SNOW MANAGEMENT BY SWATHING AT DIFFERENT HEIGHTS

by

W. Nicholaichuk and D.W.L. Read*

INTRODUCTION

Snow is the main source of manageable fresh water on the Canadian Prairies. It provides a source for replenishing reservoirs, stream flow and soil moisture. Generally, snow constitutes over 25% of the amount of precipitation on the Canadian Prairies. The water equivalent of snow is about 3½ to 5 inches.

Recognizing the potential of snow as an additional source of soil moisture, attempts have been made to manage this resource by snow ridging and by use of shelterbelts. At Scott, Sask., Matthews (1946) investigated the effect of snow ridging on crop production. Yield increases were generally modest, except on crested wheatgrass stands. Moisture increases in the 3-foot depth ranged from 10 to 33%. Recent studies by the University of Saskatchewan (Steppuhn and Erickson 1979) indicated that beneficial effects of ridging were only derived in 2 of 5 years.

In a 5-year study, the effect of shelterbelts on soil moisture and wheat yield were considered by Staple and Lehane (1955). Because of nonuniform distribution of snow, the overall average increase attributed to shelterbelts was 0.7 bushels/acre. Competition for soil moisture by trees affected wheat yields up to 25 feet from the shelterbelt row.

Another method that attempts to manage snow is by swathing at alternate heights. Based on observations by interested farmers on the effect of nonuniform stubble stands on soil moisture conservation, and reports of similar activities in the U.S.S.R., a study was initiated at Swift Current in 1972 to evaluate this system of management. This paper will review the findings to date.

MATERIALS AND METHODS

Four uniform plots ranging in size from 4 to 4.8 ha (which were in a 2-year rotation of spring wheat and summerfallow), were used in the study. One swathing treatment consisted of alternately swathing the wheat crop at two different heights using a self-propelled swather. The heights depended on the crop stand conditions (Table 1). The other plot was swathed at a uniform height.

Standard meteorological snow survey procedures were used to determine the snowpack accumulation in the two treatments. The survey consists of sampling at five locations spaced 30 m apart along a transect within

* Research Scientists, Research Station, Research Branch, Agriculture Canada, Swift Current, Saskatchewan, S9H 3X2.

each plot. Snow samples taken with a "Prairie Snow Sampler" were weighed and melted down to determine the water content. The depth of snow was noted to determine the water equivalent.

Table 1. Snowfall and snow accumulation on the uniform and nonuniform stubble system of snow management (1972-79)(cm)

	Uniform stubble				Nonuniform stubble		
Year	Snow-fall	Stubble height	Avg snow depth	Equiv. moisture	Stubble height	Avg snow depth	Equiv. moisture
1972-73	12.6	28	8	1.3	30 & 13	9	1.6
73-74	19.4	15	30	7.7	23 & 15	37	11.9
74-75	12.6	15	22	5.4	23 & 13	27	5.3
75-76	14.5	15	19	5.3	15 & 8	18	4.5
76-77	6.0	25	14	3.0	25 & 13	16	4.0
77-78	12.7	31	21	6.0	31 & 15	31	9.8
78-79	18.8	23	29	6.8	31 & 13	30	8.5
Average			20	5.0		23	6.7

Mean difference in equivalent moisture = 1.7 cm (significantly different at 2.5% level)

Gravimetric soil moisture samples at six locations on each plot to a depth of 120 cm were taken to determine the soil moisture content in the spring and fall. In addition, in the fall of 1976 and spring of 1977, six sampling sites were established on each treatment on a large farm field to determine the effect of snow management by swathing at alternate heights.

RESULTS AND DISCUSSION

The average stubble height at the time of swathing is given for the two treatments (Table 1). Depending upon crop conditions, the upper height of alternate swathing treatment was limited to a point where swath could be laid with a minimum of straw. Uniform height, as determined by the operator, was considered a height suitable to lay a good swath that would stand up to typical fall conditions in southwestern Saskatchewan.

The average depth of snow in the alternate height stubble was 23 cm, compared to 20 for the uniform stubble. This difference in stubble equates to an average moisture of 5.0 and 6.7 cm of moisture, respectively. Generally, the water equivalent of snow in the alternate height stubble was higher than the uniform stubble. The snow tended to accumulate in the short stubble at a higher density than within the tall stubble (data not shown). The density of snow within tall stubble was approximately the same as within the uniformly swathed plots.

More importantly, the question is, to what extent is the trapped snow stored in the soil? The 7-year average of 4.67 cm of moisture stored over winter in a uniform stubble field (Table 2) is somewhat lower than the 20-year average of 5.1 cm reported by Staple and Lehane (1952). The

average increase in moisture stored in the profile by an improved system of stubble management was 1.43 cm which represents a 30% increase. The increase in the amount of moisture conserved ranges from 0.38 to 5.19 cm. Based on a large farm scale trial near Swift Current in 1977-78, the added amount of soil moisture available by this system was 2 cm.

Table 2. Available soil moisture (0-120 cm depth) as affected by snow management practices (1972-79)(cm)

	Uniform stubble			Nonuniform stubble		
Year	Fall	Spring	Difference	Fall	Spring	Difference
1972-73	4.39	7.96	3.57	3.10	9.40	6.30
73-74	-.41	7.04	7.45	-1.63	6.52	8.15
74-75	4.82	9.09	4.27	4.06	8.74	4.68
75-76	4.35	5.48	1.13	3.42	5.88	2.46
76-77	3.98*	7.12*	4.14*	-0.77	10.51	4.52
77-78	.15	6.08	5.93	-1.40	9.72	11.12
	0.60**	5.50**	4.90**	3.98**	10.96**	6.98**
78-79	1.03	7.24	6.21	0.93	6.40	5.47
Average			4.67			6.00

Mean difference in available moisture = 1.43 (significant at the 5% level)
* estimated from adjacent rotation studies on South Farm.
** large field scale private farm observations near Swift Current.

According to Staple and Lehane (1954), the average seeding to harvest rains amount to 19 cm. As a result, there must be 8 cm or more of reserved moisture, or more than average rainfall, to produce a crop of 14 bushels on stubble land. With an improved stubble management system for moisture conservation, the average available water in the spring over the 7-year period was 8.16 cm. If 8.0 cm available water was considered the criteria for seeding stubble, then stubble could have been seeded in four out of the seven years. For a uniform system of management, only three years out of seven would be considered suitable for seeding stubble.

Based on snow surveys, approximately 92% of the trapped snow is stored as soil moisture. From year to year, the amount stored in the profile appears to be linearly related to the amount of snow potentially available. However, trapping additional snow does not always guarantee more water is available for conservation. Hydrologic studies at Swift Current have shown that the presence of late fall rains often increases the runoff potential, depending on springmelt conditions. As a result, there may be years in which swathing at alternate heights may not be of benefit.

An important consideration that must be made when considering snow management is that if the method proves successful, the resultant stored moisture should be utilized for growing a crop. Otherwise, there is the risk of contributing to the ever-increasing problem of dryland salinity.

CONCLUSIONS

Snow management by swathing at alternate heights in southwestern Saskatchewan increases the amount of stored moisture by 1.4 cm. Depending on the year and snowfall, the added amount of stored moisture can be as high as 5 cm at the time of seeding. If such increases in stored soil moisture can be achieved, then the system of managing stubble for snow management is definitely worthwhile. However, there is always an element of risk which is always associated with farming in southwestern Saskatchewan.

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