A Practice to Enhance Soil Physico-chemical Properties and Viable Microbial Count as Effected by Organic Nutrient Sources in Iris under Mid Hill Zone of Himachal Pradesh, India

ABSTRACT

The current studywas conducted at Experimental Farm of Department of Floriculture and Landscape Architecture, Dr. YSParmar UHF, Nauni, Solan, H.P. during the year 2019-2020 to determine the ideal Jeevamrit dosage for enhancing the physico-chemical and microbiological characteristics of soil for irisAt intervals of 15 days, sixteen applications of jeevamrit were applied as a foliar spray and drench. Three replications of the field experiment were set up using Randomized Block Design (RBD). The study showed that treatment T_{16}, which involved both 7.5% Jeevamrit drenching and 15.0% Jeevamrit foliar application, had the most positive impact on soil quality. This treatment resulted in the highest organic carbon level (1.48), nitrogen content (362.59 kg/ha), phosphorus content (137.48 kg/ha), potassium content (267.85 kg/ha), and a high count of viable bacteria (75.63 $\times10^6$cfu/g soil), viable fungi count (28.57 $\times10^4$cfu/g soil), and viable actinomycetes count (45.90 $\times10^3$cfu/g soil). Additionally, this treatment had the lowest pH and EC levels.

Key words: Jeevamrit, Microbial count, Organic farming, Soil properties

INTRODUCTION

The 'Green Revolution' was a significant shift in agricultural practices that took place between the 1940s and 1960s. During this period, the application of chemical fertilizers, pesticides, herbicides, and fungicides became the industry standard worldwide. However, the excessive use of these techniques resulted in soil degradation, poor quality production, environmental pollution, and severe health hazards. Inorganic fertilizers can only provide one or two nutrient elements, which is why organic farming is considered an alternative practice to enhance microbial biomass and soil structure. (Naeem *et al*., 2006; Suresh *et al*., 2004). Agriculture is the primary source of livelihood for small and marginal farmers in states like Himachal Pradesh. Due to the topographic challenges, these farmers already practice traditional agriculture methods with minimal use of chemical inputs.

However, with the steep increase in the cost of inorganic fertilizers, small and marginal farmers find it hard to afford them. To make technology accessible to economically poor farmers, we can adopt the practice of zero-budgetnaturalfarming (ZBNF), which is the process of farming with nature and without the use of chemicals. ZBNF replaces inorganic fertilizers with organic manure, making it a sustainable and cost-effective option for farmers. (Naeem *et al*., 2006).Jeevamrit is a word that comes from two Hindi words: 'Jeevan' which means life and 'Amrit' which means medicinal potion. Earthworm activity and microbial population both significantly increase when Jeevamrit is applied to soil. This, in turn, increase nutrient availability in the soil and fortifies its resistance and resilience mechanisms. As a result, crop productivity is significantly increased (Vashishat *et al*., 2021; Lazarovits *et al*., 1997; Sreenivasa *et al*., 2009). The soil ecosystem's resistance and stability are increased by the elevated microbial population diversity index. (Palekar *et al*., 2006; Devakumar *et al*., 2008; Pathak *et al*., 2013). The rich microbial community of soil microorganisms plays a crucial role in transforming organic matter in soil and acting as a source and sink of nutrients that plants can use. This helps to improve soil fertility and crop yield (Gupta *et al*., 1988). Applying Jeevamrit to the soil is a great way to enhance the growth of beneficial microorganisms. These microorganisms convert nutrients from an unavailable form to an easily absorbable form, so that plants can absorb them more easily. You can use Jeevamrit by either spraying or sprinkling it on the crop field. It is essential to adopt sustainable agricultural practices based on scientific facts for growing different crops. In this context, a study was carried out in the mid-hill region of Himachal Pradesh to assess the effects of organic nutrient sources on the physico-chemical properties of the soil and the viable microbial count.

MATERIALS AND METHODS

The purpose of this study was to investigate the impact of organic nutrient sources on Iris (*Iris orientalis* Mill.) cv. Frigia, soil physical and chemical properties, and viable microbial count. The research was conducted from December 2019 to May 2020 at the Experimental Farm of Department of Floriculture and Landscape Architecture, Dr. YSParmar UHF, Nauni, Solan, H.P.This experimental site is situated at a latitude of 30o51’0” North and a longitude of 77o11’30” East, at an elevation of 1276 m above mean sea level. The experimental site is in the Himachal Pradesh mid-hill region, which is classified as an agro-climatic zone with moderate rainfall between 1000 and 1300 mm.

The experiment was set up on December 30, 2019, in a Randomized Block Design (RBD) using combination of sixteen treatments with three replications. The treatment combinations were assigned to different plots randomly, and Table 1 presents the details of the treatments. For a networking area of 1.00 square meters, beds measuring 1.20 by 1.20 meters were made for the planting of rhizomatous plants. The rhizomatous plants are spaced 20 cm x 30 cm apart. The treatment combinations will be applied at 15-day intervals alternatively in treatments T_8 to T_{16}, as shown in Table 1.

Table 1: Detail of treatments:

Treatments		Treatment details
T_1	:	Control (Without Jeevamrit)
T_2	:	2.5% Jeevamritdrenching
T_3	:	5.0% Jeevamritdrenching
T_4	:	7.5% Jeevamritdrenching
T_5	:	5.0% Jeevamritfoliar application
T_6	:	10.0% Jeevamritfoliar application
T_7	:	15.0% Jeevamritfoliar application
T_8	:	2.5% Jeevamritdrenching + 5.0% Jeevamrit foliar application
T_9	:	2.5% Jeevamritdrenching + 10.0% Jeevamrit foliar application
T_{10}	:	2.5% Jeevamritdrenching + 15.0% Jeevamrit foliar application
T_{11}	:	5.0% Jeevamritdrenching + 5.0% Jeevamrit foliar application
T_{12}	:	5.0% Jeevamrit drenching + 10.0% Jeevamrit foliar application
T_{13}	:	5.0% Jeevamrit drenching + 15.0% Jeevamrit foliar application
T_{14}	:	7.5% Jeevamrit drenching + 5.0% Jeevamrit foliar application
T_{15}	:	7.5% Jeevamrit drenching + 10.0% Jeevamrit foliar application
T_{16}	:	7.5% Jeevamrit drenching + 15.0% Jeevamrit foliar application

Preparation of Jeevamrit

Jeevamrit was prepared by dissolving the suggested ingredients (Sreenivasa *et al*, 2011).

Table 2. Composition of Jeevamrit

Ingredients	Quantity
Cow dung	10 kg

Cow urine	10 litres
Jaggery	2 kg
Pulse flour	1 kg
Live soil	A handful of soil
Water	200 litres

*Dilution of 5 litres of Jeevamrit in 100 litres of water for 5% foliar spray/drench.

All the ingredients were mixed in a plastic drum, wrapped with a moist jute sack, and then kept in the shade before being used according to the treatment schedule.

RESULTS AND DISCUSSION

The viable microbial count along with various soil physico-chemical property data are shown in Table 3 and Table 4 respectively.

Organic carbon (%)

A noteworthy maximum of 1.48 percent of organic carbon was observed when 7.5% of Jeevamrit was drenched and 15.0% of Jeevamrit foliarwas applied (T16). Minimum organic carbon (1.02 %) was noticed with treatment T_1 (Control). The application of liquid manure may have increased the incorporation of organic materials and stimulated root growth, which has resulted in an increase in soil organic carbon. Increased soil organic carbon content could have been the consequence of these compounds' breakdown(Kumari *et al*., 2019). Applying Jeevamrit may have caused a drop in bulk density, which could be linked to higher levels of organic carbon content (Chandrakala, 2008; Jenny and Malliga, 2016). The findings of Singh et al. (2014) and Rai et al. (2014) corroborate the results.

pH and EC

The application of 7.5% Jeevamrit drenching + 15.0% Jeevamrit foliar (T_{16}) application resulted in the lowest soil pH (6.58). Soil EC was non significantly affected by the application of Jeevamrit. It is preferable to have lower soil pH and Electrical ConductivityOne possible explanation for the drop in soil pH and EC levels is the organic acids released during the organic manure's breakdown. This might be because applying these manures has increased the permeability of the soil. Rai *et al.* (2014) have similarly noted a reduction in soil EC and pH when Jeevamrit is applied.

Available N (kg/ha)

It is clear from the information in Table 3 that the application of Jeevamrit influenced the available nitrogen. Maximum nitrogen (362.59 kg/ha)was found in T16 with application of 7.5 % Jeevamrit drenching + 15.0 % Jeevamrit foliar. However, minimum available nitrogen (240.89 kg/ha) was registered with treatment T_1 (Control).The nitrogen content in soil becomes more available when supplemented with organic manures, which increases basal respiration by promoting the growth of microorganisms (Rathore *et al*., 2023). The gradual release of nutrients through FYM may have contributed to the rise in the pool of accessible nitrogen. Applying jeevamrit increased the rate at which soil microorganisms multiplied and nitrogen-fixing bacteria worked synergistically to convert organic nitrogen to inorganic form. The outcomes align with the findings of Rai et al. (2014).

Available P (kg/ha)

Significantly maximum phosphorus (137.48 kg/ha) was recorded with the application of 7.5 % Jeevamrit drenching + 15.0 % Jeevamrit foliar application (T_{16}). Minimum available phosphorus (93.33 kg/ha) was recorded with treatment T_1 (Control).Due to soil microbial activity resulting in the release of organic acids during the decomposition of organic matter, phosphates were eventually solubilized, increasing the phosphorus content of the soil. This could be the reason for the increase in phosphorus availability in the soil as a result of the addition of these manures. Nitika et al. (2018) reported similar results.

Available K (kg/ha)

Maximum potassium (267.85 kg/ha) was recorded with the application of 7.5 % Jeevamrit drenching + 15.0 % Jeevamrit foliar application (T_{16}). Whereas minimum available potassium (204.19) was noticed with treatment T_1 (Control).Potassium may have been added directly to the soil through organic manures, and organic matter may have interacted with clay to release K2O ions that resulted in an increase in the amount of potassium that is available in the soil. Suklabaidya et al. (2017) and Prativa and Bhattarai (2012) reported identical results.

Viable microbial count:

Treatment T16 (5% Jeevamrit foliar application + 7.5% Jeevamrit drenching) produced the highest viable bacterial count (75.63 × 106 cfu/g soil), viable fungal count (28.57 × 104 cfu/g soil), and viable actinomycetes count (45.90 × 103 cfu/g soil).The microbial population may have increased as a result of organic inputs (Jeevamrit), which release carbon dioxide (CO2) during the soil's breakdown process, giving bacteria food and a microenvironment in which to develop and multiply (Subba Rao, 2018). Similar results were recorded by Pathak and Ram (2007); Devakumar *et al*. (2014) and Vemaraju (2014).

Table 3: Effect of Jeevamrit on the soil physico-chemical properties in Iris

Treatments	Organic carbon (%)	pH	Electrical conductivity (dS/m)	N (kg/ha)	P (kg/ha)	K (kg/ha)
T_1	1.02	6.82	0.41	240.89	93.33	204.19
T_2	1.15	6.70	0.39	284.55	112.51	223.86
T_3	1.18	6.65	0.32	301.91	123.29	242.03
T_4	1.20	6.62	0.28	345.07	129.83	259.16
T_5	1.06	6.77	0.40	258.67	97.96	211.53
T_6	1.09	6.74	0.39	268.12	100.97	219.03
T_7	1.12	6.70	0.38	276.73	104.62	228.26
T_8	1.19	6.72	0.39	289.01	113.50	226.92
T_9	1.21	6.71	0.39	294.69	114.40	229.15
T_{10}	1.24	6.71	0.37	298.16	115.40	231.82
T_{11}	1.27	6.68	0.34	312.26	125.10	243.82
T_{12}	1.31	6.66	0.32	320.90	126.43	245.86
T_{13}	1.35	6.64	0.30	326.08	128.22	248.76
T_{14}	1.41	6.62	0.95	352.55	132.45	262.26
T_{15}	1.45	6.60	0.27	358.33	134.61	264.89
T_{16}	1.48	6.58	0.25	362.59	137.48	267.85
C.D. $_{(0.05)}$	**0.009**	**0.008**	**NA**	**1.837**	**0.568**	**1.845**

Table 4: Effect of Jeevamrit on the soil's microbial count (cfu) in Iris

Treatments	Viable bacterial count ($\times 10^6$ cfu/g soil)	Viable fungi count ($\times 10^4$ cfu/g soil)	Viable actinomycetes count ($\times 10^3$ cfu/g soil)
T_1	32.40	9.57	30.67
T_2	41.57	15.33	38.07

T_3	51.37	21.33	42.70
T_4	60.83	25.00	44.67
T_5	30.69	9.07	30.70
T_6	32.93	9.77	31.20
T_7	34.83	9.77	32.30
T_8	58.93	18.93	38.57
T_9	59.03	19.17	38.70
T_{10}	59.50	19.23	39.17
T_{11}	67.33	24.17	43.37
T_{12}	67.67	24.23	43.47
T_{13}	68.87	24.93	43.50
T_{14}	74.07	28.23	45.43
T_{15}	73.30	28.03	45.33
T_{16}	75.63	28.57	45.90
C.D. $_{(0.05)}$	**2.07**	**1.08**	**0.98**

CONCLUSION

After conducting the experiment, it was determined that applying a mixture of 7.5% Jeevamrit drenching and 15.0% Jeevamrit foliar application (T_{16}) at 15-day intervals significantly improved the NPK content, organic carbon, and viable microbial count of Iris plants in the mid-hill zone of Himachal Pradesh. Moreover, the application also resulted in reduced pH and electrical conductivity levels.

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