



AZOLLA A BIOFERTILIZER FOR HEALTHY PADDY CROP AND A PROTEIN RICH ANIMAL FEED SUPPLEMENT

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ABSTRACT

Azolla is a small aquatic free floating fern belongs to family Salviniaceae. Azolla hosts an endosymbiotic filamentous, nitrogen-fixing, blue green alga *Anabaena azollae* on dorsal cavity of the leaves which belongs to family Salviniaceae. The fern appears as green mat over water. *Anabaena azollae* is responsible for the fixation and assimilation of atmospheric nitrogen and to maintain soil fertility. Azolla in turn provides the food source and favorable environment for the growth and development of the alga. Because of symbiotic relationship this plant gained interests of botanists and agriculturists for years. Since the Azolla-Anabaena combination grows in aquatic condition and provide potential nitrogen source for flooded crops it could introduce in the crop fields such as rice as bio-fertilizer and acts as nitrogen fertilizer factories. Azolla is grown for two to three weeks in flooded fields and grow at great speed doubling its biomass every two or three days. It maintains soil fertility and crop productivity. Azolla is not only a bio-fertiliser but also a good sustainable food resource to cattle, poultry and ducks. The use of Azolla may be an important factor in the world's future food needs and may play an important role in reducing the world's dependence on fossil fuel based fertilizers. At present, Azolla is grown as a green manure in many rice producing areas and becoming quite popular among the farmers of West Godavari district particularly in Pedavegi, Denduluru and Unguturu mandals because it is eco-friendly nature. Present paper emphasizes on the cultivation and application of Azolla by farmers of West Godavari District.

KEYWORDS: Azolla, *Anabaena azollae*, Nitrogen-fixing, Bio-fertilizer, Symbiotic, Animal feed.

INTRODUCTION

There are many examples of plant, bacteria and algae that have friendly associations with each other. One such most fascinating association includes a tiny aquatic fern Azolla with a blue green alga *Anabaena azollae* which is used as a biofertilizer. Azolla is an aquatic pteridophyte belongs to the family Salviniaceae which hosts microscopic filamentous blue green alga, *Anabaena azollae*. *Anabaena azollae* is accountable for the fixation and assimilation of atmospheric nitrogen whereas Azolla provides the food and favorable environment for the growth and development of the alga. They grow together at the surface of the streams and ponds. It has been nicknamed as a super plant as it can readily colonize fresh water areas and grow at greater speed doubling its biomass every two to three days depending on the conditions. Water is drained out and fresh Azolla is incorporated in the paddy field before transplantation or in standing waters after one week of plantation. Nitrogen-fixing Azolla, could commendably help the developing countries to establish a more sustainable and healthy agriculture because it synthesizes nitrogen fertilizer, releases plant growth regulators and vitamins for increasing crop yield. Azolla solubilizes Zn, Fe and

Mn and make them available to the rice plant. Other advantages are, dry Azolla flakes can be used as poultry feed which increases the weight of the broiler chicken and egg production. Fresh Azolla is used as a feed for sheep, goats, and cattle and increases milk production because of its high protein content, amino acids and minerals. It is also used as fish feed and in the preparation of salads because of its nutritive value, and as a bio-scorer as it takes away all heavy metals and as a mosquito repellent. It also used as weed suppressing mulch and suppresses tender weeds such as Chara and Nitella. It forms a dense mat on the surface of the water and reduces water evaporation from the irrigated rice field. The oxygen released, helps in the respiration of crops as well as other soil micro-organisms.

The use of Azolla is quite popular among the farmers of Vietnam and China. In fact the initial reports of using Azolla as a low-priced source of nitrogen was understood by the Chinese farmers and there were several records on the use of Azolla as manure in the beginning of 17th century in China and Vietnam. They described this plant as miniature nitrogen fertilizer factories. In India, Singh et al., (2007) studied about the

use of Azolla in Asian organic farming. At present many progressive farmers and nongovernmental organizations are employing Azolla as an precious input in agriculture and some of them are actively engaged in its popularization as biofertilizer, green manure, poultry feed and fodder. Kondo et al (1989) research study reported the effect of Phosphorus on Azolla. Alalade et al., (2006) studied about chemical composition and the feeding value of *Azolla pinnata* for chicks. Arora et al., (2006) reported the phytoaccumulation capability of Azolla. Pabby et al (2000) studies indicated the changes in Nitrogen metabolism. In the recent times Azolla is gaining tremendous importance in phytoremediation of polluted waters.

METHODOLOGY

“Technology Resource Centre” developed a simple and inexpensive technology to grow Azolla, an aquatic fern. Similar method was followed and Azolla units were constructed in Gavaravaram, West Godavari District, Eluru.

Azolla cultivation: Artificial concrete units (4 numbers) measuring four feet diameter and one and half feet height was prepared and placed under shade net. 4kg of cow dung and 2kgs of sieved fertile soil were mixed and made into slurry. To this slurry 10 to 20 gms of powdered phosphate is added. This slurry is applied at the bottom of the Azolla unit. Then $\frac{3}{4}$ th of the unit is filled with water. The unit is set aside without any disturbance for 12 hours. Later unwanted top material was removed with the help of a net. Now $\frac{1}{4}$ th kg of pure Azolla culture is inoculated in each unit. Phosphate is added once in every 5 days for rapid multiplication of Azolla. In 25 to 35 days Azolla can easily fix enough nitrogen with 4 to 6 tonnes /hectar.

Ideal conditions for Azolla cultivation

- Temperature 20^oC-30^oC
- Light 25-50% full sunlightfor 20h / day (3000 - 6000 lux)
- Water 5-12cm and Maintenance of adequate water level.
- Relative Humidity 85 - 90%
- pH 5 - 7
- Salinity 0.3% - 2.5% depending on species

Harvesting of Azolla and inoculation in paddy fields

Azolla will fill up the unit within 10-15 days. About 1 kg of cultivated fresh Azolla was harvested and thereafter 0.5-1 kg of Azolla was harvested every week. Harvested Azolla is inoculated in the waters of one acre paddy fields of Gavaravaram, Chodimella, Munduru, Unguturu and Tadikalapudi before and after transplantation of rice seedlings.

RESULTS

Azolla as bio-fertiliser in paddy fields

Azolla is a highly productive plant. It is widely used as a bio-fertilizer and fixed the atmospheric nitrogen in the

soil and supplied to the paddy crops. Thus it acted as a nitrogen fertilizer factory. The inoculated Azolla doubled its biomass in 3-10 days depending on conditions and reached 6-8 tonnes fresh matter/acre and covered the water surface of paddy fields. It also enhanced soil fertility by providing nutrient rich humus through decomposition and controlled mosquito's larva in rice fields.

Results regarding inoculation percentage of Azolla in one acre Paddy fields of various villages such as Gavaravaram, Chodimella, Munduru, Unguturu and Tadikalapudi were tabulated in Table-1 Azolla inoculation was high in Gavaravaram, Unguturu and Tadikalapudi and low in Munduru. The studies showed increased yield in rice production in Gavaravaram, Unguturu and Tadikalapudi.

Table 1: Inoculation percentage of Azolla in one acre Paddy fields.

S.No	Village Name	Inoculated area	Un Inoculated area
1	Gavaravaram	90%	10%
2	Chodimella	70%	30%
3	Munduru	60%	40%
4	Unguturu	90%	10%
5	Tadikalapudi	80%	20%

The response of Azolla biofertiliser in Gavaravaram, Chodimella, Munduru, Unguturu and Tadikalapudi fields showed the increase in the straw yield, number of panicles and number of grains. Farmers from these places reported that paddy crop yield increased from 10-20 % per acre was due to Azolla application.

Azolla as cattle feed, poultry feed, fish feed:

Azolla is fed to livestock in fresh and dried form. It is given directly and mixed with concentrates to cattle, poultry, sheep, goats, pigs and rabbits. It catches a few days for the animals to acquire the taste of Azolla, as a result it is better to nourish it with small quantities in the initial stages. Sr Kodalia incharge of dairy farm, St. Ann's convent, Gavaravaram expressed that 10% milk enhancement in cattle was observed due to application of Azolla as supplementary feed. The unique combination of proteins, minerals, vitamins and essential amino acids make it a promising and most economic feed substitute for livestock.

CONCLUSION

Azolla is low cost aquatic green manure for agricultural crops which increases productivity, a nutritious feed to cattle which enhances milk production, and a healthy feed for poultry which amplifies its weight. Azolla is certainly a valuable plant which will thrive with little care and maintained masses of Azolla in ordinary tap water. The significance of its symbiotic relationship with anabaena is outstanding that millions of lives depend on these two organisms. However, environmental

conditions, nutrient availability, and time of inoculation have an influence on the growth and nitrogen fixing potential of Azolla. Lack of proper awareness programmes on importance of Azolla continues to remain it as an un-utilized plant even though it has greater significance. The researchers focused at the idea that Azolla might be on the menu for humans in the near future. Azolla has been studied for its possible use as feed not only for livestock but also for humans since it is rich in fibers, proteins, fatty acids, amino acids, vitamins, minerals, and others. It would be beneficial to meet the human nutritional requirements and cope the health problems.

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