

CASHEW PRODUCTION

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Professor and Head

Prologue

- ❖ Cashew is native to north eastern Brazil, in the area between the Atlantic rain forest and the Amazon rainforest.
- ❖ The Portuguese introduced cashew to the west coast of India and east Africa in the 16th century, shortly after its discovery in 1578.
- ❖ It was planted in India initially as soil binder crop to reduce erosion, and uses for the nut and pseudo fruit, the cashew apple, were developed much later.
- ❖ At present, cashew is considered sixth most important agricultural commodity exported from India.



TOP 10 COUNTRIES (% OF WORLD PRODUCTION)

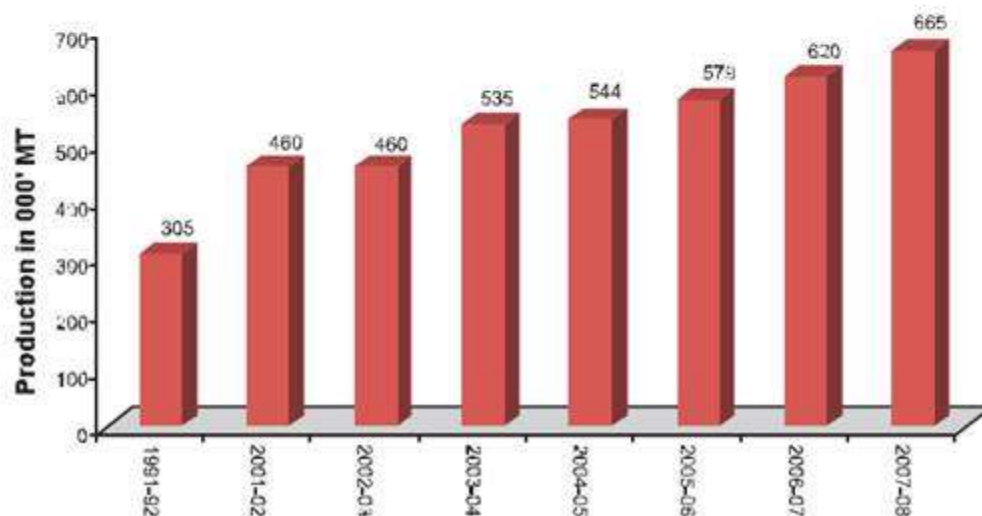
1. Viet Nam (28%)
2. India (25%)
3. Nigeria (10%)
4. Brazil (8%)
5. Tanzania (6%)
6. Indonesia (4%)
7. Guinea-Bissau (4%)
8. Cote D'Ivoire (4%)
9. Mozambique (3%)
10. Benin (2%)



Production Trend : India

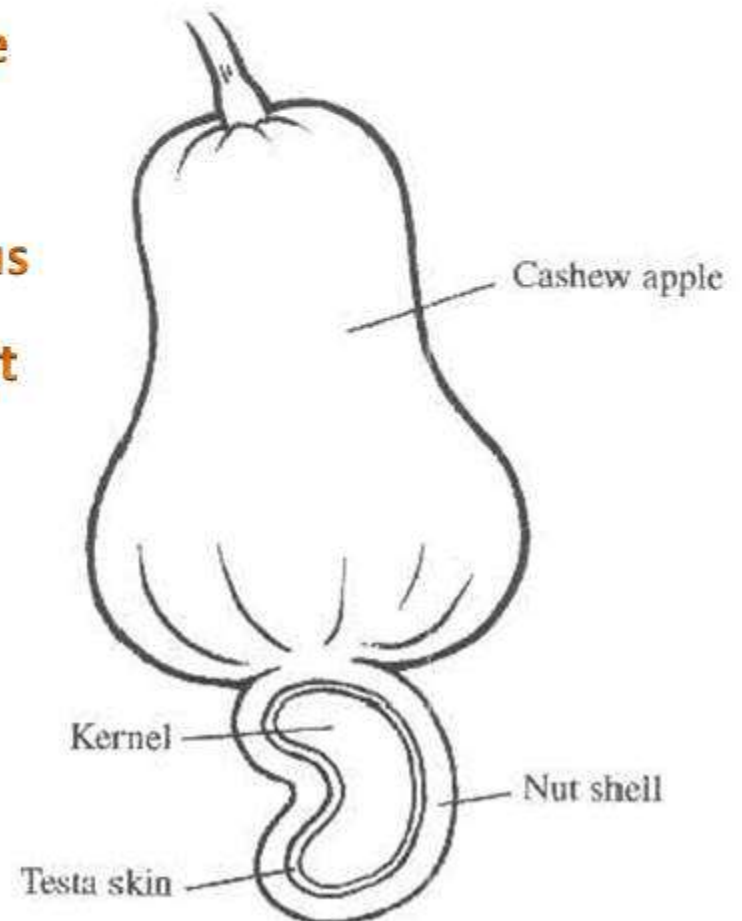
Year	Area ('000 ha)	Production ('000 MT)	Productivity (MT/ha)
2002-03	740	460	0.6
2003-04	780	535	0.7
2004-05	820	544	0.7
2005-06	843	579	0.7
2006-07	854	620	0.7
2007-08	868	665	0.8

Source : NHB Database 2008



Taxonomy

Common name	: Cashew
Botanical Name	: <i>Anacardium Occidentale L.</i>
Family	: Anacardiace
Origin place	: Brazil
Type of inflorescence	: Polygamous
Type of fruit	: Pseudofruit
Chromosome no.	: 2n = 42



Nutritive Value

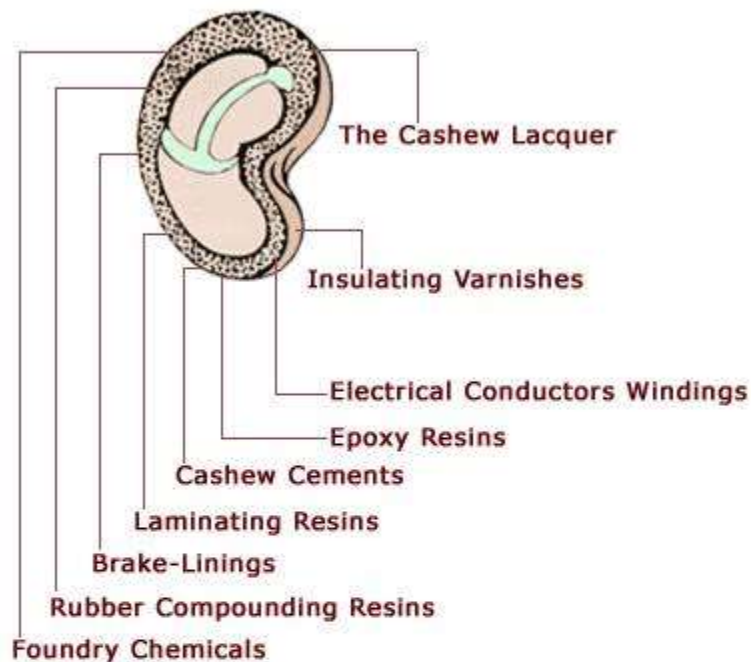
Contents*	Cashew Nut	Cashew Apple
Water (%)	3-7	86
Calories	578	---
Protein (%)	18-22	0.1
Fat (%)	46	0.3
Carbohydrates (%)	27	9-15
Crude Fiber (%)	1.1	0.75

**Per 100 g basis*



Cashew Nut Shell Liquid (CNSL)

- CNSL is a by-product of the cashew industry.
- The nut has a shell of about 1/8 inch thickness inside which is a soft honeycomb structure containing a dark reddish brown viscous liquid.
- CNSL is the pericarp fluid of the cashewnut.




Uses...

- ❖ CNSL is also used in mouldings, acid-resistant paints, foundry resins, varnishes, enamels and black lacquers for decorating vases, and as insecticides and fungicides.
- ❖ In tropical medicine, CNSL has been used in treating leprosy, elephantiasis, psoriasis, ringworm, warts and corns.

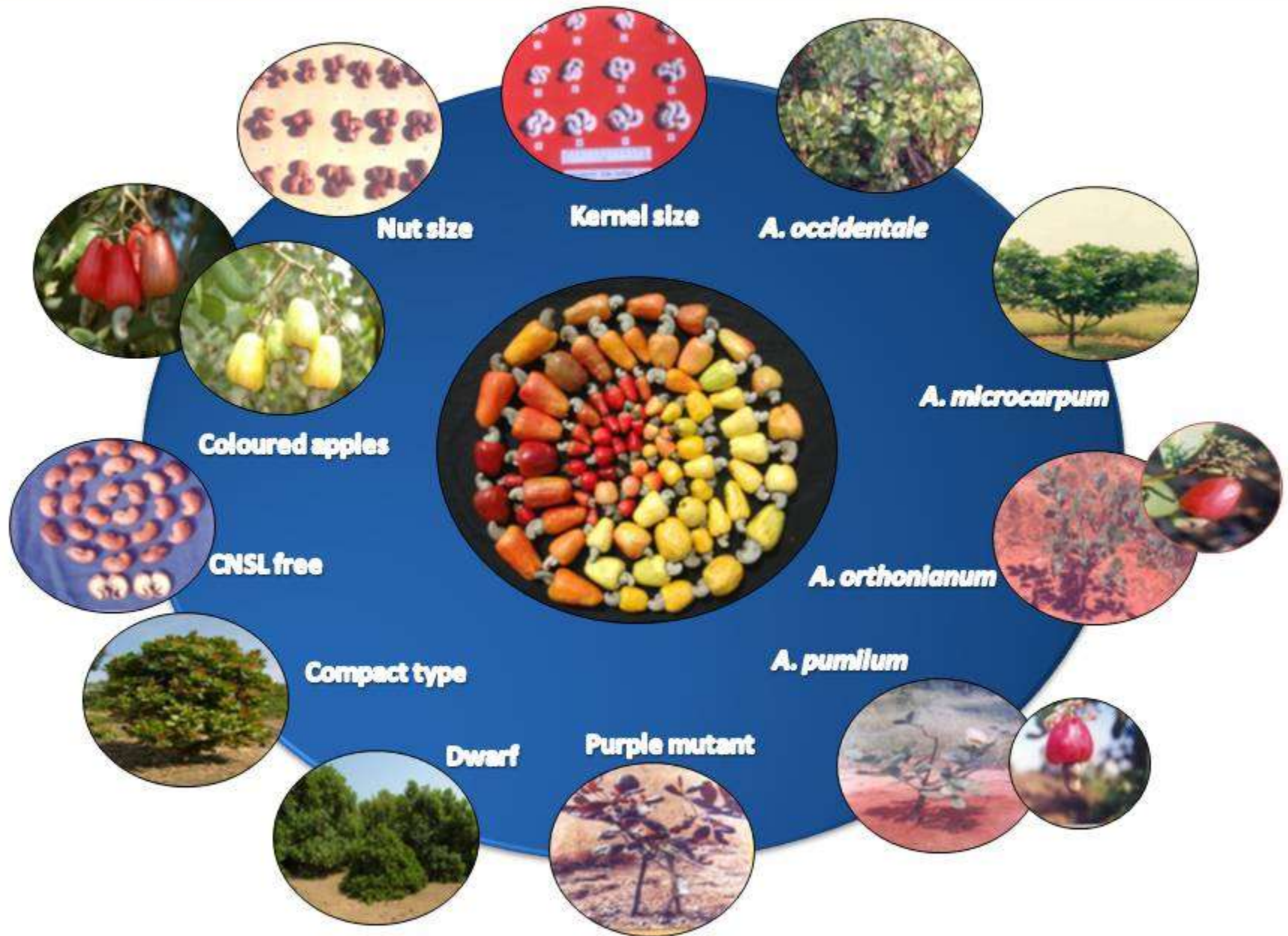
UTILIZATION OF CASHEW APPLE

Products	Care to be taken
Juice Jam Pickles Jelly Squash Candy Wine Feni	<ul style="list-style-type: none">❖ To be harvested from the tree and fallen apples not to be used❖ Only steel knife to be used❖ Astringency (tannins) to be precipitated by gelatin addition, or PEG or starch or sodium chloride treatment
<ul style="list-style-type: none">❖ Currently, cashew apples are being utilized only in Goa for the preparation of Feni (alcoholic liquor).	
<ul style="list-style-type: none">❖ Cashew apple pomace (residue after extraction of juice) is rich in fibre which could find use in animal/cattle feeds.	
<ul style="list-style-type: none">❖ Technologies developed for preparation of various cashew apple products by CFTRI, Mysore, KAU, Thrissur and UAS, Bangalore; - commercially not exploited.	

Use of Cashewnut

- ❖ **directly by the consumer**
 - ❖ **As roasted and salted nuts**
 - ❖ **in confectionery and bakery products, for example, finely chopped kernels are used in the production of sweets, ice creams, cakes and chocolates, both at home and industrially, and as paste to spread on bread**
 - ❖ **Separately packed cashew nuts are a good selling line, mainly as an appetiser to cocktail drinks. Salted cashews are part of the snack food market**
 - ❖ **They compete mainly with other nuts, although chips, salted popcorn and other savoury snacks can impinge on the nut market**
- 

Variability of Cashew in India



Varieties

STATE	NAME OF VARIETIES
Kerala	Madakathara -2, Amritha, Dhana (H-1608), Priyanka (H-1591), Kanaka (H - 1598) Selection-2, V4, V6, V7, VRI - 3 ,VRI- 2, Ullal-1, Ullal-3, Ullal-4
Karnataka	Ullal - 1 ,Ullal - 2, Ullal - 3, Ullal - 4, UN - 50, Selection-2, Chintamani - 1, VRI-2 , VRI-3 ,V4
Goa	V4 , V6 , V7 ,VRI- 2, VR1 - 3, Goa - 1
Maharashtra	Maharashtra V1, V4, V6, V7, VR1 - 2, VRI - 3, Ullal -1, Ullal - 3, Ullal - 4, BPP - 8
Tamil Nadu	VRI-2, VRI-3
Andhra Pradesh	BPP - 4 ,BPP - 6 ,BPP - 8, VR1 - 2, Selection - 2, Ullal -1, Chintamani -1
Orissa	BHB - 1, VR1 - 2, V4, BPP - 8, Dhana
West Bengal	Jhargram - 1, Madakathara - 1, BPP - 8
Madhya Pradesh	VR1 - 2, V1 ,V4 ,V7, BPP 4, BPP 6, BPP 8
Manipur	V1, V4, V7, Ullal - 3, Ullal - 4
Tripura	Ullal-3 , Ullal - 4, V1, V4, V7, VRI - 2
Meghalaya	V1, V4, V7, Ullal - 3, Ulla - 4, VRI - 2
Nagaland	VR1 - 2, Ullal - 3, Ullal - 4, V1, V4, V7
Assam	Ullal - 3, Ullal - 4, V1, V4, V7, VR1 - 2
Pondicherry	VRI-2, VRI-3

Kerala



Vengurla



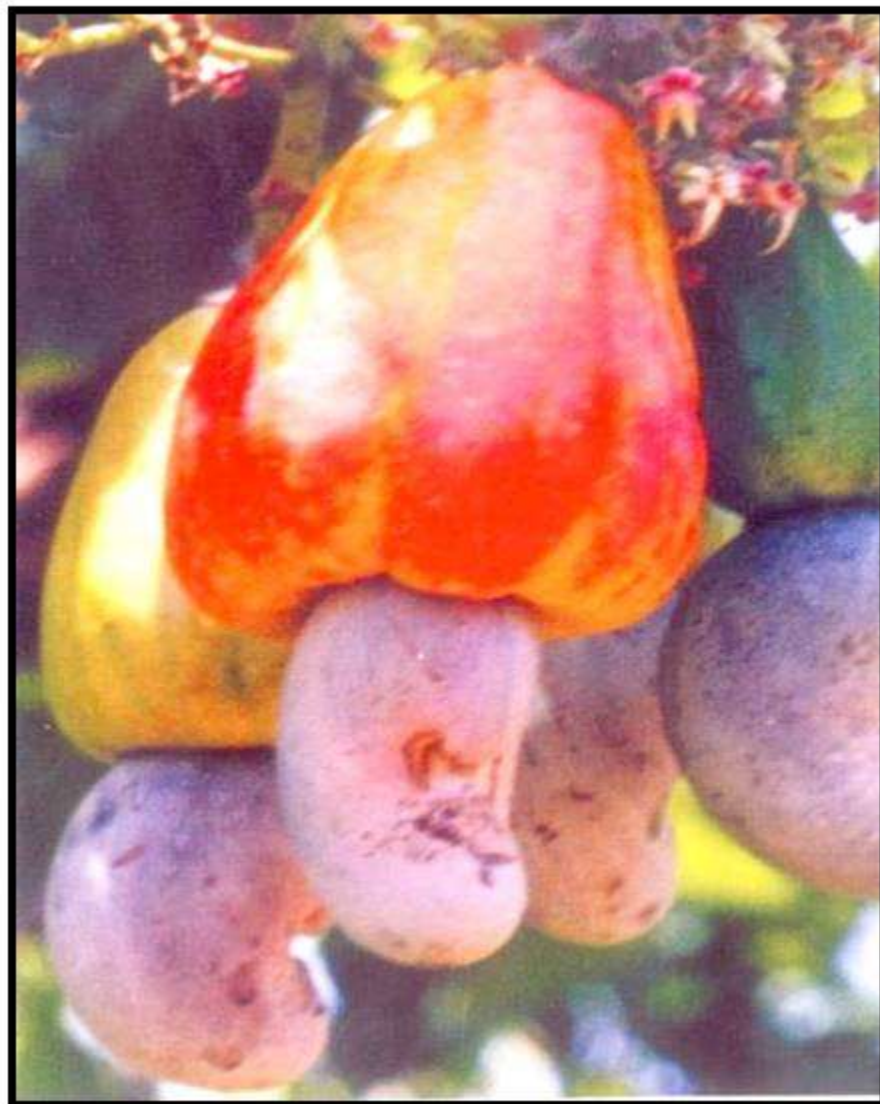
Virdhachalam



Bapatla



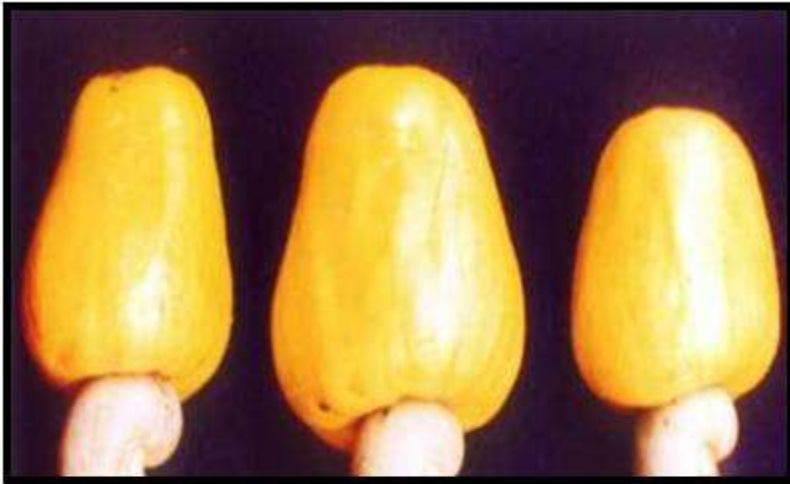
Chintamani



Madakkathara



Ullal



Puttur



Name of Varieties	Parentage	Institutions	Year
Kanaka(H 1598)	BLA 139xH3-13	KAU, Madakkathara	1993
Dhana (H 1608)	ALGD-1x K30-1	KAU, Madakkathra	1993
Amrutha (H 1597)	BLA 139xH3-13	KAU, Madakkathara	1998
Priyanka (H-1591)	BLA 139-1x K-30-1	KAU, Madakkathara	1995
Madakkathara-2	Neduvellur Material	KAU, Madakkathara	1990
Vengurla 1	Ansur 1	KKV, Vengurla	1974
Vengurla 4	Midnapur Red x Vettur 56	KKV, Vengurla	1981
Vengurla 6	Vettur 56 x ansur 1	KKV, Vengurla	1991
Vengurla 7	Vengurla 3 x M-10/4	KKV, Vengurla	1997
BPP 4	9/8 Epurupalam	ANGRAU	1980
BPP 6	T No.56	ANGRAU	1980
BPP 8	T1xT39	ANGRAU	1993
Vridhachalam 2	T1668 of Katterpalli	TNAU, Vridhachalam	1985
Vridhachalam 3	Edayanchavadi	TNAU, Vridhachalam	1991
Ullal 1	8/46 Taliparmba	UAS, Ullal	1984
Ullal 3	5/37 Manjeri	UAS, Ullal	1993
Ullal 4	2/77 Tuni	UAS, Ullal	1994
Chintamani	8/46, Taliparamba	UAS, Chintamani	1993
UN 50	2/27 Nileshwar	UAS, Ullal	1995
NRCC 2	2/9 Dicheria	NRCC, Puttur	1989
Jhargram-1	T. No.16 of Bapatala	BCKV, Jhargram	1989
Bhubaneshwar -1	WBDC-5(V-36/3)	OUAT, Bhubaneshwar	1989
Goa-1	Balli-1	ICAR Res. Centre, Goa	1999

Name of Varieties	Yield (Kg/tree)	Nut Wt.(gm.)	Kernel Wt.(gm.)	Shelling (%)	Export grade
Kanaka(H 1598)	12.80	6.80	2.08	30.58	W 280
Dhana (H 1608)	10.66	8.20	2.44	29.80	W 210
Amrutha (H 1597)	18.35	7.18	2.24	31.58	W 210
Priyanka (H-1591)	17.03	10.80	2.87	26.57	W 180
Madakkathara-2	17.00	7.25	1.88	26.20	W 210
Vengurla 1	19.00	6.20	1.39	31.00	W 240
Vengurla 4	17.20	7.70	1.91	31.00	W 210
Vengurla 6	13.80	8.00	1.91	28.00	W 210
Vengurla 7	18.50	10.00	2.90	30.50	W 180
BPP 4	10.50	6.00	1.15	23.00	W 400
BPP 6	10.50	5.20	1.44	24.00	W 400
BPP 8	14.50	8.20	1.89	29.00	W 210
Vridhachalam 2	7.40	5.10	1.45	28.30	W 320
Vridhachalam 3	11.68	7.18	2.16	29.10	W 210
Ullal 1	16.00	6.70	2.05	30.70	W 210
Ullal 3	14.70	7.00	2.10	30.00	W 210
Ullal 4	9.50	7.20	2.15	31.00	W 210
Chintamani	7.20	6.90	2.10	31.00	W 210
UN 50	10.50	9.00	2.24	32.80	W 180
NRCC 2	9.00	9.20	2.15	28.60	W 210
Jhargram-1	8.50	5.00	1.50	30.00	W 320
Bhubaneshwar -1	10.50	4.60	1.47	32.00	W 320
Goa-1	7.00	7.60	2.20	30.00	W 210

Climate

- ❖ **Cashew is essentially a tropical crop**
- ❖ **Sun loving tree and does not tolerate excessive shade**
- ❖ **Grows best in the warm, moist and typically tropical climate**
- ❖ **The most favourable temperature lies between 24⁰C to 28⁰C.**
- ❖ **Maximum distribution at an altitudes below 700 m where the temperature does not fall below 20⁰C for prolonged periods, although it may be found growing at elevation up to 1200 m**
- ❖ **The cashew is hardy and drought resistant, but it is damaged by frost**
- ❖ **Best adopted to the coastal regions**



Soil

- ❖ Cashew is an hardy crop
- ❖ It can be grown on a wide range of soils except heavy clay, water logged and saline soils
- ❖ Well drained red, sandy and laterite soils are ideal for good growth and yield of cashew
- ❖ Tolerant of sandy, poor soils and pH 4.5-6.5
- ❖ Susceptible to poor soil drainage



CROP PRODUCTION



Propagation

- **Selection of planting material is most important in cashew cultivation.**
- **Cashew is highly cross pollinated and vegetative propagation is mainly recommended on commercial scale to produce true to type planting materials**
- **Softwood grafting is the only method which is commercially feasible and practically highly successful in cashew**



Stages of establishment root stock seedlings



ESTABLISHMENT & MANAGEMENT OF SCION BANK (BUDWOOD ORCHARD)

- Recommended varieties be planted in closer spacing (4m x 4m)
- Yearly pruning and detopping is necessary
- Regular manuring and plant protection measures need to be followed to maximize higher scion yield



Preparation of material for grafting

Raising of root stocks

- Collect graded seeds (7 - 8g) of single variety
- Use dried seed for sowing
- Staggered sowing to be done for continuous supply of ideal root stock



Preparation of scion

- Select 3 – 4 month old lateral shoots
- Precure scion sticks by clipping of the leaves 10 days before grafting
- Collect scions on the day of grafting



Softwood grafting methods

Preparation of root stocks

- Remove the top leaves and retain two pairs of bottom leaves
- Vertical cut at 30cm height of the seedling be made
- Make a cleft of 3–4cm on softwood portion



Preparation of scion

- Use 10-12 cm long scion stick
- Prepare a wedge at bottom end
- Insert the scion into cleft of root stock and tie with polythene strip
- Cover scion stick with polythene cap to prevent drying



Problematic grafts



Emerging off shoots from root stock



Insect-pest attack



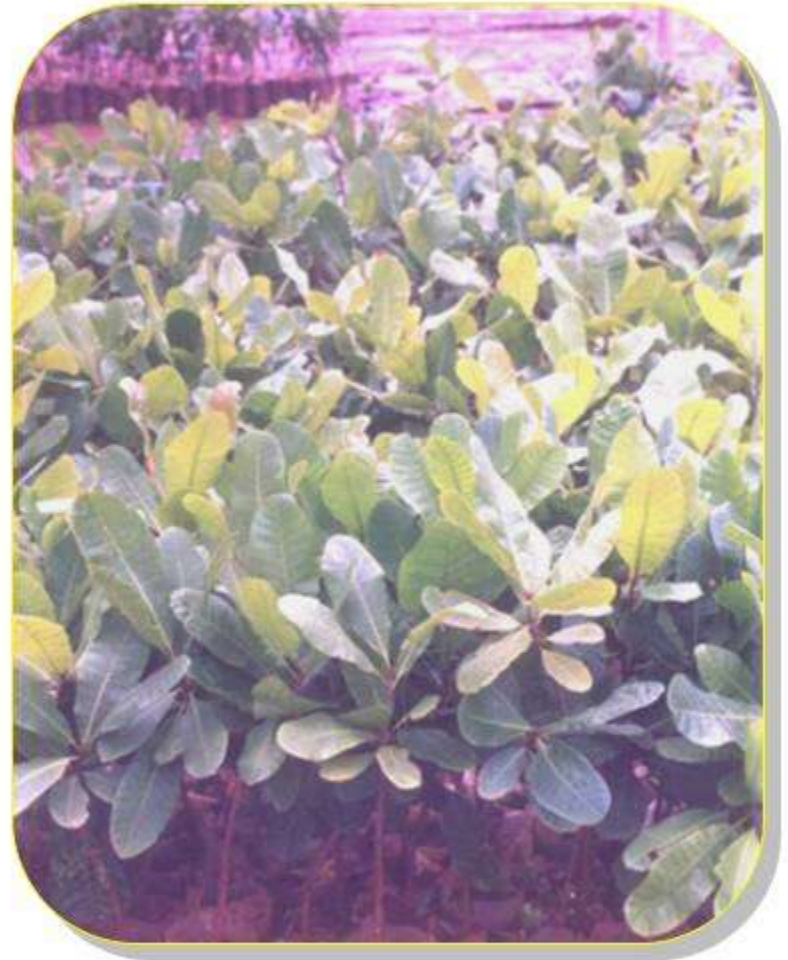
Flowering in nursery stage



Nutrient deficiency

Standards for saleable grafts

- Graft should be more than 5 months old
- Height of the graft > 30cm
- Graft should have 4-5 fully matured leaves
- Graft joint should be above 15-20cm from collar region
- Graft should be healthy and erect growing
- Graft joint should be perfect without girdling
- Free from sprouts from root stocks
- Polythene bag should be intact



Nursery Management

- ❑ Initially arrange the grafts under shade (15-20 days)
- ❑ Remove the sprouts on the root stock
- ❑ Arrange the grafts on polythene sheet to avoid roots striking ground
- ❑ Provide shade during summer
- ❑ Irrigate daily
- ❑ Retain terminal single shoot
- ❑ Remove the polythene strip from graft joint (after 4 months)





Planting

- ❖ Dig the pits at least 15-20 days before planting and expose to sunlight so that termites and ants, if any, which damage the roots of the grafts will migrate elsewhere
- ❖ The pits should be completely filled with a mixture of top soil and organic manure to $\frac{3}{4}$ of the pit capacity
- ❖ The grafts are planted after carefully removing the polythene bag
- ❖ Care should be taken to see that the graft joint remains at least 5 cm above the ground level at the time of planting
- ❖ The polythene tape around the graft union need to be removed carefully.
- ❖ Mulch the basins of plants with organic waste materials during early years.



Spacing

- ❖ The normal recommended spacing is 7.5 x 7.5 m to 8 x 8 m
- ❖ High Density Planting : 3-4 m x 3-4 m depends on type of soil and managerial capacity
- ❖ Square system of planting is followed in cashew



Pit Preparation and Planting

Size of the pit : 1 x 1 x 1 m³

Planting time : Sept-Oct



Stacking

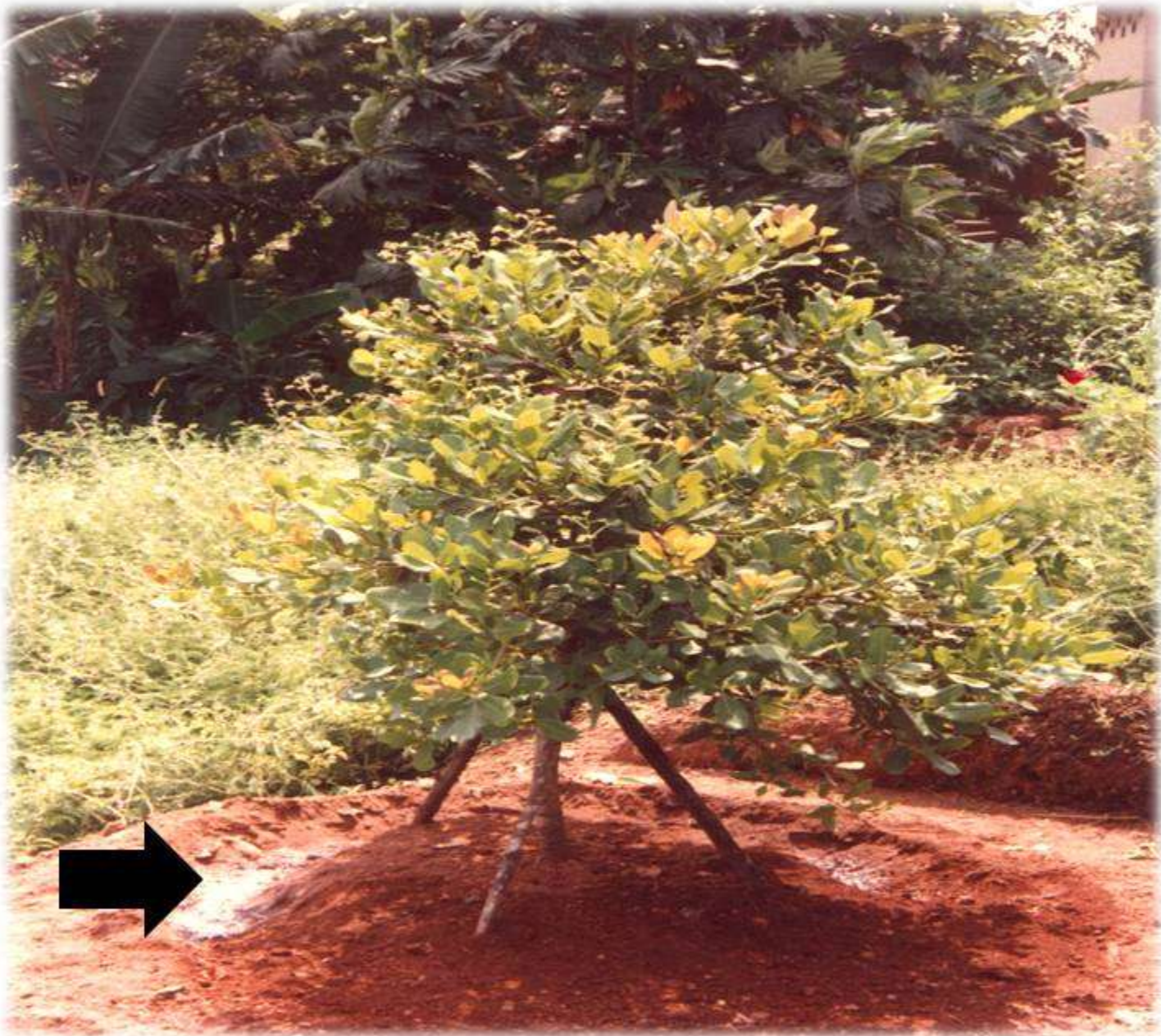


Staking should be done immediately after planting to protect the grafts from wind damage

Nutrient Management

- ❖ Application of 10-15 kg of farm yard manure or compost per plant is beneficial.
- ❖ The current fertilizer recommendations for cashew is 500 g N (1.1 kg urea), 125 g P_2O_5 (625 g rock phosphate) and 125 g K_2O (208 g Muriate of potash) per plant per year
- ❖ The ideal period for fertilizer application is immediately after the cessation of heavy rains and with available soil moisture
- ❖ 1st year : 1/3rd of RDF
2nd year : 2/3rd of RDF
3rd year onwards : Full dose
- ❖ Application of vermicompost and biofertilizer is also beneficial for cashew





Water Management

- ❖ In India cashew is grown mainly under rain fed condition
- ❖ However protective irrigation especially summer months during January-march at fortnightly intervals @ 200 liters/plant improves fruit set, fruit retention, thereby increasing nut yield
- ❖ Cashew is susceptible to poor drainage



Crop Architecture

- ❖ Canopy management is the important horticulture practice to be employed to make better frame work of cashew plant
- ❖ It helps to control growth and make easy for cultural practices
- ❖ The sprouts arising from the root stock portion of the cashew graft should be removed frequently during the first year of planting
- ❖ Removal of water shoots, lower branches, crisscross branches and dry branches are found to be beneficial to enhance flowering and the yield
- ❖ Pruning can be done manually or by motorized pruner



Motorized Telescopic Pruner



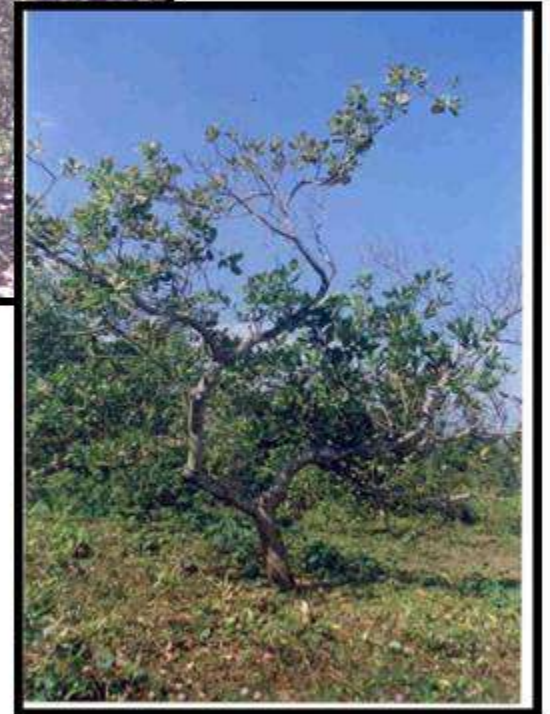
- ❖ Efficiency 40 to 50 times higher than manual labourers
- ❖ Cost – Rs. 70,000/unit.
- ❖ Petrol consumption – half a litre per hour.



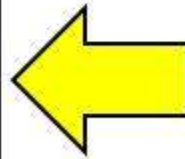
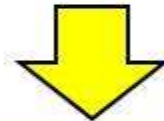
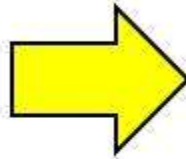
Crop architecture of cashew grafts



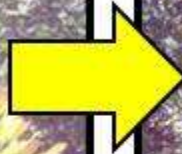
Old plantation



Top working



Redevelopment of canopy



Rejuvenated plant



Weed management


- ❖ Clearing the area by manually within 2 m radius of the trunk and slashing the remainder is essential until the trees shade out most of the trees
- ❖ Glyphosate (post emergent) application at 6 to 7 ml per litre of water (0.8 kg a.i./ha) during June – July also effectively controls weeds



Mulching

- ❖ Mulching the tree basins will help in conservation of soil moisture and prevents soil erosion
- ❖ Mulching with organic matter or residues inhibits weed growth and reduces surface evaporation during summer and also regulates the soil temperature

Vertical mulching

- ❖ Suitable for sloppy areas
 - ❖ by making trenches of 30 cm width, 60 cm depth and convenient length in between rows along the contour
 - ❖ The trench is filled by coconut husk, crop residue or locally available grasses
 - ❖ This will not only conserve soil and moisture but will also enable to enhance the growth of cashew
- 



Cashew Based Cropping System (CBCS)

- ❖ For maximum utilization of natural resources i.e. land, water and solar radiation
- ❖ Depends on land situation, soil type, water availability and climatic condition
- ❖ Tomato, brinjal, okra
Elephant foot yam, tapioca
Pulses
Beans
Leafy vegetables
Turmeric, ginger, chilli
- ❖ Once the plants become sufficiently pepper can be taken as mixed crop





Cashew Based Cropping Models



CROP PROTECTION



Tea mosquito bug (TMB)

- ❖ Tea mosquito bug (*Helopeltis antonii* S.)
- ❖ Yield reduction to the tune of 30-40 % damaging tender shoots, inflorescence and immature nuts at various growth stages
- ❖ It attacks the tree in all the seasons during flushing, flowering and fruit setting period
- ❖ Peak period of infestation is from October to March.
- ❖ Control – 3 sprays synchronizing new flushing (October-November), flowering (November-December) and fruit setting (January – February) with the following chemicals-
 - Quinalphos (25% EC) - 0.05%
 - Carbaryl (50% WP) - 0.01%
 - Phosphamidon (85% WSC) - 0.03%
- ❖ The number of sprays should be limited to 3 and the same insecticide should be used for the subsequent sprays

Nymph and adult of TMB





Damage by TMB



Stem and root borer

- ❖ Stem and root borer (*Placaederus ferrugineus* L.)
- ❖ A dangerous pest and kill the entire plant
- ❖ Mostly seen in neglected gardens
- ❖ The larvae of a beetle tunnel into the tree trunk and eats the bark all around the trunk
- ❖ Control – Manual removing of grubs and pasting the damaged portion with mixture of Carbaryl 50 gm (50%) and copper Oxychloride (25 gm) in 1 liter of water give effective control



Cashew stem and root borer



HARVESTING AND POST HARVEST TECHNOLOGY



Developmental stages



New flushes



Bud burst



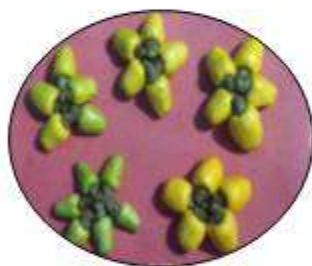
Panicle stage



Male & Bisexual flowers



Fallen fruits



Apple development



Fruit bunch



Fruit set



Coloured apples bunches



Cashew nuts



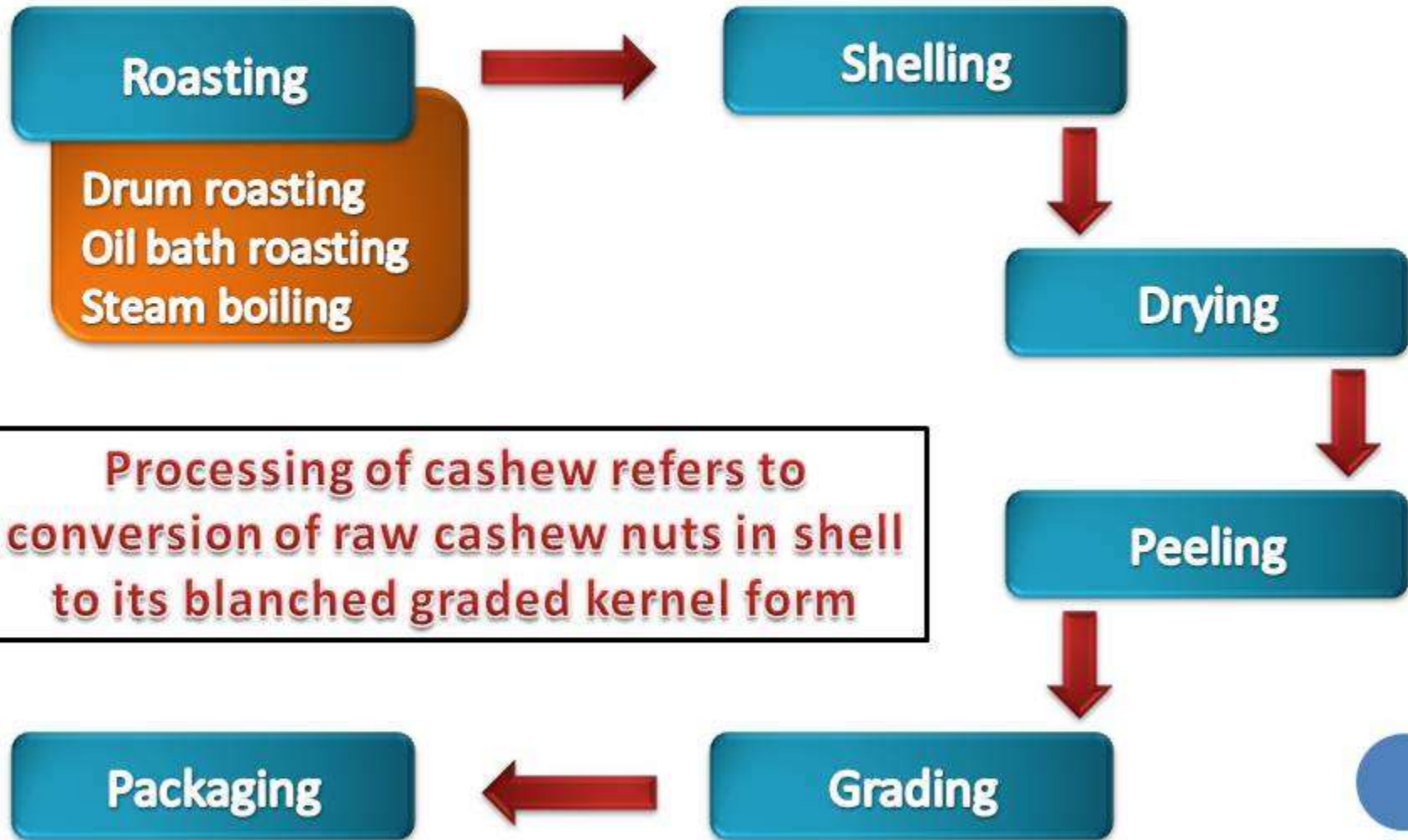
Kernels

Harvesting and yield

- ❖ The flower panicles emerging from the graft during 1st and 2nd year should be removed in order to allow the plant to put good vegetative growth and better framework
- ❖ Economic bearing in cashew commences after 3rd year of planting
- ❖ The ripened will fall down and nuts from fallen fruits have to be collected.
- ❖ The yield starting from 1 kg in 3rd-4th year
- ❖ yield goes on increasing as the canopy develops and one can expect more than 10 kgs. of nuts in 8 to 10 years old plant depending on management.
- ❖ Nuts can be dried in sun for 2 to 3 days on cement floor and can be stored in gunny bags



Cashew processing

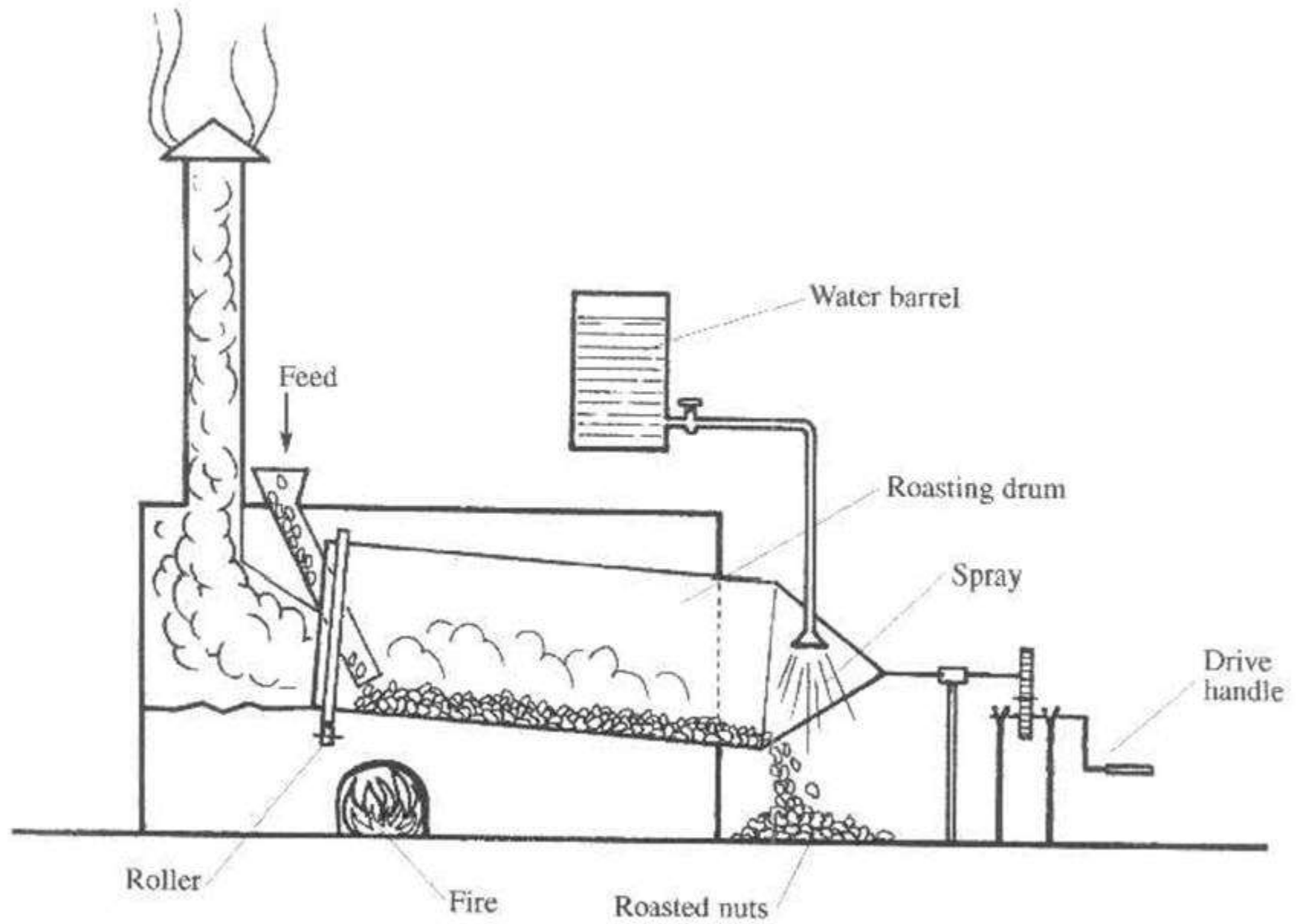


Roasting

DRUM ROASTING

- ❖ This is one of the oldest and more widely used methods
- ❖ The nuts are fed into a rotating red hot drum which will ignite the shell maintaining its temperature because of the burning of the shell liquid
- ❖ The drum is kept in rotation for 3-4 minutes and the roasted nuts are discharged from the lower end of the drum and immediately covered by ash after sprayed with little water, so as to absorb the oil on the surface
- ❖ This facilitates the removal of the remaining oil on the shell





OIL BATH ROASTING

- ❖ Conditioned nuts are passed through CNSL bath heated to 170-200°C by conveyer buckets for 1-2 minutes
- ❖ The shell gets heated rupturing the wall and releasing the oil into the bath
- ❖ The oil is recovered by continuous over flow arrangement
- ❖ The roasted nuts are centrifuged to remove adhering oil, cooled and shelled by hand and leg operated shelling machines



STEAM BOILING

- ❖ Most convenient method of cashew processing
- ❖ The raw nuts are steam cooked at about 120-140 lbs/sq inch pressure
- ❖ Shell oil can be extracted in later stages by crushing
- ❖ The nuts are shelled by hand and leg operated shelling machines



Shelling

- ❖ Cashew nuts after roasting and cooling are to be shelled to remove kernels
- ❖ One has to be very careful while shelling the nuts
- ❖ Hands are to be protected from Cashew Nut Shell Liquid (CNSL) which is highly corrosive
- ❖ Hand gloves should be used while shelling
- ❖ For the same reason, it is advisable to dust the nuts with wood ash
- ❖ Commercial processing units use foot operated shell cutters (mechanical device) for shelling
- ❖ After shelling the kernels and shell pieces are separated manually
- ❖ The nuts have to be grouped into various sizes, each size matching a pair or blades of appropriate size





This device consists of a pair of blade (knives) shaped in the counter of half a nut which could be operated by foot. The blades cut through the shell all around the nut, leaving the kernel untouched

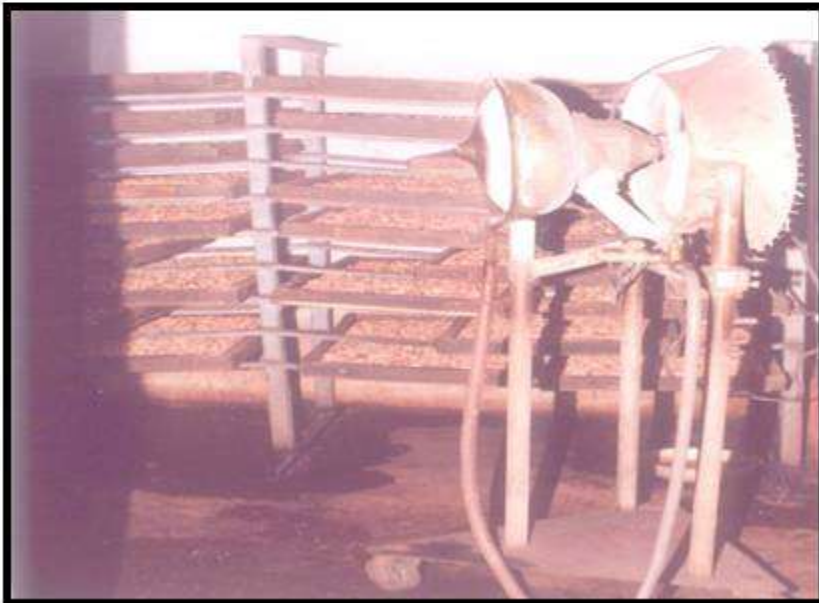


Drying

- ❖ The kernels after shelling will have moisture content of more than 6%
- ❖ Drying of these kernels is necessary to prevent fungus attack during subsequent storage and to facilitate peeling of testa
- ❖ The kernels are to be dried to moisture content of about 4 -5%
- ❖ This is done by drying the kernels in hot chambers at 70⁰C - 80⁰C in perforated trays for about 6 - 8 hours
- ❖ Uniform drying could be achieved with a cross flow drier using forced hot air circulation through the kernel layers



- ❖ In order to ensure uniform drying, the position of the trays has to be changed frequently, as scorching may occur at hotter places
- ❖ Excess drying results in very brittle kernels whereas improper drying leads to poor quality
- ❖ After drying, the kernels are kept in the moist chamber for 24 hours which facilitates easy removal of testa (peeling) and minimizes broken kernels




Peeling

- ❖ This process involves the removal of testa (seed coat) from the kernel
- ❖ Peeling is done using a sharp knife or bamboo piece
- ❖ Care has to be taken while removing the testa
- ❖ If kernels are scorched more it results in poor quality kernels



Grading

- ✓ Kernels are graded according to the size manually.
 - ✓ In the International Market bold whole kernels fetch premium price.
 - ✓ The grading standards developed in India refer to white whole (undamaged) kernels and indicate the number of kernels per lb of weight.
 - ✓ The largest kernels come in the grade W 210 (440-460/kg) and the smallest of the seven grades is W 500 (1000-1100/kg).
 - ✓ Further classification refers to broken kernels, butts, splits, pieces, small pieces and whether kernels are white or scorched.
- 





W 180



W 210



W 240



W 280



W 320



W 400



W 450



W 500



SSW



DW



SW



SW



SW

VARIOUS GRADES OF CASHEW KERNELS



SS



S



SB



SB



LWP



SWP



SWP



SWP



SP



SSP



SSP



BB



BB

Packaging

As far as possible packaging material used should be eco-friendly and recyclable and containers are hermetically sealed after filling carbon dioxide.

Vita Packing



FUTURE THRUST AREAS



- ✓ **Development of Dwarf variety**
- ✓ **Standardization of High Density Planting**
- ✓ **Cashew Rejuvenation Package**
- ✓ **Management of Cashew Stem and Root Borer**
- ✓ **Organic Production Package**
- ✓ **Molecular Marker Assisted Selection**
- ✓ **Quality Improvement for Alternative Use**
- ✓ **Transfer of Technology**

