

EFFECT OF VERMIWASH ON GROWTH AND SOIL CHARACTERISTICS OF A FEW COMMERCIALY IMPORTANT SPINACH SPECIES

Abstract

The aim of the study was to assess the impact of various concentrations of vermiwash on the growth of *Brassica juncea*, *Coccinia grandis*, *Anethum graveolens*, and *Sauropus androgynous* by analysing changes in shoot lengths and the micro and macronutrient composition in the soil. The pots were prepared using a mixture of red soil, sand, and coir in a 1:1:1 ratio. Vermiwash solutions at 25% and 50% concentrations were prepared, and the plants were treated with these solutions. The shoot lengths were measured at regular intervals over a period of 28 days. Treatment with 50% vermiwash resulted in increased plant height. After 28 days of irrigation, the soil samples from the treated pots were analyzed for available macronutrient and micronutrient content. Among the plant species studied, *Sauropus androgynous* showed the maximum shoot length of 26.1 ± 2.3 in both the 25% and 50% vermiwash concentrations. Soil analysis revealed that *Coccinia grandis* exhibited higher nutrient content compared to the other species. Thus, vermiwash can be considered promising alternative to conventional manures such as cow dung and vermicomposts.

Keywords: Brassica Juncea, Coccinia Grandis, Anethum Graveolens, Sauropus Androgynous, Vermiwash

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I. INTRODUCTION

Spinach is a rich source of fiber, vitamins A, C, E, K, B6, and B2, as well as minerals like magnesium, manganese, iron, calcium, potassium, copper, phosphorus, zinc, and selenium. It also contains folate, betaine, folic acid, protein, niacin, and omega-3 fatty acids, carotenoids such as beta-carotene and lutein, and bioflavonoid like quercetin, along with many other flavonoids. Harvesting and post-harvest costs account for 56 percent of the production costs for spinach, making it a labour-intensive process, particularly in terms of weed management, bunched spinach harvests, and careful handling. The production costs and net profit vary depending on factors such as location, farm size, level of mechanization, and market conditions. The use of chemical fertilizers in agriculture is increasing, leading to a decrease in soil quality and fertility.

Consequently, it is imperative to find alternatives and embrace organic methods to address this issue. Switching to organic farming practices represents the best solution. By doing so, we can meet nature's demand for reduced chemical usage in agriculture.

Organic farming promotes sustainability and ecological balance by avoiding harmful chemicals and utilizing organic fertilizers, compost, and natural pest control methods. This transition allows spinach and other crops to be cultivated in an environmentally friendly manner, preserving soil health and natural ecosystems. Farmers who adopt organic methods contribute to sustainable agriculture while producing spinach that retains its nutritional value and benefits for consumers.

Vermiwash is liquid manure, which is an extract of vermicompost enriched with a high number of earthworms. Its foliar spray application has been found to significantly enhance crop growth and productivity (Bucker *et al.*, 1999). Vermiwash contains coelomic fluid, which is rich in enzymes, plant growth hormones such as cytokines and gibberellins, as well as vitamins, micro, and macronutrients. It is commonly used as a foliar spray, a recognized and important method of fertigation.

The nutrients in foliar sprays are known to easily penetrate the leaf cuticle and stomata, entering the plant cells for rapid and efficient nutrient utilization. Vermiwash, with its earthworm enzymes and secretions, acts as a stimulant for crop growth and yield. Leafy green vegetables, including spinach, are widely recognized as excellent sources of nutrition and natural medicine. They are packed with essential nutrients such as iron, calcium, vitamins, antioxidants, and fiber, making them crucial components of a healthy and balanced diet.

Vermiwash is considered one of the best alternative methods to reduce the use of chemicals in agriculture. It is a liquid obtained by passing clean water through columns of earthworms and soil units. This Liquid contains the excretory products and mucus of earthworms, along with numerous micronutrients present in the soil. Earthworm casts, which are produced by earthworms, contain nutrients in forms that are easily accessible to plants (Taylor *et al.*, 2003; Suthar and Singh, 2009). These casts also contain plant growth-promoting substances, as reported by Krishnamoorthy and Varjranabhaian (1986). Additionally, casts contribute valuable growth factors (Muscolo *et al.*, 1999). Vermiwash itself contains cytokinins, auxin, vitamins, enzymes, and amino acids.

Therefore, it is intriguing to explore the possibility of cultivating commercially and economically important varieties of spinach and attempting to enhance growth while measuring soil characteristics using this cost-effective liquid fertilizer, vermiwash.

II. MATERIALS AND METHODS

The experimental pots were prepared using red soil, sand, and coir (1:1:1 ratio). Seeds of *B. juncea*, *C. grandis*, *A. graveolens* and *S. androgynous* were collected from natural conditions and were soaked in pots with good humus. The sample vermiwash (better grow brand) was bought commercially from the market which is eco-friendly and free from chemical input. It is used as a foliar spray as well in soil that provides essential to all plants at various growth stages in all plants. It contains various types of micronutrients along with microbes which help for the better growth of the plant. It is ideal for all vegetable plants, flowering plants, indoor plants & outdoor plants. It increases the immunity of plants, making them less disease & pest attack. It is also used as biopesticides to add cow urine to control pest attacks.

The vermiwash was prepared at different concentrations like 50% and 25%, for our experiment. The pots were fertigated with vermiwash. It is applied as a foliar spray. This is transported to the leaf, shoots, and other parts of the plants in the natural ecosystem.

Mature plants are analyzed after 4 weeks of planting. The stems were measured regularly to assess the growth parameter. The standard methods were adopted for the analysis of different parameters. All measurements were done in three replicates and the mean was calculated. The analysis was taken based on the growth and soil.

Growth analysis consisted of shoot length that was recorded every 4 days and differences in growth were observed up to 28 days. Soil analysis contains soil pH, electrical conductivity, available nitrogen, available phosphorus, available potassium, and micronutrient. Results of the elemental analysis are reported on oven-dry weight basis.

III. RESULTS AND DISCUSSION

1. Growth analysis: 50% concentration of vermiwash significantly affected the growth of *B. juncea*, *C. grandis*, *A. graveolens* and *S. androgynous* with a maximum shoot length of 15.8 ± 0.06 cm, 24.4 ± 1.8 , 12.1 ± 0.93 and 26.6 ± 2.3 followed by a 25% concentration of vermiwash with a length of 14.2 ± 0.85 cm, 21.1 ± 3.0 , 10.6 ± 0.25 and 26.1 ± 2.3 when compared to the control.

Table 1: Effect of two different concentrations of vermiwash on *B. juncea*, *A. graveolens* and *S. Androgynous*

S.No	Name of the plant	Days	Control	25%	50%
1.	Brassica juncea	1	1.9 ± 0.08	0.5 ± 0.06	0.9 ± 0.02
		10		6.3 ± 0.58	5.6 ± 0.36
		17		9.8 ± 0.13	11.2 ± 0.75
		28		14.2 ± 0.85	15.8 ± 0.96
2.	Coccinia grandis	1	10.3±1.0	10.1 ± 0.9	10 ± 0.9
		10		13.4 ± 1.2	13.6 ± 1.1
		17		17.7 ± 2.1	18.1 ± 1.3
		28		21.1 ± 3.0	24.4 ± 1.8
3.	Anethum graveolens	1	3.0 ± 0.18	0.5 ± 0.12	0.5 ± 0.14
		10		4.6 ± 0.28	5.4 ± 0.19
		17		9.7 ± 0.14	9.9 ± 0.38
		28		10.6 ± 0.25	12.1 ± 0.93
4.	Sauropus androgynous	1	15 ± 1	13 ± 0.8	12.5 ± 1
		10		17.2 ± 1	17.9 ± 1.4
		17		22 ± 2.1	21.7 ± 1.9
		28		26.1 ± 2.3	26.6 ± 2.3

#Mean ± S.E

2. **Soil analysis - Parameters:** pH – pH value of *B.juncea* was lowest (5.0) in the soil maintained in control and highest (5.8) in the soil containing 50% concentration of vermiwash, the pH of *C.grandis* was also lowest (4.5) in the soil maintained in control and highest (6.1) in the soil of 50% concentration of vermiwash, the pH of *A.graveolens* was also lowest (4.6) in the soil maintained in control and highest (6.2) in the soil of 50% concentration of vermiwash and the pH value of *S.androgynous* was lowest (5.0) in the soil maintained in control and highest (6.1) in the soil containing 50% concentration of vermiwash.

Electrical conductivity– EC was lower in the soil of the control plant (0.25 ds/m) and higher in the soil containing 50% of vermiwash (0.66 ds/m) than the 25% concentration in *B.juncea* and the EC was lower in the soil of control plant (0.33 ds/m) and higher in the soil containing 50% of vermiwash (0.90 ds/m) than the 25% concentration in *C.grandis*. EC of *A.graveolens* was lower (0.15 ds/m) in controlled soil and found higher (0.95 ds/m) in the soil treated with 50% of vermiwash and the EC of *S.androgynous* was lower (0.23 ds/m) in controlled soil and found higher (0.85 ds/m) in the soil treated with 50% of vermiwash. Micronutrients – Among the micronutrients studied (Ca, Cu, Fe, Zn, Mg), magnesium content of the soil was comparatively higher (145mg) in the soil containing 50% concentration of vermiwash in *C.grandis* and slightly higher (92mg) in the soil containing 50% concentration of vermiwash in *S.androgynous* and similarly in *B.juncea* was found to be 75 mg and lowest in the *A.graveolens* 56mg. Macronutrients – In the macronutrient content of soil (N, P, K),

Nitrogen (67.0mg) and potassium (260mg) content was significantly increased in soil containing 50% concentration of vermiwash in regard to both *B.juncea* and *A.graveolens*, which increases the nutrient content of the soil. In the macronutrient content of soil (N, P, K), phosphorus (210 mg) and potassium (310 mg) content was significantly increased in soil containing 50% concentration of vermiwash, in regard to *C.grandis*. The results are shown in Table 2.

Table 2: Analysis of soil parameters of *B. juncea* *C. grandis*, *A. graveolens* and *S. androgynous* treated with vermiwash

S. No	Parameter	Species	Control	S-I(A) 25 %	S-I (B) 25 %	S-I (C) 25 %	S-II (A) 50 %	S-II (B) 50 %	S-II 50%
1.	pH	<i>B. juncea</i>	5.0	5.5	5.6	5.4	5.8	5.7	5.8
		<i>C. grandis</i>	5.0	5.5	5.4	5.3	5.8	6.1	6.0
		<i>A. graveolens</i>	4.6	5.2	5.3	5.5	6.0	6.2	5.8
		<i>S. androgynous</i>	4.5	5.9	5.9	6.0	6.1	6.3	6.1
2.	Electrical Conductivity (EC) (ds/m)	<i>B. juncea</i>	0.25	0.50	0.55	0.52	0.65	0.66	0.60
		<i>C. grandis</i>	0.33	0.72	0.68	0.62	0.89	0.90	0.80
		<i>A. graveolens</i>	0.15	0.60	0.53	0.75	0.85	0.90	0.95
		<i>S. androgynous</i>	0.23	0.70	0.65	0.59	0.78	0.85	0.77
3.	Texture (Sand) (%)	<i>B. juncea</i>	35.00	54.70	52.60	64.10	69.00	74.60	70.30
		<i>C. grandis</i>	40.00	70.00	74.00	69.20	90.00	93.80	87.54
		<i>A. graveolens</i>	20.00	32.00	25.00	27.10	40.00	35.60	48.30
		<i>S. androgynous</i>	38.00	45.00	58.00	50.10	62.00	69.60	58.30
4.	Lime (CaCO ₃) (%)	<i>B. juncea</i>	0.10	0.46	0.56	0.52	0.86	0.76	0.78
		<i>C. grandis</i>	0.20	0.49	0.62	0.58	0.78	0.81	0.87
		<i>A. graveolens</i>	0.15	0.38	0.52	0.54	0.92	0.77	0.94
		<i>S. androgynous</i>	0.19	0.30	0.27	0.37	0.68	0.62	0.73

5.	Copper (mg/kg)	<i>B. juncea</i>	1.10	1.65	1.80	1.98	2.01	1.98	1.88
		<i>C. grandis</i>	3.70	4.20	5.30	4.90	6.65	7.00	6.37
		<i>A. graveolens</i>	0.90	1.30	1.67	1.90	2.8	1.34	2.60
		<i>S. androgynous</i>	0.90	2.0	1.65	1.85	2.76	2.60	2.86
6.	Iron (mg/kg)	<i>B. juncea</i>	3.8	5.8	4.9	4.5	6.5	5.9	6.1
		<i>C. grandis</i>	4.0	7.8	6.7	5.8	8.9	7.5	7.2
		<i>A. graveolens</i>	2.8	3.2	2.7	3.5	4.0	4.9	4.7
		<i>S. androgynous</i>	1.9	2.8	3.5	4.2	5.3	6.0	5.8
7.	Zinc (mg/kg)	<i>B. juncea</i>	0.22	0.38	0.33	0.40	0.58	0.61	0.68
		<i>C. grandis</i>	0.46	1.20	0.90	1.10	1.78	2.35	2.56
		<i>A. graveolens</i>	0.17	0.28	0.26	0.31	0.42	0.46	0.38
		<i>S. androgynous</i>	0.13	0.26	0.31	0.37	0.62	0.75	0.76
8.	Magnesium (mg)	<i>B. juncea</i>	54	60	65	55	70	72	75
		<i>C. grandis</i>	67	75	90	98	120	145	138
		<i>A. graveolens</i>	30	40	37	39	51	56	48
		<i>S. androgynous</i>	60	68	76	68	92	80	79
9.	Nitrogen (mg)	<i>B. juncea</i>	27.0	48.0	52.0	44.0	60.0	67.0	63.0
		<i>C. grandis</i>	30.0	56.0	52.0	61.0	70.0	65.0	72.0
		<i>A. graveolens</i>	22.0	29.0	38.0	36.0	59.0	67.0	54.0
		<i>S. androgynous</i>	40.0	60.0	71.0	66.0	80.0	88.0	93.0
10.	Potassium (mg)	<i>B. juncea</i>	90	150	190	180	220	260	250
		<i>C. grandis</i>	120	220	200	195	290	310	305
		<i>A. graveolens</i>	60	90	85	103	134	143	128
		<i>S. androgynous</i>	71	170	186	174	320	300	280
11.	Phosphorus (mg)	<i>B. juncea</i>	17	23	27	29	40	37	34
		<i>C. grandis</i>	70	150	120	143	190	210	185
		<i>A. graveolens</i>	19	28	25	32	42	50	40
		<i>S. androgynous</i>	30	49	60	55	90	101	92

The present study aimed to assess the impact of vermiwash at different concentrations on the growth and soil parameters of *B. juncea*, *C. grandis*, *A. graveolens* and *S. androgynous*. The results revealed a significant increase in plant growth parameters attributed to the nutrient quality of vermiwash. Vermiwash plays a crucial role in promoting plant growth and development by contributing to root initiation, root growth, overall plant development, and promoting growth rates. It also enhances crop production by increasing soil organic matter and making nutrients readily available for plants, resulting in improved crop yield (Makkar *et al.*, 2019). Consistent with these findings, the plant height of *B. juncea*, *C. grandis*, *A. graveolens*, and *S. androgynous* was found to be highest in the plants treated with a 50% concentration of vermiwash compared to the control group.

The 50% concentration of vermiwash resulted in an increase in the total number of leaves and shoot length in *B. juncea*, *C. grandis*, *A. graveolens*, and *S. androgynous*. A study by Sundararasu and Jeyasankar (2014) found that different concentrations of vermiwash spray had a greater effect on plant height, number of leaves, and number of flowers in *Solanum melongena* compared to the control group over a 28-day period. Nath and Singh (2012) also reported that foliar sprays of vermiwash derived from different combinations of animal dung and agro kitchen wastes significantly increased the growth of mustard plants. Consistent with these findings, *S. androgynous* exhibited maximum growth (26.6 ± 2.3) on the 28th day. Vermiwash derived from various combinations is a valuable source of enzymes, vitamins, and plant growth regulators such as IAA and cytokinins, in addition to macro and micronutrients that enhance plant growth (Garg *et al.*, 2004). Analysis of soil nutrients, including pH, electrical conductivity, texture, micronutrients (CaCO₃, Cu, Fe, Zn, and Mg), and macronutrients (Nitrogen, Potassium, and Phosphorous), was conducted. The results revealed that the 50% vermiwash concentration contained a higher amount of macro and micronutrients and plant growth promoters, resulting in improved growth of *B. juncea*, *C. grandis*, *A. graveolens* and *S. androgynous*. Similar observations were made by Manyuchi *et al.* (2013).

In the case of spinach species, the soil treated with 50% vermiwash exhibited higher potassium content with 300 mg and 310 mg compared to the control. Nitrogen, phosphorus, and potassium are well-known sources that can enhance soil moisture (Stevenson and Bates, 1968). In accordance with this statement, the soil nutrient levels in the 25% and 50% vermiwash concentrations demonstrated significant control over nitrogen and potassium compared to other nutrients.

IV. CONCLUSION

In this study, it was concluded that vermiwash, a liquid fertilizer derived from earthworms, plays a significant role in promoting plant growth. The study findings indicate that plants treated with a 50% vermiwash concentration exhibited the highest shoot length, indicating robust growth. The soil analysis results also highlight that plants treated with 50% vermiwash had increased nutrient content compared to both the control group and the plants treated with a 25% vermiwash concentration. This suggests that vermiwash serves as a promising substitute for traditional organic fertilizers such as cow dung and vermicompost, delivering essential nutrients that support effective plant growth and enhance soil fertility.

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