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Effect of fertilizer application and irrigation on germination of Jimson weed (*Datura stramonium* L.) as a medicinal plant

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Abstract

An experiment was conducted in order to evaluate the effect of 3 and 6 ton/ha vermicompost and 150 and 300 kg/ha nitrogen on seed germination of Datura stramonium L. at Shiraz University in 2012. Nutrition of maternal plants with six tons per hectare vermicompost caused the highest seed dormancy and lowest germination rate and seed vigor. In contrast, the highest germination rate and seed vigor was obtained in the maternal plant nutrition with 300 kg per hectare nitrogen. Place the seeds on maternal plants had a significant effect on seeds germination. So that the middle and lower seeds on the maternal plant had less germination rate and seedling vigor than those in upper part of the plant. Six tons vermicompost per hectare decreased the emergence percentage in seeds of this weed through increasing of dormancy in produced seeds.

Keywords: Emergence, vermicompost, dormancy, nitrogen, drought.

INTRODUCTION

Datura stramonium, known as Jimson weed or Datura, is belongs to Solanaceae family and mostly grow as a weed in tropical regions [2]. *Datura stramonium* is a plant having various medicinal and pharmacological properties. Phytochemical of the plant are alkaloids, atropine, scopolamine, tannin, saponine, glycosides, phenol, sterols, lignins, fats, carbohydrates and proteins [1]. Traditionally leaves past and extracts are externally used for injuries, wounds, bleeding and pain. Juice of flower petals is used in ear pain and seeds are used as purgative, in cough, fever and asthma [3].

Datura stramonium has both toxics and medicinal properties. Jimson weed is used in skin disorder, ear pain, cough, fever and asthma. Leaves extract are externally used for injuries, wounds bleeding and pains. Juice of fruit is applied to scalp for falling hair and as antidandruff. Jimson weed contains biologically active substances such as alkaloids, atropine, scopolamine, tannin, carbohydrate and proteins. It is used in many drugs due to its analgesic and antiasthmatic activities.

Seeds of this plant have a seed dormancy that they cannot germinate in appropriate condition despite having high seed viability [12]. Seed dormancy is a natural adaptation to the environmental conditions which causes the appearance of plants in various time intervals and thus have more chance of being alive [11].

Seed size and its position on maternal plant is an important factor in germination and seedling vigor of the seeds. Environmental factors such as temperature, daytime, maternal plant height and time of ripening seeds on maternal plant have an important role in the survival of weed seeds [13].

Although application of chemical fertilizers can increase crop yields, but if used improperly, it can be unintentionally useful for weeds more than crops. Consumption of fertilizers can change the competitive abilities of weeds and crops, as the better response of weeds to nitrogen, leading to increase their interference and the competitive abilities against crop [5].

This study was conducted to assessment the effect of fertilizers and irrigation interval on germination of *Datura stramonium*

MATERIALS AND METHODS

This experiment performed as completely randomized block design (CRBD) with 4 replications at Agricultural Research Station of Shiraz University in 2012. The seeds of *Datura stramonium* weed were collected from the farm Agricultural Research Station of Shiraz University.

Five experimental treatments were applied for seed dormancy, germination rate and seed vigor index of jimson, included: control (without fertilization), 3 and 6 t/ha vermicompost and 150 and 300 kg/ha nitrogen. The irrigation was performed as furrow, and each block had a separate drainage channel. Also, six experimental treatments were applied for emergence percentage, shoot length, fresh weight of root, fresh weight of shoot and dry weight of shoot in jimson, included three fertilizer treatment (control (without fertilization), 6 t/ha vermicompost and 300 kg/ha nitrogen) and three irrigation intervals (4, 7 and 14 days).

Then, the seeds in each treatment were planted in five kg pots and irrigated regularly. Emergence percentage was calculated by dividing the number of emerged seedlings by the total seeds sown.

Data were analyzed using the analysis of variance (ANOVA), General Linear Model (GLM) procedure. Means comparison tests were performed with Least Significant Difference (LSD). All statistical analyses were performed using SAS software.

RESULTS AND DISCUSSION

Seed dormancy and germination tests

As shown in Table 1, significant differences were observed between the fertilizer treatments for seed dormancy, so that the highest seed dormancy in six tons per hectare vermicompost (47.9 percent), followed by control (37.6 percent). While the least seed dormancy was obtained in the 300 kg/ha nitrogen that were significantly different with the other fertilizer treatments. Jacobs and Lesmeister (2012) revealed that germination and plant growth of *Erodium cicutarium* strongly affected by nutrition of maternal plant using fertilizer, as the application of fertilizers decreased seed dormancy and increased seed germination compared to the control (without fertilizer).

Table 1. Effects of nitrogen fertilizer and vermicompost on seed dormancy, germination rate and seed vigor index of jimson.

Fertilizer	Seed dormancy	Germination rate	Seed vigor index
Control	35.6 b	11.5 c	701.8 d
3 t/ha vermicompost	31.3b c	13.7 c	896.2 c
6 t/ha vermicompost	47.9 a	5.6 d	655.5 e
150 kg/ha nitrogen	29.9 c	19.6 b	1016.5 b
300 kg/ha nitrogen	21.6 d	28.6 a	1136.8 a

Means with same letter within a column are not significantly different at the 1 % probability level according to LSD test.

Germination rate also significantly affected by the type and amount of fertilizer. The highest germination rate observed in the 300 follow by 150 kg/ha nitrogen which were significant differences with each other. Germination rate in three tons per hectare vermicompost was not significant different from control, but in the six tons per hectare vermicompost was significantly lower that all of the other treatments. Hejcman *et al.* [5] demonstrated that rapid seed germination in sorrel need proper nutrition and a balanced amount of nitrogen, phosphorus and potassium.

They also revealed that providing much nitrogen to maternal plant, cannot compensate deficiencies lack of phosphorus and potassium to maternal plant and seed germination can be reduced in this condition.

The most significant differences between treatments was related to seed vigor index, so that all the treatments were significantly different from each other. The highest seed vigor index was observed in 300 follow by 150 kg per hectare nitrogen. Then, three tons per hectare vermicompost and control had the highest seed vigor index, respectively. The lowest seed vigor index was observed in six t/ha vermicompost (Table 1). Hejcman *et al.* [5] found that the supply of nitrogen, potassium and phosphorus for maternal plant increase seed germination in sorrel. Seed vigor index indirectly reflects the lifetime of seed. Thus, according to the results of this study, seed lifetime significantly increased in 300 kg/ha nitrogen and decreased in significantly six t/ha vermicompost.

The effects of irrigation intervals on Jimson

Seedling emergence of jimson was varied between different fertilizer treatments, so that the highest seedling emergence was obtained in the control that was not significantly difference from 300 kg/ha nitrogen. Also, the lowest seedling emergence was observed in vermicompost fertilizer. Increasing irrigation interval had a negative effect on seedling emergence of *Datura stramonium*, so that emergence decreased by reducing the irrigation intervals. Although with increasing irrigation interval of 4 to 7 days, there was no significant decrease in the percentage of seedling emergence in *Datura stramonium*, while increasing the irrigation interval to 14 days led to a significant decrease in the seedling emergence (Table 2). Also, Neilson and Nelson [10] reported that the seedling emergence reduced with increasing water stress.

Table 2. Effects of fertilizer and irrigation on emergence percentage, shoot length, fresh weight of root, fresh weight of shoot and dry weight of shoot in jimson.

	Seedling emergence (%)	shoot length (cm)	fresh weight of root (g)	fresh weight of shoot (g)	dry weight of shoot (g)
Fertilizer					
Control	11.41a	8.49a	1.43a	19.66a	1.44a
6 t/ha vermicompost	8.91b	4.78b	1.24a	10.93b	1.12b
300 kg/ha nitrogen	11.25a	7.78a	1.24a	18.02a	1.40a
Irrigation					
4 days	12.25a	7.67a	1.44a	21.92a	1.52a
7 days	11.91a	7.21a	1.17ab	15.86b	1.34a
14 days	7.41b	6.05b	1.10b	9.03c	0.80b

Means with same letter within a column are not significantly different at the 1 % probability level according to LSD test.

Control and 300 kg/ha nitrogen did not have significantly different in shoot length, but significantly had longer shoots than 6 t/ha vermicompost. Although shoot length decreased with increasing irrigation interval, but there was no significant difference between 4 and 7 days.

Irrigation with 14 days interval, significantly reduced the *Datura stramonium* shoot length (Table 2). Applying water stress, especially during critical stages of development such as shoot elongation stage, reduces plant height and therefore decreased production and storage of photosynthetic materials. These results is consistent with studies done by Nabati [8] and who demonstrated that decrease in irrigation and applying water stress at different growth stages, decreased the plant height. In many plants, water deficit caused a delay in the stem elongation, which reduced the stem segments and a decrease in the size of the plant [8].

The highest and lowest fresh weight of root were obtained in 4 and 14 days irrigation treatments, respectively, which were significantly different. Fresh weight of roots in irrigation regime with 7 days interval had no significant difference with 4 and 14 days (Table 2).

Shoot fresh weight was significantly affected by fertilizer and irrigation regimes. Significant differences not observed between shoot fresh weights of control plants and fed with fertilizer at the rate of 300 kg nitrogen per hectare. While the shoot fresh weight in vermicompost was significantly less than the two treatments (Table 2). The greatest differences between the regimes of irrigation were observed in shoot fresh weight, as all three irrigation regimes were different significantly. The highest and lowest fresh weight of shoot were obtained in 4 and 14 days irrigation treatments, respectively (Table 2). Increasing plant growth in reduced irrigation intervals can be due to better vegetative growth, canopy development and thus better using of solar radiation and higher photosynthesis [7].

Shoot dry weight was reduced by drought stress, so that increasing irrigation interval from 4 to 14 days decreased shoot dry weight of Jimson (47.3 percent). There was no significant differences between 4 and 7 days irrigation intervals. Lebaschi reported that mild drought stress (- 0.3 bar) and severe drought stress (- 0.15 bar) reduced the growth of *Hypericum perforatum*. Ganpat *et al*. [4] studied the reaction of *Plantago ovate* to the number of irrigation and concluded that increasing the number of irrigation up to 4 and 5 times increased seed yield and plant residues, respectively.

In general, the highest seed dormancy, lowest seed germination and vigor index observed in 6 tons per hectare vermicompost. While the highest seed germination, germination rate and seed vigor was obtained in the 300 kg/ha nitrogen fertilizer.

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