Survey of fusarium head blight and possible effects of cultural practices in wheat fields in Lambton County in 1983

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Severity of fusarium head blight was lower where wheat was not planted after maize, where nitrogen and phosphorus fertilization were adequate and where weed density was low.

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La sévérité de la fusariose du blé s'est avérée moins importante dans les champs où il n'y avait pas eu de maïs l'année précédente, où la fertilisation était adéquate en azote et en phosphore et où la densité de mauvaises herbes était peu élevée.

Introduction

Fusarium head blight of wheat is caused by *Fusarium graminearum* Schwabe and other associated *Fusarium* species. The fungus may attack wheat prior to kernel-filling and cause lower yield, shrivelled kernels and reduction in crop value.

Fusarium graminearum, the anamorph of *Gibberella zeae* (Schw.) Petch is the principal head blight pathogen in Canada (Sutton 1982). Two natural populations exist: Group 1, normally associated with fusarium crown rot, and Group 2, associated with fusarium head blight in cereals and ear rot in maize.

Sutton (1982) in his review of the epidemiology of *F. graminearum* identified the principal inoculum reservoir as host debris: stalks and ears of maize and cereal stubble. The amount of inoculum is reduced as stubble decomposes but even under conditions favorable for decomposition the pathogen can survive for at least a year. Airborne ascospores and macroconidia of *F. graminearum* are probably the major inocula for both fusarium head blight and corn ear rot.

Wheat heads are susceptible to infection by *F. graminearum* from anthesis but receptivity declines after the soft dough stage. Infection by macroconidia is favored by warmth and persistent surface wetness. Symptoms may appear within 2 days of infection (Sutton 1982) or may take a long time to develop.

There are no proven methods of controlling head blight in wheat, but there is abundant conjecture. Seaman (1982) observed that maize and wheat grown in rotation leave abundant debris which is a primary source of inoculum. Burying this debris may reduce primary inoculum, other than chlamydospores which can persist for some years. Several researchers have reported that disease severity may be reduced by avoiding both dense planting and high nitrogen fertilization (Maric *et al.* 1969, Munteanue *et al.* 1972, Wimmer 1978). Martin and Johnston (1982) surveyed wheat fields in the Atlantic provinces to compare occurrence and severity of fusarium head blight in an attempt to correlate these with cultural practices. They suggested that correct timing and appropriate land preparation, incorporating the crop residue as early as possible, rotation with a non-host crop, and controlling host weeds such as quackgrass and barnyard grass may reduce disease frequency. They found that fungicides such as propiconazole applied to the foliage reduced head blight severity and recommended that an integrated program of rotation, tillage, weed control, seed treatment and possibly foliar fungicides may be effective in reducing the severity of head blight in wheat.

Methods

Twenty-nine fields were chosen at random. Wheat growers cooperating in this study were interviewed to obtain information on field histories, including: planting and tillage methods, soil type, fertility, nitrogen applications, previous crops, herbicides, and the previous occurrence of head blight in the preceding three years. For sampling purposes, fields larger than 10 ha were sub-divided. Soil cores were taken from fields which had not been tested in the three years preceding this study, and these were sent to the OMAF Soil Analysis Lab in Guelph, Ontario for nutrient analysis. All of the fields were located in Lambton County in Southern Ontario.

In June, prior to anthesis, the fields were surveyed qualitatively for weed population density and predominant species and foliar diseases such as powdery mildew which might conceivably affect susceptibility of the wheat to head blight.

Between July 4 and 14, (anthesis to soft dough stage) each field was visited twice and the incidence of head blight was estimated as follows: the number of blighted heads in each of 36 quadrats, spaced along 3 diagonal transects (approx. 10 m apart) was counted. The quadrats were 10 m (6 rows by 16 paces) and the number of diseased heads per 100,000 heads was later calculated using the average number heads/m row (counted from sections of 6 rows) for each field.

Because of the dry season, some wheat fields were too

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mature by the second set of visits for head blight to be detected, reducing the survey to twenty-two fields.

For analysis, fields were categorized according to their cultural characteristics. The disease incidence of these groups was then compared by analysis of variance (p = 0.05).

Results and discussion

Lack of wet weather during anthesis in 1983 resulted in very low overall incidence of head blight in Lambton county. Averages from the first set of observations (July 4-8) were analyzed, but the second set which had a higher disease level, was considered more reliable, and thus was used to decide on significant differences between factors.

Previous crop. Average incidence of head blight on wheat following maize was 6 to 7 times greater than that of wheat following soybeans or cereals (wheat, barley, oats) (Table 1). While *F. graminearum* can overwinter on both maize and cereal residues, possibly maize debris deteriorates less rapidly or can supply more initial inoculum than cereal debris. None of the growers had noticed 'pink mold' on cereals or maize in the past three years. The abnormally high averages obtained for

Table 1. Frequency of fusarium head blight from July 11-13 as influenced by several factors

Factor	No. of fields	Mean number of heads with symptoms per/ 100,000 plants	Differences significant at $P < 0.05$
Previous crop			yes
maize	5	36.0	(maize vs other)
small grain	4	7.2	
soybeans	13	5.2	
Nitrogen fertilization			yes
adequate	13	4.6	
inadequate	4	8.8	
Weed density			yes
high	13	6.4	
low	4	2.9	
Phosphorus rating			yes
high	11	4.4	
medium — low	6	7.9	
Fall plowed			no
yes	3	8.5	
no	14	5.0	
Nitrogen source			no
ammonium nitrate	9	6.6	
urea	1	2.9	
both	4	5.1	
other	3	4.3	
Powdery mildew			no
present	4	6.6	
not present	13	5.3	
June rain			no
$>$50 mm	6	5.9	
$<$50 mm	11	5.4	
1983 Herbicides			no
applied	5	5.4	
not applied	12	5.7	
Underseeded with clover			no
yes	3	5.4	
no	14	5.7	
Soil acidity			no
pH $>$7.0	8	5.2	
pH $<$7.0	9	8.0	

fields planted after maize tended to obscure any differences due to other factors, therefore the other variables were analyzed without data from fields with preceding maize crops.

Five fields were underseeded with red clover, which had no apparent effect on disease.

Soil fertility. Growers provided information on the season, rate and type of fertilizer applied. Fields with the recommended 90 kg/ha or less of actual N, showed significantly higher blight levels than those with extra nitrogen. Possibly nutrient stress may have increased susceptibility to *Fusarium* infection, or simply produced confusing symptoms such as chlorophyll loss from glumes.

Blight incidence in fields fertilized with nitrates was not significantly higher ($p = 0.05$) than in those fertilized with urea, urea + nitrate, or manure. Nitrogen was applied in both the spring and fall for most fields, an exception will be discussed later.

There were significantly higher blight counts in fields with medium-low phosphorus ratings than in those with high ratings. Potassium and magnesium ratings were high for nearly all fields. Disease levels for fields on acid soils were not significantly higher than for those on soils of pH > 7.0.

Herbicides and weeds. A comparison was made between fields with and without herbicide on the wheat crop and the difference in disease was negligible. Herbicide-treated fields differed in weed population density. Fields with noticeable amounts of weeds (mainly quackgrass, ragweed, buckwheat and mustards) averaged twice as much blight as those without weeds. Weeds could have affected disease by increasing water or nutrient stress on the wheat, or by modifying the crop environment.

Almost all growers used a herbicide on their 1982 crop, however it was difficult to isolate the residual effects of different herbicides since herbicides were confounded with the type of crop grown.

Other factors. Data for fall plowing vs other tillage, mean June rainfall by townships and powdery mildew were analyzed; there were no significant effects.

Fields were prepared by plowing, discing, cultivating, and/or harrowing. A comparison was made between plowed and unplowed fields since plowing is the most effective means of burying crop residues. Only fields previously in cereal were plowed.

From the weather data available, it appears that the time of infection in 1983 was during the last week in June. Townships recording high rainfall for June (> 50 mm) did not have higher blight levels than those with less rainfall (< 50 mm). However, monthly records for townships are too vague a source of weather data, weekly on-farm records would be preferable, and duration of surface wetness is more important than the amount of rainfall.

Early infections of powdery mildew, some of which reached the flag leaf before the onset of dry weather had no significant effect on head blight levels. There was no mildew on the heads.

All but two fields were planted with treated seed (Vitaflo-280). The untreated fields were not more diseased: it is unlikely that the seed treatment would inhibit infection of the spikelets as late as anthesis.

On each of two farms two fields were alike except for the fact that one was seeded with a drill and the other by airplane. The aerial-seeded fields were both on untilled soybean stubble in 1982, were seeded in September rather than October, and nitrogen was applied in the spring only. On both farms, blight counts were lower for seeding by airplane than for drilled fields (0.6 vs 1.6, and 1.9 vs 10.9 heads/100,000), which were also following soybeans. Differences in plant density varied with each farm; apparently this cannot explain the difference in disease levels.

Cultivars. Since the majority of wheat currently grown in Lambton county is Fredrick, no formal comparisons were made between cultivars. Qualitative observation of two Frankenmuth fields showed negligible blight levels, as was the case for adjacent Fredrick areas. Small plots of Houser and Augusta varieties gave blight counts close to that of Fredrick in a field which average 11 diseased heads/100,000.

Conclusion

From these data it appears that of all of the factors studied, the one having the greatest influence on the frequency of fusarium head blight, was a previous crop of maize. Avoiding planting winter wheat on maize stubble appears to be prudent. Controlling weed population density and maintaining adequate soil fertility, in addition to promoting yield, also appear to reduce the frequency of fusarium head blight.

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