the leaves turn yellow and shed prematurely.

### Management

The control measures include pruning the affected branches or shoots well below the point of infection and destroying the pruned material. The cut surfaces should be protected by applying Bordeaux paste (10%). In addition, prophylactic sprays of Bordeaux mixture (1%) or any other copper-based fungicide should be applied during October-November to prevent further spread of the disease.



### **Powdery mildew**

Powdery mildew is caused by *Oidium anacardii* Noack. The disease generally appears during December-January and characterized by whitish or greyish-white, powdery film of mycelial hyphae and conidiospores on tender leaves, inflorescence and young nuts. Initially, infected leaves show slight discoloration, followed by appearance of extensive, irregular dark patches. Under severe infection, older leaves curl and dry prematurely, while younger leaves remain undeveloped and distorted. The flower buds and flowers wither and fruits drop prematurely.

### **Management**

Powdery mildew can be managed by spraying wettable sulphur (0.2%) at pre-bloom stage and again at full-bloom stage.

## 11. General pest and disease management practices

- Regularly monitor pests on the farm. This helps to take-up timely control measures and avoid unnecessary insecticide sprayings.
- Phytosanitation measures, such as removing borer-infested branches, unproductive or dead trees, and weed hosts like *Terminalia paniculata* and *Chromolaena odorata*, help to reduce the survival and spread of pests in the plantation.
- The removal and destruction of various life stages of insect pests (eggs, larvae, pupae, cocoons, adults) and heavily infested parts (leaves, branches, panicles) in young trees helps to reducing the pest populations.
- Carry out regular pruning by removing dead, diseased, criss-crossing, and ground-touching branches to improve aeration, enhance light penetration, and reduce pest and disease incidence.
- Prune diseased branches or shoots well below the point of infection and destroy the pruned material. Protect the cut surfaces by applying fungicide.
- Field sanitation, including removal of infected plant parts before flowering, can delay disease development and reduce its severity. Maintaining proper spacing and formation pruning during establishment followed by maintenance pruning, can reduce the carryover of inoculum to next season.
- Regularly remove weeds in cashew plantations, as they compete for nutrients, moisture, sunlight, and space, and also harbour pests and diseases.
- Keep the nursery well drained and provide adequate spacing for seedlings. This helps to prevent soil-borne diseases.
- The conservation of natural enemies such as spiders, ants, reduviids, coccinellids, neuropterans, hemipteran bugs, and praying mantids can aid in the natural regulation of insect pests in cashew. Several parasitoids have been documented from cashew insect pests; hence, indiscriminate insecticide spraying should be avoided to preserve these natural enemies.
- Red ant colonies on old cashew trees are reported to regulate pest populations, particularly tea mosquito bugs.

- The biopesticides such as neem oil (3–5%), karanj (Pongamia) oil (2%), fish oil rosin soap, and neem seed kernel extract (NSKE, 5%) can be used to control foliage pests, including leaf miners and leaf-feeding caterpillars, at the early stages of infestation. Use soap solution (0.5%) or teepol (0.1%) as emulsifiers for botanicals.
- The pest control measures targeting tea mosquito bug are generally sufficient to manage most of the foliage pests and additional spray are required only in case of severe infestations.
- Rotational use of insecticides, following label instructions and ad-hoc recommendations, is advised to prevent the development of pest resistance.
- Cashew is pollinated by a variety of insects (bees, ants, wasps and dipterans); hence insecticide sprays should be avoided during peak pollinator activity (10:00 AM to 1:00 PM). Spraying should generally be done before 9:00 AM or after 4:00 PM to protect non-target pollinators.



## References

- Bhat P.S. and Sundararaju D. and Raviprasad T.N. (2002) Integrated management of insect, pests and diseases in cashew. Indian Cashew Industry (Eds: Singh et al.). DCCD, Cochin. pp 111-117.
- Eradasappa E., Mog, B., Savadi S. and Mangalassery S. (2020) Training manual on cashew production and post-harvest technologies. ICAR-Directorate of Cashew Research, Puttur, Karnataka, India. pp. 143.
- Maruthadurai R., Desai A. R. and Ramesh R. (2021) A field guide on identification and management of cashew insect pests, Technical Bulletin No: 71, ICAR - Central Coastal Agricultural Research Institute (Indian Council of Agricultural Research), Ela, Old Goa-403 402, Goa, India. pp. 1-34.
- Maruthadurai R., Desai A.R., Prabu H. R. C. and Singh N. P. (2012) Insect pests of cashew and their management. Technical Bulletin No. 28, ICAR Research Complex for Goa (Indian Council of Agricultural Research), Old Goa-403 402, Goa, India. pp. 1-16.
- Saroj P.L. and Swamy K.R.M. (2017) The Cashew. Indian Council of Agricultural Research, New Delhi. pp. 312.
- Vanitha K., and Saroj P.L. (2015) Insect pests of cashew and their management. Technical bulletin 27. ICAR-Directorate of cashew research. pp 1-70.

## Acknowledgement

The authors acknowledge several anonymous sources for the technical information referenced in this bulletin. We also thank the cashew farmers for allowing us to capture images from their fields. The financial support under the Scheduled Caste Sub-Plan (SCSP) is also acknowledged.



