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## Effect of different Jeevamrut based liquid organic formulations on biochemical properties of soil and on plant growth of blackgram [*Vigna mungo* (L.) Hepper] under pot culture conditions

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**Abstract**

A pot culture experiment was conducted at organic farming unit, Rajasthan College of Agriculture, MPUAT, Udaipur, to study the effect of different jeevamrut based liquid organic formulations on biochemical properties of soil and on plant growth of blackgram during *khari* 2019. The various types of liquid organic formulations were prepared from plant and animal origin wastes and are effective in the promotion of growth and fruiting in blackgram. Jeevamruth promotes immense biological activity in soil and enhance nutrient availability to crop. Similarly, beneficial effects of silicon, vermiwash and leaf extracts (of lemon grass and *Aleo vera*) have been reported to protect the crop from soil borne and seed borne pathogens and also improves seed germination. In the present study, significant highest plant growth and root length was recorded with the application of jeevamrut + lemon leaf extract (2.5%) + *Aleo vera* leaf extract (2.5%) + silica (1%) + vermiwash (5%) and it was found to be significantly superior over other treatments. The N, P, and K concentration of plants and microbial population and dehydrogenase activity of soil was significantly highest in the treatment given jeevamrut + lemon leaf extract (2.5%) + *Aleo vera* leaf extract (2.5%) + silica (1%) + vermiwash (5%).

**Keywords:** Jeevamrut, liquid formulations, vermiwash, blackgram, leaf extracts

**Introduction**

Intensification of agriculture has greatly increased the food availability over recent decades. However, this has led to considerable adverse environmental impacts, such as increase in nitrogen over supply, eutrophication of land and water bodies, declining water table and factor productivity, greenhouse gas emissions and biodiversity losses. It is, therefore, crucial to curb the negative environmental impacts of agriculture, while ensuring that the same quantity of food can be delivered.

Liquid formulations used in organic agriculture like panchagvya, beejamrut, vermiwash and jeevamrut are the fermented products which are used as plant growth enhancing substances prepared with material available with farmers. They are rich sources of beneficial micro- flora, macro nutrients, essential micro nutrients, many vitamins, essential amino acids, growth promoting factors like IAA, GA and beneficial microorganisms which stimulate the plant growth and help in getting better vegetative growth and also good quality yield while improving soil health. Formulations prepared from agricultural by- products, viz., bran of grains, oil cakes, farmyard manure, leaf extracts etc., are excellent carriers of growth substances, storage media (Devakumar *et al.* 2011)<sup>[3]</sup> and can be used to enhance the liquid formulations through different combinations.

**Material and Methods**

The present study was carried out at organic farming unit, Rajasthan College of Agriculture, MPUAT, Udaipur. The experiment was laid out in completely randomized design (CRD) with three replications comprising of seven treatment combination of liquid formulations, the soil in each pots was mixed with 200g of NADEP and 100g of vermicompost, ten seeds of blackgram (each treated with *Rhizobium* culture) were sown in each pot at a depth of 1.5-2 cm, a week after germination only 5 plants were kept in each pot under normal practices, the details of treatment combination is given in Table. 1.

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**Table 1:** The details of treatment combination

T <sub>1</sub>	Jeevamrut (Control)
T <sub>2</sub>	Jeevamrut + Lemon Leaf Extract (2.5%)
T <sub>3</sub>	Jeevamrut + <i>Aloe vera</i> Leaf Extract (2.5%)
T <sub>4</sub>	Jeevamrut + Lemon Leaf Extract (2.5%) + <i>Aloe vera</i> Leaf Extract (2.5%)
T <sub>5</sub>	Jeevamrut + Silicon (1%)
T <sub>6</sub>	Jeevamrut + Vermiwash (5%)
T <sub>7</sub>	Jeevamrut + Lemon Leaf Extract (2.5%) + <i>Aloe vera</i> Leaf Extract (2.5%) + Silicon (1%) + Vermiwash (5%)

The liquid formulations were analysed for the nutrient status and microflora present in them following standard methodologies and the results are presented in Table no. 2. The present trial was aimed to study the influence of these nutrients and microflora on soil, plant growth and yield of blackgram. The different biometric observations were recorded at 60 DAS (days after sowing) and at harvest from all the five plants in each pot. The mean of five plants were considered for analysis.

**Table 2:** The present trial was aimed to study the influence of these nutrients

S.no	Parameters	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>	T <sub>6</sub>	T <sub>7</sub>
1.	pH	5.04	5.03	5.06	5.13	5.34	4.96	5.50
2.	EC(dSm <sup>-1</sup> )	0.57	0.53	0.55	0.54	0.53	0.70	0.54
3.	Total N (%)	1.897	1.998	2.012	2.053	1.960	1.925	2.152
4.	Total P (%)	0.220	0.636	0.697	0.776	0.568	0.525	1.167
5.	Total K (%)	0.296	0.409	0.417	0.458	0.342	0.329	0.588
6.	Total Zn (ppm)	0.078	0.010	0.012	0.026	0.017	0.032	0.020
7.	Total Fe (ppm)	2.348	1.270	1.310	2.022	2.267	2.653	1.900
8.	Bacterial count(cfu ml <sup>-1</sup> )	0.85X 10 <sup>7</sup>	7.21 X 10 <sup>7</sup>	1.9 X 10 <sup>8</sup>	6.5 X 10 <sup>7</sup>	8.0 X 10 <sup>7</sup>	4.8 X 10 <sup>7</sup>	9.7 X 10 <sup>7</sup>
9.	Fungal count (cfu ml <sup>-1</sup> )	0.60X 10 <sup>4</sup>	5.21 X 10 <sup>4</sup>	37.5 X 10 <sup>4</sup>	2.15 X 10 <sup>4</sup>	1.1 X 10 <sup>4</sup>	3.15 X 10 <sup>4</sup>	2.25X 10 <sup>4</sup>
10.	Actinomycetes (cfu ml <sup>-1</sup> )	4.0X 10 <sup>4</sup>	47.6 X 10 <sup>4</sup>	77.5 X 10 <sup>4</sup>	50 X 10 <sup>4</sup>	6.5 X 10 <sup>4</sup>	18.85 X 10 <sup>4</sup>	41 X 10 <sup>4</sup>
11.	Dehydrogenase (µg ml <sup>-1</sup> )	4.0	6.28	7.33	6.46	6.81	7.86	5.93

### Application of formulations

Different doses of jeevamrut combinations were sprayed in experimental pots @10% as per treatments during crop period as described in Table 1. Jeevamrut combinations were prepared as per treatment applications, for example jeevamrut + lemon leaf extract (2.5%) was prepared by adding 2.5 litres of lemon leaf extract in 100 litre of jeevamrut and then taking 10 litre of this solution in 100 litres of water. Foliar application was done on 15<sup>th</sup>, 30<sup>th</sup> DAS, and at initiation of branching (10%) and at initiation of flowering (10%) with respect to the size and number of plants using hand sprayer.

**Table 3:** Effect of Jeevamrut based liquid organic formulations on growth attributes of organic blackgram

Treatments	Plant Height (At 60 DAS)	Plant Height (At Harvest)	Root length (At Harvest)	No. of Leaves plant <sup>-1</sup> (60 DAS)	No. of Leaves plant <sup>-1</sup> (At Harvest)	Dry matter accumulation (g plant <sup>-1</sup> )
Jeevamrut (control)	42.72	43.00	20.14	12.07	4.94	9.70
Jeevamrut + Lemon Leaf Extract (2.5%)	43.75	44.08	21.22	13.00	5.63	10.57
Jeevamrut + <i>Aloe vera</i> Leaf Extract (2.5%)	44.11	44.29	21.69	13.07	5.93	10.79
Jeevamrut + Lemon Leaf Extract (2.5%) + <i>Aloe vera</i> Leaf Extract (2.5%)	44.65	45.06	22.22	13.45	6.39	12.14
Jeevamrut + Silica (1%)	44.29	45.01	23.41	13.05	5.87	10.87
Jeevamrut + Vermiwash (5%)	44.54	45.02	23.70	13.30	6.30	12.03
Jeevamrut +Lemon Leaf Extract (2.5%) + <i>Aloe vera</i> (2.5%) + Silica (1%) + Vermiwash (5%)	45.96	46.67	23.87	14.71	6.70	13.23
S.Em±	0.28	0.27	0.25	0.24	0.19	0.20
CD(P = 0.05)	0.85	0.83	0.75	0.74	0.57	0.60

### Results and Discussion

The results showed that the application of different jeevamrut based liquid organic formulations significantly influenced the biomass production of blackgram at growth stages.

The application of T<sub>7</sub> treatment recorded the maximum height of plant (45.96 cm) at 60 DAS and (46.67 cm) at harvest. Also it resulted in significant increase in length of root (23.87 cm at harvest), number of leaves (14.71 at 60 DAS and 6.70 at harvest plant<sup>-1</sup>) and dry matter accumulation (13.23 g plant<sup>-1</sup>) at harvest as shown in (Table 2.)

The higher growth attributes with application of jeevamrut based liquid organic formulations may be due to the increased availability of nutrients at initial stage through organic sources in addition to nutritional benefits from jeevamrut. The fermented liquid organic manures contain microbial load and plant promoting substances in addition to nutrients that help in improving plant growth, metabolic activities and resistant to diseases and pest attacks, (Devakumar *et al.*, 2008) [4], also Lanka (2018) [6] reported that the leaves of *Aloe vera* plant contain numerous vitamins, minerals, natural sugars, enzymes, amino acids, and well rich in various bioactive compounds that exhibit emollient, purgative, anti-inflammatory, antioxidant, antimicrobial, anti-helmenthic, antifungal activities.

Also a significant increase in yield and yield attributing characters (Table 3.) were observed with the application of jeevamrut + lemon leaf extract (2.5%) + *Aloe vera* leaf extract (2.5%) + silica (1%) + vermiwash (5%) over other formulations. The increase in seed and haulm yield of blackgram due to application of above treatment could be due to greater availability of nutrients and plant growth hormones due to augmenting effect of organic based liquid formulations during the critical period of growth period. These findings are in accordance with Kasbe *et al.* (2009) [7] wherein it is reported that better nutrient status of jeevamrut formulation (2500 litre ha<sup>-1</sup>) resulted in profused growth in the form of higher dry matter accumulation and yield parameters. Similar findings were also observed by Shwetha and Babalad (2008) [9] and they reported a significant improvement in plant height, accumulation of dry matter, number of branches, leaf area index (LAI) and seed yield with the application of organic manures in combination with fermented organics such as Beejamrut, Jeevamrut and panchagavya.

The easy transfer of nutrients and growth stimulants to plants through foliar sprays of jeevamrut based liquid organic formulations was more effective and might be the reason for enhancement of yield attributes. Smaller amounts of growth hormones like IAA and GA, micro and macro nutrients, beneficial microorganisms present in formulations (Somasundaram *et al.*, 2003) [10].

when foliar sprayed could have created stimuli in the plant system which in turn increased the production of growth regulator in cell system and the action of growth regulators in plant system stimulated the necessary growth and development, leading to better yield.

Application of T<sub>7</sub> significantly improved nitrogen, phosphorus, potassium, zinc and iron contents in seed and haulm of blackgram over control and other treatments.

The formulation of jeevamrut + lemon leaf extract (2.5%) + *Aloe vera* leaf extract (2.5%) + silica (1%) + vermiwash (5%) contains N (2.152%), P (1.167%), K (0.588%), Zn (0.020 ppm) and Fe (1.90 ppm), and greater microbial populations. This may be due to increased availability of nutrients due to buildup of soil micro flora resulting from increased bacteria, fungi, actinomycetes, P-solubilizers and N fixers population in the soil which resulted in high nutrient concentration and better growth and yield of blackgram and consequently total uptake of macro and micro nutrients increased. Similar, results were observed by Gore and Sreenivasa (2011)<sup>[5]</sup> that with the application of liquid organic manure + RDF followed by beejamrut (200 l ha<sup>-1</sup>) + jeevamrut (500 l ha<sup>-1</sup> at transplanting) + panchagavya (500 l ha<sup>-1</sup>) recorded significantly higher nutrient uptake of, N, P and K in tomato crop (4.38 kg ha<sup>-1</sup>, 0.43 kg ha<sup>-1</sup> and 1.03 kg ha<sup>-1</sup> respectively) as compared to application of beejamrut, jeevamrut and panchagavya (3.36 kg ha<sup>-1</sup>, 0.35 kg ha<sup>-1</sup> and 1.087 kg ha<sup>-1</sup>, respectively). Atal (2017)<sup>[1]</sup> observed that application of

vermicompost @ 7 t ha<sup>-1</sup> along with jeevamrut (drenching + foliar spray) in bell pepper recorded 82.4 per cent higher soil available N, P & K contents, N, P & K uptake.

The protein content was also improved significantly due to the applications of jeevamrut base organic liquid formulations. The significant increment may be ascribed to different structural and functional roles of macro and micro nutrients and growth hormones at cellular level which resulted from higher nitrogen content in seeds. Ananda *et al.* (2017)<sup>[2]</sup> reported higher protein content and protein yield with the application of enriched biodigested liquid organic manure at 50 kg N equivalent ha<sup>-1</sup> + PG spray at 3% followed by enriched biodigested liquid organic manure at 50 kg N equivalent ha<sup>-1</sup> + vermiwash spray at 3% and jeevamrut at 50 kg N equivalent ha<sup>-1</sup> + PG spray at 3% might be due to increased availability of nutrients particularly nitrogen which is an integral part of protein.

Different formulations of jeevamrut significantly increased the population of bacteria, fungi and actinomycetes in soil over control (Table 4.) which is seen after the harvest of blackgram. All the biological reactions in soil are carried by the enzymes. Soil enzyme activities are believed to indicate the extent of specific processes in soil and in many cases act as indicators of soil fertility. A significant higher dehydrogenase activity was observed with application of jeevamrut + lemon leaf extract (2.5%) + *Aloe vera* leaf extract (2.5%) + silica

**Table 4:** Effect of Jeevamrut based liquid organic formulations on yield and yield attributes of organic blackgram

Treatments	No. of pods plant <sup>-1</sup>	No. of seeds pod <sup>-1</sup>	Test weight (g)	Seed yield (g pot <sup>-1</sup> )	Haulm yield (g pot <sup>-1</sup> )	Biological Yield (g pot <sup>-1</sup> )
Jeevamrut (control)	20.87	5.63	34.52	25.11	54.48	79.59
Jeevamrut + Lemon Leaf Extract (2.5%)	21.63	6.10	35.28	26.31	57.31	83.62
Jeevamrut + <i>Aloe vera</i> Leaf Extract (2.5%)	21.95	6.18	35.39	27.32	59.50	86.81
Jeevamrut + Lemon Leaf Extract (2.5%) + <i>Aloe vera</i> Leaf Extract (2.5%)	22.47	6.23	36.52	28.22	61.45	89.67
Jeevamrut + Silica (1%)	21.61	6.17	34.84	28.13	61.27	89.41
Jeevamrut + Vermiwash (5%)	22.99	6.22	36.17	28.33	61.71	90.04
Jeevamrut +Lemon Leaf Extract (2.5%) + <i>Aloe vera</i> (2.5%) + Silica (1%) + Vermiwash (5%)	24.14	6.58	36.80	30.30	66.00	96.30
S.Em±	0.22	0.14	0.22	0.33	0.72	1.05
CD(P = 0.05)	0.66	0.41	0.67	1.00	2.19	3.19

(1%) + vermiwash (5%) according to Table 5. The dehydrogenase enzyme activity is commonly used as an indicator of biological activity in soils. Maximum dehydrogenase activity in treated plots than control may be due to enormous amount of microbial load in jeevamrut formulations which multiplies in the soil and acts as a tonic to enhance the microbial activity in the soil. Palekar (2006)<sup>[8]</sup>; Shreenivas *et al.* (2011) also reported that liquid manures contain micronutrients in addition to different microflora especially nitrogen fixers and phosphate solubilizers. Similar

observations were made by Swaminathan (2005)<sup>[11]</sup> who reported that presence of naturally occurring beneficial microorganisms predominantly bacteria, yeast, actinomycetes, photosynthetic bacteria and certain fungi were detected in organic liquid manures. Devakumar *et al.* (2011)<sup>[3]</sup> also reported that the use of handful of soil for jeevamrut preparation served as source of initial inoculum of bacteria, fungi, actinomycetes, N- fixers and P- solubilizers. Hence, more number of beneficial microorganisms were found in organic liquid manure formulation.

**Table 5:** Effect of Jeevamrut based liquid organic formulations on N, P, K Zn and Fe content in seed and haulm of organic blackgram after harvest

Treatments	Nitrogen content (%)		Phosphorus content (%)		Potassium content (%)		Zinc content (ppm)		Iron content (ppm)	
	Seed	Haulm	Seed	Haulm	Seed	Haulm	Seed	Haulm	Seed	Haulm
T1(control)	3.12	1.85	0.360	0.220	1.32	1.89	10.87	18.67	50.76	224.58
T <sub>2</sub>	3.35	2.01	0.376	0.230	1.41	2.01	11.09	19.33	51.54	226.35
T <sub>3</sub>	3.42	2.13	0.399	0.250	1.42	2.04	11.41	21.29	53.18	227.27
T <sub>4</sub>	3.44	2.26	0.453	0.287	1.46	2.05	12.22	22.44	53.19	228.44
T <sub>5</sub>	3.40	2.16	0.437	0.237	1.39	2.01	11.72	21.79	51.64	226.73
T <sub>6</sub>	3.55	2.22	0.462	0.257	1.45	2.09	12.23	22.25	53.01	227.45
T <sub>7</sub>	3.61	2.49	0.490	0.296	1.48	2.17	13.07	23.27	54.41	230.03

S.Em±	0.08	0.04	0.015	0.011	0.01	0.05	0.12	0.14	0.26	0.22
CD (P = 0.05)	0.23	0.12	0.046	0.033	0.04	0.14	0.37	0.44	0.77	0.66

**Table 6:** Effect of Jeevamrut and its combinations on soil microbial population and dehydrogenase enzyme activity after harvest of organic blackgram

Treatments	Microbial count (cfu g <sup>-1</sup> soil)			Dehydrogenase activity (µg TPF g <sup>-1</sup> h <sup>-1</sup> )
	Bacteria (1 × 10 <sup>6</sup> )	Fungi (1 × 10 <sup>4</sup> )	Actinomycetes (1 × 10 <sup>5</sup> )	
Jeevamrut (control)	63.98	23.51	33.51	10.11
Jeevamrut + Lemon Leaf Extract (2.5%)	65.15	24.86	34.88	11.25
Jeevamrut + <i>Aloe vera</i> Leaf Extract (2.5%)	68.14	25.16	35.80	11.40
Jeevamrut + Lemon Leaf Extract (2.5%) + <i>Aloe vera</i> Leaf Extract (2.5%)	67.23	25.96	36.13	11.89
Jeevamrut + Silica (1%)	66.11	25.27	35.84	11.80
Jeevamrut + Vermiwash (5%)	66.97	26.72	36.30	12.32
Jeevamrut +Lemon Leaf Extract (2.5%) + <i>Aloe vera</i> (2.5%) + Silica (1%) + Vermiwash (5%)	71.06	28.24	38.06	12.94
S.Em±	0.34	0.27	0.18	0.14
CD(P = 0.05)	1.04	0.82	0.54	0.41

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