

## Makhana: The wetland wonder

**Makhana, Gorgon nut or Fox nut (*Euryale ferox*) also known as black diamond is a diploid plant with a chromosome number of  $2n=2x=58$ . It belongs to the family Nymphaeaceae and is an endemic and endangered plant representing the only extant species in the genus *Euryale*. It is an annual aquatic herb with gigantic floating leaves and rhizomatous stem, flourishing with bounty in the muddy wetlands.**

INDIA has a lion's share in global makhana production with Bihar alone producing 90% of world's total makhana. Besides being an excellent dietary source of carbohydrates, protein, minerals and fibre, this crop is loaded with therapeutic benefits and has been used in traditional Chinese medicine for over 3000 years along with the Ayurveda and Unani system of medicine in India. Thus, makhana can be considered as a wonder crop that can not only ensure the food and economical security of the poor and marginal farmers, but along with aquaculture can increase the productivity of the otherwise marginal wetlands of Bihar to its maximum. Taking into consideration, the immense economic potential of this crop, a regional centre was set-up in Darbhanga district of Bihar under the ICAR Research Complex for Eastern Region to conduct research on various aspects of Makhana which resulted in the release of the first ever variety of Makhana 'Swarna Vaidehi' suitable for growing in the wetlands of Bihar.

In addition to India, fox nut grows well in the tropical and sub-tropical parts of the world and is an important crop of South-East Asian countries like China, Japan, Malaysia, Thailand, Philippines, Nepal and Bangladesh. In India, commercial cultivation of makhana is mainly limited to the north-eastern part, particularly in northeast of Bihar with Madhubani, Darbhanga, Sitamarhi, Saharsha, Katihar, Purnia, Samastipur, Supaul, Kishanganj and Araria districts being the major producers.



An experiment plot of Makhana at MBAC, Agwanpur, Saharsa with fully expanded Makhana leaves



Harvesting of Makhana

Fox nut fruit is a berry, large, round, spongy consisting of 20-25, small black seeds which are processed into the final edible product i.e. makhana. The seeds being low in saturated fats, calories, sodium and cholesterol are considered as an ideal snack and high level of minerals like magnesium along with low glycemic index makes it beneficial for people suffering from heart diseases and diabetes. It is an excellent anti-oxidant and has been traditionally used for the treatment of chronic diarrhoea, diabetes, gonorrhoea, kidney disorders, constipation, stomach-ache and beri-beri. In Ayurveda and Unani medicine, Fox nut is believed to possess aphrodisiac properties. An alkaloid 'drummine' is found in the leaves is considered to be responsible for the anti-rheumatism activity of the leaves and all the plant parts are reported to have tonic, astringent and de-obstruent properties.

### Cultivation

Makhana is ideally cultivated in stagnant perennial water bodies like ponds, land depressions, oxbow lakes, swamps and ditches where a water depth of 1-1.5 meter is maintained throughout the year. It grows well in humid to sub-humid conditions and at an air temperature of 20°C-35°C, relative humidity of 50-90% and annual rainfall of 100-250 cm is conducive for its optimum growth. Makhana is an obligate self-pollinated, seed propagated plant and an average seed rate for a hectare land is 90-100 kg seeds. Sowing is done preferably in the month of December. Seed germination in makhana is hypogeal and thinning is done to maintain optimum plant density with a plant-to-plant spacing of one meter. By the month of April-June, large orbicular leaves can be seen floating on the water surface. In makhana flowering and fruiting takes place from May and continues up to October-November. Fertilization taking place at a very early stage of flowering ensures selfed fruits. Fruits become fully matured within 35-40 days of flowering.

## Harvesting

The ripe fruits burst during the month of July-August and the ripened seeds get settled in the bottom of the pond within 2-3 days. Collection of seeds from the pond bottom starts from August onwards and is a very tedious job performed only by skilled professionals mainly comprising of women population of a specific community of 'Mallah' of northern Bihar. The collected



Harvested seeds of Makhana being taken out



Harvested Makhana seeds

seeds are thoroughly washed to remove mud and other debris from pond bottom. The yield of fox nut from a hectare land may vary from 12-20 quintals/ hectare.

## Post-harvest handling

The fresh cleaned seeds of fox nut are sun dried for 2-3 hrs to reduce the moisture content to approximately 25%. Further, the dried seeds with optimum moisture percentage are graded for uniform heating and popping. Wooden framed sieves of different sizes with highest pore size of 12 mm diameter and lowest of 4 mm diameter respectively are used for grading of seeds. Next in processing comes pre-heating where the sun dried, graded seeds are heated in earthen pitcher or iron pan with continuous stirring. These pre-heated seeds are then stored under ambient conditions for 48-72 hours for the equilibration of moisture, a process known as tempering. Finally, the pre-heated and tempered seeds are roasted at a temperature of 300°C and cracked with wooden hammer to obtain popped makhana lava. The recovery rate for popped makhana is 40-42% and on average, 100 kg of seed yield 38-40 kg of popped nuts. The popped makhana is then packed in gunny bags with plastic lining and can be stored for long time.

## Economic potential

Being loaded with heavenly goodness, be it gluten free protein source or an antioxidant rich fruit with low glycemic index, low calories and fat content, the popularity of Fox nuts is increasing among the health conscious consumers, thus, boosting its market growth. Fox nuts are highly popular in countries like India, China, Japan and Thailand with India being a major player in the global Fox nuts market. India's exports of fox nuts grew at 11.2% annually from 2013 to 2017 and in 2017-18 and India exported USD 21.2 Million worth of fox nuts to the world. The global fox nuts market is estimated to grow by USD 72.5 million during 2019-2023 and the presence of several untapped markets are likely to encourage new players to enter the market thus, boosting the economic potential of this wonder crop.

## Export promotion strategies and scope for entrepreneurs

The Agricultural and Processed Food Products Export Development Authority (APEDA) in India has been putting efforts to enhance the economic/export potential

of Makhana and in this regard it has proposed to interact with the State Governments of Makhana producing states and ICAR institutions to collate production data and identify specific pockets for inducing development programs for export growth along with conducting export awareness programs. It has also emphasized on the interaction with ICAR RCER Research Centre for Makhana located at Darbhanga, Bihar for assistance in promoting production and processing technology for Makhana. The potential of makhana market in Western countries like USA and UK still needs exploration and to tap high growth potential of these markets several start-ups and entrepreneurs may play a significant role by introducing processed Makhana products in these countries. The drudgery involved in harvesting process warrants development of advanced technologies and equipments to improve the efficiency of Makhana harvesting as well as reducing the operational hazards which is another major field wherein the entrepreneurs can be major players.

## Conclusion

Makhana is primarily marketed as a pop with very limited value addition. In spite of being a wholesome, nutritious, organic food the potential of Makhana production still remains under-exploited and by and large remains till date, besieged with several constraints like lack of technological interventions, absence of organized marketing structure, inefficient supply chain and most importantly weak socio-economic condition of Makhana growers and processors. However, it remains an unequivocal fact that this sector holds immense potential both as fresh product and value addition, product development and innovation. Thus, an intensive and focused work on different aspects of Makhana production and a comprehensive collaboration between different stakeholders will be highly significant in improving the livelihood of millions of Makhana growers and bringing glory to this under-explored wet land wonder.

For further interaction, please write to:

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