Effect of Different Vermiwash Sources on Germination and Seedling Growth of Fenugreek (*Trigonella foenum-graecum* L.)

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10.18805/ag.D-153

**ABSTRACT**

Physiological process of germination depends on several factors such as temperature, water potential, light and nutrients. A laboratory study was carried out to assess the effect of different Vermiwash sources on germination and seedling growth of fenugreek. A factorial design was used with four replications. Treatments were factorial of different Vermiwash (water as a control=W₀, Vermicompost extract of wheat straw=W₁, horse manure=W₂, sheep manure=W₃, 25% straw + 75% horse manure =W₄, 25% straw + 75% sheep manure =W₅, 50% straw + 50% horse manure =W₆, 50% straw + 50% sheep manure =W₇, 25% alfalfa residue + 75% sheep manure =W₈, 50% alfalfa residue + 50% sheep manure =W₉, 25% chicken manure + 75% straw manure =W₁₀) and two levels of Vermiwash concentration (20% and 40%). Results showed that germination rate was significantly affected by all treatments. The maximum germination rate was observed at concentration of 40 percent of vermiwash with 25% alfalfa residue + 75% sheep manure. The maximum percentage of germination was obtained in 20 percent of vermiwash with sheep manure treatment and concentration of 40% in wheat straw. A significant difference was observed through treatments at 1% level in root length. In addition, root dry weight differed significantly among treatments at the 5% level. Also, a significant increasing was considered in root length by increasing the concentration of vermiwash.

**Key words**: Germination, Germination index, Vermiwash.

**INTRODUCTION**

Fenugreek (*Trigonella foenum-graecum* L.) is an annual herbaceous plant that belongs to legume family (*Fabaceae*) that is consumed for multiple medicinal purposes such as reinforcing effect, appetizing, expectorant and anti-fever effects. Also it increases the breast milk even while blood sugar has been reduced. Additionally, fenugreek is involved in nicotinic acid or niacin that prevents pellagra disease categories and prohibits heart attack by vasodilatation effects. Iran region has a scientific background related to the herbs which are freshly harvested and supplied according to the consumer markets. Vermicompost is a complex of organic fertilizer that is the result of the earthworm’s activity in vast variety of organic materials which is increasingly used in agriculture (Choudhary and Suri, 2018a, 2018b). It has significant effects on crops growth and productivity (Choudhary et al., 2010; Lazcano et al., 2010; Choudhary and Suri, 2018a).

Vermiwash provides biological and chemical structures for the solid vermicompost whereas, several methods are well documented for the production of vermicompost extract (vermiwash). In all methods, important factors for plant growth such as dissolved nutrients, beneficial microorganisms, humin acids, folic acids, hormones and plant growth regulators are added during the extraction into vermicompost extract (Greytak et al. 2006; Choudhary et al., 2009, 2010; Choudhary and Rahi, 2018).

Organic manures also stimulates nutrient concentration in root zone and increases nutrient absorption by plants that lead to better plant growth, seed germination and crop yield (Choudhary, 2013; Choudhary and Suri, 2013). Thus, the objectives of this study was to evaluate the effect of various vermicompost extract concentrations on fenugreek seed germination and compare effect of different vermicompost sources on seedling growth parameters.

**MATERIALS AND METHODS**

In order to evaluate the effect of vermiwash on germination and seedling growth of fenugreek, a factorial experiment carried out in completely randomized design with four replications at Gonbad Kavous University, Iran. Treatments were included factorial of different Vermiwash (water as a control=W₀, Vermicompost extract or Vermiwash of wheat straw=W₁, horse manure=W₂, sheep manure=W₃, 25% straw + 75% horse manure =W₄, 25% straw + 75% sheep manure =W₅, 50% straw + 50% horse manure =W₆, 50% straw + 50% sheep manure =W₇, 25% alfalfa residue + 75% sheep manure =W₈, 50% alfalfa residue + 50% sheep manure =W₉, 25% chicken manure + 75% straw manure =W₁₀) and two levels of Vermiwash concentration (20% and 40%).

Petri dishes were sterilized at 105°C oven for 24 hours. Seeds were treated by sodium hypochlorite 1.5% and then Petri dishes were sterilized at 105°C oven for 24 hours. Seeds were treated by sodium hypochlorite 1.5% and then seeds were sown in paper towel in Petri dishes. Seeds were sown in Petri dishes in a plastic box, which was placed in a growth chamber at 25°C with 16 hr of light and 8 hr of dark. Seeds were irrigated with sterilized water. Seeds were sown in Petri dishes in a plastic box, which was placed in a growth chamber at 25°C with 16 hr of light and 8 hr of dark. Seeds were irrigated with sterilized water. Seeds were sown in Petri dishes in a plastic box, which was placed in a growth chamber at 25°C with 16 hr of light and 8 hr of dark. Seeds were irrigated with sterilized water. Seeds were sown in Petri dishes in a plastic box, which was placed in a growth chamber at 25°C with 16 hr of light and 8 hr of dark. Seeds were irrigated with sterilized water.

**RESULTS**

**Germination:** The maximum germination rate was obtained in 20 percent of vermiwash with sheep manure treatment and concentration of 40% in wheat straw. A significant difference was observed through treatments at 1% level in root length. In addition, root dry weight differed significantly among treatments at the 5% level. Also, a significant increasing was considered in root length by increasing the concentration of vermiwash.

**Seedling Growth:** The maximum percentage of germination was obtained in 20 percent of vermiwash with sheep manure treatment and concentration of 40% in wheat straw. A significant difference was observed through treatments at 1% level in root length. In addition, root dry weight differed significantly among treatments at the 5% level. Also, a significant increasing was considered in root length by increasing the concentration of vermiwash.

**DISCUSSION**

The results showed that seed germination and seedling growth were significantly affected by vermiwash treatments. The maximum germination rate was observed at concentration of 40 percent of vermiwash with 25% alfalfa residue + 75% sheep manure. The maximum percentage of germination was obtained in 20 percent of vermiwash with sheep manure treatment and concentration of 40% in wheat straw. A significant difference was observed through treatments at 1% level in root length. In addition, root dry weight differed significantly among treatments at the 5% level. Also, a significant increasing was considered in root length by increasing the concentration of vermiwash.
25 seeds were placed on filter paper (experimental unit) in each petri dish and 20 percent and 40 percent concentrations of extract were prepared 0.5 ml of each extract added to each petri dish. Petri dishes were placed for seven days in germinator with 12 hours night - 12 hours day and 40 percent humidity condition.

Root emerging was considered as germination. Therefore, the number of germinated seeds was recorded from emerging rootlet until reaching to seventh day. In last day, length of root and shoot was measured. Root and shoot were removed and their dry weight was calculated by digital scale with an accuracy of one ten-thousandth of a gram. Root and shoot were dried in the oven for 48 h at 60°C in order to determine their dry weight (Rana et al., 2014).

Germination percentage, germination rate, seed vigor index, mean time of germination and germination index were calculated by following formulas:

\[ GP = (N_i / S) \times 100 \]

Where,

GP is germination percentage, \( N_i \) is the number of germinated seeds in \( i^{\text{th}} \) day and \( S \) is the total number of seeds (Bajji et al. 2002):

\[ GR = \sum N_i / T_i \]

Where,

GR is the germination rate (in terms of number of germinated seeds per day), \( N_i \) is number of germinated seeds in \( i^{\text{th}} \) day and \( T_i \) is the number of days to counting the \( i^{\text{th}} \) (Bajji et al. 2002):

\[ VI = (RL + SL) \times GP \]

Vigor index (VI) of seed was also obtained by multiplying the total root length (RL) and total shoot length (SL) in germination percentage (GP) (Bajji et al. 2002):

\[ MGT : \sum (N_t / \sum N) \]

Mean time of germination: \( N \) is the number of germinated seeds and \( \sum N_t \) is total number of seeds germinated in time (De and Kar, 1994):

\[ GI = \sum d_i n_i / N \]

Germination Index (GI): where \( d_i \) is the number of days after the start of experiment, \( n_i \) is the number of germinated seeds per day and \( N \) is the number of planted seeds (Scott et al., 1984). Data analyzed by SAS software and mean comparisons were done with LSD test.

**RESULTS AND DISCUSSION**

Results showed that vermiwash had significant effect on germination rate, root length, seed vigor index, shoot, root dry weight and total dry weight, ratio of root dry weight to shoot dry weight and mean time of germination (Table 1). Vermiwash concentration showed significant effect on germination percentage germination rate, germination index and mean time of germination (Table 1). Interaction of treatments had significant effect on germination rate, germination index, root dry weight and total dry weight, ratio

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**Table 1**: Variance analysis of germination traits.

| Source of changes | Germination percentage | Germination rate (mean time of germination) | Root length (Mean of squares) | Shoot length (Mean of squares) | Root dry weight (Mean of squares) | Shoot dry weight (Mean of squares) | Total dry weight (Mean of squares) | Ratio of root dry weight to shoot dry weight | Germination index (Mean of squares) |
|-------------------|------------------------|-------------------------------------------|-------------------------------|---------------------------|-----------------------------------|-----------------------------------|--------------------------------|------------------------------------------|-----------------------------------|
| Vermiwash         | 10.78±**               | 0.97±**                                   | 21.4±**                       | 18.5±**                   | 1.0±**                            | 0.99±**                           | 23.4±**                        | 0.009±**                                 | 0.001±**                           |
| Concentration     | 10.78±**               | 0.97±**                                   | 21.4±**                       | 18.5±**                   | 1.0±**                            | 0.99±**                           | 23.4±**                        | 0.009±**                                 | 0.001±**                           |
| Vermiwash x       | 10.78±**               | 0.97±**                                   | 21.4±**                       | 18.5±**                   | 1.0±**                            | 0.99±**                           | 23.4±**                        | 0.009±**                                 | 0.001±**                           |
| Error             | 63                     | 3.04±**                                   | 25.7±**                       | 19.9±**                   | 1.9±**                            | 0.94±**                           | 27.6±**                        | 0.007±**                                 | 0.007±**                           |
| CV                | 300                    | 10.97±**                                  | 19.9±**                       | 19.9±**                   | 1.9±**                            | 0.94±**                           | 27.6±**                        | 0.007±**                                 | 0.007±**                           |
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Table 2: Mean comparison of germination traits.

| Treatment                                    | Root dry weight/ shoot dry weight | Total dry weight (g) | Root length (cm) | Germination rate (seed per hour) | Seed vigor index |
|---------------------------------------------|----------------------------------|----------------------|------------------|---------------------------------|-----------------|
| W₀                                          | 0.16cdde                        | 0.069abcd            | 2.92e            | 21.62ab                         | 757.76cd        |
| W₁                                          | 0.16cdde                        | 0.064bde             | 3.58abde         | 21bdc                           | 873.56abcd      |
| W₂                                          | 0.20bdce                        | 0.065bde             | 3.90abdc         | 19.87bdefg                      | 950.24a         |
| W₃                                          | 0.16cde                         | 0.073abc             | 3.35abcede       | 21.75ab                         | 862.50abcd      |
| W₄                                          | 0.14e                           | 0.056e               | 3.19cde          | 18.37efghi                      | 806.71bdc       |
| W₅                                          | 0.21bdcde                       | 0.065bdcde           | 3.22bdcde        | 19cdefg                         | 798.82bdc       |
| W₆                                          | 0.20bcdc                        | 0.065bdcde           | 3.63abcede       | 19.87bcdef                      | 884.46abc       |
| W₇                                          | 0.21bde                         | 0.066abdc            | 3.89abdc         | 19.87bcdef                      | 916.46ab        |
| W₈                                          | 0.31a                           | 0.075ab              | 3.48abced        | 16.12ij                         | 829.41abcd       |
| W₉                                          | 0.23abc                         | 0.069abcd            | 3.92abdc         | 20bcde                          | 891.57abc       |
| W₁₀                                         | 0.14de                          | 0.064cde             | 3.27bcde         | 18.5efghi                       | 846.05abcd       |
| W₁₁                                         | 0.16cde                         | 0.069abcd            | 2.92e            | 21.62ab                         | 757.76cd        |
| W₁₂                                         | 0.25ab                          | 0.061de              | 4.04abc          | 21.12bdc                        | 937.75ab        |
| W₁₃                                         | 0.18bdc                         | 0.062de              | 4.15ab           | 15.87j                          | 847.41abcd       |
| W₁₄                                         | 0.15de                          | 0.07abcde            | 4.28a            | 18.62defgh                      | 889.37abc       |
| W₁₅                                         | 0.22bcd                         | 0.061de              | 4.28a            | 15.62j                          | 931.67ab        |
| W₁₆                                         | 0.18bdc                         | 0.060de              | 3.90abdc         | 17.5fgihj                       | 872.07abcd       |
| W₁₇                                         | 0.23abc                         | 0.068abdc            | 3.68abdc         | 16.62fghi                       | 840.15abcd       |
| W₁₈                                         | 0.22bdc                         | 0.068abdc            | 3.5abcde         | 16.75fghi                       | 833.88abcd       |
| W₁₉                                         | 0.25ab                          | 0.057e               | 3.11cde          | 23.87a                          | 741.38d          |
| W₁₀₀                                        | 0.20bdc                         | 0.077a               | 3.23bcde         | 16.37fghi                       | 825.10abcd       |
| W₁₀₁                                        | 0.20bdc                         | 0.068abd             | 3.06de           | 16.5fghi                        | 756.65cd         |

Similar letters represent no significant difference statistically at the 5% level.

Water as a control=W₀, Vermicompost extract of wheat straw=W₁, horse manure=W₂, sheep manure=W₃, 25% straw + 75% horse manure=W₄, 25% straw + 75% sheep manure=W₅, 50% straw + 50% horse manure=W₆, 50% straw + 50% sheep manure=W₇, 25% alfalfa residue + 75% sheep manure=W₈, 50% alfalfa residue + 50% sheep manure=W₉, 25% chicken manure + 75% straw manure=W₁₀.

of root dry weight to shoot dry weight and mean time of germination (Table 1). The results showed that, control treatment had the same results with the vermicompost extract involving horse manure and vermicompost extract include 25% alfalfa residue + 75% sheep manure at the 20% concentration with treatment of 25% wheat straw + 75% horse manure at the 40% concentration (Table 2). The mentioned results are relevant to Zaller (2007) results that had studied n the vermicompost extract has impact on germination of tomato cultivars. In germination rate, similar results were observed between control treatment and vermicompost extract of sheep manure at the 20% concentration treatment (Table 2). Although Vermicompost increases germination by increasing microbial activity and improving nutrients cycle and reduction of pathogen, high concentration of some nutrients in rich vermicompost can be inhibit and reduce germination (Choudhary and Suri, 2018a, 2018b; Harish et al., 2017, 2018, 2019).

Maximum mean comparison length of root was observed at 40% concentration of vermicompost extract of 25% wheat straw + 75% horse manure and sheep manure vermiwash (W3) (Table 2). Results showed that root length was increased by concentration of vermicompost extract. Keeling et al. (2003) reported that root growth in canola plant has been increased by vermicompost extract application. Also they reported that regulators or hormones isolated from vermicompost might have a positive impact on improving root growth. In terms of shoot length, the longest shoot was observed in treatment of horse manure vermiwash at the 20% concentration.

The total dry weight was observed at the 40% concentration of extract and in treatment of vermicompost of 50% alfalfa residue + 50% sheep manure (Table 2). In addition, the highest dry weight of root to shoot was observed at the 20% concentration of vermicompost extract of 25% alfalfa residue + 75% sheep manure treatment (Table 2). Pritam and Garg (2010) told that the biomass of marigold has been increased by vermicompost treatment and its effect on increasing root diameter, development and dry weight by microorganism’s presence and their role in increasing the electrical conductivity of water in the roots circle of marigold. Their results are in line with results of the study conducted by Abrishamchi *et al.* (2012).

**CONCLUSION**

Overall, vermiwash concentration showed significant impact on components of germination percentage and germination rate of fenugreek in comparison to control treatments.
Therefore, vermiwash can be mentioned as a priming method in order to increase the seed germination percentage and root length.

REFERENCES
Abrishamchi, P., Ganjali, A., Khvirmzy, A. and Avan, A. (2012). Effect of vermicompost on seed germination and seedling growth of tomato varieties. Journal of Horticultural Science. 27: 1-4.

Bajji, M.J., Kinet, M. and Lutts, S. (2002). Osmotic and ionic effects of NaCl on germination, early seedling growth and ion content of Atriplex halimus L (Chenopodiaceae). Canadian Journal of Botany. 80: 297-304.

Choudhary, A.K. (2013). Technological and extension yield gaps in pulses in Mandi district of Himachal Pradesh. Indian J. Soil Conser. 41(1): 89-97.

Choudhary, A.K. and Rahi, S. (2018). Organic cultivation of high yielding turmeric (Curcuma longa L.) cultivars: A viable alternative to enhance rhizome productivity, profitability, quality and resource-use efficiency in monkey-menance areas of north-western Himalayas. Industrial Crops and Products. 124: 495-504.

Choudhary, A.K. and Suri V.K. (2009). Effect of organic manures and inorganic fertilizers on productivity, nutrient uptake and soil fertility in wheat (Triticum aestivum)-paddy (Oryza sativa) crop sequence in western Himalayas. Current Advances in Agricultural Sciences. 1(2): 65-69.

Choudhary, A.K. and Suri, V.K. (2013). Scaling-up of pulse production under frontline demonstration technology transfer program in Himachal Himalayas, India. Commun. Soil Sci. Pl. Anal. 45(14): 1934-1948.

Choudhary, A.K. and Suri, V.K. (2018a). Low-cost vermi-composting technology and its application in bio-conversion of obnoxious weed flora of north-western Himalayas into vermi-compost. Communications in Soil Science and Plant Analysis. 49 (12): 1429-1441.

Choudhary, A.K. and Suri, V.K. (2018b). System of rice intensification in short duration rice hybrids under varying bio-physical regimes: New opportunities to enhance rice productivity and rural livelihoods in north–western Himalayas under a participatory–mode technology transfer program. Journal of Plant Nutrition. 41(20): 2581-2605.

Choudhary, A.K., Rahi, S., Singh, A. and Yadav, D.S. (2010). Effect of vermi-compost and biofertilizers on productivity and profitability in potato in North-Western Himalayas. Current Advances in Agricultural Sciences. 2(1):18-21.

De, F. and Kar, R.K. (1994). Seed germination and seedling growth of mung bean under water stress induced by PEG 6000. Seed Science and Technology. 23: 301-304.

Gretyak, S., Edwards, C. and Arancon, N. (2006). Effects of vermi-compost teas on plant growth and disease. Retrieved August 19, http://www.wormdigest.org/content/view/3112/.

Harish, M.N., Choudhary, A.K., Singh, Y.V., Pooniya, V., Das, A., Vararatham, T. and Babu, S. (2019). Influence of varieties and nutrient management practices on productivity, nutrient acquisition and resource-use efficiency of rice (Oryza sativa) in north-eastern hill region of India. Indian Journal of Agricultural Sciences. 89(2): 367-370.

Harish, M.N., Choudhary, A.K., Singh, Y.V., Pooniya, V., Das, A. and Vararatham, T. (2018). Influence of promising rice (Oryza sativa) varieties and nutrient management practices on micronutrient biofortification and soil fertility in Eastern Himalayas. Indian Journal of Agronomy. 63(3): 377-379.

Harish, M.N., Choudhary, A.K., Singh, Y.V., Pooniya, V., Das, A. and Vararatham, T. (2017). Effect of promising rice (Oryza sativa) varieties and nutrient management practices on growth, development and crop productivity in eastern Himalayas. Annals of Agricultural Research. 38(4): 375-384.

Keeling, A.A., McCallum, K.R. and Beckwith, C.P. (2003). Mature green waste compost enhances growth and nitrogen uptake in wheat (Triticum aestivum) and oilseed rape (Brassica napus) through the action of water-extractable factors. Bioresource Technology. 90: 127-132.

Lazcano, C., Sampedro, L., Zas, R. and Dominguez, J. (2010). Vermicompost enhances germination of the maritime pine (Pinus pinaster). New For. 39: 387-400.

Pritam, S.V.K. and Garg, C.P.K. (2010). Growth and yield response of marigold to potting media containing vermicompost produced from different wastes. Environmentalist. 30: 123-130.

Rana, K.S., Choudhary, A.K., Sepa, T.S., Bana, R.S. and Dass, A. (2014). Methodological and Analytical Agronomy. Post Graduate School. IARI, New Delhi, pp 276.

Scott, S.J., Jones, R.A. and Williams, W.A. (1984). Review of data analysis methods for seed germination. Crop Science. 24: 1192-1199.

Subler, S., Edwards, C. and Metzger, J. (1998). Comparing vermicomposts and composts. Biocycle. 39: 63-66.

Zaller, J.G. (2007). Vermicompost as a substitute for peat in potting media. Effects on germination, biomass allocation, Yields and fruit quality of three tomato varieties. Scientia Horticulturae. 112: 191-199.