Winter Survival and Spring Assessment of Winter Wheat

Winter survival of winter wheat is dependent upon many climatic and management factors. Often producers are faced with making early spring fertility decisions on wheat stands that appear dead or thin. The following information has been prepared to address these questions.

The ability of the winter wheat plant to survive the winter often depends on its ability to withstand low temperatures. Through the process of "cold acclimation" the plant acquires cold tolerance. Factors that impact the level of cold hardiness of the plant are listed in Table 1.

Table 1. Factors influencing winter hardiness of winter wheat.

Factor	Poorly hardened – susceptible to cold injury	Well hardened – able to withstand cold temperatures
Weather	Warm fall, early snow cover	Open fall with no snow cover until freeze up Soil temperatures slowly decline to 0°C
Fertility	Seedplaced N fertilizer	Seedplaced P_2O_5 fertilizer
Seeding date	Early August or late September-October	August 25- September 5 so plant reaches 3 leaf stage entering winter
Seeding depth	2-3" deep resulting in weak spindly seedlings	1" or less

Regardless of the amount of cold acclimation, the wheat plant must receive insulating snow cover to survive the cold prairie winters. As a result, they must be direct seeded into the standing stubble of the preceding spring crop. The snow trapping potential of this stubble is based upon the height of the stubble and stubble density (number of stems per given area). Preceding crops of cereals usually have the greatest snow trapping potential, followed by oilseed crops such as canola and flax. Pulse crops rarely leave sufficient stubble height to be effective. A minimum of 4 inches of trapped snow cover through December to early March will buffer soil temperature changes and provide protection to the crown tissue. Variable snow catch in fields may occur due to topography, where knolls may still be wind swept bare of snow or on headlands where field traffic tramps stubble flat.

Cold hardiness of plants is greatest in late fall-early winter so low temperature damage is unlikely at this time. But cold hardiness gradually decreases as spring approaches in order to allow plants to "deharden" and resume growth. As long as there is February-March snow cover there is little likelihood of winter injury but lack of snow cover may cause soil temperatures to drop. Survival will be a function of fall hardening and the degree and duration of cold temperatures.

The fall of 2001 was extremely dry in western areas of Manitoba and there were numerous reports of poor germination and establishment, ranging from ungerminated seed to plants in the 2-3 leaf stage. Many producers are wondering if their plants survived the winter and what type of stand they might expect in the spring. The stage of crop development in the fall influences not only winter survival and yield potential but also crop competitiveness, maturity and the risk of infection with diseases such as rust and fusarium head blight.

Table 2. Potential impacts of fall growth stages on winter wheat production factors.

Growth stage	Date of germination	Yield factor	Competition factor*	FSI**	Rust risk**	Relative maturity
3 leaf & tiller	Sept 5	100%	5	514	1	0 days
1-2 leaf	Sept 15	90-100%	4	510	2	+ 4
Sprouted (not emerged)	Oct 1	80-100%	2	476	4	+ 8
Not germinated (imbibed)	Oct 15	60-100%	1	499	5	+ 10

* Competition factor: 5 = most competitive, 1 = least competitive
** FSI: Field survival index, measure of cold tolerance, 514 is max for winter wheat
*** Rust risk: 1 = lowest risk, 5 = highest risk

Winter wheat needs to "vernalize" or grow under cool conditions to permit head initiation in the spring. Usually this occurs in the fall, but in these delayed germination situations may occur under the cool spring conditions.

Assessment of crop life

Brown, dried leaves do not necessarily indicate winter injury, and green overwintering leaves are not a sure sign that the crop has survived. The only way to properly assess the condition of individual plants is to examine the crown for the development of new white roots. If the crown appears white and healthy, and new roots are developing, the plant is

in good condition. Growth from the crown tissue is soil temperature dependent. Crown temperatures of 9^{o}C accelerate growth and complete dehardening, which may take several weeks.

Options for assessing the crop life:

1. Wait until soil and crowns warm up and root growth commences – but this could take until mid May.
2. Extract several "sods" from the field and allow to warm up inside. Keep soil moist and assess crowns for new root growth (about 5-7 days). Sample from average and worst-case areas of the field (knolls, headlands with low snow trapping stubble levels, low spots where spring flooding or winter icing may have occurred).

Stand Assessments

Optimum plant stand is 20-30 plants per square foot. The ability of the winter wheat crop to aggressively tiller often compensates for lower plant densities (Table 3).

Table 3. Winter wheat yield at different stand densities (Lafond and Gan, 1999).

Wheat stand (plants/square foot)	Yield bu/ac
7.7	47
13.3	55
19.0	58
23.0	59
25.5	59
30.4	60

Often the variability of stand within the field makes the decision more difficult.

Production practices for thin wheat stands

When stands are thin or weakened the crop will need help. Consider the following factors:

- Early nitrogen application to encourage tillering of remaining plants
- Early control of broadleaf weeds and wild oats in thinner, less competitive stands
- Weakened plants may be delayed in maturity, which increases their risk to rust and fusarium head blight.

Where stands are deemed unacceptable and the decision is made to reseed to another crop, consider:

- Wheat streak mosaic may carry over from infected winter wheat into spring seeded cereals. Avoid replanting to cereals, especially wheat.
- Tillage and/or burn-down herbicides will not likely control all plants – particularly if some are suffering injury and slow spring regrowth. Delay applications until the plants have greened-up and are actively growing. In crop volunteer cereal herbicides may be required.
- Remember to credit any spring applied nitrogen to the following crop.

Summary

Winter wheat has an unmatched ability to compensate by producing tillers in thin or winter injured stands. Proper spring nitrogen management will be required to increase competitiveness of injured stands, and additional herbicide and fungicide operations may be required.
If wheat stands are to be destroyed for reseeding another crop, several management factors such as disease and weed control must be considered.

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Information from:
Basics of cold tolerance and winter survival in winter wheat. 2001. Struthers and Greer. Manitoba Agronomists Conference 2001.