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Full Length Research Paper

Studying the effect of 1000 grain weight on the sprouting of different species of *Salvia* L. grown in Iran

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The harmful effects of chemicals and the side effects of chemical drugs on human health have a widely focused global attention on herbal drugs and medicinal plants. The increasing use of medicinal plants in the world is more than enough to show the significance of cultivating and producing such plants. Grains of most medicinal plants have very long dormancy periods, so shortening the dormancy period and increasing sprouting rates through laboratory methods may be effective in the proliferation of medicinal plants. *Salvia* L. is a member of the family Lamiaceae with more than 900 species all over the world. One of the major standards of seed quality is the 1000 grain weight, which is effective on sprouting, seed potential, seedling growth, and plant performance. Therefore, an experiment was run in the form of completely random blocks in 3 iterations to study the effects of the 1000 grain weight on the sprouting rate and seed potential of *Salvia* L. Ten different 1000 seed weight treatments were used in a standard sprouting test and accelerated aging test inside a germinating machine. The experiments were run in three iterations, each including 50 seeds based on rules set forth by the International Seed Testing Association. The experiments tended to analyze seed properties such as sprouting percentage, seedling length, and weight of dried seedling. Obtained data was analyzed by SAS software. Results indicated that in the standard sprouting test, the 1000 grain weight had significant effects on growth traits such as length and weight of dry seedling, yet it had no significant effect on sprouting percentage. In addition, in the accelerated aging test the 1000 seed weight had a significant effect on sprouting percentage and dry seedling weight, while there was no significant effect on seedling length.

Key words: *Salvia* L., sprouting, 1000 grain weight, standard sprouting test, accelerated aging test.

INTRODUCTION

The harmful effects of chemicals and the side effects of chemical drugs on human health have widely focused global attention on herbal drugs and medicinal plants. The increasing use of medicinal plants in the world is more than enough to show the significance of cultivating and producing such plants (Akbari et al., 2004; Ebadi and Hisoriev, 2011; Cao et al., 2011; Dunand, 1992). 1000 grain weight is a very important measure of seed quality, which is effective on sprouting, seed potential, seedling growth, and plant performance. This quality is dependent on the size of embryo and reserved nutrients quantity used for sprouting and growth. *Salvia* L. is a member of the family Lamiaceae with more than 900 species all over the world. Many good properties have been attributed to salvia such as anti-seizure and anti-coughing. Due to positive effects of 1000 grain weight on different properties of seed sprouting, this study was run to find the effects of this measure on sprouting and seed potential of *Salvia* L (Ebadi and Hisoriev, 2011; Cao et al., 2011; Dunand, 1992; Gharineh et al., 2004; Jorge and Ray, 2004; Khan, 2003; Malcolm, 2003; Mashtati et al., 2008).

MATERIALS AND METHODS

For this experiment, 10 treatments of 1000 grains of *Salvia* were put in three iterations of a completely random block of standard sprouting and accelerated aging tests. To determine the rate of sprouting and some other related traits, the seeds used in the

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Table 1. Variance analysis of the effect of 1000 grain weight on sprouting of *Salvia* L.

Source of changes	Degree of freedom	Squares mean					
		Standard sprouting test			Accelerated aging test		
		Sprouting rate (%)	Seedling length (cm)	Dry weight (g)	Sprouting rate (%)	Seedling length (cm)	Dry weight (g)
1000 seed weight	9	0.98 ^{ns}	39.86 **	0.0000037**	87.17 **	1.49 ^{ns}	0.00000366**
Error	20	1.43	1.04	0.0000004	24.37	1.56	0.00000068
Total	29						

ns and **: insignificant and significant at a 99% reliability level.

Table 2. Comparison of studied traits.

Treatments	1000 seeds weight (g)	Traits mean			
		Standard sprouting test		Accelerated aging test	
		Seedling length (cm)	Dry weight (g)	Seedling length (cm)	Dry weight (g)
1	4.98	13.556^{f}	0.0167^{e}	92^{a}	0.014926^{ab}
2	5.28	14.254^{ef}	0.017d^{e}	84.5^{abcd}	0.01236^{c}
3	5.95	15.204^{e}	0.0174d^{e}	81.5^{bcd}	0.01386^{b}
4	6.3	16.746^{d}	0.18^{cd}	82.5^{ab}	0.015214^{ab}
5	7.13	18.183^{cd}	0.0181^{cd}	90^{bcd}	0.0153^{ab}
6	9.23	18.336^{cd}	0.0182^{cd}	80.5^{cd}	0.015776^{ab}
7	9.51	19.424^{c}	0.019b^{c}	76^{d}	0.014726^{ab}
8	10.43	21.224^{b}	0.0194^{b}	81^{cd}	0.014439^{ab}
9	11.13	21.864^{ab}	0.0206^{a}	88.5^{abc}	0.015514^{ab}
10	12.73	22.95^{a}	0.0206^{a}	84.5^{abcd}	0.015764^{a}

In each column and for each trait, means with similar letters (at least) have no significant difference at a $p<0.05$ level in FLSD test.

standard sprouting tests were prepared according to rules set forth by the International Seed Testing Association. For this purpose, 150 seeds (3 iterations of 50) were cultured on a sprouting paper on capped plastic containers, and were placed inside germinating machines for 7 days at 20°C. In the accelerated aging test the seeds were placed inside plastic boxes containing water to supply the required saturated humidity about 98%) over net sheets (to prevent direct contact between seeds and water) at 45°C for 72 h. They were then transferred into the standard sprouting test conditions and kept at 20°C for 5 days, after which the number of sprouted seeds was counted so that the final percentage of sprouting was known. One sample was randomly chosen from each test unit for the measurement of growth and length among 25 seedlings.

To measure dry seedling weight, once the seedlings were dried at 70°C for 24 h, a fine balance (up to 0.001 g sensitive) was used to measure the weights. Data analysis was done by SAS software and trait mean comparison was done by FLSD test (Gharineh et al., 2004).

RESULTS

Standard sprouting test

Sprouting percentage

Results indicated that 1000 grain weight had no significant effect on the sprouting percentage/rate of seeds (Table 1).

Seedling length

Results indicated that there was a significant effect of 1000 grain weight on seedling length (Table 1). In addition, mean comparison showed a significant difference between various treatments. Based on mean comparison results, the seedling length increased with 1000 grain weight (Table 2). Minimum seedling weight was obtained for treatment 1, while maximum belonged to treatment 10.

Dry seedling weight

Results indicated that 1000 grain weight had a significant effect on dry seedling weight (Table 1). In addition, mean comparison demonstrated a significant difference among treatments. Based on mean comparison results, dry seedling weight increased with 1000 seed weight increase (Table 2). Minimum and maximum dry seedling weights were obtained for treatments 1 and 10.

Accelerated aging test

Sprouting percentage

Results indicated that 1000 grain weight had a significant effect on the sprouting percentage/rate of seeds (Table 1). In addition, mean comparison showed a significant difference among treatments. According to those results, sprouting percentage declined with increased 1000 seed weight. Minimum and maximum sprouting rates were obtained from treatments 7 and 1.

Seedling length

Results indicated no significant effect of 1000 grain weight on seedling length (Table 1).

Dry seedling weight

Results indicated that 1000 grain weight had a significant effect on dry seedling weight (Table 1). In addition, mean comparison demonstrated a significant difference among treatments. Based on mean comparison results, dry seedling weight increased with 1000 grain weight increase (Table 2). Minimum and maximum dry seedling weights were obtained for treatments 2 and 6.

DISCUSSION

The quality of grains as the plant-replicating organ and the most important element in the production of agronomic crops has a very special position and effect on the nice performance and growth of agronomic crops. This is influenced by many different factors such as genetic features, nominal potential or sprouting potential, seed potential, humidity, storage quality, seed preservation and health, but the most important ones are sprouting rates and seed potential (Jorge and Ray, 2004; Khan, 2003; Malcolm et al., 2003; Akbari et al., 2004). Sprouting and birth of seedlings require lots of energy obtainable through oxidation of nutrients already stored inside the seed. Seeds must be filled with sufficient nutrients for the growing seedling for the seedling is totally depending on reserved nutrients before it develops into a self-sufficient plant. A high 1000 grain weight index brings higher rates of sprouting and larger numbers of bushes kept until harvest time, which in turn boosts performance. Khan (2003) stated that the weight increase of *Artocarpos heterophyllus* L. from 4 to 6 g to 12 to 14 g caused the sprouting rate to increase from 15 to 85%. This indicates a positive and significant correlation between seed weight and sprouting percentage. Malcolm et al. (2003) tested five varieties of peach rootstock and said that increased seed size tended to increase seed sprouting percentage. George and Ray (2004) reported that increased 100 seed weight of Golayol brought about an increased sprouting rate. For instance, an increase in the 100 seed weight from 0.08 to 0.1 g caused the sprouting percentage to grow from 34 to 80%.

Conclusion

The information obtained from this study leads us to the conclusion that in the standard sprouting test, the 1000 seed weight has significant effects on growth traits such as seedling length and dry weight, but it has no significant effect on sprouting percentage. In addition, in the accelerated aging test the 1000 seed weight has significant effects on sprouting percentage and dry seedling weight, while it has no significant effect on seedling length. It seems like the observed difference on studied traits/properties in the two tests comes from the stresses associated with accelerated aging test (Mashtati et al., 2008; Mozaffarian, 1998; Noor Mohammadi et al., 1997; Sharma et al., 2011; Zargari, 1991).

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