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"Influence of *Septoria tritici* on yield and baking quality of wheat"

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Introduction:

Leaf Blotch (LB) caused by the hemibiotrophic pathogen *Septoria tritici* causes reductions in grain yield and quality in wheat by affecting the photosynthetic active area of the crop. Reductions in photosynthesis rate may increase grain protein content (GPC) due to a dilution effect, influencing the baking quality of flour. On the other hand, Nitrogen (N) fertilization is required for achieving high yields in wheat but may enhance the development of LB, depending on the environment, cultivar and genotype-environment interaction.

Objective:

The aim of this study was to evaluate the effect of three nitrogen levels (Fe); fungicide applications (Fu), triazole-strobilurin and triazole-only; on LB severity, grain yield, GPC and rheological properties (Farinograph and Alveograph), in three different quality groups cultivars (Cu).

Materials and Methods:

A field experiment was conducted in a split-split plot design with three replications at Estación Experimental Julio Hirschhorn, Facultad de Ciencias Agrarias y Forestales, La Plata, Argentina during 2009. Fungicide treatments were the main plot: Nativo fungicide (Strobilurin + Triazol, 600cm3/ha), Folicur fungicide (Triazol, 500cm3/ha) and the control (without fungicides). Nitrogen fertilization rates were the subplots (0, 70 and 140 kg N/ha) applied split as Urea at sowing and tillering. Cultivars were the sub-sub-plot (Buck Guapo, Klein Escorpión and Baguette 10) differing in their tolerance to LB and bread-making quality aptitude.

All plots were inoculated with spores of LB . A mixture of four virulent isolates of LB (FALP 201, 202, 205 and 147) was used to prepare the inoculum. The isolates were grown on malt extract agar. The conidial suspension was adjusted to 5 x 106 spores/ml. Inoculations were performed three times between the end of August and the beginning of November, at beginning of tillering (GS 20, Zadocks *et al.,* 1974), at three nodes stage (GS 32) and at the beginning of flowering (GS 60). Plants were sprayed with the inoculum suspension until runoff. After inoculations, plants were kept moist by spraying with water several times a day for a period of 3 days.

Disease severity (necrosis percentage) of LB was assessed at GS 32, GS 55 and GS 82 by visual estimation of the percentage of leaf area affected by the disease on seven plants in each plot. Area Under Disease Progress Curve (AUDPC) (Schanner & Finney, 1977) was calculated. Each plot was harvested and threshed. Grain yield (kg/ha) was calculated and Grain Protein Content (GPC) was determined by Microkjeldahl method. Alveogram and Farinogram variables were calculated.

All the data obtained were analyzed by ANOVA for split - split- plot design with Genstat 12.Ed. Mean values were compared with LSD test.

Results and discusion:

Fungicides containing strobilurins caused the greatest reductions on disease severity (Fig. 1A). Similar findings are reported by Jorgensen *et al.* (1999). Severity reductions were found with increasing N levels. This results were also found by Tompkins *et al.* (1993); other authors, however; reported increases of disease severity with rising N rates (Howard *et al.,* 1994; Simón *et al.,* 2003). Ishikawa *et al.* (2011) concluded that there might be an optimum of N concentration for the disease development. Differences among cultivars were significant in GS 32 and GS 82 (Fig 1A). Baguette 10 presented the lowest severity among all growth stages evaluated followed by Buck Guapo and Klein Escorpión. Fungicide and fertilizer doses were significant in GS 55 and GS 82 (Fig. 1B and 1C). The AUDPC decreased significantly with fungicide treatments and with increasing N rates. Baguette 10 showed the lowest value of the AUDPC while Buck Guapo and Klein Escorpión were similar and higher than Baguette 10 and resulted significant (Fig. 1D).

Grain yield increased when disease was controlled with fungicides, especially with strobilurins, and with increases of N rates. Grain yield increases are due to a green leaf life extension. Strobilurins are reported to prolong green flag leaf area duration and increase main grain weight (Gooding *et al.,* 2000) significantly more than triazoles (Dimmock & Gooding, 2002). In this study, the highest yield was obtained with 70 kg N/ha. Baguette 10 achieved the highest grain yield followed by Buck Guapo and Klein Escorpión (Fig. 1E).

GPC was higher when severity increases. Arabi *et al.* (2007) also reported increases in GPC when LB was not controlled. GPC increased with the maximum N levels. Similar findings are reported by Ayoub *et al.* (1995), López Bellido *et al.* (1998) and Godfrey *et al.* (2010). Fungicide application reduced the protein content. Strobilurin had more effect on the reduction of the protein compared to the triazole-only (Fig. 1F). Regarding alveogram values, Tenacity (P) decreased with fungicides, especially with strobilurins (Table 1). P value was higher in the best quality group (QG) cultivar. Extensibility (L) tended to increase with fungicides treatments, N levels and the best QG variety. Dough strength (W) was higher with high N doses and in the best QG variety. The P/L ratio showed significant differences among cultivars only; the better QG was, the better P/L values were (Table 1). Farinogram values, Water absorption (A), Development time (B) and Stability (D) were better in the best QG (Table 2). Only Degree of softening (E) showed significant Fu x Cu and Fe x Cu interactions (data not shown).

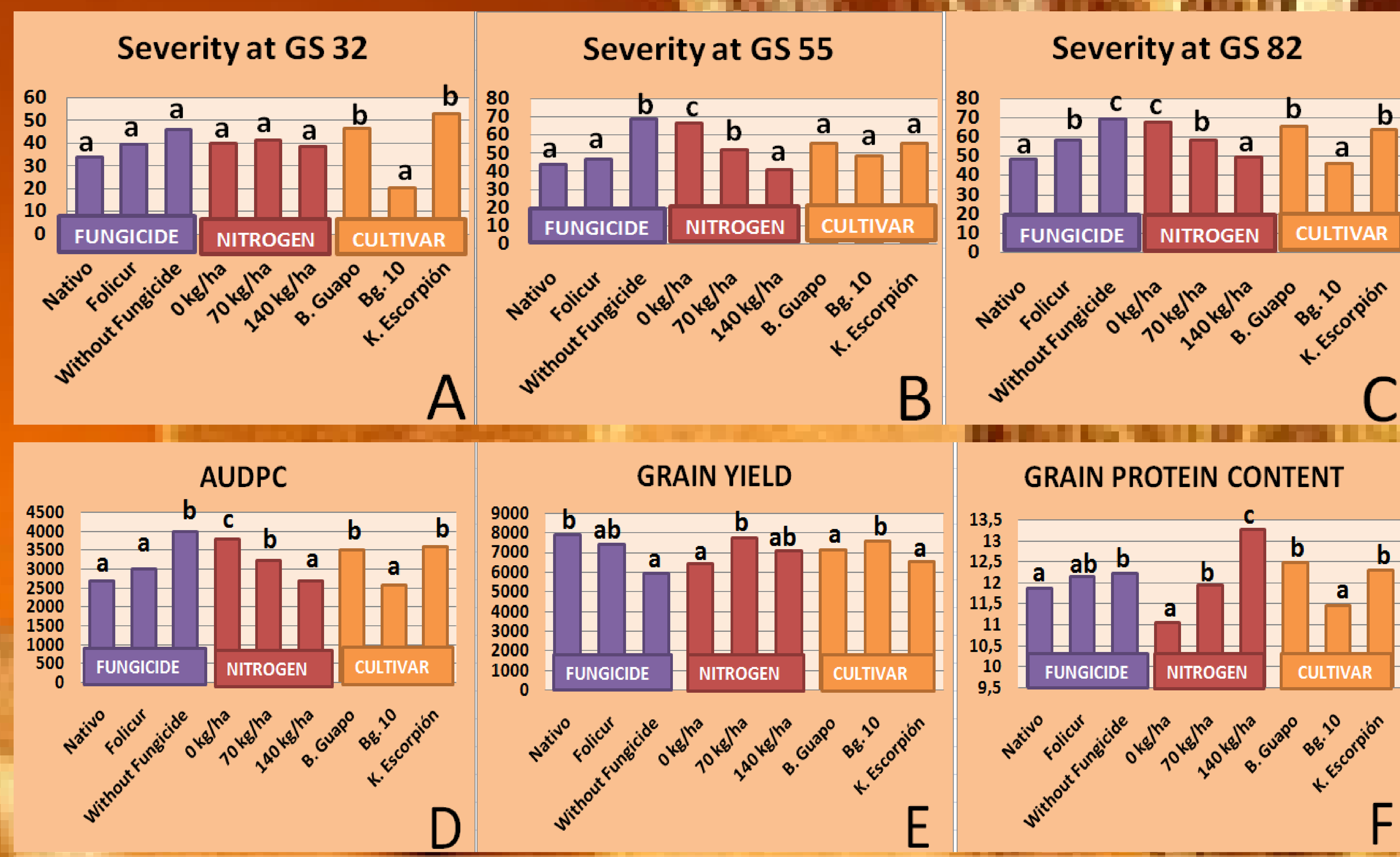

Fig.1. A: Disease severity in percentage at GS 32 with different treatments. **B:** Disease severity in percentage at GS 55. **C:** Disease severity in percentage at GS 82. **D:** Area under disease progress curve. **E:** Grain yield in kg/ha. **F:** Grain protein concentration in percentage. Different letters indicates significant differences (*P< 0.05*).

	P	L	P/L	W
FUNGICIDE				
Nativo	82.4 a	56.5 a	1.811 a	197.4 a
Folicur	98.9 a	59.2 b	1.871 a	232.5 a
Without Fungicide	104.5 b	55.2 a	2.079 a	238.3 a
NITROGEN				
0 kg/ha	92.9 a	53.9 a	1.843 a	207.8 a
70 kg/ha	95.6 a	51.7 a	2.097 a	204.9 a
140 kg/ha	97.3 a	65.3 b	1.821 a	255.4 b
CULTIVAR				
B. Guapo	107.5 c	61.5 b	2.009 b	254.9 b
Baguette 10	83.4 b	38.9 a	2.326 b	154.9 a
K. Escorpión	94.9 a	70.6 c	1.427 a	258.4 b

Table 1. Alveograph variables: Tenacity (P), Extensibility (L), Dough strength (W) and P/L ratio with different treatments. Different letters indicates significant differences (*P< 0.05*).

	A	B	D	E
FUNGICIDE				
Nativo	56.92 a	4.83 a	8.86 a	85.3 a
Folicur	57.96 a	7.13 a	11.50 a	53.4 a
Without Fungicide	52.25 a	6.96 a	10.97 a	60.9 a
NITROGEN				
0 kg/ha	56.99 a	5.82 a	9.65 a	61.6 a
70 kg/ha	57.27 a	6.10 a	11.12 a	63.4 a
140 kg/ha	57.86 a	6.99 a	10.56 a	74.6 a
CULTIVAR				
B. Guapo	58.94 b	8.23 b	12.22 b	65.2 a
Baguette 10	55.27 a	4.69 a	5.53 a	68.8 a
K. Escorpión	57.91 ab	6.00 ab	10.58 ab	65.6 a

Table 2. Farinograph variables: Water Absorption (A), Development Time (B), Stability (D) and Degree of Softening (E). Different letters indicates significant differences (*P< 0.05*).

Conclusions:

·Fungicide containing strobilurins (Nativo) produces a superior grain yield increases comparing with the fungicide containing triazol-only (Folicur) due to a better disease control.
·Rising nitrogen rates causes reductions on disease severity.
·Leaf Blotch decreases grain yield but increase grain protein content.
·Disease control tend to decrease Tenacity (P) and Dough strength (W) but improve P/L ratio.
·Fungicide and nitrogen application effects on baking quality variables depend on the quality group of the genotype.

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