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Morphological Characteristics of Makhana Germplasm of Manipur under Darbhanga Conditions

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ABSTRACT

Makhana (Fox Nut or Gorgon Nut) botanically it is known as *Euryale ferox* Salisb is a flowering belongs to family *Euryalaceae* (Nymphaeaceae). Makhana is grown in both field and pond conditions. Seed is sweet and sour in taste, astringent herb that acts as a tonic for the kidney and spleen. The seeds are mostly used as a stomachic and for treatment of articular pains, micturition and seminal loss. All the germplasms selected for study were from Manipur. A research trial was carried out in the experimental plots of the Research Center for Makhana, Darbhanga (Bihar). Its commercial cultivation is limited to North Bihar, Manipur, parts of West Bengal and Madhya Pradesh. In the state of Bihar, approximately, 80% of total production of processed Makhana comes from Darbhanga, Madhubani, Purnia and Katihar districts alone. Area under makhana cultivation is about 13,000 ha. It was recorded that germplasm number 10 registered the highest fresh (14.342) and dry (1.148 kg) yield of biomass. However, the lowest fresh (4.214 kg) and dry (0.464 kg) biomass yield was recorded with the germplasm number 4.

Keywords: Euryale ferox Salisb, Makhana, Morphology, evaluation

INTRODUCTION

Makhana seeds are popularly called as Black Diamond as raw and famously known as white ball when it popped. Makhana is a flowering plant classified in a distinct family *Euryalaceae* (Nymphaeaceae), botanically it is known as *Euryale ferox* Salisb. It is also known as Fox Nut or Gorgon Nut. This crop is an aquatic emergent macrophyte. Makhana is such a cash crop which is cultivated normally without the application of any chemical fertilizers or manures. It is grown in both field and pond conditions. Euryale seed is a sweet and sour astringent herb that acts as a tonic for the kidney and spleen. The seeds are mostly used as a stomachic and for treatment of articular pains, micturition and seminal loss. Seeds are used in the remedy of diseases of the spleen and gonorrhea. It helps women to overcome postnatal weakness (Jha and Barat, 2003). Makhana is consumed as roasted snacks. It is used in kheer mix, pudding, milk based sweets, dal makhani, and vegetable curries. In north Bihar region, it is used as an ingredient of puja and havan items and is also taken during fasts besides medicine. Makhana is used as starch for coating on the quality fabrics like Benarsi sarees etc (Jha and Barat, 2003). According to Singh *et al.* 2012, there is need to mitigate imminent climate change to enhance of agricultural system productivity through efficient carbon sequestration and improved production technologies. Makhana is one of the prominent nutritious aquatic crop can be utilized for improving water bodies productivity through efficient carbon sequestration and improved production technologies.

Makhana plant is considered as a native of South-East Asia and China, but distributed to almost every part of the world. In general, its distribution is extremely limited to tropical and subtropical regions of South-East and East Asia and known to exist in Japan, Korea, Russia, North America, Nepal, Bangladesh and some parts of India. In India it grows abundantly in Bihar, West Bengal, Assam and Manipur. In the state of Bihar, major Makhana producing districts include Darbhanga, Sitamarhi, Madhubani, Saharsa, Supaul, Araria, Kishanganj, Purnia

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and Katihar. Approximately, 80% of total production of processed Makhana comes from Darbhanga, Madhubani, Purnia and Katihar districts alone. Area under makhana cultivation is about 13,000 ha. The plant does best in hot, dry summers and cold winters. For its proper growth and development, the conducive range of air temperature is 20°C-35°C, relative humidity 50%-90% and annual rainfall 100cm-250cm. Singh (2003) has provided an account of the distribution and uses of Makhana in Manipur. Makhana is also known as a crop of ponds, land depressions, ox-bow lakes, swamps, ditches and fields. Makhana growing in swamps is shallow and rich in nutrients (Singh, 1992). If the same pond is continuously used for its cultivation year after year, scarcely any external application of fertilizers or manures is done. Hence, an ecosystem is established in which decayed and mineralized organic matter from previous crop supports the subsequent crop. Makhana has thick fibrous roots comprising of 4-6 clusters each consisting of about 15 rootlets. Technically, Makhana is a perennial and growing from a short, thick erect rhizome. It is usually best raised annually from seed. Leaves show heterophyllous growth. The leaves are about 4 different types appearing in the chronological order of sinuate, hastate, sagittate and orbicular types. The first three sets of leaves are not prickly but the last set of leaves is prickly. The orbicular leaves by their perpetual growth attain larger, heavy, orbicular, corrugated structure with spines (Singh, 2003).

There are many germplasms of the plant found at national and international levels. These germplasms do not possess very similar morphological characteristics. On the basis of this fact, this study has been initiated to examine the differences in morphological characters on germplasm collected from different locations of Manipur. The fresh seeds are lumpy, and surrounded by a streaked bright red arils. After some time (3-4 days), the aril of fresh seeds gets decomposed and they turned into black colour. Seeds are enough bold and having a hard outer covering. The diameter varies from 0.5 to 1.5 cm. The edible part of the seed is its perisperm, which is white and starchy in nature. Euryale is a monotypic genus. Hence, there are no other species under this genus. Makhana is a diploid plant and the chromosome constitution of this plant is 2n=2x=58 (Mishra *et al.*, 2003; Kumar *et al.*, 2011 and Singh *et al.*, 2014). In the absence of genetic diversity, no improvement could be made in crop plants. Keeping this fact in view, studies on genetic diversity in makhana, using 36 germplasm (collected from different places of Bihar and Manipur) was conducted and the range of different quantitative traits is depicted as : Days to germination (28-35); Days to initiation of flowering (112-126); Days to fruit bursting (146-156); No. of effective fruits per plant (8-15); Fruit diameter (4-8 inch); No. of seeds per fruit (20-200); Seed yield per fruit (15-150g); Diameter of seed (0.4-1.5cm); 100-seed weight (40-130g); Seed yield per plant (150-1600g) Owing to peculiar characteristics of makhana buds, the artificial hybridization is not possible through conventional means in this crop. Therefore, artificial selection is the only possible way for genetic improvement in Makhana (Mishra *et al.*, 2003 and Kumar *et al.*, 2011)

MATERIALS AND METHODS

This work was carried out in the experimental plots of the Research Center for Makhana, Darbhanga, North Bihar, India, located in the Bagmati flood plain (lat. 26° 10′ N, Long. 85° 87′ E, Elev. 49 m msl and mean annual rainfall 1150 mm). Prior to the experiment, the field had not been under any cropping. All the germplasms selected for the study were collected in the month of October, 2010 from Manipur. A case study approach involved methods of observation, measurement and bagging etc. All these works have been done on germplasms collected from different parts of Manipur. The study for comparison of morphological characteristics of different germplasms consisting the parameters like no. of leaves, dimension of leaves, no. of flowers, no. of fruits, biomass and seed yield per plant on dry weight basis were measured under in situ condition (Fig 1to 6). At first the seeds were sowed in nursery in December 2010. After that germination started and plants attained proper growth. After 2 months of seed sowing, plants were transplanted in the field in the month of March in the fields having 1.0 ft. of water. In the mid of May flowering started. Flowers emerged on the water surface for 5-6 days and sank thereafter, the individual plants were tagged with sticks and numbers were put on the aluminium sheets. No. of leaves was counted. The lengths of peduncles were measured with the help of measuring tape starting from the center of the leaf to the rhizome. For measuring the biomass the plants were uprooted from the field. Attached mud, was removed through washing. Measurement was taken on the weighing machine. No. of flowers was also counted. After 4-5 days of flowering the flowers were bagged so as to enable the number of fruits to be counted. At the grand growth stage, all the leaves attained maximum size. Thereafter the dimensions of leaves were measured with measuring tape. All these observations were repeated at the interval of 20 days. Hence, seeds of all

10 germplasms were collected and oven dried at 70°C for two days. Thereafter, the oven dry weight of the seed was taken. Experimental soil pH was 6.8-7.4, with low to medium status of organic carbon (0.30-0.574%), low in available P (8 kg/ha) and medium in available K (140 kg/ha)

RESULTS AND DISCUSSION

Data for different germplasms were collected with reference to the parameters like number of leaves, leaf dimension, total number of flowers, number of total fruits, yield and biomass yield per plant (Fig 1 to 7). Data represented in table 1 revealed that the number of leaves varied from 2.5 to 5.5. The maximum number of leaves (5.5) was recorded with germplasm number one followed by germplasm number 10 (4.3) and number 6 (4.0), respectively. The linear leaf areas of ten germplasms ranged from 80 cm X 76 cm to 114 cm X 112 cm with the highest in germplasm number nine (114 cm x 112 cm) followed by germplasm number eight (114 x 105 cm). The maximum number of flower was recorded with the germplasm number 1 followed by 4 and 10. It was recorded that germplasm number 10 registered the highest fresh (14.342) and dry (1.148 kg) yield of biomass. However, the lowest fresh (4.214 kg) and dry (0.464 kg) biomass yield was recorded with the germplasm number 4. Pertaining to the fresh and dry yield of seed, it was found that germplasm number 10 showed the highest potential. Similar to the yield pattern of biomass, the germplasm number 10 was also observed to be recorded the maximum fresh (1.726 kg) and dry (1.295 kg) yield of seed while the germplasm number 4 registered the minimum fresh (1.371 kg) and dry (1.084 kg) seed yield. On the basis of seed yield potential the germplasm 10 was economically superior to other germplasms which could be multiplied further at a larger scale to

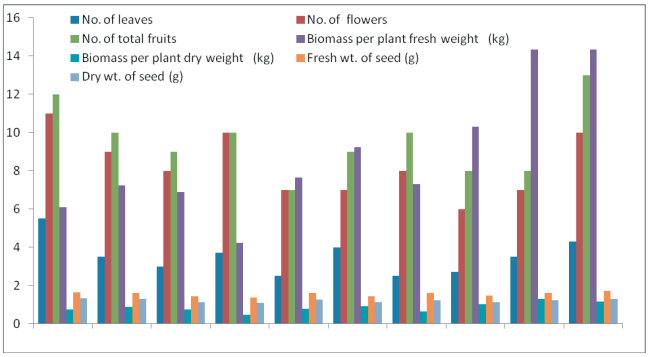

Fig1: Morphological diversity in Euryale *ferox* Salisb germplasms collected from Manipur, India

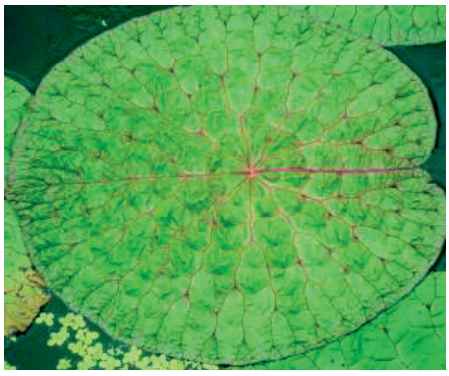

Fig. 2: Upper surface of leaf

Fig. 3: Dorsal portion of leaf

Fig. 4: Flower of makhana in bloom

Fig. 5: Flower and fruit of makhana

Fig. 6: Two half section of well-developed fruit

Fig. 7: Fresh seeds of makhana

Table 1: Morphological characteristics of ten germplasms of *Euryale ferox* Salisb. collected from Manipur, India.

Code No.	No. of leaves	Leaf dimension Length x Width (cm)	No. of flowers	No. of total fruits	Biomass per plant fresh weight (kg)	Biomass per plant dry weight (kg)	Fresh wt. of seed (g)	Dry wt. of seed (g)
1	5.5	88 x 80	11.0	12.00	6.090	0.731	1.653	1.323
2	3.5	114 x 112	09.0	10.00	7.234	0.869	1.615	1.282
3	3.0	80 x 76	08.0	9.00	6.875	0.757	1.424	1.125
4	3.7	110 x 100	10.0	10.00	4.214	0.464	1.371	1.084
5	2.5	95 x 90	07.0	7.00	7.635	0.764	1.603	1.251
6	4.0	89 x 82	07.0	9.00	9.214	0.922	1.449	1.116
7	2.5	105 x 102	08.0	10.00	7.302	0.658	1.599	1.216
8	2.7	114 x 105	06.0	8.00	10.310	1.031	1.456	1.122
9	3.5	110 x 103	07.0	8.00	14.312	1.289	1.605	1.228
10	4.3	100 x 90	10.0	13.00	14.342	1.148	1.726	1.295

achieve a better yield. Another feature was found that the numbers of flowers are directly proportional to the number of fruit.

CONCLUSION

The data indicate that the less genetic variability has been found among these makhana germplasms. This may be because of the fact that makhana is an absolutely self-pollinated crop as there is no chance of cross–pollination and as a result of this there is no genetic combination. Further, the material belongs to the same geographical locality. These two factors seem to be possible causes of the narrow range of different traits. Makhana is one of the prominent nutritious aquatic crops for efficient mitigation imminent climate change and to enhance water bodies productivity (Singh *et al.*, 2012).

REFERENCES

Jha V and Barat GK. 2003. Nutritional and medicinal properties of *E. ferox* Salisb. In: R.K Mishra, V. Jha and P.V Dehadrai, (Eds). *MAKHANA*, DIPA, ICAR, Delhi pp. 230 to 238.

Kumar L, Gupta VK, Khan MA, Singh SS, Jee Janardan and Kumar Askok. 2011. Field based Makhana cultivation for improving cropping intensity of rice fields. *Bihar Journal of Horticulture* **1**(1): 71-72.

Mishra RK, Jha Vidyanath and Dharai PV. 2003. *Makhana* (eds.), ICAR, New Delhi, 340p.

Singh S, Goel AK and Sharma SC. 2003. Prospects of makhana cultivation in central Uttar Pradesh. In: R.K Mishra, V. Jha and P. V Dehadrai (eds.) *MAKHANA*, DIPA, ICAR, Delhi, 221 - 227.

Singh JK. 1992. Studies on conservation and management of makhana (*Euryale ferox* Salisb). Ph. D Thesis, L.N Mithila University Darbhanga.

Singh AK, Sangle UR and Bhatt BP. 2012. Mitigation of imminent climate change and enhancement of agricultural system productivity through efficient carbon sequestration and improved production technologies. *Indian Farming* **61**(10):5-9

Singh PK. 2003. Distribution and uses of makhana in Manipur. In: R.K Mishra, V. Jha and P.V Dehadrai (Eds). *MAKHANA*, DIPA, ICAR, Delhi 8-13.

Singh SS, Singh AK and Sundaram PK. 2014. Agrotechnological options for upscaling agricultural productivity in eastern Indo Gangetic Plains under impending climate change situations: A Review. *Journal of AgriSearch* **1**(2): 55-65.

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