Available online at www.sciencedirect.com
ScienceDirect
Journal of Integrative Agriculture
2014, 13(10): 2260-2267
October 2014
RESEARCH ARTICLE

Yield Evaluation of Twenty-Eight Alfalfa Cultivars in Hebei Province of China

ZHANG Tie-jun[1], KANG Jun-mei[1], GUO Wen-shan[1], ZHAO Zhong-xiang[2], XU Yu-peng[2], YAN Xu-dong[2] and YANG Qing-chuan[1]

[1] *Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing 100193, P.R.China*
[2] *Cangzhou Technical College, Cangzhou 061001, P.R.China*

Abstract

Cultivar selection is important for alfalfa (*Medicago sativa* L.) hay production. From 2009 to 2012, a field study was conducted to evaluate the dry matter yield (DMY) of 28 cultivars in Cangzhou District of Hebei Province, China, and to determine the most suitable cultivars for this province and other zones with similar climate conditions. 28 alfalfa cultivars were sown in late March of 2009 and were harvested for hay four times in each subsequent year. The results showed that the climatic conditions resulted in significant differences in annual DMY among years, with the second year being the highest and the first year the lowest. The top five cultivars with the highest total DMY were L2750 (62.75 t ha^{-1}), Horn (62.72 t ha^{-1}), 86-266 (61.55 t ha^{-1}), German (61.44 t ha^{-1}) and Zhongmu 1 (61.18 t ha^{-1}), respectively. Across all four years, first harvest had the highest ratios to annual DMY except the cultivar of Rambler, while the fourth harvest had the lowest ratio. There were positive correlation relationships between DMY of each harvest and annual DMY, and the correlation coefficients were all significant in four years. And the path coefficients of first harvest were always the highest in four years. The qualities showed small variations among these cultivars and the cultivar L3750 presented the highest crude protein in both years. Crude protein had significant positive correlation with relative feed value (RFV) in both years while crude fiber had significant negative correlation with RFV and crude fiber.

Key words: alfalfa, cultivars, yield, forage quality

INTRODUCTION

Alfalfa (*Medicago sativa* L.) is a very important legume forage and has a wide distribution plant in China and all over the world (Iannucci *et al.* 2002). In recent years, the expanding intensive livestock systems have resulted in a large demand for forage in China. However, grassland sown to alfalfa was only about 2.6×10^6 ha and produced 3.0×10^5 t hay products, far lower than the actual demand, and this has led to a sharp increase in the hay import and price of alfalfa forage (Yang and Wang 2011). A program titled Returning Degraded Land or Marginal Land to Forest or Grass, similar to the Conservation Reserve Program in USA, was initiated across China in 1999 to conserve soil and water resources in areas prone to erosion (Wang 2005). Alfalfa was widely cultivated as a soil cover or as windbreaks in arid and semi-arid areas of northern China. And from 2012 to 2016 the Ministry of Agriculture of the People's Republic of China spend 525 millions CNY each year to encourage the standard production of alfalfa hay. Thus, the area devoted to forage production of alfalfa has increased steadily in last

Received 9 June, 2013 Accepted 22 July, 2013
ZHANG Tie-jun, Tel: +86-10-62816357-601, Mobile: 18911629095, E-mail: tiejunzhang@126.com; Correspondence YANG Qing-chuan, Tel/Fax: +86-10-62735996, E-mail: qchyang66@163.com

doi: 10.1016/S2095-3119(13)60576-6

years, which has stimulated researches in the factors that limit alfalfa forage production.

The cultivar selections are important for hay production of alfalfa. The increase of yield owns about 30% to the cultivar and unsuitable cultivar probably results in the decrease of yield especially the failure of establishment (Wang *et al.* 2009). Some field experiments have been conducted to test the performance of alfalfa cultivars in North China and suggested the suitable cultivars such as WL324, Forerunner and DKl27 (Mao 2006; Wang 2011). However, most research last for two or three years and the relative feed value (RFV) of these cultivars were not test. With the expansion of alfalfa planting area, the import of alfalfa seed has increased twice from 2010 to 2012 and many new alfalfa cultivars have been introduced into China (Wang *et al.* 2012), most of which have not been test on their performance before popularizing in North China. Thus, little information is available on the forage yield and the resistance of these cultivars to disease and insects in the local climate and soil condition, which limited the forage production of alfalfa.

Huanghuaihai plain, including southern and central parts of Hebei Province, is one of the largest alfalfa production area in China. In this study, 28 alfalfa cultivars were tested over four consecutive years. The main objective was to determine the adaptability of these alfalfa cultivars and select the best ones for forage production in this area. The second objective was to provide information for alfalfa breeding in this area.

RESULTS

Statistical probabilities of the *F* test for year, cultivar and their interactions for dry matter yield (DMY) and annual plant height are summarized in Table 1. There were significant year×cultivar interactions for annual DMY and annual plant height, indicating the variable performance of different cultivars among years.

Dry matter yield

During the last three years, the climatic conditions including the mean temperature and precipitation were quite variable, resulting in significant DMY differences among years (Fig.). The highest annual DMY were obtained in 2010 for all cultivars.

Table 1 Statistical probabilities of *F* test for year, cultivar and their interactions on annual dry matter yield and annual plant height

Source	*df*	Annual dry matter yield (*F* values)	*df*	Annual plant height (*F* values)
Year (Y)	3	743.8**	3	2441.0**
Cultivar (C)	27	31.6**	27	19.6**
Y×C	81	2.5**	81	1.5**

**, significant at P=0.01; *, significance at P=0.05. The same as below.

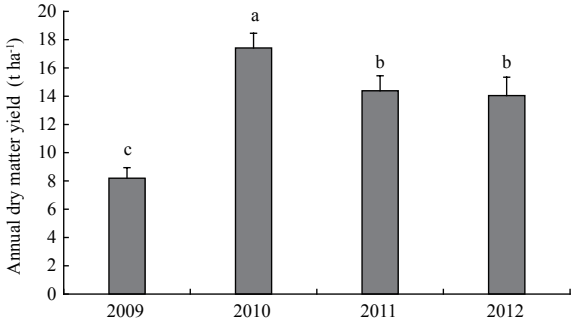

Fig. Mean annual yield (t ha^{-1}) of different years. Different letters indicate a significant difference at P<0.05.

Total annual DMY of each cultivar were quite variable, ranging from 22.07 to 62.75 t ha^{-1} (Table 2). The five cultivars with the highest total DMY were L2750 (62.75 t ha^{-1}), Horn (62.72 t ha^{-1}), 86-266 (61.55 t ha^{-1}), German (61.44 t ha^{-1}) and Zhongmu 1 (61.18 t ha^{-1}), respectively; these cultivars were not significantly different (P<0.05). The three cultivars with the lowest total annual DMY were Rambler (22.07 t ha^{-1}), Emperor (41.01 t ha^{-1}) and Kitawakaba (44.11 t ha^{-1}), and Rambler were significantly lower than other 27 cultivars.

DMY and ratios of each harvest

Averaged across four years, there were significant differences in mean DMY of each harvest (Table 3) (P<0.05). For 27 cultivars except Rambler, first harvest resulted in the highest DMY and fourth harvest, the lowest, and there was a decreasing trend in DMY from first to fourth harvest. The top five cultivars with the highest DMY of first harvest were Zhongmu 1 (5.83 t ha^{-1}), German (5.61 t ha^{-1}), Horn (5.57 t ha^{-1}), L2750 (5.52 t ha^{-1}) and 86-266 (5.50 t ha^{-1}), which were the same as those with the highest total annual DMY. Similarly, the cultivars with the lowest total annual DMY also had the lowest