

THE FREQUENCY AND DISTRIBUTION
OF THE FUNGI ASSOCIATED WITH
WESTERN HARD RED SPRING WHEAT
SEED DEGRADED DUE TO MILDEW

A Thesis Submitted to
The Faculty of Graduate Studies
University of Manitoba

In Partial Fulfillment of the
Requirements for the Degree
Master of Science

by

RANDALL MACDUFF CLEAR

Department of Botany
Winnipeg, Manitoba
October, 1987



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ABSTRACT

Hard red spring wheat (Triticum aestivum) seed samples with various levels of a degrading factor known in the trade as mildew were collected for 3 years from primary elevators in the prairie provinces. Samples were examined for viability and the presence of seed-borne fungi. Members of 32 fungal genera were isolated, with Alternaria spp. and Cladosporium spp. the most frequently isolated taxa. When the mycoflora of seeds displaying the mildew discoloration was compared with the mycoflora of the heterogenous mixture of seeds in the original sample from which they had been selected, only Cladosporium spp. showed a significant increase in frequency. The geographic origin of the samples influenced the frequency of a number of fungi. It appears prolonged wet weather at crop maturity bleaches the kernels and stimulates further growth of fungi, primarily Alternaria spp. and Cladosporium spp., at the exposed brush end of the seed. This growth discolors the kernels producing what is termed mildew. However, it is primarily the wet harvest weather which affects the actual end-use of the grain. The fungus induced discoloration and the bleaching of the kernels serve the grain inspectors as visual indicators of damp harvest conditions. Although the principle of degrading grain due to the presence of mildewed kernels is soundly based on actual quality reduction, it is suggested that a less ambiguous and more descriptive term such as grey-brush be used.

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GLOSSARY

BLACKPOINT

"Distinct discoloration of the germ and surrounding area" (Anonymous, 1985). The discoloration is caused in the field by Drechslera sorokiniana and Alternaria spp.

BRUSH END

The end opposite the germ where hair-like protuberances known as the apical hairs are found. This is the end exposed when the seed develops.

CREASE

The fold which runs the length of the wheat seed on the ventral side.

FIELD FUNGI

"Fungi which invade the seed while the plants are still growing in the field or after the grain is cut and swathed but before it is threshed". (Christensen, 1982)

GRAIN GRADES

"Divisions of quality, forming the basis on which grain is bought and sold" (Anonymous, 1985). HRS wheat is graded from #1 to #3, below which it is in the feed grade.

MILDEW

"A condition that develops in unthreshed kernels of grain caused by excessive moisture making the kernels greyish in color and affecting their quality" (Anonymous, 1985). However, to a plant pathologist, mildew refers to a group of parasitic diseases.

PRIMARY ELEVATOR

These elevators are "designed to receive grain from the producers' farm trucks, store the grain in bulk lots in separate bins according to kind and grade of grain, and transfer it quickly and efficiently into rail cars for shipment to domestic processing plants and export ports" (Anonymous, 1982).

PRIMARY STANDARD SAMPLES

"Used as guides for grading grain in Canada and, by definition, represent the minimum quality of the grade" (Anonymous, 1985).

RED SMUDGE

A reddish discolouration of amber durum wheat caused by the field fungus Drechslera tritici-repentis.

SMUDGE

"A dark brown or black discoloration or stain similar to blackpoint affecting more than one half of the kernel or extending onto the crease of the kernel, and includes the reddish discoloration associated with some plant diseases" (Anonymous, 1985).

STORAGE FUNGI

Fungi which invade the seed after harvest. They are able to grow at lower moisture levels than field fungi.

STREAK MOULD

"Kernels bearing unusually dark grey streaks on the sides of the kernels toward the brush may be affected by a very slow growing mould that is harmless in wheat, except that it affects kernel appearance" (Anonymous, 1985).

TERMINAL ELEVATOR

"An elevator, the principal uses of which are the receiving of grain upon or after the official inspection and official weighing of the grain and the cleaning, storing and treating of the grain before it is moved forward" (Anonymous, 1971).

TOMBSTONE

Refers to a chalky white, shrivelled wheat kernel resulting from the disease, fusarium head blight.

INTRODUCTION

Canada is a country which financially depends on exporting large quantities of agricultural produce. It is the second largest supplier of wheat on the world market, wheat that is grown mainly in the prairie provinces. Between 1978 and 1982, 78% of the wheat production was exported, bringing foreign capital into the country to help our net balance of payments. In the world market, Canada has a reputation second to none for supplying grain of a consistent high quality. This consistency is achieved by regulations controlling all aspects of the handling, grading and marketing of the crop.

In 1912, the Canada Grain Act gave control of grain inspection and grading to the Canadian Grain Commission. Grain grades represent divisions of quality defined by grading factors, and form the basis upon which grain is bought and sold in world markets. The grading of the grain is primarily visual, consequently the grade, and price received is affected by the appearance.

Mildew, after frost, is the second most common degrading factor which affects the appearance of the kernel. In 6 of the 18 years from 1961 to 1978, mildew was a major degrading factor in the prairies. In those same 6 years, sprouting was also a major degrading factor (Anonymous, 1979). The frequency with which mildew occurs, and the reduction in grade (and thus value) of one of our major exports emphasizes the need for a better understanding of the causes of mildew. At present, it is known that prolonged wet harvest weather re-

sults in the appearance of the mildewed kernels. However, the identity of the organisms which may cause this discoloration have not been examined.

The object of this study was to identify the fungi associated with this degrading factor, examine their geographical distribution, and compare these results with samples from the same area which were not mildewed.

For this 3-year study, samples were gathered from areas where mildew was known to be a problem each year. Levels of fungal infection were recorded under the categories of field and storage fungi as defined by Christensen and Kaufmann (1965). The moisture content of each sample was measured, and the health of the seeds determined by germination tests.

A sample graded as mildewed is a heterogenous mixture of kernels with and without the appearance of mildew. In 1985, a comparison was done between selected seeds displaying mildew symptoms and the original heterogenous sample from which they had been removed. By this approach, it was hoped to better define the differences, if any, between mildewed and symptomless seeds.

1.) Mildew

Mildew on Red Spring wheat is a degrading factor and considered in the statutory grade definition under "degree of soundness". Soundness for the No. 1 Grade of Red Spring wheat is defined by the Canadian Grain Act as being "reasonably well matured and reasonably

free from damaged kernels". The incidence and severity of mildewed kernels detract from the general appearance and end-use quality of wheat which results in the degrading of the wheat sample. The interpretation of soundness as it relates to mildew involves visually evaluating both the amount and the severity of the mildew in relation to a physical reference sample. This judgmental evaluation is performed by inspectors trained in the correct application of maximum limits of mildewed kernels.

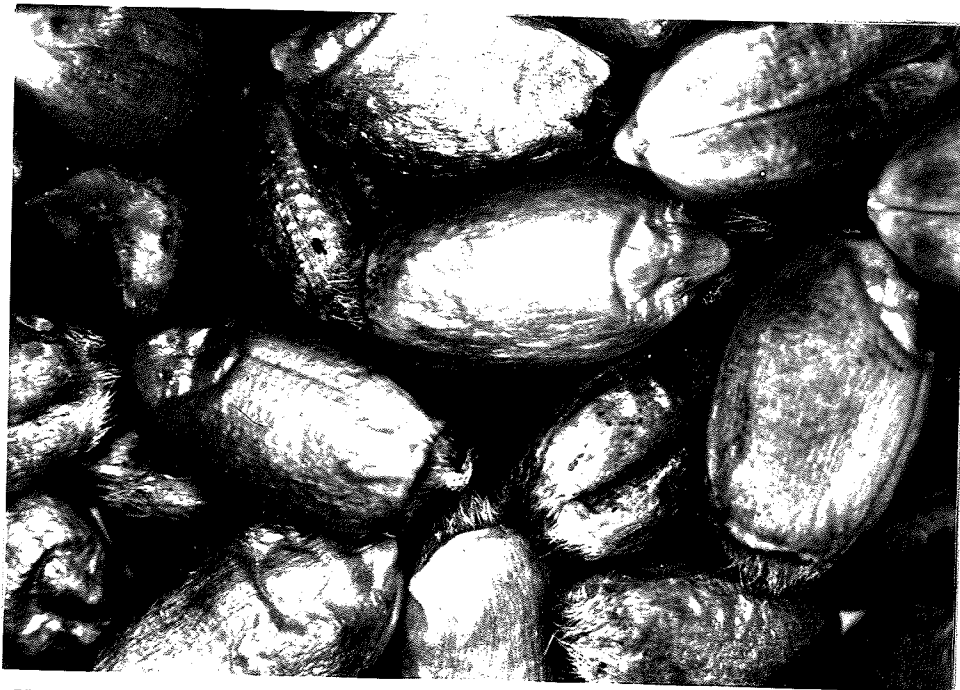
Using experience gathered over many years, the grain inspector judges the percentage of kernels showing the discoloration and the intensity of the discoloration in the sample. In addition, primary grain standards are prepared each year to interpret visually the lowest limit of soundness acceptable for each numerical grade. In certain years, special guide samples may also be prepared which reflect only the maximum allowable limit of mildew for each grade.

The assessment of mildew is thus subjective. Levels of mildew affect the overall appearance of the sample and thus the grade. A sample with light mildew has a slight white haze (plate 1), whereas one with moderate mildew levels has a darker appearance (plate 2). Individual kernels can be described thus: a lightly mildewed kernel has a dull white brush end; moderately mildewed has a greyish brush end more deeply discolored and the bran of the kernel is a light grey; and in severely mildewed kernels, the brush end is dark grey to black. Severely mildewed kernels also exhibit dark grey to black discolorations on the entire surface of the kernel (plate 2). In extreme

Plate 1



Hard Red Spring Wheat Without Mildew



Hard Red Spring Wheat With Light Mildew