SWATHER ATTACHMENTS FOR SNOW MANAGEMENT

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INTRODUCTION

Research in northern Montana and at the Swift Current Research Station has shown that grass barrier strips can be used effectively to trap snow and increase soil moisture. However, the disadvantages of a permanent competitive barrier has led to the search for a noncompetitive means of snow management without the restrictions to field operation created by a permanent barrier (Nicholaichuk 1980).

Initial attempts used alternate height cutting made by a swather with a double swath attachment. One pass is cut at normal height; the second pass is cut as high as possible and delivered onto the first windrow. This approach traps more snow than standard height stubble but is not as effective as desired.

The current concept consists of tall narrow strips of stubble alternating with normal height stubble for the remaining width of a swather. This approach has aerodynamic properties similar to the grass barrier strips and is capable of trapping more snow than alternate height cutting. Preliminary work at the Swift Current Research Station during 1979 indicated this could be done with relatively simple attachments mounted on a swather during the harvest operations. Development was continued with two Agriculture Canada AERD contracts with Agricultural Engineering, University of Saskatchewan, during 1979 and 1980 and subsequently at the Swift Current Research Station during 1981 to the present.

ATTACHMENTS CONCEPTS AND DESIGN

Clipper Type

Two models were designed by the Agricultural Engineering Department. The first mounted externally on the reel arm of the right-hand end of a self-propelled swather. The clipper consisted of a 0.4-m cutter bar, a reel and a narrow draper to deliver the cut material onto the upper portion of the larger draper of the swather. The clipper reel and cutter bar are at constant distance but the cutter bar height can be adjusted by raising or lowering the main reel. It is normally set to cut the upper 15 to 20 cm of the grain stalk. Depending on the crop height, about 30 to 60 cm differential in stubble height can be achieved.

The second model mounted inboard on the right-hand end of the cutter bar and required extensive modifications to the swather reel. It essentially achieved the same result but the heads of grain were mixed into the longer material whereas the first model delivered the cut material onto the top of the windrow.

The stubble pattern of both clippers is of block design 0.4 m wide (Fig. 1). Care must be taken in driving the swather to avoid cutting off the barrier on the next round.

Fig. 1. Clipper stubble pattern

Deflector Type

Two models of deflection were developed: a single V-shaped unit and a double triangular-shaped unit with a space between the two. The double deflector can be mounted in a diverging or converging mode (Fig. 3 and 4).

The single deflector leaves a single V-shaped pattern as illustrated in Figure 2. This is achieved by bending the stalks of grain to each side before they get to the cutter bar, thus when they are cut a longer stubble is left as compared to the stalks that are cut when standing straight. The differential length is determined by the distance the stalk is bent over prior to cutting. A lifter finger is employed on each side of the deflector to ensure that the heads get cut and get deposited onto the draper (Fig. 2).

The double deflector is designed to leave two strips of tall stubble side by side. Barrier porosity is thus reduced and a more

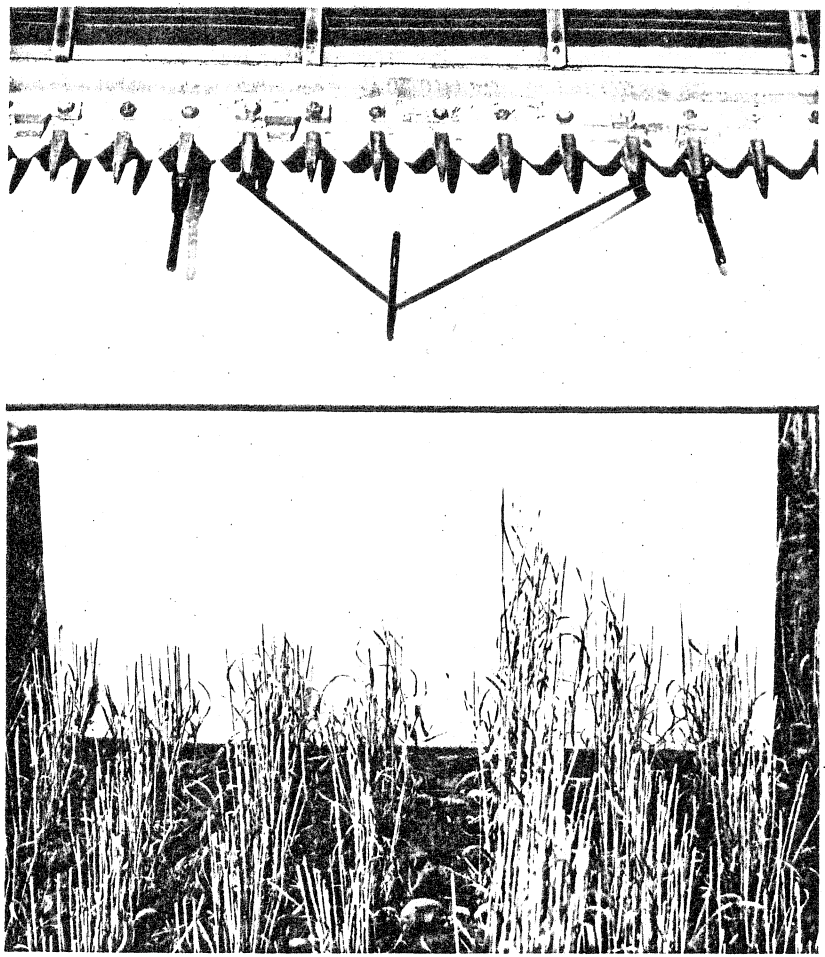

Fig. 2. Single deflector with stubble pattern

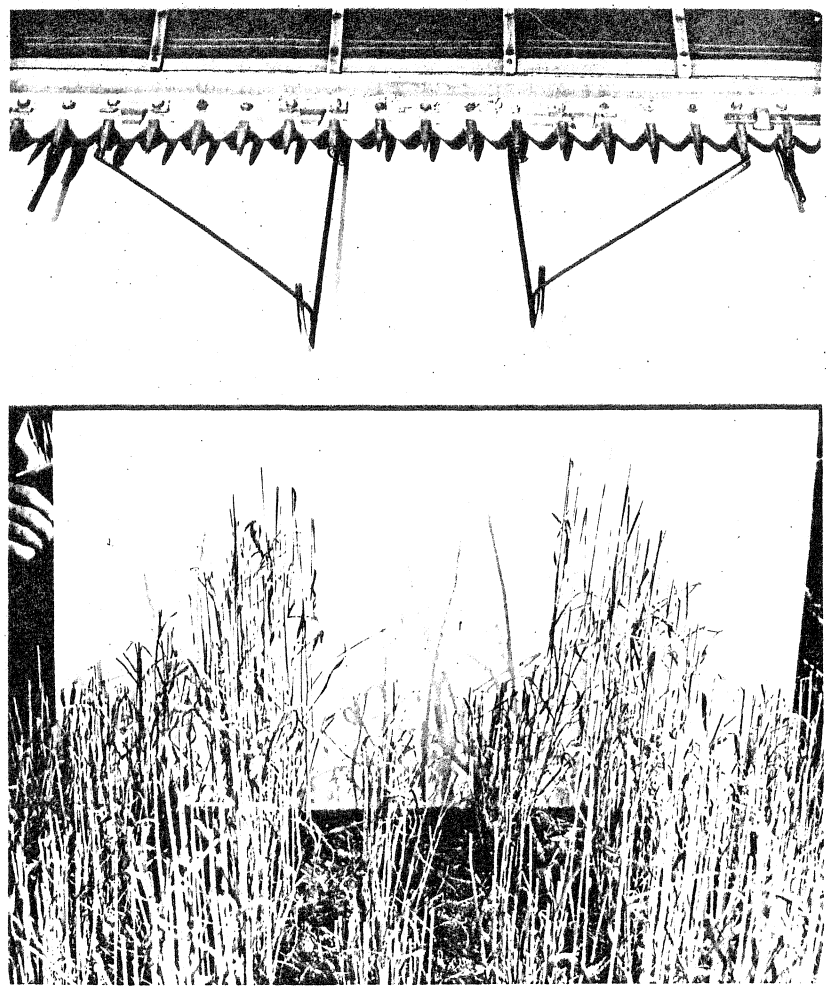

Fig. 3. Double diverging deflector with stubble pattern

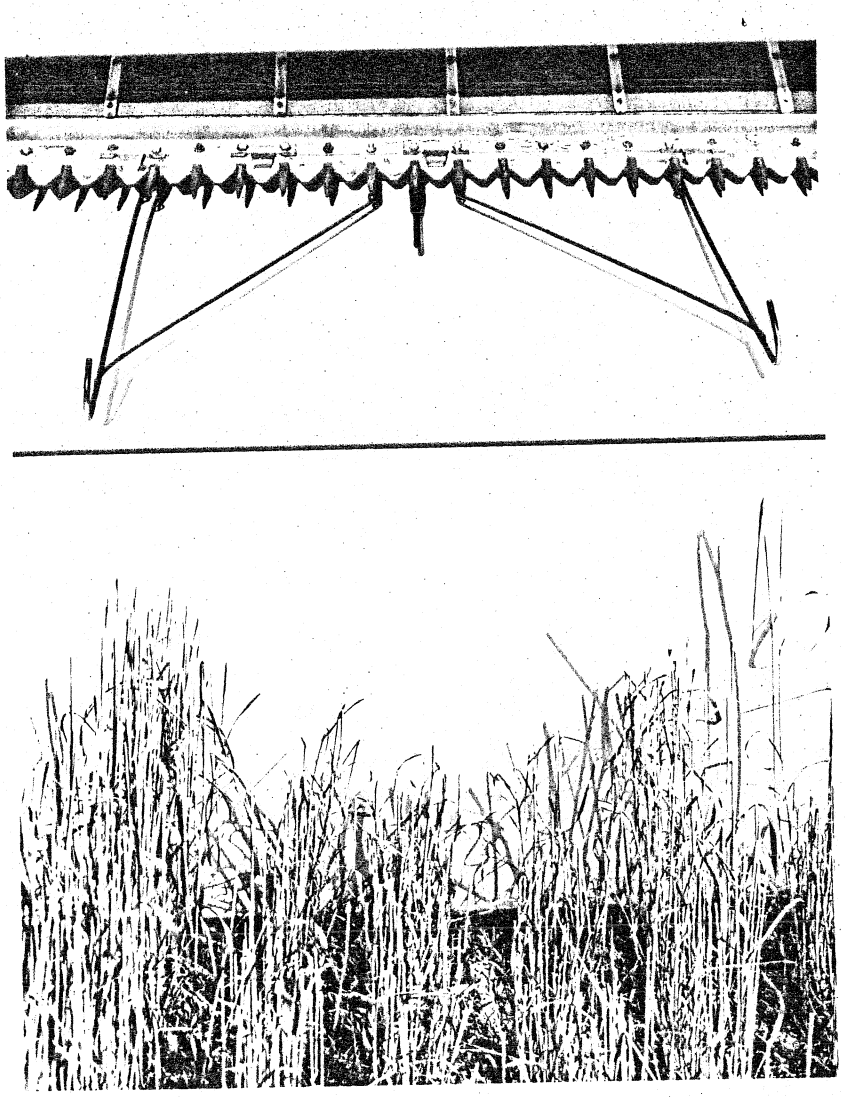

Fig. 4. Double converging deflector with stubble pattern

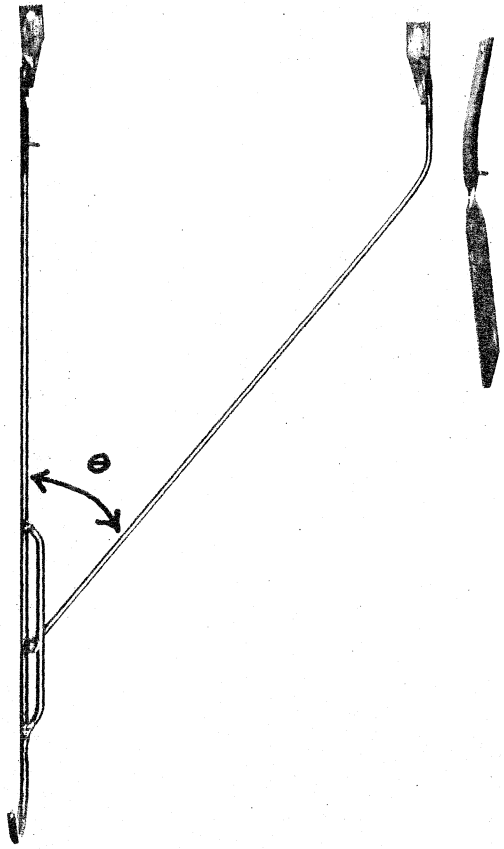

Fig. 5. Adjustable double deflector and lifting finger (side view)

effective snow fence is created. Mounted in the diverging mode (Fig. 3), an M-shaped barrier is left. Various widths of deflector can be used depending on crop height (Table 1). A crop height of 60 cm is about the minimum that will leave an effective barrier when cut with a deflector-equipped or clipper-equipped swather.

Table 1.

Crop height	Double deflector width	Barrier height
24-26" 60 cm	4 space = 30 cm	15-18" 45 cm
32-34" 80 cm	5 space = 38 cm	20-23" 60 cm
40-42" 100 cm	6 space = 45 cm	30-32" 75 cm

In designing a deflector a number of factors are important. Good division of the crop is essential and can be achieved with a long leading edge. A ski on the front reduces the possibility of digging into the ground when cutting low or when a ridge is encountered. To maintain crop flow while the stalks of grain are "deflected" or bent to the side, a moderate angle (40° or less) should be used. Too blunt an angle will result in a bulldozing action and the stalks of grain will bend forward, rather than to the side, and slip under the cutter bar without being cut. Smooth round edges (like a rod) on the deflecting member also minimize the drag on the stalks as they are deflected to the side. The deflector should be roughly parallel to the ground when the cutter bar is at normal cutting height.

RESULTS AND DISCUSSION

Table 2 summarizes the snow trapping data using various methods and swather attachments at the Research Station, Swift Current during the winter of 1981-82 until mid-February. It appears that the end clipper traps more snow than the deflector attachments. This is contrary to the results of the University of Saskatchewan test during the winter of 1979-80 which yielded data of similar magnitude but opposite (Steppuhn 1980). Since the test summarized in Table 2 is not replicated it cannot be used as an absolute measure of attachment effectiveness. Border effects, wind direction, plot location and size all have a profound effect on the data collected. It would be very desirable to run a test on a full-field basis for each type of attachment. This was only done for the double 4-space diverging deflector. On a 20-hectare field the average amount of water trapped was 7.14 cm as of February 9, 1982. Experience to date would indicate the double diverging (as wide as crop height allows) is as good as the end clipper and is much cheaper and simpler to use.

The deflector works best in a tall upright crop. It is best to swath early when the crop is still erect and the stems are strong and resilient. Losses tend to increase as the crop tends to lean or lodge from maturity, sawfly damage, etc.

Losses were measured from two square meter samples taken at six sites in the plot along the barrier strip. Table 2 shows that the end clipper had greater losses than the deflectors but all were under 0.2%.

Table 2.

Attachment type	Barrier ht. (cm) High	Barrier ht. (cm) Low	Loss - kg/ha Wheat	Loss - kg/ha Barley	Snow depth (cm)	Water equiv. (cm)
End clipper	53	15	7.8	31.7	47.5	14.2
Single deflector	44	15	2.6		33.3	8.8
Double deflector 4D	50	15	4.2	15.3	30.8	7.3
Double deflector 4C	49	25	2.1	18.6	29.9	8.1
Double deflector 5D	60	25	2.9	19.3	42.7	11.4
Double deflector 5C	53	15	7.1	20.3	37.0	9.9
Alternate height	32	15			29.5	7.9
Check		15	10.9		17.0	4.8
20-hectare field DD4D	45	14	8.5		25.7	7.14
20-hectare check		12.7			13.5	3.53

This does not include pick-up losses or heads which fell out of the windrow as it was formed. The greater losses of the clipper attachment were attributed to the greater amount of low heads which were not cut over the full 0.4 m width of the attachment. The deflector type only cut the minimum length of stalk for a small portion of the barrier width and therefore more of the lower heads were cut and windrowed.

Fall field operations must be restricted or the effectiveness of the barrier is reduced or destroyed. One operation of shanking-in fertilizer (1.5-cm shanks at 30-cm spacing) reduced the amount of water in the trapped snowpack by 2.5 cm.

CONCLUSIONS

Swather attachments for snow trapping offer a simple economical means of increasing soil moisture during seasons of adequate snowfall. Tests to date indicate that the double diverging deflector is equally as effective as the clipper type and much more economical. From 7 to 14 cm of moisture can be collected in this way. This technique should enable farmers to extend crop rotations and increase grain production in the drier areas of the prairies.

Detailed plans and information are available from the Research Station, Swift Current, Sask.

REFERENCES

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