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Scientific Cultivation of Makhana for Improving Farmers' Livelihood in Eastern India

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Abstract

Makhana (*Euryale ferox* Salisb.) is being increasingly recognized as a super food packed with nutritional and medicinal properties. While its demand is on rise globally, its commercial production is limited in northern part of Bihar. This provides a unique opportunity for the makhana growers to improve their income and livelihood by increasing makhana productivity using the scientific techniques of cultivation. Makhana production can be further increased by expanding the area under its cultivation. Traditionally, it is being grown in the ponds and perennial water bodies, but recently we have developed technologies for its cultivation in field condition as well. Integration of makhana with fish, and its inclusion as a component crop in the local cropping sequences together with the crops like rice, wheat, water chestnut, berseem *etc.* are also possible, which would certainly improve the land productivity and farm income. This article deals briefly with the scientific cultivation of makhana for improving farmers' livelihood in Bihar and other parts of Eastern India.

Introduction

Makhana (*Euryale ferox* Salisb.) is an important aquatic cash crop grown primarily in eastern India. Although it is cultivated in Bihar, West Bengal, Assam, Manipur, Tripura, Madhya Pradesh and a few other states in India, its commercial cultivation is practiced mostly in eight to ten districts of north Bihar including Darbhanga, Madhubani, Samastipur, Saharsa, Supaul, Purnia, Kisangani and Katihar. Together they cover an area of around 27,000 ha and contribute nearly 80% to the total makhana production in India. In view of the growing awareness about nutritional and medicinal values of makhana, its demand has been on rise globally. Makhana is also known as fox nut and gorgon nut. Considering its profound commercial, medicinal and nutritional importance, makhana seed is also known as black diamond. Conventionally, makhana is being grown in the ponds and perennial water bodies particularly by the fishermen communities of north Bihar. However, to meet its rapidly growing demand, productivity and the area under makhana cultivation both need to be increased. As the number of ponds and natural water bodies are believed to decline gradually, introduction of makhana cultivation in field condition, like rice, may be required for further expansion of the area under makhana cultivation. The perceived benefits include better harvesting efficiency of makhana seeds leading to higher productivity in field, and possible inclusion of makhana as a component crop in cropping sequences common to north Bihar and other states of eastern India. Scientifically cultivated in field, particularly in the region with sufficient availability of water in growing season, makhana production and productivity can be substantially enhanced, and in conjunction with the improved makhana farming

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in traditional pond system, a lot can be achieved towards meeting the rising global demand of makhana from eastern India.

Nursery Raising and Transplanting

Nursery is not required for makhana farming in ponds, but for field cultivation, an area of 500 m^2 is required to raise nursery for transplanting in one hectare area. Twenty kilograms of healthy makhana seeds are broadcasted in a well prepared nursery (enriched with organic manure and fertilizers) in the month of December/ January, maintaining sufficient level of water all through. Seedlings become ready for transplanting by March. Young makhana plants should be uprooted carefully from nursery so as to avoid any damage to root, and transplanted in a well prepared field in the month of March/ April, maintaining a line to line and plant to plant distance of 1.25 m. Conventionally, no external fertilization is given to makhana growing in ponds as the pond systems are self-sustaining in nutrient supply due to decomposition of the leftover plant biomass post makhana harvesting. However, under intensive cultivation in field conditions, wherein more than a single crop (makhana) is to be taken, external application of nutrients is required to sustain nutrient supply to the growing plants and the crop(s) that follow. Recommended fertilizer dose for field cultivation of makhana is 100:60:40 kg of N:P:K per hectare (Kumar *et al*., 2011). Organic matter is extremely important in makhana cultivation. Farm yard manures or other organic sources of nutrients should therefore be added sufficiently to reduce the reliance on mineral fertilizers. Heavy textured soils with high water retention capacity and high level of organic carbon is preferred for makhana cultivation. As the soils of eastern and north-eastern India are mostly deficient in micronutrients like zinc and boron, which are of critical importance to crop production in the region (Kumar *et al*., 2016), additional yield benefit can be harvested by micronutrient fertilization in makhana farming. Recent experimental observations of the lead author have rather confirmed the positive effects of secondary nutrient (Mg) application and micronutrient fertilization (Zn, B, Cu) on yield and quality of makhana in north Bihar.

Figure 1: Frontal view of makhana leaf

Figure 2: A general view of makhana field

Intercultural Operations

Most important requirement for the field cultivation of makhana is ensuring sufficient availability of water (at least 1.0-1.5 fit in depth) throughout the growing season. Manual weeding is required during the initial phase of makhana growth (up to 45 days of transplanting). Once the makhana leaves cover the entire water surface, no effort is required for weed control. As makhana is grown in aquatic environment, using high quantities of chemical pesticides is not advisable due to associated environmental concerns. Organic pesticides are instead better advised for controlling pests in makhana field. Neem cake @ 25 kg/ha can be used as basal dose during land preparation. If required, spraying 0.3% aqueous solution of neem oil can be used to repel the insect pests like aphids and caseworm.

Harvesting and Processing

Flowering and fruiting starts in the month of May (nearly 2 months after transplanting) and continues up to October/ November. It takes around 40-45 days (after flowering) for the fruits to become fully mature. Thereafter, the fruits start rupturing and the seeds with pinkish cover remain afloat on the water surface. After 2-3 days, they get settled on the bottom of the field. Since flowering, fruiting and rupturing of the fruits are highly unsynchronized in nature, a practical decision has to be taken before harvesting as to how much time to allow for the fruiting and rupturing in order to avoid any significant yield loss and to accommodate the crop(s) to follow in the cropping sequence on the same field. A crop transplanted in March can be harvested in early August, although fruiting may continue up to November, if left unharvested. Makhana seeds are collected from the floor of the field using a local device called '*Gaanja*'. Using scientifically devised cultivation techniques, farmers can get a seed yield of up to 3.0 t/ha from an improved variety. '*Swarna Vaidehi*' - the first ever makhana variety (developed by Research Centre for Makhana (RCM), Darbhanga, Bihar), is the recommended variety for cultivation in *Mithila* region of Bihar. Sabour Makhana-1 is another variety available for the region.

Figure 3: Harvesting of makhana seeds using local device 'Gaanja'

In addition to giving better yield compared to conventional pond system (1.5-2.0 t/ha), makhana cultivation in field saves as much as four months of time wherein other crops can be accommodated. Even double cropping of makhana on the same field is also possible. Rice, berseem, wheat, water chestnut *etc.* are the crops that can be taken after Makhana on the same piece of land. Ensuring a water depth of at least a metre, fish can also be integrated with makhana for improved system productivity and farm income. After harvesting, black colored seeds of makhana have to undergo a series of highly skilful procedures including sun drying, seed grading, pre-heating, tempering, roasting, popping and polishing before we see the consumable white colored pops of makhana.

Conclusion

On the whole, makhana is a highly remunerative crop, and if cultivated scientifically, it can greatly enhance the income and livelihood of farmers in Bihar and other states of eastern India. Apart from its field cultivation, ponds and other natural water bodies, with ensured availability of water during growing season, can be utilized for horizontal expansion of makhana farming in other parts of the country.

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