

## Abstract

Cystic nematodes of cereals are one of the most important pathogens of wheat grains in the world, among which the *Heterodera filipjevi* species has a large distribution in the country's cereal crops. The use of resistant varieties is environmentally compatible and is used to control pathogenic agents. In this research, the relative resistance of 13 indigenous wheat genotypes and seven common cultivars of wheat to cyst nematode in greenhouse was investigated in a completely randomized design with 20 treatments and 4 replications. Based on the classification of Sharma *et al.*, The susceptible cultivar of Bozostaya standard was classified as susceptible genotype, kata cultivar and germplasm No. 84 as resistant and the rest of the cultivars and germplasm were classified as relatively resistant and based on the minimum difference test. Also, they were in one group and did not have a statistically significant difference at 1% level. In the next step, the induction of resistance to the disease by nanosiliconic acid inducing agent at concentrations of 62.5, 125 and 250 µg/L in the sensitive species of Bozostaya was investigated. The effects of salicylic acid (SA) nano-formulation on expression of peroxidase (113-114) genes and peroxidase and phenylalanine ammonia lyase (PAL) were investigated in wheat cultivar susceptible (Bozostaya) to *Heterodera filipjevi*. The wheat roots and leaves were randomly divided into control group and groups exposed to 62.5, 125 and 250 µg/ml SA. A spectrophotometric analysis was carried out using root extracts from infected plants at 4, 7 and 11 days after inoculation with nematode for peroxidase and PAL. The expression of peroxidase (113-114) genes was evaluated by Real time PCR analysis. Peroxidase activity was significantly increased in treatments exposed to 250 µg/ml of nanosalicylic acid at 11 after inoculation. Phenylalanine ammonia lyase activity was induced in the treatments exposed to 250 and 125 µg/ml nanosalicylic acid compared to the control at 4 and 7 after inoculation, respectively. Phenylalanine ammonia lyase activity was also increased in the treatments exposed to 62.5 and 250 µg/ml of nanosalicylic acid compared to the control at 7 after inoculation. The expression level of peroxidase 113-114 in wheat leaves significantly raised at 4 after inoculation when 62.5 µg/ml of nanosalicylic acid was used. There was also a significant difference between expression levels of peroxidase 113-114 genes at application of 125 and 250 µg/ml of SA in comparison with the control at 4 and 7 after inoculation, a significant decrease was revealed in the gene expression exposed to 62.5, 125 and 250 µg/ml of nanosalicylic acid compared to the control at 11 after inoculation. It was concluded that higher concentrations of nanosalicylic acid have the potential effect on peroxidase and PAL activities in wheat infected by *H. filipjevi*. High concentration of nanosalicylic acid has inhibitory effects on the expression level of peroxidase gene.

**Keywords:** Cereal Cyst Nematode, PAL, Peroxidase, SA.



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**Evaluation of some indigenous-wheat genotypes to cereal  
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pattern, enzyme changes and yield components in resistant  
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