

SEED PRETREATMENT WITH BRASSINOLIDE INDUCES THE ANTIOXIDANT DEFENSE SYSTEM OF *HELIANTHUS ANNUUS* AGAINST SUNFLOWER BROOMRAPE INFECTION

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Abstract

Sunflower (*Helianthus annuus*), an economically important crop species, can be specifically infected by the root holoparasitic angiosperm sunflower broomrape (*Orobanche cumana*), resulting in a severe growth retardation and yield loss, globally. This study was conducted to examine the protective effects of brassinolide (BR) application on the seeds of susceptible sunflower (cultivar TK0409) against *O. cumana* infestation. Sunflower seeds were primed with different concentrations of BR (0, 0.005, 0.05, 0.5 mg L⁻¹) for 24 hours. The primed seeds of sunflower were grown along with *O. cumana* for 4 weeks. Results showed that *O. cumana* infection contributed to an inhibition of plant growth, accompanied by notable chlorophyll loss and protein degradation. Furthermore, *O. cumana* infection induces oxidative stress by enhancing the production of reactive oxygen species (hydrogen peroxide and superoxide), which led to the lipid peroxidation and activation of antioxidant defense system. Enhanced expression of antioxidant enzymes (superoxide dismutase, peroxidase, ascorbate peroxidase, glutathione reductase) as well as their transcript levels under *O. cumana* infection were confirmed by quantitative Real-Time PCR (RT-qPCR) assays. Pretreatment of sunflower seeds with 0.05 mg L⁻¹ BR significantly increased the full plant height (27.5%), fresh weight (63.1%) and dry weight (51.9%) compared with control, respectively. BR application also reduces the number and biomass of established *O. cumana*. Morphological observations, supported by ultrastructural analysis revealed exogenous application of BR significantly modified the damaged organelles caused by infection of *O. cumana*. The impairment in the photosynthetic efficiency affected by *O. cumana*, was significantly recovered with the application of 0.05 mg L⁻¹ BR as compared with other BR treatments. The findings of the present study revealed that BR improves the plant growth and biomass, photosynthetic efficiency and antioxidant defense system against *O. cumana*-induced oxidative stress in the leaves and roots of susceptible sunflower (TK0409).

Keywords: *Orobanche cumana*, sunflower, brassinolide, antioxidants, gene expression