Production and Bacterial analysis of Jeevamrit: A traditional organic farming practice for sustainable agriculture

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***Abstract*—The increasing global population has enhanced the demand for eco-friendly agro practices and safe organic food. Jeevamrit application will be a better alternative to chemical pesticides and fertilizers to fulfil the huge global demand for organic food by supporting the sustainable agriculture. Soil rejuvenating ability of Jeevamrit is due to the presence of plant growth promoting microorganisms in it which makes it one of the best liquid biofertilizer made from the easily available substrates like cow dung, cow urine, jaggary, and gram powder.**

The present study was conducted to analyse microbial flora of jeevamrit and to study their ability to enhance the soil fertility and to increase the crop productivity. It was found that this fermented liquid biofertilizer showed maximum bacterial load on 10th day. Total 11 isolates are studied from prepared Jeevamrit for multiple plant growth promoting traits. The observations shows that prepared biofertilizer contains phosphate solubilizers, nitrogen fixers, potassium solubilizer, potassium mobilizers, indole acetic acid producers. Along with that they have ability to degrade starch, cellulose, proteins, lipids, lignin, and pectin. The use of this easily available liquid biofertilizer in field will help the farmer to produce more higher-quality good crops.

***Index Terms*—Jeevamrit, biofertilizer, plant growth promoting microorganisms, vital enzymes, colony forming units.**

I. INTRODUCTION

To achieve significantly higher crop yields and meet the demands of a rapidly growing global population, farmers are utilizing the chemical fertilizers, which does its work on food supply but eventually it challenges to the environment and human health in multiple ways. The organic carbon content of Indian soil is drastically reducing (Devasenapathy et al., 2008). To balance the need and to minimize the hazards of environment we need the eco-friendly sustainable agricultural practices. Application of biofertilizer is one of the sustainable practices in our traditional agriculture, it improves the soil fertility with the use of different kinds of microorganism like nitrogen fixing bacteria, phosphate solubilizing bacteria, potassium mobilizing bacteria, etc and the vital enzymes like amylase, protease, lipase, cellulase and pectinase released by the bacteria increase the availability of essential nutrients to the crops. Biofertilizers, restores soil health, enhances soil biomass and helps in maintaining the long-term productivity of crops, ensures the quality of food crops and reduces the risk of plant diseases. The future demands more sustainable and natural farming practices in agriculture. There are four major components of natural farming Beejamrit, Jeevamrit, Acchadana (Mulching) and Whaapasa (Moisture) (Harshika et al., 2024)

Liquid biofertilizers offers a range of benefits for modern agriculture, it is sustainable alternative to conventional chemical fertilizers. Jeevamrit is one the traditional organic liquid formulation which used in ancient Indian farming practices. Today, Jeevamrit is widely promoted as an affordable, eco-friendly alternative to chemical fertilizers, helping farmers restore soil health. Zero Budget Natural Farming System (ZBNFS) is an agricultural practice where the investment of the farmers is minimum that means farmers can easily adopt it with less investment. This farming system was developed by an Indian agriculture expert, Subash Palekar. There is a saying of Palekar, that after continuous use of Jeevamrit for three years, the soil itself becomes full of the micro nutrients required for the plant. According to Palekar's formulation of Jeevamrit constituents such as cow dung, cow urine, legume flour and jaggery provides macro and essential micro nutrients, essential amino acids, many vitamins, growth promoting substances like gibberellic acid (GA), indole acetic acid (IAA) and beneficial microorganisms (Palekar, 2006; Sreenivasa et al., 2010; Neelima and Sreenivasa, 2011). Since ancient times, cow dung and urine have been proved to improve soil and crop productivity. Now this cow urine and dung is the part of Beejamrit, Jeevamrit and Panchgavya. (Shubha et al., 2014 and Sreenivasa et al., 2009). The cow dung present in jeevamrit contains nitrogen fixer like *Azotobacter*, *Azospirillum* and potassium solubilizing bacteria like *Bacillus subtilis* along with that *Pseudomonas fluorescence* like phosphorus solubilizing bacteria are also present (Ramprasad et al.,2009). Jeevamrit helps in maintaining the soil health by fostering a balanced microbial ecosystem. It enhances the microbial population of bacteria, fungi, actinomycetes in soil this helps in drenching of nutrients to crops (Puneet Kaur et al.,2020). Under zero budget natural farming (ZBNF) system, the study of biological properties of soil regarding the microorganism, enzyme and arthropods shown that there is increase in population of bacteria, fungus and actinomycetes and dehydrogenase, phosphatase and urease activity is also increased along with that there is increment in the population of Hymenoptera, Hemiptera, Coleoptera, Isoptera, and Isopoda (Abdul et al,.2021).

The study of microbial population of Jeevamrit from 1 to 30 days exhibited presence of different bacteria like- *Bacillus* sp., *Pseudomonas* sp., and N-fixing bacteria like *Azotobacter* sp., *Beijerinckia* sp., fungi like *Aspergillus* sp., *Fusarium* sp., *Penicillium* sp., *Trichoderma* sp., also reported P-solubilizers fungi like - *Aspergillus* sp., *Penicillium* sp., Actinomycetes - *Streptomyces* sp. (Kirtidhvaj and Gudadhe 2023 and Devakumar et al.,2014). Jeevamrit helps in maintaining the soil pH, too. (Kulkarni et al.,2019)

II. MATERIALS AND METHODS

Bacterial analysis is done in laboratory at Rajarshi Shahu Mahavidya Latur (Autonomous), Maharashtra, India.

The Jeevamrit is prepared by mixing 10 kg local cow dung with 10 litres cow urine, 2 kg local jaggery, 2 kg pulse flour and 500gm fertile soil (garden soil) 200 litres of water. (Palekar, 2006). The mixtures were kept for incubation under shade for 4-16 days and stirred thoroughly for 10–15 minutes three times a day.

Various plant growth promoting bacteria present in Jeevamrit sample for nitrogen fixation, phosphate solubilization and potassium solubilization were isolated using nitrogen free mannitol agar, Pikovskaya's agar and Aleksandrow Agar, respectively.

Bacterial load of the Jeevamrit was determined by calculating the colony forming units (CFU) daily for up to16 days. The sample was diluted up to 10^{-5} and spread on standard plate count agar and incubated at room temperature for 24 hrs.

The bacterial isolates obtained were studies for cultural, morphological and biochemical characteristics. (Table 1). The starch and Pectin degradation activity after incubation was studied by flooding the plates with iodine to observe zone of degradation. To observe cellulose degradation activity the plates were flooded with congo red & kept for 20min. Clear zone around the colonies are observed on minimal salt medium with lignin and guaiacol for lignin degradation activity of isolates. The Indole Acetic Acid production by bacterial isolates was tested inoculating in tryptone medium appearance of red colour on adding Salkowski reagent, after 48hrs of incubation.

Field Application –For the field application of Jeevamrit, it is sprayed on the plant surface and drenched near root site of soybean crop, tomato (a vegetable) and Nerium (a flowering plant) after every four days and the visible results on the growth of plant were recorded.

Table 1- Details of Biochemical tests performed and media used for that

Sr. No	Biochemical tests	Media used
1	Starch hydrolysis	1% starch agar
2	Cellulose hydrolysis	Carboxymethylcellulose agar

3	Casein hydrolysis	10% skimmed milk agar
4	Lipid hydrolysis	10% butter agar
5	Lignin degradation	Minimal Salt Medium with lignin and guaiacol
6	Indole Acetic acid production	Tryptone Broth
7	Pectin hydrolysis	1% pectin Agar

III. RESULT AND DISCUSSION

Bacterial Load of Jeevamrit observed over 16 days is given in Fig-1.

Total 11 bacterial isolates along with the nonsymbiotic nitrogen fixing *Azotobacter* are isolated from the Jeevamrit. Those are listed as RSML J1, RSML J2, RSML J3, RSML J4, RSML J5, RSML J6, RSML J7, RSML J8, RSML J9, RSML J10 and RSML J11.

The results of various tests studies for each of above isolates are given in Table 2.

The visible results are seen on the soyabean crop, tomato plant and also in the Nerium (flowering plant), recorded as photographs (Photoplates-1, 2 and 3, respectively)

Multiple studies were documented regarding the applications of Jeevamrit on various types of crop plants like Wheat (Puneet et al., 2020) Cowpea (Sutar et al., 2018), Potato (Rudra et al., 2024), Soybean and Maize (Harshika et al., 2024), Vegetable Crops, Garden plants. The self life of Jeevamrit is 60 to 75 days (Ashish et al.,2024) But the best results were observed after applying the 8-12th day old Jeevamrit cause the higher microbial load is observed in this specific period (Devkumar N. et al. 2008 and Kulkarni et al.,2019).

Fig 1 – Number of colony forming units (CFU) from day 1 to day 16

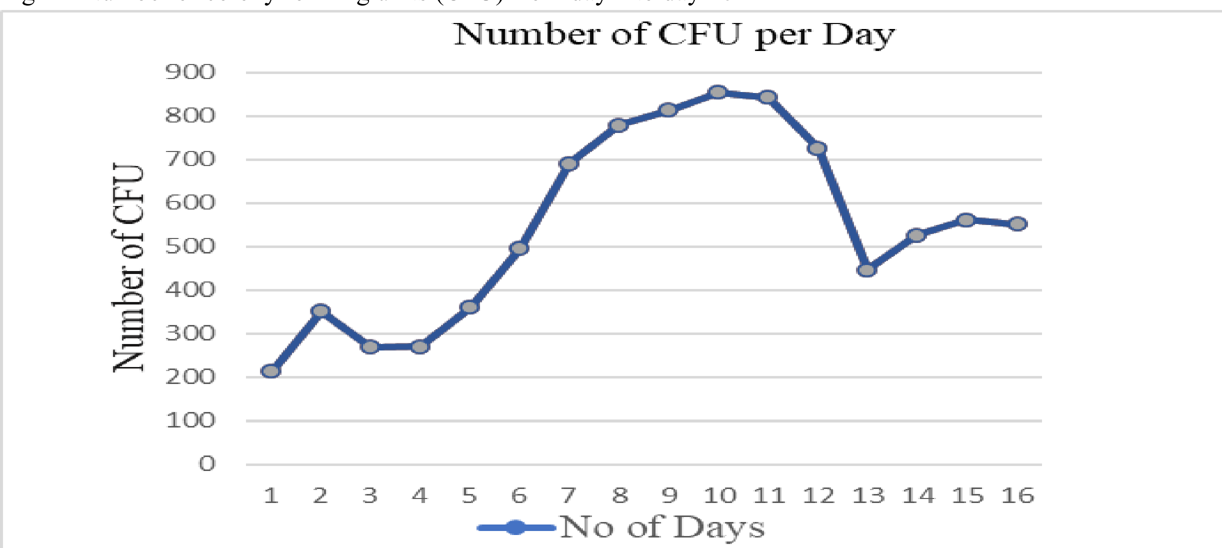

Table 2- Observations of biochemical tests of 11 isolates

Biochemical Activity	Isolates										
	RSML-J1,	RSML-J2,	RSML-**J3,**	RSML-J4,	RSML-J5,	RSML-J6,	RSML-J7,	RSML-J8,	RSML-J9,	RSML-J10,	RSML-J11,
Starch hydrolysis	+	-	+	+	+	+	+	+	-	-	-
Cellulose hydrolysis	+	+	+	+	+	+	-	+	+	+	-
Protein hydrolysis	+	+	+	+	+	+	-	+	+	+	-

Potassium mobilization	+	-	-	-	-	-	-	+	-	-	+
Phosphate Solubilization	-	+	+	-	+	+	+	-	-	-	-
Lipid hydrolysis	+	+	-	+	+	+	+	+	-	-	-
Lignin degradation	-	-	+	-	-	-	-	+	-	-	-
IAA production	+	+	+	+	+	+	+	+	-	-	-
Pectin Hydrolysis	+	+	+	-	+	-	+	+	+	+	+

Photo-1 [A] soybean plant has no jeevamrit treatment and [B] soyabean plant has Jeevamrit treatment

Photo-2 [A] tomato plant has no jeevamrit treatment and [B] tomato plant has Jeevamrit treatment

Photo-3 [A] Nerium flower plant has no jeevamrit treatment and [B] Nerium flower pant has Jeevamrit treatment

IV. CONCLUSION

Jeevamrit is the rich source of the beneficial micro-organisms for soil and crops, farmers should include it in their agricultural techniques as it will help to reduce the amount of commercial inorganic fertilizer application.

Jeevamrit is easy to integrate in the farming practices. It is used from long back in time but still there is lot more to discover and discuss about it.

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