Karonda : A Potential fresh fruit of Future

P.C. Tripathi ,G.Karumakaran V. Sankar and R. Senthilkumar

Central Horticultural Experiment Station
Indian Institute of Horticultural Research
Chettalli – 571 248, Kodagu, Karnataka
E mail: cheschettalli@yahoo.co.in

Karondais an evergreen shrub or short stature tree.It grows naturally in the Himalayas and Western Ghats at elevations of 300 to 1800 meters. It is found grown in wild in India , Malaysia, South Africa. In India, it grows in Bihar, West Bengal, Maharashtra, Karnataka and other states. It is cultivated in Rajasthan, Gujarat , Uttar Pradesh states of India. It is a well suitedto arid climate and grown well at higher temperature. It is commonly uses for making ledge for orchards .karonda fruit is a rich source of iron and contains a fair amount of Vitamin C. Mature fruit contains high amount of pectin The fruits are used for pickle making,. It is also used for Jam. Jelly, Squash, Syrup, Chatney etc. There are good demand Karonda products in market.

Karonda has good nutrition value. It is rich in Iron, The fruits also containsvitamin C and It is antiscorbutic and very useful for cure of anaemia. (Table 1). Karonda fruits are used in many ayurvedic formulations and us to their nutritional values. The extract of root is used for Chest pain. The extract of leaves is used for fever. The study conducted at Indian Horticultural Research Institute, Bangalore revealed that the fruit are rich inThiamine (B1),Riboflavin (B2),Pantothenic acid (B5),Pyridoxine (B6),Biotin (B7),Folic acid (B9).

Table 1: Nutritional value of Karonda fruits

Nutrients	Nutritional value (100 gram)	
	Fresh	Dried
Energy (Calorie)	42	364
Moisture (%)	91	18.2
Protein (%)	1.1	2.3
Carbohydrate (%)	2.9	67.1
Fat (%)	2.9	9.6
Mineral (%)	-	2.8
Calcium (mg)	2.1	160
Phosphorus (mg)	28	60
Iron (mg)	-	39
Vitamin –C (mg)	200-500	1

Karonda***(Carissa carandas***) belongs to Apocynaceae family. It produces berry-sized fruits that are commonly used as a condiment or additive to pickles and spices. It is a very hardy, drought-tolerant plant that thrives well in a wide range of soils. There are more than 25 species in genus *Carrissa*Out of these , 5 species are indigenous to India. Karonda is a medium-sized, thorny shrub It has a greenish white bark on young shoots and greyish brown on mature stems. The spines are straight and 1-3 cm long. At times, these are also forked. Its leaves are opposite, generally 2-3 cm x 1-1.5 cm, and ovate. They are green with shine above and a dull green shade below. Old leaves keep shedding throughout the year. New buds also keep sprouting

through the year, though more during spring.Karonda flowers from February to June. The flower of these are white, scented and produced in clusters of 2 to 5 flowers. The corymbose cymes appear at the ends of twigs. The fruit is a globose berry. It appears from March to August and ripens between May and December. Immature fruits are green in colour and turn to white to reddish purple at maturity. These are round to oblong , sweet, though slightly acidic, juice when fully ripe. Karonda wood is hard, straight-grained and use for firewood purpose. The green plant serves as a protective hedge around agricultural holdings.. Apart from Karonda,Natal plum (*Carissa grandiflora*), *Carissa bispinosa,Carissaedulis, Carissa ovata* and Carissa are other cultivated species.

Fig 1: Plant and Flowers of Karonda

Climate:

Karonda is a handy fruit. It can be grown successfully is tropical and subtropical climate plant growth is affected in high rain fall and waterlogged areas. High temperature and arid climate is suitable for karonda cultivation. Temperature climate with high frost and snowfall areas are not suitable for this fruit.As the plants are sensitive for low temperature and front injury. The water logged areas of tropical and subtropical regions are not suitable f for it cultivation.

Soil:

Karonda is grown successfully on a wide range of soil types, viz. sandy loams, laterite, alluvial sand, and calcareous soil even it is found growing well in in stony , rocky and less fertile soils.but the better growth and higher yield is obtained in alluvial sandy loam soils with good drainage. The

performance of orchards is very poor on clay soil with poor drainage. The can be grown in wide ranges of soil pH ranging from 5.0to 8.0.

Varieties:

The Karonda cultivarsmay be categories as per their colour of fruits viz., pink-white, greenish pink and reddish purple or on the basis of utilization. The fruits of pink varieties are white in colour at stage and turn to pink at maturity. The colour of reddish , purple varieties are green at immature stage and turn to Reddish purple at maturity. The karonda varieties may be also classified in two categories i.e. pickle type varieties and table purpose varieties. Some varieties of Karonda varieties have been developed during last two decades . Pant Manohar, Pant Sudarshan, Pant Suvarna are pickle type varieties develop at GB Pant university of agriculture and technology. The varieties have smaller fruits (3.5 g weight) and acidic in taste while Konkan bold, CHES K-II-7 and CHESK-35 are bold size and suitable table purpose.

Pant manohar

This variety is developed from GB PUA&T Pantnagar (Uttarakhand) in 2007. The plants of this varieties are medium– sized dense bushes ,fruits are dark pink blush on white background , weighing 3.49g. seeds 3.94 / fruit , flesh 88.27%, dry weight 12.77% , TSS 3.92%, total titrable acidity 1.82% and yield 27 kg / plant.

Pant Sudarshan

This variety is developed from GB PUA&T Pantnagar (Uttarakhand) in 2007. The plants of this varieties are medium– sized dense bushes. Fruits are pink blush on white background. On ripening fruits become dark brown. Average fruit weigh 3.46 g, seeds 4.68 / fruit , flesh 88.47% , dry weight 11.83% , TSS 3.45%. total titrable acidity 1.89% and yield 29 kg / plant.

Pant Suvarna

This variety is developed from GB PUA&T Pantnagar (Uttarakhand) in 2007. Plants are upright growing and sparse. Fruitsare colour dark brown blush on green background. Average fruit weight 3.62 g, seeds 5.89 /fruit, flesh 88.27% , dry weight 12.39%, TSS 3.836, total titrable acidity 2.30% and yield 22 kg / plant. On ripening, fruit colour changes to dark brown.

Konkanbold

This variety is developed from KonkanKrishi VidyaPeeth, Dapoli (Maharashtra) in 2004. The plants are medium in size and vigourous. It flower in the month of Feb.-March and fruit ripe in the month of May-June under Coorg conditions. Fruits are oblong in shape and 12-154g in weight. The colour of fruits is dark purple . The fruits are sweet with 10-12 ^{O} Brix Total soluble

solid. The tree are prolific bearing and produced 2000-2500 fruit per year. This variety is suitable for table purpose.

CHES- K-II-7: This is promising line indentified from the seedling population at CHES Chettalli .The plants are medium size and flower in the month of Feb.-March and fruit ripe in the month of May-June. Fruits are oblong in shape and 12 -13 g in weight. The colour of fruits is dark blackish violet in colour and Thin fruit skin. The fruits are seedless (0.3 seeds/fruit) Afour year old trees yield around 1800-2100 fruits per plants per year. Fruits are sweet with TSS 15^0 Brix and acidity - 1.08% (Table 2& 3). This is suitable for table purpose and processing.

CHES- K- V-6:

This is promising line indentified from the seedling population at CHES Chettalli.The plants are medium size and it flowers in the month of January-Februaryand fruits in May-June. The average fruit weight around 13-15 g,dark blackish redin colour with red pulp and very less seeds. The Total soluble solids of fruit is around 16^O Brix with 1.18perecent acidity and 21 mg vitamin-C/100g pulp. A four year old tree yield 1200-1500 fruits per year(Table 2& 3).Fruit are alsorich in Vitamin –B. This variety is suitable for table purpose.

Table 2: Characteristics of elite lines of Karonda**CHES K-V-6 and CHES K-II-7**

Characters	**CHES K-V-6**	**CHES K-II-7**
Tree	Spreading	Spreading
Maturity	Mid and regular	Mid and regular
Size	Medium	Medium
Flowering	January- February	January- February
Fruit colour	Dark blackish red	Dark blackish red
Harvesting	May-June	May-June
Fruit weight (g)	13-15	12-13
Pulp	Thick, firm, Juicy and sweet, Table purposes	Thin, firm, Juicy and sweet Table and processing purposes
TSS (^{0} Brix)	16	15
Acidity (%)	1.18	1.07
Vitamin C(mg/100 g pulp)	21	27
Pulp recovery (%)	90.0	91.0
Yield (fruits/tree)	850-1350	1800-2100
Yield (kg/tree)	15.27	21.8

Table 3: Water soluble Vitamins content in elite lines of Karonda

Vitamin B (µg/100 gm fwt.)	Karonda Accessions	
	CHES-K-II-7	CHES-K-V- 6
Thiamine (B1)	2.499±0.704	2.255±0.168
Riboflavin (B2)	19.151±1.850	42.239±0.873
Niacin (B3)	N.D	N.D
Pantothenic acid (B5)	129.370±0.765	297.984±2.036
Pyridoxine (B6)	20.600±1.710	43.224±0.946
Biotin (B7)	26.512±1.608	44.033±0.100
Folic acid (B9)	0.030±0.008	0.182±0.011
Cyanocobalamin(B12)	ND	0.573±0.153

Source: Shamina*et al* (2014)

Propagation

karonda is propagated through seed propagation and vegetable propagation methods such ascutting, layering and budding .

Seed Propagation

Karonda plants can be multiplied through seed very easily. Seed propagation is mostly commonly used methods in Karonda. The seed should be collected immediately after harvesting.The seeds sown immediately after extraction give higher germinated. Seedsare shown in trays and these seedlings are transplanted in poly ethylene bags at 3-4 leaf stage. The plants because ready for planting in 8-10 months.The germination in seedless or less seeded varieties is low. The plants produced from seeds have lot of variability with respect to fruit size, colour, taste etc. Thus it is not preferred for multiplication of varieties and elite lines.

Vegetative propagation:

Stem cutting, air layering and budding are used for multiplication ofvarieties / eliteslinesto produce true type planting material.

Cuttings: The semi hard wood cuttings are suitable for multiplication of plants. Generally, 25-30 cm long and 1’ diameter cuttings may be used for propagating plants. The best time for planting cutting is June –July. The trial conducted at CHES,Chettalli found that success was higher in semi hard wood cutting than softwood ,semi hard wood and hard wood cutting.The semi hard wood cutting planted during July - August gave 30 -40 % success as compared to hard wood cutting and soft wood cuttings.The treatment of IBA failed to enhance the success in both hardwood and soft wood cutting. The success in table purpose ,bold fruit varieties is lower than pickle type varieties.

Air layering:

The air layering of Karonda plants was found successful well performing during June –July. The success rate was variable from 30-60% in different years. The air layers were removed the plants in the month of September and planting in polythene bags and they become ready for planting after 6-7 months.

Planting:

The soil should be leveled before planting and all the old plants need to be removed. These pits filled with FYM and soil mixture to one by one different time of planting of these June-July. The table purpose variety of Karonda should be planted at 3X3 meter distances in square. The method of planting the pits of 3X3 ft.size should be prepared at least one month before planting. These pits should be filled with equal amount of FYM and soil mixture. The proposed time of planting of this is June-July.The land should be cleaned and leveled with a mild slope in the opposite direction of the water source. The hedge plating of karonda is done at 2 fit distances.The hedge planting trench of 1X 1 feet size is done. The pits of 1x1 feet can be also made instead of trench. For planting of orchards, the planting is done at 3x 3 m distance with square system. The pits of 2x2 feet size should dug before rainy season. The rocky soil pits of 3x3 feet size to

Fig.2. Fruits of Karonda promising lines CHES K-V-6 and CHES K-II-2

should be opened. Pit opening is normally recommended in April-May. These pits are filled with topsoil mixed with about 510 kg decomposed compost, 1 kg neem cake, 50 gsingle super phosphate and 50g muriate of potash before the onset of monsoon. Then the soil is allowed to settle with the first few rains and leveled properly. Planting is done during June to July. At the time of planting a hole the size of ball of earth is made in the centre of the pit at the marked point where the plant is fixed and the soil is pressed

remove air. Watering is done immediately after planting for proper establishment. Subsequently the plant is regularly irrigated till it is properly established.

Fig. 3.Field view of Karonda orchard

Manure and fertilizer

Balanced nutrition is considered to be the most important which determines productivity and quality. Karonda responds to exogenously applied manure and fertilizers and response varies depending upon cultivar, climatic conditions and soil types. Since soil and climate of different places are highly diverse, there is wide variation in the response of fertilizer application. One year old plant should be provided 5 kg of FYM and 100 gm mixture of Nitrogen, Phosphorus and Potash. This growth should be increase in same ratio up to 3 years. The four and more than 3 year old plants should given 15-20 kg of FYM and 400 g of mixture of NPK. The best time of fertilizer application is June-July after harvesting of fruits(Table 4).

Table4 : Recommended doses of fertilizers

Year	Quantity/annum/tree			
	FYM(Kg)	Nitrogen (g)	Phosphorus (g)	Potash (g)
1	5	50	25	25
2	10	100	50	50
3	15	150	75	75
4 onwards	20	200	75	125

Training and Pruning:

Karonda plant hascomparatively weaker stem in initially years .Thus it is necessary to provide support after planting. The plant has tendency to produce several branch just above ground surface.The branches which are emerging near the ground surface need to be removed for convenience in cultural operations. Training of the plant in the initial stage is essential to provide the required framework. Unwanted branches should be pruned to provide definite shape and to promote growth of the trunk and crown of the tree. Three to four branches 30-45 cm from ground opposite to each other are allowed to form the proper frame of the tree.The branches should be trained in open centre system for better production. The training of plant is performed only in first two years. Once the plant is big the pruning is required to maintain the size of the plant. The Karonda plant grows slowly in arid areas and required comparatively less pruning but in humid and tropical region of the plant grow very vigorously . Heavy pruning is required every year. This help in maintaining tree size and producing regular yield. Further, water suckers,crowded and crisscross branches are removed to facilitate better growth. The branches with narrow angles are also avoided. Dried, and diseased branches should also be periodically removed. Pruning is generallyperform in the month of October in Coorg conditions.

Karonda planted for hedges purposes need not be trained in this manner and 3-4 branches are allowed to near ground level to make a compact hedge. The hedges are trimmed after harvesting of fruits.

Inter crop:

Karonda is generally grows in dry soil where water facilities are not available some vegetables are can be grow during rainy season. During the initial period of establishment, the space between the plants can be utilized for planting of intercrops. These give additional income in the initial stage of planting without competing with the main crop. Cowpea, french bean, okra, brinjal or other suitable crops of the regions are grown as intercrops. In the mature karonda

orchards, green manure cropsmay be grown and incorporated into the soil, which improves its fertility, moisture holding capacity and physical condition.

Water Management:

Karonda is a hardy plant. The newly planted plants should be given irrigation. Young plants should be irrigated at 10-15 days interval in the winter and 6-7 days in summer season. The basin or flood method of irrigation is normally practiced. However, adoption of drip irrigation has been found to be effective in the economic use of water and enhanced growth. The adults orchards are generally not irrigated. Mulching with dry leaves or residues in the basin helps in moisture conservation.

Diseases and pests:

Anthracnose

The Karonda plants are affected by Anthracnose..The symptoms are developed in the leaves as Irregular size black, brown, lesions e. These spots increase and decreasing the size of the leaves. The disease also effects fruits and branches. The diseases may controlled by sprayingof copper based fungicide copper oxide, copper trioxide in the initial stage. The orchards sanitation like burning of fallen leaves and fruitshelp to reduce inoculums.

Leaf eating caterpillars:

Caterpillars cause much damage, mainly by eating leaves.This affects the growth of the plants. Caterpillars may be controlled by through the use of pesticides, biological control and cultural practices. The chemicals, monocrotophos (2ml/l may be used for control of leaf eating caterpillars.

Fruit fly, *Bactroceradorsalis, B. caryeaea*

Moderate infectation of fruit fly infestation was noticed on karonda**.** Fruit fly infests the ripened fruits. Its infestation is more in southern states. The female fruit fly lays eggs on the mature fruits with the help of its pointed ovipositor. After hatching the maggots feed on pulp of these fruits and the infested fruits starts rotting and fall down. As a result brown patch appears around the place of oviposition. The maggots come out of the affected fruit and pupate in the soil.Pre-harvest IPM combined with sanitation (Collection and destruction of fallen/infested fruits) + Placing Methyl eugenol trap @ 4-6/acre + In severe infestation spraying of bait spray (Decamethrin (Decis) 2ml+ 100g of jaggery in 1 litre of water) is recommended.

Harvesting and yield :

Karonda plant starts yielding after 3rd year.In WesternGhats flower starts in December to March and fruit mature in the month of April to June. Thematurity of fruits is judged on the basis of change in colour. All fruits generally do not mature at one time therefore harvesting is generallydone 3-4 times. Harvesting is done manually. The harvesting of fruits with stock helps to minimum the oozing of latex by fruits and enhances quality and storage of fruits. A plants may yields 4-5 kg fruits. The promising linesplanted as orchard may yield 10-15 kg per tree. The fruits can be stored for 3-4 days under room temperature. The fruits used for making jam, candy and pickles.

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