

Study of Liquid Biofertilizer as an Innovative Agronomic Input for Sustainable Agriculture

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Received: 26.07.2018 | Revised: 21.08.2018 | Accepted: 30.08.2018

ABSTRACT

Bio fertilizers have been identified as an alternative to chemical fertilizers to increase soil fertility and crop production in sustainable farming. Bio-fertilizer are inexpensive and ecofriendly. Biggest challenge in the bio-fertilizer is the survival of organisms up to time of field application. In Carrier-Based (Solid) Organic Fertilizers; there is only six months shelf life in microorganisms. Liquid bio-fertilizer technology is an alternative solution to (Solid) carrier based bio-fertilizers. These liquid biofertilizers microbes shelf life is higher than carrier based bio-fertilizers without considerable loss in viable counts. Liquid formulation of bio-fertilizer plays vital role in helping to solve the increasing self life in microorganisms. In current study the liquid bio-fertilizer is best way of sustainable agriculture for crop production.

Key words: Liquid biofertilizer, Sustainable agriculture, Soil fertility, Self life

INTRODUCTION

After the Green Revolution, modern farming depends on the addition of more chemical fertilizers. Production of chemical fertilizers is decreasing day by day. More use of it spoils the atmosphere and surface water. So such bacteria have been discovered in this context, which can provide essential elements to crops, mainly contains nitrogen, phosphorus and potash. Their use not only protects the environment from being contaminated, together, crop production is also great. India is one of the important countries in bio fertilizer production and consumption. To encourage organic farming by biofertilizers, mostly six

bio-fertilizers, namely *Rhizobium*, *Azotobacter*, *Azopirillum*, *Acetobacter*, Phosphate Soluble Bacteria and Mychoriza have been included in FCO, 1985.

Bio-fertilizers manufactured in India are mostly carrier based (solid) bio-fertilizers; the microorganisms have a shelf life of only six months. They are not tolerant of UV rays and temperatures above 30 °C. At the time of production, the population density of these microorganisms is only 10⁸ (10 million) CFU / mL. At the time of production. This count reduces day by day. In the fourth month it reduces to 10⁶ (10 lakhs) c.f.u/ml and at the end of 6 months the count is almost nil.

Cite this article: Verma, N.P., Kuldeep, U.K. and Yadav, N., Study of Liquid Biofertilizer as an Innovative Agronomic Input for Sustainable Agriculture, *Int. J. Pure App. Biosci. SPI: 6(1): 190-194 (2018).*

That's why the carrier-based bio-fertilizers were not effective and did not become popular among the farmers. These defects are rectified and fulfilled in the case of Liquid bio-fertilizers.

Liquid Bio Fertilizers is Suspension; there are useful micro-organisms in terms of farming, which fixes nitrogen in the atmosphere. And insoluble phosphorus to provide soluble forms for plants. The use of this organic fertilizer is environmentally friendly, and mostly gives a similar result to the crop. And the use of chemical fertilizer directly reduces 15 to 40%. It can be kept for a long time without any special arrangements. And compared to solid matrix base bio-fertilizer, its shelf life is in one to two years range. Demand for organic food is increasing in the worldwide market. Using this liquid bio

fertilizer, Indian farmers will be able to grow organic crops and they will be able to compete in the international market. Liquid bio-fertilizers are suspension containing desired microorganisms and special cell protectants or chemicals that encourage formation of latent spores or cysts for longer shelf life and tolerance to adverse environments². Liquid bio-fertilizers are easy to use, handling and storage, the dosage is ten times less than that of powder form, it can be packed in different volumes and save carrier materials³. Since these are liquid formulations bio-fertilizer application in the field is easily and very simple. They are also applied using hand sprayers, power sprayers, fertigation tanks, drip irrigation and as basal manure mixed along with FYM etc⁵.

At present day use in different groups of microbes for liquid bio-fertilizer manufacturing

Sl. No.	Groups	Examples
Nitrogen (N₂) fixing Biofertilizers		
I	Free-living	<i>Azotobacter</i> ,
ii	Symbiotic	<i>Rhizobium</i> , <i>Frankia</i> ,
iii	Associative Symbiotic	<i>Azospirillum</i>
P-Solubilizing Biofertilizers		
I	Bacteria	<i>Bacillus megaterium</i> var. <i>phosphaticum</i> , <i>Bacillus circulans</i> , <i>Pseudomonas striata</i>
ii	Fungi	<i>Penicillium sp.</i> , <i>Aspergillus awamori</i>
P-Mobilizing Biofertilizers		
I	Arbuscular mycorrhiza	<i>Glomus sp.</i> , <i>Gigaspora sp.</i> , <i>Acaulospora sp.</i> ,
Biofertilizers for Micro nutrients		
I	Silicate and zinc solubilizers	<i>Bacillus sp.</i>
Plant Growth Promoting Rhizobacteria		
I	<i>Pseudomonas</i>	<i>Pseudomonas fluorescens</i>

Liquid Biofertilizers

A mixture of liquid and peat-based inoculants was applied; good results in dry matter, grain yield and total 'N' apache were obtained on individual bio fertilizers in faba bean¹⁰. The beneficial effect of liquid *Azotobacter* culture on the growth of maize crops than lignite based *Azotobacter* culture¹¹. The application of liquid bio-fertilizers has increased significantly

in the growth of plants such as height of plants, number of branches, dry matter and yield of okra¹².

Factors Affecting Liquid bio-fertilizer

Temperature

Temperature optima and range varies with microorganisms. Harvest Season comes in the field temperature during the harvest season, temperature is essential for growth and

development of microbes, but slows down at lower temperatures. The strains used in the liquid formulation usually go up to 37⁰ ° C. And the temperature is able to bear up to 45⁰ Celsius for two years or more. Whereas, solid base shelf life is not up to 30 degrees because the temperature is more than 35 degrees Celsius and rapidly declines in organisms¹.

Acclimatization

Many researchers have studied environmental impact on organic fertilizers. It has been reported that it has a negative effect on various strains, but all research carrier base was done on organic fertilizers. It is seen that the efficiency of the liquid is almost identical in all environments, but in the case of solid base, efficiency can reduce 20-25% in various climatic conditions.

Sunlight intensity

Its most effective for microorganisms generally microorganisms are sensitive to temperature. UVB (280-320 nm) and UVA (320-400 nm) of the most harmful rays reaching the Earth's surface have direct impact on microbes. Of course some are less harmful; however, microorganisms are sensitive to wave-length outside this range.

Effect of pH

The pH of a product plays an important role in liquid inoculums preparation. It should be stable within some categories. At very high and low temperatures the organisms are inactive; therefore, by adding some additives a buffer is maintained which provides better shelf life in the liquid. Maintaining optimal pH improves some microorganisms such as shelf life.

Effect of humidity

Some microbes may need moisture for activity and need is fulfilled by liquid inoculums. There is little direct effect of relative humidity on the spore farming bacteria in liquid form.

Need for Use of Liquid Bio-fertilizers

Sustainable agriculture is a skilled production of safe, high quality agricultural products, thus protecting and improving the social and economic conditions of the natural environment, farmers, their employees and local communities, and protects the health and

welfare of all farming species. For a sustainable farming system, it is necessary to use renewable input (fertilizer, pesticide, water etc.) which benefit the plant and do not harm the environment. There is a possible way to reduce the use of chemical fertilizers and pesticides. Liquid Bio-fertilizers is best way of career based fertilizer because LBF is tolerant of radiation and contamination not easily and their self life is increase in 10-12 month. It's free from moisture requirement easily to use by farmers.

Advantages of Using Liquid Bio-fertilizers in Agriculture

In modern agriculture, **Liquid Bio-fertilizers** is considered to be the best choice for conventional carrier-based bio-fertilizers, which helps in achieving increased crop yields, soil health and sustainable global food production. There are advantages of liquid biological fertilizers on conventional carrier-based organic fertilizers: No longer has any damage to properties due to high shelf life (12-24 months), high temperatures and no contamination, due to high temporary storage. Up to 450 c, the high population can be retained up to 10⁹ cells / ml for 12 to 24 months, Easy, high export capacity utilization by farmers, dose is 10 times lesser on career based, quality control protocols are easy and quick. In terms of organic food production, a lot of work has been done on carrier based organic fertilizers. Considering the advantages of liquid bio-fertilizers on carrier-based formulations, the research has now started on the production and testing of liquid organic fertilizers³. The inoculants manufacturers prefer products with shelf life of 1-1.5 years under home conditions to sell them in two crop seasons¹⁴. Similar research work done the case of *Azospirillum* the population came down up to 10⁵ at six month duration at room temperature where as in liquid, survived up to 2 years and population maintained up to 10⁸/ml. Similarly *Azotobacter*, KMB, *Rhizobium* inoculant in powder form maintained the shelf life up to 6 months expects PSM which serviced up to 8 months. But in case of liquid formulations,

Azotobacter, PSM, and KMB survived up to two years followed by *Rhizobium*, only for 14 months¹⁵.

Liquid bio-fertilizer enhancing soil fertility and soil health

We all know the nutrients of biological origin added to the soil to enrich the soil health and soil fertility it's called bio-fertilizer but carrier based bio-fertilizer now the time self life is not well and not rich well target site. So liquid microbial consortium is the only solution for restoration of soil health and soil fertility⁶. Liquid bio-fertilizer is the microbial preparations containing specific beneficial microorganism they capable to fixing and solubilizing or mobilizing plant nutrients and their biological activity. Applying appropriate liquid bio-fertilizers, the overall cost of production would be much lower and would improve the soil quality and yield as compared to traditional bio-fertilizers¹³.

How Liquid Bio-fertilizers are cost effective?

Liquid bio-fertilizer are special liquid formulation containing not only the desired microorganisms and their nutrients, but also special cell protectents or substances that encourage formation of resting spores or cysts for longer shelf life and tolerance to adverse condition.

In addition to generating profit, liquid bio fertilizers have a different advantage in terms of cost savings on chemical fertilizers⁶. Microbial products are now considered safer than many chemicals used, neither the toxic substances nor themselves will be stored in the micro-organisms food chain.

Liquid Bio-Fertilizer Production Scenario in Indian

Fertilizer is one of the important factors for crops. Liquid bio-fertilization has increased in the nutrition of crops, but there is still a need for years of research and development work. Liquid bio- fertilization is increasingly interested in developing and developed countries. Government has introduced strict law and policy against the quality of organic fertilizers so that farmers can get the benefit of this technique. Ministry of Agriculture,

Government of India implemented a central sector scheme “National Project on Development and use of Bio-fertilizers (NPDB)” during the 9th Five Year Plan. At current status liquid bio-fertilizer production ministry of agriculture in India 2016-2017, 7526.33 kilo liter). Liquid bio fertilizer is available in the market as one of the chemical fertilizers and pesticide options. Public sector fertilizer giant IFFCO is located in Phulpur in Uttar Pradesh, IFFCO's MLN Farmers' Training Institute produces all strains of Bio-fertilizers and have distributed it in states other than the home state⁷.

Future Perspective of Liquid Bio-Fertilizers

The liquid bio-fertilizer has the potential to replace conventional chemical fertilizers and carrier-based organic fertilizers and plays a major role in restoring soil health, but by well-trained technicians, technology, government assistance, subsidies and creative awareness Many references in the context are emphasized among agrarians. Although the field of Liquid bio-fertilizers has improved considerably since the last 3-4 decades, the bio fertilizer industry has been facing some technical constraints, some people who have solved need strong research and development activities.

CONCLUSION

Liquid bio-fertilizes is considered the best choice for traditional carrier-based bio-fertilizers in modern agriculture, which helps in achieving increased crop yields, soil health and sustainable global food production. Liquid bio-fertilizes is innovative agronomic input for sustainable agriculture. Quality standards of liquid based organic fertilizers are good and stable for six months. In carriers-based organic fertilizers, the quality is very low, the amount of moisture is very high and the count has decreased

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