



E-ISSN: 2618-0618

P-ISSN: 2618-060X

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2024; SP-7(10): 515-518

Received: 02-06-2024

Accepted: 06-07-2024

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International Journal of Research in Agronomy

Effect of vermicompost, vermiwash and *Moringa* leaf extract on seed yield of fenugreek variety RMT 305

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DOI: <https://doi.org/10.33545/2618060X.2024.v7.i10Sh.1831>

Abstract

The present experiment entitled “Effect of vermicompost, vermiwash and *Moringa* leaf extract on seed yield of fenugreek variety RMT 305” was conducted during year 2022-23 at Pt. K.L. Shukla College of Horticulture and Research Station, Bharregaon Farm Rajnandgaon (C.G.). The experiment was laid out in RBD (Randomized Block Design) with 9 treatments and three replications. The treatment consists of T₀ Control (water), T₁ (2 kg Vermicompost + 2000 ppm Vermiwash), T₂ (2.5 kg Vermicompost + 4000 ppm Vermiwash), T₃ (3 kg Vermicompost + 6000 ppm Vermiwash), T₄ (3.5 kg Vermicompost + 8000 ppm Vermiwash), T₅ (4 kg Vermicompost + 20 ml *Moringa* leaf extract), T₆ (4.5 kg Vermicompost + 40 ml *Moringa* leaf extract), T₇ (5 kg Vermicompost + 60 ml *Moringa* leaf extract) and T₈ (5.5 kg Vermicompost + 80 ml *Moringa* leaf extract). The results showed that 3.5 kg Vermicompost + 8000 ppm Vermiwash treatment (T₄) performed the best in terms of number of pod per plant, length of pod (cm), number of seed per pod, days to maturity, yield per plant (g), seed yield per plot (kg), seed yield (kg/ha), 1000 seed weight (g). This was followed closely by the treatment involving sequential application of 5.5 kg Vermicompost + 80 ml *Moringa* leaf extract (T₈) and 3 kg Vermicompost + 6000 ppm Vermiwash (T₃). The Control (water) treatment (T₀) consistently gave the lowest values for all the parameters measured. Overall, the study demonstrated that control treatment resulted in the lowest values across all measured parameters, signifying the importance of organic amendments for improving fenugreek yield.

Keywords: Fenugreek (*Trigonella foenum-graecum* L.), *Moringa* leaf extract, organic fertilizers, RBD (Randomized block design), seed yield, vermicompost and vermiwash

1. Introduction

India, ‘The land of spices’ is the world's largest producer, consumer and exporter of spices. Fenugreek (*Trigonella foenum-graecum* L.) locally known as ‘methi’ belongs to the family fabaceae and chromosome number $2n=2x=16$ is widely used as spice and condiment to add flavour in various foods (Dwivedi *et al.* 2006) [6].

Fenugreek is a multipurpose spice crop, every part of the plant is being used as leafy vegetable, fodder and condiment and medicine. Fenugreek seeds are known to lower the blood glucose and blood cholesterol levels because they have large amounts of soluble fiber in them. Recent studies in England indicate that fenugreek seeds contain substantial amounts of steroidal substance ‘diosgenin’ which is used as a starting material in the synthesis of sex hormones and as oral contraceptives, the biological and pharmacological actions of fenugreek are attributed to the variety of its constituents, *viz.*, steroids, nitrogen compounds, polyphenolic substances, volatile constituents and amino acids *etc* (Mehra *et al.* 2010) [16].

Fenugreek is mainly grown in India, Pakistan, China, Nepal and Bangladesh. In India, it is commercially grown in Rajasthan, Gujarat, Madhya Pradesh, Haryana, West Bengal, Punjab and Maharashtra. Rajasthan occupies 80% of area and production. In India, fenugreek cultivated in an area of about 120 thousand hectares with a production of 188 thousand tonnes, mostly confined to Rajasthan (84%) and Gujarat (15%) states followed by Uttar Pradesh (1%). It is also cultivated in Himachal Pradesh, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Karnataka and Chhattisgarh, mainly for leafy vegetable purpose.

In Chhattisgarh, Fenugreek is grown for seed and foliage purpose with an area of 2544.00 ha,

production of 10633.00 metric tonnes and productivity of 1.2 metric tonnes (Anonymous, 2020-21)^[3].

The long-term use of inorganic fertilizers has drastically changed the soil condition and it must be stopped as early as possible. Organic manure improves soil structure and fertility, which in turn has positive influence on yield. Manure being a bulky organic material releases the soil compaction and improves the aeration in addition to the supply of essential plant nutrients and accumulation of more humus content. Vermicompost is rich in both macronutrients and micronutrients and is considered as a bio-fertilizer because of its richness in humus forming and N fixing microorganisms. Organic manures help in rejuvenating the soil fertility by adding nutrients and also microbes. Vermicompost contains higher level of organic matter and micronutrients, microbial and enzyme activities which is an excellent fertilizer and soil conditioner (Domínguez and Edwards 1997)^[5]. Many field experiments indicated the positive effects of earthworms on agriculture. The positive role of vermicompost and vermiwash on fenugreek plant crop deals with effect that of vermicompost on some maximum growth parameters of fenugreek plants. Vermicompost is a nutrient-rich organic fertilizer produced by the decomposition of organic material through the action of earthworms. It provides essential nutrients and improves soil structure, moisture retention and microbial activity.

Moringa leaf extract is derived from the leaves of the *Moringa oleifera* tree, known for its high nutritional content. It contains various nutrients, vitamins and growth-promoting compounds that can positively influence plant growth and development. The leaf extract of *Moringa oleifera* had increased the antioxidative, Osmo protective and ion uptake potentials of NaCl-stressed of plant. Studied the response of salt-stressed fenugreek seedling to the foliar application of fresh *Moringa* leaf extract. They concluded that the interruption in the growth rate of stressed fenugreek had been resumed through the enhanced metabolic activity, minerals uptake and up-regulation of some salt tolerance genes. In the present study, we aimed at assessing the morpho-physiological, antioxidant and nutritional status responses of lead-stressed fenugreek seedlings to seed priming in the powdered *Moringa* leaf extract (Abdel Latef *et al.* 2017)^[1].

Foliar application of nutrient can be a good way to compensate for the reduced root intake of essential elements. Vermiwash as a vermicompost extract is a collection of secretion materials and extracts of earthworms combined with micronutrients and organic molecules of the soil, which is very useful for plant growth and is used as a foliar application on the plant shoot (Zambare *et al.* 2008)^[24]. This liquid fertilizer contains enzymes such as protease, amylase and phosphatase, which are useful for the growth and development of the plant, the increase in yield and plant resistance to stresses. Microbial studies and microorganisms in vermiwash show nitrogen stabilizing bacteria such as azotobacter, agro bacterium and rhizobium, as well as phosphate-soluble bacteria. Various studies have shown that the use of bio-fertilizers can improve the various growth and yield characteristics of plants to investigate the effects of different levels of vermicompost and vermiwash fertilizers on the fenugreek plant (Karuna *et al.* 1999)^[10].

2. Materials and Methods

The field experiment was conducted at the research farm of Pt. K.L. Shukla College of Horticulture and Research Station, Bharregaon Farm Rajnandgaon, Chhattisgarh during Rabi season of 2022-23. The experimental crop was fenugreek

(*Trigonella foenum-graecum* L.) of variety RMT 305. The experiment was laid out in a Randomized Block Design (RBD) with three replications. The size of each plot was 2x2 meter. The seed was sown with a spacing of 20x10 cm between row to row and plant to plant. There were a total of 9 treatments comprising of different levels of vermicompost, vermiwash and *Moringa* leaf extract. Standard cultural practices were followed for raising the crop. Seed was sown directly in the plots on 15th November 2022. Recommended dose of fertilizers was applied. Weeding and irrigation and other intercultural operations were carried out as per recommendations.

3. Results and Discussion

The data regarding combine effect of vermicompost, vermiwash and *Moringa* leaf extract on seed yield of fenugreek variety RMT 305 has been presented in Table 1.

3.1 Number of pod per plant

The observation about number of pod per plant was significantly maximum in treatment T₄ (3.5 kg Vermicompost + 8000 ppm Vermiwash) (22.35), which was at par with the treatment, T₈ (5.5 kg Vermicompost + 80 ml *Moringa* leaf extract) (22.32). The significantly minimum number of pod per plant (21.71) was seen in treatment T₀ (Control (water)). The addition of vermicompost and vermiwash led to higher pod formation per plant compared to other treatment and control. The vermicompost and vermiwash good source of plant nutrients and growth promoting substances in these organic amendments helped boost the plant growth and flowering which resulted in increased pod set and better yield. Similar study was also observed by Husain *et al.* (2022)^[7] and Lunagariya *et al.* (2018)^[13].

3.2 Length of pod (cm)

Among the data was length of pod (cm) at harvest significantly maximum in treatment T₄ (3.5 kg Vermicompost + 8000 ppm Vermiwash) (14.61 cm), which was at par with the treatment, T₈ (5.5 kg Vermicompost + 80 ml *Moringa* leaf extract) (14.16 cm) and T₇ (5 kg Vermicompost + 60 ml *Moringa* leaf extract) (13.79 cm). While the significantly minimum length of pod (cm) at harvest (9.73 cm) was seen in treatment T₀ (Control (water)). The combined application of vermicompost and vermiwash provided optimal nutrient levels and plant growth regulators, allowing the plants to develop stronger cell division and elongation processes in the pods. This led to increased pod length compared to other treatment and control. Also, similar result was also found by Meena *et al.* (2015)^[15].

3.3 Number of seed per pod

The data pertaining at significantly maximum number of seed per pod with value of (9.15) was observed in treatment T₄ (3.5 kg Vermicompost + 8000 ppm Vermiwash). Which was at par with the treatment, T₈ (5.5 kg Vermicompost + 80 ml *Moringa* leaf extract) (9.13) and T₃ (3 kg Vermicompost + 6000 ppm Vermiwash) (9.11). While the significantly minimum number of seed per pod (8.78) was seen in treatment T₀ (Control (water)). The combined application of vermicompost and vermiwash enhanced plant nutrient status and boosted cell division and enlargement within pods, allowing more space for increased seed formation. Treatment T₄ displayed maximum promoting excellent seed setting that led to the highest number of seeds per pod compared to other treatments and the control. Similar result was also found by Saxena and Singh, (2019)^[20].

3.4 Days to maturity

The data regarding on days to maturity significantly early days in the treatment T₈ (5.5 kg Vermicompost + 80 ml *Moringa* leaf extract) with value (129.63), which was at par with the treatment T₄ (3.5 kg Vermicompost + 8000 ppm vermiwash) and T₃ (3 kg Vermicompost + 6000 ppm Vermiwash) with measuring (130.67) and (131.07). In contrast, the treatment T₀ (Water) exhibited the late days to maturity at (136.37). Applying combinations of vermicompost, vermiwash and *Moringa* leaf extract significantly accelerated pod initiation compared to the control. The combined application of higher doses of vermicompost and *Moringa* leaf extract led to the improved nutrient and growth hormone levels in the organic treatment might have boosted the plant growth and development, leading to early flowering, pod initiation and finally earlier maturation of pods. These outcomes are consistent with findings of Patel *et al.* (2022)^[18].

3.5 Yield per plant (g)

The data pertaining, significantly highest yield per plant (g) (2.40 g) was observed in the treatment T₄ (3.5 kg Vermicompost + 8000 ppm Vermiwash). Which was at par with the treatment T₈ (5.5 kg Vermicompost + 80 ml *Moringa* leaf extract) (2.35 g). In contrast, the treatment T₀ (Control (water) exhibited the lowest yield per plant (g) at (1.75g). The combine use of vermicompost and vermiwash supplied vital nutrients for better plant growth. The spray of vermiwash effect positively and support more number of pods formation per plant containing a higher number of seeds per pod resulting in higher seed yield per plant. Similar studies were also observed by Kumari *et al.* (2022)^[12].

3.6 Seed yield per plot (kg)

Among the data, significantly highest seed yield per plot (kg) (0.48 kg) was recorded in the treatment T₄ (3.5 kg Vermicompost + 8000 ppm Vermiwash). Which was at par with the treatment T₈ (5.5 kg Vermicompost + 80 ml *Moringa* leaf extract) (0.47 kg). In contrast, the treatment T₀ (Water) exhibited the lowest seed yield per plot (kg) at (0.35 kg). T₄ (3.5 kg vermicompost + 8000 ppm vermiwash), produced the maximum seed per plot. It might be related to the combine effect of vermicompost. vermicompost provide sufficient does of macro

and micro nutrients and vermiwash contains nitrogen fixing bacteria like azotobacter, agrobacterium, rhizobium and some phosphate solubilizing bacteria (kaur *et al.* 2015)^[11] they produce phytohormones, which encouraged root development and nutrient absorption. The increase in seed yield per plant might be attributed to the treatment's faster growth characteristics, such as the number of branches, which raised the number of pod per plant, resulting in a highest yield of seed per plant resulted in highest seed yield per plot. By Kumari *et al.* (2022)^[12].

3.7 Seed yield (kg/ha)

The results measured significantly highest seed yield (kg/ha) (1220.58 kg/ha) was observed in the treatment T₄ (3.5 kg Vermicompost + 8000 ppm Vermiwash). Which was at par with the treatment T₈ (5.5 kg Vermicompost + 80 ml *Moringa* leaf extract) (1189.46 kg/ha). In contrast, the treatment T₀ (Control (water) exhibited the lowest seed yield (kg/ha) at (886.25 kg/ha). The treatment of T₄ (3.5 kg vermicompost and 8000 ppm vermiwash) resulted in the highest seed yield per hectare the under the indicated might attributable to a higher number of seed per plot and a higher seed yield per plant. Similar results were also obtained by Shivran *et al.* (2017)^[22] and Husain *et al.* (2022)^[7].

3.8 1000 seed weight (g)

Among the data, significantly highest 1000 seed weight (g) (11.94 g) recorded in treatment T₄ (3.5 kg Vermicompost + 8000 ppm Vermiwash), which was at par with the treatment T₈ (3 kg Vermicompost + 6000 ppm Vermiwash) and T₃ (3 kg Vermicompost + 6000 ppm Vermiwash) with measuring (11.67 g) and (11.31 g). In contrast, the treatment T₀ (Control (water) exhibited the lowest 1000 seed weight (g) at (9.30 g). The combined application of vermicompost and vermiwash effect positively they promoted enhanced photosynthetic translocation in to seeds, resulting in improved seed size weight and vigour. The highest 1000 seed weight obtained in treatment T₄ was due to synergy of nutrients and bio actives that drove maximum vegetative growth and seed development leading to heavier individual seed weight compared to other treatments and the control. Similar results were reported by Amal *et al.* (2012)^[4].

Table 1: Effect of vermicompost, vermiwash and *Moringa* leaf extract on yield parameter of fenugreek variety RMT 305.

Tr. No.	Treatment details	Number of pod per plant	Length of pod (cm) at harvest time	Number of seed per pod	Days of maturity	Yield per plant (g)	Seed yield per plot (kg)	Seed yield (kg/ha)	1000 seed weight (g)
T ₀	Control (water)	21.71	9.73	8.78	136.37	1.75	0.35	886.25	9.30
T ₁	2 kg Vermicompost + 2000 ppm Vermiwash	21.81	11.54	8.91	136.70	1.95	0.39	984.36	10.13
T ₂	2.5 kg Vermicompost + 4000 ppm Vermiwash	21.91	12.81	9.04	132.40	2.10	0.42	1070.75	10.81
T ₃	3 kg Vermicompost + 6000 ppm Vermiwash	22.03	13.16	9.11	131.07	2.25	0.45	1134.42	11.31
T ₄	3.5 kg Vermicompost + 8000 ppm Vermiwash	22.35	14.61	9.15	130.67	2.40	0.48	1220.58	11.94
T ₅	4 kg Vermicompost + 20 ml <i>Moringa</i> leaf extract	21.76	10.69	8.82	135.60	1.90	0.38	957.64	9.98
T ₆	4.5 kg Vermicompost + 40 ml <i>Moringa</i> leaf extract	21.87	12.58	8.98	133.93	2.00	0.40	1011.81	10.30
T ₇	5 kg Vermicompost + 60 ml <i>Moringa</i> leaf extract	21.95	13.79	9.07	131.73	2.15	0.43	1079.71	10.84
T ₈	5.5 kg Vermicompost + 80 ml <i>Moringa</i> leaf extract	22.32	14.16	9.13	129.63	2.35	0.47	1189.46	11.67
	SE(m)±	0.13	0.64	0.12	1.56	0.08	0.01	54.42	0.38
	C.D. at 5%	0.38	1.91	0.38	4.69	0.25	0.05	163.17	1.14
	CV (%)	1.00	8.77	2.49	2.03	7.01	7.01	8.90	6.17

4. Conclusion

The study concluded that the application of organic manure like vermicompost, vermiwash and *Moringa* leaf extract can significantly enhance the seed related yield parameters of fenugreek. Among the different treatments tested, application of

3.5 kg vermicompost along with 8000 ppm vermiwash (T₄) performed the best by recording the highest number of pods per plant, pod length, seeds per pod, yield per plant, seed yield per plot and 1000 seed weight, along with shortest maturity duration. Overall, the combined application of vermicompost,

vermiwash and *Moringa* leaf extract was found superior over the control in improving the growth and productivity of fenugreek. Their inclusion in fenugreek cultivation is recommended to sustainably boost yields.

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