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Full Length Research Paper

Effect of different cultivation beds on the vegetative growth of *Polianthes tuberosa* L.

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***Polianthes tuberosa* L. is commercially grown as an ornamental and medicinal plant and as a source of secondary metabolites used in pharmaceutical and perfume industries. Experiments were conducted to study the effect of cultivation beds (sand, fine gravel, manure, perlite and clay) on leaf number, leaf length and days to germination. Results showed that the effect of cultivation beds on these traits were significant. Sand for days to germination and perlite for leaf number and leaf length were the best.**

Key words: *Polianthes tuberosa* L., planting bed, ornamental and medicinal plants.

INTRODUCTION

Tuberose, *Polianthes tuberosa* L. (Agavaceae) is an herbaceous perennial, commercially grown for its fragrant cut flowers and for the perfume industry (Edwards, 2006). Tuberose is native to Mexico and grown in tropical and semi-tropical regions. It is cultivated commercially by bulbs. Leaves are tubular and waxy-white in color and spikes have up to 45 cm long that produce clusters of fragrant waxy white flowers (Hutchinson et al., 2004; Wei-Ren et al., 2002). Tuberose can be successfully grown in a wide range of soils. Loam and sandy loam soil with proper pH, aeration and drainage is essential for better harvest. The soil should be rich in organic matter and retain sufficient moisture for proper growth, flowering and bulbs' yield. Also, maximum yield is obtained by the use of suitable portions of nitrogen, phosphorous and potassium. Researchers have studied to show immense potential of medicinal and ornamental plants used in various traditional systems (Dhanukar et al., 2000; Kaufman, 1999). Selection of bed type and its effect on vegetative and reproductive growth in tuberose are the main mental disturbance for procedures. Some experiments showed that there was a direct correlation between increasing of phosphorous and potassium in the bed and increasing in leaf length and plant height. Days to germination decreased by increasing of nitrogen and phosphorous, but the effect of potassium was positively significant (Amarjeet and Godara, 1995). Temperature has an important role in days to germination (De Hertogh and Le Nard, 1998; Ehlers et al., 2003; Paz et al., 2003). The purpose of this study was to evaluate the effect of sand, fine gravel, manure, perlite and clay beds on leaf number, leaf length and days to germination of *P. tuberosa* L.

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MATERIALS AND METHODS

The study was carried out in a research greenhouse located in Tabriz University, Iran. Bulbs of tuberose (*P. tuberosa* L.) were prepared from a creditable company in Mahallat, Iran. Used cultivation beds were sand, fine gravel, manure, perlite, clay and soil (control). Table 1 shows some physical and chemical properties of cultivation beds. Perlite, a gray-white silicaceous material, is of volcanic origin, mined from lava flows. The crude ore is crushed and screened, then heated in furnaces to about 760°C, at which temperature the small amount of moisture in the particles changes to steam, expanding the particles to small, sponge-like kernels that are very light, weighing only 5 to 8 lb per cubic foot. Usually, a particle size of 1.6 to 3 mm in diameter is used in horticultural applications (Hartmann et al., 1990). Perlite holds three to four times its weight of water. It is essentially neutral with a pH of 6 to 8 but with no buffering capacity, it has no cation exchange capacity and contains no mineral nutrients. Perlite is useful in increasing aeration in a mixture (Hartmann et al., 1990). Pots length and diameter were 35 and 25 cm, respectively. The time of uniform bulbs cultivation was at the end of April. Bulbs were planted in depth 1 cm. Irrigation was fulfilled similarly and uniformly, daily. Data were measured in the middle of May. Stages of the leaf production and enhancing leaf length were obtained by measurements of their proportions. Criterion for day's number until germination was first sign of emerges. The experiment was carried out in a completely randomized block design with 6 treatments and 6 replications (36 plots). In each plot, 5 pots and in each pot, 1 bulb

Table 1. Some physical and chemical properties of cultivation beds of *Polianthes tuberose* L.

Cultivation beds	Silt (%)	Sand (%)	Clay (%)	Mg (meq/L)	Ca (meq/L)	K (mg/L)	P (mg/L)	N (%)	OC (%)	EC (ds/m)	pH	Soil texture
Soil (control)	30	56	14	2.5	3.5	63.7	9.1	0.3	1.7	0.38	6.8	Loam clay
Sand	2	96	2	6.2	3.3	55	4.2	0.17	1.6	0.21	7.9	Sandy
Clay	17	36	47	-	-	84	7	0.03	0.7	0.59	6.3	Clay
Manure	-	-	-	0.81 (kg/ton)	0.97 (kg/ton)	3.64 (kg/ton)	1.62 (kg/ton)	5.67 (kg/ton)	-	2.8	6.5	-

Table 2. Effect of different cultivation beds on vegetative growth of *Polianthes tuberosa* L.

Treatment	Traits		
	Leaf number	Leaf length (cm)	Days to germination
Control	1.43^{b}	1.34^{bc}	27.00^{b}
Sand	1.43^{b}	1.17^{c}	20.50^{d}
Fine gravel	1.49^{b}	1.20^{bc}	22.00^{c}
Manure	1.39^{bc}	1.55^{ab}	32.00^{a}
Perlite	1.70^{a}	1.78^{a}	23.00^{c}
Clay	1.15^{c}	1.20^{bc}	28.00^{b}

In each column, means with the similar letters are not significantly different at 5% level of probability using Duncan's test.

(totally, 180 bulbs) were used. Data were subjected to analysis of variance (ANOVA) and the means compared using the Duncan's test and SPSS software package.

RESULTS AND DISCUSSION

The overall results of the leaf number, leaf length and days to germination are summarized in Table 2. The greatest and fewest numbers of leaves per plant (1.70 and 1.15) were observed in plants cultivated in perlite and clay, respectively (Table 2). Control plants had 1.43 leaves per plant (Table 2). Other treatments had no significant difference with control. Analysis of variance revealed that differences among different cultivation beds on the leaf number were significant ($p < 0.01$) (Table 3). Plants grown in perlite produced the longest leaves length (1.78 cm). Plants grown in other cultivation beds did not show significant difference with control (1.34 cm) (Table 2). Analysis of variance showed that differences among different cultivation beds on the leaf length were significant ($p < 0.01$) (Table 3). Seeds cultivated in sand and perlite germinated 7 and 4 days earlier than control, respectively (Table 2). Seeds cultivated in manure germinated 5 days later than control (Table 2). Analysis of variance indicated that differences among different cultivation beds on germination of tuberose bulbs were significant ($p < 0.01$) (Table 3). The number of leaves (1.39) and the length of leaves (1.55 cm) in plants grown in manure bed cultivation was more than those of clay (1.15 and 1.20 cm, respectively) (Table 2). Seeds cultivated in manure germinated 4 days later than those of cultivated in clay (Table 2). In fact, manure cultivation bed had the later time for seed germination among all treatments. The number of leaves (1.70) and the length of leaves (1.78 cm) in plants grown in perlite bed cultivation was more than those of sand (1.43 and 1.17 cm, respectively) (Table 2). Seeds cultivated in sand germinated 2.5 days earlier than those of cultivated in perlite (Table 2).

Light soils containing high sand warm faster than heavy soils and cause acceleration of the germination of bulbs in sand and fine gravel cultivation beds. The main reason for the significant increase of the number and length of leaves in perlite is that this cultivation bed absorbs water about 3 to 4 times more than its volume and includes enough pores for ejection of additional water, thus there is proper aeration (Hartmann et

Table 3. Analysis of variance (ANOVA) for the effect of different cultivation beds on vegetative growth of *Polianthes tuberosa* L.

Source of variation	df	M.S.		
		Leaf number	Leaf length	Days to germination
Treatments	5	0.303**	0.350**	125.361**
Error	30	0.046	0.079	1.983
Total	35			
c.v.		5.95	7.8	3.9

**: Significant at α = 1%.

al., 1990). Clay is able to retain water but is lack of enough aeration and proper drainage. These characters cause less growth and expansion of roots. Therefore, the number and lengths of leaves are decreased (Hartmann et al., 1990). The major reason for relative decreasing of the number and lengths of leaves in sand and fine gravel is that these cultivation beds are not able to retain water. *P. tuberosa* L. needs the light and moisture cultivation bed, however, lots of soil moisture causes bulb decomposition and drying of the bed decreases the quality of flowers. One reason for reducing the number and lengths of leaves in manure cultivation bed is high EC and negative potential (Hartmann et al., 1990).

Our results are in accordance with those obtained by Amarjeet and Godara (1995) and Mohamed (1994). Studies of these researchers on the effect of growing media and fertilizer on growth characteristics of *P. tuberosa* L. showed that a composted leaves medium or its mixture with sand increased leaf length and width values. The lowest value was obtained by using clay medium. These researchers also demonstrated that increasing rates of fertilizers increased number of leaves/plant of *P. tuberosa* L. El-Naggar and El-Nasharty (2009) indicated the superiority of using composted leaves medium for increasing of total fresh and dry weight/plant in *Hippeastrum vittatum*, herb. These results are similar with those obtained by Ali (1998) on *Lawsonia inermis*. Studies of El-Naggar and El-Nasharty (2009) on the effect of growing media (clay, composted leaves and sand + composted leaves) on growth of *H. vittatum*, herb revealed that the different growing media had significant effect on the most vegetative growth characteristics. Applying the complete fertilizer of nitrogen, phosphorus, and potassium grown in composted leaves medium or its mixture with sand, gave the maximum effect on the growth characteristics like leaf length and width. Contrary to our results, El-Naggar and El-Nasharty (2009) showed that there is no significant difference in the number of leaves/plant due to using the different growing media in plantation, while, fertilizer treatments significantly increased number of leaves/plant. Studies of Mahgoub et al. (2006) on response of Iris bulbs grown in sandy soil to nitrogen and potassium fertilization showed that the plant height, number of leaves as well as fresh and dry weight/leaves increased when bulbs were fertilized with suitable levels of nitrogen and potassium in sandy soil medium. These results may be due to the growth and production of plants affected by soil type and may be sandy soil is poor in nutrient content (Mahgoub et al., 2006). These findings are similar to studies of Ramesh et al. (2002) on *P. tuberosa* Linn cv. Single. In conclusion, the type of cultivation beds due to their different fertilizers and other factors are effective on growth characteristics.

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