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Effect of different media and sowing date on growth indexes of honesty plant (*Lunaria annua* L.)

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ABSTRACT

Honesty plant (Lunaria annua L.) is endemic to southeastern of Europe and west Asia that is sown as an ornamental plant in the most countries of Europe and North American. An experiment was accomplished to study the effect of some media and sowing date on the growth indexes of honesty plant. This trial carried out as split plot test based on complete randomized block design with tow factors and three replicates. Sowing date on three levels was including: a_1) 23rd September, a2)23rd October, a3)23rd November and Sowing beds was including: b_1) garden soil, b_2) "garden soil + perlite", b_3) garden soil + Azolla compost, b_4) "garden soil + tea wastes". Some growth parameters such as germination, length and width of leaf, height, number of leaf, time of flowering, time of ripening and time of fruit drying in this plant were measured. Results showed that the longest length of leaf was obtained under "soil + tea wastes" compound and the shortest length of leaf was obtained under "soil + perlite" medium. Interaction of sowing date and beds on the width of leaf showed that the widest leaf was produced under sowing "October × soil + tea wastes" and the lowest width was produced in "September sowing × soil + perlite". Also the highest plant and the maximum leaf number were obtained under "soil + tea wastes" medium in September sowing treatment.

Keywords: money plant, planting beds, inflorescence, fruits

INTRODUCTION

Honesty Plant (*Lunaria annua* L.) belongs to Cruciferea. This biannual plant is a 0.9 meter height and grows throughout Europe and North America and it is sometimes cultivated as ornamental plant. This plant was introduced several centuries ago from east of Europe to north of Europe [26].Lunaria grows without any petioles and having toothed leaves and odorless flowers, this plant flowers in spring (April to June) [8, 23]. In addition to its beauty, this plant produces beautiful violet and white flowers and can be used at home as the ornamental plants for several years after full growth of fruits (coins) and harvesting the fruit inflorescence, Walker et al [27]announced that the best cultivation date for this plant in Scotland conditions is late May up to mid-June and the best time for harvesting is late August to September. The effect of the cultivation date on growth of Honesty Plant has been assessed in south of England and it has been reported that 30 to 40 percents of the cultivated seeds have grown to the complete plants [3].

The commercial production of the ornamental plants is a world business. Their economical value has significantly increased in the past two decades and there is much potential for continuous flower culture in future either in local markets or in international ones. The Netherlands excels in exports of ornamental plants including potted plants such as Begonia, Ficus, Cyclamen, Philodendron, Saintpaulia, Spathiphyllum and Rhododendron [24]. Iran has just commenced serious investment to produce ornamental plants. The main investment was done by private sector and the government just participates indirectly in producing lawns, flowers, shrubs and the ornamentals. It may be said that only 5 percents of the production is performed by the public section and the rest (95 percents) by the private sector [14].One of the objectives of the developing countries is to achieve the stable economical growth. Flowers and the ornamentals are of the products attainable in many parts of Iran and enjoy high capability on foreign currency earning and can be placed as one of the main non-oil goods in country exports. During the recent decades, the development world trade of ornamental plants caused to propel the advanced countries to perform specialized researches in the field of these products [5].The selection of the cultivation bed is an important and effective factor on the quality of seedling [12].The first criterion for a commercial cultivation bed is optimal growth of the plants and the continuous accessibility in an economic manner. Commercial cultivation bed should reserve water with suitable drainage and preparing appropriate placement of roots, should be devoid of toxic materials, pests and diseases [10].The producers need cultivated bed which is permanent and stable, accessible, easily usable and reasonable in cost. The optimal physical and chemical features of the cultivation beds and their compounds are among the features that are of main concern. The main physical features are the total percent of porosities, the capacity of water reservation, the percentage of air porosities, volume density, distribution and the particle size. The main chemical features include pH, concentration of soluble salt and the cation exchange capacity [9].

The cultivation bed should be penetrable and have adequate strength and stability to hold the plant firmly [4].Numbiar and Fife [20] and Oliet et al [21] reported that by optimizing the physical conditions of soil, the bed of seed will cause an increase in the seed germination, the growth of the root and seedling growth. Faraz et al [6]and Brito et al [2] found that adding organic materials of soil makes improvement of properties on germination percent, daily mean germination and germination rate. Kazemi[16] reported that the most amount of vegetative and generative growth of the ornamental pepper was acquired in the beds containing 25, 50 and 100 percent of tea waste compost.

Griffin [9] reported that perlitee does not have any effect on the chemicalfeatures of the bed. Despite many organic compounds, perlitee will not decompose. Based on Khalighi et al [17]research, Azolla compost caused to produce the most number of leaves in *Beaucarnea* and the Coco-peat beds had the least ones. The most amount of the leaf length was reported in Azolla compost 50% + Perlitee 50%, while the least amount was reported in the beds of Coco- Peat 50% + Perlitee 50%. The aim of this research was comparison of different growth beds and planting date on the vegetative indexes of honesty plant in Guilan province (northern part of Iran).

MATERIALS AND METHODS

In order to assess the effect of the cultivation dates and various cultivation beds on Honesty plants, an experiment was performed in the form of split plot based on complete block design with two factors and in three replications. The experimental factors included dates of cultivation (3 levels) and cultivation beds (4 levels) are described below: Cultivation date (A) in three levels includes: a_1= September 10, a_2= October 11 and a_3= November 10.

Cultivation beds (B) in four levels includes: b_1= garden soil (control), b_2= garden soil + Perlitee (1:1), b_3= garden soil + Azolla-compost (1:1), b_4= garden soil + tea waste (1:1)

Table 1: The specific particle density and apparent specific density of experimental beds

Treatment	Bulk density (g/cm^3)	Particle density (g/cm^3)
soil garden	1.01	2.22
soil garden + Perlitee	*0.63*	*1.35*
soil garden + Azolla-compost	0.98	2.12
soil garden + tea wastes	*0.79*	*2.05*

Measurements of Plant Growth Indexes

Measuring the length, width and number of leaves and height of plant was performed every 15 days. The time of germination, time of ripping and drying of fruit were also been registered; the size and number of the fruits measured. In addition to the features related to the experimental plant, the specific particle density and apparent specific density of trial beds was measured (table 1).

The data analysis of variance was performed by the MSTATC Software and the test of comparison on data mean was carried out based on Tukey test.

RESULTS AND DISCUSSION

The table of analysis variance shows the effect of experimental factors on the growth indexes such as the length of Honesty plant leaf was significant ($p<0.05$). In addition, the effect of cultivation bed and the interaction of these two factors have also significantly caused a change on the leaf length (table 2).

Table 2: Analysis variance of the effect of experimental factors on the growth parameters of Honesty plant

Source	df	Square mean			
		Length of leaf (cm)	Width of Leaf (cm)	Height of Plant (cm)	Number of Leaves
Replication	2	7.3 ^{ns}	6.71 ^{ns}	96.34 ^{ns}	17.003 ^{ns}
Cultivation Date (A)	2	23.97*	40.96*	1760.75**	474.85**
Error	4	4.39	3.50	29.28	3.48
Cultivation Bed (B)	3	6.29*	5.65*	296.67*	40.39*
AB	6	5.55*	6.23*	197.30*	32.75*
Total Error	18	1.87	1.47	75.49	11.80
CV (%)	-	15.26	13.96	29.34	23.71

**, * and ^{ns}: Respectively significant in the surface of 1%, 5% and non-significant.

Analysis variance of the data shows that the effect of the cultivation date has been significant on the leaf width in the level of 5 percent. Whereas, the effect of cultivation bed did not show the significant effect on the leaf width only in primary stages after cultivation (40 days) and in other cases up to the end of the experiment, it caused significant difference in the size of the leaf width. It is worth to mention that the interaction of "cultivation date × cultivation bed" has had a significant effect on the leaf width (table 2). The analysis variance of data shows that the effect of cultivation date on the plant height has statistically been significant in the whole experiment period (after commencement of the new season of growth), whereas the effect of cultivation bed and the interaction of experimental factors have been significant in the stage of active growth of the plant (spring). Based on results (table 2), the effect of date and cultivation bed in the whole stage of measurements has had a significant effect on the number of the leaves. Whereas the interaction of cultivation "date × bed" in the primary stages of measurements, has not been significant effect on the number of the experimented plants leaves. This property (number of leaves) shows the significant difference under the interaction of experimental factors after commencement of the new growth season.

Mir-Shekari and Mobasher[19] have reported that the cultivation date and the bulb size of the *Allium cepa* have significant effect on the performance of the seed and the height of the stem. Faraji[7] has concluded similar results based on the effect of cultivation date on the height of rapeseed and has announced that the early cultivation of rapeseed improves the plant height more than any other cultivation dates. These results are in conformity with the acquired results at this experiment.

Table 3: The Comparison of the data mean related to the effect of the cultivation date on growth indexes of Honesty plant

Treatment	Mean of traits			
Cultivation date	Length of Leaf (cm)	Width of Leaf (cm)	Height (cm)	Number of Leaves
September10	7.35 b	6.57 b	43.58 a	19.64 a
October 11	9.67 a	9.57 a	21.88 b	13.39 b
November10	9.91 a	9.94 a	23.40 b	10.06c

Means in a column followed by the same letter are not significantly different at $p\leq 0.05$.

By commencement of the new growth season, the leaves of cultivated plants in the months of October and November increased their growth, and in the last measurement, the length of the leaves of these plants was more than the length of the leaves cultivated in the month of September. It seems that one of the reasons for this increase in leave length in the late cultivated plants is their lack of generative growth (table 3). Based on the comparison of the related data mean, the average leaf width has changed after commencement of the new growth in the month of March and the most leaf width concerns the months of October or November, while the least is related to the month of September and also in the last measurement, the least leaf width (6.57 cm) referred to the month of September and the most leaf width (9.94 cm) to the month of November. The comparison of the data mean related to the effect of the experimental factors on the height of Honesty plants shows that the plants cultivated in the month of September have grown to their maximum amount of height, i.e., 43.58 cm, and they have constituted the most height to themselves. The most number of the acquired leaves in each 4 sampling (measurement) stages is concerned to the cultivation date in the September and the least to the cultivation date in the November.

These results show the increased number of leaves on the September cultivated. In an assessment on the effect of the cultivation date on growth indexes of sugar beet in autumn cultivation, Javaheri et al [13] found that the first cultivation date causes the most leaf area index, and the leaf area ratio in the first cultivation date (Aug. 31) has been more than the other two cultivation dates (Sept. 22 and Oct. 11), but this process has reversed in the end of the growth season, and considering the leaf size, these results are in conformity with the results acquired by our experiment. During the experiment period, average number of the leaves on each plant has increased more than twice and the maximum number of the leaves (19.6 leaves) has been acquired in the cultivation date of September. 120 days after cultivation, the acquired results were as follows:

The most length of the leaves was obtained under "soil + tea wastes" treatment (with 6.36 cm) and the least length of leaves related to "soil + perlite" medium (with 4.38 cm). Kazemi[16] in an experiment on ornamental pepperfound that the most number and size of the leaves are related to the bed of "soil 50% + compost of tea wastes 50%".

Table 4: Comparison of Data Mean Related to the Effect of Cultivation Beds on Growth Indexes of Honesty plant

Treatments	Mean of traits			
	Length of Leaf (cm)	Width of Leaf (cm)	Height (cm)	Number of Leaves
Soil	9.87a	9.73 a	29.26 a	12.11 b
Soil+ Perlite	8.62 ab	8.06 ab	24.35 b	13.44 b
Soil+ Azolla	7.99 b	7.92 b	27.18ab	15.56 ab
Soil+ tea wastes	9.42 ab	8.86 ab	37.69 a	16.85 a

Means in a column followed by the same letter are not significantly different at p≤0.05.

Table 5. The mean comparison of "cultivation date and bed "on the traits of Honesty plant

Treatments	Length of Leaf (cm)	Width of Leaf (cm)	Height (cm)	Number of Leaves
Sept. ×soil	7.67 ab	9.73 ab	42 ab	15.44 bc
Sept. × soil + Perlite	8.26 ab	8.26 ab	34.50 b	20 abc
Sept. × soil + ́Azolla	b 4.47	7.92 ab	33.20 b	22.33 ab
Sept. × soil + tea wastes	9 a	8.86 ab	64.61 a	29.22 a
Oct. × soil	10.98 a	0.40 d	19.78 b	10.11 c
Oct. × soil + Perlite	8.26 ab	7.12 bc	17.61 b	10.33 c
Oct. × soil + ́Azolla	9.56 a	3.71 cd	25.44b	13.22 bc
Oct. × soil + tea wastes	9.88 a	8.25 ab	24.67 b	10.67 c
Nov. × Soil	10.97 a	11.13 a	b 26 b	10.78 c
Nov. × soil + Perlite	9.35 a	8.48 ab	20.94 b	10 c
Nov. × soil + ́Azolla	9.94 a	9.38 ab	22.89 b	11.11 c
Nov. × soil + tea wastes	9.38 a	9.28 ab	23.78 b	10.67 c

Means in a column followed by the same letter are not significantly different at p≤0.05.

On the basis of Masterbroek and Marvin [18] research, the delay on cultivation of *Lunaria* plant will delay the floral initiation and harvesting time, so that in the last date of cultivation, a few plants succeed to flower. These results are in conformity with the acquired results at this experiment. Based on our results almost in the most times of measurements, the soil bed has had a considerable priority on the other beds, although the combination of "soil+ tea waste" causes to acquire the most plant height and number of the leaves. On the basis of the data mean in the primary stages of growth, soil mixed with the organic material, i.e. Azolla or tea waste caused to increased leaf width. Whereas, at the end (in the last measurement before flowering), the soil, has been the best bed for growing of leaf width, but it does not statistically show significant difference with combination of "soil + tea wastes". The comparison of interact mean of the experimental factors (table 5) on the leaf length showed that the most leaf length was produced under cultivation of this plant, in the "garden soil" in the October with length of 10.98 cm. Whereas the least leaf length has acquired under treatment with "Azolla + soil x the month of Sept. cultivation; although the most leaf length has statistically acquired under the most experimented soil compounds, i.e. the interaction of the most treatment has not statistically had significant difference from each other.

The comparison of interaction mean of experimental factors on leaf width of Honesty plant (table 5) shows that after 120 days of cultivation, the most leaf width of this plant has acquired under "tea wastes + soil × Oct. planting date" with 9.36 cm; whereas the least width of leaf on this plant with 3.62 cm is related to cultivation of "Azolla + soil x the month Nov.".

Comparison of interaction mean of experimental factors on height of Honesty plant showed that the most height has been acquired in plants that have been cultivated in "soil + tea wastes" bed in the October; whereas the least height has been related to the cultivation in the Sept. or Oct. and in bed of "soil + perlite" (13.67 cm). Also, May sampling, the most height has been related to cultivation of plant in the Sept. and bed of "soil + tea wastes" with 64.61 cm and the least height related to cultivation Oct. and bed of "soil + perlite" with 17.61 cm. Assessment of effects of beds on height shows that "soil + tea wastes" compounds was the best. Whereas, the comparison of interaction mean on cultivation date and the bed shows that soil bed + tea wastes cause the most height in the early new season of growth and finally the same soil compound has caused the most height in cultivation date of September.Shadanpour et al [25] found that application of organic media such as vermicompost increased significantly shoot size and weight in Marigold.

The comparison of interaction mean of experimental factors on the number of leaves (table 5) shows that the most number of leaves of this plant is acquired under cultivation in the month Sept. and the bed of "soil + tea waste"; whereas, the least number of the leaves was obtained under plants cultivated in the month Nov. in the bed of "soil + Azolla" or in the bed of "soil + perlite".

Assessment of the growth indexes such as leaf size, plant height and number of leaves showed that the cultivation date has had a significant effect on all of the above-mentioned features. Before commencement of the new growth season, mostly the size of the plant leaves which were cultivated in the months Sept. or Oct. are more than the size of the plant leaves cultivated in the Nov. But by commencement of the new growth season, the size of the plant leaves cultivated in the month Nov. has increased and in the month May and late of the growth season (before flowering) the biggest size of leaves have been related to the plants which were cultivated in the Nov. Ahmad et al. [1] and Koet al[15] found that earlier planting produced the well developed plants of gladiolus.

Cromack[3] stated that the condition of winter "vernalization" of Lunaria plant is prepared for cultivation dates of the months of June and July. But it is incomplete for cultivation date of September and will not remove the chilling requirement for plants and the yield of plants which have been cultivated late, will significantly be less than other plants (early cultivated plants). It seems that lack of flowering of most trial plants is because of being incompleteness of their chilling period.

Hashemabadi and Sedaghathoor[11] announced that the delay in cultivation of Mazandarian broad bean can cause reduction on number of nodes, plant height, percent of dry matter of seeds and number of branches, so that the early cultivation date has caused the noticeable increasing of the above-mentioned features in comparison with the late cultivation date.

PasbanEslam[22] reported that by delaying the cultivation day of fall rapeseed, fromSept. 10 to Sept. 30, the crown diameter, number of the leaves per plant and the percent of chilled plants will significantly increase. He announced that delay in cultivation, the yield of seed and oil will significantly be less. His results on the effect of cultivation date on the number of leaves are in conformity with the results of this experiment. The comparison of the effect on the data mean of cultivation bed on the number of the leaves (table 5) showed that the most number of leaves have acquired in various stages of measurement in plants which were cultivated in bed of "soil + tea wastes", whereas the least number of leaves have been related to the plants which cultivated in "soil" or in "soil + Perlite" beds. Therefore, the same as the plant height, soil bed together with tea waste has had the best results in leaf number. So, on the basis of this experiment, to cultivate Honesty Plant in Guilan conditions, it is recommended the beds with garden soil mixed with organic materials such as tea wastes and cultivation date in the month Sept. or before September. It is recommended to assess other cultivation dates such as cultivation of this plant from the middle of summer afterward. Based on the results of this experiment, *Lunaria* is mainly bush and grows without branches and the leaves of the bed surface are larger than the upper leaves. The inflorescence type of this plant is simple cluster with about 63 florets and in purple and white colors and the fruit type of this plant is silique and it is estimated that the growth period of this plant is 220 days in Guilan conditions (as from cultivation to fruiting). Number of the flowering stalk is one and the germination period of this seeds is about 3 weeks and the number of fruits per plant is about 43. Numbers of seed per fruit are 2 to 8 and the weight of 1000 seeds is about 10 grams.

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