RESPONSE TO SELECTION IN F_2 POPULATIONS OF TWO WHEAT CROSSES FOR RESISTANCE TO *SEPTORIA TRITICI*

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SUMMARY

Septoria tritici blotch is an important disease of wheat in many areas of the world that causes significant yield losses. Breeding for resistance to the disease is an important tool as a control measure. To efficiently breed wheat for resistance, an understanding of the inheritance of the resistance is required. This work is a part of a project to study the inheritance of the resistance to the disease. The aim was to determine the response to selection and realized heritability when selection for a reduction in percentage of pycnidial coverage was carried out in two wheat crosses. The response to selection and heritability showed moderate values. According to the results of these crosses, selection for resistance to the disease on a single plant basis could be successful but probably slow. Optimization of selection is discussed.

INDEX WORDS: *Triticum aestivum* - *Septoria tritici* - *Mycosphaerella graminicola* - leaf blotch - selection response - realized heritability

INTRODUCTION

Septoria tritici Rob ex Desm (teleomorph *Mycosphaerella graminicola* (Fuckel) Scroeter, in Cohn) may cause losses of more than 60% of the grain yield (Shipton et al., 1971). Breeding for resistance has been the most widely used method for the disease control.

The number of effective factors estimated for resistance to the disease varied between one and eight (Rosielle et al., 1979; Danon et al., 1982; Yechilevich et al., 1983; Eyal et al., 1985; Wilson et al., 1985). The presence of dominant, recessive, incomplete dominant and modifying genes has been reported (Shipton et al., 1971, Gilchrist et al., 1993, Jlibene et al., 1993). A few studies investigated the inheritance of the

resistance in a quantitative approach, determining preponderance of additive genetic variance for several resistance components, although dominance has been observed (Van Ginkel and Scharen, 1987; Danon and Eyal, 1989, Jlibene et al., 1994, Simón and Cordo, 1997, 1998). A few studies about heritability estimates have been carried out (Van Ginkel and Scharen, 1987). This report is a part of a study which was initiated to investigate the inheritance of the resistance to the disease. The aim of this work was to investigate the response to selection and realized heritability for resistance to *Septoria tritici* in two wheat crosses.

MATERIALS AND METHODS

During 1992 and 1993 the F_2 and F_3 generations of two wheat crosses (Don Ernesto x Buck Napostá and Don Ernesto x Marcos Juárez) were studied in the field. According to the results of previous trials, for the first cross both parents has a good behaviour to the disease. In the second cross Marcos Juárez is a susceptible cultivar. Table 1 shows the pedigree of the cultivars. In both years, the segregating populations were inoculated when each cross reached the stage 59, Zadoks scale (heading) with a single virulent isolate of *Septoria tritici*, produced as described by Simón and Cordo, 1997. In 1992, the F_2's were sown in the field together with the respective parents. Evaluations were performed on the flag leaf. Severity of the disease was assessed on the single plant basis as the percentage leaf area with pycnidial coverage. In total, for both crosses, a selection of 56 plants out of 370 was obtained by truncation selection. Truncation occurred at 9% of pycnidial coverage under a moderate selection pressure (16%). In the 1993 field trial, the 56 F_3 lines derived from the selected plants were inoculated and tested for severity to *Septoria tritici* together with the parents. Each F_3 and parent plot consisted in about 60 plants. The plots were randomized over the field. In both year trials, seeds were sown 4 cm apart in rows 20 cm apart with no more than 15 seeds per line. The trials were covered with a plastic cover for 72 hours after inoculation to maintain a wet environment. A furrow alongside the planted area was filled and kept with water after inoculation.

The differential selection (S) was calculated as the difference in the mean of the pycnidial coverage percentage of the original F_2 population (μ_0) and that of the selected sample of resistant plants (μ_s). The response to selection (R) was calculated as the difference between μ_0 and the pycnidial coverage percentage of the progeny of the selected plants based on line means (μ_1). The realized heritability was estimated by $h^2 = R/S$.

Table 1: Pedigree of the cultivars

Cultivar	Pedigree
Don Ernesto INTA	Selection of Bobwhite "S"
Buck Napostá	Rafaela x Buck Pampero
Marcos Juárez INTA	Sonora 64 x Klein Rendidor

RESULTS AND DISCUSSION

Fig. 1 shows the mean levels of the percentage of pycnidial coverage of the parental lines of the 1993 trial together with those of the 1992 trial where selection had taken place. According to those values, data of 1992 were corrected by linear regression with a coefficient of 0.83 and a constant of 2.23 before calculating μ_0, μ_s, S and R.

Table 1 presents for each cross the following results: the mean of percentage of pycnidial coverage of the original F_2 family in 1992 (μ_0), the mean *Septoria tritici* of the sample of selected plants (μ_s), the number of plants in each F_2 population (np) the number of selected plants (ns), the proportion (%s) of selected plants out of the F_2 family, the mean of the pycnidial coverage of the progeny produced by the selected plants based on F_3 line means in 1993 (μ_1), the differential selection (S), the selection response (R), the realized heritability (h^2r).

Realized heritability was intermediate in both crosses. Although literature is scarce, previous investigations about broad-sense heritability have shown values between 0 and 78% for different crosses with a mean of 38% (Van Ginkel and Scharen, 1987). Furthermore, several studies demonstrated a high proportion of additive variance as well as dominance for several resistance components to the disease (Van Ginkel and Scharen, 1987; Danon and Eyal, 1989, Jlibene et al., 1994). The response to selection and inheritance in this study are not very high probably due to the effects of dominance and also to the environmental variance. Simón and Cordo (1998) found preponderance of additive effects but also dominance for pycnidial coverage in a diallel crosses including the crosses analyzed in this work.

The fact that intermediate heritability was also found in the cross between the two moderately resistant cultivars would suggest that both cultivars carry different factors for resistance. This is possible considering that Don Ernesto and Buck Napostá have not

common ancestors (Table 1). The effects of those factors can be accumulated in segregating generations. Similar results for some other crosses have been found by Gilchrist et al, 1993.

According to the values of response to selection and heritability, progress selecting for resistance in these crosses could be successful but probably slow. Efficiency could be improved if selection is delayed to intermediate generations to minimize effects of dominance.

More crosses should be studied to generalize the scope of these results.

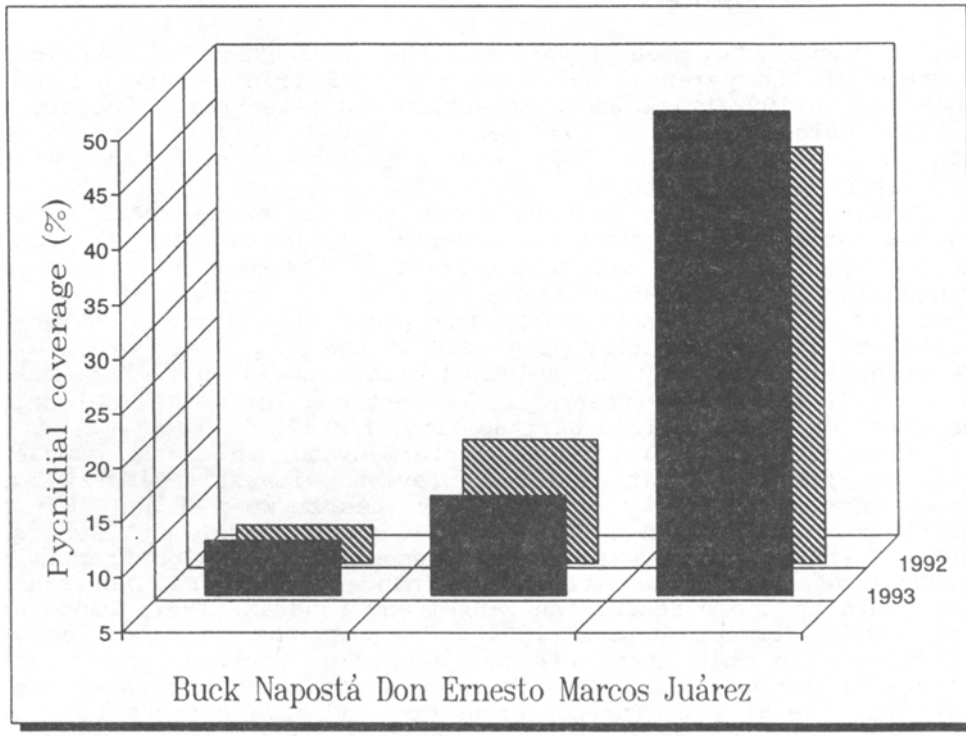

Fig. 1: Means of pycnidial coverage of the parents inoculated with *Septoria tritici* in two years

Table 2: Mean of the percentage of pycnidial coverage of the F_2 generation (μ_0), mean of the selected sample of resistant plants (μ_s), total number of plants in the F_2 population (np), number of selected plants (ns), percentage of selected plants (%s), mean of the progenies of the selected plants ($\mu 1$), differential selection (S), selection response (R) and realized heritability (h^2r) of two wheat crosses inoculated with *Septoria tritici*.

Cross	μ_0	μ_s	np	ns	%s	$\mu 1$	S	R	h^2r
DE x BN	22.9	6.5	210	14	6.7	17.3	16.4	5.6	0.34
DE x MJ	28.8	6.7	160	42	26.2	21.8	22.1	7.0	0.32

DE= Don Ernesto, BN= Buck Napostá, MJ= Marcos Juárez.

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