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PREPARATION OF LIQUID BIOFERTILIZER FROM BIOWASTE TO IMPROVE THE QUALITY AND FERTILITY OF SOIL

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ABSTRACT:
Chemical fertilizers despite having advantages cannot be visualized as most efficient because of their side effects, posing threat to human health and decreasing fertility of soil after excess use. Hence to overcome this problem, the best alternative towards which the world is aiming today is organic farming. Organic fertilizers like liquid biofertilizers can be used to reduce the risk of accumulation of chemicals in food chain.
This project aims towards the preparation of liquid biofertilizers using biowaste such as orange, lemon, Papaya, pineapple peels, activated with acid for improving the fertility of soil, which in turn increases the growth of plants and making them less prone towards the diseases. Tests were done to determine the increase in useful microbial flora amendment of LBF liquid biofertilizers in soil which are responsible for increase in phosphorous, potassium and nitrogen content of soil. The LBF increases the fertility of soil more efficiently than the regular chemical fertilizers, further they are eco-friendly and are found to be cheap alternative for agrochemicals.

Keywords :- Liquid Biofertilizer, Microbial flora, Eco friendly.

INTRODUCTION :

Commercial preparation of microorganisms added to soil to enrich the soil fertility are called biofertilizers. A biofertilizer may contain nitrogen fixing microbes and phosphate solubilizing microbes [1-4]. It is supplied to the soil either by seed treatment or by spreading it over the field during cultivation. Liquid biofertilizers (LBFs) contain specific beneficial microorganisms which are capable of fixing or solubilizing or mobilizing plant nutrients by their biological activity. Liquid biofertilizer formulation is one of the most promising and updated technology [5,6].

In the present study, we prepared liquid biofertilizers by using biowaste like orange peels, lemon peels, papaya peels, pineapple peels and its effect was tested on the growth of spinach [7,8]. We used these biofertilizers to increase soil fertility. We further confirmed the enhancement of soil fertility by testing bacterial flora in soil. Spinach (*Spinacia oleracea*) is a leafy green vegetable native to central and western Asia. It is of the order Caryophyllales, family Amaranthaceae, subfamily Chenopodioideae [9-12]. Its leaves are a common edible vegetable consumed either fresh, or after storage using preservation techniques by canning, freezing, or dehydration. It may be eaten cooked or raw, and the taste differs considerably; the high oxalate content may be reduced by steaming [13,14]. It prevents cancer, reduces blood sugar, aids in good bone health, aids in weight loss, good for eyes, reduces hypertension, shows anti-inflammatory properties, keeps body relaxed etc.

MATERIAL AND METHODOLOGY :

Collection of Samples

House hold wastes were collected from the kitchen. The four different fruit peels used for the present study were, Lemon peels, Orange peels, Papaya peels, and Pineapple peels. The peels were washed and cut into small pieces and crushed. They were used for solid state fermentation (SSF).

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Material Required for fermentation process-

1) Polyethene bottles
2) Fruit peels
3) Jaggery
4) Distilled water

For the fermentation process we used 1:3:10 proportion of Jaggery, Peels and water. The above preparation required 100 gm of jaggery which was taken in 1 lit. polyethene bottle which contains 300 gm of fruit peels and 1 lit of water. This bottle was kept at room temperature for 60-80 days for fermentation. Occasionally the lid of bottle can be opened to release gases which are generated during the fermentation process. The soluble product was filtered with a fabricated filter. The fermented solution was used as LBF.

The remaining extract of Lemon peels can be used to produce second batch fertilizer. All the other fruit peels were fermented using the same method. The collected soil without LBF and amended soil sample were analysed for different physico- chemical and microbiological properties to know the fertility status of the soil. The pH of the soil was determined by using 1:1 soil water suspension ratio (Jackson,1967), electrical conductivity was determined using conductivity meter taking 1:1 soil water suspension ratio (Jackson,1967), moisture % was determined using method of Black et al (1965), sodium and potassium was determined by using flame photometer, sulphate was estimated using barium chloride and measuring the absorbance using spectrophotometer, chlorides were estimated by titration with silver nitrate. Total nitrogen was estimated by digesting sample using conc. sulphuric acid (wet digestion) and taken for nitrogen distillation by micro Kjeldahl method using Kjel Plus instrument (Tandon, 1993). Total Phosphorous was estimated by digesting soil with mixture of nitric acid and perchloric acid (9:4) and determines the phosphate by ammonium vanadomolybdate as described by Jackson (1967). Organic matter was determined in terms of organic carbon by Walkely and Black method (1972). The physico-chemical and microbiological characteristics of Biowaste used for pot culture studies were also determined. Turbidity was measured using Nephelometric method (APHA, 2005), total solids, total dissolved solids and total suspended solids were found out using APHA methods (2005). Total alkalinity was estimated using titration method (APHA, 2005). COD of the Biowaste sample was estimated by open reflux method, BOD of the Biowaste was also determined (APHA, 2005). The seedling emergence, seedling growth, plant height and root length were recorded in each pot at a regular interval of 5 days starting from first day of sowing. The plant height and root length were measured by using ruler and scale.

The experimental set up for pot culture studies using barren soil amended with different concentrations of whey waste is given below—

Treatment of soil:-

1. Control soil : 4 Kg. Soil + 1 Kg. Sand + 1000ml water + sown 100 Spinach oleracea seeds.

2. Experimental pots

1) Lemon peels Biofertilizer: 4 Kg. Soil + 1 Kg. Sand + 1000ml water + 250ml whey + sown 100 Spinach oleracea seeds.

2) Orange peels Biofertilizer: 4 Kg. Soil + 1 Kg. Sand + 1000ml water + 500ml whey + sown 100 Spinach oleracea seeds.

3) Papaya peels Biofertilizer: 4 Kg. Soil + 1 Kg. Sand + 1000ml water + 750ml whey + sown 100 Spinach oleracea seeds.

4)Pineapple peels Biofertilizer: 4 Kg. Soil + 1 Kg. Sand + 1000ml water + 1000ml whey + sown 100 Spinach oleracea seeds.

RESULTS AND DISCUSSION :-

The results obtained from the present study have been presented under following heads:

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Physico-Chemical Characteristics:

The physico-chemical characteristics of barren land soil used in present study are given in Table-1. The soil was yellowish brown in colour. It was alkaline in nature. Total nitrogen, available phosphate, sulphate, sodium, potassium, % of moisture in soil, which are very essential for vegetation was not found in appropriate amount in the barren land soil. The physico-chemical characteristics of Biofertilizer used in pot culture studies are given in Table-2. The Biofertilizer sample was yellowish in colour, It was acidic in nature. Electrical conductivity was 6.65 us/cm. The sample was turbid in nature, containing dissolved solids, suspended solids, phosphate, potassium sodium and nitrogen. The physico-chemical characteristics of barren land soil amended with different concentration of Biofertilizer are mentioned in Table-3. The soil was alkaline in nature. Addition of Biofertilizer in each concentration gives a perfect pH condition for growth of plant. Electrical conductivity is also increased with respective Biofertilizer. Sodium, potassium also increased in order and this showed a positive effect on the growth of plant. The physico-chemical characteristics of amended soil sample after study period are given in Table-4. It was observed that after harvesting plant the physico-chemical properties showed some amount of changes in characteristics. The p^H of soil was alkaline after uprooting of plants. Sodium, potassium, percent of carbon, percent of nitrogen, phosphate level decreased (in less amount).

Response of Biofertilizer application on overall plant growth :

The germination rate of seeds was low in the control soil which increased prominently after amending it with fruit peel biofertilizer. It indicates that biofertilizer facilitates multiplication of Nitrogen fixing of microorganisms in soil and hence overall plant growth. The number of *Azotobacter* and *Rhizobia* also increased in number as compared to control. This is because biofertilizer waste being acidic contains organic acids like butyric acid, lactic acid, formic acid, acetic acid etc and nitrogen fixing bacteria like *Azotobacter* and *Rizobium* can use these organic acids for cellular proliferation and multiplication This ultimately increases the quantity of nitrogen fixed hence improves the crop yield. However, it was found that when excessive quantity of Biofertilizer was added within a short time interval, it adversely affected soil microflora and plant growth.

CONCLUSION:

The study aimed at producing Biofertilizers from household waste or Biowaste. Biowastes are defined as waste which are formed from various household activities in kitchen. The Biowaste are usually fruit peels, vegetables waste, poultry waste etc. The collected Biowaste were subjected to solid state fermentation process to produce soluble fermented solution. The Biowaste used were lemon peels, papaya peels, orange peels, and pineapple peels. Solid state fermentation aided in the fermentation of soluble products and helped to produce the microorganism such as bacteria, fungi and yeast. The fermented solution was applied to vegetation specially spinach to check the efficiency of the biofertilizer.

A better way of useful management of kitchen waste is its reuse for improving soil fertility which will also solve the problem of disposal of fruit waste in future and it will also keep our environment clean and pleasing. Present study has shown that application of fruit waste of different fruits peel biofertilizer has proportionally improved the nutrient status of soil with respect to nitrogen, phosphate and potassium level, the microbiological status of soil. It was evident from the result of physico-chemical and growth response of barren soil amended with different fruit peels biofertilizer

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that the improvement in the soil fertility has resulted in increased germination rate of *Spinach oleracea* with the increase in plant growth. However, excessive addition of biofertilizer should be avoided since it adversely affects every process due to increase in acidity of soil.

REFERENCES:

V.Kumaresan. Biotechnology book, Saras publication, Sixth Edition, Reprint 2017.

Swarnali Duary, Krishnedu Mondal and Monalisa Sahoo, Liquid Biofertilizer- an innovative tool for sustainable agriculture, international journal of natural sciences, vol. 12/ issue 69/ Dec 2021.

Dr. Geeta Sumbali and Dr. R. S. Mehrotra, Principles of Microbiology, Tata McGraw- Hill Edition Private Limited New Delhi.

Govind Choubey, Yogesh Joshi and Vijay Karadbhajne, An Efficacy of multifunctional liquid biofertilizers on mandarin oranges: field experiment results, International journal of agricultural science and research (IJASR) ISSN (P): 2250-0057, ISSN (E):2321-0087 VOL, 9, Issue 1, Feb 2019, 29-32.

Govind Choubey, Trisha Dhargave, Yogesh Joshi, Vijay Karadbhajne and Hemant Jambhekar, A pilot scale process for the production of high shelf life multifunctional liquid biofertilizers, International journal of Biotechnology and research (IJBTR) ISSN (P) 2249-6858; ISSN (E):2249-796X, VOL,8, Issue 5, Oct 2018,1-10.

Alexander, M. (1977), *An introduction to soil microbiology*," 2nd ED., John Wiley and sons.

APHA, AWWA, WEF, *Standard Methods for the examination water and waste water*, 21st Edn, 2005

Bandopadhyay, A.K. and Mathur, B.N. 1987 *Indian milk products: a compendium.* Dairy India 211-218.,

Dubey kirti and Juwarkar Asha (2001) Distillery and curd whey wastes as viable alternative source for biosurfactant production; *World Journal of Microbiology and Biotechnology 17:61-69, 2001.*

Habteselassie Mussie.Y. et.al (2006), Gross nitrogen Transformation in an Agriculture soil after Repeated Dairy Waste Application. *Soil Science Society of America Journal* 70: 1338-1348.

Halliwell, David J., Bairo Kirsten, M. And Nash David M.,(2001) *Australian Journal of Soil Research, Vol (39) pg 1259-1267.*

Isabell Shipard, *'How can I grow and use sprouts as living food?* www.herbsarespecial.com.au

Jackson, M.L. (1967). *Soil chemical analysis. Prentice Hall of India.*New Delhi.

Jelen, Pavel (1979), Industrial Whey Processing Technology: An overview. *Journal of Agricultural and Food Chemistry* 27, 658

Peterson, Arthur, E. Walker, William, G. And wastson Kenneth, S (1979), Effect of whey application on chemical properties of soil and crops. *Journal of Agricultural and Food Chemistry* 27: 654-658.

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Table-1: The physico- chemical characteristics of barren land soil

Sr.No.	Parameter	Reading
1	pH	7.6
2	Moisture %	3.9
3	Conductivity (µs/cm)	1.62
4	Sodium (ppm)	04
5	Potassium (ppm)	05
6	Chloride (mg/Kg)	47.9
7	Organic matter %	3.78
8	% of Carbon	1.53
9	Sulphate (mg/Kg)	54.04
10	Total Nitrogen %	1.80
11	Phosphate (mg/Kg)	438

Table-2: The physico- chemical characteristics and microbiological characteristics biofertilizer used in pot culture studies

Sr.No.	Parameter	Reading
1	p^H	4.00
2	Conductivity (µs/cm)	7.75
3	Turbidity (NTU)	153.6
4	Total Solids (mg/L)	44.9
5	Total suspended solids (mg/L)	21
6	Total dissolved solids (mg/L)	31.6
7	Alkalinity	ND
8	Sodium (ppm)	16
9	Potassium (ppm)	177
10	COD (mg/L)	460000
11	BOD(mg/L)	31500
12	Nitrogen(%)	2.58
13	Phosphate	563

Table-3: The physico- chemical characteristics of barren land and soil amended with following Fruit Peel biofertilizer

Sr. No.	Parameter	Control soil	Lemon peels biofertilizer	Orange peels biofertilizer	papaya peels biofertilizer	Pineapple peels biofertilizer 1
1.	**PH**	8.09	8.07	7.49	7.16	7.10
2.	**Conductivity(us/cm)**	1.58	1.54	1.68	1.63	1.68
3.	**Sodium (ppm)**	03	06	07	05	06
4.	**Potassium (ppm)**	05	05	06	07	8.9
5.	**Chloride(mg/kg)**	8.3	6.6	4.4	3.2	4.6
6.	**Organic matter (%)**	3.10	4.24	3.78	2.38	3.88
7.	**% Carbon**	2.80	2.00	1.88	1.90	2.32
8.	**Sulphate(mg/kg)**	38.88	38.43	38.31	26.16	24.18
9.	**Total nitrogen**	2.04	2.85	2.90	2.82	2.94
10.	**phosphate**	520	564	560	550	569

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Table-4: The Physico chemical characteristic of amended soil sample after study period

Sr. No.	Parameters	Control soil	Lemon peels biofertilizer	orange peels biofertilizer	Papaya peels biofertilizer	Pineapple peels biofertilizer
1.	**PH**	8.18	8.12	7.53	7.86	7.30
2.	**Conductivity (us/cm)**	0.58	0.79	0.88	0.96	0.1
3.	**Sodium (ppm)**	01	05	04	05	05
4.	**Potassium (ppm)**	02	05	04	05	04
5.	**Chloride (mg/kg)**	6.8	5.9	4	3.1	1.2
6.	**Organic matter (%)**	1.78	1.95	2.23	2.06	2.11
7.	**% carbon**	1.06	1.30	1.58	1.32	1.54
8.	**Sulphate (mg/kg)**	34.27	32.70	33.20	31.23	26.43
9.	**Total nitrogen**	1.82	2.87	2.89	1.61	1.69
10.	**Phosphate(ppm)**	498	565	545	560	549

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