



## Can Azolla Be A Substitute for N-Fertilisation in Rice?

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### Introduction

Azolla is a heterosporous free floating pteridophyte. It contains an endosymbiont, *Anabaena azollae*, a nitrogen fixing cyanobacterium, widely distributed throughout temperate and tropical fresh waters. The ability of azolla's symbiont, *Anabaena*, to sequester atmospheric nitrogen has been used for several years in the continent, where azolla is extensively grown in rice paddies to increase rice production by more than 50%. Azolla contains 0.2-0.3% N on fresh weight basis and 3-5% N on dry weight basis. There are seven species of azolla, out of which *Anabaena pinnata* is most widely distributed in India.

During the past few decades, there has been much advancement in science and technology leading to greater food production in the world, but the rate at which food production increased in many developing countries has been just sufficient to meet the increased demand for food, resulting from a rapid population growth in these countries. Thus, the sufficiency of global food production is still crucial and is likely to be more in the near future. As rice is the prime staple food of a country like India, the yield of rice play a pivotal role in maintaining the sustainability in food production. Rice is an enormously important staple food in many tropical and temperate regions of the world. Billions of people rely on the crop to live and hundreds of millions are now threatened by food shortages that are increasing each year. Nitrogen is the single most limiting factor in rice cultivation, strongly affecting the crop yield. Azolla is an important nitrogen fixing cyanobacterium adding significant amount of nitrogen (N) to rice crop during the growing period. Azolla substantially increases the amount of nitrogen fertilizer available to growing rice and it is has been used for several years as a 'green' nitrogen fertilizer

to increase rice production. For increasing the quality and quantity of rice, the role of azolla can be recognised to some extent as a substitute for nitrogenous fertilisers.

### **Why Azolla is Unique?**

Azolla is unique because it is one of the fastest growing plants on the planet having doubling rate of 2-3 days – yet it does not need any soil to grow. Unlike almost all other plants, azolla is able to get its nitrogen requirement directly from the atmosphere. That means that it is able to produce nitrogenous substances in the plants with concomitant capturing of carbon dioxide from the atmosphere, thus helping to reduce the threat of climate change.

### **Role of Azolla in Soil Fertility and Productivity**

Apart from as a source of nitrogen, azolla provides a variety of benefits for rice production and grows in a way that is complementary to rice cultivation. The major role played by the azolla can be summarized in the following manner-

- ❖ The thick mat of azolla in rice fields suppresses growth of competing crop weeds.
- ❖ The growth of azolla is sometimes better under shade condition that can be provided by the rice vegetation itself. Thus, maintaining a congenial niche for azolla growth and proliferation.
- ❖ As azolla is decomposed rapidly, its nitrogen, phosphorus and other nutrients rapidly released into water and made available for uptake by rice during grain development.
- ❖ When the rice approaches maturity, azolla begins to die and decompose due to low light intensities under the canopy. Thus, releasing its nutrients into the water for plant uptake.
- ❖ Azolla has a greater ability than rice to accumulate potassium in its tissues in low-potassium environments, providing rice with potassium after azolla's decomposition
- ❖ Azolla has got positive long-term effects, including the improvement of soil fertility by increasing total nitrogen, organic carbon, phosphorus, potassium, other nutrients and organic matter content of soil.
- ❖ The volatilisation loss of nitrogen can be minimised if nitrogenous fertilisers applied in presence of thick mat of azolla. The extent of reduction in nitrogen volatilisation may be as much as 20 to 50%. This is due to the fact that the azolla cover reduces light penetration into the floodwater, thus hindering the rise of pH which normally stimulates ammonia volatilization in an azolla-free rice field.
- ❖ Azolla can remove chromium, nickel, copper, zinc, and lead from effluent. It can remove lead from solutions containing 1-1000 ppm. Thus, can be used in bioremediation of toxic metals.

- ❖ Azolla also synthesizes growth promoting substances that increase the quality of the produce.
- ❖ Dual crop of azolla along with rice reduced the methane flux and increase grain yield similar to that of urea application. The decrease in methane efflux in plots with dual crop of azolla could be related to the release of oxygen in the standing water by the growing azolla leading to less reduced conditions in the soil.

### **Nitrogen Need of Rice Crop and the Amount Added By Azolla in Rice Field**

Nitrogen requirement is very high for rice crop production and usually applied @ 80-120kg/ha of N depending upon the soil test values and cropping season. This much amount is mainly supplied through chemical fertilizers. The prokaryotic association fix atmospheric nitrogen photosynthetically. The property and high rates of acetylene reduction in azolla demonstrate a potential agronomic role for azolla in photosynthetic production of fertilizer nitrogen. Azolla can yield around 40-60 kg N /ha/ rice crop under favourable environment that could be used as a source of nitrogen to the rice crop. Suitable growth temperature 25-30<sup>0</sup>C and good availability of phosphorus are the two important requirements for the growth of Azolla. It is most suitable for the region where temperature remains in the range of 20-30<sup>0</sup>C throughout the year. The biomass also adds carbonaceous materials along with other nutrients needed for optimum crop yield maintaining the soil fertility and quality as well.

### **How Azolla can be applied in Rice Field?**

Azolla can be used either as an intercrop in the standing rice crop or as green manure crop with subsequent incorporation prior to transplanting of rice.

**As intercrop:** Azolla incorporated 78 days after transplanting rice contributes a greater amount of nitrogen to rice grain than earlier incorporation (30-53 days after transplanting).



**As sole crop:** If Azolla is grown as a mono crop, the field should be drained several days in advance of incorporation. The last mat should be incorporated and the field kept drained for 4 or 5 days before transplanting rice in order to enhance the speed of decomposition.

It takes about 8-10 days to decompose and release about 67% of its N within 35 days.

### **Growth Promotion and Yield of Rice**

A greater amount of nitrogen is sequestered by azolla when grown either as an intercrop or as mono crop. However, only 5% of the sequestered N is immediately available to the growing rice plants. The remaining 95% remains in the azolla's biomass until the plant dies. As the plant decomposes, its organic nitrogen is rapidly mineralized and released as ammonia, which then becomes available as a biofertilizer for the growing rice plants. Azolla can prevent the insect pest infestation in rice crop and also suppresses the growth of weeds. Growth promoting substances synthesized by azolla improves the yield and quality of rice crop. Reports were found that azolla can increase the rice yield by 10-35%.

### **Conclusion**

Azolla can increase the crop yield as well maintains the soil fertility status. As N is the limiting nutrient for sustainable crop production, enormous amount of N fertilizers needed for increasing crop yield. The amount of N added by azolla is though high, it cannot substitute wholly the chemical sources of nitrogenous fertilizers as the N requirement of rice crop is too high. Thus, it can be a supplement to N fertilizers but can't be a substitute for it.

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