The Study on the Photosynthetic Characteristics of Three *Melilotoides ruthenica* Strains

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Introduction *M. ruthenica* (L.) Sojak is a relatively new forage crop and may also be a source of genes for the genetic improvement of cultivated alfalfa (*Medicago sativa* L.) for stress tolerances. Many researches about it have been made, but the researches about the photosynthetic characteristics, are few. In the present paper, mathematical modeling was used to calculate the light response curves of three *M. ruthenica* strains to compare their photosynthetic characteristics.

Materials and methods Research was conducted in Zhenglan Banner (42°16′S, 115°57′E) in August 2007. Three *M. ruthenica* strains (90-36, 00-61 and 00-81) domesticated by Grassland Research Institute of Chinese Academy of Agricultural Science. A Li-cor-6400 portable photosynthesis system (LI-COR, USA) was used to measure net photosynthetic rate (Pn) from 8:30 to 11:30 a.m. The leaf was illuminated at the PPFD of 2000, 1500, 1200, 1000, 800, 600, 400, 200, 150, 100, 50 and 0 $\mu mol \cdot m^{-2} \cdot s^{-1}$, Pns were recorded and the response curves were estimated through a non-linear regression, using the non-rectangular hyperbola model of Farquhar (1980). Fundamental parameters, such as the apparent quantum yield (AQY), the maximum net photosynthetic rate (Pmax), Light compensation point (LCP), light saturation point (LSP), and dark respiration rate (Rd), were determined according to Guo J. (2005).

Results Figure 1 showed the predicted net photosynthetic rates by the models against the observed values for the three strains. Fundamental parameters of the response curves were given in Table 1. The correlation coefficients (R^2) were statistically significant and above 0.923. There were significant differences in Pmax, LSP, LCP, and Rd among the three strains, and no significant differences in AQY (Table 1). The Pmax varied from 23.760 $\mu mol \cdot m^{-2} \cdot s^{-1}$ for 00-61 to 12.079 $\mu mol \cdot m^{-2} \cdot s^{-1}$ for 00-81. The LSP of 00-61 was 42.918% and 105.142% higher than those of 90-36 and 00-81, respectively, while all strains had similar AQY. 00-61 and 90-36 had 106.075% and 96.407% higher LCPs than 00-81, and 76.320% and 46.547% higher Rds than 00-81, respectively. All above mentioned parameters indicated that strain 00-61 performed the best in photosynthesis, strain 00-81 performed the worst, and strain 90-36 was in the middle.

Table 1 *Photosynthetic parameters of three* M. ruthenica *strains.*

Strains	Pmax	LSP	LCP	AQY	Rd
90-36	20.663[b]	537.918[b]	79.314[a]	0.040[a]	3.038[a]
00-61	23.760[a]	768.784[a]	75.593[a]	0.033[a]	2.525[a]
00-81	12.079[c]	374.758[c]	38.488[b]	0.032[a]	1.723[b]

Different letters in the same column mean significance at 0.05 level

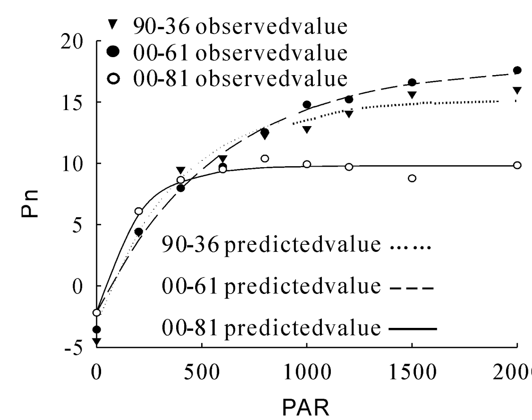

Figure 1 *Responses of net photosynthetic rate in* Melilotoides ruthenica *strains to different light intensities.*

Conclusions The non-rectangular hyperbola model proposed in this study provides a powerful and valuable tool for understanding and predicting the photosynthetic characteristics of *M. ruthenica* strains. We considered that Strain 00-61 with higher Pmax, LSP, LCP, and Rd, which may lead to a high photosynthetic capacity, can be planted in strong light regions, where the environmental conditions favorite it to accumulate more dry matters. Strain 00-81 with lower LSP and LCP, indicated that it was more tolerant to shading than other strains.

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