

Precision Farming **CASHEW** With Jain Technology™



Crop Drop Drip

Ultra High Density Cashew Plantation With JAIN Technology™

Cashew (*Anacardium occidentale*), a native of Brazil, was introduced in India during the later half of the 16th Century for the purpose of afforestation and soil conservation. Cashew has now emerged as a major foreign exchange earner next only to tea and coffee.

Commercial cultivation of cashew in India is taken up in eight states in India. It is also cultivated on small areas in other states of the country. India has an area of about 10.35 lakh ha under cashew with an estimated annual production of about 7.79 lakh tonnes of raw cashew nut. India is the largest producer, processor, consumer and exporter of cashew in the world. The current production accounts for 45% of the global production. Coastal states of the country are the main production centres. The important cashew growing states of India are Andhra Pradesh, Goa, Karnataka, Kerala, Maharashtra, Orissa and Tamil Nadu.

Cashew cultivation is taken up in small and marginal holdings and as more than 70% of the cashew area is under this category, cashew plays an important role in the development of small and marginal farmers. Cashew is generally planted at a spacing of 8 m x 8m in square (156 trees/ha) or triangular pattern (180 trees/ha).In nutrient rich deep soils 10m x 10m is recommended in square (100 trees/ha) or triangular pattern (116 trees/ha). Jain Irrigation envisaged the idea of planting cashew in hedge- row fashion with close row to row and tree to tree spacing. In ultra-high density planting of cashew (UHDP) we planted cashew in close spacing in order to stretch the limits of potential yields, and considering the fact that yield per acre and return from Agri. / Horti. ventures are the benchmark today for farm incomes rather than individual tree yields; we decided to maximize the yield per acre by going in for further closer spacing 3m x 2m accommodating 674 plants/acre.

Soil

The general notion is that "cashew is very modest in its soil requirements and can adapt itself to varying soil conditions without impairing productivity". But cashew performs much better on good fertile soils.

The best soils for cashew are deep, friable well drained sandy loams without a hard pan. Cashew also thrives on pure sandy soils although mineral deficiencies are more likely to occur. Water stagnation and flooding are not congenial for cashew.

Climate

Cashew is a tropical plant and thrives at high temperatures. Young plants are sensitive to frost. Areas where the with humidity temperatures range from 20 to 30 degree Celsius with an annual precipitation of 1000 - 2000 mm are ideal for cashew growing.

Heavy rainfall, evenly distributed throughout the year, is not favourable though the trees may grow and some times set fruit. It needs a climate with a well defined dry season of at least four months to produce the best yields. Coincidence of excessive rainfall and high relative humidity with flowering may result in flower/fruit drop and heavy incidence of fungal disease. Cashew is regarded as "essentially coastal tree" but that is not true. It also grows well at considerable distance from the coast.

The research in the field of crop improvement have identified elite materials with yield potential ranging between 20-25 kg per tree. Several varieties have been released by the different co-ordinating centres of ICAR. All the Agricultural Universities and Research Centres have established bud wood bank with the released varieties of respective centres, for further multiplication and distribution. However, yield per unit area remained very low. It is here that we thought of making a change; and that change is a package with do-able agronomy.

State	Major varieties
Andhra Pradesh	BPP-1, BPP-2, BPP-3, BPP-4, BPP- 5, BPP-6, BPP 8 and VRI 2
Karnataka	Chintamani 1, Selection 1, Selection 2, Ullal 1, Ullal 2, Ullal 3, Ullal 4, UN 50, VRI 2, Bhaskara, Vengurla 1 and Vengurla 4.
Kerala	Anakkayam-1, Dhana, K22-1, Madakkathara 1 (E), Madakkathara 2 (L) and Priyanka (M), Vridhachalam-3, Kanaka, Dhanashree, Amrutha, Anagha, Akshaya, Sulabha, Damodar, Raghav
Madhya Pradesh	T No. 40 and Vengurla 4
Maharashtra and Goa	Vengurla 1, Vengurla 4, Vengurla 6, Vengurla 7 and Vengurla 8
Orissa	Bhubaneswar -1, Jagannath (BH-6), Balabhadra (BH-85) and VRI 2
Tamil Nadu	Vridhachalam-1,Vridhachalam- 2,Vridhachalam-3,VRI 4,VRI(CW)H1
West Bengal	Jhargram-1, Jhargram-2
Goa	Goa-1 & Goa-2

Common Varieties of Cashew

Preparation of Land

Land with drainage and devoid of sub-surface hard rock or hard pan, is good for successful cultivation of cashew. The land should be ploughed thoroughly and levelled in case of agricultural lands. Pits of 1 m³ are to be dug and allowed to wither.



Planting material

Cashew is a cross pollinated crop and exhibits wide variations in respect of nut, apple and yield of seedling progenies. Therefore, vegetative propagation has been advocated to mitigate this problem.

Air-layering has been quite successful but survival percentage seems to be low and it has been reported that the plantations raised from air-layers are more susceptible to drought and the life of such plantation is shorter as compared to that of grafted or seeding ones. The anchorage has also been observed to be poor, especially in cyclone prone areas. Number of other methods of propagation such as budding and grafting have been found successful with varying degrees of success.

Epicotyl grafting and softwood grafting are found to be successful because it is easy to produce large number of grafts in a short time. Softwood grafts are preferred for UHDP. 8-12 month old grafts are best for planting.

Ultra High Density Cashew Planting

In UHDP method cashew trees are planted at 3m x 2m spacing (674 trees /acre). We also recommend planting at 4m x 2m (500 trees/acre) 4m x 3m (337 trees/acre) or 5m x 4m (202 trees/acre) wherever labour availability for pruning operations is a challenge.

Pit size of 1m x 1m x1 m is dug and filled with 15 kg organic manure, 200 gm neem cake, 100 gm Single Super Phosphate, along with native soil.

The grafted plants obtained from the superior mother plant are usually planted after filling the pits at the onset of monsoon.

It is essential to provide stakes and temporary shade with the locally available materials wherever necessary to reduce the mortality rate and achieve quicker establishment.

If the monsoon rains are inadequate, irrigation is essential during the initial stages to ensure establishment.

Mulching with black polythen or weed mat is beneficial to increase the growth and yield of cashew.

Irrigation of Cashew

Cashew is generally grown as a rain-fed crop; but in UHD plantations, drip irrigation is an essential intervention. In drip- fertigated orchards, cashew is found to double the yield. Research at National Research Centre (NRC), Cashew has shown the benefits of irrigation in cashew production. However Cashew can not withstand water stagnation and logging. Critical period for irrigation is from flower initiation to fruit set.

Water requirement of UHDP Cashew

Table 1: Irrigation schedule for ultra-high density (UHDP) Cashew. Figures are in I/tree/day estimated for 3x 2 m tree spacing based on the evaporation of the location.

Month	Evapora-	1 st yr	2 nd yr	3 rd yr	4 th yr and
	tion (mm)				onwards
Jan	4.6	0.63	2.53	5.69	10.12
Feb	5.9	0.80	3.21	7.21	12.82
March	7.29	1.00	4.00	8.99	15.98
April	6.69	0.89	3.55	7.99	14.21
May	7.54	0.94	3.76	8.45	15.03
June	7.45	1.01	4.05	9.12	16.21
July	7.47	1.03	4.11	9.24	16.43
Aug	7.84	1.09	4.35	9.78	17.39
Sept	7.78	0.96	3.84	8.64	15.35
Oct	4.74	0.55	2.21	4.97	8.83
Nov	3.84	0.59	2.35	5.28	9.39
Dec	3.9	0.58	2.33	5.25	9.33
Average	6.02	0.93	3.73	8.39	14.92

The quanta of irrigation will vary with age (crop factor), Canopy size (Canopy factor), location (Evaporation rate). Growers wanting to practice drip irrigation should get this schedule from Jain Irrigation Agronomist.

Drip system layout

- Online drip system is suitable for cashew.
- Drip laterals are spaced according to the tree spacing (3m).
- Each tree is provided with 4 (4 lph) drippers placed around the tree using extension tubes. In UHDP because of close plant to plant distance, inline drip line is also suitable with 4 lph emitters at 50 cm distance.
- For older trees (plus 5 year) two drip lines are to be placed one on either side of the trunk If necessary.
- The drip lines are to be placed 0.5 m away from the trunk.

Fertilizer application

Nutrient

Table 2: The nutritional requirements are given below :

1 year

g/tree/year

3 year & after

2 year

Fertigation

Table 3. Fertigation schedule(kg/acre/dose) for the 3 x 2m.

Year	Schedule	Urea Kg/ac	Phos- phoric Acid	MOP Kg/ ac
			Kg/ac	
1	12 doses, weekly once (July-Sept)	1.1	0.5	0.3
	20 doses, weekly once (Jan-May)	1.3	0.5	0.3
2	12 doses, weekly once (July-Sept)	2.3	0.9	0.6
	20 doses, weekly once (Jan-May)	2.5	1.0	0.6
3	12 doses, weekly once (July-Sept)	3.4	1.4	0.9
	20 doses, weekly once (Jan-May)	3.8	1.5	1.0
4	12 doses, weekly once (June-Aug)	6.5	2.6	1.7
	4 doses, weekly once (Sept)	5.9	3.9	1.5
	12 doses, weekly once (Jan-March)	4.6	1.3	1.2
5	12 doses, weekly once (June-Aug)	8.1	3.3	2.1
	4 doses, weekly once (Sept)	7.3	4.9	1.9
	12 doses, weekly once (Jan-March)	5.7	1.6	1.5

Weeding

Timings of weeding are very important to minimise the cost. Weeding with a light digging should preferably be done before the end of rainy reason. Hoeing, cutting the weeds off underground, is more effective than slashing.

Chemical weeding may be considered as an alternative, where wages are high or where there is shortage of labour.

Canopy Management by Training and annual Pruning

The grafts planted have to be trained to get a single stem up to 45-50 cm from the ground. Primary branches to be initiated by heading back main stem at 45-50 cm height. After 3-4 month of first heading back primary branches to be cut after 30-40cm length from main stem to initiate secondary branches. After 2-4 months of growth secondary branches to be cut at 35-40 cm to initiate tertiary branches.

Annual pruning is done after harvest to remove excess growth, to keep tree within its provided space and to initiate more numbers of new shoots per unit area of canopy.

Pruning is done after harvest to initiate more numbers of shoots per unit area of canopy and to remove criss-cross branches to ensure good sunlight entry throughout the canopy.





- All our Drip Lines are Five Star rated from worlds reknowned institute IRSTEA (Cemagref), France.
- Available discharge rates 0.85, 1.2, 1.6, 2.1, 4 lph @ 1kg/cm².
- 12, 16, 20, 25 mm nominal diameter.
- Dripper Spacing 15, 20, 30, 40, 50, 60, 75,90 cms.

ONE STOP SHOP for Your

Jain Turbo Excel® - एक बेमिसाल आविष्कार!

Innovative

Cascade

Labyrinth

Weir structure to prevent entry of sand particles in flow path



Computerized Continuous online quality checks for consistent performance



Double flow regine which does continuous flushing of small particles.



Computerized online checks for emitter spacing

Jain Turbo Top™ - सबसे आगे! सबसे टॉप!

- Available discharge rates 1.1 & 1.6, 2.0, 2.2 lph .
- Injection moulded silicone rubber compensates with pressure and discharge gives uniform performance.
- Anti Siphone feature (optional) prevents suction of sand and silt particles inside the dripper, used for Subsurface Irrigation.
- Cascade labyrinth gives strong, self-cleaning turbulence. Prevents Clogging.
- Available in 16 & 20mm nominal diameter. (12, 16 & 20 mm in Thin Wall option)
- Suitable for surface as well as subsurface installations.
- Operating pressure range 0.4 to 4 kg/cm².

Why Jain Drip Irrigation?

moulded silicone enables clog free diaphragm operation Weird Long and wide outlet to prevent cascade flow

Water is not the only need of the plant. To uptake this water efficiently, it requires proper air-water balance within the root zone. Drip irrigation, with its low application rate, prevents the saturation of water within the root zone and continuously maintains field capacity. This provides a favorable condition for the growth of the plant. Drip irrigation also helps to use fertilizer efficiently. With drip irrigation water can be provided at frequent intervals which helps maintain required soil moisture level within the vicinity of the plant roots. Jain is the pioneer of drip irrigation. Ours is the only company in the world, which fulfills your entire irrigation system requirement under one roof.

Characteristics of drip irrigation

- 1) Water is applied at a low rate to maintain optimum air-water balance within the root zone.
- 2) Water is applied over a long period of time.
- 3) Water is applied to the plant and not to the land.
- 4) Water is applied at frequent intervals.
- 5) Water is applied via a low pressure network.





3-D inlet filter

entry of roots

path

Injection

Micro Irrigation Needs

J-Turbo Line[®] Super - सर्वश्रेष्ठ कार्यक्षमता!



- Available discharge rates (at 1kg/cm²) 12mm - 2.2, 4 lph 16mm - 4, 8 lph 20mm - 2.2, 4, 8 lph
- Availabe in 12, 16 & 20 mm nominal • diameter.
- Suitable for surface as well as subsurface installations.



Turboline PC[®] - उच्च तकनीक - किफायती विकल्प!



- Available discharge rates 16 mm =1.1, 1.6, 2.2 & 3.5. 20 mm = 0.9, 1.6, 2.2 & 3.8 lph within pressure regulation range of 0.7 to 3 kg/cm².
- Injection moulded silicone rubber compensates with pressure and discharge gives uniform performance
- Application on undulating land/ Terrains/ Steep slopes. •
- Available in 16 & 20 mm nominal diameter. •
- Suitable for surface as well as sub-surface installation.
- Application where ever longer lateral length is . necessary.
- Conforming to IS 13488, ISO 9261 Standard.

placed multiple inlet filters

Injection

diaphragm

moulded silicone





Smooth hydrodynamic design minimizes frictional losses & helps for longer lateral running length.

More Crop Per Drop®

Widest Choice ! Customized Irrigation Solutions





Primary and secondary branches

Tertiary and Fruiting branches

Almost 95% branches facing the Sun

Management of insect Pests and Diseases

Insect Pests: Some 30 species of insects infests cashew. Out of these tea mosquito, flower thrips and stem and root borer and fruit and nut borer are the major pests, which are reported to cause around 30% loss to the yield.

Tea Mosquito

The nymphs and the adults of tea mosquito suck sap on the tender leaves, shoots and inflorescence and even young nuts and apples. Tea mosquito population builds up during the beginning of the rainy season, when the cashew tree is full of new flush.

Tea mosquito can be controlled by spraying quinalphos 0.05% (2 ml/lit) or profenofos 0.05% (1 ml/lit) or chloripyriphos (2.5 ml/lit) or thiamethoxam (0.2 gm/lit).

Spraying should be done thrice, first at the time of flushing, second at early flowering and third at the time of fruit set.

Thrips

Both nymphs and adults suck and scrape at the underside of the leaves, mainly along main veins, causing yellowish patches, latter turning grey, giving the leaves a silvery appearance. These thrips are more active during the dry season.

Spraying 0.05% monocrotophos or Dimethoate 1.6 ml/lit are very effective for controlling thrips.

Stem and Root Borers

The young white grubs bore into the fresh tissues of the bark of the trunk and roots and feed on the subsequent subepidermal tissues and make tunnels in irregular directions. Due to severe damage to the vascular tissue the sap flow is arrested and the stem is weakened. The characteristics symptoms of damage include the presence of small holes, in the collar region, gummosis, yellowing and shedding of the leaves and drying of the twigs. Complete control of this pest once the plant is infested is very difficult.

Prophylactic measures for its control can be adopted by swabbing the trunk up to 1 meter from the ground with coal tar + Kerosene mixture (1:2) or Neem oil 5 % (50 ml/lit) twice a year during March –April and November- December.

Uproot the dead trees in the field and destroy.

Swab the bark of the infested shoots and roots with Chlorpyriphos 20 EC (0.2 per cent @10 ml/lit),further drenching the same solution on the soil near root zone to minimize the reinfestation of this pest.

Fruit and nut Borers

The young caterpillar bores through the apple and nut causing deformity and /or loss of kernel weight.

Spraying of monocrotophos 0.05% concentration at flowering and fruit setting is recommended.

Diseases

Cashew crop does not have any serious disease problem, except the powdery mildew caused by fungus, which affects the young twigs and inflorescences and make it wither.

This disease generally appears when the weather becomes cloudy. Control can be obtained by dusting with 2% sulphur W.P.

Die Back

Symptoms like drying of twigs from the tip .Prune the affected shoots just below the affected portion and apply Bordeaux paste. Spray 1 % Bordeaux mixture or any copper fungicide like Blitox or Fytolan 0.25 % twice i.e. in May - June and again in October as a prophylactic measure.

Harvesting and Yield

Normally harvesting consists of reaping the nuts that have dropped to the ground after maturing. If the apples are also used for making jam, juice, syrup, fenni, etc., the fruit has to be harvested before it falls naturally.

In UHDP plantations, with the use of elite planting material coupled with a package of improved agronomic practices, and drip fertigation; an yield of 2-4 kg per tree (1.2 to 2.4/ acre) could be achieved.

Cashew varieties responded to Ultra high density and yielded very early. The crop also responded to fertigation resulting in 4 times yield compared to that in conventional soil applied fertilizer.



Fig 1. The very high yields of Cashew nut under 3x 2 m UHDP in two varieties



Pruning

UHDP Cashew at flowering and fruiting.

UHDP Cashew Fruits

Table 4: yield of cashew kg/acre for two varieties from 2012 to 2016 in 3 x2 m UHD Plantation.

Year/ Variety	2012 (3rd yr)	2013	2014	2015	2016 (7th yr)
VRI 3	910	1004	1078	1045	1091
ULLAL 3	863	890	998	923	910

Top working and conversion of old pantation to UHDP

- Boosting cashew production 3-4 folds in a short span of time is perhaps possible only by top working the existing plantations and grafting with high yielding varieties.
- The rejuvenation of unhealthy cashew trees through top working involves beheading of trees, allowing juvenile shoots to start-out and taking up of insitu grafting using procured scions of high yielding varieties.
- Trees are top worked during November to March and in situ grafting is done in February to June.
- It has been observed that the top worked trees within a period of two years have not only put forth a canopy of 3-4 m in diameter and 5-6 m in height (as that of 8-10 year old trees)
- An yield of 3 to 5 kg nuts per tree is obtained after top working in their first bearing itself.

UHD Cashew Converted from Old Traditional Orchad Spacing app. 3m x 2 m



Marketing

Marketing of cashew is not a problem. The raw material production is considerably low (around 2.60 lakh tonnes) when compared to the processing capacity of our existing factories (around 4.5 lakh tonnes developed so far).

Benefits of UHDP Cashew

- Double the yield.
- Reduces water used for irrigation by up to 50%.
- Increased fertilizer uptake by plants when fertigation is practiced. Increased fertilizer use efficiency through fertigation.
- Consequently a reduction of up to 30% of applied fertilizer from the recommended dose is possible.
- Reduces NO3-nitrogen leaching (thereby nitrate pollution) by 50% when fertigation is practiced.
- Controls weed growth as water is applied only to the root zone.
- Allows for intercropping during the early years.

Benefits of UHDP cashew to farmer

- Very low gestation period.
- Early realization of income.
- Suitable for small, medium and semi-large farmers as its management is intensive and yields good quality fruits which can get better market price.
- It makes sensible bankable project to get financial support due to assured high early returns.

Dos

- Ensure good drainage in the field.
- Adopt drip method of irrigation.
- Prepare pits and fill it with the mixture as recommended.
- Compulsorily apply organic manure as per recommendation
- Select high yielding, disease and pest tolerant variety suitable for each location.
- Practice drip irrigation from the beginning of the orchard.
- Irrigate with drip strictly following the schedule given by the engineer.
- Follow the drip system maintenance schedule given by the engineer.
- Compulsorily weed/ inter-cultivate, timely operation helps in crop growth.
- Follow fertigation schedule as given by the engineer.
- Follow the precautions while operating the drip system as explained by the engineer.
- Apply micronutrient as and when needed.
- Practice pruning and canopy management with a timely schedule
- Follow disease and pest control measures timely and effectively.
- Apply sprays in the evening or early morning only.

Table 5: Cost of establishing an UHDP cashew orchard

Deutieuleur	Cashew	1 st year	2 nd year	3 nd year	4 th year	5 th year
Particulars	Per Plant	Rs/Acre	Rs/Acre	Rs/Acre	Rs/Acre	Rs/Acre
Graft	35	23590	2360	0	0	0
Pit marking	2	1348	0	0	0	0
Pit Digging	23	15502	0	0	0	0
Organic manure shifting and pit filling	10	6740	0	0	0	0
Remarking	1.5	1011	0	0	0	0
Planting	3	2022	0	0	0	0
Staking	3	2022	0	0	0	0
Organic manure		10110	3370	3370	6740	6740
Weeding	4.5	3033	5055	5055	5392	4044
Training /Canopy of trees	0.25	337	674	2022	3370	3370
Fertilizers Total	-	722	1479	2313	3122	3842
Plant Protection	-	250	1000	2500	3000	3000
Labour costs (Spraying, staking, irri.maint.	-	2125	3000	4500	6000	6000
Interculture operations (Tractor)	-	600	600	600	750	750
Harvesting cost @Rs.10 per Kg	-	0	0	3000	6000	10000
Total Expenses	-	69412	17538	23360	34374	37746
Gross yield (kg /ac)	-	_	0	300	600	1000
Gross Income /ac @ Rs.125/ kg	-	-	-	37500	75000	125000

Don'ts

- Don't over irrigate the crop at anytime.
- For fertigation don't mix solid fertilizers and dissolve them together. Prepare individual solutions and mix them for application.
- Don't spray the crop under hot sunlight.
- Don't make a fire in the field with Drip system.
- Don't use the fertigation unit for bulky organic manure and fertilizers that are not soluble in water
- Don't add solid fertilizer from the bag directly to the fertilizer tank. Prepare solution separately and pour the solution to the fertilizer tank. Prepare solution only in plastic buckets. Don't use metal container.
- Don't stir the solution with naked unprotected hand. Use wooden spoon or stick.
- Don't heat the fertilizer solution to increase solubility.

Frequently asked questions (FAQ's)

1) Does Cashew require irrigation?

Normally cashew is rain-fed but the climatic and soil conditions where cashew is grown impose high Evapotranspiration demand. Drip irrigation is essential for higher productivity of cashew.

2) Whether the meagre quantity of water supplied through drip irrigation is enough?

Irrigation rate in Drip method is estimated based on

Urip

the Evapotranspiration of the location and therefore it is enough. A wetting depth and wetted area of 40% is sufficient for Cashew production.

3) In drip method water is applied to the surface of the root system at a very low rate. Whether this will cause root accumulation near the surface and thereby the tree may fall in the long run? In trees like cashew, only the absorptive roots are located near the surface and get directed by moisture and nutrient availability. The anchor roots penetrate into deeper soil layers and provide stability for the tree.

4. Can I prefer Impact Sprinkler method of irrigation for cashew?

Large Impact sprinklers are not suitable as it spreads water in the inter-tree spaces and the trunk of the trees will obstruct the spray jet from the sprinklers and thus affect the uniformity of irrigation. Moreover wastage of water per irrigation will be high. Sprinkler irrigation also will create the favorable environment for pests and diseases.

5. Can I take an intercrop with irrigation?

Yes. Till the canopies of cashew cover the inter-space intercropping is possible. But provide additional drip line for the intercrop. In old orchards intercropping is possible after top working for the next 2 years.

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Tel: +91-257-2258011; Fax: +91-257-2258111; E-mail: jisl@jains.com; Website: www.jains.com; Toll Free: 1800 599 5000









