A Preliminary Study on the Relationship between Tolerance to Zinc Deficiency and Cereal Nematode Resistance in Winter Wheat Breeding Germplasm

Adnan Tulek[1], Julie M. Nicol[2], Ismail Cakmak[3], Hans J.Braun[2], Arne Hede[2], Elif Sahin[1], A.Faik Yildirim[1], Necmettin Bolat[1]

[1] Anatolia Agricultural Research Institute, 26001 Eskisehir, TURKEY
(adnantulek@mynet.com)
[2] CIMMYT (International Maize and Wheat Improvement Centre), TURKEY
[3] Sabancı University, TURKEY

INTRODUCTION

Both, Zn deficiency and cereal root lesion nematodes (RLN), are widely distributed in the rain-fed cereal production system (5Mha) on the Central Anatolian Plateau (CAP) of Turkey (Cakmak et al. 1996, Nicol et al. 2002). Global data indicates that these abiotic and biotic constraints limit the productivity of wheat systems in parts of the world, particularly under rain-fed-stressed conditions (Nicol et al. 2004). Application of Zn fertilizers to wheat in different CAP regions resulted in grain yield increases (Cakmak et al. 1996).

Cereal nematodes attack cortical cells of plant roots, and Zn is important for the structural integrity of roots, especially for plant root membranes. It has been suggested that there is a relationship between nematode resistance defined as a reduction in the multiplication of the nematode in the presence of a plant and Zinc-deficiency tolerance.

To investigate this, a preliminary experiment was conducted with winter wheat germplasm from the International Winter Wheat Improvement Program (IWWIP), a joint wheat improvement program between TURKEY, CIMMYT and ICARDA. A number of F8 sister lines with a known source of resistance against the RLN (*Pratylenchus thornei*) called GS50a were screened. The resistance to RLN and Zn-deficiency tolerance were investigated.

METHODS

Resistance of the material against RLNs (*Pratylenchus thornei*) and Zn deficiency were evaluated separately. Sixty one entries, including advanced lines (F8 generation), were used in both tests. The varieties used in this study were Gerek 79 (RLN susceptible check), GS50A and GS50a T37.9 (RLN resistant source), 338-K1-1//ANB/BUC (combiner) wheat varieties, and the remaining entries were advanced wheat lines from the F8 generation 338-K1-1//ANB/BUC/3/GS50A. The RLNs were screened under aseptic greenhouse conditions using a randomized complete block design with 7 replications (Toktay et al. 2006). Plants were inoculated with 400 *P. thornei* per plant. The number of RLNs per plant was determined after 9 weeks of plant growth. In a parallel pot experiment, genotypes were screened for Zn-deficiency tolerance under controlled conditions in a Zn-deficient soil from CAP (Sultanonu-Eskisehir) using 3 replicates. Tolerance to Zn deficiency was defined on a scale of 1 (intolerant) to 5 (tolerant).

RESULTS AND DISCUSSION

There was a significant relationship (R= -0.51) between nematode number and Zn-deficiency tolerance (Fig. 1). A large genotypical variation was found in the resistance of the advanced lines to *P. thornei*. More than 20 of the F8 population showed similar or higher resistance compared to the partial resistant line GS50a (mean 407 ± 73). More than half of these showed equal or higher levels of Zn-deficiency tolerance when compared to the highly tolerant triticale (4.13) and common winter wheat Bezostaya (3.63) .

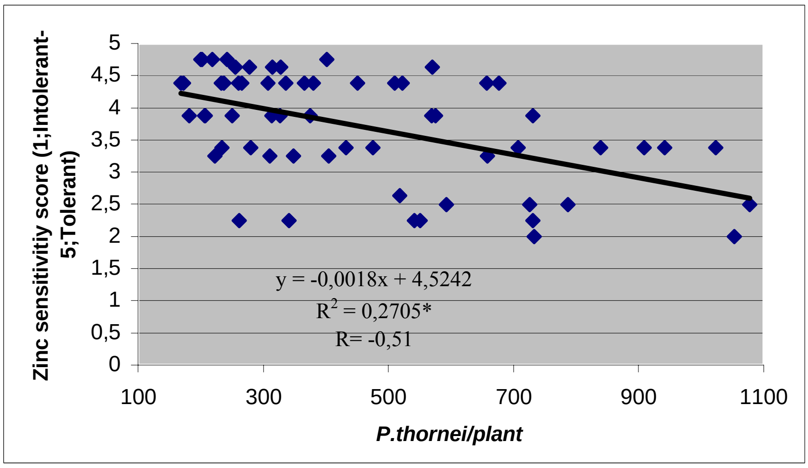

Fig. 1. The relationship between susceptibility of F8 sister lines (338-K1-1//ANB/BUC/3/GS50A) to tolerance to Zn Deficiency

CONCLUSIONS

Preliminary data indicated clearly that winter wheat germplasm can be effectively selected for both RLN resistance and Zn-deficiency tolerance. These are the first published data that suggest a correlation between RLN resistance and Zn-deficiency tolerance. Graham and Welch (1996) noted that there is no clear evidence to explain how Zn suppresses certain diseases. However, Zn might prevent root membranes from leaking substances that act as nematode attractants. Further work is needed.

The collaboration of experts in agronomy, pathology and breeding may enable the identification of germplasm that is resistant to complex abiotic and biotic soil constraints.

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