# Cashew Industry in India – An Overview

N. Kumar, V. Ponnuswami, S. Jeeva, C. Ravindran and D. Kalaivanan

## CROP HISTORY, BOTANY AND USES

Cashew (*Anacardium occidentale* L.) is a native of tropical America from Mexico to Peru and Brazil and also the West Indies. Four centuries ago, the adventurous Portuguese came sailing down the Indian coasts and brought with them the priceless nut tree to control soil erosion on the coasts. Cashew came, conquered and took deep root in the entire coastal region of India. The crop found the Indian soil more homely than its homeland. The first introduction of cashew into India was made in Goa from where it spread to other parts of the country's west and east coasts, especially in the states of Kerala, Tamil Nadu, Karnataka and Andhra Pradesh (Sham Singh et al., 1963). In the beginning it was mainly considered as a crop for afforestation and soil binding to check erosion. Although its commercial exploitation began from the early 60s, only marginal land and denuded forests were set apart for plantation development.

The word 'cashew' is derived from the Portuguese name for the nut 'caju', which was adopted by them from the native name 'acuju'. The cashew is a low, sprawling evergreen tree (Fig. 1a) with a gnarled or twisted trunk, possessing alternate, simple, leathery, oval or obovate glabrous leaves (10-12.5 cm long, 5-10 cm wide) that are rounded and often notched at the apex (Fig. 1a). The wood of the tree exudes a yellow gum. The flowers are borne in clusters on lax terminal panicles at the end of the branches (Fig. 1b). The fruit consists of a soft, shiny, pear-shaped, swollen, juicy basal portion or hypocarp, commonly known as cashew apple. In fact, the swollen peduncle and receptacle is reddish or yellow in colour when ripe. The cashew apple bears at its summit a kidney-shaped, single-seeded nut with a hard, grey-green pericarp or shell. This true fruit attains its full size before the enlargement of the receptacle. The shell of the nut contains an acrid juice or sap that causes severe irritation of the skin resulting in painful blisters. The seeds are exalbuminous with reddish brown testa, two large white cotyledons and a small embryo. They are inedible when raw and must be cooked or roasted to drive off the volatile oil before it is opened or shelled.

In the field of international development, cashew cultivation has attracted considerable interest from the development agencies, producers, governments and advocates of sustainable economic and environmental development. As a resilient and drought resistant tree that is adaptable to poor soil conditions, it offers environmental benefits in the fight to combat deforestation and soil erosion. Most importantly, its cultivation and exploitation are regarded as economically promising for both rural growers and urban industrial processors in terms of employment generated and value added to emerging economies.

Figure 1. Low, sprawling evergreen cashew tree.


Cashew nuts have a relatively high fat content (12 g per ounce and 2 g saturated fat), but it is considered "good fat". Even with a relatively high fat content, cashew nuts are considered to be a "low-fat" nut. In fact, cashew nuts contain less fat per serving than many other popular nuts commonly found in grocery stores and health food stores, including almonds, walnuts, peanuts and pecans. Cashew is composed

Table 1. Composition of cashew kernel and cashew apple (CSIR, 1985; Augustin, 2001).

| Constituents | Kernel (%) | Apple (%) |
|---|---|---|
| Moisture | 6.9 | 87.9 |
| Protein | 21.0 | 0.2 |
| Fat | 47.0 | 0.1 |
| Carbohydrates | 22.0 | 11.6 |
| Fiber | 1.3 | 0.9 |
| Minerals | 2.4 | 0.2 |
| Phosphorous | 0.45 | 0.01 |
| Calcium | 0.55 | 0.01 |
| Iron | 5 mg/100 g | 0.2 mg/100 g |
| Carotene | 100 I.U/100 g | - |
| Vitamin B1 | 630 mg/100 g | - |
| Riboflavin | 190 mg/100 g | 0.5 mg |
| Vitamin C | - | 170-350 mg/100 g |

mainly of unsaturated fatty acids (nearly 80%), which in humans raise the levels of high density lipoproteins (HDLs), which are associated with a decreased risk of atherosclerosis and coronary heart disease. Cashew kernels contain polyunsaturated fatty acids in a 1:1 ratio with saturated fatty acids, which also is considered to have potential good health effects (Nair, 2009).

There are various recommendations for use of cashew nut consumption for diet and weight loss. Cashew nuts have a high energy density and high amount of dietary fibers, both of which have been credited as having a beneficial effect on weight control, but only when eaten in moderation.

## STATUS OF AREA, PRODUCTION AND PRODUCTIVITY

India is the leading country in the world in cashew production area (923,000 ha) and production (613,000 MT). Cultivation of cashew in India is confined mainly to the peninsular areas. It is grown in Kerala, Karnataka, Goa and Maharashtra, along the west coast of the country and in Tamil Nadu, Andhra Pradesh, Orissa and West Bengal along the east coast of the country. To a limited extent it is being cultivated in Chattisgarh, North Eastern States (Assam, Manipur, Tripura, Meghalaya and Nagaland) and on Andaman and Nicobar Islands (Table 2 and Fig. 2).

## EXPORT SCENARIO

India has a creditable record of attaining good foreign exchange by exporting cashew kernels. During the year 2009-2010, India exported 108,120 MT of cashew kernels valued at US$590 million (Table 3). USA, The Netherlands, UK, Japan, UAE, France, Canada, Saudi Arabia, Singapore, Italy, Germany, Austria, Israel and Spain are the major international buyers of Indian cashews. Further, cashew nut is also imported into India from other producer countries. These nuts are processed in the country and then are either distributed in the local market or re-exported.

The first commercial cashew processing unit was set up in Kollam in the mid-1920s. However, early exports were not followed up because the cashew kernels were not vacuum-packed, but wrapped in newspapers and packed in reused tea chests. World War II put a halt to any further development of the trade. Export volumes picked up only after the introduction of airtight tins infused with carbon dioxide in the mid-1950s. Soon after this technological advancement, processing plants were established in Mangalore and Goa. Another small but important processing centre is located in Panruti, the South Arcot district of Tamil Nadu.

A major problem facing the Indian cashew industry is the acute shortage of raw cashew nuts within the country. The processing requirement is about 1,200,000 MT per annum while the domestic production is only 600,000 MT per annum. Consequently, the cashew processing industry has resorted to importing raw nuts for processing and export. Along with the increasing world demand for cashew, Indian consumption is also growing.

India and Brazil were the major suppliers of cashew to the world market until about five

**Table 2. Area, production and productivity of cashew in the different states of India (2009-2010).**

| State | Area ('000 ha) | Production ('000 MT) | Average productivity (kg/ha) |
|---|---|---|---|
| Maharashtra | 175 | 198 | 1186 |
| Kerala | 72 | 66 | 957 |
| West Bengal | 11 | 10 | 909 |
| Orissa | 143 | 84 | 641 |
| Andhra Pradesh | 183 | 99 | 544 |
| Goa | 55 | 26 | 473 |
| Tamil Nadu | 133 | 60 | 472 |
| Karnataka | 118 | 53 | 461 |
| Others | 33 | 17 | 680 |
| Total | 923 | 613 | 695 |

Source: http:/dccd.gov.in/stat.htm

**Figure 2. Major cashew growing areas in India.**


**Table 3. Export of cashew kernel, cashew nut shell liquid (CNSL) and import of raw cashew nut.**

| Year | Cashew kernel export | | CNSL export | | Raw nut import | |
|---|---|---|---|---|---|---|
| | Quantity (MT) | Value (Million US$) | Quantity (MT) | Value (Million US$) | Quantity (MT) | Value (Million US$) |
| 2009-2010 | 108,120 | 590.8 | 9748 | 4.90 | 752,894 | 617.5 |

Source: http:/dccd.gov.in/stat.htm

years ago. In recent years, Vietnam has also emerged as a major supplier, replacing Brazil in second position. At present, USA and West Europe are India's major markets, followed by Japan, West Asia and Australia. New emerging markets like Eastern Europe, Commonwealth of independent state countries and China are becoming active buyers of cashews. Another area where there is potential for significant market growth is export of organically produced cashews. Moreover, new products are being developed apart from the cashew kernels, including cashew apple, cashew nut shell liquid (CNSL), cashew shell and cashew testa.

Cashew apples can be sold fresh as soon as they have been picked, and are then used as a culinary ingredient or further processed into drinks (juice, wine), marmalade or vinegar. There are interesting prospects for setting up processing plants for utilization of cashew apples, which, at present, are mostly wasted. Many preparations like juices, jams, candies, pickles, chutneys, and alcoholic beverages can be prepared from this by-product.

Cashew nuts consist of 35-45% seed and around 55-65% shell. The shells contain 15-30% oil. A ton of nuts contains around 200 kg seeds and 180 kg oil (cashew nut oil or CNSL). CNSL is a naturally occurring phenol, which is contained in the soft honeycomb mesocarp of the shell. CNSL is a viscous, oily or balsam-like substance, pale yellow to dark brown, having bitter taste and caustic properties. Fresh CNSL contains 90% anacardic acid, which is converted into cardanol on heating. The remaining 10% is cardol, which is mainly responsible for the vesicant property. CNSL, a by-product of cashew processing, is used as oil in industry. It is a versatile industrial raw material that has applications in polymer-based industries such as friction dust, brake linings, paints and varnishes, laminating resins, cashew cements, polyurethane based polymers, surfactants, and epoxy resins (Peter, 2002).

Cashew shell, after removal of the kernel and extraction of shell liquid, is currently used as fuel. However, this shell can also be used to manufacture particle-based boards for the packaging industry. Tannin can also be extracted from the testa of the kernel. It has application in the leather industry and many other chemical industries. The major products for industrial applications are cashew lacquer, insulating varnishes, electrical windings and electrical conductors impregnated with CNSL and cashew cement (CNSL reacted with formaldehyde).

## INSTITUTES IN CASHEW INDUSTRY

### Directorate of Cashew Research (DCR)

In India, research on cashew was first carried out in the early 1950s. In 1971, Indian Council of Agricultural Research (ICAR) sanctioned the All India Coordinated Spices and Cashew Improvement Project (AICS and CIP) with its headquarters located at Central Plantation Crops Research Institute (CPCRI), Kasaragod. The National Research Centre for Cashew was established at Puttur on 18th June, 1986, after which it was upgraded and renamed by ICAR in 2009 as Directorate of Cashew Research (DCR). Subsequent to the bifurcation of AICS and CIP, the headquarters of All India Coordinated Research Project on Cashew was shifted to DCR, Puttur. At present, this Coordinated Research Project is operating in ten centers, one sub-center and three co-operating centers located in major cashew growing areas of the country.

**Table 4. Cashew processing units in India.**

| States | Processing units (Nos.) | Capacity ('000 MT) | Utilization ('000 MT) | | |
|---|---|---|---|---|---|
| | | | Indigenous | Import | Total |
| Tamil Nadu | 417 | 400 | 294 | 225 | 519 |
| Kerala | 432 | 600 | 67 | 320 | 387 |
| Andhra Pradesh | 175 | 100 | 92 | - | 92 |
| Karnataka | 266 | 300 | 45 | 20 | 65 |
| Goa | 45 | 50 | 21 | - | 21 |
| Maharashtra* | 2200 | 50 | 20 | - | 20 |
| NE States | 22 | 10 | 15 | - | 15 |
| Orissa | 209 | 100 | 11 | - | 11 |
| West Bengal | 30 | 8 | 8 | - | 8 |
| Chattisgarh | 3 | 5 | - | - | - |
| Total | 3799 | 1623 | 573 | 565 | 1138 |

*Includes 1850 small scale cottage industry
Source: http:/dccd.gov.in/stat.htm

### Directorate of Cashew Nut and Cocoa Development (DCCD)

The Directorate of Cashew Nut and Cocoa Development (DCCD) established in 1966 under the Union Ministry of Agriculture gave a greater impetus to the development of cashew in a more scientifically oriented manner. This marked the first step towards the integration and co-ordination of cashew development in association with developmental agencies of States and Research Institutes. The prime objective of DCCD is the formulation and execution of various development programmes on cashew nut and cocoa in the country.

**Figure 3. Recommended and popular cultivars grown in different states of India.**

### Cashew Export Promotion Council of India (CEPC)

The Cashew Export Promotion Council of India (CEPC) was established by the Government of India in the year 1955, with the active cooperation of the cashew industry, to promote exports of cashew kernels and CNSL from India. Through its very set up, the Council provides the necessary institutional frame-work for performing the different functions that serve to intensify and promote export of cashew kernels and CNSL. The Council provides the necessary liaison between foreign importers and member exporters of cashew kernels. The enquiries received from foreign importers are circulated amongst Council members. The Council also extends its role to settling complaints amicably in the matter of exports/imports, either on account of quality and/or variation in fulfillment of contractual obligations.

## RESEARCH ACCOMPLISHMENTS

### Breeding and Varietal Improvement

Systemic collection, conservation, cataloguing and evaluation of germplasm of cashew was attempted only very recently. At the centres of cashew research in India over one thousand collections including 69 exotic collections from Brazil, South Africa, Mexico, Tanzania, Malaysia, Nigeria, Tanganyika and Sri Lanka are being evaluated for yield and associated characters and quality of nut and apple. Five hundred and thirteen accessions in DCR, Puttur and over 1300 accessions in regional field cashew gene banks in centres under All India Coordinated Research Project (AICRP) on cashew were being maintained. A total of 40 high yielding cashew cultivars have been released in the country for commercial cultivation (Table 5 and Fig. 3).

The efforts at different research centres to improve varieties, both by germplasm evaluation as well as hybridization programmes, aim at developing superior strains with high yield, bold nuts and high shelling percentage (Bose and Mitra, 1990). Current researchers in India strive to incorporate maximum levels of pest tolerance/resistance in these cultivars so that the benefits of high yield can be realized with minimum pest control programmes. Rationalization of fertilizer input, developing cultivars with nuts containing improved nutritive qualities and developing cost-effective packaging that is within the reach of marginal farmers are the priorities at present being pursued by different research stations in India.

### Propagation

Since cashew is a cross-pollinated crop, seed propagation leads to variability in the progeny in growth and yield characters. Vegetative propagation of elite mother plants results in the production of true-to-type plants, which contributes to increased production and pro-

**Table 5. Cultivars or hybrids released from various cashew research stations in India.**

| S. No. | Cultivar | Hybrid/ selection | Year of release | Yield (kg/tree) | Nut weight (g) |
|---|---|---|---|---|---|
| **Regional Research Station, Vridhachalam, Tamil Nadu** | | | | | |
| 1. | VRI-1 | Selection | 1981 | 7.2 | 5.0 |
| 2. | VRI-2 | Selection | 1985 | 7.4 | 5.1 |
| 3. | VRI-3 | Selection | 1991 | 10.0 | 7.2 |
| 4. | VRI(Cw)-5 | Hybrid | 2007 | 13.2 | 7.2 |
| **Regional Fruit Research Station, Vengurla, Maharastra** | | | | | |
| 5. | Vengurla-1 | Selection | 1974 | 19.0 | 6.2 |
| 6. | Vengurla-2 | Selection | 1979 | 24.0 | 4.3 |
| 7. | Vengurla-3 | Hybrid | 1981 | 14.4 | 9.1 |
| 8. | Vengurla-4 | Hybrid | 1981 | 17.2 | 7.7 |
| 9. | Vengurla-5 | Hybrid | 1984 | 16.6 | 4.5 |
| 10. | Vengurla-6 | Hybrid | 1991 | 13.8 | 8.0 |
| 11. | Vengurla-7 | Hybrid | 1997 | 18.5 | 10.0 |
| **Agricultural Research Station, Mangalore, Karnataka** | | | | | |
| 12. | Ullal-1 | Selection | 1984 | 9.0 | 6.0 |
| 13. | Ullal-2 | Selection | 1984 | 14.7 | 6.0 |
| 14. | Ullal-3 | Selection | 1993 | 9.5 | 7.0 |
| 15. | Ullal-4 | Selection | 1994 | 10.5 | 7.2 |
| **National Research Centre for Cashew, Puttur, Karnataka** | | | | | |
| 16. | NRCC-sel-1 | Selection | 1989 | 10.0 | 7.6 |
| 17. | NRCC-sel-2 | Selection | 1989 | 9.0 | 9.2 |
| 18. | Bhaskara | Selection | 2005 | 18.5 | 6.5 |
| 19. | Goa-1 | Selection | 1999 | 7.0 | 7.6 |
| **Agricultural Research Station, Chintamani, Karnataka** | | | | | |
| 20. | Chintamani-1 | Selection | 1993 | 7.02 | 6.9 |
| 21. | Chintamani-2 | Selection | 2007 | 29.8 | 7.9 |
| **Cashew Research Station, Bapatla, Andhra Pradesh** | | | | | |
| 22. | BPP-1 | Hybrid | 1980 | 10.0 | 5.0 |
| 23. | BPP-2 | Hybrid | 1980 | 11.0 | 4.0 |
| 24. | BPP-3 | Selection | 1980 | 11.0 | 4.8 |
| 25. | BPP-4 | Selection | 1980 | 10.5 | 6.0 |
| 26. | BPP-5 | Selection | 1980 | 11.0 | 5.2 |
| 27. | BPP-6 | Selection | 1993 | 10.5 | 5.2 |
| 28. | BPP-8 | Hybrid | 1989 | 14.5 | 8.2 |
| 29. | Bhubaneswar-1 | Selection | 1989 | 10.5 | 4.6 |
| 30. | Jagannath | Hybrid | 2008 | 10.5 | 8.6 |
| 31. | Balabhadra | Hybrid | 2008 | 10.0 | 7.4 |
| **Regional Research Station, West Bengal** | | | | | |
| 32. | Jhargram-1 | Selection | 1989 | 8.5 | 5.0 |
| **Cashew Research Station, Annkkayam & Madakkathara, Kerala** | | | | | |
| 33. | Annkkayam-1 | Selection | 1985 | 12.0 | 6.0 |
| 34. | Madakkathara-1 | Selection | 1987 | 13.8 | 6.2 |
| 35. | Madakkathara-2 | Selection | 1987 | 17.0 | 7.3 |
| 36. | Dhana | Hybrid | 1993 | 17.5 | 9.5 |
| 37. | Kanaka | Hybrid | 1993 | 19.0 | 6.8 |
| 38. | Priyanka | Hybrid | 1995 | 16.9 | 10.8 |
| 39. | Amrutha | Hybrid | 1999 | 18.4 | 7.2 |
| 40. | K-22-1 | Selection | 1987 | 13.2 | 6.2 |

**Figure 4. Drip fertigation system in cashew orchard.**

**Figure 5. A. Tea mosquito bug (*Helopeltis antonii*). B. Cashew stem and root borer (*Plocaederus ferrugineus*).**



ductivity. Soft wood grafting methods have been standardized and the technique is being commercially utilized for large scale production of planting material in the countryside. In India, over 6,000,000 grafted cashew plants are being produced annually by this method. Over 80 regional nurseries approved by DCCD are producing quality grafts of improved cultivars.

### Research on Growing Techniques

Field crops such as groundnut (*Arachis hypogeae*), blackgram (*Phaseolus mungo*), greengram (*Vigna radiata*), vegetables such as cucumber (*Cucumis sativus*), bottlegourd (*Lagenaria siceraria*), tuber crops and fruit crops such as pineapple (*Ananas comosus*), spices such as turmeric (*Curcuma longa*), ginger (*Zingiber officinale*) and pepper (*Piper nigrum*) have been found to be suitable and profitable intercrops in cashew plantations, increasing the total return per land unit during the early stage of establishing a cashew plantation.

High density planting with 4 x 4 m spacing (625 plants/ha) was shown to be better than traditional spacing (8 x 8 m), resulting in a yield increase of 2.5 times over the control in the initial ten years.

In the summer months, providing irrigation of 200 L of water per tree once every 15 days after flowering was found to increase the cashew yields profitably. Irrigating cashew at 60-80 L water per tree once in four days through drip irrigation (Fig. 4) after flowering till fruit set and development in combination with the application of 750:188:188 g of N-P-K/tree led to significantly higher yields (Bhat et al., 2009).

Cashew is a deciduous tree that provides approximately 5 tons of cashew biomass residues (leaves, twigs, flowers and apples) per hectare in a well-established cashew orchard. Use of earthworms for the production of vermicompost from cashew biomass is a low cost technology with great potential; 3.5 tons of vermicompost can be produced per ha of adult cashew orchard per year.

Beheading seedling trees in old cashew plantations at 1 m height during June-July and soft wood grafting with 60-day-old scion shoots of high yielding cultivars, recorded a higher survival of 72.14% compared to beheading and grafting trees at 0.75 m height.

### Research on Phytosanitary Treatments

A recommended spray schedule has been developed both at DCR and centres of AICRP for effective control of tea mosquito bug (TMB - *Helopeltis antonii*) (Fig. 5a). Recently, new insecticides have been tested for the control of TMB. Among the new insecticides evaluated against this pest, l-cyhalothrin was found to be very effective in reducing the damage. Sprays are recommended during the most vulnerable periods of crop production such as flushing, flowering and fruiting.

Another devastating pest of cashew is cashew stem and root borer (CSRB - *Plocaederus ferrugineus*) (Fig. 5b). It was found that spread of the pest could be prevented by adopting phytosanitation practices. Chloropyriphos (0.2%) and Carbaryl have been shown to be effective as curative treatments after the extraction of CSRB grubs from the tree trunk (post treatment prophylaxis).

### Research on New Cashew Based Products

Technologies for production of many new value-added products of cashew apple and cashew kernels have been developed. Cashew apples can be utilized for preparation of jam, jelly, syrup, juice, etc. (Fig. 6). A sweetened and flavoured spread can also be prepared from the young tips of cashew kernels. Optimum coating of tips with honey and cane sugar occurs at 100°C at 70% concentration. Sweetened and flavoured young tips can be stored without quality deterioration for up to twelve months at ambient temperature.

## CASHEW DEVELOPMENT

The cashew development programme started with distribution of seedlings of the crop to farmers. A concerted effort to develop the cashew industry started with the focus on production, area expansion, improvement of quality planting material and development of production technology, which included rejuvenation and plant protection. Research was strengthened by establishing the All India Coordinated Research Project on Cashew. At the same time,

**Figure 6. Value-added products of cashew apple.**

**Table 6. Cultivars released by Regional Research Station (TNAU), Vridhachalam and other research stations.**

**Cultivars released by Regional Research Station (TNAU), Vridhachalam**

**VRI-2:** Selection from germplasm collected from Kathupalli village. Multiple branching with late flowering and medium sized fruit. The percentage of bisexual flowers is 10% with 5-8 fruits/bunch and average yield of 6.0 kg/tree. The nut size is medium (5 g) and shelling percentage is 28.

**VRI-3:** Seedling progeny selected from Edianchavady village of South Arcot district. The nuts are large in size. The mean weight of 100 nuts was 718 g having a shelling percentage of 29.1. The kernels conform to a grade W 210. This genotype had a mean yield of 14.17 kg/tree/year, which would equate to a yield of 2700 kg/ha. The apple is pear shaped and pink with a weight of 50.8 g.

**VRI-4:** Selection from Vazhisodanaipalayam, Cuddalore district of Tamil Nadu, which is a mid season flowering type. The apple is round shaped and thick red in colour. The average fruit weight was 42.80 g. The nuts are medium size with an average nut weight of 6.63 g and a kernel weight of 1.7 g. The shelling percentage was 28.5 with grade W 320 kernel count. It is moderately resistant to the tea mosquito bug.

**VRI (Cw) H1:** High yielding selection suitable for cashew growing districts of Tamil Nadu. The hybrid is a cross between M 26/2 and M 26/1. It has a typical cluster bearing property with 4-6 fruits per panicle. The nuts are bold, 7.2 g, kernel 2.2 g, easy peeling testa, high shelling percentage of 30.5, grade W 210. The cashew apple is pink with a yellow tinge, 50-53 g weight, with TSS of 12.5° brix. The trees are moderately resistant to tea mosquito bug under field conditions.

**Other Research Station released cultivars**

**VENGURLA – 7:** Released from Cashew Research Station, Vengurla, Maharashtra. Mean nut yield/tree: 18.5 kg. Nut weight: 10 g. Shelling %: 30.5. Export grade: W180.

**BPP 8:** Released from Cashew Research Station, Bapatla, Andhra Pradesh. Mean nut yield/tree: 14.5 kg. Nut weight: 8.2 g. Shelling %: 29. Export grade: W210.

**BHASKARA:** Released from Directorate of Cashew Research, Puttur, Karnataka. Mean nut yield/tree: 10.7 kg. Nut weight: 7.38 g. Shelling %: 30.6. Export grade: W240.

**PRIYANKA (H-1591):** Released from Cashew Research Station, Madakkathara, Kerala. Mean nut yield/tree: 17.03 kg. Nut weight: 10.8 g. Shelling %: 26.57. Export grade: W180.

the State Forest Departments started systematic plantation of this crop using seedlings from high yielding plants. The formation of Cashew Development Corporations and Forest Development Corporations was a significant developmental step in the promotion of cashew to the public. Due to the absence of any recommended cultivars and suitable multiplication techniques, massive areas were covered using seeds and seedlings as planting material.

High yielding cultivars suitable for different agro-climatic conditions have been identified. The establishment of regional nurseries, both under public and private sectors closely monitored by DCCD, provided an excellent infrastructure for the production of quality planting material. Forty high yielding cultivars were developed (Table 6). A standardized soft wood grafting technique and standardized production practices were developed. These efforts continued with substantial increase in allocation of funds coupled with accelerated growth in production and productivity. The emphasis is now placed on removal of old unproductive plantations and replanting with high yielding cultivars.

## Constraints in Cashew Production

Even though cashew production is blessed with a huge research effort, a vast network of processing industries and elite private processing sector, and the most congenial climatic conditions, there are still a number of constraints on production. For example, many early cashew plantations were established with poor quality seedling progeny and are now unproductive. Also, poor soil fertility in cashew growing areas, seedling progeny of indistinct origin and neglect of crops have resulted in low yields. This was prevalent in most of the cashew growing areas of Karnataka, Goa, Andhra Pradesh, Orissa and Tamil Nadu. The lack of transfer of technology programmes to better equip farmers is yet another constraint.

## Opportunities for Enhancement of Production and Productivity

There is enormous scope to introduce cashew into the nontraditional states of Orissa, Maharashtra, Andhra Pradesh and Karnataka. Massive replanting programmes to replace the aging cashew plantations with improved cultivars, establishing cashew export zones, using quality clonal planting material, establishing cottage industries for the processing of raw nuts and cashew apples, effective transfer of technology programmes, and introduction of a contract farming system, provide opportunities to enhance production and productivity and to overcome the shortage of raw nuts required by the processing industries.

## PROSPECTS OF INDIAN CASHEW

Among the cashew growing countries, India has the largest planted area, and is the largest producer, exporter and importer. The Indian cashew industry is one of the few industries in the country that is so export oriented. Apart from earning valuable foreign exchange, the cashew industry is providing many concrete employment opportunities. In global trade contracts, cashew is one of the items supporting the multilateral trade policy. Indian production is meeting only 50% of its industrial capacity. Any effort to increase the production will therefore not be in vein in the context of expanding consumer preference and market absorbability. Clonal material of high yielding cultivars are proving better and, if such material can be used for replanting in the ever increasing aging areas, Indian production can very well touch one million tons within a period of 15 years.

## References


Augustin, A. 2001. Utilization of Cashew Apple. Souvenir of World Cashew Congress 2001. The Cashew Export Promotion Council of India, Kochi.

Bhat et al. 2009. 7th National Seminar "Cashew Development in India Enhancement of Production and Productivity" Souvenir, 2-3 November, 2009, Bhubaneshwar, Orissa.

Bose, T.K. and Mitra, S.K. 1990. Fruits: Tropical and Subtropical. Naya Prokash, Calcutta, India. p.386-417.

CSIR, 1985. The Wealth of India. A Dictionary of India Raw Materials and Industrial Products. Raw Materials Vol. I A. Publication and Information Directorate, CSIR, New Delhi. p.244.

Nair, C.K. 2009. Cashew Processing. p.125-133. In: J. Mathew, C. Mini and M. Abraham (eds.), Cashew Research and Development in Humid Tropics with Emphasis on Cashew Apple Processing.

Peter, K.V. 2002. Cashew - Plantation Crops. National Book Trust. p.55-80.

Sham Singh, Krishnamurthi, S. and Katyal, S.L. 1963. Fruit Culture in India. Indian Council of Agricultural Research, New Delhi. p.377-382.


## About the Authors

N. Kumar

V. Ponnuswami

S. Jeeva

C. Ravindran

D. Kalaivanan


Dr. N. Kumar is an eminent researcher and Dean, Horticulture College and Research Institute, Tamil Nadu Agricultural University (TNAU), Coimbatore, Tamil Nadu, India, email: kumarhort@yahoo.com

Dr. V. Ponnuswami is a famous horticulturist and Dean, Horticultural College and Research Institute, TNAU, Periyakulam, Tamil Nadu, India, email: swamyvp2002@yahoo.co.in

Dr. S. Jeeva is a cashew breeder, Regional Research Station, Vridhachalam, India, email: jeeva_6299@yahoo.com

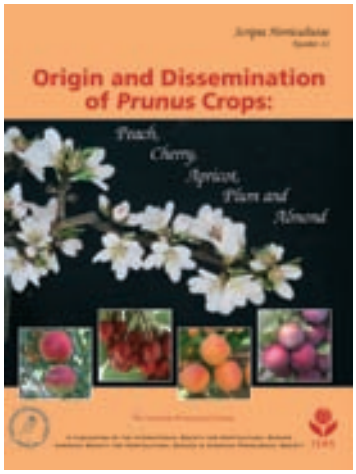
Dr. C. Ravindran is an Assistant Professor (Horticulture), Krishi Vigyan Kendra, TNAU, Tamil Nadu, India, email: ravi_hort@yahoo.com

Dr. D. Kalaivanan is a Scientist (Soil Science and Agricultural Chemistry), Directorate of Cashew Research, Darbe Post, Puttu, India, email: kalainith2003@gmail.com


# New Books, Websites

## BOOK REVIEWS

**Origin and Dissemination of *Prunus* Crops: Peach, Cherry, Apricot, Plum and Almond. Edited by Jules Janick. 2011. *Scripta Horticulturae* 11. A publication of the International Society for Horticultural Science. 241p. ISBN 978-90-6605-436-3. € 30. Available from the ISHS Secretariat (www.ishs.org/pub/scripta.htm).**




Scripta 11, dedicated to the late Miklos Faust, contains reviews on the origin and dissemination of *Prunus* fruit and nut crops that were published in *Horticultural Reviews* between 1995 and 2011. The five tree crops covered originated in Europe, Central Asia, or China and are now distributed worldwide where they are considered among the most well-known and beloved fruits or nuts of temperate and subtropical climates. The first four reviews (peach, cherry, apricot, and plum) were coauthored by Miklos Faust and colleagues Bela Timon, Dezsö Surányi or Ferenc Nyujtó, while the last one on almond was authored by Thomas M. Gradziel. The collection is sponsored by the International Society for Horticultural Science, The American Society for Horticultural Science, and the American Pomological Society.

**The books listed here are non-ISHS-publications. For ISHS publications covering these or other subjects, visit the ISHS website www.ishs.org or the Acta Horticulturae website www.actahort.org**

**Transgenic Horticultural Crops: Challenges and Opportunities. Beiquan Mou and Ralph Scorza (eds.). 2011. CRC Press (Taylor & Francis Group), Boca Raton, Florida, USA. 364p. ISBN 978-1-4200-9378-0 (hardback). $129.95 / £82.00. www.crcpress.com**

This volume edited by Beiquan Mou and Ralph Scorza is composed of 20 chapters by a total