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New bathua cultivars: a weed to wealth

AMONG the green leafy vegetables, chenopodium (*Chenopodium album* L.) which is commonly known as bathua grows as a weed during winter season and consumed as leafy vegetable. It is also known as pigweed or lamb's quarters and belongs to family Chenopodiaceae. It is rich in nutrients and cheapest available in winter in North India. It is good source of dietary fibre and store house of vitamin A, vitamin C, folic acid and riboflavin as well as minerals viz. iron, calcium and phosphorous, hence suitable for overcoming problem of anaemia. Its leaves can be used in fresh as well as dry forms like kasuri methi through various preparations viz. *roti/ puri/ parantha* etc. with wheat flour. The green foliage of bathua can be used as fodder for animal. Bathua can be used as a potential vegetable as well as fodder for diversification of agriculture to newer areas, environmental sustainability and for combating the nutritional deficiency in human being in many parts of the world. Its cultivation does not require much inputs and could be easily grown on agriculturally marginal lands. Keeping view its potential as a cheap source of antioxidants and other nutrients, nutritionally rich and high yielding genotypes, Pusa Bathua-1 and Pusa Green with good quality traits have been developed by Division of Vegetable Science, ICAR-Indian Agricultural Research Institute, New Delhi. Similarly, ICAR-Indian Institute of Vegetable Research, Varanasi has also developed two cultivars, namely Kashi Bathua-2 and Kashi Bathua-4 & notified by CVRC for cultivation. The characteristics of bathua varieties are given below.

Pusa Bathua-1: This is the first improved variety developed by Division of Vegetable Science, ICAR-Indian Agricultural Research Institute, New Delhi. It is a multi-cut variety with large size and dark green leaves. Plants are 2-2.5 m tall having reddish green leaves and red pigmentation on stems. The tender leaves can be harvested 45 days after transplanting. It is 60% more rich in vitamin C and 10% more rich in beta carotene than locally available bathua marketed. It may attain a height of 1.8-2 m at 150 days after sowing. The average green leaf yield is 30 tonnes per hectare.

Pusa Green: It is a multi-cut variety with large size and dark green leaves which is developed by Division of Vegetable Science, ICAR-Indian Agricultural Research Institute, New Delhi and notified by Central Variety Release Committee for cultivation in NCT Delhi. It gives leaf yield of 36.8 t/ha. It is suitable for both direct sowing in October and transplanting in November. Plant growth is luxuriant. Leaves are smooth and attractive dark green in colour with medium lobbing and serration. The leaves are big in size having 18 cm length and 9 cm width. It recorded high total carotenoids (91.31 mg/100g), iron content (7.6 mg/100g), dry matter 13% and ascorbid acid (50 mg/100g) on fresh weight basis. It may attain a height of 2-2.5 m at 150 days after sowing. It is late bolting in nature and less attacked to diseases and insects.

Kashi Bathua-2: It is a high yielding (36.7 t/ha) cultivar having green leaf, petiole and stem. Plant growth is luxuriant which is ready for first cutting after 40 days of sowing and it continues up to 120 days at regular interval. Its leaves contained 15.2% dry matter alongwith source of vitamin C (21.2% higher), vitamin A, folic acid and minerals. It is an excellent source of phenolics (30% higher) and antioxidants (43.1% higher) than wild bathua. It may attain a height of 1.8-1.95 m at 160 days after sowing. It is notified for Uttar Pradesh.

Kashi Bathua-4: It is a high yielding (40.7 t/ha) cultivar having purplish green leaf and petiole with pink pigmentation on nodes at early stage of growth, and stem colour turns to complete pink at flowering

Pusa Green

Pusa Bathua-1

Kashi Bathua-4

Kashi Bathua-2

stage. Plant growth is luxuriant which is ready for first cutting after 40 days of sowing and continued up to 120 days at regular interval. Leaves have 16.1% dry matter alongwith excellent source of vitamin C, vitamin A, folic acid and minerals. It is also good source of phenolic and antioxidants. It may attain a height of 2-2.15 m at 160 days after sowing. It is released and notified for Uttar Pradesh.

Crop production

It is a cool season crop and fairly tolerant to frost. At high temperature early flowering takes place. It can be grown on a variety of soils but sandy loam or loam soils are best suited than heavier soils. It is a moderately salt tolerant and can also be grown successfully in saline-sodic soils. It responds well to farm yard manures. 1.5-2.0 kg seed are required for direct sowing, however; 450 g seed is sufficient for raising nursery for transplanting 1 hectare field. Treat the seeds with Thiram @ 3g/kg of seed. For direct sowing, seed is mixed with sand and broadcasted in field as it is very small in size. It can be sown in the month of October-November. The seed being very small should be sown not more than 3 mm deep in the soil. The seed is either sown directly in the main field or transplanted after raising nursery. For direct sowing, it is sown in main field in rows 30 cm apart in proper soil moisture. 35 days old seedlings raised in the nursery bed are transplanted at spacing of 30 cm between rows and 20 cm between plants. Immediately after sowing or before transplanting, pendimethalin @3.5 litre/ha should be applied on ground in 500 litre water solution to control pre-emergence weeds. A basal dose of 25-30 tonnes of farmyard manure per hectare should be incorporated in the soil at the time of preparation of land. Application of nitrogen fertilizer is the foremost requirement for leafy growth. N: P: K @ 80:50:50 kg/ha should be applied. It is advantageous to apply 50-60 kg urea per hectare as top-dressing in three split doses after first, second and third cuttings of the leaves. Apply 1% urea and 0.5% micronutrients solution (multiplex) after each cutting for quick growth of leaves. One light irrigation is given immediately after transplanting the seedlings in case the crop is raised by transplanting method. This crop requires less irrigation. However light irrigation should be given in 10-12 days interval. Two to three weeding or hoeing are required to keep the crop free of weeds i.e. 30, 45 and 60 days after sowing/transplanting. First harvest is available 40-45 days after seed sowing or transplanting. Subsequent cuttings can be done at about 20 days interval and 4-6 cuttings are possible till the crop starts flowering when the leaves become unfit for consumption. Average 35 t/ha green leaves are harvested. No serious insect-pest is observed. However, aphids may sometimes cause damage and can be controlled by spraying of malathion @ 2 ml/litre of water. Spray 5% neem seed kernel extract after cutting to keep insects away from crop.

Leaves of Pusa Green

Pusa Green seeds

Seed production

Bathua is cross pollinated crop where pollination takes place by wind. Isolation distance for foundation and certified seed production of *Chenopodium* is 1600 m and 1000 m respectively. The seed crop of these varieties must be raised through transplanting and 400-500 g seed is required for raising nursery on raised bed for transplanting 1 hectare area in the month of October. Seed should be sown in rows at 2-3 mm depth and 35-40 days old seedlings with 3-4 leaves having 10 cm height are used for transplanting. The transplanting is done at a spacing of 60 cm × 45 cm. About 20-25 tonnes of farm yard manure along with 50 kg nitrogen, 50 kg phosphorus and 50 kg potash are applied to the soil at the time of field preparation. Two leaf cuttings are generally taken after 45 and 60 days of transplanting and after that it is left for seed production. An additional dose of 20 kg nitrogen/ha should be applied after each cutting. Rogueing should be done for off-type plants, plants of other varieties, volunteer plants, weeds and diseased plants. All early bolters should be removed from seed production field. A minimum of three field inspection should be made at pre flowering, flowering and post flowering stages. The seed crop should be harvested at right stage of maturity and becomes ready for harvesting in the month of May after 150-180 days after transplanting. It is threshed by stick beating or by mechanical thrasher and then seeds are cleaned by winnowing. Seeds must be dried 6-8% moisture levels and packaged in different packaging materials. A good crop may give yield upto 6-7 quintal seed per hectare.

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Water chestnut

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Water chestnut is most commonly used as edible nut. Kernel contains a large amount of protein, starch, tannins, fat and sugar. It is also a good source of fibre and vitamin B along with Ca, K, Fe and Zn. Nuts with different husk colour like green, red or purple and a blending of red and green colour are found.

Propagation is commercially done by seeds. The fully mature nuts are placed in container with little water to germinate the seeds. Harvesting of nut is usually done at the month of September and continues up to November. Fresh nut yield ranges between 25.0-30.0 q/ha area of pond.

Harvested kernel can be stored in the bottom of the fridge in sealed plastic bags or containers to prevent them from drying out. Content of zinc, iron and manganese are more in nut husk than shelled nut. Popularization and proper augmentation of water chestnut on a large scale could make a significant contribution towards nutritional security and economic upliftment of the society. In addition to food and nutritional security, this is also likely to generate on-farm and off-farm (transportation, storage, processing, marketing etc.) employment.

Concerted efforts are needed to assess the food value for their exploitation at commercial scale. In view of the importance of water chestnut, crop improvement programme has been initiated at ICAR-Indian Institute of Vegetable Research, Varanasi, India in order to popularize and augment its production among growers.