Iranian Journal of Field Crops Research
Vol. 13, No. 4, Winter. 2016, p. 728-737

نشریه پژوهشهای زراعی ایران
جلد ۱۳، شماره ۴، زمستان ۱۳۹۴، ص. ۷۳۷-۷۲۸

Effects of Chitosan Spraying on Physiological Characteristics of *Ferula flabelliloba* (Apiaceae) Under Drought Stress

Gh. Taheri[1*]

Received: 15-02-2014
Accepted: 06-01-2015

Introduction

Ferula flabelliloba Rech. F. & Aell., (Apiaceae), a perennial plant with medicinal value, is one of important soil protective grown in Binalood mountains. Decreased precipitation in the previous years caused plants subjected to drought stress condition. Drought stress limits the growth and productivity of plants more than any other environmental factors. Drought stress can alter plant light absorption and consumption processes and increases production of reactive oxygen species (ROS). ROS is responsible for lipid peroxidation and associated injury to membranes, nucleic acids, proteins and enzymes. To detoxify ROS, plants develop different types of antioxidants to reduce oxidative damage and confer drought tolerance. ROS scavengers are either non-enzymatic (ascorbate, glutathione, flavonoids, alkaloids, carotenoids and phenolic compound) or enzymatic containing superoxide dismutase, catalase, ascorbate peroxidase, and glutathione reductase. The activity of these antioxidants and enzymes allows short-term acclimation to temporary water deficit, but these biochemicals cannot overcome the effects of extreme or prolonged drought.

Chitosan is a natural biopolymer formed by low alkaline deacetylation of chitin, an important component of the exoskeletons of crustaceans such as crab, crawfish and shrimp. Chitosan can affect plant physiology and gene expression, hence these materials can increase the plant resistant to many unfavorable environmental condition. The biological properties of chitosan have led to use it for various purposes. Chitosan has been used as plant protectant against fungi, bacteria and viruses, to improve soil fertility and to stimulate plant defense system. Thus, it seems that chitosan is a promising material for improving plant growth, especially under drought stress conditions where water deficit limits plant growth and establishment. In the present study, the effects of chitosan as foliar spraying of *F. flabelliloba* with different concentrations were investigated. The main objective of this study was to examine the potential benefits of chitosan by reducing damage to *F. flabelliloba* at the seedling stages under water-deficit conditions.

Materials and Methods

In order to evaluate the effects of chitosan spraying and drought stress on physiological characteristics of *F. felabelliloba*, a factorial experiment in a completely randomized design with three replications was conducted in laboratory. The experimental treatments included drought stress (irrigated in Field capacity, depletion of soil water content up to 35% and 65% of FC condition) and foliar chitosan spray (Zero, 0.2, 0.4, 0.6 and 0.8 mg l^{-1}).

Seeds of *F. flabelliloba* were harvested in June-July of 2012 from natural habitat in Binalood mountain and kept in laboratory condition until the study started. *F. flabelliloba* seeds were germinated and grown in soils at light/dark temperature cycle of 20-16 degree centigrade and photoperiod of 16-8 h. Irrigation treatments were performed after 20 days, when seedling established and chitosan sprayed simultaneous and repeated one month later.

The shoot from 60-day-old plants were taken and used for analysis the physiological parameters. Shoot dry weight was measured in oven at 70 ºC for 24 hours. Enzyme activity was determined from the extract prepared according to the method of Sairam and Saxena (2000). Catalase and Peroxidase activities were determined according to Weydert and Cullen (2010) and Superoxide dismutase activity assayed as described by Beauchamp and Fridovich (1971). Lipid peroxidation was estimated by measuring spectrophotometrically malondialdehyde (MDA) content of plant based on Jiang and Hung (2001). Total phenolic content was determined according to Ebrahimzadeh and Bahramian (2009). Data from the experiment was analyzed using SPSS *ver*. 17 and MSTAT-C software and mean comparison was carried out using Duncan´s multiple range test at the 95% of probability.

1- Assistant Professor, Department of Plant Biology, Neyshabur Branch, Islamic Azad University, Neyshabur, Iran
(*- Corresponding Author Email: Ghadirtaheri@gmail.com)

Results and Discussion

Results showed that shoot dry weight of the plants maintained under depletion of soil water content up to 65% of FC decreased and total phenolic content, Malondialdehyde (MDA) concentration, the activity of Superoxide Dismutase (SOD) and Catalase (CAT) increased. The highest shoot dry weight was obtained in plants treated with 0.4 mg l^{-1} chitosan. The highest phenolic content, CAT and SOD activity were obtained in plants subtended in depletion of soil water content up to 65% of FC and sprayed with 0.6 and 0.8 mg l^{-1} chitosan.

Defensive mechanisms against oxidative damage related with drought stress, including production of antioxidative enzymes can be increased by exogenous application of chitosan. Chitosan may have had the beneficial effects on plant growth under water deficit stress condition, often by anti-transparent and causing the closure of stomata which conserves water. The lower amount of MDA in plants sprayed with chitosan, whether under well-watered or drought conditions, suggests that chitosan protects against oxidative damage. Moreover, our study demonstrates that application of chitosan to 0.6 mg $l^{-1,}$ increased total phenolic content in *F. flabelliloba* leaf tissue, and decreased the lipid peroxidation. The decrease in shoot dry weight against drought stress in the *F. flabelliloba* plants sprayed with 0.8 mg l^{-1} of chitosan, might be result of factors that occurred alone or in combination. High rates of chitosan can reduce plant growth by decreasing photosynthesis and the rates of some biochemical processes.

Conclusions

The Results of this study indicated that chitosan sprayed under drought condition could stimulate enzymatic and non-enzymatic anti-oxidative defence system of *F. flabelliloba* and decreased oxidative damage in water stress condition. According to the result, it can be concluded that chitosan foliar spraying can decrease harmful effects of drought stress and can be used as a plant growth enhancer for *F. Flabelliloba*.

Keywords: Anti-oxidant, Enzyme, Irrigation, Phenol, Vegetative growth