e-TRAINING MANUAL

on

Cashew Production and Post-Harvest Technologies

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FOREWORD

Cashew is an important foreign exchange earning plantation crop of India. India is the first country to exploit the commercial value of this crop. ICAR-Directorate of Cashew Research (DCR) is the nodal agency for cashew research in the country. The research on cashew was initiated in the early 1950s. Then All India Coordinated Spices and Cashew Improvement Project (AICS & CIP) was started at CPCRI, Kasaragod. Later in 1986 National Research Centre for Cashew (NRCC) was established at Puttur, D.K., Karnataka to take forward the research programmes on cashew and in 2009, NRCC was upgraded as Directorate of Cashew Research (DCR).

The demand for cashew is increasing at both global and national levels. However, the cashew yield levels in India have been low, mainly due to insect pest attacks and lack of proper management of cashew orchards. Thus, it has become imperative to transfer the scientific cashew production technologies to the cashew growers to enhance the cashew productivity and production in the country. Besides, development of value added products of cashew kernel and apples is needed for improving the income of the cashew growers. Towards achieving this, DCR is continuously striving by improving the cashew production and processing through research and extension activities.

I am pleased that ICAR-Directorate of Cashew Research, Puttur in collaboration with Meghalaya Basin Management Agency (MBMA), Govt. of Meghalaya is organizing a National Level Training Programme on “Cashew production and postharvest technologies” during 10-14 February 2020 for the farmers and officials. The training emphasizes on the latest concepts and practices in the field of cashew production and processing for the benefit of stakeholders.

I congratulate the editors and all scientists involved in bringing out this training manual and I hope it will be immensely useful to the trainees, researchers, policy makers and other stakeholders who are engaged in research and development of cashew in the country.

11/2/2020.

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Table of Contents

Strategies for soil and water conservation, and irrigation management in cashew

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ICAR- Directorate of Cashew Research, Puttur 574202, Dakshina Kannada, Karnataka, India

Introduction

Cashew is one of the important foreign exchange earning crops and is traditionally grown in the coastal region in India. The major cashew growing states in the west coast are Maharashtra, Goa, Karnataka and Kerala. Along the east coast, the major cashew growing states are Tamil Nadu, Andhra Pradesh, Odisha and West Bengal. The non-traditional areas of cashew cultivation are Bastar region of Chhattisgarh and Kolar (Plains) regions of Karnataka, Gujarat, Jharkhand and in NEH region. In India, cashew is generally grown as a rainfed crop mainly along the coastal areas in low fertile soil. Majority of cashew orchards in India are not irrigated. The productivity levels of cashew are low in India compared to other producer countries. The research studies showed that the mean rainfall distribution in cashew area ranged from low rainfall (1500-2000 mm in Gujarat) to high rainfall (2700 to 3500 mm in West coast and NEH region). In India, the vegetative development of cashew occurs during rainy season, and the reproductive phase during the dry season. Although cashew is grown in high rainfall environment, it experiences severe moisture stress during January to May with the highest water deficit during March to May. Incidentally the critical growth phases such as flushing, flowering and nut formation in cashew also occur during these periods. Any form of stress biotic and abiotic stresses during these periods adversely affects the flowering and fruit set and results in premature nut drop and finally reduces the yield and productivity of cashew. Lack of moisture availability during fruiting season is one of the several factors associated with the low yield in cashew. Studies have shown that supplemental irrigation can significantly improve the productivity and yield of cashew. This bulletin addresses various issues in water management in cashew. The bulletin 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.

Cashew (*Anacardium occidentale* L.), is native to Brazil and was introduced to India by Portuguese travelers as a soil binding crop, to control soil erosion in coastal areas during 16th century. Sooner its commercial importance and adaptability to adverse soil and environmental conditions were recognized and its cultivation on commercial scale occurred along the east and west coast of India. Export of cashew kernels and cashewnut shell liquid bring foreign exchange to the country. In India, cashew is cultivated on a wide range of soil types such as sandy to sandy loam, laterite soil, loam and red lentisols. Due its drought hardiness, cashew is widely cultivated in degraded hillocks and slopy lands, where profitable production of other crops are not possible. Majority of cashew growing soils are low in soil fertility in terms of nitrogen, base status, cation exchange capacity and micronutrients such as zinc and boron. Due to heavy precipitation in the coastal areas where cashew is grown, the basic cations are washed out causing increased soil acidity. The high soil acidity in turn decreases the nutrient uptake by the plant, making some of the nutrients unavailable for cashew.

Water requirement of cashew

In India, the vegetative development of cashew occurs during rainy season, and the reproductive phase during the dry season. Although cashew is grown in high rainfall environment, it experiences severe moisture stress during January to May. Incidentally the critical growth phases such as flushing, flowering and nut formation in cashew also occur during these periods. Any form of stress biotic and abiotic stresses during these periods adversely affects the flowering and fruit set and results in premature nut drop and finally reduces the yield and productivity of cashew.

Water management in cashew

The cashew growing regions are characterized by high intensity rainfall over a short duration which lead to runoff and soil erosion. Cashew experience moisture stress during December/January to May which coincide with flowering and fruit setting phase of cashew, leading to flower drying and immature nut drop. Moreover the traditional areas of cashew cultivation lack access to water sources for irrigation purposes. Research studies indicate that cashew though a hardy crop respond well to water and manure management. In areas with no access to irrigation water, the water deficit to the crop can be managed to some extent by the adoption of region specific soil and water conservation practices. Adoption of such practices

is part of cashew production technology in case of slopy areas to prevent surface runoff and soil erosion.

Soil and water conservation practices

Cashew plantations are raised on landscapes which are unsuitable for many other crops, and generally lack source of water for irrigation. Arranging irrigation in such landscapes will be difficult and costly. Adoption of proper soil and water conservation techniques *in-situ* in such sloppy and degraded landscapes play 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. Among different soil and water conservation techniques studied, modified crescent bunds, staggered trenches with coconut husk burial and reverse terrace are recommended for cashew orchards. The other popular soil conservation practice recommended for cashew is terrace with catch pits. These practices were found beneficial to harvest pre-monsoon rainfall and increase the cashew yield to the tune of 32-35%. Other benefits are reduction in runoff velocity and soil loss, increased soil moisture retention and ground water recharge. With the adoption of such soil and water conservation practices, barren / sloppy lands can be brought under cashew cultivation in order to increase the farm income and land productivity.

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 soil.

Trenches

Continuous contour trench: These trenches are taken in sloppy 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.

Modified crescent bund for soil and water conservation in cashew orchards

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.

Reverse terrace for soil and water conservation in cashew orchards

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.

Terrace with catch pits for soil and water conservation in cashew in steep slopes

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 form a catch pit to deposit soil and conserve 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 soil for longer periods. This practice of coconut husk burial can be adopted around 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 convex side of first layer of husk touching ground. The last layer of husks should be placed with convex side upper side. 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.

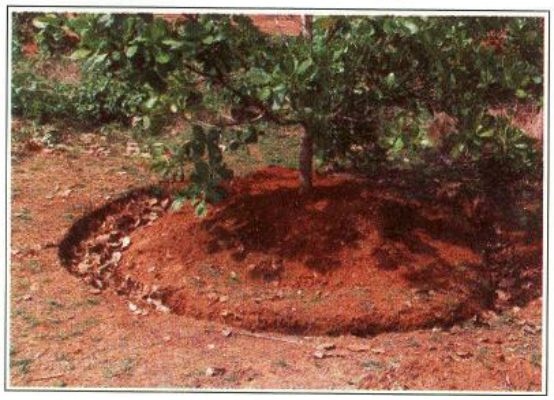
Coconut husk burial for soil and water conservation in cashew orchards

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 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 centre of this pit and proper mulching to be done.

Trenches with vegetative barriers: Inclusion of vegetative barrier along with continuous contour trenches and staggered trenches (in reversely sloppy areas) can substantially reduce runoff and soil loss. *Stylosanthes hamata, Vetiveria zizanioides* are some of the recommended vegetative barriers. Apart from helping to reduce run off 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.



Circular trench with leaf litter and coconut husk

Supplementary/Protective irrigation

While establishing the new plantations, the planted cashew grafts requires enough soil moisture for 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 3 to 7 days, to ensure the root ball of the graft is kept moist, but not water logged. Once established, due to the deep tap root system, the cashew trees can survive the moderate dry season without irrigation, but with effect on yield. Cashew is known for its drought hardiness and generally grown as unirrigated, however the yield can be increased if irrigated. Wherever source of irrigation water is available, providing supplementary irrigation can benefit in improving the nut yield.

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 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 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. 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: $\pi r^2 = 3.14 \times 2 \times 2 = 12.56\ m^2$

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

Advantages of drip irrigation

- It reduces direct loss of water by evaporation, seepage and percolation.
- Slow application rates facilitates easy infiltration to the soil.
- It reduces water consumption by weeds and grasses.
- It allows watering in the root zone of plant.
- Yield increases due to optimum soil moisture status at root zone.
- It can be adopted in undulating areas, where surface methods of irrigation is not possible.
- Increased water use efficiency.

Disadvantages of drip irrigation

- The drippers are clogged with soil/mineral particles and algae.
- The soil moisture is limited and depends on discharge of drippers, dripper spacing and the soil type.
- The rodents and insects may damage some of teh components of drip system.
- The initial investment and annual maintenance cost are higher compared to other irrigation methods.

Drip irrigation schedule for cashew

In cashew drip irrigation can be started from the second fortnight of December to end of March. However for new plantations, irrigation can be continued upto end of May. 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 each of 6 L/h capacity, running for 1.5 hours (that provide 36 litres of water per tree per day) during the months of 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. The drippers should be installed at the base of the tree located at 1 m equidistance from the base of the tree.

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 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 grow up over different years.

Fertigation

It is the technique of applying plant nutrients by dissolving them in irrigation water mainly through 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 crop, at right place (at the zone of highest root activity) and right time. The right combination of water and nutrients is to be used to obtain desired results through fertigation. The advantages of fertigation are as follows.

- Higher nutrient use efficiency.
- Less pollution of water bodies through leaching of fertiliser nutrients.
- Savings of water, nutrients, energy, labour and money

- Effective application of micronutrients.
- Reduced weed growth.
- Increased yield and quality of the produce.

The disadvantages in fertigation is given below.

- Chances of non-uniform distribution of fertilisers to different trees in case of any fault in the drip irrigation system.
- Clogging of emitters / laterals pipes due to precipitation of chemicals.

Fertilisers used in fertigation

The fertilisers used in fertigation should be readily soluble in water, compatible with other fertilisers, low content of insoluble matters and low corrosiveness. The general thumb rules on solubility are given below.

- All ammonium, nitrate, potassium, sodium and chloride salts are soluble.
- All sulphates are soluble except for calcium sulphate.
- All oxides, hydroxides and carbonates are insoluble.
- Urea, MOP and chelated micronutrients are generally soluble.
- Phosphates, sulphates, calcium, magnesium and trace elements may lead to precipitation and blocking if mixed or used with hard water (high in calcium and magnesium). For example, ammonium sulphate causes precipitation of calcium sulphate and magnesium as sulphate.
- Tracer elements such as Mg, Zn, B, Fe, Cu etc ., are difficult to apply through drip irrigation because they need in very low quantities, may reacts with salt in water and causes clogging.
- However, chelated form such as Fe- EDDHA, Fe- DTPA can be used, on chelation the solubility increases.
- Custom made liquid fertilizer designed for fertigation are also available in the market, however this may be costly.

When fertilisers are solubilised by mixing together, they may react and tend to precipitate, if they are not compatible. Such fertilisers are better applied separately through fertigation on different days/time or different fertilisation tanks. Examples of such incompatible fertilisers

are Ammonium sulphate and potassium chloride; calcium nitrate with phosphates or sulphates or DAP, MAP; Phosphoric acid with iron, zinc, copper and manganese etc.

Fertigation recommendation in cashew

It has been reported that fertigation can save 50% in the fertilizer requirement and doubled the cashew yield. Under fertigation only 50% of the recommended dose of fertilizer 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 fertilizer need to be given in equal splits at weekly interval starting from the month of October to February. The required quantity of fertilizers are to be dissolved in water and applied through drip system.

Immediately after cessation of monsoon rains, the flushing phase get intensified in cashew and fertilizer 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 needs to be applied as basal dose as soil application. Rest of the dose may be applied in equal split doses at weekly intervals starting from the month of October upto February. For young and establishing plantations irrigation is to be given at 100% CPE.

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 need to customize 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 fertilizer, soil conditions, density of planting, age of the tree etc needs to be taken into consideration while formulating a fertigation schedule. To empower the users to do drip/fertigation calculations and scheduling at their convenience by inputting their specific needs and resources, a software and mobile App is being developed by ICAR-Directorate of Cashew Research, Puttur and will be shortly available on ICAR-DCR website and Google Play store.

Maintenance of drip system

Daily maintenance

- Start the pump and allow developing stable pressure.
- Clean all the filters as per the protocol.
- Open the bye pass valve meant for sending water to the drip system to obtain desired pressure in the system.
- Traverse the field and check for leakage or damage to any components. Rectify the defects by replacing the parts, removing the folds and kinks in the laterals. Check the position of drippers and microtubes and keep them in correct location if misplaced.
- Check the drippers for uniform discharge of water. Open and clean the filters if required. Do not pull the emitter from laterals as it will lead to enlargement of hole and leakage.
- Remove the end stops and flush the laterals for about 1-2 minutes.
- Flush each submain at the end of irrigation to remove the debris. This is important, since dirt is accumulated in mains and submains and if not flushed off, this may directly go the dripper and clog the pores.

Fortnightly maintenance

Clean the filters

Sand filter: Clean the sand filter by backwash, after adjusting the flow using bypass valve such that sand doesnot come out. Carefully stir the sand thoroughly while backwashing and also break the lumps if any. Continue this until clean water flows out. If the sand is not filled upto the mark indicated, refilling with new sand may be required. Since the sand filter uses special crushed silica, ordinary sand will not serve the purpose.

Screen filter: Remove the filter from the assembly, remove the rubber seals from both ends and clean with a light brush in running water.

Disc filter: Remove the filter from the assembly, remove the rubber seals and clean in running water.

Monthly maintenance

If required perform acid treatment to remove precipitated salts from drippers, microtubes and laterals. Perform chlorine treatment to remove algal growth, slime and bacterial growth.

1. Clogging of emitters is one of the major problem in drip irrigation systems. Take out the emitter/micro tube from lateral pipe and shake it or blow it to remove the trapped dirt. Open able types of emitters can be opened and clean with accessories such as needle.

2. Leakage in the lateral, main and sub-mains: Cut the damaged part and connect it with joiner/connector.

3. Flush and clean the filters by opening and cleaning the screen

4. Flush the sub-mains and laterals by releasing the end caps.

5.Lubricate the movable screws and parts of the system both after using and when not using.

Care during rainy season

Before the onset of rainy season, back wash 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.

References

Anonymous, 2011. Methods manual - Soil testing in India. Department of Agriculture and Coopertaion, Government of India, New Delhi, p. 217.

Anonymous, 2015. Guidelines for use of micronutrients, soil ameliorants and integrated nutrient management practices in NFSM states. National Food Security Mission, Department of Agriculture and Cooperation, Government of India, New Delhi, p. 27.

Anonymous. 2013. Indian fertiliser scenario 2013. Department of fertilisers, Ministry of Chemicals and Fertilisers, Government of India. pp. 246.

DCCD, 2018. Area and production of cashew 2017-18, Directorate of Cashewnut and Cocoa Development, Kochi.

https://www.floramax.com/nutrient-deficiencies/plant-deficiency-symptoms-flow-chart/ (Date accessed: 03-09-2018).

Mangalassery, S., 2018. Ad-hoc recommendations on nutrient deficiency management in cashew. ICAR-Directorate of Cashew Research, Puttur, India, p. 7.

Nayak, M.G., Muralidhara, B.M., Mangalassery, S., 2018. Innovative production technologies to enhance production and processing of cashew. In: Parameswaran, P.A., Jayalakshmi, V.S., Nikhil, V.M., Shine, K.K., Rohith, H.S., Lukose, V., Gopinath, L. (Eds.), National Conference on Cashew Directorate of Cashewnut and Cocoa Development, Kochi, India Hotel Swosti Premium, Bhubaneswar, Odisha, India, pp. 28-37.

Poduval, M., Yadukumar, N., 2011. Effect of different doses of fertilizers on different densities of cashew plantation. Journal of Plantation Crops 39, 35-40.

Rejani, R., Rupa, T.R., Nayak, M.G., 2013. Suitability of cashew growing areas in India - an appraisal using GIS. Journal of Agrometeorology 15, 123-128.

Rejani, R., Yadukumar, N., 2010. Soil and water conservation techniques in cashew grown along steep hill slopes. Scientia Horticulturae 126, 371-378.

Rupa, T.R., 2017. Nutrient and water management. In: Saroj, P.L. (Ed.), Cashew: improvement, production and processing. Astral International Pvt Ltd, New Delhi, pp. 233-252.

Salam, M.A., Peter, K.V., 2009. Cashew-A monograph. Studium Press (India) Pvt. Ltd., New Delhi, India. pp. 257.

Singh, D., Chhonkar, P.K., Dwivedi, B.S., 2016. Manual on soil, plant and water analysis. Westville Publishing House, New Delhi.

Yadukumar, N., Rejani, R., Nandan, S.L., 2012. Effect of organic and inorganic nutrition in cashew. Journal of Plantation Crops 40, 1-8.

Goyal, M.R., 2012. Management of drip/trickle or micro irrigation. Apple Academic Press, New Jersey, USa. pp. 408.

http://jainpipe.com/Designtechnical/maintenance%20guidelines%20for%20filters.htm

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