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Research Article

EVALUATION OF FREEZING TOLERANCE OF FIVE VARIETIES OF DUTCH ROSES

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ABSTRACT
Winter cold is one of the limiting, damage causing and costly factors in harvesting greenhouse products. This study was conducted with the aim of investigating the quantitative and qualitative properties and the rate of winter freezing tolerance of 5 selected varieties of Dutch roses in Random Complete Block Design with three replications in Touss greenhouse institute of Chenaran in 2013 and 2014. The results showed that the selected varieties had a significant difference in many properties in terms of vegetative and morphological characteristics, as well as the rate of freezing tolerance at 5% level (relative leakage percent, relative water content of branches, relative pH). The most tolerant and sensitive varieties of roses to winter freezing were Obrigado and control (common rose) varieties.

***Keywords*:** *Freezing Tolerance, Dutch Roses, pH, Leakage Percent*

INTRODUCTION
Roses are the most beautiful and popular ornamental flowers in the world. Dutch roses are plants that are known as the best flower in the world in terms of beauty, stability and resistance. Frosting in winter of temperate zones often cause severe damages to plants. The effect of cold and frosting in plants is dependent on the heat intensity, its duration and the developmental stage of the plant and here cold duration is more effective than cold intensity (Mian Abadi et al., 2009).
Apparently cold damage at first causes metabolic changes in plants such as increase in the amount of Ethylene, then causes cellular changes (Electrolic Leakage) and eventually lead to damage signs in stressed plants (MirMohammadi et al. 2004). While investigating adaptation to cold weather and reaction to cold in roses of South France, Amiglo et al. (2003) used a simple tool to test the cold and evaluated it in comparison to the classic method of LT50 and conductivity of electrolyte leakage test. The new test, GELISTA^{TM}, presented similar results for stability to freezing. Several factors are effective in stability of buds to cold such as plant genotype, flower phenology, ice formation in target tissues, water content of cells, nutritional state of trees and material accumulation in cells and tissues (Lu and Rieyer, 1993, Probesting, 1978, Tamassy and Zayan ND Warren, 1998). Rodrigo, (2000) stated that ion settlement rate in tissues subject to freezing damage will increase. Ion settlement of cell wall related to degredative enzymes' activity is a cell wall in which the activity of enzymes increases in cold conditions (Burk et al., 1976). Water loss in plant tissues gives many advantages to the plant In terms of stability to freezing because as a result of water reduction, there remains little water in tissues to be frozen (Levit, 1980). Recent researches conducted on pistachio showed that there is a direct relationship between soluble sugar, promin, interstitial water and bud depression and their stability to cold (Pak Kish, 2009).

MATERIALS AND METHODS
This study was conducted on 5 selected varieties of Dutch roses called Rmini, Redforever, Obrigado, Classic Cezanne, Dolce Vita and control rose (Rosa sp var) in Random Complete Block Design with three replications in a greenhouse in Mashhad during 2013. Geographic coordinates of the location were 36o34' North and 59o13' East and its altitude was 1050 meters above sea level. In this experiment four 5 year old shrubs were chosen to be examined from each variety which were brought out already from the greenhouse due to aging and were cultivated in pots. They were cultivated in 2×2 crates in neighboring lands of the greenhouse. In order to evaluate the stability of the 5 selected varieties of Roses to freezing and their comparison with the control variety, four shrubs were selected from each variety and the

interstitial water of one year old branches in November, October and December months on 2013, ion settlement rate in one year old branches in March of 2014 were measured and then damage symptoms were observed in spring and summer of 2014 as will be described. The following formula was used in order to measure the interstitial water of stems:

Interstitial water percent = wet weight – dry weight

Ion Settlement Test is separated using the electric conductivity measures of pure water in tissue samples and is applied after a freezing cycle process (Linden, 2002). For this purpose, one year old branches of the selected varieties were chosen in terms of four different aspects and were put in plastic pockets after being cut. Their characteristics were attached to the pocket and given to the laboratory of Islamic Azad University of Shirvan. After being washed with distilled water, 3 gr of one year old branches from each genotype were separated and placed in freezing chamber. For cold treatments, the device was set to -15, -20 and -25 centigrade degree as the following method. Then the samples were brought out of the device and 15 cc distilled water was added and mixed by a shaker (model GFL3005) for one hour. The EC of water containing the sample was measured after 20 hours. Then the samples were autoclaved for 90 minutes in 121oC with autoclave device (Brand HIRAYAMA Model HG-80 made in Japan). After 20 hours again the EC of water containing the autoclaved samples was measured. According to the relative leakage formula, the amount of ionic settlement of each samples were determined (Linden, 2002).

STATISTIX 8.0 was used to analyze the data and compare the means and Excel was used to draw diagrams.

RESULTS AND DISCUSSION

Evaluation of Stability to Freezing

The results of variance analysis showed that the effect of time on the interstitial water percentage was significant at 5 percent probability level. They also indicated that the effect of varieties interaction on interstitial water percentage was not significant.

The Effect of Different Times on Interstitial Water Percentage

The results of variance analysis showed that the effect of different times on interstitial water percentage was significant at 5% probability level. The maximum interstitial water percentage was for December with the mean of 2.64 percent and the minimum interstitial water percentage was for November with the mean of 2.02 percent (Figure 1-3).

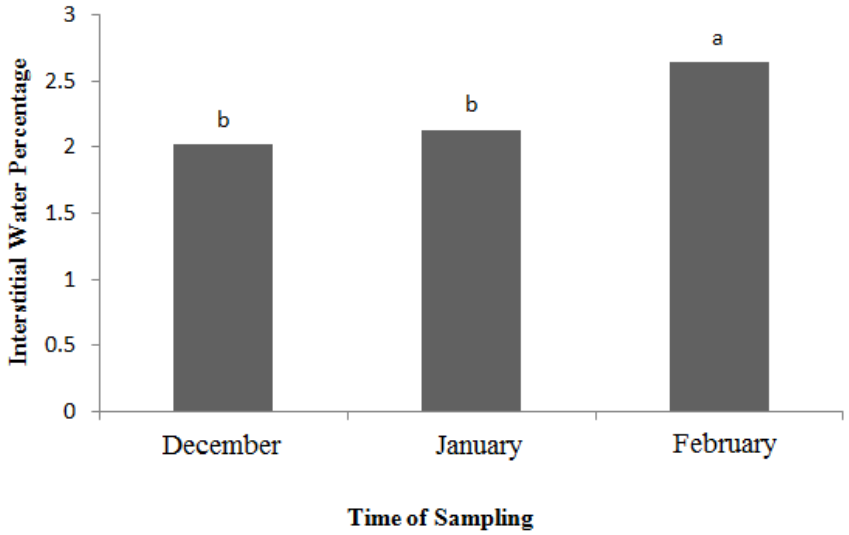

Figure 1: The Effect of different Times of sampling on interstitial water percentage

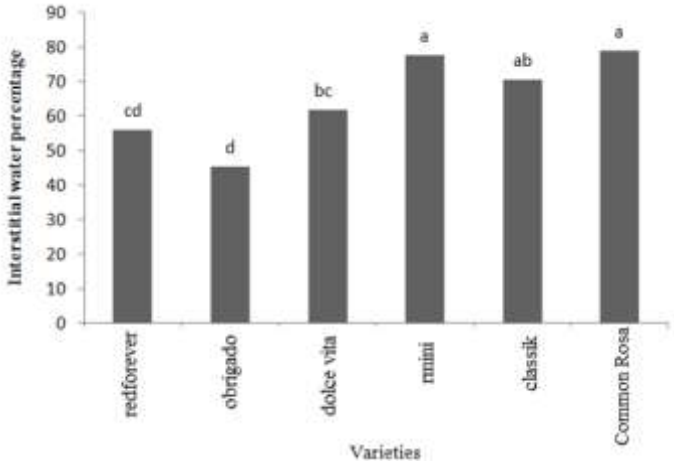

Figure 2: The Effect of varieties on interstitial water percentage

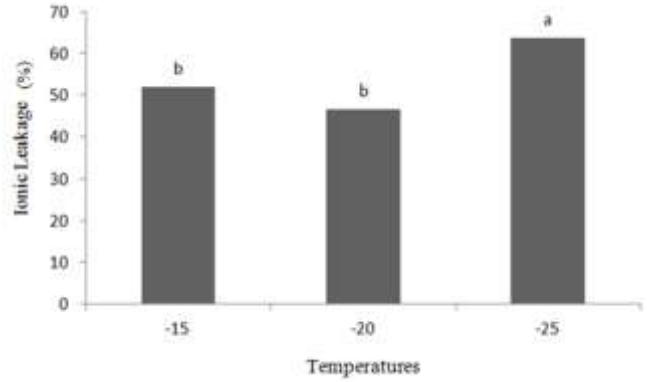

Figure 3: The Effect of Different Temperatures on Ionic Leakage

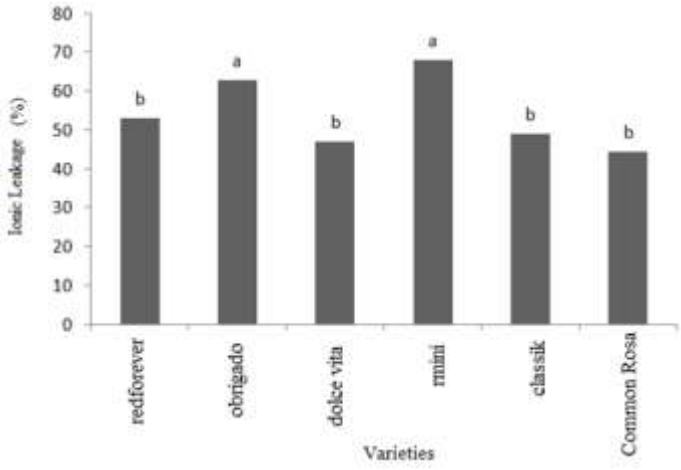

Figure 4: The Effect of different Species of Dutch Roses on Ionic Leakage

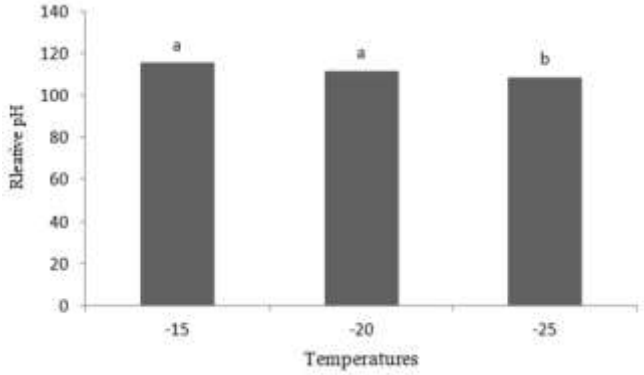

Figure 5: The effect of temperature on relative pH

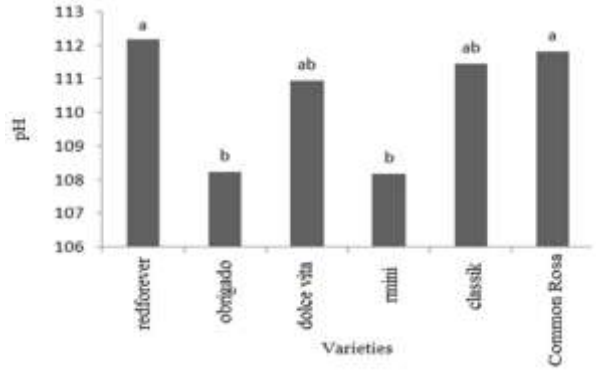

Figure 6: The effect of various species of Dutch roses

The effect of different species on interstitial water percentage

The results of variance analysis showed that the effect of different species of Dutch roses on interstitial water percentage was significant at 5% probability level. So the maximum interstitial water percentage was for the common rose variety with the mean of 78.66. The minimum interstitial water percentage was for Obrigado treatment with the mean of 45.33. There was no significant difference between pink lip and classic roses.

The results of variance analysis showed that the effect of temperature on ionic leakage and relative pH was significant at 5% probability level and the interactive effect of varieties and degree had no significant difference on heat, ionic leakage and relative pH.

The effect of different temperatures on ionic leakage

The results of variance analysis showed that the effect of different temperatures on ionic leakage was significant at 5% probability level. So the maximum ionic leakage happened at -25^{o}C with the mean of 63.68 and the minimum ionic leakage happened at -20^{o}C with the mean of 46.57 which was not significantly different from -15^{o}C.

Miandoabi et al. (2009) stated that freezing stress increased the ionic leakage and reduced the survivability and regrowth percentage of violets. Although a relatively similar trend was observed in most of the characteristics in temperature range of 0 to -18, lower temperatures increased the electrolyte

leakage percentage and sharply reduced the survivability and regrowth percentage of the plant which are consistent with research results.

The Effect of different species of Dutch roses on ionic leakage

The results of variance analysis showed that the effect of varieties on ionic leakage was significant at 5% probability level. The results of comparing treatment means showed that the maximum ionic leakage was related to Obrigado and yellow species with the means of 67.72 and 67.92, respectively. There was no statistically significant difference between Black and Classic species.

The effect of temperature on relative pH

The results of variance analysis showed that the effect of temperature on relative pH was significant at 5% probability level. The maximum amount of relative pH was observed at -15^{o}C with the mean of 115.377 and the minimum amount of relative pH was observed at -25^{o}C with the mean of 108.49. There was a statistically significant difference between -15 and -20 temperatures in terms of relative pH.

The effect of various species of Dutch roses on relative pH

The results of variance analysis showed that the effect of varieties on pH was significant at 5% probability level. The maximum pH was related to the common rose variety with the mean of 111.81 and the minimum pH was related to Obrigado variety with the mean of 108.22. The results show that the most stability to cold was related to Obrigado variety with the least amount of pH.

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