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Analysis of Effect of Organic Fertilizer on Yield and Active Substance of *Psyllium* Herbal Plant (*Plantago ovata* L.)

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ABSTRACT: In terms of environmental impact and qualitative and quantitative yield of medicinal plants, consumption management of organic fertilizers is very importance, especially in arid and semiarid areas. Organic matter is one of the most useful sources in improving the quality of cultivating lands and increasing the performance of different vegetables. To evaluate the effects of organic fertilizers on the yield and the active substance of the psyllium herb (*Plantago ovata* L.), an experiment was conducted on a field in Zabol in 2011-2012. The experiment was implemented in completely randomized blocks with three replications. Treatments consisted of different levels of organic fertilizers including 1) Manure (20ton/ ha), 2) composting (20 ton/ha), 3) lack of fertilizers. The results showed that grain yield, spike length, number of tillers, number of spike, 1000-seed weight, and mucilage content were significantly influenced by fertilization. In general, it can be inferred that the 20 ton/ ha treatment of manure for *Psyllium* is desirable.

Keywords: organic fertilizer, *Psyllium*, grain yield, mucilage

INTRODUCTION

During the recent century, numerous researches have been conducted on medicinal plants. In fact, natural medicines have opened the way to advent of new horizons for communities of doctors, pharmacologists, and other researchers. One of the most considerable issues in agriculture and medical science, and even world trade is paying attention to producing, processing, and using medicinal plants (Pirzad *et al.* 2006). At present, a third of medicines used for human have plant origins and this rate is rising sharply (Omidbeigi 1997). Low amounts of organic matter in soil in arid and semi- arid areas as well as the significance of organic matter in sustainable management of agricultural ecosystems in arid areas have taken the attention of researchers and farmers to organic fertilizers. Adding residual organic matter such as municipal waste compost , vermin compost, manure and crop residue to soil is a common practice in many parts of the world to preserve soil organic matter, soil fertility and nutrient availability (Safari Sanjani *et al.,* 2003; Chen *et al.,* 2003; Arunachalam *et al* ., 2003; Thuries *et al.,* 2001). *Psyllium* (*Plantago ovata*), is one of the most valuable medicinal plants belonging to the herbaceous family (Plantaginaceae). It is an annual grass, 5 to 10 cm tall, with soft hair. It is native of India, Iran and other Middle Eastern countries. Nowadays, India is the largest exporter of *Psyllium* seed in the international markets (Gupta, 1982). Although Iran is one of the natural habitats of this plant, its cultivation has little economic background. The mucilage of its seeds can be used to stabilize ice cream, chocolate as well as ingredients used in salad (Cho *et al.,* 2004). *Psyllium* seeds are useful in reducing blood cholesterol, inflammation, dysentery and removing biliary abnormalities due to tract problems in digestion system (Carrubba *et al.,* 2002; Zargari, 1997) .the seeds of this plant have great impact on healing and treating gout and inflammation caused by rheumatism and dysentery (Carrubba *et al.,* 2002; Gupta, 1982). In countries like Iran, where the climate is arid and semi-arid, it is more convenient to use soil and water resources. In this context, to reduce the country's dependence on imported food (including human food or animal feed), there is no choice but to make more efforts in increasing agricultural production. This is just possible through creating changes in the agricultural basis of the country and effective and sustainable usage of available water and soil resources and providing necessary facilities to apply the potential soil and water resources (Bahremand *et al.,* 2002; Jafari Malekabadi, 2000). Reducing earthworm activities by the use of large amounts of chemical fertilizers has been reported which is due to higher salt concentration in the soil solution (Brinton, 1979) Apart from its effect on providing nutrition, organic matter have various effects on soil features, especially those associated with soil physical characteristics (Pedra *et al.,* 2006). Increased manure leads to reduction of soil compressibility, because organic matter acts as a cushion and it prevents the transfer of stress to the lower ground (Mossadeghi and Hajabbasi, 1999). Studies have shown that application of 20 ton/ ha of compost from municipal wastes in vegetables increase their performance by 15 per cent (Ferguson, 2001, Avnimelech and Kochva, 1992).

In a research, the effect of organic fertilizers on several medicinal plants was studied, and it was found that adding compost increases the height of the plant (Echinaceae purpurea) and consequently, increases fresh and dry weights of lemon balm plant (*Melissa officinalis*) (Delate, 2000). Many of the companies producing herbal medicines usually prefer herbal compounds, which are produced through organic or Biodynamic processes (Griffe *et al.,* 2003).

MATERIALS AND METHODS

The experiment was conducted on a farm in the eastern part of Zabol, a small city in Sistan and Baluchistan province in the winter, 2012. The testing site is located in 61° 41' E longitude and 30° latitude 54' N, and its altitude is 481m above sea level. The testing soil had a clay texture, pH = 7.9. Its physicochemical characteristics are listed in Table 1.

Table 1: Physical and chemical properties of the soil at a depth of 0-30 cm.

Soil texture	sand (%)	clay (%)	Lai (%)	Mg (ppm)	Zn (ppm)	Fe (ppm)	potassium (ppm)	P (ppm)	nitrogen (percent)	Organic matter (%)	apparent weight g / cm3	pH	Electric conductivity (ds/m)
clay	31.6	48	20.4	2.80	3.2	1.97	119	9.45	0.09	0.87	1.49	8.2	1.5

Table 2: Some features of the used fertilizer.

Organic Matter (%)	Nitrogen (%)	Phosphorous (%)	Potassium (%)	pH	EC dS/m	Humidity (%)
26.5	1.71	0.72	2.59	7.6	6.6	38

Table 3: Some features of the used compost.

Organic Matter (%)	Nitrogen (%)	Phosphorous (%)	Potassium (%)	pH	EC dS/m	Humidity (%)
19.6	1.1	0.40	1.24	7.2	7.4	32

The experiment was conducted in a completely randomized block design with three replications. The fertilizing treatments had various levels of organic fertilizers including 1) manure20 ton/ ha, 2) compost 20 tons per ha, 3) lack of fertilizers. Planting was done manually using the wet method on Esfand 3. Seeds were planted at a depth of up to 0.5 cm. In order to prevent the crust effect on emergence and rise of plant seedlings, they were irrigated regularly after till the topsoil was dried until the seedlings emergence. Hand weeding of the weeds was done during the growing season in two steps. To measure the height, the spike length, the number of grains per spike, the number of spikes per plant, 10 plants from each plot were randomly selected and measured. Moreover, to determine the seed yield, the samples were taken while monitoring each plot removing the marginal effects of a 1.5 m2 area. Likewise, the amount of mucilage was measured to assess the qualitative indicators (Kalayasundram *et al.,* 1982). The gathered data were analyzed using SAS software and the means were compared using Duncan test.

RESULTS

A. Effects of fertilizing treatments on yield and its components

The results showed that the fertilizing treatments had an effect on all traits, except the number of grains per spike. This effect was significant in a level of 5%. In addition, in other traits, it had a 1% significant effect (Table 4), so that these characteristics showed a positive response to fertilization and in terms of all studied traits; it was observed that the treatments containing fertilizers were superior to the control (no fertilization). Of the measured traits, just the spike length and the number of grains per spike had significant differences between treatments of the compost fertilizer and the control (no fertilization). Manure application increased the plant height, the number of ears per plant, and the number of tillers per plant. The highest performance of *Psyllium* was obtained in the treated manure, respectively, so that this treatment increased the ratio of the seed yield to the control (no fertilization) and the compost fertilizer as 84.79% and 45.98%, respectively (Fig. 1).

Table 4. Analysis of variance of the properties of *Psyllium* morphological traits under different levels of fertilizer.

Variation resources	Freedom degree	Plant height (cm)	Spike length (cm)	number of tillers	number of ears per plant	number of grains per spike	100-seed (gr) weight	Seed yield (kg/ha)	%age of mucilage	Mucilage yield
Frequency	2	4.19	0.04	0.006	2.94	5.21	0.005	4501.49	0.002	159.99
Fertilizer	2	19.06**	0.46**	3.04**	44.58**	215.27*	0.18**	72725.14**	4.87**	** 3095.76
Error	12	1.42	0.04	0.04	2.73	47.93	0.01	2719.40	0.25	96.79
Variation coefficient(%)		6.86	8.79	6.41	15.80	10.19	5.82	18.34	2.77	18.78

*, **, and ns, are respectively significant at the 5%, 1%, and no significant

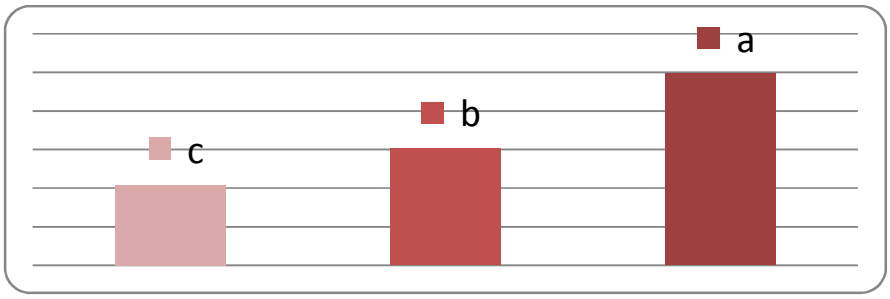

Fig. 1. Effect of different fertilizers on *Psyllium* crop yield a: manure, b: compost, c: control (no fertilization)

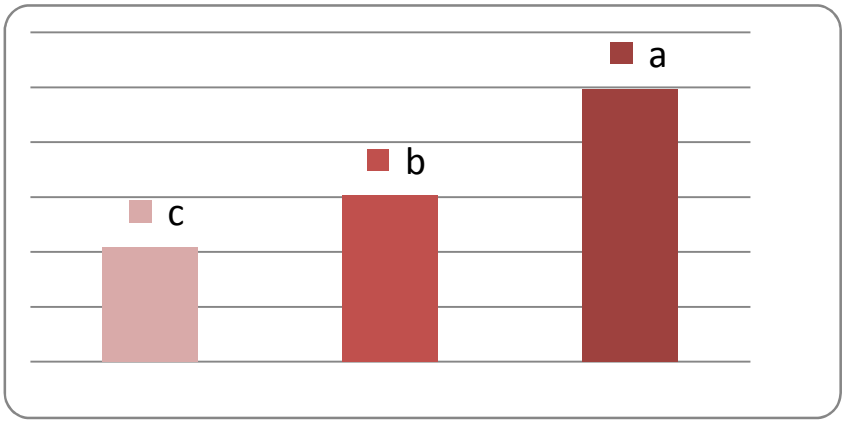

Fig. 2. Effect of different fertilizers on percentage of *Psyllium* mucilage (a: manure, b: compost, c: control (no fertilization).

B. Effect of fertilizing treatments on qualitative characteristics of Psyllium

The effect of fertilizing treatments on all traits except plant height was not significant at a level of 5% (Table 4). According to the results shown in Table 4, a significant difference ($p \leq 0.01$) was observed in terms of mucilage between the fertilizing treatments, so that all treatments significantly increased the percentage of the mucilage compared with the control to have (Figure 2). In the percentage of mucilage, a significant difference was also observed between those treatments, which received fertilizer. The highest mucilage content belonged to manure application (18.98). It has been recorded that the percentage of mucilage of this treatment compared to the control (no fertilization) and compost increased by 8.20% and 5.38%, respectively (Fig. 2).

DISCUSSION

Although plant height is a factor limited by the geographical coordinates and heat, especially with the advent of flowering, shortage or improper access to water or nutrition play a significant role in determining the plant height. The fertilizing treatments have increased the *Psyllium* height significantly. The effect of fertilizers on increasing the plant height has been reported by Ahmadian (2006) on cumin, Jahan (2004) on MC and Koocheki *et al.* (2007) on *Psyllium*. The results showed that all fertilizing treatments caused a significant increase in seed yield compared to the control, whereas manure treatment had more effect on increasing P*syllium* seed yield. Jahan *et al.,* 2004 also showed that consuming 30 ton/ ha manure can increase sub- branches of chamomile (MatricariachamomillaL).the uptake of the organic matter will increase soil nutrition content and its absorbing capacity and at the same time, it enhances nitrogen equilibrium and phosphorous absorption efficiency. All fertilizing treatments caused a significant increase in seed yield compared to the control; however, manure treatment was more effective in increasing the performance of *Psyllium*. Manure also was effective in improving soil porosity and plant tolerance to heavy metals. Numerous researches have been conducted on the effect of manure on *Psyllium* plant. Most of them have come to this conclusion that the application of manure can be very effective in increasing grain yield (Intodia and Tomar, 1998; Patel et al., 1996, Singh *et al.,* 2003). The percentage of mucilage in manure treatment increased in comparison with other fertilizing treatments and it was due to factors such as increased absorption content of Potassium and phosphorous in *Psyllium* plant and especially in its seeds; however, its results were in correspondence with the findings of Bajiya, 1994.

Hence, according to the fact that the highest yield and the optimum percentage of mucilage have economical and medicinal importance and are obtained by applying manure, it is suggested to use this treatment as the most suitable manure treatment for *Psyllium*.

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