RAMA UNIVERSITY

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FACULTY OF AGRICULTURAL SCIENCES AND ALLIED INDUSTRIES

Groups of leaf vegetable

- Leafy vegetables could be grouped into:

1. Cultivated indigenous vegetables
2. Uncultivated naturally occurring leafy vegetables
3. Introduced leaf vegetables
4. Cultivated perennial leafy vegetables

1. Cultivated indigenous leafy vegetables

A. Amaranthus tricolor

B. Amaranthus viridis

C. Amaranthus dubius

D. Atriples hortensis

E. Anethem rowa

F. Alterneathera sessiles

G. Hibiscus carbis

H. Coriandrum sativan

I.Portulaca grandiflora

J. Trigonella foenum gracum

2. Non cultivated naturally growing leafy vegetables

A. Alternanthera echinate

B. Amaranthus sessiles

C. Amaranthus caudetus

D. Amaranthus gangeticus

E. Amaranthus polygamus

F. Amaranthus spinosus

G.Centella asiatica

H.Celosia argentia

I. Coleus amboinicus

J. Jatropa prostrate

K. Oxalis carniculate

3. Perennial greens

A. Subania grandiflora

B. Moringa olerifera

C. Sauropus androgynus

D. Tamarindus indica

4. Introduced leafy vegetables

Spinach, Celery, Lettuce. Parsely, Basella, Ceylon (Talinium triangulare) etc,.

Amaranthus

Scientific name : *Amaranthus Sp.*

Family : *Amaranthaceae*

Chromosome number : *2n=32 or 34*

Origin : *India*

Leaf type

Amaranthus tricolor/ganetious	Amaranthus blitum
Amaranthus tristis	Amaranthus durbius
Amaranthus lividus	Amaranthus viridis

Grain Amarath species

Amaranthus caudatus	Amaranthus hypochondriacus.
Amaranthus cruentus	Amaranthus edulis.

Importance and utility

- Amaranthus is the most common leafy vegetable grown during summer and kharif season in India. It fits well in crops rotation because of its very short duration and large yield of edible matter per unit area. The estimation of the extent of its cultivation is not available. Green or leafy types are usually grown in kitchen and market garden. The grain amaranthus species are popular in the high lands of tropical and sub-tropical America. It is gaining importance in the Indian plains also, particularly in Gujarat and Maharashtra. Grain types are usually grown as mixed crops along with cereals, pulses and vegetables.
- The leaves and tender stems of Amaranthus are rich in protein, minerals, vitamin A and C.100g of edible portion of Amranthus consists of Protein 4.0 g, Calcium 397 mg, Iron 25.5 mg, Magnesium 247 mg, Phosphorus 83 mg, Potassium 341 mg, Sulphur 6 mg, Vit C 99 mg and Vit A 9200 IU. Besides, the soft fibrous matter provides necessary roughage in the diet.
- The fresh tender leaves and stem of amaranthus are delicious when cooked and consumed like other leafy vegetables. The tiny seeds of grain. Amaranthus

are parched and milled for flour.Amaranthus flour compares favourably with other cereals in taste, nutritional value and yield.

- The grain amaranthus is a rich source of protein and essential aminoacids like lysine, leucine and isoleucine which are required for growth of children.

Varieties

Varieties released from TNAU,

Coimbatore Co.1 (Amaranthus dubius)

- Developed at TNAU
- Selected for tender leaves and mature stem
- Suited for early harvest
- Not suited for clipping of leaves
- 7-8 t/ha in 30 days
- Suited for late harvesting

Co.2 (Amaranths tricolor)

- Developed at TNAU
- Suited for early harvest
- Not suited for clipping of leaves
- 10-11 t/ha in 25 days

Co.3 (Amaranthus tristis)

- Developed at TNAU
- Suited for clipping tenders greens at weekly cultivars
- First clipping 20 days after spring green
- Ten clippings can be taken continuously
- Grain yields 10-12t/ha

Co.4 (Amaranthus hypochondriacus)

- Green cum grain type. - Plants are dwarf

-Make rapid vegetative growth in 20-25 days. -7-8 tonnes of green matter per hectare

-Grain yields 2 to 2.5 tons per hectare in 80 to 120 days

IARI Varieties:

Chhoti chaulai (Amaranthus blitum)

- Plant erect, dwarf, small green leaves - Respond well to clippings/cuttings

- Suited for sowing in early summer

Badi Chaulai (Amaranthus tricolor)

- Plants have thick stem and longer leaves - Well to clipping/cutting

- Suited for sowing at warm summer

Pusa Chaulai (Amaranthus tricolour)

- Stem medium thick, tender and leaves medium to large in size.

- Suited for sowing at early summer - Yields 45 t/ha

Pusa Kiran

- Suited for growing in rainy season

- It gives yield of 35 t/ha

Pusa Keerthi

- Suited for growing in summer season

- It gives yield of 50 t/ha

IIHR Varieties

Arka Suguna:

- A pure line selection from an exotic collection from Taiwan (IIHR 13560) Light green, succulent stem and broad leaves.First harvest in 25-30 days after sowing and 5-6 cuts in 90 days. Moderately resistant to white rust under field conditions.Yield 25-30 t/ha.

Arka Samraksha:

- It is a high yielding amaranth variety, with high antioxidant activity of 499mg (AEAC units) and minimum nitrate content of 27.3 mg and 1.34g of oxalates per 100g fresh weight of leaves. It is a pulling type amaranth variety with green leaves and stem, yields 10.9t/ha in 30-35 days duration.

Arka Varna:

- It is a high yielding amaranth variety, with high antioxidant activity of 417mg (AEAC units), nitrate content of 37.6mg and 1.42g of oxalates per 100g fresh weight of leaves. It is a pulling type amaranth variety with green leaves and pink stem, yields 10.6 t/ha in 30-35 days duration.

Climate

- Amaranthus species are widely distributed in temperate and tropical regions of the world. Different species differ in their day length (Photo period) requirements and respond differently to changes in photo and thermoperiodism. A. caudatus, Amaranthus edulis and A.cruents are short day (plants) species while A. hypochondriacus is reported to be day neutral. However it does well under warm situations temperature ranging from 22 to 300C. Grain Amaranthus is highly resistant to drought.

Soil

- Amaranthus can be grown in a wide range of soil, however well drained loamy soils are best suited for this crop. Heavy soils with poor drainage and sandy soils with poor water holding capacity are unsuited for its cultivation. It can be grown in a pH range of 5.5.-7.5. However slightly acidic in nature are preferred.

Season, Seed rate & fertilizer recomendation

Season

- It can be grown throughout the year. However March to September are the best months to start the crop.

Seed rate & fertilizer recomendation

- One hectare area requires around 2.5 kg seeds with recommended NPK is 100-50-50 kg inaddition to well decomposed 15-20 tons of FYM.

Land preparation and sowing

- Prepare the land thoroughly by ploughing, harrowing and bring the soil to fine tilth. Incorporate entire quality of organic manure into the soil. Prepare the beds of convenient size. 3mx2m or 2mx1.5m with irrigation channels running between every two rows of beds. After the beds are ready apply entire dose of P and K along with 50% N and mix them well in the soil.
- Sow the seeds thinly. On account of smallness of seed ,it should be sown shallow to a depth of 0.5-1cm .Since the seeds of Amaranthus are small in size, to achieve even distribution, mix the seed with fine sand or red soil before sowing. For line sowing spacing between rows is 20cm.
- In grain amaranthus (Amaranthus hypochondriacus), the plants are thinned that have a spacing of 30cm x 30 cm on 25th day and they are allowed for flowering. The crop will be ready for harvest in 80-120 days depending on the variety and season. The dried spikes are threshed to separate grain which is

used to prepare popped grain, green cakes, infant foods and the preparation like amaranthus malt.

Irrigation & inter cultivation

- Provide light irrigation after sowing. Three days once or weekly irrigation is necessary, depending on soil and weather conditions. Top dress the crop with remaining 50% of N 20-25 days after sowing. Keep the land free from weeds.

Harvesting

- Young seedlings are pulled out with roots, washed, tied into bundles and sent for marketing. Crop will be reading for first clipping or cutting 25-30 days after sowing. The subsequent cuttings can be made at an interval of 6-10 days. It gives about 6-10 cuttings.

Yield

- It is highly perishable hence leaves should be used same day of harvest. Average yield is 25 tonnes per hectare in leaf types whereas grain types yield is around 2 to 2.5 tonnes per hectare.

Basella

Botanical name : *Basella alba*

Family : *Basellaceae*

Chromosome No. : *2n = 44, 48*

Common name : *Malabar night shade/poi/ Indian spinach*

Importance and utility

- The plant is a climbing vine with think fleshy stem and leaves. The different botanical forms are available viz., Basella rubra, Basella cannifolia, Basella cordifolia. They are chopped and cooked as vegetables and has ornamental value. It is a rich source of vitamin A (3250 IU/100g), protein (1.2%) and rich source of iron (1.4mg/100g). The succulent leaves with petioles and tender leaves are cooked as vegetables.

Climate and soil requirements

- Basella grows well in warm and moist climate. But it cannot tolerate extremes of temperature (optimum temperature is 25-320C). It can be grown successfully under partial shade.
- It can be grown under wide range of soil right from sandy soil to clayey soils. Sandy loam with sufficient organic matter will be the best suited.

Sowing

- Basella is propagated by seeds as well as by stem cuttings. Usally stem cuttings are preferred and commonly followed cuttings of 40-45 cm long are planted before the onset of monsoon. Both direct seeding and transplanting after raising the seedling can be adopted. For trailing on the ground a spacing of 60cm x60cm can be adopted. If it is trained on trellis, a spacing of 60x30 or 60x20cm can be adopted. Rooted cuttings can be used for planting.

Manuring

- A basal dressing of 20-25t of FYM and 60:60:40 kg of NPK/ha has to be applied before transplanting/sowing.

Varieties

- There are no named varieties. Cultivars having dark green round oval leaves (Petiole and stem) with reddish petiole and stem and dark green cordate leaves are available.

Eclipse

- Producing a crop in 55 - 60 days in warm areas. Very early cultivar producing small and compact plants that can be planted close together. The leaves are thick and medium to deep green in colour. Yields very well under warm humid conditions.

Red

- The leaves, stems and flowers are tinged with red. The colour is lost when the plant is cooked and so it is best used in salads. Basella alba is a fast-growing, soft-stem vine, reaching 10 m in length. Its thick, semi-succulent, heart-shaped leaves have a mild flavour and mucilagenous texture. The stem of the cultivar Basella alba var.Rubra is reddish-purple.

Malabar Spinach (Red Vine)

- This is a unique variety that has red-purple vines and dark green leaves. This variety has relatively small leaves and vines. The vines grow much faster than the Green Vine variety. Many people also like to grow this variety as the backyard decorative plants due to the beautiful vine and flowers.

Malabar Spinach (Green variety)

- This variety produces large dark green leaves and vines. This vegetable is very popular in Chinatown and Vietnamese markets. Young leaves and tips are excellent for stir-fry cooking.

Seed rate

- One hectare area requires around 12-15 kg seeds.

Sowing

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Manuring

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Plant protection

- Damping off, leaf spot and mosaic diseases are common in basella. The seeds can be treated before sowing and soil can be sterilized before sowing. To the

extent possible, it is advisable to avoid the use of any chemicals on the crop, since the leaves are edible part.

Harvest and yield

- The first cutting starts from 45-60 days after planting. A quantity of 15-20 t/ha of green matter can be harvested from a hectare. Crop duration is 120-150 days. The leaves are tied in bundles of 15-20 and sprinkled with water. Use of polyethylene bags prolongs storage life.

Curry Leaf

Botanical Name : *Murraya koenigi*

Family : *Rutaceae*

Chromosome number : *2n=18.*

Origin : *Burma*

Area and Production

- Curry leaf is grown on large scale in West Bengal, Assam, Deccan plateu, Western Ghats, TamilNadu, Karnataka and Kerala. It is cultivated in Coimbatore, Salem and Thruchirapalli districts of Tamil Nadu on a commercial scale.

Importance and utility

- Curry leaf is an important perennial tree vegetable cum spice crop of India. It is an under exploited crop. The leaves are widely used in Indian cookery for flavouring food stuff. The leaves have slightly pungent, bitter and feebly acidic taste and they retain their flavour and other qualities even after drying. Curry leaf is used in many of the Indian Ayurvedic and Unani prescriptions.
- It has many industrial values and medicinal uses. Since the leaves are widely used for foods flavouring in curry preparation. Its leaves, roots and bark are credited with tonic, stomachic and carminative properties. Leaves are reported to cure piles and allay heat of body. The green leaves are said to be eaten raw for

treatment of dysentery. External application of pulped bark and root is reported to relive eruptions and bites of poisonous animals. An injection of toasted leaves is used to stop vomiting. The tribal people of India use its ground bark and they rub the bark on the bitten part as a snake bite remedy. The powdered leaf is used to aid in healing of fresh cuts and decoction of the leaves is drunk for dropsy.

- The dried curry leaf powder is a good spice powder for use in the food stuff preparation. It is also being exported. Fresh leaves on a steam distillation under high pressure yield 2.6 % (curry leaf oil) volatile oil which is used as fixative for heavy type of soap and perfume. Rectified leaf oil is deep yellow in colour with a strong spicy odour and pungent clove like taste. A volatile oil a crystalline glucoside 'Koenigia" from the leaves and 'Murayam from the flowers are industrial products.

Varieties

DWD-1 (Suwasini):

- It was evolved at UAS, Dharwad. It is a clone of single plant root suckers. The leaves are dark green (0.1629 mg of chlorophyll/ gram of fresh leaf), shiny and highly aromatic. It is sensitive to low temperature in winter season and hence the bud burst is poor. The leaves have oil content of 5.22 % and can be dehydrated at 50oC without loss of quality and made into powder.

DWD-2:

- It was evolved at UAS, Dharwad. It is a seedling progeny of unknown source. The leaves are slightly pale green and less aromatic. It is not very sensitive to low temperature and much superior in number of bud burst, inter nodal length and 8 times higher in growth of shoot than DWD-1.

Senkambu:

- It is a Coimbatore local type and the leaves have better aroma and flavour due to higher oil content.

There are other two types of curry leaf viz., broad leaved and small leaved types. The small leaved types are more fragrant and hence used for the extraction of essential oil.

Harvesting and yield

- The leaves can be clipped from young shoots at the end of 1st year. A total number of 4 harvests can be had. The yield ranges from 5t/ha in 2nd year to 10t/ha in 4th year. From 4th year onwards the foliage yields around 20t/ha.

Post harvest management

- Young shoots and leaves are packed in gunny bags and transported. The leaves are dried and ground into powder and used as curry powder.

Moringa

Botanical Name : *Moringa oleifera*

Family : *Moringaceae*

Chromosome number : *2n =28*

Origin : *North West Indian and African tropics*

Importance and uses

- Drumstick is one of the most popular vegetables in the south Indian households. The fruits, leaves and flowers are used in culinary preparation. Immature fruits are cut into pieces and used in several culinary dishes. The roots of the plant are used for seasoning pickles. It is highly valued for the distinct and appealing flavour for its tender fruits.
- They are rich source of protein, minerals and vitamins. Seeds contain an oil called ben or behen oil which has been much used for illumination, soap industry and highly priced for lubricating watches, computers , delicate machinery etc. Seeds contain 38-40% of non drying oil which is clear and odourless, never

becoming rancid. It is edible and useful in the manufacture of perfumes and hair dressing.

- The press cake remaining after oil extraction is high in saponin, not edible, but utilized as manure. The oilcake is a water coagulant and used for purifying effluent water. It is used as organic substitute for water purifying chemicals such as alminium sulphate. Wood yields blue dye and coarse fibre. The plant is used for treatment of rheumatism and as cardiac and circulating stimulants.

Varieties

Jaffna:

- It is introduced from Sri Lanka. Highly suited for coastal tracts of TN, Kerala and Karnataka. It bears long pods (60-90cm) and with a soft flesh of good taste. This type yields 500 pods/tree/year.

Moolanur Murungai :

- Fruits are 30-53cm in long with soft flesh. One tree yields about 500-600 fruits/year.

Chavakacheri Murungai:

- It is ecotype of Jaffna moringa, which bears pods as long as 90-120 cm . Due to long size of pods, this type of moringa is highly damaged during transportation. It yields 500-600 pods/tree/year.

Chem Murungai:

- Produces flowers throughout the year. Fruit tip is red in colour.

Palmurungi:

- Pods having thicker pulp content, produces 400-500 pods/year.

Kodikal Murungai:

- Predominantly found in betel vine garden. This tree is highly useful for training of beetle vine and also gives shade. Pods are shorter (20-25cm) and thick fleshed and very tastier. This is a distinct type propagated by seeds.

Kudumianmalai 1 (KM-1):

- It is selection from local annual type propagated through seeds. Plant are dwarf, pods are short and thick. The plant comes to bearing 6 months after planting. After each harvest, the plants can be ratooned for 2-3 years by cutting the trunk at a height of 1 metre; fresh planting can be taken after 3 years. Average yield 400-500 fruits/tree.

PKM-1:

- Evolved at Horticultural College and Research Institute, Periyakulam. Plants grow a height of 4 to 6 metre and come to flowering in 160-170 days after planting. Each tree bears on an average of 200-250 pods/year. Pods are 60-75 cm long with 6.0 cm girth and 150 g weight. They are very pulpy containing 70% of edible portion. Every year after the harvest is completed, the trees have to be cut back to about one meter from ground level during September and three ratoon crops can be taken in a period of three years.

PKM-2:

- It was released from HC & RI, Periyakulam. It is hybrid derivative of the cross between MP 31 and MP 28. Plants are quick growing. Each tree has 12 branches and bears flowers in clusters, 3-4 pods/ cluster, pods harvested 170-180 days. Length of the pod 125 cm and girth 28 cm. the pods having lees seed with more flesh. Each tree yields 220 pods in a hectare and yields of 98 tonnes.

GKVK-1:

- It was released by UAS, Bangalore. Plants are dwarf, grow to a height of 1.5m, produce 250-300 plants/year. Length the pod is 35 cm. this variety is suitable for high density planting.

GKVK-2:

- It was released by UAS, Bangalore. Plants are dwarf and produces 300-400 pods/year.

GKVK3:

- Plants are dwarf, pods triangular with black mixed green colour, produces 250-300 fruits/plant, suitable for high density planting.

Dhanaraj :

- It was released by UAS, Dharwad. Dwarf, bears 250-300 fruits/year after two year of planting. Starts yielding from 9-10th month of sowing each pod measuring 35-40 cm in length.

Climate and soil

- It is a tropical plant. However, it is found growing in the subtropical climate also. It is predominantly a crop of dry and arid track where it has been found to perform well with higher yields. The optimum temperature is 25-350C. It is highly susceptible to frost, water logginig & high temperature exceeding 400C causes flower shedding.
- It grows almost all types of soils except stiff clays. However sandy loam soils containing lime is the best suited for its cultivation. The crop is more or less confined to sandy soils as seen in the coastal areas.

Propagation

- The perennial types are propagated by limb cuttings. Limb cutting of 1-1.5m length and 15-16cm circumference obtained from selected trees are planted in situ during June-October in TamilNadu. Annual types are propagated by seeds. Planting dwarf types 500 g seeds and 928 number of limbs, whereas for tall types, 100g of seeds and 392 limbs/ha are required.

Planting

- The limb cuttings are planted in well prepared pits of 60 x 60 x 60 cm at spacing of five metres for perennial types. For annual types pits 45 x 45 x 45cm are dug with 2.0 x 2.5m or 3.25 spacing. The pits are filled with a mixture of top soil and 120 kg FYM. Seeds can be either sown in situ in the prepared pits or can be transplanted after raising the seedlings in PE bags. The PE bags may be size of 15 cm length and 4 cm width. The seedlings are ready for planting in one month after sowing .An additional numbers of 75 to 100 plants are to be raised in PE bags separately for gap filling after one month of planting.

Manuring

- Add 25 tonnes of FYM per hectare. A fertilizer dose of 45:15:30 g of NPK/pit may be applied 3 months after sowing. Apply 45 g of N/pit after 6 months when the crop is in bearing. For ratoon crops above schedule with FYM is recommended.

After care

- When the seedling reach 75 cm height, the shoot tips are nipped off to encourage side shoots.The plants which are exposed to heavy winds, slender branches are liable to be damaged and break easily at the joints, especially when fully loaded with fruits .In such situations, mounds are to be formed around the tree trunks up to height of 30-45 cm from the ground level. In young plantation inter crops like cowpea or bhendi or ground nut can be cultivated till the moringa plants become dense and cover the interspace.

Harvesting and yield

- The annual drumstick types come to harvest in six months after sowing while the perennials types propagated through limb cuttings take 8-9 months for bearing. Fruits of sufficient edible maturity are harvested. The fruits are ready for harvest in 60 days after flowering. The period of harvest extends for 2-3 months and each plant bears 200-250 fruits in annual types.
- In perennial types, the yield will be generally low (80-90 fruits/plant/year) in the first two year of bearing. Then it increases to about 500-600fruits/plant/year in 4th and 5th year and the pods are harvested mainly in march-June. A second crop can be harvested in September to October. The ratooned crops will develop new shoots and will start bearing after six months. At each and every ratoon the plants are to be supplied with manures and fertilizers. The trees of perennial types are retained for about 12-15 years.