ASSOCIATION OF BUNT RESISTANCE GENE *Bt8* WITH AGRONOMIC TRAITS IN A WINTER WHEAT (*TRITICUM AESTIVUM* L.) CROSS

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ABSTRACT

Growing resistant cultivars is a preferable option in bunt control, especially in the organic agriculture, as it is more economic and environmentally friendly. Most resistance genes are found in local populations or old varieties and transferring these genes into modern high yielding backgrounds proved to be difficult. This paper presents results on the association of bunt resistance with several agronomic traits in lines randomly extracted from a hybrid population segregating for the *Bt8* gene. Ninety seven F4 progenies of spikes extracted at random from the cross Yayla305/2*Aura// 2*Rapid/3/ Delabrad were planted at the Agricultural Research & Development Station Simnic, Dolj County, half of the seed of each progeny being inoculated with bunt and used to characterize the resistance of each line, and the other half planted without inoculation, for study of agronomic traits. On average, bunt resistant lines had significantly fewer spikes, and this was not compensated by higher yield per spike. The low frequency of resistant lines having more spikes or higher number of grains per spike will make it difficult, though not impossible, to select high yielding resistant progenies. Cumulating minor genes with favorable effects on spike number and size, to counteract the negative effect of *Bt8*, or exploring other resistance genes, possibly with less negative effects on agronomic performance, are suggested.

Key words: agronomic traits, *Bt8* resistance gene, common bunt, negative associations.

INTRODUCTION

Despite widespread use of chemical control by seed treatment, common bunt (caused by *Tilletia foetida* and *Tilletia graminis*) continues to produce important quantitative and qualitative losses, where treatments are not used or are not correctly applied. Growing genetically resistant cultivars is a preferable option, especially in the organic agriculture, as it is more economic and environmentally friendly (Ittu et al., 2001).

Most resistance genes are found in local populations or old varieties and transferring the genes into modern high yielding backgrounds proved to be difficult.

This paper presents results on the association of bunt resistance with several agronomic traits in lines randomly extracted from a hybrid population segregating for the *Bt8* gene.

MATERIAL AND METHODS

Individual spikes were randomly extracted form the F2 population of the cross F676T2-1/Delabrad. The parent F676T2-1 is the results of many cycles of crossing and selection directed towards improving the agronomic type while retaining the Bt8gene from the original source Yayla 305, a selection from a local Turkish population. F676T2-1 was selected from the cross: Yayla 305/2*Aura (F778J1-111) // 2*Rapid, where Aura and Rapid are adapted but susceptible to bunt Romanian cultivars.

The lines from the cross F676T2-1/Delabrad were advanced to F4 by randomly extracting one spike from each progeny.

Ninety seven F4 progenies were planted at the Agricultural Research & Development Station Simnic, Dolj County. Half of the seed of each progeny was inoculated with bunt teliospores by mixing and shaking together in paper envelopes, in order to characterize the resistance of each line. The other half of the seed of each progeny was planted without inoculation on individual rows 1m long. The following agronomic traits were determined: Number of spikes per row, plant height, weight of grains per spike and weight of 1,000 grains (Oncica, 2007).

Based on observations of inoculated rows, lines were classified into resistant or susceptible, leaving out the lines still segregating for resistance.

Average differences in observed traits were tested by „t test" and distributions were analyzed to estimate frequency of lines having favorable values of traits.

RESULTS AND DISCUSSION

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On average, bunt resistant lines had fewer spikes and fewer grains than susceptible ones, but only the difference in number of spikes was significant (Table 1). Grain weight/spike of bunt resistant lines was on average only slightly inferior to the susceptible ones, because size of the grains was on average superior, though not significantly.

Therefore, even after so many cycles of crossing with adapted germplasm, lines which inherited the *Bt8* gene for bunt resistance could not compete on average with the lines not carrying this gene.

Whether this was due to negative pleiotropic effects of the genes or to unfavorable linkages should be the object of further studies.

The distribution of resistant and susceptible lines according to the number of spikes per linear meter clearly shows that none of the resistant lines had the maximum number of spikes found in susceptible lines (Figure 1).

Table 1. Average values of several agronomic traits in bunt resistant and susceptible progenies of the cross F676T2-1/Delabrad

Specification	Nr.spikes/m	Plant height (cm)	Nr.grains/ spike	Grain weight/ spike	Weight of 1,000 grains (g)
Bunt resistant lines	46.2	55.0	42.00	1.85	42.30
Bunt susceptible lines	53.7	54.0	43.90	1.87	40.90
Difference	-7.5*	1.0	-1.90	-0.02	1.40
t value	-2.45	0.56	-0.82	-0.22	0.85
P%	1.8	55.2	42.60	84.10	42.60

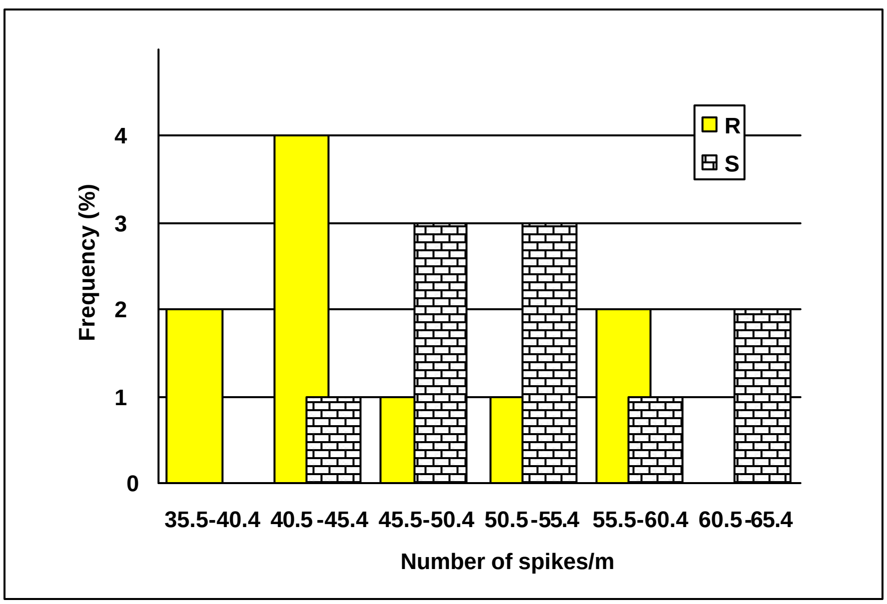

Figure 1. Distribution of bunt resistant and susceptible lines according to the number of spikes per linear meter

On the other hand the lowest numbers of spikes were only found in resistant lines. However, it should be possible to select resistant lines with a reasonable number of spikes, not far from maximum, and apparently this should be one of he selection aims when working with *Bt8* gene.

Distributions of resistant and susceptible lines for plant height were very similar (Figure 2). We can conclude that selecting bunt resistant lines of appropriate height should pose no problem.

Distributions of the two groups of lines according to the number of grains per spike illustrate the difficulty of selecting resistant lines with large spikes having many grains (Figure 3).

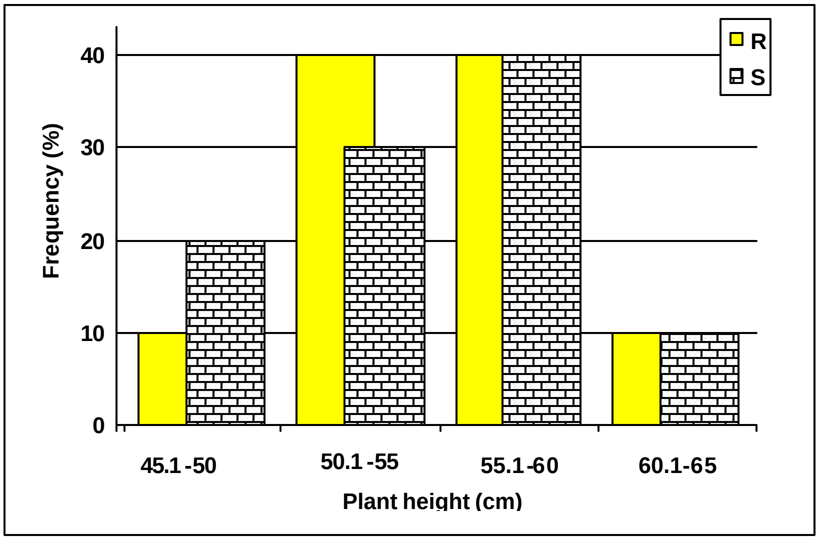

Figure 2 . Distribution of bunt resistant and susceptible lines according to plant height

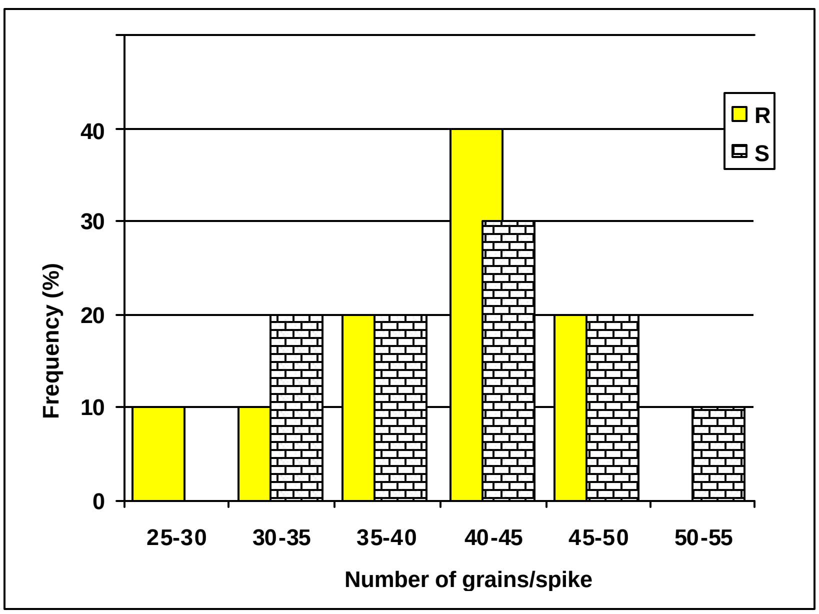

Figure 3. Distribution of bunt resistant and susceptible lines according to the number of grains per spike

The largest number of grains per spike was only found in susceptible lines, while the smaller number was only found in resistant ones. The same picture can be seen by examining the distributions for grain weight per spike (Figure 4).

Distributions of bunt resistant and susceptible lines for the weight of 1,000 grains largely overlapped, except that smallest grains were only found in susceptible lines (Figure 5).

Our results suggest that breeding high yielding bunt resistant cultivars carrying the *Bt8* gene, competitive with the susceptible ones in the absence of the disease, will be difficult, though probably not impossible. Selection of resistant plants in crosses involving *Bt8*, should be directed towards higher productive tillering and larger spikes, to counteract the average negative effect of this gene presence.

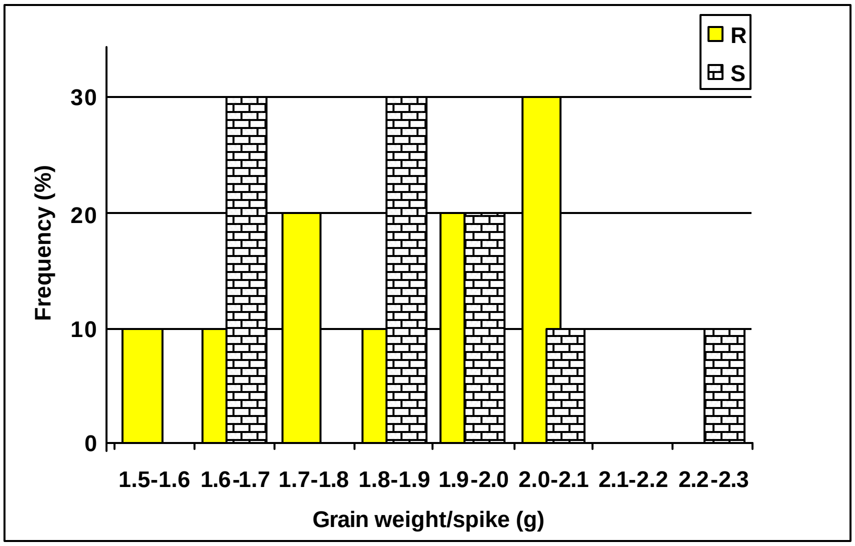

Figure 4. Distribution of bunt resistant and susceptible lines according to grain weight per spike

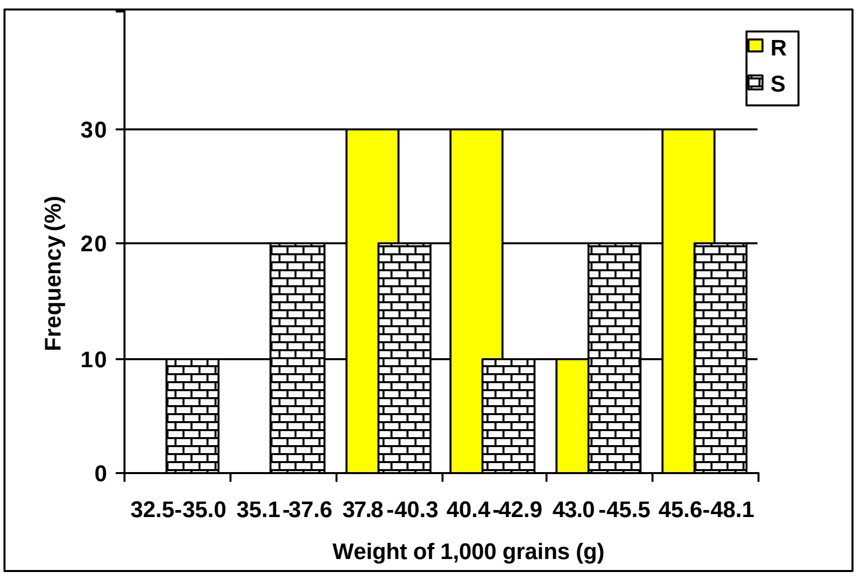

Figure 5. Distribution of bunt resistant and susceptible lines according to the weight of 1,000 grains

Alternatively, other bunt resistance genes, possibly without negative effect on agronomic performance, should be explored.

CONCLUSIONS

After several cycles of crossing with adapted cultivars and selection for bunt resistance and improved plant type, *Bt8* carrier lines still had on average significantly smaller number of spikes, and that was not compensated by higher yield per spike.

In breeding high yielding *Bt8* bunt resistant cultivars, selection should attempt to accumulate minor genes able to increase the number and size of spikes, to counteract the negative effect of the bunt resistance gene.

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