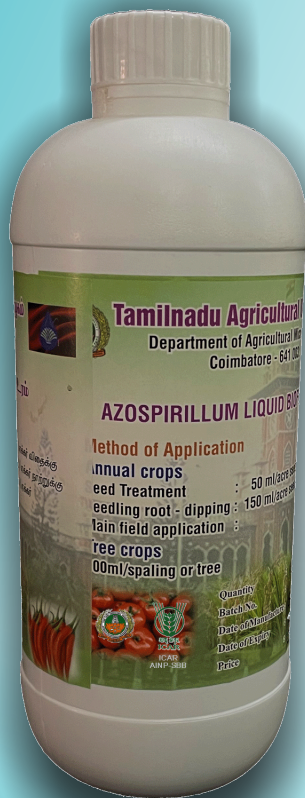


Azospirillum Biofertilizer

for Tamil Nadu crops



Salient Features



- * Associative-symbiotic nitrogen fixing bacteria.
- * Suitable biofertilizer for rice, maize, and other cereals and vegetables.
- * Contributes 5-18% of nitrogen requirement of a crop.
- * Produces siderophore for iron sequestration in rhizosphere.
- * Polybetahydroxy butrate helps stress mitigation.
- * Indole-3-acetic acid, cytokinin, gibberillin like plant growth hormones production.
- * ACC deaminase mediated drought mitigation.
- * Induced systemic resistance against soil-borne pathogens.
- * Reduces 25% of chemical fertilizer use.
- * Increases 10-20% yield.

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Introduction

Azospirillum, the member of alphaproteobacteria, is an associative symbiotic diazotroph found in the roots and rhizosphere soils of rice, cereals, millets, forage grasses, and vegetables. This bacterium colonizes the surface and interior of roots and fixes the nitrogen under microaerophilic conditions. Nearly 19 species were isolated and characterized from different plant roots and soils, of which, Azospirillum lipoferum and A. brasilense were well explored for agricultural crops. Besides nitrogen fixation, several strains are known for phosphorus solubilization, plant growth hormone production, ACC deaminase mediated drought mitigation, siderophore mediated iron sequestration, and disease resistance through induced systemic resistance.

Azospirillum biofertilizer

Azospirillum has been commercially formulated and used as a biofertilizer for non-leguminous crops, including rice, wheat, maize, banana, oilseeds, cotton, and sorghum. The effective colonizing strains were assessed for their nitrogen fixation, growth promotion, yield increase, and fertilizer savings and commercially formulated as biofertilizers.

TNAU - Azospirillum

Through extensive research, TNAU center under ICAR's AINP SBB developed three Azospirillum strains as biofertilizer mother cultures.

Azospirillum species	strain	Crops
<i>Azospirillum lipoferum</i>	Az-204	Paddy
<i>Azospirillum brasilense</i>	Sp7	All other Crops
<i>Azospirillum amazonense</i>	Y2	Acid soils

TNAU - Azospirillum biofertilizers

Azospirillum biofertilizer is commercially produced as the carrier (lignite) based and liquid formulations at TNAU.

Carrier-based biofertilizer: This lignite-based carrier formulation will have 10⁷ cells per g with three months shelf-life.

Liquid biofertilizer: The liquid formulation of Azospirillum is with 10⁸ cells per ml without any contaminants and can be stored for one year.

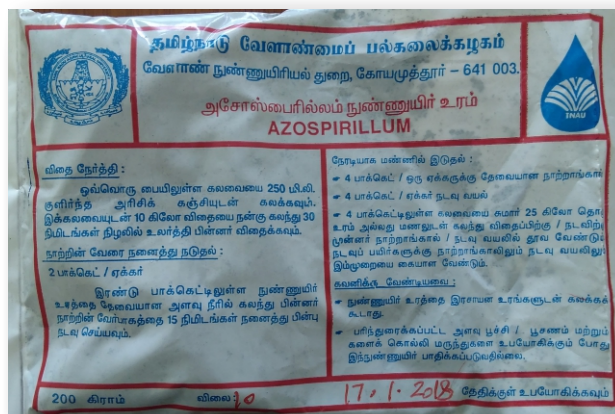


Liquid biofertilizer:

- Seed treatment: 250 ml/ha of seeds
- Seedling dip: 250 ml/ha of seedlings
- Soil application: 500 ml/ha

Carrier-based biofertilizer

- Seed treatment: 1 kg/ha of seeds
- Seedling dipping: 1kg/ha of seedling
- Soil application: 2 kg/ha



Technology adoption and impact analysis

The summarized results of the field experiments conducted at TNAU research fields and at farmers' field with Azospirillum biofertilizer for rice during 1999 to 2010 are presented.

Crop	Variety	Biofertilizer strain	Grain yield (kg/ha)		Percent increase
			75% N + 100% PK + Azospirillum	100% NPK	
Rice	ASD18	Azospirillum lipoferum Az204 [seed treatment, seedling dip and soil application]	3605	3402	6%
	ADT36		3944	3834	3%
	ADT43		5482	5303	3.5%
	Co47		3665	3395	8%
	White Ponni		5520	5175	6.7%
	Co43		5120	4800	6.7%

(Source: ICAR-AINP Consolidated reports)

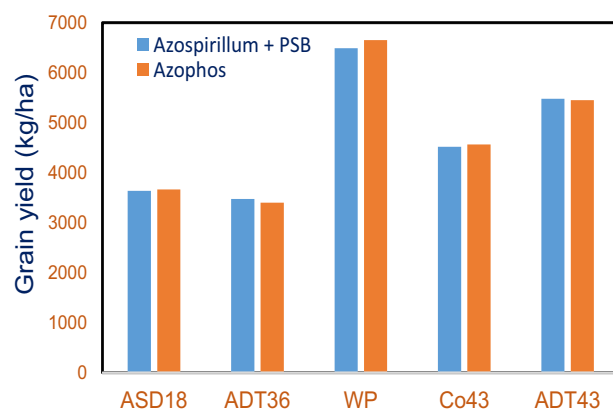
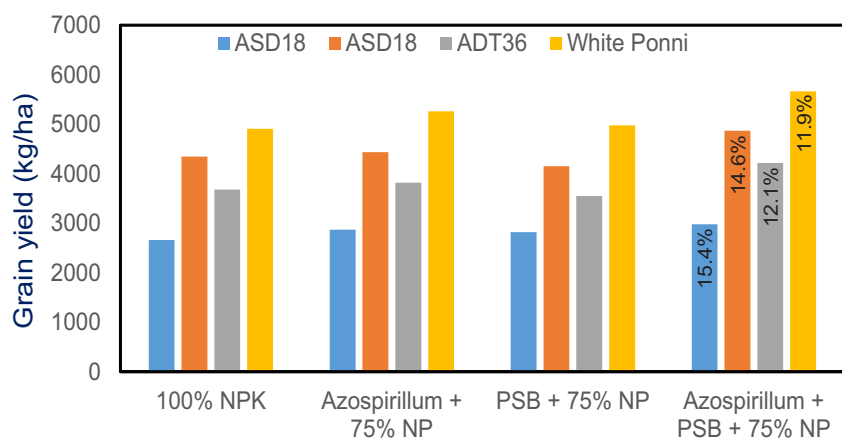
Additional yield: 200 kg/ha = **Rs.4000** (Rs. 20 per kg as minimum support prize)

Fertilizer saving: 40 kg urea/ha = **Rs.1000**

The use of Azospirillum biofertilizer with 75% recommended chemical fertilizer could benefit the farmer at Rs. 5000 per ha.

Azophos biofertilizer

Azophos is the biofertilizer containing two organisms, Azospirillum (for nitrogen) and Phosphobacteria (for phosphorus), in a single packet. The co-inoculation of Azospirillum and Phosphobacteria showed remarkable responses in different field crops in terms of yield increase as compared to either Azospirillum or Phosphobacteria. Hence, Azophos biofertilizer was developed to ensure the combined inoculation of Azospirillum and Phosphobacteria (Source: AINP Consolidated reports, 1999-2010).



Performance of Azophos is equal to combined application of Azospirillum and Phosphobacteria

Combined inoculation of Azospirillum and Phosphobacteria accounted 12-15% yield increase in rice



Azophos biofertilizer:

- Seed treatment: 2 kg/ha of seeds
- Seedling dip: 2 kg/ha of seedlings
- Soil application: 4 kg/ha

Azospirillum and Phosphobacteria as combined inoculation or Azophos application ensures

- * 12-15% additional yield
- * 25% saving on NP fertilizers
- * Net profit of Rs.6000 per ha
- * B:C ratio is 1.95

Azospirillum in biofertilizer consortium

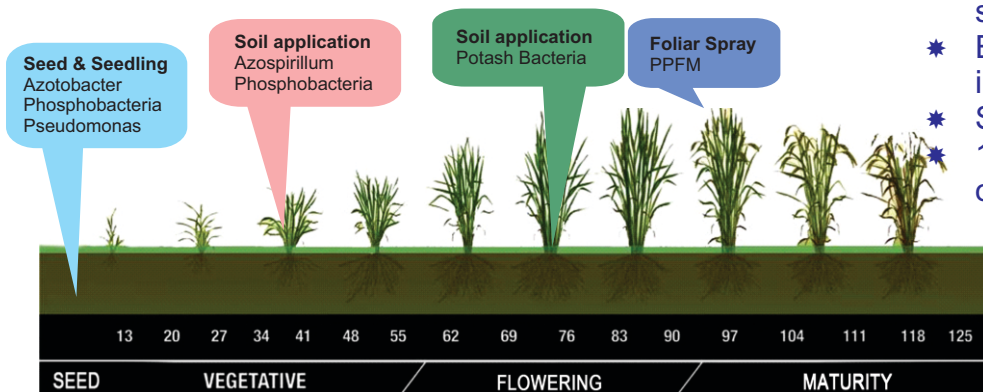
Biofertilizer consortium represents a formulation that consists of more than one strain of plant-growth-promoting bacteria, capable of providing multifaceted benefits to the crop. Azospirillum is an important component of the consortium, providing nitrogen, growth hormones and abiotic and biotic stress mitigation.

AzophosMet



- ★ Three biofertilizers, Azospirillum, Phosphobacteria and Methylobacteria as consortium for rice
- ★ Shelf life of carrier-based consortium is 3 months
- ★ Each biofertilizer strain accounted 10^7 cfu per g
- ★ Rice yield increase 14.8% higher than 100% NPK and 6.5% higher than Azophos.

Stage-specific inoculants



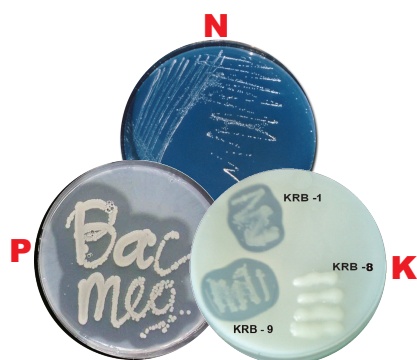
- ★ A pack contains six biofertilizers.
- ★ Appropriate biofertilizer at specific stage of rice crop.
- ★ Ensures maximum benefit from the inoculants
- ★ Suitable for organic rice production
- ★ 15% yield increase than conventional organic rice farming

Seed-coat biofertilizer



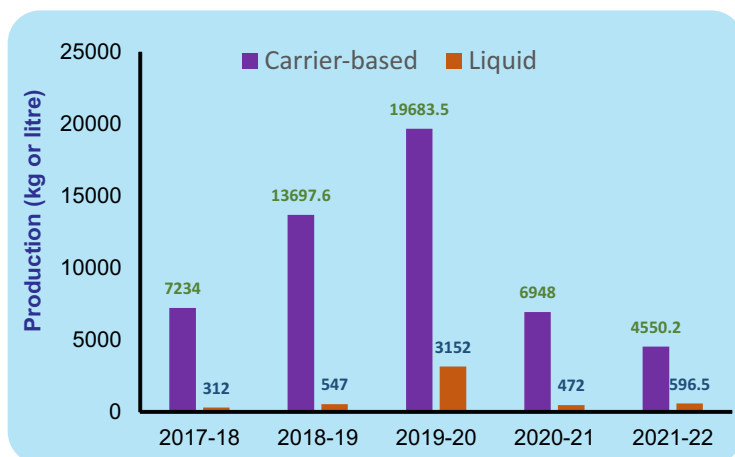
- ★ Azospirillum (N), Phosphobacteria (P), Potash bacteria (K) and Zinc solubilizing bacteria (Zn) as NPK and NPKZn consortium used for seed coating.
- ★ Film coating with HPMC and Dextrin on maize seed.
- ★ Shelf life: 10^4 cfu of each strain per seed.
- ★ This technology ensures proper delivery of suitable biofertilizers at the early stage of the crop to ensure profuse colonization and plant-growth promotion.

NPK biofertilizers



Azospirillum (N), Phosphobacteria (P) and Potash bacteria (K) as liquid biofertilizer consortium

Azospirillum biofertilizer production



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