USDA FOREST SERVICE

RESEARCH NOTE NC-157

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE
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SNOW AND FROST DEPTHS ON NORTH AND SOUTH SLOPES

ABSTRACT.--Aspect affects soil frost depth by influencing the amount of solar radiation received at the ground or snow surface. Depending on the conditions, frost can be of equal depth on north and south slopes, deeper on north slopes, or deeper on south slopes. Data illustrate all three conditions.

OXFORD: 116.12:116.21:111.211(775). KEY WORDS: soil frost, frozen ground, snowpack, aspect.

Steepness and direction of slope greatly affect snowpack accumulation and melt. Snowpack measurements on north and south slopes of 25 percent on the Coulee Experimental Forest in southwestern Wisconsin showed that the late winter snowpack was about 50 percent deeper on the north than on the south aspect (Sartz 1972). I have now found that aspect also affects soil frost or frozen ground depth on the experimental forest. Frozen ground has an important influence on spring floods because it affects snowmelt runoff.

Snow and soil frost depth were measured for 4 years on six old field plots of 15 to 20 percent slope. Three plots were on a north and three on a south aspect. Frost depth was measured at three points on each plot by direct reading frost gages as described by Harris (1970).

Aspect can influence soil freezing because direction of slope affects the amount of solar radiation received at the ground or snow surface. Radiation at the snow surface affects soil freezing because it affects snow accumulation, and snow retards soil freezing by insulating the ground. When a heavy snowpack blankets the ground, the insulating effect of the snow outweighs the effect of radiation received at the ground surface. On the other hand, when there is little or no snow, radiation at the ground surface is the dominating influence.

The interaction of these two influences determines the net effect of aspect on soil freezing and thawing. The net effect can be equal frost depth on north and south aspects, greater frost depth on north aspects, or greater frost depth on south aspects (table 1). In 1971, a snowpack formed early in the winter before the ground froze and persisted through the winter. Because of the insulating snow blanket, the ground did not freeze on either slope all winter. In 1973, a year of little snow, radiation at the ground surface was the dominating influence, and frost was deeper on the colder north slope. The relation was reversed in 1970 and 1972. The snowpack did not form in time to prevent soil freezing, but the deeper snowpack on the north slope resulted in shallower frost there by late winter.

In cold, snowless winters of deep frost penetration, the differences due to aspect would probably be unimportant. But in winters when the frost is shallower because of snow or

mild temperatures, aspect differences could be important enough to affect runoff.

Table 1.--*Snow and frost depths on north and south slopes, 1970-73*

(In centimeters)

Year and date	Snow[1]		Frost	
	North	South	North	South
1970 (Feb. 25)	25	0	8	11
1971 (Feb. 25)	55	25	0	0
1972 (Mar. 10)	45	25	16	23
1973 (Mar. 1)	5	0	21	12

[1] To nearest 5 cm.

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1973

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