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# **NEMATODES OF SMALL GRAIN CEREALS CURRENT STATUS AND RESEARCH**

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# INVESTIGATING THE RESISTANCE MECHANISMS OF WHEAT VARIETIES AGAINST ROOT LESION NEMATODES (*PRATYLENCHUS THORNEI* AND *P. NEGLECTUS*) AND CYST NEMATODES (*HETERODERA AVENAE* AND *H. FILIPJEVI*)

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## SUMMARY

Plant-parasitic nematodes affect wheat production worldwide and cause yield reduction of 10-20%. Root lesion nematodes (*Pratylenchus* spp.) and cyst nematodes (*Heterodera* spp.) are the most important plant-parasitic nematodes attacking wheat crops. Important species of those two nematode genera in wheat fields were identified and quantified in various production areas in Turkey. Especially, root lesion nematodes (*Pratylenchus thornei* and *P. neglectus*) and cereal cyst nematodes (*Heterodera avenae*, *H. filipjevi* and *H. latipons*) have been detected as the most important wheat nematodes. Wild landrace and national wheat varieties which were moderately resistant to these nematodes have been studied and promising results have been obtained. However, studies on

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molecular- and cellular-level resistance mechanisms are not fully understood. Hence, resistant, tolerant and susceptible varieties will be investigated *in-vitro* and under natural conditions in the Eastern Mediterranean and Central Anatolia Regions, and plant- nematode interactions at molecular- and cellular-levels will be assessed.

## INTRODUCTION

Turkey is an important wheat growing country with 9.5 million ha production area and 20 million tons of grain produced per year. Plant-parasitic nematodes are an important threat to this production in that they are estimated to cause 7-15% yield loss (Sasser and Freckman 1987, Whitehead 1998). Among this group, the root lesion nematodes (RLN; *Pratylenchus* spp.) and cereal cyst nematodes (CCN; *Heterodera* spp.) are the most important plant-parasitic nematodes in wheat fields. Economically important parasitic species have already been determined in Turkey. The RLNs *Pratylenchus thornei* and *P. neglectus*, and the CCNs *Heterodera avenae*, *H. filipjevi* and *H. latipons* have been determined to be the most important species.

Screening for resistance against these nematodes has been increased in Turkey during recent years. Especially, there has been a focus on resistance to *H. avenae*, *H. filipjevi* and *P. thornei*. Promising results were obtained from those studies.

In this study, the resistance reactions of wheat varieties against RLN and CCN under *in-vitro* conditions will be re-investigated, the reactions of varieties found to be resistant and tolerant will be assessed under natural conditions, and the resistant genes and the CCN feeding sites (syncytium cells) will be studied.

## METHODS

We will extract CCN from wheat fields known to be infested near Adana (*H. avenae*) and Bolu (*H. filipjevi*). Seed of resistant and tolerant wheat varieties will be obtained (Toktay 2008, İmren *et al.* 2013). Cysts will be surface sterilised (0.5% NaOCl for 10 min), rinsed in distilled water, and stored at 4°C. To initiate hatching, stored cysts will be moved to room temperature (range between 10 to 15°C) (İmren 2013). Freshly hatched second-stage juveniles (J2) will be used as inoculum *in-vitro* and under natural conditions. The popu-

lation of RLN will be from a single nematode collected from a wheat field at Adana, which will then be cultured on carrot discs.

Following seed germination in petri dishes, a single wheat seed will be planted in standard tubes (13-cm high × 3-cm diam.) filled with a mixture of sterilised sand, field soil, and organic matter. The field soil and sand will be sieved and sterilized at 121°C. After plant emergence, five tubes will be selected per genotype and will be inoculated with 175 freshly-hatched J2 of *H. avenae* or *H. filipjevi*, or with 175 mixed stages (J2, J3, J4 and adult) of *P. thornei* or *P. neglectus*. Inoculum will be placed in three holes around the stem base. Some trials will be performed with mixtures of pathogens. Plants inoculated with a CCN will be harvested nine weeks after inoculation and the number of cysts will be counted. *P. thornei* and *P. neglectus* will be extracted from roots and soil using the modified Baermann funnel and mist extraction methods (Southey 1986) and the number of nematodes/plant will be calculated.

Experiments will be conducted under natural field conditions in the Eastern Mediterranean and Central Anatolia regions.

The defence mechanisms for resistant or tolerant reactions will be carried out under *in-vitro* and natural conditions. The durability of resistant and/or tolerant genotypes against the RLN and CCN will be investigated by using *Cre* genes for CCN and sources of multiple resistance alleles for RLN. The plant DNA will be isolated from leaves and Polymerase Chain Reaction (PCR) will be performed.

## PROSPECTUS

Resistant, tolerant and susceptible wheat varieties will be validated against CCN and RLN under *in-vitro* conditions, and their reactions under natural conditions will also be determined. Molecular and cellular evaluations of nematode-plant interactions will also be assessed. Resistant, tolerant, susceptible national wheat varieties which were previously identified as resistant against CCN and RLN are the main focus of our work in Turkey. The necessary nematode inoculum sources will be acquired from the Eastern Mediterranean and Central Anatolia regions. The reactions of different populations of the same nematode species are known to affect the resistance outcome. Therefore, different nematode populations from the same nematode species in previous studies will be tested under *in-vitro* conditions to examine both the pathogen

effects and the interactions. The findings of previous studies under *in-vitro* conditions will be examined by our testing under natural conditions. Thus, in this study, the resistant and tolerant wheat varieties will be examined for reactions to plant-parasitic nematodes of wheat not only under *in-vitro* but also under natural conditions. The resistance mechanism and the histological changes in plant tissues will be investigated. Resistant and tolerant wheat varieties will also be evaluated for breeding programs.

## ACKNOWLEDGMENTS

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