9. IARI Azotobacter

- **Microbial Constituent:** *Azotobacter chroococcum* W5 (NAIMCC-B-00061)
- **Type:** Carrier based; 1×10^8 cfu/g; Liquid formulation; 1×10^9 cfu/mL
- **Shelf life:** 03 months for carrier based formulation; 36 months for liquid formulation at 25°C to 35°C
- **Target crops:** Cotton, wheat, maize, potato, brinjal, pearl millet, mustard and onion
- **Method of application:** Seed treatment (50 mL formulation diluted to one litre with water for seeds to be sown in one acre; or 200 g for coating seeds for one acre)
- **Target agroecological zones/states**: All states
- **Validation:** Multilocational trials on different crops for 30 years
- **Commercialization:** On sale counters in the Division of Microbiology, ICAR-IARI, New Delhi since 1976; Commercialized in 2010; Licensed to four companies
  - Sai Bio Organics, Moga, Punjab
  - Eco Inputs, Ludhiana
  - HBPL, East Champaran, Bihar
  - Department of Horticulture, Hoshiarpur, Punjab
- **Benefits:**
  - Saves 15-20 kg N/ha
  - 10-35% increase in grain yield
- **Cost:** ₹ 50/- per 200 g; ₹ 75/- per 50 mL

Control

Treated

Effect of IARI Azotobacter on brinjal at ICAR-IARI, New Delhi during 2002-03

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10. PUSA Azospirillum

- **Microbial Constituent:** *Azospirillum brasilense*
- **Type:** Carrier based formulation; 1×10^8 cfu/g
- **Shelf life:** 03 months at 25°C to 35°C
- **Target crops:** Sorghum, pearl millet, finger millet, Italian millet, kodo millet, barn yard millet, small millet, oats, rice and sugarcane
- **Method of application:** Seed treatment (200 g for coating seeds for one acre)
- **Target agroecological zones/states**: All states
- **Validation:** Multilocational trials on target crops for 30 years
- **Commercialization:** On sale counters in the Division of Microbiology, ICAR-IARI, New Delhi since 1982; Registered at Zonal Technology Management & Business Planning and Development Unit, ICAR-IARI, New Delhi
- **Benefits:**
  - Saves 15-20 kg N/ha
  - 10-35% increase in grain yield
- **Cost:** ₹ 50/- per 200 g

Control Treated

Effect of PUSA Azospirillum on sorghum at ICAR-IARI, New Delhi during 2002-03

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11. PUSA Rhizobium

- **Microbial Constituent:** Rhizobial strains specific to different pulse crops- chickpea (*Mesorhizobium ciceri*), pigeon pea (*Bradyrhizobium yuanmingense*), black gram and cowpea [*Bradyrhizobium* sp. (*Vigna*)], pea and lentil (*Rhizobium leguminosarum* bv. *viceae*), groundnut [*Bradyrhizobium* sp. (*Arachis*)], berseem (*Rhizobium leguminosarum* bv. *trifolii*), lucerne (*Rhizobium meliloti*), dhaincha (*Azorhizobium caulinodans*) and sunhemp [*Bradyrhizobium* sp. (*Crotolaria*)]
- **Type:** Carrier based formulation; 1×10^8 cfu/g
- **Shelf life:** 03 months at 25°C to 35°C
- **Target crops:** Chickpea, pigeon pea, black gram, pea, lentil, groundnut, cowpea, berseem, lucerne, dhaincha and sunhemp
- **Method of application:** Seed treatment (200 g for coating seeds for one acre)
- **Target agroecological zones/states**: All states – Pulse growing areas
- **Validation:** AICRPs on MULLaRP, Chickpea and Soybean; Multilocational trials for more than 30 years
- **Commercialization:** On sale counters in the Division of Microbiology, ICAR-IARI, New Delhi since 1970s; Licensed to one entrepreneur
  - Sai Bio Organics, Moga, Punjab
- **Benefits:**
  - Saves 15-25 kg N/ha
  - Increases yield by 30-60% in target crops
- **Cost:** ₹ 50/- per 200 g

Control Treated

Effect of PUSA Rhizobium on Chickpea at ICAR-IARI, New Delhi during 2014

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12. PUSA BIOPHOS

- **Microbial Constituent:** *Lactococcus lactis* PHM5-37
- **Type:** Carrier based; 1×10^8 cfu/g; Liquid formulation; 1×10^9 cfu/mL
- **Shelf life:** 03 months for carrier based and 12 months for liquid formulation at 25°C to 35°C
- **Target crops:** Wheat, rice, cowpea, soybean, lentil, gram and potato
- **Method of application:** Seed treatment (50 mL formulation diluted to one litre with water for seeds to be sown in one acre; or 200 g for coating seeds for one acre)
- **Target agroecological zones/states**: All states
- **Validation:** ICAR-IARI, New Delhi on wheat, rice, cowpea, soybean, lentil and gram for four years
- **Commercialization:** Licensed to Department of Horticulture, Hoshiarpur, Punjab
- **Benefits:**
  - Saves 10-15 kg P/ha
  - Increases yield by 15-20%
- **Cost:** ₹ 50/- per 200 g; ₹ 75/- per 50 mL

Control Treated

Effect of PUSA BioPhos on Lentil var. L4076 at ICAR-IARI, New Delhi during 2017-18

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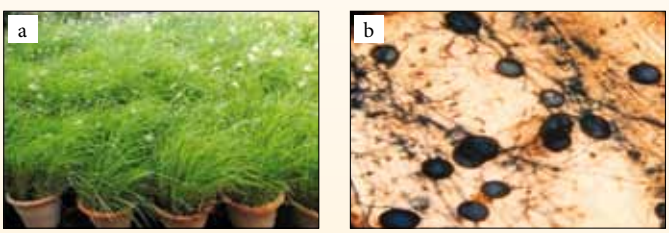
13. PUSA Mycorrhiza

- **Microbial Constituents:** *Funneliformis mosseae* (=*Glomus mosseae*), *Rhizophagus intraradices* (=*G. intraradices*) and *Scutellospora* sp.
- **Type:** Soil based formulation; 100 infective propagules/g soil
- **Shelf life:** 06 months at 25°C to 35°C
- **Target crops:** Nursery raised crops, crops grown under protected cultivation; useful in tissue culture crops where it helps in hardening the roots before transplanting
- **Method of application:** Soil application (5 kg/acre)
- **Target agroecological zones/states**: All states
- **Validation:** Multilocational trials on different crops for 20 years
- **Commercialization:** Commercialized in 1985; Licensed to twenty five entrepreneurs. Few are listed here
  - Patanjali, Haridwar, Uttrakhand
  - Bharat Agro Molecules Ltd., Meerut, Uttar pradesh
  - Pratishtha Industries Ltd., Secunderabad, Uttar pradesh
  - Vaishnavi Biotech Ltd., Secunderabad, Uttar pradesh
  - Prabhat Fertilizer and Chemical Works, Karnal, Haryana
- **Benefits:**
  - Improves crop yield by 15-25%
  - Improves P-uptake in crops under P-deficient soil conditions
  - Sustains the crop under water stress conditions and improves soil aggregation
  - Enhances microbial population near the roots and enhances uptake of micro- (Zn, B, Cu, Fe etc.) and macro-nutrients like N & P
- **Cost:** ₹ 50/- per kg



Production of AM fungi using (a) *Cenchrus ciliaris* as host and (b) root colonization by AM fungi

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14. PUSA BIOPOTASH

- **Microbial Constituent:** *Bacillus* sp.
- **Type:** Liquid formulation; 1×10^7 cfu/mL
- **Shelf life:** 12 months at 25°C to 35°C
- **Target crops:** Maize, wheat, rice and pearl millet
- **Method of application:** Seed treatment (50 mL formulation diluted to one litre with water for seeds to be sown in one acre)
- **Target agroecological zones/states**: Delhi, Punjab, Bihar, Jharkhand, West Bengal, Odisha, Chhattisgarh, Madhya Pradesh and Rajasthan
- **Validation:** In wheat and maize at ICAR-IARI, New Delhi for two years; Three years on rice, wheat and pearl millet in collaboration with KVKs of target states
- **Commercialization:** Licensed to Department of Horticulture, Hoshiarpur, Punjab
- **Benefits:**
  - Augments 10-15 kg K/ha
  - 2-5% increase in yield
- **Cost:** ₹ 75/- per 50 mL

Control Treated

Evaluation of PUSA BIOPOTASH on wheat var. HD2967 at ICAR-IARI, New Delhi during 2016

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15. PUSA BioZinc

- **Microbial Constituent:** *Bacillus* sp.
- **Type:** Liquid formulation; 1×10^8 cfu/mL
- **Shelf life:** 12 months at 25°C to 35°C
- **Target crops:** Wheat, soybean, rice and pearl millet
- **Method of application:** Seed treatment (50 mL formulation diluted to one litre with water for seeds to be sown in one acre)
- **Target agroecological zones/states**: Delhi, Punjab, Uttar Pradesh, Bihar, Jharkhand, West Bengal, Odisha, Chhattisgarh, Madhya Pradesh, Rajasthan, Gujarat, Uttarakhand and Haryana
- **Validation:** ICAR-IARI, New Delh on soybean and wheat for two years; Three years on rice, wheat and pearl millet in collaboration with KVKs of target states
- **Commercialization:** Commercialized in 2013; Licensed to M/s Kirti International, Ludhiana, Punjab
- **Benefits:**
  - Augments 2 to 5 kg Zn/ha
- **Cost:** ₹ 75/- per 50 mL

Control

Treated

Evaluation of PUSA BioZinc on wheat var. HD2967 at ICAR-IARI, New Delhi during 2013-14

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16. NPK Biofertilizer

- **Microbial Constituents:** *Azotobacter chroococcum* (MTCC 25045), *Burkholderia cepacia* (MTCC 25043) and *Bacillus decolorationis* (MTCC 25044)
- **Type:** Liquid formulation; 2×10^8 cfu/mL of each
- **Shelf life:** 12 months at 25°C to 35°C
- **Target crops:** Wheat, rice, citrus, turmeric and garlic
- **Method of application:** Seed treatment (100 mL formulation diluted to one litre with water for seeds to be sown in one acre); root dip for seedlings (500 mL formulation diluted to 2.5 L with water for seedlings to be planted in one acre) and soil application for tree plants (10 mL/tree)
- **Target agroecological zones/states**: Bihar, Jharkhand, West Bengal, Odisha, Chhattisgarh, Madhya Pradesh, Punjab, Rajasthan, Gujarat, Delhi, Uttarakhand and Haryana
- **Validation:** Two years on-farm trials at ICAR-IARI, New Delhi and farmers' fields at Punjab with rice and wheat; One year on citrus in Punjab, on garlic and turmeric in Gujarat; Three years on rice, wheat and pearl millet in collaboration with KVKs of target states
- **Commercialization:** Commercialized in 2015; Licensed to two entrepreneurs
  - M/s Monal Potteries and Ceramics Ltd., Una, Himachal Pradesh
  - Pratishtha Industries Ltd., Secunderabad, Telangana
- **Benefits:**
  - Saves chemical fertilizers up to 25-30 kg N, 10-15 kg P and 2-5 kg K/ha
  - 5-10% increase in grain yield in rice and wheat
- **Cost:** ₹ 125/- per 100 mL

Control

Treated

Evaluation of NPK Biofertilizer on rice at ICAR-IARI, New Delhi during 2013-14

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17. PUSA SAMPOORN

- **Microbial Constituents:** *Azotobacter chroococcum* W5 (MTCC 25045), *Pseudomonas psychrophila* and *Bacillus decolorationis*
- **Type:** Liquid formulation; 2×10^8 cfu/mL of each
- **Shelf life:** 12 months at 25°C to 35°C
- **Target crops:** Wheat and rice
- **Method of application:** Seed treatment (100 mL formulation diluted to one litre with water for seeds to be sown in one acre); root dip for seedlings (500 mL formulation diluted to 2.5 L with water for seedlings to be planted in one acre)
- **Target agroecological zones/states**: Delhi, Punjab and Haryana
- **Validation:** Four years on-farm trials at ICAR-IARI, New Delhi with rice and wheat
- **Commercialization:** Available for licensing through Agrinnovate India Ltd. (www.agrinnovateindia.co.in)
- **Benefits:**
  - Saves chemical fertilizers up to 25-30 kg N, 10-15 kg P and 2-5 kg K/ha
  - 5-10% increase in grain yield in rice and wheat
- **Cost:** ₹ 100/- per 100 mL

Control Treated

Evaluation of PUSA SAMPOORN on wheat var. HD2967
at ICAR-IARI, New Delhi during 2017-18

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18. Biofort IARI

- **Microbial Constituents:** Biofort (W)-*Bacillus pumilus* PW1 (NAIMCC-B-00550) + *Providencia* sp. PW5 (NAIMCC-B-00557) + *Brevundimonas diminuta* PW7 (NAIMCC-B-00559); Biofort (R)-*Providencia* sp. PR3 (NAIMCC-B-00563)+ *B. diminuta* PR7 (NAIMCC-B-00566)+ *Ochrobactrum anthropi* PR10 (NAIMCC-B-00568)
- **Type:** Carrier based formulation; 3×10^9 cfu/g
- **Shelf life:** 06 months at 25°C to 35°C
- **Target crops:** Biofort (W) for wheat and Biofort (R) for rice
- **Method of application:** Seed coating; soil application or seedling dip (500 g/acre)
- **Target agroecological zones/states**: Delhi, Punjab, Haryana and Andhra Pradesh
- **Validation:** Five years in rice-wheat cropping system at ICAR-IARI, New Delhi; On-farm trials at KVKs of Andhra Pradesh with rice; Ambala District, Haryana with rice for one year
- **Commercialization:** Commercialized in 2015; Registered at Zonal Technology Management & Business Planning and Development Unit, ICAR-IARI, New Delhi
- **Benefits:**
  - Effective micronutrient mobilization to grains, with 13–40% increase in Fe, Zn and Mn concentrations
  - Saves chemical fertilizers up to 30-50 kg N/ha
  - 10-15% increase in yield in target crops

a. Control-100% NPK (RDF) b. 50% N + Full dose of P & K + Biofort IARI

Influence of Biofort IARI application in wheat var. HD 2967at ICAR-IARI, New Delhi during 2017-18

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