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Effect of organic manures, microbes and microbial formulations on soil properties in kalmegh (*Andrographis paniculata* Nees) var. CIM - Megha

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Abstract
The present investigation on "Effect of organic manures, microbes and microbial formulations on soil properties in kalmegh (*Andrographis paniculata* Nees) var. CIM – Megha" was carried out in the Depatment of Plantation, Spices, Medicinal and Aromatic crops at Dr. YSRHU – College of Horticulture, Anantharajupeta during *kharif* season 2022. From the experiment it was revealed that application of 100% RDN through Vermicompost + Microbial consortium + Jeevamrutham + Panchagavya recorded maximum nitrogen, phosphorus, potassium content in soil and maximum NPK uptake by plants, soil organic carbon and highest microbial load *viz.*, bacteria, fungi and actinomycetes population.

Keywords: Organic manures, microbes, microbial formulations, soil properties, kalmegh

Introduction
Kalmegh (*Andrographis paniculata* Nees) belongs to the family Acanthaceae. It is also known as 'Rice bitters' in West indies and 'King of bitters' or 'Chirette' in England. It has been utilized in Indian system of medicine since time immemorial and constitutes the primary component of the Ayurvedic medication 'Switradilepa', known for its efficacy in treating vitiligo. The active principle present in kalmegh is Andrographolide, which is highly bitter in taste and colourless crystalline in appearance. Whole plant (leaf, stem and inflorescence) is used in drugs, which is the source of several Diterpenoids of which Andrographolide is important. The leaves contain maximum (2.5%) Andrographolide content while the stem contains (2.0%) of this active principle. It serves as a blood purifier and suggested for use in instances of leprosy, boils, skin eruptions as well as chronic and seasonal fevers. Fresh and dried kalmegh leaves, along with the juice extracted from the herb, are recognized as official drugs in the Indian pharmacopoeia (Shwetha *et al.* 2021) [7]. Andrographolide have anticancer, anti-inflammatory, antimalarial and hepatoprotective properties.

Modern and intensive agriculture relies heavily on fertilizers and agro-chemicals, which not only incur high costs but also have adverse effects on environmental sustainability. Furthermore, organic nutrient management has beneficial impact on soil properties and produces healthy plants free from chemical residues and contaminants. The existence of residues and contaminants (pesticides and heavy metals) is the major concern for the export of raw herbal drugs in the international market (Basak *et al.* 2020) [2]. As per the recommendations outlined by the World Health Organization (WHO) for Good Agricultural Practices (GAP), it is advisable to minimize or avoid the use of agrochemicals when cultivating medicinal herbs. Alternative sources like organic manures and biofertilizers have been given more emphasis for the cultivation of medicinal herbs. Furthermore, there is a substantial demand in the international market for organically certified medicinal herbs. Under these circumstances, organic cultivation emerges as a promising approach for producing high quality medicinal herbs while mitigating the excessive use of chemical fertilizers.

Organic manures are widely recognized as plant growth media and soil conditioners that provide essential nutrients to plants throughout their growing period (Basak *et al.* 2020) [2]. In addition to this, utilization of bio inoculants such as nitrogen fixing, phosphate solubilising, potassium solubilising bacteria along with biodynamic preparations like jeevamrutham, Panchagvaya, was observed to be effective in enhancing the growth and yield of medicinal herbs. Considering the economic importance of kalmegh and possible environmental problems caused by chemicals, organic nutrient management can be a promising sustainable option and hence the present study was carried out.

Material and Methods

The present experiment entitled "Effect of organic manures, microbes and microbial formulations on soil properties in kalmegh (*Andrographis paniculata* Nees) *var*. CIM – Megha" was carried out at Dr. YSRHU - College of Horticulture, Anantharajupeta, Andhra Pradesh from July to October 2022.

Treatment details

The experiment was laid out in split plot design with three replications

Main plots: Organic manures

1. M_1 – Control
2. M_2 – 100% RDN through FYM
3. M_3 – 100% RDN through vermicompost
4. M_4 – 100% RDN through neemcake

Sub plots: Bioformulations

1. S_1 – Control
2. S_2 – Microbial consortium {Azotobacter + Azospirillum + Phosphate solubilisng bacteria (PSB) + Potassium solubilising bacteria (KSB)}
3. S_3 – Jeevamrutham
4. S_4 – Panchagavya
5. S_5 – S_2 + S_3 (Microbial consortium + Jeevamrutham)
6. S_6 – S_2 + S_4 (Microbial consortium + Panchagavya)
7. S_7 – S_3 + S_4 (Jeevamrutham + Panchagavya)
8. S_8 – S_2 + S_3 + S_4 (Microbial consortium + Jeevamrutham + Panchagavya)

Note:

1. RDF (Recommended dose of fertilizer): N:P:K @ 75:75:50 kg ha^{-1}.
2. Jeevamrutham (5%) sprayed at 25, 50, 75 days after transplanting (DAT).
3. Panchagavya (3%) sprayed at every 15 days interval from 15 days after transplanting (DAT).
4. Microbial consortium (Azotobacter + Azospirillum + Phosphate solubilisng bacteria (PSB) + Potassium solubilising bacteria (KSB) will be applied at the time of plots preparation.

Observations recorded

1. Pre and post-harvest soil fertility status (NPK)

Available nitrogen (kg ha^{-1})

Soil available nitrogen was estimated by alkaline potassium permanganate method as described by Subbaiah (1956) [8].

Available phosphorus (kg ha^{-1})

Soil available phosphorus was extracted using 0.5 M $NaHCO_3$ and then adjusted p^H to 8.5 (Olsen, 1954) [6] and estimated by using ascorbic acid as reducing agent. The intensity of colour was read at 660 nm and expressed in kg ha^{-1}.

Available potassium (kg ha^{-1})

Soil available potassium was extracted with neutral normal ammonium acetate in soil to Extractant ratio of 1:5 by equilibrating for 5 min. The concentration of potassium in the extract was estimated using flame photometer and was expressed in kg ha^{-1} (Jackson, 1973) [5].

2. Nutrient uptake at harvest (%)

Leaf samples were collected in each treatment at harvest. Collected samples were oven dried at 60 ºC, powdered in Willey mill and stored in butter paper cover for further analysis.

Total nitrogen in leaf samples

Exactly 0.5 g of powdered plant sample was digested with $CuSO_4$, K_2SO_4 and H_2SO_4 mixture in micro-processor based block digestion unit. Digested sample was distilled using micro-processor based automatic distillation unit and liberated ammonia was trapped in boric acid containing mixed indicator and back titrated with standard H_2SO_4 (Jackson, 1973) [5].

Estimation of P and K

Oven dried powdered plant material of 0.5 g was digested by wet digestion method using 10 ml of di acid extract containing nitric acid (HNO_3) and perchloric acid ($HClO_4$) in the ratio of 9:4. The digested material was made up to known volume with distilled water. The phosphorus in the extract was estimated by Vanado molybdo phosphoric acid yellow colour method at 420nm. Potassium was estimated by flame photo meter method at 770 nm.

3. Pre and post-harvest Soil organic carbon (%)

Soil samples were collected randomly from plough layer depth with the help of soil sampling auger before sowing and after harvesting of the crop from each treatment. The collected samples were mixed thoroughly and dried in air, crushed, sieved through 2 mm sieve. The soil samples were prepared and subjected to chemical analysis for evaluating the soil organic carbon by Walkley and Black oxidation method (Jackson, 1967) [4].

4. Soil microbial load

Soil samples were collected from different treatments of the present investigation were used for enumeration of general soil microorganisms *viz.*, bacteria, fungi and actinomycetes at pre and post- harvest stages of kalmegh crop.

Each soil sample was sieved through 1000 micromesh to remove the bigger particles and debris and they were used for enumeration of bacteria, fungi and actinomycetes using Nutrient agar (Anon, 1957) [1], Potato dextrose agar and actinomycetes isolation agar media respectively by serial dilution pour plate method. The plates were incubated for 24 – 48 hr. at 28 ºC and the colonies that appeared on the media were enumerated and expressed in terms of colony forming unit per gram (CFU g^{-1}) of soil on a dry weight basis (Bunt and Rovira, 1955) [3].

Results and Discussion

1. Pre and post-harvest soil fertility status (NPK)

Pre-harvest soil fertility status (NPK)

Pre harvest soil fertility status was recorded as 184 N (kg ha^{-1}), 13.2 P (kg ha^{-1}) and 459 K (kg ha^{-1}).

Post-harvest fertility status (NPK)

Data related to NPK content in soil as influenced by different organic manures, biodynamic preparations and their interactions are significantly varied and presented in Table 1.

Nitrogen content (kg ha^{-1})

Maximum nitrogen content (163.87 kg ha^{-1}) was recorded in the treatment M_2 (100% RDN through FYM) followed by M_3-100% RDN through Vermicompost (M_3 – 150.02 kg ha^{-1}) and

minimum nitrogen content (M_1 –142.83 kg ha^{-1}) was recorded in control.

Among different subplot treatments, nitrogen content was maximum (S_2 – 157.93 kg ha^{-1}) in S_2 – Microbial consortium which was statistically comparable with the treatment S_6 - Microbial consortium + Panchagavya. However, minimum nitrogen content was recorded in (S_8 – 141.26 kg ha^{-1}) S_8 - microbial consortium + jeevamrutham + panchagavya.

Among various combinations, M_2S_1 - 100% RDN through FYM combination recorded maximum nitrogen content (M_2S_1 –176.00 kg ha^{-1}) which was comparable with M_2S_4 (174.31 kg ha^{-1}) – 100% RDN through FYM + panchagavya and minimum nitrogen content (M_3S_8 – 109.63 kg ha^{-1}) was recorded in M_3S_8 - 100% RDN through vermicompost + microbial consortium + jeevamrutham + panchagavya.

Phosphorus content (kg ha^{-1})

Among different organic manures, M_2 - 100% RDN through FYM recorded maximum phosphorus content (M_2 – 44.70 kg ha^{-1}) in soil followed by M_3 – 100% RDN through vermicompost (M_3 – 40.54 kg ha^{-1}). While, minimum phosphorus content (M_1 – 29.04 kg ha^{-1}) was recorded in control.

Maximum phosphorus content (S_2 – 45.50 kg ha^{-1}) was recorded in the treatment S_2 - microbial consortium followed by S_4 (40.66 kg ha^{-1}) – panchagavya, whereas minimum phosphorus content (S_8 –33.08 kg ha^{-1}) was noted in S_8 - microbial consortium + jeevamrutham + panchagavya with regard to interaction response, the treatment combination M_2S_2 - 100% RDN through FYM + microbial consortium recorded maximum phosphorus content (M_2S_2 –52.00 kg ha^{-1}) which was statistically on par with M_3S_1 (47.33 kg ha^{-1}) – 100% RDN through vermicompost. Whereas phosphorus content (M_3S_8 – 23.00 kg ha^{-1}) was minimum in M_3S_8 - 100% RDN through vermicompost + microbial consortium + jeevamrutham + panchagavya combination.

Potassium Content (kg ha^{-1})

Maximum potassium content (M_4 – 370.58 kg ha^{-1}) was recorded in the treatment M_4 (100% RDN through Neemcake) followed by M_3- 100% RDN through Vermicompost (M_3 – 347.15 kg ha^{-1}). Conversely, minimum potassium content (M_1 – 285.33 kg ha^{-1}) was noted in control.

Among different subplot treatments, potassium content was maximum in the treatment S_6 - microbial consortium + panchagavya treatment (S_6 – 335.24 kg ha^{-1}) which was statistically comparable with S_2 (293.33 kg ha^{-1}) – microbial consortium. However, minimum potassium content (S_8 – 322.99 kg ha^{-1}) was recorded in microbial consortium + jeevamrutham + panchagavya.

Among various interactions, M_4S_2 - 100% RDN through Neem cake + microbial consortium combination recorded maximum potassium content (M_4S_2 – 377.46 kg ha^{-1}) which was statistically on par with M_4S_6 (376.01 kg ha^{-1}) – 100% RDN through neem cake + microbial consortium + panchagavya. While potassium content (M_4S_1 – 177.33 kg ha^{-1}) was minimum in M_4S_1 – 100% RDN through Neem cake.

2. Nutrient uptake at harvest (kg ha^{-1})

Data regarding nutrient uptake by crop at harvest as influenced by different organic manures, bio formulations and their combinations were found to be significant and presented in Table 2.

Nitrogen uptake (kg ha^{-1})

Among various organic manures applied, maximum nitrogen uptake (M_3 – 61.98 kg ha^{-1}) was recorded in the treatment M_3 (100% RDN through vermicompost) followed by M_2- 100% RDN through FYM (M_2 –56.13 kg ha^{-1}). Whereas, minimum nitrogen uptake (M_1 – 41.16 kg ha^{-1}) was noticed in control.

Maximum nitrogen uptake was recorded in the treatment S_8 microbial consortium + jeevamrutham + panchagavya treatment (S_8 – 62.98 kg ha^{-1}) followed by S_4 (56.81 kg ha^{-1}) – panchagavya and minimum nitrogen uptake (S_1 – 48.46 kg ha^{-1}) was noted in control.

Among various combinations, the treatment combination M_3S_8 - 100% RDN through vermicompost + microbial consortium + jeevamrutham + panchagavya recorded maximum nitrogen uptake (M_3S_8 –102.36 kg ha^{-1}) followed by M_4S_4 (80.98 kg ha^{-1}) – 100% RDN through neem cake + panchagavya. Wheras, the nitrogen uptake (M_1S_1 – 29.27 kg ha^{-1}) was minimum in control.

Phosphorus uptake (kg ha^{-1})

Plants applied with 100% RDN through vermicompost (M_3 – 12.72 kg ha^{-1}) recorded maximum phosphorus uptake followed by M_2 – 100% RDN through FYM (M_2 – 10.88 kg ha^{-1}). While, minimum phosphorus uptake (M_1 – 6.62 kg ha^{-1}) was noticed in control.

Among various subplot treatments, phosphorus uptake was maximum in S_8 - microbial consortium + jeevamrutham + panchagavya treatment (S_8 – 12.85 kg ha^{-1}) followed by S_4 (11.78 kg ha^{-1}) – panchagavya. However, phosphorus uptake (S_1 – 7.99 kg ha^{-1}) was minimum in control.

Among various interactions, maximum phosphorus uptake (M_3S_8 –24.68 kg ha^{-1}) was recorded in M_3S_8 - 100% RDN through vermicompost + microbial consortium + jeevamrutham + panchagavya combination followed by M_4S_4 (19.08 kg ha^{-1}) – 100% RDN through neem cake + panchagavya. Whereas, minimum phosphorus uptake (M_1S_1 – 3.63 kg ha^{-1}) was noticed in control.

Potassium uptake (kg ha^{-1})

Maximum potassium uptake (M_3 - 37.84 kg ha^{-1}) was recorded in the treatment M_3 - 100% RDN through vermicompost which was comparable with M_2 – 100% RDN through FYM (M_2 – 33.64 kg ha^{-1}). Whereas, potassium uptake was minimum in control (M_1 – 23.67 kg ha^{-1}).

Among various bio formulations, potassium uptake was maximum in S_8 - microbial consortium + jeevamrutham + panchagavya treatment (S_8 – 39.00 kg ha^{-1}) followed by S_4 (35.36 kg ha^{-1}) – panchagavya. While, minimum potassium uptake was noted in control (S_1 – 27.36 kg ha^{-1}).

With regard to interaction response, the treatment combination M_3S_8 - 100% RDN through vermicompost + microbial consortium + jeevamrutham + panchagavya recorded maximum potassium uptake (M_3S_8 – 64.61 kg ha^{-1}) followed by M_4S_4 (51.51 kg ha^{-1}) – 100% RDN through neem cake + panchagavya. Conversely, the minimum potassium uptake (M_1S_1 – 14.50 kg ha^{-1}) was noted in control.

3. Pre and post-harvest soil organic carbon (%)

Pre-harvest soil organic carbon (%)

Pre-harvest soil organic carbon was recorded as 0.48%.

Post-harvest soil organic carbon (%)

Significant data pertaining to post-harvest soil organic carbon,

influenced by different organic fertilizers, bio formulations and their combinations has been presented in Table 3.

Highest soil organic carbon content (M_3 – 0.634%) was observed in M_3 - 100% RDN through vermicompost followed by M_2 – 100% RDN through FYM (M_2 – 0.616%). In contrast, lowest organic carbon content was observed in control (M_1 – 0.526%).

Among various bio formulations, maximum soil organic carbon content was recorded in S_8 - microbial consortium + jeevamrutham + panchagavya treatment (S_8 – 0.639%) followed by S_4 (0.623%) – panchagavya. Conversely, the minimum organic carbon content (S_1 – 0.559%) was recorded in control. Among various interactions, the treatment combination M_3S_8 - 100% RDN through vermicompost + microbial consortium + jeevamrutham + panchagavya (M_3S_8 –0.740%) recorded maximum organic carbon content followed by M_4S_4 (0.710%) – 100% RDN through neem cake + panchagavya. In contrast, minimum organic content (M_1S_1 – 0.503%) was recorded in control.

4. Soil microbial load

Data related to soil microbial load based on the influence of organic manures, biodynamic preparations and their interactions were found to be significant and presented in Table 4.

Bacterial population (CFU)

Higher bacterial population (M_3 – 67.45 cfu x 10^6 g^{-1}) was observed in M_3 - 100% RDN through vermicompost followed by M_2 – 100% RDN through FYM (M_2 – 62.70 cfu x 10^6 g^{-1}). Conversely, lower bacterial population was noticed in control (M_1 – 46.25 cfu x 10^6 g^{-1}).

Among various bio formulations, maximum bacterial population (S_8 – 70.83 cfu x 10^6 g^{-1}) was recorded in S_8 - microbial consortium + jeevamrutham + panchagavya which was statistically on par with S_4 (67.33 cfu x 10^6 g^{-1}) – panchagavya among different bio formulations. While, minimum bacterial population was noted in control (S_1 – 49.83 cfu x 10^6 g^{-1}). With regard to interaction response, M_3S_8 - 100% RDN through vermicompost + microbial consortium + jeevamrutham + panchagavya (M_3S_8 –111.00 cfu x 10^6 g^{-1}) combination recorded maximum bacterial population followed by M_4S_4 (90.00 cfu x 10^6 g^{-1}) – 100% RDN through neem cake + panchagavya. Whereas, minimum bacterial population (M_1S_1 – 41.00 cfu x 10^6 g^{-1}) was observed in control.

Fungal population (CFU)

Among various organic manures, maximum fungal population (M_3 – 46.62 cfu x 10^4 g^{-1}) was recorded in M_3 - 100% RDN through vermicompost followed by M_2 – 100% RDN through FYM (M_2 – 44.29 cfu x 10^4 g^{-1}). Whereas, fungal population was minimum in control (M_1 – 29.62 cfu x 10^4 g^{-1}).

Maximum fungal population (S_8- 47.25 cfu x 10^4 g^{-1}) was recorded in S_8 - microbial consortium + jeevamrutham + panchagavya followed by S_4 (44.75 cfu x 10^4 g^{-1}) – panchagavya. While, minimum fungal population was noted in control (S_1 – 32.58 cfu x 10^4 g^{-1}).

Among various combinations, maximum fungal population was recorded in M_3S_8 - 100% RDN through vermicompost + microbial consortium + jeevamrutham + panchagavya combination (M_3S_8 –67.66 cfu x 10^4 g^{-1}) followed by M_4S_4 (60.66 cfu x 10^4 g^{-1}) – 100% RDN through neem cake + panchagavya. Whereas, fungal population was minimum in control (M_1S_1 – 20.00 cfu x 10^4 g^{-1}).

Actinomycetes population (CFU)

Among various organic manures, actinomycetes population was maximum in M_3 - 100% RDN through vermicompost (78.79 cfu x 10^2 g^{-1}) followed by M_2 – 100% RDN through FYM (M_2 – 71.37 cfu x 10^2 g^{-1}). Whereas, actinomycetes population was minimum in control (M_1 – 52.70 cfu x 10^2 g^{-1}).

Higher count of actinomycetes was observed in S_8 - microbial consortium + jeevamrutham + panchagavya which was statistically on par with S_4 (75.08 cfu x 10^2 g^{-1}) – panchagavya. Conversely, lower actinomycetes population was noted in control (S_1 – 57.16 cfu x 10^2 g^{-1}) with regard to interaction response, high actinomycetes population was recorded in M_3S_8 - 100% RDN through vermicompost + microbial consortium + jeevamrutham + panchagavya (M_3S_8 –119.00 cfu x 10^2 g^{-1}) combination followed by M_4S_4 (105.00 cfu x 10^2 g^{-1}) – 100% RDN through neem cake + panchagavya. Whereas, actinomycetes population was low in control (M_1S_1 –48.00 cfu x 10^2 g^{-1}).

The foliar application of jeevamrutham and panchagavya at various intervals, coupled with the drenching of microbial consortium along with vermicompost application, improves the accessibility of nitrogen, phosphorus and potassium uptake. This is attributed to the higher presence of bacteria, fungi, actinomycetes, nitrogen – fixing, phosphorus – solubilising and potassium solubilising organisms.

Table 1: Impact of different organic manures, microbes and biodynamic preparations on post-harvest soil fertility status (NPK) of kalmegh

	Nitrogen (kg ha^{-1})					Phosphorus (kg ha^{-1})					Potassium (kg ha^{-1})				
	M_1	**M_2**	**M_3**	**M_4**	**Mean**	**M_1**	**M_2**	**M_3**	**M_4**	**Mean**	**M_1**	**M_2**	**M_3**	**M_4**	**Mean**
S_1	137.68	176.00	149.44	142.97	151.52	28.00	40.00	47.33	37.00	38.08	286.22	326.56	345.19	372.29	332.56
S_2	154.73	155.98	163.44	157.56	157.93	43.66	52.00	45.00	41.33	45.50	283.59	316.92	356.57	377.46	333.63
S_3	138.30	171.35	154.88	138.41	150.73	27.66	46.00	41.00	38.33	38.25	283.27	321.39	351.36	363.77	329.95
S_4	142.23	174.31	153.18	120.01	147.43	24.66	45.00	44.66	48.33	40.66	284.15	323.66	347.26	351.48	326.64
S_5	146.29	171.88	154.93	136.65	152.43	25.33	42.66	46.00	34.33	37.08	288.78	319.32	355.48	365.65	332.31
S_6	143.69	158.82	160.81	154.42	154.43	27.33	46.66	36.66	34.33	36.25	294.50	316.77	353.68	376.01	335.24
S_7	149.79	141.75	153.83	148.60	148.49	29.00	43.66	40.66	32.00	36.33	287.93	300.92	347.33	373.89	327.51
S_8	129.95	160.85	109.63	164.62	141.26	26.66	41.66	23.00	41.00	33.08	274.19	313.31	320.38	384.09	322.99
Mean	142.83	163.87	150.02	145.40		29.04	44.70	40.54	38.33		285.33	317.35	347.15	370.58	
Factors	SEM±		CD (P = 0.05%)			SEM±			CD (P = 0.05%)		SEM±		CD (P = 0.05%)		
M	1.67		5.90			0.56			1.99		1.45		5.14		
S	2.59		7.37			0.90			2.55		2.02		5.76		
S at M	4.73		15.12			1.60			5.24		4.12		11.88		

Table 2: Impact of different organic manures, microbes and biodynamic preparations on nutrient uptake (kg ha^{-1}) by crop at harvest (NPK) of kalmegh

	Nitrogen (kg ha^{-1})					Phosphorus (kg ha^{-1})					Potassium (kg ha^{-1})				
	M_1	**M_2**	**M_3**	**M_4**	**Mean**	**M_1**	**M_2**	**M_3**	**M_4**	**Mean**	**M_1**	**M_2**	**M_3**	**M_4**	**Mean**
S_1	29.27	43.99	62.55	58.03	48.46	3.63	7.52	8.79	12.05	7.99	14.50	24.44	39.81	30.71	27.36
S_2	46.32	64.02	48.55	43.43	50.58	8.60	15.15	10.20	5.49	9.86	25.41	34.08	28.42	25.53	28.36
S_3	45.69	48.64	57.12	62.58	53.51	6.14	11.42	12.37	12.03	10.49	25.72	29.61	33.63	39.22	32.05
S_4	41.76	45.69	58.82	80.98	56.81	6.41	9.24	12.41	19.08	11.78	24.85	27.33	37.74	51.51	35.36
S_5	37.70	48.12	57.07	64.34	51.81	6.84	7.75	13.44	8.94	9.24	20.21	31.68	29.52	37.34	29.69
S_6	40.31	61.17	51.18	46.58	49.81	7.37	8.10	9.57	8.22	8.31	22.78	34.22	31.32	26.99	28.83
S_7	34.21	78.25	58.16	52.39	55.75	5.72	18.15	10.33	10.36	11.14	21.07	50.08	37.66	29.11	34.48
	54.04	59.15	102.36	36.37	62.98	8.24	9.69	24.68	8.78	12.85	34.81	37.68	64.61	18.91	39.00
Mean	41.16	56.13	61.98	55.59		6.62	10.88	12.72	10.62		23.67	33.64	37.84	32.41	

Factors	SEm±	CD (P = 0.05%)	SEm±	CD (P = 0.05%)	SEm±	CD (P = 0.05%)
M	0.25	0.89	0.15	0.55	0.18	0.64
S	0.30	0.87	0.29	0.82	0.22	0.64
S at M	0.71	1.80	0.44	1.68	0.51	1.33

Table 3: Impact of different organic manures, microbes and biodynamic preparations on soil organic carbon (%) of kalmegh

	Soil organic carbon								
	S_1	**S_2**	**S_3**	**S_4**	**S_5**	**S_6**	**S_7**	**S_8**	**Mean**
M_1	0.503	0.520	0.533	0.510	0.543	0.517	0.527	0.553	0.526
M_2	0.573	0.633	0.570	0.607	0.623	0.590	0.693	0.640	0.616
M_3	0.563	0.607	0.653	0.663	0.577	0.660	0.610	0.740	0.634
M_4	0.597	0.593	0.663	0.710	0.553	0.523	0.593	0.623	0.607
Mean	0.559	0.588	0.605	0.623	0.574	0.573	0.606	0.639	
Factors			SEm± CD				(P= 0.05%)		
M			0.005				0.016		
S			0.005				0.013		
M at S			0.010				0.030		
S at M			0.013				0.028		

Table 4: Impact of different organic manures, microbes and biodynamic preparations on soil microbial load (CFU) of kalmegh

	Bacteria					Fungi					Actinomycetes				
	M_1	**M_2**	**M_3**	**M_4**	**Mean**	**M_1**	**M_2**	**M_3**	**M_4**	**Mean**	**M_1**	**M_2**	**M_3**	**M_4**	**Mean**
S_1	41.00	45.33	56.00	57.00	49.83	20.00	36.00	40.33	34.00	32.58	48.00	56.66	63.00	61.00	57.16
S_2	44.00	62.33	63.00	48.00	54.33	29.00	41.33	42.34	42.66	38.83	51.00	70.00	78.00	65.00	66.00
S_3	46.00	61.00	60.00	49.33	54.08	27.00	43.00	40.00	40.01	37.50	54.00	72.00	75.00	67.00	67.00
S_4	48.66	57.66	73.00	90.00	67.33	29.33	44.66	44.33	60.66	44.75	53.66	66.00	75.66	105.00	75.08
S_5	47.66	51.33	54.33	66.00	54.83	31.00	43.67	48.00	43.66	41.58	55.00	72.33	72.33	68.00	66.91
S_6	48.67	69.00	52.00	50.33	55.00	33.66	44.00	46.00	38.00	40.41	53.33	68.00	73.33	56.66	62.83
S_7	46.66	83.00	70.33	61.00	65.25	32.00	57.66	44.34	41.00	43.75	54.00	93.00	74.00	63.66	71.16
S_8	47.33	72.00	111.00	53.00	70.83	35.00	44.00	67.66	42.33	47.25	52.66	73.00	119.00	65.66	77.58
Mean	46.25	62.70	67.45	59.33		29.62	44.29	46.62	42.79		52.70	71.37	78.79	69.00	

Factors	SEm±	CD (P = 0.05%)	SEm±	CD (P = 0.05%)	SEm±	CD (P = 0.05%)
M	0.66	2.35	0.50	1.77	1.22	4.33
S	1.66	4.72	0.83	2.37	1.63	4.64
M at S	3.18	9.13	1.64	4.76	3.29	9.67
S at M	1.88	9.54	1.42	4.85	3.47	9.59

Conclusion

The current research findings indicate that the treatment combination *i.e.*, M_3S_8 - 100% RDN through vermicompost + microbial consortium + jeevamrutham + panchagavya resulted in the highest levels of nitrogen, phosphorus and potassium uptake. This treatment also led to increased soil organic carbon, and a greater population of bacteria, fungi, and actinomycetes.

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