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Effects of Vermicompost and Manures on Growth Characteristics and Yield Components of Purslane *(Portuleca oleracea* L. var Behbahani*)*

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ABSTRACT
Fertilizer management is an important factor in successful cultivation of pharmaceutical plants. In order to investigate the effects of vermicompost and manures on growth characteristics and yield components of purslane (*Portuleca oleracea* L. var Behbahani), this study was carried out in a randomized complete blocks design with three replications in research greenhouses of Islamic Azad University- Isfahan Branch in 2014. Treatments were cow manure, sheep manure, buffalo manure and vermicompost of cow in 10, 20, 30, and 40% levels plus control (17 treatments). According to results, using manure had significant superiority ($p<0.05$) in all studied traits, so that, the highest fresh and dry weights of leaves, stem, and root, stem length, number of leaves, fresh and dry weights of aerial parts were obtained in 30% cow manure. Also, this treatment had the highest number of capsules per plant, seeds per plant, and 1000- seeds weight as yield components. On the whole, results showed that using manure can play important role in production and yield increment of Behbahani pursalne to reduce chemical fertilizers pollution and reach to sustainable agriculture.

Keywords: Pharmaceutical plants, Purslane (*portuleca oleracea* L. var Behbahani), Manure, Vermicompost, Growth characteristics, Yield components

INTRODUCTION

Desire to produce pharmaceutical plants and also request for natural products are increasing in the World (Omidbeigi. 1994). Producing healthy food products plus saving environment have been considered in recent years (Nesson. 2004). Long-term studies about chemical fertilizers show that their over-use reduces crop yield due to negative effects on soil (Karmaka *et al*., 2007). Therefore, replacing these fertilizers with non-chemical fertilizers including manures can improve soil properties and increase quality and quantity of products (Renato *et al*., 2003, Sharpley *et al*., 2004, Gryndler *et al*., 2008).

Organic fertilizers (compost and vermicompost) have been used in world agriculture successfully. These fertilizers improve nutritional aspects and physical and microbial condition of the soil (Robin *et al*. 2001). Using manures is another component of sustainable agriculture. Many researches have reported production increment by using manures.Bachman

and Metzeger (2008) reported increase in growth of transplanting vegetables by using vermicompost. Afsharmanesh *et al*. (2008) studied cow manure effects on fleawort and observed desire results.

Purslane (*portuleca oleracea* L.) is a herbaceous annual plant with fleshy stems from portulacacea family which has been used as vegetable or pharmaceutical plant from the ancient times (Rashed *et al*., 2003, Chan *et al*., 2000). This plant is native to Iran and has been cultivated for more than 2000 years (Stephan. 1994). Purslane is used for nutrition and medicinal industries (Asadi *et al*., 2006). Using purslane prevents cardiovascular diseases, cancer, asthma, diabetes, and infectious diseases because of its high anti-oxidants and omega-3 fatty acids (Palanisvami *et al*., 2004, Simopols *et al*., 1992).

Since purslane is a valuable pharmaceutical plant of Iran, it is necessary to determine its agronomic managements such as fertilizer requirements. Therefore, this study was conducted to investigate the effects of vermicompost and manures on growth characteristics and yield components of purslane (*Portuleca oleracea* L. var Behbahani).

MATERIALS AND METHODS

The study was carried out in research greenhouses of Islamic Azad University- Isfahan Branch as a randomized complete blocks design with three replications, in 2014. Treatments were cow manure, sheep manure, buffalo manure and vermicompost of cow at 10, 20, 30, and 40% levels plus control (17 treatments Table 1) with three replications. Prior to adding fertilizers, soil and fertilizer samples were analyzed physically and chemically. Results are presented in Table 2.

Table1. Treatments of experiment

Bed	First level	Second levels	Third level	Fourth level
Cow manure	10% fertilizer+ 90% soil	20% fertilizer+ 80% soil	30% fertilizer+ 70% soil	40% fertilizer+ 60% soil
Sheep manure	10% fertilizer+ 90% soil	20% fertilizer+ 80% soil	30% fertilizer+ 70% soil	40% fertilizer+ 60% soil
Buffalo manure	10% fertilizer+ 90% soil	20% fertilizer+ 80% soil	30% fertilizer+ 70% soil	40% fertilizer+ 60% soil
Cow vermicompost	10% fertilizer+ 90% soil	20% fertilizer+ 80% soil	30% fertilizer+ 70% soil	40% fertilizer+ 60% soil
Control	-	-	-	-

Table 2. Physicochemical properties of soil and fertilizers

Bed type	PH	EC ds/m^2	N %	P %	K %	organic carbon
Soil	7	3.40	0.1	0.15	0.035	0.7
Cow manure	7.4	2.56	2.6	0.21	0.68	55
Sheep manure	7.6	1.87	2.8	0.24	0.62	42
Buffalo manure	7.1	2.75	2.3	0.18	0.44	35

Silt 50% Clay23% Sand 17% (silty loam)

Seeds were prepared from the Institute of Agriculture and Natural Resources. Seeds were sown in wood boxes (42*30*23cm) in two rows with 10 cm inter row space and one centimeter depth. Appropriate irrigation and weeding were applied and thinning was done at 4-6 leaves stage. Herbicides, pesticides and fungicides were not used. Forty five days after cultivation (before flowering), five plants were selected randomly and traits such as plant length, leaves numbers, fresh and dry weights of root, stem and leaves and aerial part weight and moisture percentage were measured in laboratory.

Plants were harvested at full maturity (blackish brown grain) and the numbers of capsules per plant, seeds per plant and 1000-seeds weights were measured. Obtained data were analyzed using SAS9.1and means were compared using Duncan's multiple ranges test at 5% probability level.

RESULTS AND DISCUSSION

Statistical analysis showed significant differences ($p<0.05$) between treatments for all traits studied (Tables 4 and 5).

Table 4. Variance analysis of vegetative traits

Source of Variation	df	Mean squares							
		Leaves fresh weight	Stem fresh weight	Root fresh weight	Leaves dry weight	Stem dry weight	Root dry weight	Stem length	Leaves number
Replication	2	0.66^{ns}	0.753^{ns}	0.006^{ns}	0.020^{ns}	0.016^{ns}	0.003^{ns}	0.622^{ns}	3.471^{ns}
Bed	16	582.814^{**}	595.565^{**}	1.139^{**}	0.832^{**}	4.365^{**}	0.415^{**}	23.240^{**}	3293.154^{**}
Error	32	1.537	1.491	0.045	0.013	0.053	0.014	1.266	9.435
CV%		7.39	6.79	16.51	11.61	12.39	15.64	5.11	8.17

ns, *, and ** : non-significant, and significant at 5% and 1% probability levels, respectively.

Table5. Variance analysis of vegetative traits and yield components

Source of Variation	df	Mean squares				
		Capsules numberper plant	Seed number per plant	1000seeds weight	Dry weight of aerial part	Fresh weight of aerial part
Replication	2	1.537^{ns}	4351.314^{ns}	0.001^{ns}	0.008^{ns}	2.470^{ns}
Bed	16	184.359^{**}	667293.532^{**}	6.885^{**}	8.649^{**}	2323.710^{**}
Error	32	0.549	1455.918	0.009	0.072	4.330
CV%		3.46	3.38	5.10	9.51	5.99

ns, *, and ** : non-significant, and significant at 5% and 1% probability levels, respectively.

Table 6. Mean comparison of vegetative traits

Substrate	Leaves fresh weight	Stem fresh weight	Root fresh weight	Leaves dry weight	Stem dry weight	Root dry weight
Cow manure10%	32.37b	35.46c	2.16ab	1.18c	2.78b	1.18b
Cow manure20%	31.81b	37.49b	1.73c	1.17c	2.84b	1.13b
Cow manure30%	57.78a	51.61a	2.25a	2.57a	5.10a	1.70a
Cow manure40%	29.48c	35.22c	1.83bc	1.48b	3.05b	1.23b
Sheep manure10%	12.60e	10.18f	1.25d	0.91def	1.05efg	0.83c
Sheep manure20%	16.36d	21.07d	1.78bc	1.00cde	1.53d	0.79c
Sheep manure30%	15.43d	19.96d	1.93abc	1.19c	2.05c	0.75cd
Sheep manure40%	16.41d	21.50d	1.87bc	1.08cd	2.84b	0.64cde
Buffalo manure10%	14.69d	16.56e	1.02def	0.89def	2.72b	0.65cde
Buffalo manure20%	10.01f	9.36f	1.05de	0.85ef	1.16def	0.64cde
Buffalo manure30%	7.33g	6.61g	0.95defg	0.73fg	1.07ef	0.50ef
Buffalo manure40%	12.22e	9.77f	1.08d	1.06cd	1.26def	0.52ef
vermicompost10%	7.14g	6.86g	0.67efgh	0.55gh	0.64gh	0.57def
Vermicompost20%	5.97gh	6.93g	0.59gh	0.46h	0.86fgh	0.51ef
Vermicompost30%	5.75gh	5.81gh	0.60gh	0.39h	0.83fgh	0.37fg
Vermicompost40%	5.58gh	7.22g	0.64fgh	0.47h	1.30de	0.41fg
control	4.12h	4.09h	0.36h	0.37h	0.55h	0.27g

There is no significant differences between means of each column with at least one common letter.

Table 7. Mean comparison of vegetative traits

Substrate	Stem length	Leaves number	Aerial parts fresh weight	Aerial parts dry weight
Cow manure10%	19.44g	17.78fg	67.83bc	3.96c
Cow manure20%	24.24bc	23.77e	69.31b	4.01c
Cow manure30%	29.63a	151.0a	109.4a	7.67a
Cow manure40%	25.16b	62.77b	64.70c	4.54b
Sheep manure10%	20.95efg	53.66c	22.77f	1.97fg
Sheep manure20%	23.39bcd	52.66c	37.44d	2.53e
Sheep manure30%	23.11cde	47.00d	35.39d	3.25d
Sheep manure40%	22.22cdef	48.89cd	37.91d	3.93c
Buffalo manure10%	22.33cde	22.86ef	31.25e	3.61cd
Buffalo manure20%	21.98def	21.49efg	19.37f	2.01fg
Buffalo manure30%	21.30defg	21.67efg	13.94g	1.80g
Buffalo manure40%	20.96efg	23.40ef	21.99f	2.33ef
vermicompost10%	21.08efg	19.89efg	14.00g	1.19i
Vermicompost20%	21.08efg	18.33efg	12.90g	1.33hi
Vermicompost30%	20.11fg	17.80fg	11.57gh	1.22i
Vermicompost40%	21.30defg	20.09efg	12.80g	1.77gh
control	16.31h	15.88g	8.22h	0.93i

There is no significant differences between means of each column with at least one common letter.

Table 8. Mean comparison of yield components

Substrate	Capsules per plant	Seeds per plant	1000seeds weight
Cow manure10%	30.47c	1676.0c	3.35bc
Cow manure20%	33.07b	1818.6b	3.35bc
Cow manure30%	36.53a	2009.3a	3.71a
Cow manure40%	31.53c	1734.3c	3.21c
Sheep manure10%	26.70e	1335.0e	3.50b
Sheep manure20%	25.40f	1270.0f	3.30c
Sheep manure30%	26.80e	1340.0e	3.33bc
Sheep manure40%	28.63d	1431.6d	3.50b
Buffalo manure10%	15.90ghi	795.0g	0.45d
Buffalo manure20%	14.93ijk	746.6g	0.47d
Buffalo manure30%	15.80ghi	790.0g	0.46d
Buffalo manure40%	15.10hij	755.0g	0.45d
vermicompost10%	16.40gh	738.0g	0.46d
Vermicompost20%	16.80g	756.3g	0.49d
Vermicompost30%	14.40jk	648.6h	0.49d
Vermicompost40%	16.73g	753.0g	0.45d
control	13.60k	612.0h	0.49d

There is no significant differences between means of each column with at least one common letter

Fresh Weight of Leaves, Stem and Root

Results showed significant differences between leaves, stem and root fresh weights of all treatments and control (Table 4).

Among beds, control treatment had the least fresh weights whereas 30% treatment cow manure produced the highest fresh weights (Table 6). It seems that by increasing nitrogen from organic sources, fresh weight of leaves is increased. Also, better manure nitrogen mineralization along with increased availability of other nutrients (Alizadeh *et al*., 2012) and match between available nitrogen and plant requirements (Mooleki *et al*., 2004) have increased the growth and fresh weight of stem in this bed.

More oxygen penetration, more soil spaces and therefore higher respiration and ventilation in root environment caused by cow manure, increase in soil organic matter and better physicochemical properties were probable reasons of higher root's fresh weight (Khayyat *et al*., 2007, Javaheri. 2000).

Dry Weight of Leaves, Stem and Root

As it is shown in Table 6, the highest dry weights of leaves, stem and root were obtained in 30% cow manure treatment whereas control treatment produced the least weights. It seems that organic manure has the most necessary elements and will balance soil elements in long time. Also, manures such as cow manure prepare optimum condition for increasing dry weight by positive changes in physicochemical properties of the soil and early providing elements in the growing season. Since phosphorus plays important role in root development (Mengle and Kirkby 1995), increase in root dry weight of mentioned treatment can be ascribed to high phosphorus absorption.

Stem Length

The effect of studied treatments on stem length (Table 4) was significant ($p<0.05$). So that 30% cow manure produced the longest stems (Table 7). The reason can be increase in the number and length of nodes which leads to growth increment and longer stems. Since nutrients deficit is one of the main factors in determining plant length (Singh and Chauhan.1994), control treatment had shorter stems. Available water and sufficient nutrient are really important in stem elongation especially nitrogen through its effects on cell division and enlargement (Pouryousef *et al*., 2010)

Number of Leaves per Plant

All treatments increased the number of leaves in proportion to control and 30% cow manure produced the highest leaves number which was significantly different from other treatments (Table 4). More leaves of this treatment can be probably due to improved absorption of nutrients in the soil (Pouryousef *et al*., 2010) and effects of these nutrients on vegetative growth of plant, especially nitrogen which leads to more leaf production (Sifola and Barbieri. 2006, Tahami *et al*., 2010).Also, increase in nitrogen mineralization potential and higher available nitrogen (Alizadeh *et al*., 2010) would increase leaves number.

Fresh and Dry Weights of Aerial Parts

The use of 30% cow manure had the highest fresh and dry weights of aerial parts whereas control treatment produced the least (Table 7).The main reason for higher fresh weight in this treatment was microorganisms activity in the soil (Gryndler *et al*., 2008) which improved mineralization of nutrients and caused extended roots and higher water and nutrient absorption (Tinka *et al*., 2007) and finally increased the yield. Manures provide necessary macro and micro nutrients (Erkossa *et al*., 2002, Blaise *et al*., 2005). Result of Blaise *et al*. (2005) showed that absorption of nitrogen, phosphorus and potassium was significantly higher in manure containing substrates.

Number of Capsules per Plant

All studied treatments had significantly higher capsules than control (Table 8). The highest capsule number was observed in 30% cow manure treatment. The reason can be attributed to manure ability to supply macro and micro nutrients, improving photosynthesis, soil ventilation, and overall growth of plant. Using organic and manure fertilizers improve vegetative growth of plant and yield components by gradual releasing of nutrients which leads to increase of capsules numbers (Singh and Beisin. 1998, Yadav *et al*., 2003).

Number of Seeds per Plant

Mean comparison results (Table 8) showed significant differences between seeds number of treatments and control group. The highest seed number was observed in 30% cow manure treatment. Since using nitrogen affects biochemical reactions, photosynthesis, growth period, dry matter accumulation and yield components, its effect on the number of seeds is obvious (Lioyd *et al*. 1997). Seed production is the result of a set of physio-morphological processes

after flowering. Soil fertility due to using manures plays important role in yield components formation (Mohamed and Hussein. 1994).

1000- Seeds Weight

According to the results, all treatments had higher 1000- seeds weight than control group (Table 8). The highest weight was observed in 30% cow manure treatment. Considering that cow manure had the highest amount of nitrogen, it seems that nitrogen affects carbon dioxide assimilation and photosynthesis enzymes (Hasani *et al*., 2013). Better nutrition of plant and increase in available water caused by better physical properties of soil due to the consumption of organic fertilizers and manures increased plant growth, capsule number per plant, seed number per plant and finally 1000-seed weight.

CONCLUSION

On the whole, results of this study showed that application of organic matters and manures plays important role in improving quality and quantity of pursalne. Also, manures act as a main source of increasing soil fertility in sustainable agriculture systems. Considering the necessity of producing pharmaceutical plants in agricultural systems and also importance of cultivating these plants in low-input systems, using organic fertilizers and manures is an appropriate replacement for chemical fertilizers to produce healthy plants.

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