Introduction

Cashew is one of the important foreign exchange earning crops and is traditionally grown in the coastal regions in India. Although cashew is grown in high rainfall environment, it experiences severe moisture stress during January to May with the highest water deficit from March to May. The critical growth phases such as flushing, flowering and nut formation in cashew also occur during these periods. Any form of biotic and abiotic stresses during these periods adversely affect the flowering and fruit set and result in premature nut drop and finally reduces the yield and productivity of cashew. Studies have shown that supplemental irrigation can significantly improve the productivity and yield of cashew. This extension pamphlet intend to highlight the importance of water management in cashew, different options available to address the issue of irrigation, water conservation and water management for increasing the yield.

Soil and water conservation practices

Cashew plantations are raised on landscapes which are unsuitable for many other crops, and generally lack a source of water for irrigation. Arranging irrigation in such landscapes will be a difficult and costly affair. Adoption of proper soil and water conservation techniques *in-situ* in such slopy and degraded landscapes play a very important role in preventing further soil degradation by controlling soil erosion, conserving soil moisture and improving tree growth and productivity in a sustainable manner. Different technologies for *in-situ* soil and water conservation recommended for cashew are detailed below. The adoption of these practices should be done in accordance with the local conditions, topography, water holding capacity and infiltration characteristics of the soil, and the cost consideration.

Trenches/engineering measures

Continuous bench terraces: Terraces stop the downslope soil and water movement and also give the advantage of providing a flat surface for the planting of cashew, thereby further reducing the possibility of erosion.

Continuous contour trench: These trenches are taken in slopy areas (7 to 8% slope), running through entire field length along the contour. The trench dimension recommended is 0.5 m x 0.6 m.

Modified crescent bund: The modified crescent bund consists of a crescent-shaped bund of 6 m length, 1 m width and 0.5 m height at 2 m radius, which is to be taken at upstream of the cashew terrace which will help to retain water as well as litter.

Staggered trench: The staggered trenches of size 5 m length, 1 m width and 0.5 m depth are to be taken between two rows of cashew or in the middle of 4 plants, across the slope, in which coconut husks can be buried to enhance water retention.

Reverse terraces: The recommended dimensions for reverse terraces are 2 m length, 2 m width and 0.7 m depth, which are constructed so as to be inclined from periphery to the centre.

Catch pits: The recommended dimensions for catch pits are 3 m length, 0.5 m width and 0.5 m depth, which are constructed upstream of cashew planted terrace, to catch and retain the runoff and to increase percolation of water.

Tree base terrace: Formation of tree base terrace at 2 m radius around the plant, taken over three years of planting shall be beneficial for moisture conservation. It is made by taking soil from the upper side of the slope and filling at the lower portion. The upside shall be taken in such a way that it forms a catch pit to deposit soil and conserve the moisture.

Bioengineering measures

Coconut husk burial: Adoption of coconut husk burial techniques with soil and water conservation techniques like modified crescent bund, staggered trenches etc. improve the water retention in the soil for longer periods. This practice of coconut husk burial can be adopted around the cashew plants also. Husks are to be buried in trenches of 3.5 m length, 1 m width and 0.5 m depth, opened across the slope between two rows of cashew. In such trenches, 3 to 4 layers of husks can be buried with the convex side of the first layer of husk touching ground. The last layer of husks should be placed with the convex side upper side. A thin layer of soil and leaf materials can be placed between layers of husks. Then the trench can be filled with soil, leaving about 10 cm depth.

Use of bigger pits and mulching: This practice is to be followed during the establishment of cashew plantations. Pits of 1 m^3 size are to be dug open at the recommended spacing following other soil and water conservation measures such as terracing. These pits are to be filled with topsoil, organic manure and rock phosphate at recommended rate up to 2/3rd depth. Plant the graft at the centre of this pit and proper mulching is to be done.

Trenches with vegetative barriers: Inclusion of vegetative barrier along with continuous contour trenches and staggered trenches can substantially reduce runoff and soil loss. *Stylosanthes hamata, Vetiveria zizanioides* are some of the recommended vegetative barriers. Apart from helping to reduce runoff and soil loss, the vegetative barriers can be harvested to provide additional income.

Green manuring and mulching: Growing green manure crops like *Glyricidia* at vacant spaces and borders provide material for mulching. Mulching the tree basin with green mulch helps to conserve the soil moisture.

Circular trench with leaf litter and coconut husk: This practice is generally recommended for east-coast areas, wherein coconut husks and leaf litter are buried in circular trenches of 0.3 m width and 0.5 m depth opened at 2 m away from the cashew trunk.

Supplementary/protective irrigation

Protective irrigation

While establishing the new plantations, the planted cashew grafts require enough soil moisture for the initial establishment and hence it is recommended to plant the cashew grafts during the monsoon season. Under drought situation, the newly planted grafts need to be watered once in every 2 to 7 days, to ensure the root ball of the graft is kept moist, but not waterlogged. Once established, due to the deep taproot system, the cashew trees can survive the moderate dry season without irrigation, but with an adverse effect on yield. Cashew is known for its drought hardiness and generally grown as unirrigated, however, the yield can be increased if irrigated.

Providing irrigation @200 litres per tree at 15 days interval during November to March increases the nut retention and yield. For yielding trees, protective irrigation is to be given only after the plant enters the flowering phase, during nut set and nut development stages.

By providing black polythene mulch the quantity of irrigation to be provided can be reduced to 60 L/tree once in a fortnight.

Drip irrigation

In drip system of irrigation water is applied through a network of pipelines and applied to the root zone of crop drop by drop by use of emitters or drippers. In this system, water is applied based on ET demand of the crop and root zone is always maintained at field capacity levels.

Drip irrigation allows water saving to the tune of 40 to 70% in comparison to other methods of irrigation and 25-80% increase in yield when practiced with other cultural practices. The water requirement in cashew is decided based on the climatic condition, canopy area and growth phase of the plant. Based on canopy coverage and daily water evaporation, the water

requirement of cashew can be calculated as follows:

To meet 20% CPE
Age of tree: 5 years
Canopy spread or diameter: 4 m [mean of EW and NS length of canopy]
Ground coverage of canopy: πr^2 = 3.14 x 2 x 2 = 12.56 m^2
Daily CPE = 5mm; 20% CPE = 1 mm
The quantity of water to be given to meet 1 mm of water in 12.56 m^2 area = 12.56 x 1/1000 = 0.01256 m^3.
1 m^3 = 1000 L
0.01256 m^3 = 12.56 L/tree/day

Drip irrigation schedule for cashew

In cashew, for yielding trees, the drip irrigation can be started from the second fortnight of November/December till the end of March, depending on the variety. However, for new plantations, irrigation can be continued throughout the summer period. For well established normal density plantations, the rate of drip irrigation recommended is to meet 60% of the evaporative demand. In general, this can be met by providing 4 drippers with each of 6 L/h capacity, running for 1.5 hours (that provide 36 litres of water per tree per day) during December and January. The general recommendation during February and March under normal density planting is to provide 48 L/tree/day (4 drippers of 6 L/h capacity, running for 2 hours). These rates are for grown-up trees.

In case of high density planting system, drip irrigation is to be given to meet 20% of the evaporative demand. This is provided by installing two drippers each of capacity 2 L/h at the base of the tree located at 1 m equidistance from the base of the tree, running for 1 h 45 minutes (giving 7 litre water per tree per day) during December and January and running for 2 h 15 minutes (giving 9 L water per tree per day) during February and March.

Irrigation should be started only after flowering and stopped before starting the harvest. When the drip system is planned right from the establishment of plantations, two drippers can be placed at 0.5 m away from the base of the tree on both sides on the lateral pipe, and another two drippers 1 m away from the base of the tree on both sides of the cashew tree. Microtubes of 1.5 to 2 m length can be connected to the drippers to facilitate changing the water dripping points near the root zone as the tree grows up over different years.

Fertigation

It is the technique of applying plant nutrients by dissolving them in irrigation water mainly through the drip system. It helps to deliver the correct quantity of water and nutrients to plant roots zone. Fertigation ensures almost 90% use efficiency for the applied fertilisers, as it enables applying the nutrients at the most nutrient demanding stage of the crop, at the right place (at the zone of highest root activity) and the right time. The right combination of water and nutrients is to be used to obtain desired results through fertigation.

Fertigation recommendation in cashew

It has been reported that fertigation can save 50% in the fertilizer requirement. Under fertigation, only 50% of the recommended dose of fertiliser be given through drip and remaining may be applied in the form of castor cake (4 kg/tree/year in case of normal density planting system Or 2 kg castor cake per tree per year in case of high density planting system). The application of organic manure or castor cake may be done during August in pits dug out near water dripping point located 1 m distant from the base of the trees. The recommended dose of fertiliser needs to be given in equal splits at weekly interval starting from October to February. The required quantity of fertilisers is to be dissolved in water and applied through the drip system.

Immediately after the cessation of monsoon rains, the flushing phase gets intensified in cashew and fertiliser application is highly essential during this phase. However, since flowering induction in cashew needs dry period, irrigation is not recommended during these periods. So to meet the nutrient demand 25% of the recommended dose can be applied as basal dose as a soil application. Rest of the dose may be applied in equal split doses at weekly intervals starting from October up to February. For young and establishing plantations, irrigation can be given at 100% CPE during summer months.

However, under the actual field conditions, the no. of drippers, flow rate, availability of labour to run the system daily, age of the cashew trees, its development stages etc vary widely and user needs to customise his/her requirement. Similarly in designing fertigation schedule, the field conditions vary widely under each farmer's field and a general recommendation may not be useful. The availability of fertiliser, soil conditions, density of planting, age of the tree etc needs to be taken into consideration while formulating a fertigation schedule.

Care during the rainy season

Before the onset of the rainy season, backwash by flushing the system after removing the end cap of the lateral pipes. Replace the end cap of lateral pipes, roll the lateral pipes in circle and place near sub-main pipe at a high elevation.

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