Management of Red Smudge in Durum Wheat

M. R. Fernandez and J.M. Clarke

Semiarid Prairie Agricultural Research Centre, Agriculture and Agri-Food Canada,
P.O. Box 1030, Swift Current SK, S9H 3X2.

The quality and market grade of durum wheat can be affected by kernel discolouration, such as smudge and blackpoint. In 2004, rainfall and heavy dews during grain development and low temperatures that delayed crop maturation gave rise to significant losses from red smudge in durum-growing areas of the Canadian Prairies.

Red smudge appears as a reddish or pinkish discolouration most often over the seed coat, and can also be accompanied by black point. This kernel disease is caused by *Pyrenophora tritici-repentis*, the same fungal pathogen that causes tan spot, the most prevalent leaf spot disease of durum wheat in western Canada. Research conducted a few years ago showed that there was no correlation between reaction of vegatative tissue (tam spot at seedling or adult stage or glume discoloration) and reaction of kernels to red smudge/black point. However, under high moisture conditions, the development of red smudge is expected to be associated with the presence of fungal inoculum formed in tan spot lesions on the upper leaves of wheat plants. However, in 2004, even though low temperatures during crop growth resulted in a lower severity of tan spot on upper leaves than expected, severe seedling infections due to wet conditions in the spring would have provided an abundance of fungal inoculum for the development of kernel infections.

High levels of red smudge in 2004 caused this kind of kernel discolouration to be one of the most important downgrading factors in Saskatchewan, leaving many growers with lower than expected returns. This is similar to what occurred in 2002. To date, only about 10 percent of the durum wheat crop for 2004/05 has graded No. 1. Although red smudge is not associated with mycotoxins as is fusarium head blight, it still lowers the value of the crop. Kernel discolouration affects the visual quality of the end product by causing specks in the semolina and pasta. For No. 1 grade durum, smudge (from both the tan spot fungus and other fungal pathogens) cannot exceed 30 kernels per 500 grams, and smudge and blackpoint combined cannot exceed 5 percent. Durum wheat producers are now also concerned about using their low quality seed this coming season.

In the early 1990s, the Semiarid Prairie Agricultural Research Centre at Swift Current, SK conducted extensive research on red smudge. A few years ago, the need to deal with the

emergence and spread of fusarium head blight in the western Prairies made us divert resources away from red smudge. The significant losses caused by red smudge in 2002 and 2004 point to the need and importance for continuing research on this disease. No other institution in the world is presently working on this important disease of durum wheat.

Red smudge is a difficult disease to work with. Its incidence and extent vary greatly from year to year. Because levels of naturally-occurring red smudge infections in Saskatchewan are very low in most years, it is necessary to simulate optimum environment under controlled conditions.

To date, what has been learned about the effects of red smudge on quality of the following crop and how producers can minimize its impact? First, there is no transmission of the tan spot/red smudge pathogen from infected seed to seedlings. Red smudge itself does not appear to affect seed germination either, but it may reduce seedling emergence and vigour. Under normal field growing conditions, grain yield is not likely going to be affected due to compensation caused by reduced competition among plants. Increasing the seeding rate is an option if seed infection levels are high. However, a higher seeding rate might increase the severity of tan spot on leaves later in the season due to higher moisture levels caused by a more dense leaf canopy.

Fungicide seed treatments may protect germinating seed and young seedlings from seed-borne pathogens. However, it should be remembered that seed treatments will not prevent the development of tan spot later in the season since the main source of inoculum for development of this disease is crop residue.

What measures can producers take to help reduce the development of red smudge in their durum crops if environmental conditions again prove conducive to this disease? All registered durum wheat cultivars are susceptible to red smudge and tan spot, although there are differences among them in their reaction to tan spot. Producers should consult the *2005 Saskatchewan Seed Guide — Varieties of Grain Crops* for information on the resistance of currently registered durum wheat cultivars.

Foliar fungicides are registered for application up to 45 days before harvest and, therefore, are not useful in direct control of red smudge. However, there are other management tools that producers can use to reduce the impact of red smudge on the quality of their crops. Keeping inoculum levels of the tan spot pathogen low during the growing season might not only increase yields but might also reduce the chances of red smudge developing later on if environmental conditions are favourable for infection. Crop rotation away from wheat for more than one year is one of the best ways of reducing inoculum levels of the tan spot fungus. However, depending on environmental conditions, rotation may have little effect on infections late in the season because of the spread of wind-borne spores from neighbouring fields. It is also important to control volunteer wheat and grassy weeds in and around fields since they can serve as pathogen reservoirs. If tan spot levels are high early in the season and rainfall and temperature are favourable for its continued development, there could also be some benefit from controlling tan spot with a foliar fungicide. However, it would be important to consider the timing of fungicide

application, because spraying fungicides early (before flag leaf emergence) could lead to an increase in the incidence of kernel discolouration. Finally, it is important to remember that effective management of cereal diseases involves regular scouting for early detection. The sooner a problem is identified in a field, the more effective control measures are going to be.

What is being done to develop red smudge-resistant durum wheat cultivars? Recent extensive screening has identified several genotypes with good resistance, some of which has being incorporated into adapted backgrounds. Ongoing screening of some of the breeding lines resulting from these crosses has identified some with low levels of red smudge. Future work will involve further crosses and screening, in the hope that we will be able to develop a cultivar with both tan spot and red smudge resistance. However, we will continue facing the challenge of combining resistance to leaf spot diseases and kernel discolouration with high grain quality and resistance to other more important diseases in western Canada, such as fusarium head blight.

Research on tan spot and kernel discoloration done at the Semiarid Prairie Agricultural Research Centre at Swift Current, SK:

Fernandez, M.R., Clarke, J.M., DePauw, R.M., Irvine, R.B., and Knox, R.E. 1994. Black point and pink smudge in irrigated durum wheat in southern Saskatchewan. Can. J. Plant Pathol. 16:221-227.

Fernandez, M.R., Clarke, J.M., and DePauw, R.M. 1994. Response of durum wheat kernels and leaves at different growth stages to *Pyrenophora tritici-repentis*. Plant Dis. 78:597-600.

Fernandez, M.R., DePauw, R.M., Clarke, J.M. and Lefkovitch, L.P. 1995. Red smudge in durum wheat reduces seedling vigour. Can. J. Plant Science 76: 321-324.

Fernandez, M.R., Clarke, J.M., DePauw, R.M. and Lefkovitch, L.P. 1996. Comparison of durum and common wheat cultivars for reaction to leaf spotting fungi in the field. Plant Dis. 80:793-797.

Fernandez, M.R., Clarke, J.M., DePauw, R.M., and Lefkovitch, L.P. 1997. Emergence and growth of durum wheat derived from red smudge-infected seed. Crop Sci. 37:510-514.

Fernandez, M.R., Clarke, J.M. and DePauw, R.M. 1998. Effect of environmental variables on the development of kernel discolouration by *Pyrenophora tritici-repentis* in durum wheat. Can. J. Plant Path. 20:104-110.

Fernandez, M.R., DePauw, R.M., Clarke, J.M. and Fox, S.L. 1998. Discoloration of wheat kernels by *Pyrenophora tritici-repentis*. Can. J. Plant Pathol. 20:380-383.

Fernandez, M.R., Zentner, R.P., McConkey, B.G. and Campbell, C.A. 1998. Effects of crop rotations and fertilizer management on leaf spotting diseases of wheat in southwestern Saskatchewan. Can. J. Plant Sci. 78:489-496.

Fernandez, M.R., B.G. McConkey, and Zentner, R.P. 1999. Effects of tillage method and fallow frequency on leaf spotting diseases of spring wheat in the semiarid Canadian prairies. Soil Tillage Res. 50:259-268.

Fernandez, M.R., Clarke, J.M., DePauw, R.M., Irvine, R.B., and Knox, R.E. 2000. Black point reaction of durum and common wheat cultivars grown under irrigation in southern Saskatchewan. Plant Dis. 84:892-894.

Fernandez, M.R., DePauw, R.M. and Clarke, J.M. 2000. Reaction of common and durum wheat cultivars to infection of kernels by *Pyrenophora tritici-repentis.* Can. J. Plant Pathol. 23: 158-162..

Fernandez, M.R., J.M. Clarke and DePauw, R.M. 2001. The effect of plant height on tan spot on durum wheat in southern Saskatchewan. Crop Science 42: 159-164.

Wang, H., M.R. Fernandez, F.R. Clarke, R.M. DePauw, and Clarke, J.M. 2002. Effect of leaf spotting diseases on grain yield and seed traits of wheat in southern Saskatchewan. Can. J. Plant Sci. 82: 507-512.

Wang, H., M.R. Fernandez, F.R. Clarke, R.M. DePauw, and Clarke, J.M. 2002. Effects of foliar fungicides on kernel black point of wheat in southern Saskatchewan. Can. J. Plant Pathol. 24: 287-293.

Fox, S.L., M.R. Fernandez, and DePauw, R.M. 2003. Red smudge infection modifies sprouting response in four wheat lines. Can. J. Plant Sci. 83: 163-169.

We acknowledge financial support from: Saskatchewan Agriculture Development Fund, Western Grains Research Foundation, Canadian Seed Growers Association, AAFC's Matching Investment Initiative.