A study of knowledge and traditional wisdom of makhana cultivation in Bihar

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Received 15 February 2020; revised 11 March 2020

Makhana (Euryale ferox) is an aquatic crop from the family Nymphaeace and is commonly grown in stagnant water bodies like ponds, swamps and ditches with shallow water. Euryale is a self-pollinated plant, in which pollination takes place at the early stage of flower development. Bihar is the largest producer of makhana throughout the country with an area of approx 15,000 ha. In spite of several uses and immense market potential in India and abroad, makhana is still cultivated through traditional system, area of which is declining in recent years. Therefore, an attempt was made to understand traditional wisdom of makhana production practices with special reference to its post harvest management. For this purpose, 100 makhana growers were identified from Madhubani district of Bihar which occupies more than 30% of the total area and production. They were personally interviewed with the help of a structured schedule consisting of different components such as, suitable soils in terms of type, quality and its strength, the type, slope and depth of ponds of makhana, the preparation and management of pond for makhana cultivation, seeds with respect to source and quality, fertilizer and disease management, harvesting process of makhana with respect to its the time and process of maturity along with the grading and marketing of makhana. The results indicated that makhana production practices are primarily governed with the traditional knowledge system which the growers obtained through their forefathers.

**Keywords:** Disease and pest management, Euryale ferox, Makhana, Knowledge, Traditional wisdom

**IPC Code:** Int Cl. A61K 36/18, A61K 36/185, A01H 6/00

Makhana is considered as a superior dry fruit, as it contains several rich and nutritional ingredients. Edible parts of the seeds contain 12.8% moisture, 9.7% protein, 0.1% fats, 0.5% minerals, 76.9% carbohydrates and 1.4 mg/100 g of iron and traces of carotene. The calorific value of raw and popped seeds of makhana is 362 and 328 K Cal/100 g, respectively. From sustenance point of view, the eminence of makhana protein is very superior to a number of food plant- and animal-based diets.

In the year 2016, India exported popped makhana worth with US$ 1,049,544 to Australia, Canada, Greece, Singapore, Togo, United Arab Emirates, United Kingdom and United States of America. It is believed that makhana is used in many traditional medicines in China. In spite of this gloomy picture, the cultivation of makhana is highly unorganized and least explored with limited documentation for its cultivation and estimated production. Since, no systematic documents pertaining to the system of makhana production, its processing and marketing are available and as yet no reliable data pertaining to cultivation practices are available hence, considering its importance, uses, market and export potential, a need was felt to have systematic study to figure out the grass root reality related with makhana cultivation and its production.

It is well recognized fact that makhana growers are not able to get good return of their produce as commensurate their hard labour and expenditure. At the same time, due to troublesome practice and lack of scientific knowledge they are in the process of quitting their traditional business of makhana production. Hence an attempt was made to generate much needed information related with makhana production technology through its producers directly in order to get the true feedback involved in makhana cultivation.

**Methodology**

The present study was conducted in Madhubani district of Bihar as this particular district accounts for 30% of total area and production. Further, 100 makhana growers were selected from four blocks of the district viz, Pandaul, Rahika, Kaluahi and Benipatti based on the production. A list of growers was obtained who received training by the institute on various occasions. Further, from the list, 100...
respondents were identified from selected blocks by using proportionate probability principle. The data related with extent of knowledge and makhana production technology was obtained through structured interview. During the data collection, the investigator visited to their respective home or farm wherever they were made available along with interview schedule. The data were systematically arranged and tabulated for meaningful interpretation.

**Results and Discussion**

In the course of research, the main effort was made to assess the knowledge and traditional wisdom of makhana growers with respect to their different makhana production practices. The makhana cultivation component were described under the different segment such as, suitable soils in terms of type, quality and its strength, the type, slope and depth of ponds of makhana, the preparation and management of pond for makhana cultivation, seeds with respect to source and quality, fertilizer and disease management, harvesting process of makhana with respect to its time and process of maturity along with the grading and marketing of makhana. The results related to these aspects are presented in Tables 1-6.

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<tr>
<th>Component</th>
<th>Knowledge</th>
<th>Traditional wisdom</th>
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<tr>
<td><strong>Type</strong></td>
<td>73% of respondents believe that black clay soil is essential</td>
<td>100% makhana growers believe that soil is most essential component in makhana cultivation.</td>
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<td><strong>Soil Quality</strong></td>
<td>100% growers reported that soil quality is important.</td>
<td>83% of respondents ranked soil quality as most essential while, only 17% respondents ranked it as an essential component.</td>
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<td><strong>Strength</strong></td>
<td>57% of residents reported that soil colour and texture are the indication for good soil strength; however, 43% respondents said about soil structure, general appearance or stickiness along with soil colour as the strength of soil.</td>
<td>100% of respondent reported that soil strength/water holding capacity were the most essential element of soil.</td>
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<td><strong>Shape</strong></td>
<td>None of the respondents reported about the actual ideal shape of pond for makhana production.</td>
<td>91% makhana growers said that shape of pond doesn’t matter in makhana cultivation, however; 9% respondents reported it as an essential component.</td>
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<td><strong>Pond Slope</strong></td>
<td>74% of respondents reported that 45° slope of pond is essential to avoid soil erosion, while, 26% said that 30° slope is sufficient enough for water holding.</td>
<td>58% of makhana growers reported that slope of pond is most essential element while, 33% reported essential whenever only 9% reported least essential.</td>
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<td><strong>Depth</strong></td>
<td>For plant growth: 74% of respondents reported that 3 feet standing water is best for plant growth followed by 19% growers who reported 2 feet standing water is enough. Only 7% of respondents told that 4 feet standing water is best suited for makhana production. For Harvesting: 57% of respondents reported that 6 feet depth of water is best for harvesting while 43% were found 5 to 5.5 feet water depth sufficient for guri (seed) collection.</td>
<td>It was found during the study that ideal depth of pond is most essential component as reported by 78% of respondents whenever 22% found it essential.</td>
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<td><strong>Pond preparation and management Preparation</strong></td>
<td>100% of selected respondents reported that pond preparation (Eradication of weed, cleaning of pond etc.) before seed sowing is most essential for makhana production.</td>
<td>100% respondents reported that pond preparation before seed sowing is most essential for makhana production.</td>
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<tr>
<td><strong>Management</strong></td>
<td>The eradication of aquatic weed is most important for makhana cultivation. This fact was revealed of aquatic plants/weeds before and after by 94% of respondents while only 6% seed sowing is most essential component. Of makhana growers were found to control their weed either manually or chemically.</td>
<td>100% respondents reported that eradication of aquatic weed is most important for makhana cultivation. This fact was revealed of aquatic plants/weeds before and after by 94% of respondents while only 6% seed sowing is most essential component.</td>
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On the basis of findings, the study revealed that black clay soil was most suitable for makhana cultivation and soil quality is the most essential component in makhana production. Makhana grows best at the 2 to 6 feet of water depth; however, shape of pond has no role in makhana production. Pond preparation and management are an important event in makhana production and almost all the growers perform this event. Seeds are the basis of life and so in case of makhana, 83% of the selected growers often found to use their own collected seed as there was no available market for makhana seed in their locality. However some varieties like Swarn Vaidehi and Sabour Makhana have been developed from National Research Centre for Makhana and Bihar Agricultural University, Sabour respectively, but farmers were mostly unaware about them. The 61% of selected respondents did not apply any fertilizer in their Makhana pond, but 39% of respondents were found to apply inorganic fertilizer commonly Urea, DAP and trace amount of household organic manures. Insects/pests are the major problem as reported by all the respondent, major insects reported by them were aphids, leaf hopper, fruit borer, leaf feeder, stem borer, fruit rot, production. For the remedial measure, 71% of respondent mainly found to use Fenvalerate (Trade name Fenval) and lime only while, 29% respondents were found to apply anyone Fenvalerate, Mancozeb, Carbendazim along with lime to control diseases and pests as per availability. The perusal of findings also revealed that August-September was the ideal period for maturing and harvesting of makhana while
harvesting is primarily carried out early in the morning and finished till mid of the day. The harvesting (collection of guri) is often performed manually by all the respondents. As per the report of findings makhana is graded into five categories viz, Thurri, Murra, Olwa, Lawa and Lawa Top. The 47% of the respondents sell their produce directly in the market at a price range of Rs. 200-300/= per kg but the sell price varies according to the quality and market demand.

**Conclusion**

Overall, it can be concluded from the study that traditional cultivation of makhana is widely adopted in northern region of Bihar. The knowledge related to indigenous makhana production has been passed down from generation to generation and it must be explored for better scientific inclusion. Districts of northern Bihar face severe flooding during monsoon every year and it has numerous traditional water bodies which needed to be utilised effectively. Traditional knowledge and technologies are sustainable and cost effective; however, it has several complications with modern scientific innovations these needed to be addressed in right way. The study was aimed to open an insight into various traditional knowledge and wisdom related with makhana production technology. Introduction of new improved variety, application of nutrients and control of pests was found to be major challenges during the study. The findings from this study will be thus helpful in conserving traditional cultivation of makhana production and at the same time help the farmers to adopt better technologies for improved production and productivity as well as create a new pathway for policy formulation and future research in concerned area.

**Acknowledgements**

The authors would like to pay their gratitude to the local makhana growers for sharing their wisdom. We are also thankful to NRC, Makhana, Darbhanga and Fisherman cooperative society, Madhubani for their cooperation while data collection in remote village areas. The author would also like to thank RPCAU, Pusa for providing fellowship to conduct the research.

**Conflict of Interest**

The authors of this manuscript hereby declare that there is no conflict of interest in publishing this manuscript.

**Authors’ contribution**

The present work has been conceptualized and designed by A K and A K S. Co-authors B K and S K helped during data collection and reviewing the manuscript. A K S checked and corrected the final
draft. All authors read and approved the final manuscript.

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