

Azolla: An Emerging Component of Integrated Farming System

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Azolla is a small, free-floating aquatic fern belonging to the genus *Azolla*. It forms green to reddish-brown mats on the water surface and has a short, branched stem with roots extending into the water. Its leaves are arranged alternately and consist of two lobes. The upper lobe contains chlorophyll, while the lower lobe is thinner and generally colourless. Plant size varies among species, from about 1–2.5 cm in *Azolla pinnata* to 15 cm or more in *Azolla nilotica*. Under certain conditions, Azolla may develop a reddish or brownish colour due to anthocyanin pigments. A major characteristic of Azolla is its symbiotic association with the nitrogen-fixing cyanobacterium *Anabaena azollae*. The plant provides a protected environment and nutrients to the microorganism, while the cyanobacterium fixes atmospheric nitrogen, making Azolla valuable in agricultural systems.

Climatic and environmental requirements

Water is essential for Azolla growth, as it is highly sensitive to drying. It can grow in water and may survive on moist soil or organic matter. Azolla tolerates pH 3.5–10.0, with optimum growth generally at pH 4.5–7.0. A temperature of 20–30°C is favourable for growth and nitrogen fixation. Very low or high temperatures reduce growth; below 5°C or above 45°C may cause severe damage. Some species, such as *A. filiculoides*, can tolerate temperatures near –5°C under suitable conditions.

Method of azolla cultivation

Pit preparation: Prepare a 2 m × 2 m × 0.2 m pit in a partially shaded area. Line it with UV-resistant silpaulin/polythene, ensuring a uniform base and protection from tree roots.

Soil and nutrient addition: Add 10–15 kg fertile soil to the pit. Mix 2 kg cow dung and 30 g superphosphate in 10 L water and add the slurry. Fill the pit to about 10 cm water depth.

Azolla inoculation: Introduce 0.5–1 kg healthy Azolla culture. Under favourable conditions, Azolla covers the surface within 10–15 days and may yield about 500–600 g/day. For continuous growth, add approximately 1 kg cow dung and 20 g superphosphate every 5 days, along with a suitable micronutrient mixture periodically.

Harvesting of Azolla

Azolla can be collected from the water surface using a fine mesh, such as a 2-mm mesh, which allows excess water to drain away. Another practical option is to use a perforated plastic tray with holes of approximately 1 cm. After harvesting, the Azolla should be washed properly to remove the odour of cow dung and other unwanted material. Small pieces of Azolla that escape through the tray or remain in the collected water can be returned to the production bed so that they can continue multiplying.

Azolla as livestock and poultry feed

Fresh Azolla can be used as a supplementary feed for livestock. Initially, it may be mixed with conventional concentrate feed in approximately a 1:1 proportion. After animals become accustomed to the feed over a period of about two weeks, Azolla can also be supplied without concentrate as a supplementary feed. Azolla can also be incorporated into poultry feeding systems for both layers and broilers. Its comparatively high protein concentration makes it useful as a supplemental protein source.

Use of azolla in crop production

As green manure: When used as green manure, Azolla biomass is incorporated into the soil before rice planting. It can either be multiplied directly in the rice field before transplanting or produced separately in nursery beds and subsequently transported to the field.

The biomass can then be incorporated into the puddled soil. Azolla decomposes relatively rapidly after incorporation, generally within 7–10 days. Although decomposition is rapid, nitrogen release and availability continue for several weeks. The source reports that approximately 34% of the total nitrogen was available after two weeks, 63% after four weeks, 76% after six weeks and 85% after eight weeks.

Major Benefits of Azolla

Azolla offers several advantages in agricultural production

1. It has the ability to contribute to biological nitrogen fixation.

2. Under favourable environmental conditions, it can produce biomass rapidly.
3. Its relatively high protein concentration makes it useful as a supplementary feed.
4. It can be incorporated into integrated farming systems.
5. It may help reduce nitrogen losses associated with fertilizer volatilization.
6. It can be used in integrated combinations such as rice–fish–Azolla, rice–duck–Azolla, rice–duck–fish–Azolla and pig–fish–Azolla systems.
7. Azolla generally contains approximately 19–30% protein, which is comparatively high among many green forage and aquatic plant resources. Its amino-acid profile includes essential amino acids such as lysine, making it potentially valuable as a protein supplement for ruminants, poultry, pigs and fish.

Important precautions during azolla production

- Proper management is necessary to maintain a healthy and productive Azolla culture.
- Approximately 200 g of biomass per square metre should be removed daily or on alternate days to prevent excessive crowding. Overcrowding can

restrict growth and reduce the productivity of the culture.

- The production bed should preferably be established in a shaded environment. The temperature should ideally remain below approximately 25°C. When temperatures increase, additional shade should be provided to reduce the intensity of sunlight reaching the culture.
- The pH should be monitored periodically and maintained approximately within the 5.5–7.0 range for good culture performance.
- Water quality also needs regular attention. About 25–30% of the water should be replaced with fresh water approximately every 10 days. This helps prevent excessive accumulation of nitrogen and other substances in the production bed.

Conclusion

Azolla is a fast-growing aquatic fern useful in sustainable agriculture. Its nitrogen-fixing association supports biological nitrogen management. It serves as green manure and supplementary feed in rice, livestock and integrated farming. Successful production requires suitable water, temperature, pH and nutrient management.
