



Major Diseases of Makhana Crops and Their Management Tactics

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Makhana (*Euryale ferox* Salib) is crucial aquatic cash crop and about 80-90 percent of the world's total production comes from Bihar which circumstantially Mithila and Simanchal-Koshi region of Bihar, spanning over 35,000 hectares of wetlands. It thrives in stagnant water bodies like ponds, shallow wetlands and swamps, and cultivation mostly in tropical and subtropical climates (20°C – 35°C). This is highly profitable cash crop serves as a major source of livelihood for thousands of rural farmers. Considering the medicinal properties and nutritional values of makhana, its global demand is increasing rapidly, creating a good opportunity to enhance the income of the makhana farmers in Bihar. In current years due to modern research and favourable government policies, farmers' interest in makhana cultivation has increased significantly. Traditionally, makhana has been considered a hardy crop, but in recent times the incidence of direct diseases has been increasing steadily. Hence, proper management of these diseases is essential to achieve higher productivity and better income from makhana cultivation. Therefore, through this literature, an attempt has been made to provide farmers with brief information about the major diseases affecting makhana plants, along with their management tactics.

Major Diseases of Makhana Crops

Makhana is a highly valued aquatic cash crop and susceptible to several fungal and pest-related diseases that can severely impact yields, primarily affecting its leaves, shoots, fruits and seeds. The primary diseases and their symptoms were discussed as follows.

1. Leaf Blight and Fruit Blight

Fungal Pathogen: *Alternaria alternata* / *Alternaria tenuis*

Symptoms: This is the most devastating disease for makhana crops. It begins as small, bright-brown, circular, sunken, necrotic lesions on the leaves. Over time, these spots grow into large, dark, blighted patches. If it spreads to the fruits during the peak summer months, it causes them to become small, twisted, and distorted with fewer seeds.

Impact: If left unchecked, it spreads to the fruits, causing them to become distorted and twisted with fewer seeds.

2. Leaf Spot

Fungal Pathogen: *Cercospora cruenta* and *Phytophthora parasitica*

Symptoms: This disease causes large, irregular-shaped spots on the leaves. The spots start out bright brown and gradually turn black, eventually leading to the affected leaf tissues/parts of the foliage to decay and dry off.

Impact: Severe infections result in the death of the affected plant parts, drastically reducing the overall yield.

3. Leaf and Floral Hypertrophy

Fungal Pathogen: *Doassansiopsis euryaleae*

Symptoms: Abnormal swelling, overgrowth (hypertrophy), and deformation of the plant's floral parts.

Impact: Reduces the yield and quality of makhana.

Management Practices :

- **Crop Monitoring:** Consists of regular monitoring of the water bodies (ponds/fields) and manually collecting and destroying affected plant parts (leaves, shoots and other parts).
- **Seed Treatments:** Treat seeds with fungicides like **Captan 75 WP** or **Thiram 75 WP** (2–2.5 g/kg seed) before sowing to prevent seed-borne disease infection.
- **Balanced Dose of Nutrition:** Maintain balanced plant nutrition to ensure the crop has the vigor to withstand disease infestation.
- **Sanitation:** Collect and burn diseased plant debris to stop the spread of seed- and soil-borne pathogens.
- **Cleaning the Water Body:** Effective management involves treating the water and keeping the water body clean.
- **Makhana–Fish Farming System:** Natural and biological control measures should be adopted to reduce disease incidence and minimize the use of chemical fungicides. Foliar spray of neem-based formulations (3 ml/litre of water) at 15-day intervals may be applied. Generally, 2–3 sprays are recommended as needed.
- **Makhana Farming System:** Use safe and recommended chemical fungicides when there is severe infestation of diseases.
- **Foliar Application:** Apply **Copper Oxychloride 50 WP** (3 g/litre of water) as a foliar spray at 15-day intervals. Generally, 2–3 sprays may be given as required. This treatment is effective against several **seed-borne and soil-borne fungal diseases**.

4. Fungal Decay (Rotting)

Cause: Soil and seed-borne fungal infections.

Fungal Pathogens: *Alternaria alternata* and *Alternaria tenuissima*

Symptoms of the Disease :

- **Alternaria alternata:** The primary causal organism of Alternaria leaf and fruit blight in North Bihar makhana ponds. It causes dark, sunken necrotic lesions on leaves and distorts the fruit, which ultimately leads to reduced seed quality.
- **Alternaria tenuissima:** Another significant fungus responsible for causing dark leaf spots and blighting in makhana crop.

Impact: Affected plants experience rotting of leaves, stems, and roots. It affects plant vitality causing the leaves to turn yellow and the entire plant to decay rapidly.

5. Common Insect-Pests Often Associated with Diseases

Aphids, caseworms, and rib borers directly attack the leaves and stems, which often facilitate or exacerbate deadly fungal infections like Alternaria leaf blight and details as follows :

(a) Makhana Aphids: These small insects suck the sap from tender leaves. They secrete honeydew, which promotes black sooty mold growth and attracts other fungal spores.

Disease Link: Heavy aphid infestations weaken the plants, making them highly susceptible to fungal infections such as leaf blight.

(b) Caseworms: The larvae construct oval cases by cutting leaf margins and feed heavily on the green tissues, causing premature leaf death and fungal contamination.

(c) Leaf Midge / Rib Borers : These larvae feed on the stalks and developed ribs under the leaf surface.

Disease Link: The wounds and tunnels they create act as direct entry points for fungal and bacterial pathogens, leading to rotting and tissue blight.

(d) Singhara Beetle : Although often considered a minor pest, both the grubs and adults feed on the leaves, leaving them perforated and susceptible to blight diseases.

Management Practices: Because makhana is grown in a sensitive aquatic ecosystem, farmers generally rely on Integrated Pest Management (IPM) rather than heavy chemical usage.

- **Seed Treatment:** Nursery seeds can be treated with systemic insecticides such as Imidacloprid 70 WS or Thiamethoxam 70 WS (5 ml/kg of seed) prior to sowing to prevent early aphid and midge attacks.
- **Root Dip Treatments:** Dip plant roots in a solution of Thiamethoxam 25 WG or Imidacloprid 17.8 SL (4–5 ml/litre of water) for 30 minutes at the time of transplanting to check early infestation of pests.
- **Organic Repellents:** Spraying Neem Seed Kernel Extract (NSKE) 5% at regular 15-day intervals effectively manages pests and helps prevent the onset of blight diseases.
- **Cultural Control Measures:** Regularly remove and destroy heavily infested or blighted leaves. Maintain optimum water levels in ponds/fields.
- **Varieties:** Cultivate resistant varieties such as Swarna Vaidehi and Sabour Makhana-1, which show moderate field resistance to aphids, caseworms, and leaf blight disease.

6. Fungal Contamination and Mycotoxins

Fungal contamination in processed makhana is a significant post-harvest and food safety issue. It primarily occurs due to poor storage conditions, high ambient moisture (above 10%), and prolonged exposure to warm and humid environments. Beyond growing in the pond/field, harvested and dried makhana seeds and puffs are susceptible to post-harvest storage molds if exposed to high moisture. These storage fungi can contaminate the seeds or puffs with harmful toxins (aflatoxins and ochratoxins), making them unsafe for human consumption.

Fungal Pathogens: *Aspergillus niger*, *Aspergillus flavus*, *Aspergillus ochraceus*, *Penicillium citrinum*.

- **Aspergillus Species:** *A. flavus* and *A. niger* are highly prevalent in dried makhana (puffs) and seeds. *A. flavus* is particularly hazardous as it produces toxic and carcinogenic mycotoxins (aflatoxins).
- **Penicillium Species:** Often found on dried commodities, contributing to spoilage and reduced shelf life when moisture levels are not tightly controlled.

Health Risks: When processed makhana is stored under humid conditions, these fungal pathogens thrive and produce mycotoxins. Ingestion of these toxins, even in small cumulative amounts, can lead to serious health issues, including liver damage, immune suppression, and an increased risk of cancer.

Preventive and Curative Control Measures

To prevent fungal growth and mycotoxin contamination, the Food and Agriculture Organization (FAO) outlines strict guidelines for the production and handling of food products.

- (a) **Moisture Control :** Ensure that makhana puffs are carefully dried and maintained at safe moisture levels (typically below 10–12%) before packaging.
- (b) **Proper Storage :** Store in airtight, dry and the temperature-controlled environments.
- (c) **Hygiene / Sanitation :** Implement strict sanitation protocols during processing, packaging and supply chain transport.

Conclusion

Effective makhana disease management requires a shift from reactive chemical control measures to proactive and ecologically safe strategies. For localized makhana cultivation in Bihar the conclusion should emphasize bridging farmers knowledge gaps through integrated pest and nutrient management approaches. To maximize yields and farmers' profitability in Bihar, the focus must shift from basic cultivation practices to modern, scientifically backed management techniques. Bridging the knowledge gap through farmer training, adopting sustainable Integrated Pest Management (IPM) practices, and utilizing modern field-farming technologies will help farmers fully unlock the economic potential of this valuable crop economic potential.