SNOW MANAGEMENT INCREASES ALFALFA YIELDS

by

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ABSTRACT

Alfalfa was seeded in May 1986 within and adjacent to a 3.3 ha shelterbelt area of tall wheatgrass windbreaks near Swift Current, Saskatchewan. The windbreaks, established in 1976 as north-south oriented double rows spaced 15 m apart, occupy about 9% of the land area. The snow deposition capacity between the 1 m tall grass culms exceeds the 75th snowfall percentile by 3-fold. Although this maximum was not reached in 1987 or 1988, snowcover retentions were at least double those outside the shelterbelts. Alfalfa forage production in 1987 averaged 3430 kg/ha within the shelter: 47% greater than that from unprotected plots. In the drier year of 1988, production was 980 kg/ha within the shelter: 83% greater than yields from the unprotected areas. Shelterbelts reduce wind speeds, and enhance snow covers in winter. This increases soil water reserves, resulting in more alfalfa forage.

INTRODUCTION

In the northern Great Plains, rows of tall wheatgrass (Elytrigia pontica (Podp.) Holub) spaced on about 15 m centers behave as low-level perennial windbreaks, reducing evaporation rate and retaining wind-transported snow (Aase and Siddoway, 1976). They have also increased yields of annual grains grown between them (Black and Siddoway, 1976). Overwintering cereals benefitted from the temperature - moderating snow covers trapped by the windbreaks (Steppuhn and Nicholaichuk, 1986).

Southwest Saskatchewan is semi-arid. Mean annual precipitation is 360 mm, one-third of which occurs as snowfall. Mean growing season precipitation is 165 mm, pan evaporation is 735 mm. Only one hay cut is obtained per year without irrigation. Very winter-hardy drought-resistant alfalfa (Medicago spp.) varieties are used. Regrowth potential is unimportant. Further north, or with irrigation, more favorable precipitation-evapotranspiration relationships allow two or three cuts of hay per year. Flemish varieties from eastern Canada and adjacent areas of the U.S.A. are attractive because of their excellent regrowth potential, but are reliably hardy for only 1-2 years. They require a good snow cover to reduce winterkill in older stands (Goplen et al., 1980).

We wished to know if the use of tall wheatgrass windbreaks would a) increase alfalfa hay yields of adapted varieties, and b) improve the microclimate sufficiently to allow less hardy alfalfa varieties to demonstrate their superior production potential.

EXPERIMENTAL PROCEDURE

In 1976, tall wheatgrass (var. Orbit) was seeded on a square 3.3 ha area, using a double row system on 15 m centers with a north-south orientation of the windbreaks. The area occupied by the wheatgrass windbreaks is about 8% of the land area. The land has about a 1% slope facing south. The areas between the windbreaks were each divided crosswise into three. The center plot was 46 m long; the outer two were 68.5 m long, to allow for edge effects due to wind direction relative to the windbreak direction. The eastern

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most and westernmost strips had no windbreak on one side. They were seeded and harvested as the rest but were not included in the analyses. In May 1986, three varieties of alfalfa (Table 1) were seeded into these plots at random in rows spaced at 61 cm and running north-south. Immediately south, an area identical in size but without windbreaks was seeded in a similar arrangement at the same time. In both areas, the alfalfa was seeded into standing wheat stubble.

Table 1. Characteristics of the alfalfa varieties grown

Alfalfa Variety	Rooting Pattern	Regrowth Potential	Winter-Hardiness in Saskatchewan
Rangelander	Creeping	Poor	Excellent: no damage most winters
Beaver	Tap	Good	Good survival most winters
Angus	Tap	Excellent	Young stands are usually hardy: hardiness decreases with age

In late January, 1987, visual estimates of snow cover were made. There was insufficient snow for a reliable measurement. Soil water volumes were determined gravimetrically from cores extracted to a depth of 122 cm in each alfalfa plot at the start (Sept.-Oct.) and end (April) of each overwinter recharge period. The 1986-87 data were averaged from 6 cores per plot positioned one-third and two-thirds of the distance between the windbreaks, while 3 cores down the plot center provided the 1987-88 samples. In early February, 1988, at least 30 snow depth measurements were combined with at least 5 water equivalent gravimetric cores sampled along the center and approximately 3 m from the windbreaks in each plot to obtain snow cover data. In late June 1987 and 1988, alfalfa was cut to a stubble height of 7 cm for a length of 1 m from every third row across each plot, dried at 90 C and weighed for yield. In 1987, a second cut was taken in September.

RESULTS

The winter of 1986-87 was mild with little snow: snowcover was intermittent and usually incomplete. however, the area between the windbreaks usually had more snow than the adjacent open area, and this was reflected in the soil moisture the following April (Table 2). The winter of 1987-88 was also milder than usual, but there was a measureable amount of snow on the experimental site in early February, 1988. The area between the wheatgrass windbreaks had three times the snow of the open area (Table 2) but it was not distributed uniformly (Figure 1).

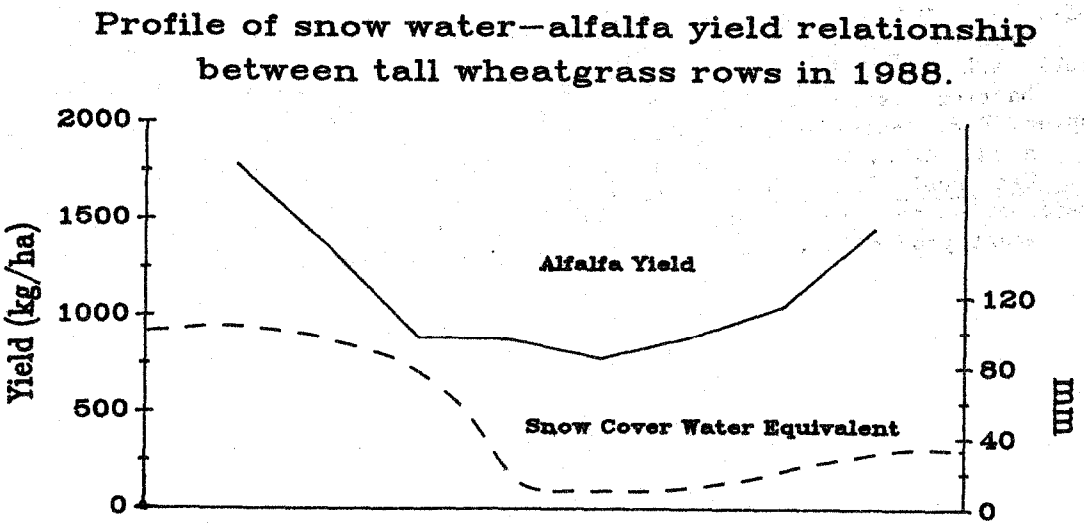
Table 2. Water and alfalfa dry matter yield measurements for areas sheltered between tall wheatgrass rows and open areas.

	Measurement			
	1987		1988	
Parameter	Open	Sheltered	Open	Sheltered
Jan-Feb. snow cover (Water equivalent-mm)	5	10	18	52
Soil water, 0-122 cm depth, April (mm)	240	265	150	170
Alfalfa dry matter yield (kg/ha)	2330	3430	530	980

Alfalfa production followed the snow and spring soil moisture patterns (Table 2): in both years, alfalfa used all available soil water (Table 3). Yields were good in 1987, and enough regrowth occurred for a second cut in September (Table 4). All alfalfa varieties were consistent in their yield: they produced on average 53% and 32% more forage respectively at the first and second cuts when growing between the windbreaks than when growing in the open field. Alfalfa growth on the open field in 1988 was very poor and from a commercial standpoint was probably not worth harvesting. Production between the windbreaks was 85% greater than that in the open field. Growth was very uneven, being good near the windbreaks and little better than in the open field midway between the wheatgrass rows (Figure 1). There was no regrowth.

Table 3. Soil water volume (mm) in the upper 122 cm of the profile during the period 1986-88

Site	Fall 1986	April 1987	Fall 1987	April 1988	Fall 1988
Sheltered by tall Wheatgrass windbreaks	246	265	149	168	140
Open field	245	239	145	150	145



In 1987, the creeping-rooted variety 'Rangelander' produced more forage than the other two in the spring, but the locally-adapted tap-rooted variety 'Beaver' produced the same amount of regrowth as 'Rangelander' (Table 4). In 1988, both these varieties produced the same amount of forage. The Flemish variety 'Angus' had significantly lower production at each harvest. To date it seems that its rapid regrowth characteristics have no advantage; perhaps the variety is not well-enough adapted to the soil conditions present for most of the year.

Table 4. Dry matter yields kg/ha (hand-sampled)

Alfalfa Variety	Sheltered between tall wheatgrass rows	Open: No tall Wheatgrass Rows
1st cut, June 1987		
Rangelander	2920	1860
Beaver	2490	1600
Angus	2290	1570
2nd cut, Sept. 1987		
Rangelander	900	700
Beaver	990	670
Angus	710	600
One cut, June 1988		
Rangelander	1080	540
Beaver	1090	600
Angus	770	460

REFERENCES

Aase, J.K. and Siddoway, F.H. (1976) Influence of tall wheatgrass wind barriers on soil drying. Agron. J. 68: 627-631.

Black, A.L. and Siddoway, F.H. (1976) Dryland cropping sequences within a tall wheatgrass barrier system. J. Soil Water Conserv. 31: 101-105.

Goplen, B.P., Baenziger, H., Bailey, L.D., Gross, A.T.H., Hanna, M.R., Michaud, R., Richards, K.W.. and Waddington, J. (1980) Growing and managing alfalfa in Canada. Agr. Can. Publ. 1705. Supply and Services, Canada. pp.50.

Steppuhn, H. and Nicholaichuk, W. (1986) Managing snow to extend the areal range of winter wheat production. Proc. 54th Ann Meet. Western Snow Conf. 34-40.