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RECENT TRENDS IN CASHEW RESEARCH

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THE importance of cashew came to be realized and research received due attention only recently. In fact the research on cashew can be considered to have commenced with the sanction of an *ad hoc* scheme by the Indian Council of Agricultural Research from 1951 onwards, in three States of Travancore, Madras and Bombay. Later the scheme was extended to Andhra Pradesh and Assam also. Introduction and evaluation of germplasm, production and evaluation of hybrids, floral biology studies, and propagation trials were the important items of investigations under the scheme. Germplasm collections both indigenous and exotic were established and evaluated for their yield potential and nut characters at Ullal, Bapatla, Vridhachalam, and Vengurla. Out of over 300 indigenous and exotic types screened at these centres, 10 selections and two hybrids evolved at Bapatla were found to be promising under sandy loam soil conditions of Bapatla in the East Coast.

Thirty-five varieties at Vridhachalam, six varieties and one hybrid at Anakkayam, and 4 at Vengurla were also found to be promising. They possess larger percentage of perfect flowers and higher fruit set and better quality.

Hybridisation. Hybridisation work at different centres initiated in the early 1960s yielded good results. A number of hybrids evolved at Ullal, Bapatla, Anakkayam and Vengurla are being evaluated and a few of them are found to be high-yielding with good quality nuts. Promising varieties and hybrids are being put under comparative yield trial with a view to assessing their adaptability and yield potential under different agroclimatic conditions. The establishment of a seed orchard with the promising varieties and hybrids for simultaneous evaluation and large scale multiplication of seeds has been initiated.

Propagation. The vast majority of cashewnuts are collected from trees from self-sown seedlings or from plantations raised from seeds and seedlings. As might be expected from heterogeneous seedling population, the yield of nuts varies widely from tree to tree as also the shape and size of the nuts. Cashew apples also vary markedly in shape, size, colour and quality. Results

of study in India suggest that high-yielding trees are more likely to bear nuts of medium size. In Tanzania, trees bearing large number of nuts tend to produce nuts that are too small to be suitable for the cashew trade. Because of this phenomenon less than 1% of the trees in a population are considered worthy of selection on the basis of high yield, satisfactory nut size and nut quality and only very low percentage of high yielders are reported to show uniformity in the fruit characters of the progeny. All the same, as things are at present, the only positive step that can usually be taken is to collect seeds from individual trees producing high yield of good quality nuts. The effect of raising seedlings from orchards composed of selections of superior performance is yet to be determined. A comprehensive scheme has already been drawn up to establish a seed orchard for simultaneous evaluation and multiplication of high-yielding lines. Laying out of the seed orchard with the promising lines identified at the Cashew Research Stations is in progress.

Attempts have, however, been made to standardise various methods of vegetative propagation in cashewnut. In India, approach grafting often called 'inarching' and air-layering are generally reported as most satisfactory means of propagating selected trees vegetatively. Of these, air-layering is found to be comparatively more economical. In a few comparisons that were made, air-layers and grafts have grown better and fruited earlier than seedling trees of similar age. The early yield performance was also better. However, the field establishment of airlayers was not quite satisfactory especially along the East Coast where the rainfall is low and are restricted only to one monsoon. Side grafting, veneer grafting and budding, attempted earlier, have not yielded any encouraging results. Recently, however, very encouraging results have been reported from Cashew Research Station, Vengurla. Both veneer grafting and breeding have been found to be successful at this centre. Veneer grafting is done in June to August and budding during September-October. With the encouraging results already achieved, a coordinated effort is being made to standardise the method under different agro-climatic conditions and for large scale field application of the technique. Side grafting was also found possible in cashew and the best takes, ranging from 35-70 per cent, were reported from Cashew Research Station, Ullal during February-May. Very high success with over 75% takes has also been obtained at Vengurla recently. Intensive study to standardise the best season for side grafting under different agroclimatic conditions and for large scale field application is in progress.

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that the importance of the crop in the national economy has been realised. As already stated earlier, increase in area has had no appreciable impact on production probably because of the inadequate attention paid for the plantation management. Preliminary trials carried out at the Cashew Research Stations have shown that there is very good response to application of fertilizers. Studies on the nutrient exhaust of cashew tree shows that the plant will absorb nutrients particularly major nutrients in very high amounts. Results of demonstration plots organised by the State Department of Agriculture with the assistance from the Central Government in the cultivators field also confirm the beneficial effect of fertilizer application and plant protection measures. Selection of planting material and adequate attention for management practice including fertilizer application, have been found to reduce prebearing age to less than two years. As this crop is grown almost in the low fertile soils and its absorption of nutrients is very high, the application of fertilizers at optimum levels is a must for getting high yield. As already indicated elsewhere, balanced fertilization could also reduce fruit fall to a great extent. Taking these factors into consideration, a comprehensive manurial trial has been planned under the Co-ordinated Project. Being a dry crop growing under very low rainfall conditions foliar application of nutrients is considered a worthwhile proposition, which will also minimise the cost of fertilization. A comprehensive trial on the foliar application of nutrient in cashew is already envisaged under the project.

Pests and Diseases

Cashew plantations are subject to the ravages of a large number of insect pests. The most destructive insect enemy is the stem borer *Plocaederus ferrugineus* the grubs of which tunnel into the trunk and kill the tree outright. The infestation can be controlled by injecting 1% Pyrethrins pipernoil butoxide (Pyrocon-E) or carbaryl (Sevin) or application of 10 g Phorate (Thimet) granules to the tunnels in the tree trunk. Another serious pest is tea mosquito, (*Helopeltis antonii*) which sucks up sap from tender shoots, flushes, floral branches and even tender nuts. Spraying with Malathion or Phosphamidon will control infestation. Other insect enemies of cashew which have assumed importance as pests along the East Coast are the leaf miner (*Acrocercops syngrema*), the leaf and blossom webber (*Mecalla* sp.) and the inflorescence and shoot tip caterpillar (*Chelaria haligramms*). The leaf miner can be controlled by spraying 0.05% BHC or 0.025% Parathion and the leaf webber with 0.2% BHC or 0.03% Endrin.

The drying up of inflorescence commonly known as 'inflorescence blight' is a serious malady affecting cashew trees and causing considerable reduction in yield. This is primarily due to infestation of tea mosquito followed

by infection of the fungus, *Gloeosporium mangiferae*. Earlier studies carried out at Ullal have shown that a combination spray with Cuman and Dimecron controls inflorescence blight effectively. Recent trials carried out at Kasaragod have revealed that insecticide and fungicide combination sprays with Malathion and Aureofungin Sol, Thiocarb and Dithane Z-78 Dimecron and Dithane Z-78 and Sumithion and Dithane Z-78 are effective and comparatively more economical.

'Die-back' or pink disease is caused by *Pellicularia salmonicolor*. The affected portions are to be pruned and burnt and wounds protected with Bordeaux paste. Application of Bordeaux mixture 1% during the pre- and post-monsoon periods is an effective prophylactic measure. In the nursery, seedlings are affected by damping-off disease caused by *Phthium* sp., *Fusarium* sp. and *Phytophthora palmivora*. Drenching of nurseries with Ceresan wet 0.1% or Bordeaux mixture 1% has been reported to be effective.

The loss due to insect pests and disease is quite heavy in the early stages of fruit set and development. Preliminary investigations at this Research Institute show that insect attack accounts for 4.6% of shedding at mustard stage and 58% at peanut and later stages of development. In view of the fact that less than 20% of the fruit set only is carried to maturity and the indications that a very high percentage of the fruit drop is due to insect attack and imbalanced nutrition, an integrated pest and disease control schedule and the possibility of combining the pesticides with the foliar application of nutrients is being investigated under the All India Co-ordinated Project.

A good deal of work has been done at various research centres in our country, on the technological aspects of cashew. For every tonne of cashew nuts produced the production of cashew apple is about 10 tonnes. Our present estimated production of cashew apple, therefore, works out at over 1 million tonnes. Cashew apple is very rich in minerals and compares very well with other fruits in their nutritive values.

Central Food Technological Research Institute, Mysore, evolved techniques to prepare a number of edible products from cashew apple which at present is being wasted. National Chemical Laboratory, Poona, has carried out investigations on the uses to which CNSL (Cashewnut Shell Liquid) could be put to. One of the important results of these studies was the evolution of a cation exchange resin for softening water for boilers and air conditioning units. The work on the utilisation of CNSL carried out at Industrial Research Laboratory, Hyderabad, has led to a number of processes for its use in coatings. Various types of varnishes and lacquers have been formulated from CNSL and cardanol which are recommended as finishes for timber and metal, and as insulating varnishes. Rubber

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compounding resins prepared by compounding different types of CNSL resins with rubber, elasto-plastic sealants for cracks and joints for buildings, expansion joint filler using CNSL and coconut pith and water, and weather proof resins are some of the economic products developed.

The Morrow

Superior trees that are now being selected for seed selection are all derived from open pollination and therefore, it is possible that the progeny of such trees will continue to show wide variations in the yield and quality of nuts. It remains to be determined whether the progeny of artificially pollinated superior trees or collection of superior trees assembled in isolated orchards will yield sufficiently large crops of the quality desired by the trade and thus obviate the necessity to propagate vegetatively. In view of the limitations for adopting the vegetative propagation in cashew for raising large plantations, simultaneous evaluation and multiplication of promising lines deserve priority.

Budding is the most economical method of grafting both in terms of labour and the amount of graftwood needed. Only very recently, budding and veneer grafting have been found successful in cashew. There is an urgent need to intensify this work as well as to standardise the side grafting techniques to make it applicable on a large scale in the field. The compatibility between root stock and scion and the effect of root stock on plant type will have to be investigated in greater details.

Cashew is being grown mostly on marginal land where the fertility level is very low. Being a very heavy feeder, there is an urgent necessity to standardise the agrotechniques and work out nutritional requirement of the crop to maximise the production. Being a dry crop, feasibility of foliar application of nutrients is worth investigating. High percentage of fruit drop at the early stages of development is found to be associated with insect attack and imbalanced nutritions. An integrated pest control schedule in combination with nutrient sprays appear to be worth investigating.

At present the flowering season extends to over 4 months in plantations and the flowering period of individual trees also varies very widely resulting in very frequent harvesting of fruits. The heavy expenditure incurred for harvesting the nuts often leads to wastage of fruit. Breeding and selection to reduce the flowering phase appear to deserve due priority.

At present about 10 lakhs of tonnes of cashew apples are produced every year. The quality of fruit is comparable with any other fruit as for nutritive value is concerned. The quality, no doubt, varies very widely between trees and trees and this can easily be improved by selection. In spite of the high quality of the fruit, the percentage of fruit consumed either as fruit or for industrial purpose appears very negligible. The work on the utilisation of cashew apple for edible purpose require greater attention. The technological aspect, in general, of cashew fruit and byproducts have not received the attention it deserves.