Assessment of drought resistance for 17 alfalfa varieties at the seedling stage

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Introduction

Alfalfa is a crop of relative water demand, and the good quality, the high and stable yield could be obtained directly depending on water supplies and strong or weak drought resistance ability of alfalfa cultivars (Geng 1995; Chen and Jia 2000). To guide steady and effectively development of alfalfa industrialization in the arid and semi-arid regions of China, we systematically selected the excellent drought resistant alfalfa cultivars, and then identified and assessed their drought resistant capacity. In this study, a pot experiment was conducted by simulating drought stress in a greenhouse to assess the drought resistance of seventeen alfalfa cultivars at home and abroad during seedlings period, which aim at selecting a high quality and yield perfectly suited to growing alfalfa cultivars.

Methods

The pot experiments were conducted by simulating drought stress in a greenhouse to assess the drought resistance of 17 alfalfa cultivars during seedlings stage. Fifty seedlings were transplanted into each of three experimental plastic pots (23 cm diameter × 20 cm height) filled with 3.5 kg farmland soil: turf soil: sand mixture (2:2:1, v:v:v). Once plants had three or four leaves, seedlings were treated for 0d, 4d, 8d and 12d under different drought conditions, and leaves were harvested at 9:00 am, respectively. The leaf relative water content (LRWC) was measured by weighing method, the leaf relative membrane permeability (LRMP) was determined by conductivity meter, and the leaf free proline content (LFPC) was performed using triketohydrindene hydrate methods (Zhou 1995). The change rates of these physiological indexes were performed one-way analysis of variance (ANOVA) and cluster analysis using SAS 8.0 and weighted Euclidean distance methods, respectively.

Results

With the prolonging of drought stress time, the LRWC reduced gradually in all alfalfa cultivars, and the declining rate showed the trend of acceleration. Under drought stress for 12d, LRWC reached more than 60% in DK140 and Zhaodong cultivars, while its change rates were only 22.9% (DK140) and 22.1% (Zhaodong) relative to the control (0d), indicating its exhibited strong ability of leaf water holding; the change rates was however 48.7% (Grandeur),

44.9% (WL323MF), 42.3% (8920MF) or 41.9% (DK134) with large variation range, suggesting the ability of leaf water holding and drought resistance had relatively poor.

The LRMP of all alfalfa cultivars showed an increase trend with the prolonging of the treatment time. Compared with the control, the change rates were 273.8% (Zhaodong), 281.2% (CW400), 309.0% (DK140) or 312.3% (No. 1 Gongnong), in contrast to that, they reached 823.8%, 816.3%, 757.4% and 715.9% in 8920MF, WL323MF, Forerunner and Grandeur, respectively.

The LFPC followed an increase trend in all alfalfa cultivars with the increase of treatment time. The change rates of CW400, 8925, DK140 and Zhaodong cultivars were less than 4000% compared to others, which showed the stronger drought resistance capacity; while the LFPC were more than 4000% among WL323MF, 8920MF, Grandeur and DK143.

The change rates of LRWC, LRMP and LFPC were analyzed using the weighted Euclidean distance methods of cluster analysis, 17 alfalfa cultivars were divided into three groups based on the different drought resistance, *e.g.* the stronger (Zhaodong, CW400, DK140 and 8925), the medium (No.1 Zhongmu, Xiangjiang Daye, No. 1 Gongnong, Algonquin, Forerunner, Phabulous, DK127, DK134, DK124 and DK143) and the weaker (Grandeur, WL323MF and 8920MF) (Fig.1).

Conclusions

With the prolonging of treatment time, the LRWC of 17 alfalfa cultivars showed a decline trend, accompanied with the enhancement of RMP and Pro contents. This suggested that the change rates of these physiology indexes which can identify and assess drought resistance of alfalfa during seedlings stage, is a practical way. 17 alfalfa cultivars could be divided into three groups based on the different drought resistance, *e.g.* the stronger (CW400, DK140 and 8925), the weaker (Grandeur, WL323MF and 8920MF) and other cultivars belong to medium.

References

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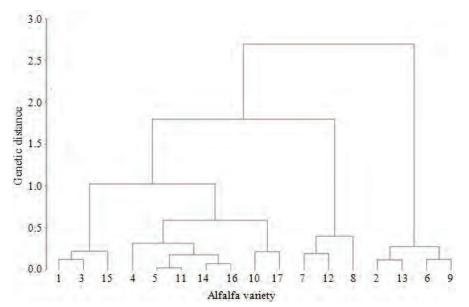
Figure 1. Cluster map of drought resistance of 17 alfalfa varieties. Note: 1-No.1 Zhongmu, 2-Zhaodong, 3-Xinjiang Daye, 4-No.1 Gongnong, 5-Algonquin, 6-CW400, 7-WL323MF, 8- 8920MF, 9-8925, 10-Forerunner, 11-Phabulous, 12-Grandeur, 13-DK140, 14-DK127, 15-DK134, 16-DK124, 17-DK1.