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Preliminary Studies on the Natural Incidence of Wheat Blackpoint under Different Nitrogen Fertilization Levels and Tillage Systems in Argentina

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Abstract: Natural variations in the incidence of blackpoint was evaluated in two bread wheat cultivars (Buck Poncho and B. Charrúa) in a field assay growing under three tillage methods: mouldboard plow, chisel and no-till and under three nitrogen fertilization treatments, N_0: (no nitrogen), N_1: 90 kg N ha^{-1} (as urea) at sowing and N_2: splitted half at sowing and half at the end of tillering. At harvest, 30 ears per plot were randomly collected and handthreshed. Natural disease incidence (% of grain discoloured) was determined and the grains were separated visually in healthy or normal grains and discoloured and then weighed. Natural levels of the disease were mainly influenced by cultivars and N fertilizer applications, but not by tillage systems. Discoloured grains were heavier than normal ones and normal grains of these ears were also heavier than normal ones of ears with no disease symptoms. Susceptibility differences associated to cultivars morphophysiological features and nutritional stages are discussed.

Key words: *Alternaria alternata*, *Bipolaris sorokiniana*, kernel smudge, grain quality, grain weight

INTRODUCTION

Blackpoint is a grain fungal disease of wheat, barley and rye. In wheat it is characterised by a brownish or black discolouration, localized mainly at the embryo, but that also may extend into the surrounding area and crease (kernel smudge)[1,2]. It is often associated with the presence of *Alternaria alternata* and *Bipolaris sorokiniana*[1].

The disease is known to adversely affect grain quality, impairing flour, semolina and their products[3,4].

Fungal infection levels have been mainly related to the cultivar characteristics although it can be very influenced by environmental conditions[5]. The different susceptibility among cultivars has been associated to differences in grain size and weight[6-8].

Blackpoint incidence variations have also been attributed to cultural practices such as nitrogen fertilization[9] and changes in tillage systems[10]. Nitrogen application can cause an increase[9] or a decrease[11] in this disease incidence, suggesting that the fertilization effects would also depend on the interaction with another factors. Sisterna and Sarandón[10] reported differences in the percentage of contaminated grains under different tillage methods (no-till vs. conventional tillage) after artificial inoculations with *B. sorokiniana*.

In the last years, there was an increase of the wheat area cultivated under conservative systems in Argentina and, as a consequence, an increase in the use of nitrogen fertilizers. Probably an interaction effect between nitrogen fertilization and tillage systems on blackpoint natural incidence could be expected.

The aim of this study was to evaluate variations in natural infections of blackpoint disease in two contrasting bread wheat cultivars growing under different tillage methods and nitrogen fertilization treatments.

MATERIALS AND METHODS

In a field trial carried out at the Experimental Station of the Faculty of Agricultural and Forestry Sciences, University of La Plata (35° S) under a typical Argiudol soil, the blackpoint natural incidence in 1995 was studied. Three tillage systems: Mouldboard Plow (MP), Chisel (CH) and No-till (NT); two bread wheat cultivars Buck Poncho (BP) and B. Charrúa (BCh) and three fertilization treatments, N_0: control (no N), N_1: 90 kg N ha^{-1} at sowing and N_2: the same dose, splitted half at sowing and half at

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the end of tillering were performed. The fertilizer was applied as urea at broadcasting. The plots were 30.8 m^2 size distributed in a Randomized Block Design with 4 replications. At sowing 100 kg ha^{-1} of P_2O_5 was applied as triple superphosphate (0-46-0) in all the plots.

At harvest, 0.3 m^2 were sampled in each plot and 30 ears were randomly collected and handthreshed. Natural disease incidence (percentage of discoloured grains) was determined. The grains were separated visually in healthy or normal grains and discoloured and then weighed.

Grains showing typical symptoms were sown on PDA (potato dextrose agar) with a previous surface sterilization. These dicoloured grains also were placed on petri dishes following the blotter test (ISTA)[12] but without sterilisation. These two ways were used to confirm the causal agents of the disease.

RESULTS

Alternaria alternata and *Bipolaris sorokiniana* were isolated from discoloured grains sown on PDA and from blotter test, confirming the etiology widely known as associated for blackpoint.

Blackpoint natural incidence levels were mainly influenced by cultivars and nitrogen fertilizers application but not by tillage systems. Although it was observed a higher incidence in CH and NT than in MP, this difference was not statistically significant (Table 1). B. Poncho was more susceptible to blackpoint (21.30%) than B. Charrúa (2.20%). Lower levels of disease incidence were seen in fertilized plots as compared with no fertilized ones, independently of timing application. In BP, the cultivar with the higher disease presence and in both treatments, decreases up to 50% of incidence levels due to nitrogen fertilization were registered. The same ocurred with B. Charrúa.

In both cultivars discoloured grains were heavier than normal ones (Table 2). In those plots with highest levels of incidence, healthy grains were also heavier than normal ones of the lowest diseased plots. A direct relationship between normal and discoloured grain weight in BP (r= 0.564**) and in BCh (r= 0.527**) was observed. In BP, the more susceptible cultivar, an inverse correlation (r= -0.725**) between discoloured grain percentage and grain number per ear was registered (Fig. 1). Besides, it was observed a negative correlation with the incidence in both the number of fertile spikelets (r= -0.655**) and the number of grains per spikelets (r= -0.647**).

Table 1: Blackpoint incidence in 2 wheat cultivars under different fertilization levels and tillage systems

Fertilization	B Poncho	B Charrúa	Tillage systems
N0	31.00a	3.14a	MP 10.97a
N 90	17.50b	1.90b	CH 12.30a
N 45+45	15.35b	1.60b	NT 12.00a
Mean	2l.30	2.20	

Within each column, values followed by the same letter do not differ between them at 0.05 probability level

Table 2: Normal and discoloured grain weight in 2 wheat cultivars

	B Poncho	B Charrúa	Mean
Normal	36.47b	41.70b	39.30
Discoloured	42.10a	45.06a	43.40

Within each column, values followed by the same letter do not differ between them at 0.05 probability level

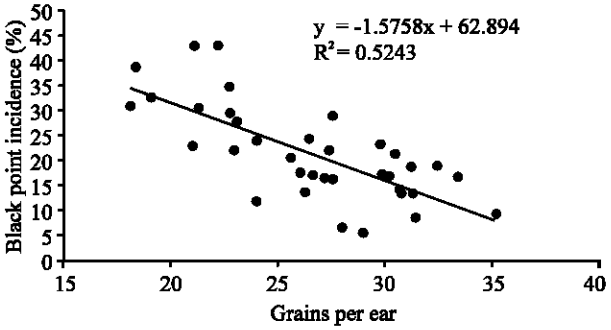

Fig. 1: Relationship between blackpoint incidence (%) and grain number per ear in wheat Cv. Buck Poncho

DISCUSSION

The presented results showed that blackpoint incidence levels in natural conditions could be influenced either by the cultivar characteristics used or by some cultural practices such as nitrogen fertilization.

The susceptibility differences among cultivars have been attributed to differences in morphological characteristics of the reproductive organs[2]. In this sense, a largest grain size and weight has been associated to a largest susceptibility. This suggests that those cultivars with the smallest grain size would have largest disease resistance. Nevertheless discoloured grains were on average 10% heavier than normal ones. The cultivar of lightest grain (BP) showed a larger blackpoint incidence than that of heavier grain (BCh). This can be explained by the inverse correlation observed between the grain number per spike and the incidence in the cultivar with highest incidence. This could be a consequence of decreases in the grain number due to damages originated in the flowering period, depending on the main pathogen and the moment of infection[13]. In this case, the destruction of some flowers could have provoked a compensatory increase in the weight of the remainder grains. This is supported by the fact that, in the plots with highest incidence, the normal grains were also heavier than the normal grains of the plots with low levels of disease. Therefore, the grain weight would not be

a cause but a consequence of the highest incidence of the disease. So, the importance of this characteristic as an intrinsical resistance factor could be discussed.

Plant nutritional condition has been associated to crop diseases susceptibility[14]. The low levels in the blackpoint natural incidence in nitrogen fertilized plots would confirm the importance of a good crop nutritional condition. This agrees with the results of Melegari *et al.*[11]. However, in artificial inoculations of *B. sorokiniana*, Sisterna and Sarandón[10] found little influence of N fertilization on disease incidence. Therefore, further investigations are necessary to clarify if the positive effect observed in this trial can be attributed to an escape mechanism due to small changes in crop phenology by N application, or by an increase of the intrinsical resistance to the disease.

Working with artificial inoculations, Sisterna and Sarandón[10] registered an important effect of the tillage systems. In the present assay the absence of differences between tillage methods could be related to the cropping sequences of the experimental field (only a year 1993 of wheat crop after 20 years of non-agricultural use) that would have favoured low initial levels of inoculum in no tillage plots. On the other hand, the size of the plots used in this trial and the edge effect would have facilitated the inoculum transmission among the plots and minimized the treatment effect. Nevertheless, in production fields this possibility should not be discarded.

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