International Section

NORTHWEST CHINA

Sustaining Higher Alfalfa Yields in Inner Mongolia

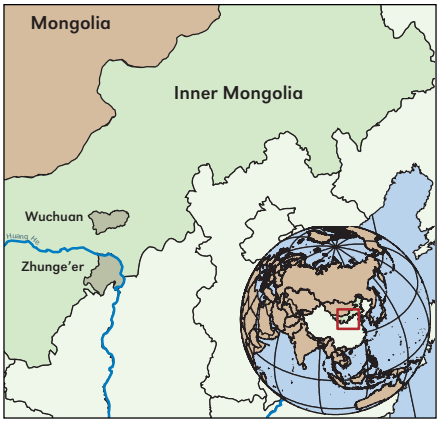
By Duan Yu, Tuo Debao, Zhao Peiyi, and Li Huanchun

The fact that forage crops in Inner Mongolia receive little, if any, fertilizer input is highly evident in the face of general declines in productivity, crop quality, and soil quality. The region's land resource is of great importance to the food production goals of China. The identification of balanced nutrient strategies is an integral part of creating a revitalized forage production system.

Among the biggest challenges faced by the Inner Mongolia Autonomous Region (IMAR) are improving fragile range land ecosystems, increasing productivity in grazed and fodder producing systems, and strengthening crop management to meet local challenges (usually drought). The autonomous region is well known for its expansive range lands, estimated at about 87 million hectares (M ha) in 2001, which represents over 73% of total area in IMAR, and about 22% of all grasslands within China. IMAR also has a large cultivated area at 5.8 M ha, but its low crop index of 0.7 means that 30% of sown areas are unharvestable due to adverse conditions such as drought. Barren fields are a source of repeated dust storms, resulting in severe soil erosion events causing great environmental and economic loss.

IMAR is gradually increasing its land use efficiency through a steady, government-supported conversion of less productive arable lands to grasslands or forestry. By the end of 2003, 1.5 M ha of arable land has been returned to various forms of forest and grassland reserves in IMAR. The region is also steadily retiring its degraded grazing/pasture lands and establishing responsible management systems for those forage lands identified as still having good production potential. This process is imperative and is in harmony with the nation's strategy to improve its managed ecosystems. Traditionally, managed forage crops receive little to no fertilizer inputs. As such, it is a low value, environmentally degrading system.

Improved forage crops or seeded grasses are required to reduce the stress caused by the current numbers of livestock. The introduction of highly productive grass varieties along with proper fertilizer management will be important for sustained success. No doubt forage crop production will con-



The Inner Mongolia Autonomous Region has vast range lands.

Table 1. Soil test results of field sites in Zhunge'er and Wuchuan counties, Inner Mongolia.

Site	pH	OM	Ca	Mg	K	Ca/Mg	Mg/K	N	P	S	B	Cu	Fe	Mn	Zn
		- % -	------ mg/L ------					---------- mg/L ----------							
Zhunge'er	8.4	0.2	1,603	111	74	14.4	1.5	3.0	13.7	1.8	2.1	0.7	6.4	6.8	1.7
Wuchuan	8.5	1.0	2,950	166	78	17.8	2.1	47.8	18.4	2.4	3.2	2.0	10.7	8.5	1.4

tinue as a prominent agricultural activity in IMAR. Recent forecasts indicate that Chinese farmers will expand the numbers of beef animals by 4.5% to 68.6 M head in 2006, matching a similar increase in 2005.

This research demonstrates the impact of balanced fertilizer use on alfalfa production. Success will not only entrench a large economic driver, but also an effective means of protecting the region's agro-ecology.

Field experiments were conducted in Zhunge'er and Wuchuan counties in 2004 and 2005. Soils at these sites had deep plough layers, were sandy loam in texture, but had poor fertility (**Table 1**). These soils are calcareous, high in available calcium (Ca) and magnesium (Mg), with moderate potassium (K) availability, and low nitrogen (N) and phosphorus (P) fertility. The study sites used 30 m^2 plots (7.5 m x 4 m), randomly arranged to receive urea, triple superphosphate, and potassium chloride (KCl) fertilizers prior to seeding. Fertilizers were applied as a band 20 cm below the surface.

In Wuchuan, alfalfa was sown in mid-May and first harvested in mid-September. In Zhunge'er, alfalfa was sown in mid-June and first harvested in mid-September. An "optimum" fertilizer treatment of 45-60-45 kg N-P_2O_5-K_2O/ha was set for both sites. This recommendation was a combined result of soil test interpretation and regional nutrient recommendations for other crops. Three omission plots were also included to quantify the relative effects of excluding N, P, and K from the optimum. A second cut was harvested from both sites in 2005. The vast majority of cultivated forages in IMAR are grown under rainfed conditions.

Results from the nutrient omission plots suggest large benefits at both sites from a one-time, balanced application of fertilizer (**Table 2**). First cut yields at Zhunge'er seemed more affected by nutrient omission than at Wuchuan. Regardless, the omission of K fertilizer had the greatest impact on first cut dry matter (DM) production at either location in the year of stand establishment. Yield gaps caused by K omission ranged between 1.0 t/ha (-28%) in Wuchuan to 1.5 t/ha (-44%) in Zhunge'er. Local economics placed the average value:cost ratio for K fertilizer at 10:1 (data not provided). Omission of N and P resulted in DM losses of 0.6 and 0.8 t/ha at Zhunge'er, and 0.3 t/ha each at Wuchuan.

Production during the second cut was considerably higher at both sites, but production at Zhunge'er was especially improved. Yield gaps still existed between treatments. However, DM yield responses indicated that the effect of omitting P was now most significant. Thus, yield gaps due to N, P, and K omis-

Table 2. Rainfed alfalfa yields in Zhunge'er and Wuchuan counties (2004-2005).

Dry matter yield, t/ha	Zhunge'er				Wuchuan			
	NPK†	- N	- P	- K	NPK†	- N	- P	- K
1st cut	3.4	2.8	2.6	1.9	3.6	3.3	3.3	2.6
2nd cut	11.5	10.7	8.7	10.2	5.8	5.7	4.5	5.5
Total	14.9	13.5	11.3	12.1	9.4	9.0	7.8	8.1

† NPK = 45-60-45 kg N-P_2O_5-K_2O/ha

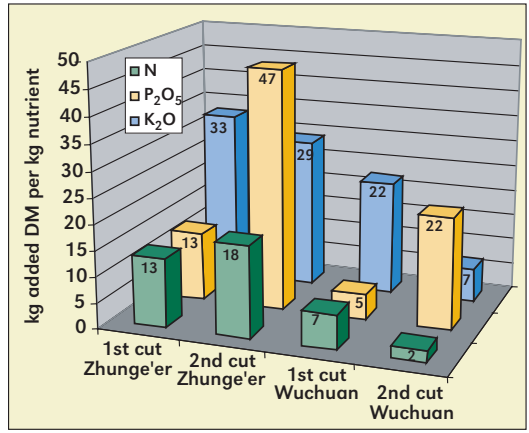


Figure 1. Contribution of N, P, and K towards added alfalfa dry matter production.

sion were 0.8 t/ha (-7%), 2.8 t/ha (-24%), and 1.3 t/ha (-11%) at Zhunge'er. In Wuchuan, the gaps were 0.1 t/ha (-2%), 1.3 t/ha (-22%), and 0.3 t/ha (-5%). This trend was similar for the combined yield totals since the second cut had large influence on total production figures. Dry matter contributions per unit nutrient are provided for each cut in **Figure 1**.

Conclusions

The present productivity of grasslands in IMAR is not capable of sustaining the intensity of animal husbandry and will certainly not support any future plans for expansion as a means to inject much needed cash into the region. Alfalfa stands rarely thrive and common practice without fertilization typically results in a short-lived stand with low productivity. Application of fertilizers promotes growth and will prolong stand longevity. In addition, increased plant and root density resulting from fertilizer application increases protective ground cover and reduces the severity of wind erosion events, effectively preventing desertification. Under the conditions of this study, nutrient omission plots suggest significant initial contributions to dry matter production from both K and P fertilizers. The advantage gained from applied P became especially evident with time. The research suggests that stand establishment and growth can be enhanced through the implementation of balanced fertilization. BC

Mr. Duan Yu of Inner Mongolia Academy of Agricultural and Animal Husbandry Sciences observes the effect of balanced fertilization on alfalfa growth.

Mr. Duan is Associate Professor, Mr. Tuo is Professor, Mr. Zhao is Associate Professor, and Ms. Li is Assistant Professor, all with Plant Nutrition and Analysis Institute, Inner Mongolia Academy of Agricultural and Animal Husbandry Sciences, China; e-mail: yduan@ppi.caas.ac.cn.

World Congress of Soil Science Set for July 9-15

The 18th World Congress of Soil Science (WCSS) will take place in Philadelphia July 9-15, 2006, under the theme "Frontiers of Soil Science: Technology and the Information Age." PPI Senior Vice President Dr. Paul Fixen serves on the organizing committee and PPI/PPIC Southern Cone Program Director Dr. Fernando García is the convenor of a symposium organized jointly by the University of Nebraska and PPI addressing nutrient use efficiency and global agriculture. For further information, a link is available at: >**www.ppi-ppic.org**<.