BIFERTILIZERS

Dr. V.P.Saini

Dean

College of Fisheries Kishanganj

Biofertilizer

The term 'Biofertilizer' itself means 'Live Fertilizer'.

- contain live or latent beneficial microbes which help to fix atmospheric nitrogen, solubilize and mobilize phosphorus, translocate minor elements (Zinc, Copper, etc.,) to the plants, produce plant growth promoting hormones, vitamins, amino acids and control plant pathogenic fungi.
- Extremely advantageous in enriching the soil fertility and fulfilling the plant nutrient requirements by supplying the organic nutrients through microorganism and their byproduct.

Why Biofertilizers

- Biofertilizers are environmentally safe or eco-friendly as they do not contain any chemicals which are harmful to the living soil.
- Biofertilizers are eco-friendly organic agro-input and more cost effective than chemical fertilizers.
- Biofertilizers like *Rhizobium*, *Azotobacter* and blue green algae (BGA) are in use since long time ago.
- *Rhizobium* inoculant is used for leguminous crops.
- *Azotobacter* can be used with crops like wheat, maize, mustard, cotton, potato and other vegetable crops.

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- Blue green algae belonging to genera *Nostoc*, *Anabaena*, fix atmospheric nitrogen and are used as inoculants for paddy crop grown both under upland and low land conditions.
- *Anabaena* in association with water fern *Azolla* contributes nitrogen up to 60 Kg/ha/season and also enriches soils with organic matter.

AZOLLA

- *Azollae*, a free-floating aquatic fern fixing atmospheric nitrogen through the cyanobacterium. *Anabaena azolla*, present in its dorsal leaves, is one of the potential nitrogenous biofertilizers.

- Its high nitrogen-fixing capacity, rapid multiplication as also decomposition rates resulting in quick nutrient release have made it an ideal nutrient input in farming systems.

- *Azolla* is a heterosporous fern belonging to the family *Azollaceae* with seven living species.

- Proliferation of *Azolla* is basically through vegetative propagation but sexual reproduction occurs during temporary adverse environmental conditions .

Potentials of *Azolla*

- Though *Azolla* is capable of absorbing nitrogen from its environment, *Anabaena* meets the entire N_2 requirements of *Azolla–Anabaena* association.
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- The mean daily N_2 fixing rates of a developed *Azolla* mat are in the range of 1.0–2.6 kg/ha and a comparison with the process of industrial production of nitrogenous fertilizers would indicate the efficacy of biological nitrogen fixation.
- While the latter carried out by the enzyme nitrogenase

- The normal doubling time of *Azolla* plants is three days and one kg. of phosphorus applied results in 4-5 kg. of nitrogen, through *Azolla*, *i.e.* about 1.5 – 2.0 t of fresh biomass.

- *Azolla* can survive in a wide pH range of 3.5 to 10.0 with an optimum of 4.5-7.0

- withstand salinities of up to 10 ppt.

- With a dry weight range of 4.8–7.1% among different species, the nitrogen and carbon contents are in the ranges of 1.96–5.30% and 41.5–45.3% respectively.

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- The ranges of elemental composition are phosphorus 0.10–1.59% potassium 0.31–5.97% calcium 0.45–1.70%, magnesium 0.22–0.66% and sulphur 0.22–0.73%.

- Added to these are its high rates of decomposition with mean daily loss rates of 1.36–4.57% of the initial weight and nitrogen release rates of 1.25% which make Azolla a potential biofertilizer in aquaculture systems.

- The percentage ranges of other constituents on dry weight basis are crude protein 13.0-30.0, crude fat 4.4–6.3, cellulose 5.6–15.2, hemicellulose 9.8–17.9, lignin 9.3–34.8 and ash 9.7–23.8.

A perusal of the published accounts on *Azolla* reveals that it is a multifaceted and multipurpose bio-resource. It can be used as:

- green manure specially for rice;
- mosquito-controlling agent;
- Water purifier-capable of absorbing the nutrients from the eutrophic waters;
- poultry and duck feed; fish feed
- source of nitrogen;
- Antifungal agent
- natural biofertiliser; and
- source of hydrogen gas

Cultivation of *Azolla*

- It is necessary to cultivate *Azolla* separately for aquaculture and resort to periodic application in fish ponds.
- A system suitable for such cultivation comprises a network of earthen raceways (10.0 x 1.5 x 0.3 m) with facilities for water supply and drainage.
- The operation in each raceway consists of application of *Azolla* inoculum (6 kg), phosphatic fertilizer (50g single super phosphate) and pesticide (carbofuron dip for inoculum at 1.2 ppm), maintenance of water depth of 5-10 cm and harvesting 18-24 kg in a week's time.

- The maintenance includes periodic removal of superficial earth layers with organic accumulation, dyke maintenance, application of bleaching powder for crab menace and algal blooms, etc.
- A unit of 0.1 ha area that can hold about 50 raceways is suitable for a family to be taken up as cottage industry in rural areas.
- *Azolla* can be cultured in puddles, drainage and shallow water stretches, at the outlets of ponds and tanks and hence prime agricultural land need not be used.

Applications in fish farming

- *Azolla* is useful in aquaculture practices primarily as a nitrogenous biofertilizer.
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- Its high decomposition rates also make it a suitable substrate for enriching the detritus food chain or for microbial processing such as composting prior to application in ponds.
- Further, *Azolla* can serve as an ingredient of supplementary feeds and as forage for grass carp too.

- Studies made on Azolla biofertilization have shown that the nutrient requirements of composite carp culture could be met through application of Azolla alone at the rate of 40t/ha/yr providing over 100 kg of nitrogen, 25 kg of phosphorus and 90 kg of potassium in addition to about 1500 kg of organic matter.
- This amounts to total substitution of chemical fertilizers along with environmental upkeep through organic manuring.
- On the basis of the operation of *Azolla* culture system at CIFA farm over a period of three years, it is observed that about 1 tonne of *Azolla* biomass could be harvested every week from a water spread area of 650m^2, with a phosphorus input-nitrogen output ratio of 1:4.80.
- With an approximate water to land ratio of 1 : 0.5 the total land requirement of such an *Azolla* farm is 0.1 ha.

- For fertilizing 1ha of water area at the above suggested rate of 40t/ha/yr, about 550m^2 of water spread is required (1.5kg/m^2/week; 42t/yr) with the total area of 800m^2, accounting for 6% if the area to be fertilized.
- Larger production plots (20m x 5m) could be provided reducing the total land area required for mass cultivation.
- There would however be regional variations depending on the agro-climatic conditions, as some species of *Azolla* give poor yields during low temperatures in winter.
- *Azolla* is a new aquaculture input with high potentials in both fertilization and trophic enrichment.

- Studies are also being made with regard to reduction of land requirement and production costs through in situ cultivation in shallow zones or floating platforms in fish ponds, use of organic inputs like biogas slurry, etc.
- The costs may be reduced further if the *Azolla* culture system is managed by the farmer or by his household members.
- The technology would pave the way for economic, eco-friendly and environment – conserving fertilization in aquaculture.

- The suggested application rate of *Azolla* to meet the nutrient requirements in carp polyculture (and substitute for chemical nitrogenous fertilizer) is 40 tons/ha/year.
- This requires an area of about 800 sq m, a unit that could be taken up as a subsidiary farming activity.
- Along with the environmental benefits, a saving of up to 30-35% over the traditional manuring practices is estimated.

THANKS