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

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ABSTRACT

Physiological process of germination depends on several factors such as temperature, water potential, light and nutrients. A laboratory study was carried out to asses, 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=W_0, Vermicompost extract of wheat straw=W_1, horse manure=W_2, sheep manure=W_3, 25% straw + 75% horse manure =W_4, 25% straw + 75% sheep manure =W_5, 50% straw + 50% horse manure =W_6, 50% straw + 50% sheep manure =W_7, 25% alfalfa residue + 75% sheep manure =W_8, 50% alfalfa residue + 50% sheep manure =W_9, 25% chicken manure + 75% straw manure =W_{10}) 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 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, humic 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.

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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

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:

$$GP = (Ni/S) \times 100$$

Where,

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

$$GR = \Sigma Ni/Ti$$

Where,

GR is the germination rate (in terms of number of germinated seeds per day), Ni is number of germinated seeds in i^{th} day and Ti is the number of days to counting the i^{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):

$$MGT : \Sigma (Nt / \Sigma N)$$

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

$$GI = \frac{\Sigma d_i n_i}{N}$$

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

Table 1: Variance analysis of germination traits.

Source of changes	Df	Mean of squares										
		Germination percentage	Germination rate	Root length	Shoot length	Seed vigor index	Dry weight of root	Dry weight of shoot	Germination index	Total dry weight	Ratio of root dry weight to shoot dry weight	Mean time of germination
Vermiwash	10	13.78ns	18.51**	1.02*	0.29ns	23400*	0.0023ns	0.021**	50.51**	0.00014**	0.0085**	0.08**
Concentration	1	58.77*	46.97**	0.1ns	0.99ns	16922ns	0.000034ns	0.028ns	160.97**	0.000028ns	0.00045ns	0.26**
Vermiwash × Concentration	10	17.04ns	21.54**	0.9*	0.17ns	16063ns	0.0017ns	0.022ns	69.07**	0.00016**	0.0066*	0.13**
Error	63	8.78	2.58	0.42	0.26	9368	0.0015	0.012	7.69	0.000052	0.0032	0.016
CV	-	3.04	8.49	18.46	10	11.46	25.72	15.19	19.98	10.97	28.21	8.78

*, ** and ns represent respectively significant difference at 5%, significant difference at 1% and non-significant respectively.

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
Concentrations of 20	W_0	0.16cde	0.069abcd	2.92e	21.62ab	757.76cd
	W_1	0.16cde	0.064bcde	3.58abcde	21bcd	873.56abcd
	W_2	0.20bcde	0.065bcde	3.90abcd	19.87bcdef	950.24a
	W_3	0.16cde	0.073abc	3.35abcde	21.75ab	862.50abcd
	W_4	0.14e	0.056e	3.19cde	18.37efghi	806.71bcd
	W_5	0.21bcde	0.065bcde	3.22bcde	19cdefg	798.82bcd
	W_6	0.20bcde	0.065bcde	3.63abcde	19.87bcdef	884.46abc
	W_7	0.21bcde	0.066abcd	3.89abcd	19.87bcdef	916.46ab
	W_8	0.31a	0.075ab	3.48abcde	16.12ij	829.41abcd
	W_9	0.23abc	0.069abcd	3.92abcd	20bcde	891.57abc
	W_{10}	0.14de	0.064cde	3.27bcde	18.5efghi	846.05abcd
Concentrations of 40	W_0	0.16cde	0.069abcd	2.92e	21.62ab	757.76cd
	W_1	0.25ab	0.061de	4.04abc	21.12bc	937.75ab
	W_2	0.18bcde	0.062de	4.15ab	15.87j	847.41abcd
	W_3	0.15de	0.07abcd	4.28a	18.62defgh	889.37abc
	W_4	0.22bcd	0.061de	4.28a	15.62j	931.67ab
	W_5	0.18bcde	0.060de	3.90abcd	17.5fghij	872.07abcd
	W_6	0.23abc	0.068abcd	3.6abcde	16.62ghij	840.15abcd
	W_7	0.22bcde	0.068abcd	3.5abcde	16.75ghij	833.88abcd
	W_8	0.25ab	0.057e	3.11cde	23.87a	741.38d
	W_9	0.20bcde	0.077a	3.23bcde	16.37hij	825.10abcd
	W_{10}	0.20bcde	0.068abcd	3.06de	16.5hij	756.65cd

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

Water as a control=W_0, Vermicompost extract of wheat straw=W_1, horse manure=W_2, sheep manure=W_3, 25% straw + 75% horse manure=W_4, 25% straw + 75% sheep manure=W_5, 50% straw + 50% horse manure=W_6, 50% straw + 50% sheep manure=W_7, 25% alfalfa residue + 75% sheep manure=W_8, 50% alfalfa residue + 50% sheep manure=W_9, 25% chicken manure + 75% straw manure=W_{10}.

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 increasing concentrations 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.

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