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Evaluation on Mengnong clover no.1 - China's first variety of Caucasian clover (*Trifolium ambiguum Bieb.*)

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Introduction

Many research reports about Caucasian clover (*Trifolium ambiguum* Bieb.) could be retrieved. A breeding research for Caucasian clover was started since 1996 in Inner Mongolia Agricultural University, China. The goal was to breed new varieties with strong cold resistance and drought, salt tolerance, as well as quick regenerating capacity after use. By December 2012, China's first new variety of Caucasian clover - "Mengnong clover No.1" (Mc No.1) was successfully registered by Forage Variety Approval Committee of Inner Mongolia Autonomous Region. Through a comparison test with red clover (*T. pratense*) and white clover (*T. repens*), Mc No.1 showed outstanding prospects for animal forage and garden use.

Materials and Methods

Test site was in Huhhot, Inner Mongolia which has a frost-free period of 134 days. The average minimum temperature in January was -16.9 ℃; the average maximum temperature in July was 28.5 ℃. The annual average rainfall was 400mm and the land could be irrigated. Experimental materials were Mc No.1, red clover and white clover.

Biomass and wintering rate tests were carried out at the field plots. The area of each plot was 12m^2 and randomly arranged with three repeats. All seeds were planted in spring, and the pH value of soil was 8.1. Nodule observation was done at the suitable time. Drought and salt tolerance tests were conducted non-continuously in a greenhouse from 2005. When the plants of Caucasian clover and white clover grew up for 50 days from emergence in pots (28 pots for each clover), watering was stopped until the plants died. During drought stress, soil moisture was regularly measured. Salt tolerance was observed by treating the clover seeds with mixed salt solution (NaCl :Na_2SO_4=1 :1). Seven salt gradients were setted with four repeats.

Results and Discussion

Biomass and wintering rate: In Huhhot conditions, Mc No.1 established relatively slow in the first season after sowing. But the root systems developed rapidly. The average depth of taproots was 65cm, and the longest could reach to 105cm depth. After 100days of emergence, root rhizome buds formed around root crown and passed through the winter. The high biomass produced from second year (3 cuts per year). Red clover and white clover could flower and fruit in the first planting year and formed higher biomass (2 cuts per year). Since second year the biomass declined due to low wintering rates (table 1).

Table 1. Comparison of biomass and wintering rate between Mc No.1, red clover and white clover during the period of 2011 to 2014 in Huhhot, Inner Mongolia

	2011		2012		2013		2014	
	AB/UB (g/m^2)	WR (%)	AB/UB (g/m^2)	WR (%)	AB/UB (g/m^2)	WR (%)	AB/UB (g/m^2)	WR (%)
Mc No.1	135/182	100	476/758	100	551/922	100	583/1088	100
Red clover	490/223	61	351/320	0	—	—	—	—
White clover	298/176	8	41/23	—	—	—	—	—

Note: AB—above ground biomass; UB—under ground biomass; WR—wintering rate

Red clover and white clover had forage value in the sowing year because of relatively higher above ground biomass and density of coverages. However, because both had low wintering rates, they usually were used as annual or biennial forage plants that required high cost to cultivate, and that was the reason to not be popularly utilized. Since second year of sowing Mc No.1 got increasing biomass and 100% of wintering rate. The increase rate of root system biomass was higher than plant biomass that produced an extensive network of rhizome. At the same test site no signs of recession for a Caucasian clover pasture (original material of Mc No.1) were observed. So Mc No.1 is welcomed not only as a grazing forage, but also as garden plant and soil and water conservation variety.

Drought and salt tolerance: In the grassland region of Inner Mongolia, dry weather and high soil pH value have limited many legumes to normal grow. It is needed for clover variety to have the characteristics of drought and salt tolerance under no or less irrigation conditions. Comparative tests showed that when the soil moisture was 5.2%, the white clover leaf curled; when it was 3.8%, the white clover died, which lasted 15-17days. For Mc No.1 those data were 2.5%, 2.1% and 24-25days respectively （fig.1）. If the

dead plants in the pots were irrigated immediately after dry up, 60% of Mc No.1 plants could restore growth ability. But white clover had no the same ability. The results of salt stress showed that the salt concentration for Mc No.1, red clover and white clover normal germination could be no more than 0.5%, 0.4% and 0.2%; the salt concentrations causing no germination for three clovers were 1.2%, 1.1% and 0.9% respectively. Therefore Mc No.1 can normally grow on the soil of pH8.2 at test field.

Fig. 1 Comparison test between Mc No.1 and white clover for drought tolerance. When the soil moisture in the pots was 3.0%-3.8%, white clover (left) died and Mc No.1 (right) kept green

Nodule observation: Some studies suggest that Caucasian clover needs special rhizobium for ordinary growth, and inoculation is necessary for Caucasian clover stand establishment (Pryor *et al*., 1998; *Seguin et al.*, 2001). In Huhhot soil condition, red clover and white clover could produce nodules. But no any nodules were found on Mc no.1 roots although it could normally grow and develop. This will undoubtedly be the focus of future research for soil improvement.

Conclusion

Breeding and successful registration for the Mc no.1, China's first variety of Caucasian clover, is an important event because it ended the history in Inner Mongolia region where no perennial clovers could be cultivated and used due to the extreme cold winter and dry summer. Mc No.1 possessing excellent properties like winter hardiness, drought and salt tolerance, long life and high biomass has become an important resource for forage and the other ecological purposes being concerned.

References

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