

Karonda: A nutritionally rich crop suitable for arid ecosystem

Climate change has emerged as critical global problem, hampering productivity and production of perennial horticultural crops. Under the biotic and abiotic stresses, there is a need to explore some hardy indigenous crops which can sustain by mitigating these adverse conditions. Among them, *Karonda* is an emerging underutilized fruit, gaining economic importance due to its enormous health and wealth benefits. It is a very rich source of phytonutrients, especially iron and ascorbic acid. In addition to that, fruits are used for preparing many processed products like jam, jelly, RTS, squash and pickle. *Karonda* pickle is very famous in some central parts of India and now-a-days, *Karonda* jam is getting high commercial value. To improve its varietal wealth, some elite genotypes from its diversity centre need to be collected and evaluated. Collection, evaluation and conservation of elite genotypes for the crop improvement is being done in different parts of the country. Under the scenario of climate change, hardy crops like *Karonda* could replace the major cultivated fruit crops and be cultivated commercially for sustainable development.

KARONDA (*Carissa carandus*) is a perennial shrub of the Apocynaceae family bearing small berry-size fruits. It is also known as 'Christ Thorn', *Karonda*, Karonza, Karmanda and Kavale hannu in different regional languages. Fruits are white, green and red-pink in colour which is acidic in nature and widely used to prepare pickles, candy and chutney. It is cultivated in a very confined area and small tracts of Chhattisgarh, Madhya Pradesh, Rajasthan and Gujarat. However, in most parts of India, it is found in wild form. *Karonda* is very useful and remunerative as it is used for bio-fencing, fruits are commercially sold and many processed products are being prepared from both mature and ripe fruits.

Karonda is an ocean of nutraceuticals. It contains plenty of iron and ascorbic acid thus fruits are suitable to cure anaemia. Fruit also has antiscorbutic, antibacterial and antifungal properties. Traditionally, fruits are used to cure wound, ulcer and remove worm from intestine. It is a good source of vitamin C, organic acids, iron and secondary metabolites such as phenolics, anthocyanins, and antioxidants. It has strong potential to cure several cardiovascular diseases owing to its inherent strong bioactive compounds hence, it acts as an important source of nutritional and livelihood security for tribal people. In most of tribal belts, people collect fruits and sell in local market. Local female candidates prepare value added products from the fruits and they fetch extra return from it. In addition to that, *Karonda* is also used for making ornamental hedge. Now-a-days, in urban areas, university and institutions, *Karonda* hedge is getting popular.

Geography and distribution

Karonda is a crop of arid and semi-arid regions. It performs well in undulated lands as well as in hilly tracts. *Karonda* is widely available in wild forms and is found in Chhattisgarh (especially near Bastar, Raipur, and Jagdalpur districts), Madhya Pradesh, Karnataka, Konkan region of Maharashtra, Rajasthan, Uttar Pradesh and some parts of Western Ghats. In Rajasthan, *Karonda* plants are generally grown in backyard plantations and bio-fencing of fields. The Southern parts of Rajasthan such as Jhalawar, Banswara, Dungarpur, Chittorgarh, and the border area of Madhya Pradesh have a rich diversity of *Karonda*. Most of tribal belts of Rajasthan are having rich diversity of *Karonda*. *Karonda* (purplish colour fruits) are widely available and are a major source of economic security for tribal people.

Varietal wealth and germplasm conservation

Karonda is a wild, underutilized fruit and is found in backyards of rural areas. The progression of the varietal improvement programme, germplasm collection and their evaluation expanded its cultivation among fruit growers. In addition to that, processing and value-addition of improved varieties is also getting commercialized in a sustainable mode.

Under the climate change scenario, there is a need to explore climate-resilient indigenous crop which has wider adaptability and sustainable production under stress conditions. Improvement programmes are run by ICAR through AICRP on arid zone fruits which is

Table 1. Some important varieties of *Karonda* released for commercial cultivation

Variety	Releasing institute	Specific traits
Pant Suvarna, Pant Sudarshan and Pant Manohar	GBPUA&T, Pantnagar (Uttarakhand)	Pickling type, low TSS ranges from 3.0-4.0°B
Konkan Bold	Konkan Krishi Vidya Peeth, Dapoli (Maharashtra)	10-12°B, sweet type and prolific bearer, suitable for table purpose
CHES-K-II-7 and CHES-K-V-6	CHES, Chettalli (Karnataka)	High TSS 15-16°B with a good amount of ascorbic acid
Maru Gaurav	CAZRI, Jodhpur (Rajasthan)	Very high-yielding variety with 40 kg/plants. Ascorbic acid is 35.88 mg/100 g with 9.4°B TSS.
Thar Kamal	CIAH, Bikaner (Rajasthan)	Deep red skin colour with high pulp content. Suitable for processing purposes.

Varietal wealth of *Karonda*

emphasizing on germplasm collection and their evaluation for specific traits. Some of the specific varieties that have been released by selection under different improvement programmes are given in Table 1. Based on fruit colour, there are four types of varieties, i.e. green, creamish-white, pinkish-red and purple. Mostly, purple colour *Karonda* fruits are sweeter than others and can be consumed as fresh. The content of anthocyanin and sugars are more in purple *Karonda*.

Apart from these cultivars, several ICAR institutions are working on germplasm conservation and maintaining the gene pool for *Karonda*. Institutes like CIAH, Bikaner; CAZRI, Jodhpur; CIAH, RS, Godhra; AICRP AZF centre, Jhalawar; NBPGR RS, Jodhpur; CHES, Chettalli, etc. are working and maintaining a good population of germplasms that can be used further in the improvement programme. *Karonda* is very sensitive to frost as well as heat scorching which deteriorates the fruit quality. The germplasm should be collected based on DUS guidelines. Some of the ideal characteristics include bold fruit size, bunch-bearing habit, prolific bearer with high yield, higher sweetness and tolerance to stresses.

Important characteristics of *Karonda* for the selection of elite germplasm:

- Bold fruit size, prolific bearer, bunch-bearing habit and coloured fruits
- Short stature of plants with fewer thorns and fruits with fewer seeds or seedless
- Fruits with good keeping quality and rich in sugars and TSS
- Fruits with suitable processing characters

- Frost and heat-tolerant species

Cultivation propagation: *Karonda* is now being cultivated in many parts of the country. Farmers prefer to grow *Karonda* on boundary wall plantations for live hedges as it checks the entry of wild animals through its dense thorny branches which makes a thick wall-like structure. In kitchen gardens and backyard cultivation, people grow some wild types for vegetable purposes. Commercial growers want vegetatively propagated plants of a suitable variety. Generally, *Karonda* fruits are propagated through seeds. Fresh seeds are extracted in the month of August-September from fully ripened fruits. Well-dried treated seeds can be sown in prefilled polybags or portrayed with a mixture of soil, sand and vermicompost (in a 25:25:50 ratio).

Besides, *Karonda* can be multiplied through vegetative means. Hardwood cuttings from the mature branch of 15-20 cm length treated with 500 ppm IBA are planted in polybags. After rooting and attaining the 4-5 leaves stage, plant can be transplanted into the field. Sometimes, it may take up to one year for attaining the stage. Similarly, air layering can be also attempted in the month of July-August or during the monsoon season. But practise of air layering is very difficult due to dense thorns on the branches. However, it can be done carefully and tied with a transparent 100-gauge polyethene containing pre-soaked sphagnum moss. The initiation of roots takes place in 30-45 days. The branch should be detached after proper rooting and planted in the prefilled polyethene bags.

Profuse fruiting in *Karonda* shrub

Transplanting and aftercare: Planting of *Karonda* can be done during monsoon season in the month of July to September. The pits of 3 ft² for commercial crops and 2 ft² for bio-fencing are suitable. *Karonda* starts branching in a very early stage and before attaining a height of even 1 ft. Therefore, it is necessary to remove those

extra branches before transplanting. The pits should be filled with 3 kg vermicompost or 5 kg well-rotten FYM, one kg neem cake, and 20-50 g of each urea and SSP. Vermicompost can be enriched with *Trichoderma* which may help in mitigating some soil-borne diseases, especially in hard clay soils where water stagnation is a major problem. After that the plant should be trained either on a single-stem system or a multi-stem system. However, a multi-stem system could be more profitable and minimize the risk of plant damage during any stress. For aesthetic hedge, plants are regularly pruned at a height of 3-4 ft or as per requirement of hedge. In case of dividers and gardens its height maintained lower than the normal fencing. The plant starts flowering in the month of May-June. However, flowering time may vary according to varieties and region. Under the southern part of Rajasthan, flowering starts in the month of June and fruits ripen in the month of August-September.

Harvesting and post-harvest handling

Fully mature fruits are harvested for vegetables, curry and pickle purposes and ripened fruits are harvested for colour extraction and jam-making. Different varieties show different colour indications as a maturity index. Pink and red coloured varieties first exhibit green colour followed by tinged and then finally respective colours pink and purple. Harvesting operation is a little difficult due to the presence of thorns.

Therefore, care must be taken during harvest. To avoid latex injury, harvesting should be done along with calyx. Milky latex can cause fruits to become sticky and gummy. Plastic and bamboo baskets are generally used to collect harvested fruits.

Processing and value-addition

Karonda is mainly used for making pickles, jelly, jam, squash, syrup and chutney on an industrial scale. Matured-ripened fruits may be harvested for chutney, pickle and candy preparation, while ripened fruits may be used for extraction of juice for the preparation of beverages like squash, RTS and nectar. Jam of *Karonda* is in high demand and possess better nutritional value with higher shelf life. Seeds are removed from the fruits after cutting into two halves followed by boiling. Fruits are crushed and juice is boiled with required amount of sugar (equal quantity of juice). Similarly, pickle is prepared



Processing and value addition of *Karonda*



Flowchart for *Karonda* chutney, pickle and jam

from matured fruits. Fruits are washed, cut and seeds are removed followed by drying for 3-4 days. The required spices are added into cool boiled mustard oil and pickle can be filled in clean glass container. In rural areas, earthen pots are common in use.

Now-a-days, *Karonda* flakes and ready-to-use powder formulations are available in the market which can be used as taste enhancers.

Marketing

Freshly harvested fruits can be sold directly in the market which fetches prices ranging from ₹ 30-60/kg fruits. In tribal belts, people sell the fruits in nearby town and market. Some of them put their temporary stall alongside highways and they display the fruit in bamboo baskets. Recently, introduction of some processing industry uplifted the economic conditions of tribals. They procure the fruits from the villagers at a single sale point and give them bit higher price than those of markets. Involvement of Krishi Vigyan Kendra's, NGO's and Self-Help Groups (SHG's) makes them popular and helps them to sell out their fresh as well as value added products. They are also providing training facilities in remote areas.

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