

Prospects and Potentials of Neglected and Underutilized Leafy Amaranth as a Vegetable

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Scientific Name: *Amaranthus spp.*

Family: Amaranthaceae (2n = 32)

Introduction

Amaranth is a warm season crop that is grown in summer and rainy seasons in India. It is a tall and softwood, herbaceous annual with upright growth habit which is primarily used as potherb (boiled greens) and grown extensively throughout the India for its green leaves and succulent stem. Amaranth is one of the cheapest leafy vegetables in tropical and sub-tropical parts of the country and hence most commonly known as poor man's leafy vegetable. It is a multipurpose crop and provides grain, leafy vegetable and fodder. There are two types of amaranths i.e. leaf amaranth and grain amaranth. The leaf amaranth is eaten as vegetable whereas seeds of grain amaranth are milled for flour or popped like popcorn and eaten as cereal. Grain amaranth has more protein than corn and other major cereal grains; sorghum, rice, and wheat. The protein lysine in grain amaranth ranges from 14.5 % to 15.1 %. Some important characteristics of amaranths are short duration, high nutritive value, rapid growth, high edible matter per unit area and quick rejuvenation after each harvest. It is extensively cultivated throughout India but more in southern regions (Tamil Nadu, Kerala, Karnataka and Andhra Pradesh). It is also cultivated in the hills of north India, especially the grain amaranth. It is not a true cereal such as wheat, corn and barley, but is rather considered as a pseudo – cereal like Kathu (Buckwheat; *Fagopirum esculentum*) and quinoa (*Chenopodium quinoa*).

Origin

The wild ancestors of amaranth are pan tropical cosmopolitan weeds. *A. tricolor*, vegetable amaranth originated somewhere in South Asia or Southeast Asia. It is a native to

India, from where it spread to the neighbouring countries, Indonesia, Indo – China, Malaysia, Hong – Kong, Taiwan and Southern China. *A. dubis* has probably originated in Central America. It has much diversity in Central America, Indonesia and India. The species *A. blitum* occurs as a weed in Southern and Central Europe where it is popular as a leafy vegetable. Commonly it is also grown in Greece, Taiwan and India, particularly in Madhya Pradesh. All grain amaranths have originated in Central and South America (*A. cruentus* in Guatemala in Central America, *A. hypochondriacus* in Argentina and Peru in South America and *A. caudatus* in the cold regions of the high Andes in South America). Secondary Centre of diversity of the grain amaranth is the Hindustani subcontinent. The weed, *A. hybridus*, has spread to the other tropical countries, like Mexico, Malaysia, Thailand, Indonesia and the Philippines where this species is used as a grain amaranth. *A. spinosus* and *A. viridus*, the weed species are edible as leaf vegetable in India.

Health Benefits

Amaranth is an important nutritional crop; both its grains and leaves are used by humans as well as by animals as a feed (Mustafa et al 2011). It is a valuable vegetable for malnutrition India. Leaves and tender stems of amaranth are rich source of proteins, minerals, calcium, iron, folic acid, and vitamins (A and C). The 100 grams of amaranth greens provide 4 grams of protein, 397 milligrams of calcium, 83 milligrams of phosphorus, 25.5 milligrams of iron, 341 milligrams of potassium, 247 milligrams of magnesium, 9200 IU of vitamin A and 99 milligrams of vitamin C. In amaranth there are some anti nutrient factors, like oxalates and nitrates. The oxalates result in kidney stone whereas nitrates form meta-haemoglobin in the blood. Boiling the leaves like spinach and chard for 5 to 10 minutes and then discarding the water alleviates both potential oxalate and nitrate toxins. Nevertheless, normal consumption does not have such problems. Regardless, in research it is shown that consumption of 200 grams of cooked amaranth poses no health problems.

Leaves of *A. caudatus*, in India are used as tea to purify blood and to get relief from pulmonary problems, piles and strangury in scrofula. Amaranth plant is used as a refringent, purgative, diuretic, as a laxative, against inflammation, enemas in stomach problems, as an antidote to snake bite, for reduction of excessive bleeding during menstruation, in uterine bleeding, in skin problems, in wounds and cough & cold. Its plant is also considered as febrifuge and sudorific therefore recommended for eruptive fevers. It is also used as a

medicine and lotion. The boiled amaranth roots with honey act as a laxative. Boiled leaves are also used in swellings and in stomach troubles. Seeds of amaranth are used in reducing blood pressure, hypertension, cardiovascular diseases and lowering cholesterol. Roots are used to treat diarrhea, ulcer, throat & mouth problems, inflammation, diabetes and allergies. Roots and seeds are used for curing leucorrhoea and impotence. Extract of amaranth leaves has anticancer effect on breast, liver, colon cancer cells and the leaves used for vegetables also has anti - tumour properties.

Uses

- Amaranth is an under - utilized crop whose leaves are eaten as leafy vegetable while seeds are eaten as cereal. Its leaves, shoots and tender stems are eaten as potherb in soups and sauces.
- As dye: Now a days there is an increasing trend towards the replacement of synthetic dyes by natural pigments. In this regard, the whole plant of amaranth can be used in preparing yellow and green dyes. Red pigment present in the plant is used as a colorant in foods and medicines. The roots of amaranth are used to produce dye, in America, which fades very slightly. In North- Western Argentina and Bolivia, red dye of amaranth leaves is used to colour beverages whereas in South-Western United States and Mexico it is used for colouring maize dough.
- In crafts: Due to everlasting property and bright colour of flowers amaranth is used in crafts in some parts of the world.

Improved Varieties:

- ✚ **TNAU Varieties:** Co-1(*A. dubis*), Co-2 (*A. tricolor*), Co-3 (*A. tristis*), Co-4 (*A.hypochondriacus*) and Co-5 (*A.blitum*)
- ✚ **IARI Varieties:** Chhoti Chaulai (*A. blitum*), Badi Chaulai (*A. tricolor*), Pusa Kirti (*A. tricolor*), Pusa Kiran (*A. tricolor x A. tristis*) and Pusa Lal Chaulai (*A.tricolor*)
- ✚ **KAU, Vellanik kara:** Amt-105 (*A.tricolor*) and Amt-237 (*A.tricolor*)
- ✚ **IIHR Varieties:** Arka Suguna, Arka Arunima, Arka Varna and Arka Samraksha
- ✚ **Other Variety:** Konkan Durangi (*A. tricolor*)

Climate and Soil

Being a warm season crop of humid tropics Amaranth is widely distributed in tropical and sub- tropical regions. In temperate, it is grown during summer season. It is grown

throughout the year in tropics, in autumn and spring. Different species of amaranth have different response to photo and thermos periodism. Most of the leaf types are day neutral but differ in day length requirement. Grain species (*A. cruentus*, *A. caudatus* and *A. edulis*) are short day whereas leafy species *A. hypochondriacus* is day neutral. The optimum temperature requirement is 20⁰C-30⁰C. Bright sunlight is required by amaranth for development of colour. Grain amaranth is highly resistant to drought, but lodges as a result of high wind velocity or heavy rainfall resulting in loss of yield. It can be grown on all types of soils. But fertile, rich in organic matter, well drained loam and sandy loam soils, slightly acidic in nature are best for vegetable amaranth. Heavy clay soils with poor drainage or sandy soils with poor water holding capacity are unsuitable for its cultivation. Soil pH ranging 5.5 and 7.5 is ideal for its cultivation, but there are types which require pH as high as 10.0.

Field Preparation

For growing amaranth, field is ploughed to the fine tilth as it requires a very good tilt hand thorough field preparation for getting the best growth. Beds of 2.0 x 1.2 m in size are generally prepared. Weeding and hoeing should be done as and when required, to keep field weed free during field preparation.

Propagation and Planting

Planting method of this crop involves directly seeded or transplanting. Generally, the seeds are directly sown in the field either by broadcasting or in rows.

Sowing, Spacing and Seed Rate

Amaranth can be grown throughout the year in South India. In North India the appropriate time for sowing of leaf amaranth as a summer crop is February - March, whereas as a kharif crop it can be sown during June – July in plains and May – July in the hills. About 2 kg seed is required for one hectare area. As seeds are small in size, they are mixed with fine sand at sowing time. For transplanted crop 1 kg seed per hectare is required. The spacing of plants is kept 20 cm after thinning. When seeds are sown in rows then row distance is kept 20 to 30 cm. Seeds are sown at a depth of 1.0 to 1.5 cm.

Nutrient Management

Being a high yielding crop amaranth is a heavy feeder. About 25 to 30 tonnes of Farmyard Manure at the time of last ploughing and 50:50:20 kg NPK per hectare as a basal dose is recommended for this crop. However, a higher dose of fertilizers 75 kg N, 25 KG



each P and K per hectare is recommended for clipping type of Amaranth (CO-3). Nitrogen is provided in split doses. Half quantity of N is applied for basal application and the remaining half is top-dressed after taking one or two cuttings. Foliar spray of urea or diluted cow urine (1:10; 1litre in 10 litres of water) after every harvest/clipping is good for promoting further vegetative growth and for higher yield.

Irrigation

After sowing and transplanting irrigation is very important to ensure a good crop stand in amaranth. It requires soil moisture to germinate but needs less water to grow. Therefore, first watering is to be done soon after broadcasting and further irrigations are to be given once weeks with gentle water flow. Some of the amaranth species (grain type) are relatively tolerant to drought conditions but in other species (green type) lack of water will lead to stress condition resulting in early flowering with decreased yield and market quality. It has evolved so that it can grow under moisture stress. It extends its taproots under water stress conditions. Frequency of irrigation depends on soil.

Weed Control

Amaranth is a short duration crop with shallow root system. Light hoeing is done to prevent formation of soil crust after irrigation. During initial stages field should be kept free of weeds otherwise it may get stifled by weeds. Some of the primary cause of poor stand in this crop is low soil moisture and soil crusting along with poor seed to seed contact and uneven planting depth.

Harvesting and Yield

Amaranth plant grows rapidly and harvested when it attains a height of 25 to 30 cm. Amaranth plant is ready for harvesting in 20 to 30 days or 30 to 35 days after sowing depending on its variety and method of harvesting. At 25th day plant performance is found to be superior with increases in stem weight, stem diameter leaf weight, leaf length, and leaf breadth and plant height. To get highest yield as well as nutritious and palatable green harvesting stage should be fixed to 25-30 days after sowing. Full grown side leaves are removed only. Tops of the plants may also be cut, leaving the lower leaves to produce new shoots in their axils. Single or multiple harvests may be taken. The leaf quality and yield, both are higher with frequent harvestings/clippings. In case of single harvest amaranths grown for commercial purpose are often uprooted after 3-4 weeks of sowing. For multiple

harvests, first cutting can be taken after 3 weeks of sowing whereas the subsequent cuttings can be taken periodically at 10 to 15 days interval depending upon vegetative growth. It is possible to take as many cuts until flowering begins and vegetable material of preference is no longer available. Generally, 6 to 8 cuttings can be taken but in multi-cut variety CO-3 cuttings can be had for about three months. Subsequent harvests are lower in quality of leaves and quantity as the vegetative stage ends and flowering begins. To prolong vegetative growth one can, go for cutting flower heads. Leafy greens yield ranges in between 10 to 15 tonnes per hectare depending upon the variety, location, season, cultural practices followed and number of cuttings. In mixed cropping system or in dual purpose variety yield of leafy greens is about 7 to 8 tonnes per hectare.

Post- Harvest Handling

Grain: Harvesting of amaranth grain involves three stages:

1. Heads Drying: When the grains mature, heads are cut and dried under shade. Don't left the heads with mature grains for too long, as it will result in shattering of the grains.
2. Grains Threshing: For threshing purpose a few heads are placed in a cloth bag and beaten against the floor or strike with a wooden stick a few times to knock it loose.
3. Winnowing: Threshed grains have a lot of chaff with it and to remove this chaff winnowing is done. For winnowing an empty container is placed in front of a fan or any steady but light breeze. After that threshed grains are poured into that empty container. Being denser the grains will fall in the empty bucket and chaff being lighter in weight will be removed. Grains are poured back and forth until clean. Final cleaning of grains can be done by using fine screens or by gentle swirling and shaking of grains. By this remaining chaff will float to the top and can be easily removed by hands. The clean grains are then dried and stored in an air tight container.

Diseases

No such severe problem of diseases has been noticed in amaranth crop. However, Leaf spot and White Rust are the two diseases that affect this crop.

Leaf Spot: Causal Organism: *Cercospora*Spp.

Symptoms:

Characterized by the presence of numerous small brown circular spots on the leaves. In the beginning, the spots are small, roundish with concentric rings but in later stages these spots increase in size and sometime coalesce.

Management:

Spraying Bordeaux Mixture(5:5:50) or 0.3 per cent Blitox three times at an interval of 15 days.

White Rust: Causal Organism: *Albugobliti*

Symptoms:

Disease is characterized by white coloured, blister like circular or irregular pustules on the lower surface of leaves and opposite each pustule on the upper surface a yellow patch develop. In severe infection leaves die and turn brown thereby give the field a blighted look.

Management:

Following crop rotation and spraying Diathene M-45 or any other copper fungicide @ 2g per litre of water.

Pests

No serious insect – pests have been reported in amaranth crop. However, caterpillars, ants and leaf Webbers are some of the pests which attack this crop.

Control measures:

Leaf webbers and caterpillars can be controlled by spraying Malathion @ 1.5 to 2 ml per litre of water.

Physiological Disorders

Premature flowering or Bolting:

It deteriorates the quality and yield. Usually associated with the short- day varieties plantation during the month November to December, nitrogen deficiency, high temperature and poor soil aeration.

Control measures:

Depending upon the locality, raising the crop at ideal time. Recommended application of nitrogenous fertilizers, light hoeing to keep soil loose can also be practiced.