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Research Article

INVESTIGATION THE EFFECTS OF SOME CHEMICAL TREATMENTS ALONG WITH WARM AND COLD TREATMENTS ON ZIZIPHUS JUJUBA SEED GERMINATION CHARACTERS

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ABSTRACT
The present study aimed to investigate the effects of several chemical treatments, heat treatment and stratification on jujube seed germination to overcome poor germination, seed dormancy and increase percentage of seed germination in 2014 as a factorial experiment in randomized complete block design with four repeats. The means were compared using Duncan's Test. The seeds were collected from the trees in summer 2013. Then, the collected seeds were transferred to the laboratory in order to eliminate the need for cooling. As a result, germination was imposed by Tiura, potassium nitrate and gibberellin hormones at four concentrations (2500, 5000, 7500 and 10000 ppm). The results suggested that chemical treatments had significant effect on germination percentage at 75, days after beginning of the experiment. However, the chemical treatment had no significant effect on germination speed. The results indicated that the effect of concentration on germination percentage was significant at 75 days after beginning of the test. In addition, the effect of concentration on germination speed was highly significant.

Keywords: *Jujube, Germination, Gibberellin, Tiura, Potassium Nitrate*

INTRODUCTION
According to Association of Official Seed Analysis (AOSA), germination refers to the ability of the seeds to produce a normal crop in favorable conditions. The seed germinates after overcoming various risks at maturity, distribution and dormancy step on the condition that favorable environmental conditions are provided. Any species requires a different set of conditions for germination. Chemical environmental conditions either prevent or stimulate germination (Khosravi, 1996; Chiwocha *et al.*, 2005). Seed dormancy is considered as an ecological advantage in natural conditions since the seed is dormant until favorable conditions are provided and harsh environmental conditions are passed. However, dormancy is considered as a restricted factor when the seed needs to germinate and grow after the harvest. Certain chemicals facilitate germination. Many resources addressed that chemicals stimulate and accelerate seed germination. Gibberellic acid (GA3) is one important growth hormone, which breaks seed dormancy, replaces stratification and seed germination in hard shell seeds (Ghasemi *et al.*, 2007). Potassium nitrate is one important chemical widely used to increase seed germination. Potassium nitrate breaks seed dormancy in the darkness, particularly those seeds dependent on light. This chemical significantly reduces the need for light and increases germination. In addition, this chemical is useful in response to seed metabolic processes. This combination stimulates auxin biosynthesis and triggers growth of the embryo (Khan *et al.*, 1999). One reason for the positive effect of chemical stimuli such as potassium nitrate on seed germination probably lies in the hormonal balance of the seed and reducing the growth-inhibiting substances such as abscisic acid (ABA) (Ghasemi *et al.*, 2007). ISTA and many researches recommended 0.1% to 0.2% percentage of potassium nitrate to stimulate germination. Using higher concentrations in several cases reduced germination (Mahmoudzadeh and Bagheri, 2005). Tiura eliminates dormancy of several seeds. This chemical has an inhibitory effect on the seed shell in Pseudomonassyringae in Prunus genus. This chemical also reduces high temperature inhibitory effect on germination of lettuce seed. Hilton (2006) investigated the effect of light and potassium nitrate on seed dormancy and stimulating germination in Avena fatua. It was reported that potassium nitrate treatment has little effect on seed germination in this genus in the dark. However, 0.2, 0.002 and 0.0002 molar concentrations of this chemical stimulate germination in the light. Research on Datura stramonium L. showed that seed

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dormancy in such species as stramonium (Benvenuti and Macchia, 1998) and ferox (Botto *et al.*, 1998) and Datura is highly sensitive to light. Therefore, vegetation and agricultural operations affect seed dormancy in these species. One reason for seed dormancy in these species lies in lack of light (Benvenuti, 1995).

In another experiment, gibberellin broke seed dormancy in Datura (ferox species). This effect is similar to the effect of red light on seed germination in Datura (Shakeel *et al.*, 2004). Bellucci *et al.*, (2006) examined the effect of gibberellic acid, sulfuric acid, stratification, potassium nitrate in stimulating germination and dormancy of annual alfalfa. They concluded that gibberellic acid at a concentration of 750 ppm per million with 4 ° C stratification is considered as the most effective method to stimulate seed germination in annual alfalfa. Mahmoodzadeh and Bagheri (2005) reported that gibberellic acid treatment at a concentration of 500 parts per million has a significant effect on stimulation of seed germination in Datura (Datura stramonium). However, potassium nitrate treatment at a concentration of 0.8, 0.6, 0.4, 0.2 and 0.1 percent, perforated seed, concentrated sulfuric acid and boiling water increased germination, although the same treatment showed an inhibiting effect in several cases. Demir *et al.*, (2006) studied seed germination under salinity stress in sunflower, although salinity stress reduces seed germination speed and percentage. However, potassium nitrate treatment can be effective in improving the germination speed and percentage.

MATERIALS AND METHODS

The required seeds were collected from the fruits in Mashahd in summer 2013. Thousand grain weights were equal to 25.75. Seeds longitudinal mean was equal to 0.4 while transverse mean was equal to 0.2. The seeds were divided randomly into two groups of 80 seeds. Given the number of treatments including three chemical treatments at five concentrations, 20-seeds in four repeats were considered for each treatment. Then, the seeds were submerged in aqueous solutions of Tiura, gibberellin and potassium nitrate for 24 hours. The seeds were disinfected with 1000-ppm Benomil solution to eliminate a potential fungal contamination. Then, the seeds were kept in perforated plastic bags (for ventilation) among perlite, which was already wet, for five weeks at room temperature. Then, the seeds were transferred to 1±4C temperature inside the refrigerator.

The seeds were checked every week for moisture control and ventilation. The number of germinated seeds was recorded during the experiment. A number of germinated seeds were randomly selected from each treatment. The root length was measured. The roots were grown in cocopeat. Leaf number, stem height and root length were recorded at the end of 75 days from seed growth. A Factorial experiment in a randomized complete block design with four replications was used for statistical analysis. Duncan's test was used for comparison of means. The number of germinated seeds was recorded on a weekly basis from beginning of germination. Those seeds whose root length was above than 5.0 mm were considered as germinated seeds.

RESULTS AND DISCUSSION

Discussion

Germination Percentage

Based on these results, chemical treatment significantly increased germination percentage up to 75 days after the start of the test at 1% level of significance. Gibberellin-treated seeds germinate faster than other seeds. More seeds germinated after 75 days. Meanwhile, gibberellin had the highest effect on germination at a concentration of 5000 ppm. The treatment showed no significant difference in increasing germination percentage at 118 days after the test. The treatment showed no significant difference in terms of chemical concentration in late germination. Gibberellin and Tiura showed the highest germination percentage.

These results are consistent with those obtained by Shatat (1989). Gibberellin increased the germination percentage. Koyanclu and Cetinbas (2006) reported the same results in Cherries. All three treatments increased the germination percentage. Gibberellin showed the highest percentage of germination. In the second place, Tiura at 5000-ppm concentration and potassium nitrate at 10000-ppm concentration increased germination. In another experiment, the best results were obtained for Jujube by gibberellin,

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which correspond with the results obtained in this study. However, the effective concentrations in this study are consistent with those obtained by Koyanclu and Cetinbas (2006) in cherries. The latter showed that this difference might be due to species differences.

Germination Speed

Not all three treatments were effective in increasing the germination speed in jujube. Gibberellin showed the highest germination speed. Then, Tiura and potassium nitrate increased the germination speed at the second and third places. However, gibberellin had higher effect on germination speed than Tiura and potassium nitrate. Germination-treated seeds increased germination faster than Tiura and potassium nitrate. In 75 days, the highest germination speed was related to gibberellin while other treatments resulted in lower germination speed.

Table 1: Analysis of variance for characteristics jujube seed germination

SOV	df	Seedling Length	Leaf Number	Radical Length	Germination after 75 day	Germination Rate
Chemical treatment	2	4446.11**	82.01**	80.13**	5.417**	2469.13^{ns}
Concentration	4	5514.58**	39.36**	104.11**	127.408**	10096.43**
Chemical ×treatment Concentration	8	2345.03**	10.16**	24.05**	108.118**	7344.15**
Error	42	4.22	0.35	1	1.47	1506.40
CV	-	14.37	10.54	11.86	12.63	15.84

**, ** significantly at the 1% and 5% levels of probability respectively and ns (non significant)*

Table 2: Mean comparison of jujube seed characters

Concentration of tuber extract	Seedling Length	Leaf Number	Radical Length	Germination after 75 day	Germination Rate
GA	14.06 C	2.1 b	1 c	46.5 a	56.3 A
Tiora	43.45 A	6.65 a	4.25 a	32.8 b	73.4 A
Nitrate potassium	15.54 B	1 c	1.15 b	16.7 c	57.4 A

Statistically, there is no significant difference among the means with the same letter in each column in Duncan's test (p = 5%)

These results are consistent with those obtained by AL-Absi (2010). Gibberellin reduced the mean time to germination and increased germination speed. However, the effective concentration to increase the germination speed varied in this experiment. This difference may be due to differences in the type of species in this experiment.

Conclusion

Studies conducted in 2013-2014 in relation to increasing germination speed and percentage in jujube indicated that using gibberellin and Tiura treatments could increase germination speed and percentage in jujube. Gibberellin-treated seeds increased germination faster than other treatments. At 75 days, an increased number of seeds germinated. Gibberellin at a concentration of 5000 ppm had the highest effect on germination. It seems that potassium nitrate had the lowest effective in improving seed germination in jujube. In other periods, gibberellin showed significant differences with two other treatments in terms of

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germination speed. Gibberellin showed the highest germination speed. In addition, 5000-ppm concentrations of gibberellin revealed better results for germination percentage. It is recommended to use 5000-ppm gibberellin for increased seed germination speed and percentage.

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