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Microbiology in the service of Farmers

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Biofertilizer Technology

Biofertilizers have been recognized in Indian agriculture since last three decades in view of their low cost, effectiveness, contribution in crop productivity, soil sustainability and eco-friendly nature. Peat, lignite and charcoal, in India are mainly used as carrier materials in the biofertilizers industry. At present, the department is supplying biofertilizer in liquid formulation.

The basic and applied research carried out with beneficial microorganisms such as *Rhizobium, Azotobacter, Azospirillum, Gluconoacetobacter* and phosphate solubilzing bacteria (PSB) have led to the development of efficient strains for bioinoculant production. The department has been producing biofertilizers like:

(i) *Rhizobium* biofertilizer (*Rhizoteeka*) for nitrogen fixation in different pulses and other legumes like moong, urd, pigeonpea, soybean, pea, chickpea, berseem and groundnut etc.

(ii) *Azotobacter* biofertilizer (*Azoteeka*) for nitrogen fixation in different crop plants including vegetables, flowers and fruits etc.

(iii) PSB biofertilizer (*Phosphoteeka*) for solubilization of insoluble/ fixed P in the soil for all crop plants.

(iv) Biocontrol bioinoculants- for nematode control- *Azotobacter* HT-54 for wheat and *Gluconoacetobacter* for cotton.

These bioinoculants are compatible with recommended doses of insecticides and pesticides for different crops. During 2009, the Department of Microbiology has produced more than one lakh bioinoculants. During 1986, the department received productivity award conferred by National Productivity Council of India, New Delhi for biofertilizer production.

These biofertilizers increase the yield 5 to 10% in addition to the saving of chemical fertilizer to the tune of 25%. So far, there is no other organization except CCS HAU, Hisar in northern India to supply quality biofertilizers at large scale to meet the demand of biofertilizers for different states viz., Haryana, Punjab, Rajasthan, Himachal Pradesh and Jammu & Kashmir. Thus, there is a lot of scope for marketing of biofertilizers in these states.

Biofertilizer Production Technology

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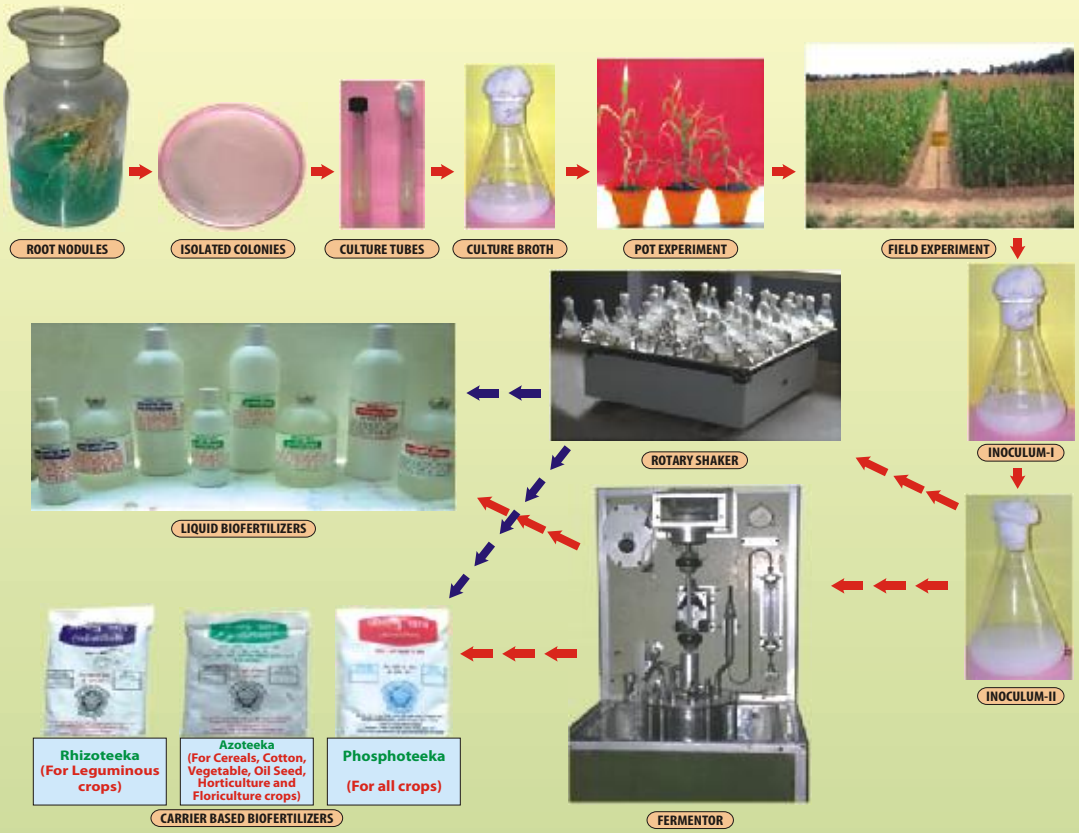
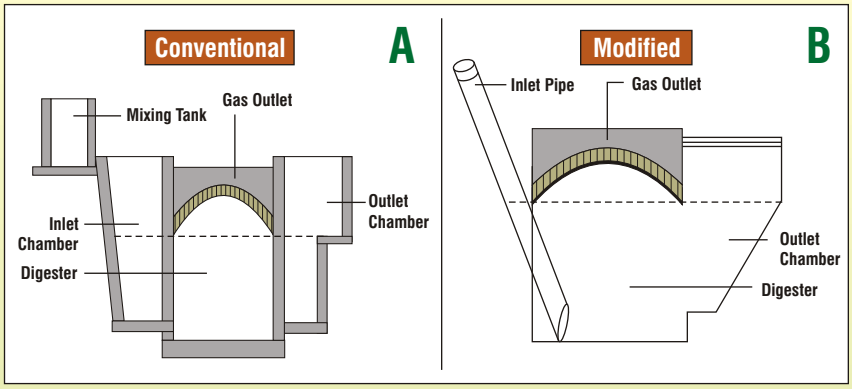


Solid state fixed dome Janta biogas plant

Family size biogas plants of floating drum design (KVIC) as well as fixed dome type (Janta model) installed in our country, use cattle dung as substrate and every day require water in quantity equal to the dung (8-10% total solids) for satisfactory operation of the plant. The digested slurry discharged from these plants is watery and contains 94-96% water (total solid content 4-6%). The slurry is spread on to the ground or collected into open pits for drying over a period of upto 45 days to facilitate its transportation to the fields for use as manure. This technology is not accepted in water scarce and drought prone regions of the country. The Department of Microbiology, CCS Haryana Agricultural University, Hisar has successfully modified the popular fixed dome Janta type biogas plant design for digestion of cattle dung at high solid content (15-16% total solids). The inlet and outlet of the plant is modified for feeding of plant at high solid (16-17% total solids) content and discharge of paste like slurry (10-12% total solids). Salient features of the solid state plant are as follows:

- The inlet chamber of the Janta plant has been replaced with a commercially available 30 cm internal diameter RCC pipe as against 15 cm diameter PVC pipe.
- The outlet slurry chamber is enlarged to accommodate total volume of the slurry displaced from the digester.
- The step type construction of the outlet chamber of the Janta plant has been changed to an inclined smooth surface for streamlined flow of the digested slurry.
- The outlet channel is widened from 15 cm to 30 cm to facilitate self-discharge of the digested slurry on to the ground.
- The interior side of the gas dome is provided with an additional layer of 1:1 cement sand mortar plaster of about 8 mm thickness to withstand gas pressure. The plant is initially charged with 1:1 mixture of cattle dung and water along with 10% inoculum (effluent of running biogas plant). The plant is left undisturbed for a week, thereafter, plant is fed with fresh cattle dung @ 25kg/m^3 capacity of the plant.



Design of conventional (A) and modified (B) Janta Biogas Plant

Slurry discharged from solid state Janta biogas plant

Advantages of solid state biogas plant

- Solid state fixed dome type plant generates upto 30% more biogas than the common design. The retention time for solid state plants is nearly twice (75-80 days) of the common plant (40 days).
- No or very little water is required for mixing with the dung, therefore, feeding is far easier.
- The paste like digested slurry discharged from the solid state plant gets dried within a week. It requires much lower space for drying and labour for handling.
- Less space is required for its installation.
- Other household and agricultural wastes can be fed with dung.
- The cost of construction of the solid state Janta biogas plant has been estimated to be nearly same as that of the respective common designs.

Composting

Organic matter is an essential component of all soils and serves to improve physical, chemical and biological properties of the soil. Proper management of organic wastes can make available substantial quantities of plant nutrients which can partially substitute for inorganic fertilizers. The large amount of organic wastes produced in intensive agriculture can cause serious disposal problems. Composting is one of the methods of utilization of farm and city wastes to produce nutrient rich organic manures than burning or dumping. Large quantities of these composts are needed to apply in fields which makes handling and transportation difficult. So, these composts are enriched with phosphorus and nitrogen.

(a) Preparation of phosphorus enriched compost : Composting of organic wastes consisting of animal dung, feed lot wastes and crop residues on composting with Mussorie rock phosphate @ 25% on dry weight basis can be carried out in pits of size 10 ft. long, 4 ft. wide and 2.5 ft. deep depending upon the amount of waste available (About 400 kg of field wastes, leaves, grasses, straw of different crops +3000 kg of cattle dung + 100-150 kg of rock phosphate and spraying with water to keep moisture content up to 60%). The above mixture is added in pits, turn the material after 30, 60, and 90 days. Spray wastes from time to time to keep moisture content to 60%. After 90 days compost will be ready and will have 0.1% N, 3-4% P and 0.5% K. Two tons of P compost prepared in this way will replace 60 kg of phosphorus.

(b) Preparation of N enriched compost: Mostly the composts prepared from different plant wastes have low nitrogen content which can be increased by composting the above mentioned composting material with MRP @ 25%, 1% urea and pyrite @ 10% up to 90 days in above pits. The addition of pyrite will decrease the pH of composting material which in turn will help in retaining the 80% of added urea N. The N enriched phosphorus compost will give response equal to about 20-30 kg N/ha besides providing P which is comparable to phospho compost and single super phosphate on equal P basis.

RICE STRAW COMPOSTING

*Suspend 10 g *Aspergillus awamori* culture inoculant in 1000 L water and add one kg urea to it.

Dip rice straw in this suspension for about three min. Drain excess suspension.

Stack the soaked straw in the form of a heap 1.5 m wide, 1.5 m high and 5 m long.

- Cover the heap with thick layer of straw or a polythene sheet.
- Maintain moisture at about 70% by watering with a bucket at weekly interval.
- Compost is ready in 50-60 days. Every ton of compost contains 12-14 kg N, 6-7 kg P and 19-22 kg K.

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