Comparing Germination percentage in Hydroponic System

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Abstract: To investigate the effect of the type of germination medium on germination of three species, namely Ammodendron, Milk Thistle and Silybummarianus, a factorial experiment with a completely randomized design with three replications was conducted. The studied factors were plant type, hydroponic culture, hydroponic culture with nutrition by Liquid fertilizer phosphorus and potassium, and soil culture. Daily germination speed and amount data was collected in 11 days. The studied indices germination percentage in three species. Results showed that the highest germination percentage was observed in Silybummarianus. Among the studied treatments, the best medium was hydroponic culture with fertilizer and there was a significant difference between this medium and the other media at p=.05. This type of medium performs better than soil medium in providing nutrition for the plant and is recommended for cultures with a better performance.
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1. Introduction

Qualitative and quantitative restriction of soil and water resources is considered as a fundamental pasture production bed. A high percentage of arable land in Iran faces with problems of salinity, sodium and water logging, to varying degrees. Considering these, it seems necessary to adopt new policies and provide more favorable conditions for the plant's nutrient. Hydroponic cultivation is an advanced form of planting the crops that makes special controls on distribution of nutrients to plants possible (calpas, 2001). According to many researchers, hydroponic substrate must be drained easily, have adequate ventilated power, have a good water holding capacity, be free of weed seeds and other harmful substances, and be affordable in a low price (Khoshgoftar at al., 2007, Allaire et al., 2004). In Hydroponics, despite the need for sufficient expertise and a relatively high initial capital compared to soil cultivation, many advantages such as high performance, low labor requirement, easy working, no need to complying with crop rotation, weed control, uniformity of plant growth, minimal water loss, lack of plants' competition for water and nutrients, possibility to supply nutrients tailored to the needs of plants and less use of chemicals and consequently the availability of more healthy agricultural products can be seen (Miceli et al., 2003; Takeda, 2000; Jaenaksorn & Ikda, 2004). Due to the above reasons and the point that in hydroponic systems, influential factors in nutritional production and substrate temperature can be better controlled, an increasingly tendency to convert soil units into hydroponic ones has been created and hydroponic units are added every day in Iran (Delshad, 2005, Allaire et al., 2004). So far, few studies have been conducted on the comparison of hydroponic germination with other planting methods. Among these, Kazemi's (2013) study can be mentioned wherein water use efficiency in Agropyroncristatum in early stages of growth in a hydroponic medium was evaluated and it was concluded that there was a significant difference between dry matter and water use efficiency. Roosta et al. (2013) compared vegetative growth and microtuber yield in three varieties of potato in air-culture and hydroponic systems and concluded that wet weight of root and aerial organs and potato plant height in air-culture system are significantly more than their counterparts in hydroponic system.

2. Materials and methods

This study was conducted in the greenhouse of Yazd University, Faculty of Natural Resources in 2014. To this aim, seeds of Ammodendron, Milk Thistle and Silybum marianus were prepared. The pot experiment was carried out in greenhouse of Yazd University with a factorial experiment, using a completely randomized design with three replications. The three factors were hydroponic culture, hydroponic culture with nutrition by Liquid fertilizer phosphorus and potassium, and culture in the soil medium with a loamy context, respectively. Finally, some traits such as Final Emergence Percentage (FEP), Mean Daily Germination (MDG), Germination Speed (S), Germination Index (GI), E10 (the time it takes for germination to reach 10% of its maximum rate), E50

(the time it takes for germination to reach 50% of its maximum rate), E90 (the time it takes for germination to reach 90% of its maximum rate) and finally Uniformity Index (UI) were measured.

FEP was calculated using the following formula (Mahmoud & Uthman, 2014):

$$FEP = (^{Ni}/_{N}) \times 100 \qquad (1)$$

Where FEP is germination percentage, Ni, the number of germinated seeds in the last counting day, and N, the total number of planted seeds.

MDG which is a measure of daily germination speed was calculated from the following formula (Scott et al., 1984):

$$MDG = \frac{FEP}{d} \qquad (2)$$

In this relation, FGP is final germination percentage, and d, the number of days it takes for reaching final maximum germination (length of the experimental period).

To calculate FGP, equation (3) was used in which germination speed is:

$$AVI = \frac{\sum Nt}{\sum t} \qquad (3)$$

Wherein AVI is emergence speed of seeds (per day), $\sum Nt$, the total number of germinated seeds at t, and $\sum t$, total time (days).

In fact, AVI is moment speeds of seeds emergence which is an appropriate criterion for germination speed (Bonkar & Ranjbar, 2013).

Germination index was calculated by the following formula (Scott et al., 1984):

$$GI = \frac{\sum T_i N_i}{S} \qquad (4)$$

Wherein Ti is counting time (days) after planting, Ni, the number of germinated seeds on each count (days), and N, total planted seeds.

Uniformity Index (UI) is the time it takes for germination to reach from 10% of its maximum amount to 90% of its maximum. The shorter UIs show a more uniform (simultaneous) emergence (Egli et al., 2010).

UI=E90-E10 (5)

Because the assumptions of normality and equality of variances were met, the collected data were analyzed using two-way ANOVA. Means of treatments were compared using Duncan's test and corresponding graphs were plotted using Excel software. All the statistical analyses were done using SPSS 16 (Shojaei et al. 2016).

3. Results

ANOVA results showed a significant difference between the accessions (table 1), in the case of germination percentage (p <./ 01). ANOVA indicated a significant difference between the growth rate of three plant species in three different media (hydroponic culture with fertilizer, hydroponic culture without fertilizer and soil with fertilizer) (Shojaei et al. 2016).

Mean comparison using Duncan test showed that the highest plant growth in terms of germination was related to hydroponic culture (with or without fertilizer) (table 2).

Accession of germination percentage had shown the highest growth efficiency in hydroponic culture, respectively. The highest and lowest germination percentage rates were observed in the three plant species, Ammodendron, Milk Thistle and Silybum marianus, and it just depended on their media (figure 1).

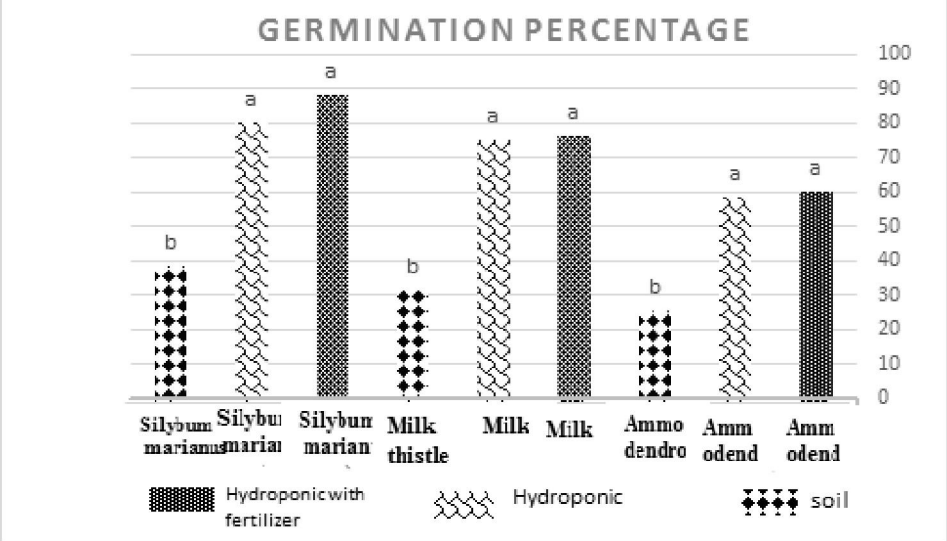

Figure 1. Comparison of germination percentage in 3 species in different experimental media

Table 1. The mean squares from analysis of variance of the studied traits

Germination percentage	DF	Sources of changes
*333/1732	2	Treatment

*- significance at.01 level

Table 2. Comparing the means of the experimented accessions in terms of the studied traits

Germination percentage	Medium	Row
a6667/74	Hydroponic with fertilizer	1
a71	Hydroponic	2
b3333/31	Soil	3

Based on Duncan's multiple range test (5%), there is no statistically significant difference between the average treatments with the same letters.

4. Discussion

According to the experiment, it was concluded that hydroponic systems are more efficient and cheaper relative to soil and fertilizing system, in increasing the efficiency of growth of different parts of plants. Hydroponic system (with or without fertilizer), is of best effectiveness in germination compared to soil culture with variety of physical and chemical soil-borne diseases. Ammodendron was the best species for planting in this system. Results of the present study are consistent with the results of Muro et al. (1997) and Ritter et al. (2001). According to the findings of the present study, it can be recommended that the system be used in the cultivation of some range plants in conducting the projects, however, further studies, except for the economic sector, should be done in other parts of the cultivation of range plants.

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