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Study of germination and seedling characteristics of castor bean (*Ricinus communis* L.) mother plant's seeds under foliar spray of micronutrient

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ABSTRACT

In order to study the germination and seedling characteristics of castor bean mother plant's seeds under foliar spray of micronutrient, two separated field and pot experiments were conducted during 2010 growing season. At first for foliar spray of micronutrient on castor mother plant, an experiment was conducted at the Agricultural Research Station in Urmia, Iran.Then for study germination and seedling characteristics of castor bean mother plant's seeds, a pot experiment. Both experiments were arranged as factorial on the basis of randomized complete block design (RCBD) with three replications. Treatments were time of foliar application of micronutrients on castor bean mother plant (T_1= flowering stage of first raceme, T_2= flowering stage of first raceme + flowering stage of secondary racemes, T_3= flowering stage of first raceme + flowering stage of secondary racemes + grain filling of secondary racemes, and T_4= control (without foliar application) and type of obtained grain. The plant characteristics were studied in terms of such as, radicle length, 100 seeds weight and radicle dry weight. Results of the data review showed that, the time of foliar application on castor bean mother planthad significant effect on plumule length, seedling fresh weight and 100 seeds weight. The highest 100 seeds weight (27.68 g) was obtained for T_3. Also, the effects of type of grain had significant effect on all characteristics except radicle length. But interaction of two factors had not significant effect on characteristics. It seems that for improve germination and produce stronger seedlings, suitable time of foliar application is T_3 on produced seeds from the first raceme.

Key words: Castor bean (*Ricinus communis* L.), foliar application, micronutrient, seedling.

INTRODUCTION

During the recent decades, medicinal plants gained a substantial importance in agricultural production, pharmacy and exportation because of their use as a raw material for the pharmaceutical industry [3]. Castor bean (*Ricinus communis* L.) belongs to the Euphorbiaceous family and is one of the medicinally important oil seed crop [9]. Castor bean is currently cultivated as an oil seed crop and also grown as an ornamental plant in many countries of Asia, Central and North America, Africa and Europe [5].

Primary stage of seedling growth in most of the plants is restrictive. Therefore, we can increase seed production with application of the correct principles. Seed vigor is one of the important factors of seed quality which can potentially influence crop yield through affecting seedling establishment, particularly under adverse environmental conditions [7]. Maximum seed vigor on the mother plant is attained at the end of seed filling phase [12]. or slightly after this phase [6]. High vigor seed lots typically exhibit fast and uniform germination, large and uniform seedlings and good emergence potential in most planting environments and soil conditions. Storage potential is also greater for high

vigor seed lots. Low vigor seed lots typically germinate and emerge erratically and slowly, producing smaller and more variable seedlings. Also low vigor seed lots also have poor storage potential. High vigor planting seed is justified for all crops, however, to ensure establishment of optimal plant populations over the wide range of field conditions that occur during planting and seedling emergence.

Also one of the ways to increase seed vigor in many crops including castor bean is mother plant nutrition by foliar spray of micronutrient at different growth stages. Foliar sprays are widely used to apply micronutrients for many crops. The effect of micronutrient elements on yield and crop performance has been reported by many investigators. Rehm and Albert (2006) reported that, yields were higher for the treatments with micronutrients [10]. In this study, they showed that, foliar sprays of ferrous sulphate or chelates are found to be more effective and efficient than soil application in correcting Fe-chlorosis in wheat [2]. indicate that micronutrients such as iron, manganese and zinc have important roles in plant growth and yield of aromatic and medicinal plants.

Therefore the objective of this paper was to study the germination and seedling characteristics of castor bean mother plant's seeds under foliar spray of micronutrient.

MATERIALS AND METHODS

location

In this study two separated field and pot experiments were conducted, during 2010 growing season. Field experiment was conducted at the Agricultural Research Station of Saatlo in Urmia, Iran, (37°44'18"N latitude and 45°10'53"E longitude), at an elevation of 1338 m above mean sea level, and pot experiment was conducted at the Seed Science laboratory of Faculty of Agriculture, University of Ardabil, Iran.

Methodology

These treatments in both experiments were arranged in a factorial experiment on the basis of randomized complete block design with three replications. The treatments were time of foliar application of micronutrients (i.e. Fe, Zn, Cu, B and Mo) on castor bean mother plant (T_1= at flowering stage of first raceme, T_2= at flowering stage of first raceme + at flowering stage of secondary racemes, T_3= at flowering stage of first raceme + at flowering stage of secondary racemes + grain filling of secondary racemes, and T_4= control) and type of grain (seed production from the first raceme, seed production from secondary racemes).

In this experiment, foliar application of micronutrients on castor bean mother plants was performed on specified times (mentioned above).Then the seeds harvested from the different clusters (first raceme and secondary racemes), and 100 seeds weight was measured. Then, to evaluate the germination and seedling characteristics of seeds, an experiment was conducted under greenhouse conditions, and obtained seeds from mother plant, planted on prepared pots. The pots were 15×10 cm and soil content of each pot was (1.3 g) sand and (2.3 g) clay loam. Soil moisture was kept at adequate levels to prevent water deficit and wilting. Weed control was done by hand as required.After the seeds sprouting, in two-leaf stage (when the leaf color of plantlet was yellowish) the seedlings harvested and plumule length, radical length, radicle fresh weight, seedling fresh weight, radical dry weight and seedling dry weight was measured.

The data were processed by analysis of the variance (ANOVA) and analyzed with SAS program and we used Excel software for drawing of the charts. The means were compared using the Duncan test.

RESULTS AND DISCUSSION

Analysis of variance in table 1 indicated that, time of foliar application of micronutrient (Fe, Zn, Cu, B and Mo) on castor bean mother plant's had significant effects on plumule length and 100 seeds weight ($p<0.01$). Seedling fresh weight was also significantly affected by time of foliar application of micronutrient on castor bean mother plant's ($p<0.05$). However, the interactions of these treatments were not significant for any of the parameters (Table 1). The highest mean plumule length (227.2 mm), 100 seeds weight (27.68 g) and seedling fresh weight (1.42 g) were obtained in flowering stage of first raceme + at flowering stage of secondary racemes + grain filling of secondary racemes time of foliar application of micronutrients on castor bean mother plant in comparison with the control (Table 2). Micronutrients caused to transfer photosynthetic material to the seeds, and with compared to the control (without foliar application), produced stronger seeds and finally seed germination is improved. The positive effects of micronutrients on plant may be due to their effects as a metal component of some enzymes or regulatory for the others. Moreover, they have essential roles in plant metabolism [1]. A balanced fertilization program with macro and micronutrients in plant nutrition is very important in the production of high yield with high quality products [11].

For adequate plant growth and production, micronutrients are needed in small quantities; however, their deficiencies cause a great disturbance in the physiological and metabolic processes in the plant [4].

Analysis of variance (ANOVA) results showed that, type of obtained grain (seed production from the first raceme and seed production from secondary racemes) had significant effects on plumule length, radical fresh weight and seedling fresh weight ($p<0.01$). 100 seeds weight, radicle dry weight and seedling dry weight was also significantly affected by type of obtained grain from the first raceme and secondary racemes($p<0.05$). Although was not observed significant difference on radical length treatment (Table 1).The highest mean plumule length (Figure 1), 100 seeds weight (Figure 4), radical dry weight (Figure 5) and seedling dry weight (Figure 6)were obtained from the first raceme's seeds, and highest radical fresh weight (Figure 2) and seedling fresh weight (Figure 3) were obtained from the secondary raceme's seeds. Seed vigor in obtained seeds from the first raceme was more than the obtained seeds from the secondary racemes and high vigor seed lots typically exhibit fast and uniform germination, large and uniform seedlings and good emergence potential in most planting environments and soil conditions. However, other researchers achieved to these results [8].

Table 1: Results of analysis of variance (mean squares) treatments in castor bean.

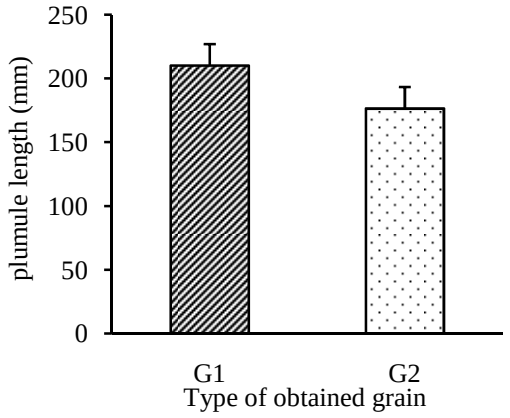
Source of variation	d.f.	Plumule length	Radicle length	Radicle fresh weight	Seedling fresh weight	100 seeds weight	Radicle dry weight	Seedling dry weight
Rep	2	1150 ^{ns}	158.6 ^{ns}	0.0039 ^{ns}	0.0097 ^{ns}	1.397 ^{ns}	0.002 ^{ns}	1.0004 ^{ns}
Time (T)	3	3661**	142.4 ^{ns}	0.025 ^{ns}	0.107 *	11.117 **	0.022 ^{ns}	0.0008 ^{ns}
Grain (G)	1	6740**	129.3 ^{ns}	1.287 **	30.26 **	8.89 *	0.86 *	0.6824 *
T×G	3	1186 ^{ns}	229.3 ^{ns}	0.0021 ^{ns}	0.007 ^{ns}	1.058 ^{ns}	0.014 ^{ns}	0.0013 ^{ns}
Error	14	420.9	89.8	0.0078	0.021	1.106	0.0002	0.0006
CV (%)		10.61	9.05	16.78	10.98	3.97	16.55	7.75

**, **, ns, Significant at P = 0.05, P = 0.01 and non-significant, respectively. d.f. degree of freedom.*
***Time (T)** = Time of foliar application of micronutrients on castor bean mother plant.*
***Grain (G)** = Type of obtained grain (seed production from the first raceme and seed production from secondary racemes).*

Table 2. Mean comparison of traits on castor bean.

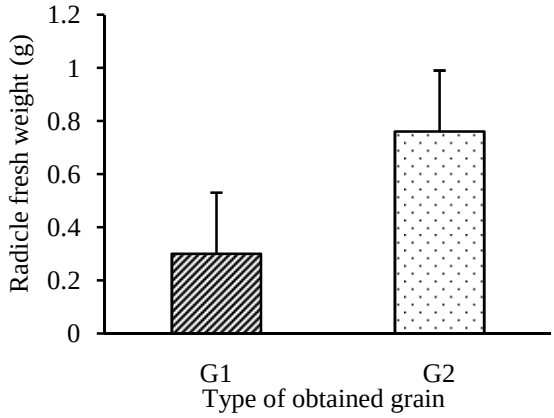
Studied factors	Plumule length (mm)	Radicle length (mm)	Radicle fresh weight (g)	Seedling fresh weight (g)	100 seeds weight (g)	Radicle dry weight (g)	Seedling dry weight (g)
T_1	175.4 b	104.6 a	0.52 ab	1.38 ab	26.52 b	0.08 b	0.32 a
T_2	195.7 ab	105.6 a	0.56 a	1.22 ab	27.03 ab	0.11 a	0.34 a
T_3	227.2 a	18.8 a	0.59 a	1.42 a	27.68 a	0.12 a	0.35 a
T_4	174.3 b	97.3 a	0.43 b	1.14 c	24.53 c	0.08 b	0.32 a

In each section, means followed by the same letter within columns are not significantly different according Duncan test.
***T_1**= at flowering stage of first raceme, **T_2**= at flowering stage of first raceme + at flowering stage of secondary racemes, **T_3**= at flowering stage of first raceme + at flowering stage of secondary racemes + grain filling of secondary racemes, and **T_4**= control.*



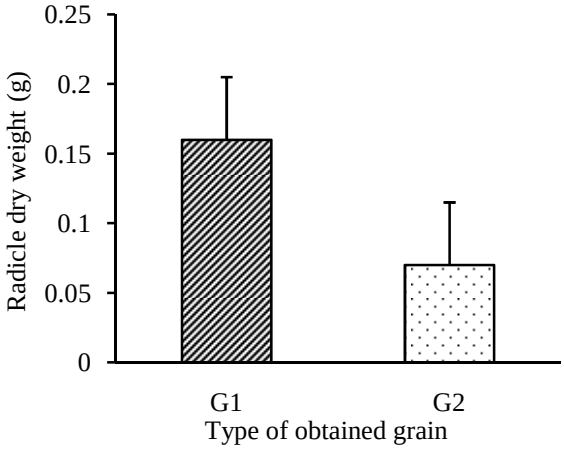
G_1= seed production from the first raceme
G_2= seed production from the secondary racemes

Figure 1: Mean comparison of plumule length on castor bean. Vertical bars indicate standard error.



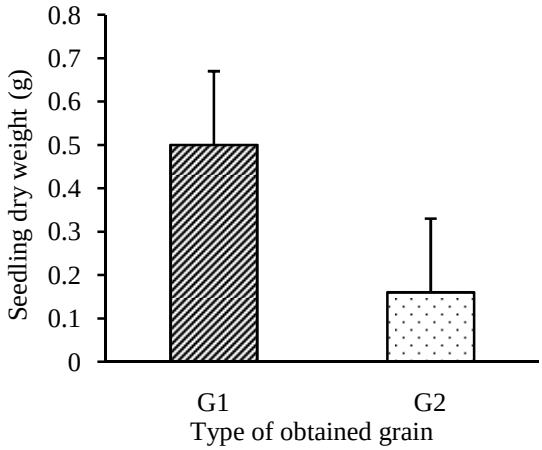
G_1= seed production from the first raceme
G_2= seed production from the secondary racemes

Figure 2: Mean comparison of radicle fresh weight on castor bean. Vertical bars indicate standard error.



G_1= seed production from the first raceme
G_2= seed production from the secondary racemes

Figure 5. Mean comparison of radicle dry weight on castor bean. Vertical bars indicate standard error.



G_1= seed production from the first raceme
G_2= seed production from the secondary racemes

Figure 6. Mean comparison of seedling dry weight on castor bean. Vertical bars indicate standard error.

CONCLUSION

In general, it can be concluded that foliar application of micronutrient on castor bean mother plants specially at flowering stage of first raceme + at flowering stage of secondary racemes + grain filling of secondary racemes time considerably improve 100 seeds weight, plumule length and seedling fresh weight treatments, particularly if these seeds were obtained from the first raceme of castor bean plant.

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