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The Effect of 24-Epibrassinolide on Germination, Physiological, Growth Parameters and Fruit Yield of Tomato (*Solanum lycopersicum* L.)

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Introduction

Solanum lycopersicum is an important and commercial crop belonging to the *Solanaceae* family (Peralta et al, 2008) and contains the most efficient antioxidants that protect cells against damage by scavenging free radicals (Salim et al, 2020).

Seed priming is a low-cost and effective physiological process that leads to stimulation of seed germination and increased plant yield (Rhaman et al, 2020). Biopriming or hormonal seed priming plays an important role in seed metabolism and is widely used in commercial seeds (Wiszniewska, 2021).

Brassinosteroid (Br) is an important steroid regulator of plant growth that is involved in multiple developmental processes, including cell division, reproductive development, and regulation and modulation of gene expression (Nolan et al, 2020). It has been reported that Br improved tomato plant growth and fruit yield and quality (Hayat et al, 2012) and sword lily postharvest performance (Mollaei et al, 2018). The present study was conducted to study the effect of Br treatments as seed priming, foliar spraying and a combination of both on germination, seedling production and fruit yield and quality of tomato.

Material and Methods

Three experiments (seed germination in Petri dish, seedling production in greenhouse and field experiment) were conducted. The treatments at the stage of germination and seedling production

included seed priming in distilled water (control) and Br solution with concentrations of 0, 0.25, 0.5 and 0.75 µM for 24 hours. After 7 weeks, seedling related parameters were measured.

The field experiment was conducted in the research farm of the Faculty of Agriculture of Bahoner University, Kerman, and seedlings produced in the greenhouse were used under seed priming treatments at the levels of 0, 0.5 and 0.75 µM of Br. One month after the plants were transferred to the field, foliar spraying was done with concentrations of 0, 0.5 and 0.75 µM Br. The recorded parameters were leaf relative water content, leaf ion leakage, fresh and dry weight, the number of lateral branches and flowering clusters, the number of days until flowering, the number of fruits, the average weight of each fruit per plant, the weight of harvested fruit per plant (plant performance), chlorophyll and carotenoid, vitamin C, total soluble solids and fruit juice pH were measured.

Statistical analysis was performed using SPSS software (version 22) and DMRT (p=0.05) was used to compare the means.

Result and Discussion

Compared to the control, 0.75 µM Br increased the percentage and speed of germination and the relative water content by 21, 34 and 16 %, respectively, and decreased ion leakage by 23%. Also, this concentration increased root length by 33 % and seedling height by 121 %, and increased fresh and dry weight by 72 % and 89 % in root and 154 % and 131 % in shoot, respectively. The field results also showed that the effect of foliar spraying on relative water content and ion leakage was more effective than priming, and the effect of priming along with foliar spraying with 0.75 µM Br was more pronounced and led to a 63 % increase and a 56 % decrease, respectively. It also increased the fresh and dry weight of the plant by 76 and 75 % and the number of side branches and flowering clusters by 118 and 117 %, respectively. Also, the effect of priming was more effective than foliar spraying. 0.75 µM Br in priming conditions along with foliar spraying reduced the number of days until flowering and increased the number of fruits by 120 %. Also, this concentration increased fruit yield by 100 % in priming, 65 % in foliar spraying, and 145 % in the combination of priming and foliar spraying. Seed priming along with foliar spraying with 0.75 µM of Br had the greatest effect on chlorophyll a, total chlorophyll, chlorophyll index, amount of vitamin C, solid soluble substances and titratable acid, while the concentration of 0.5 µM of Br had the greatest effect on the amount of chlorophyll b.

Br by affecting the signaling pathway of the key transcription factor BZR1 involved in the expression and activity of α-amylase and starch degradation in the endosperm leads to the improvement of rice seed germination (Xiong et al, 2022) and through increasing the length and number of secondary roots leads to an increase in water absorption potential and increasing the relative water content of the plant (Swamy & Rao, 2006). Similar results have been observed about

increasing the relative water content of tomato plants (Hayat et al, 2012). It has been shown that the use of Br analogues increased plant growth, photosynthesis, carotenoid accumulation and fruit quality characteristics, while the Br biosynthesis inhibitor with brassinazolium had the opposite effect (Nie et al, 2017).

Br improved germination, production of flowery branches and growth of inflorescence and caused faster formation of female flowers in watermelon and significantly reduced the number of male flowers in the first nodes and by changing the ratio of sexes and increasing the number of female flowers, increased the number of fruits to 60 % and yield to 66 % (Susila et al, 2012). It seems that Br has accelerated flowering through its effect on plant growth and speeding up the time of entering the reproductive phase. Seed priming through root production and improving metabolic processes involved in germination increases nutrient uptake Rhaman et al, 2020; (Zhao et al, 2020)) and crop production (Qamar et al, 2022). The findings of this research were consistent with the improvement effect of brassinosteroid in tomato and cucumber (Ali, 2017), wheat (Shopova et al, 2021), beans and peas (Quamruzzaman et al, 2021).

Conclusions

Br improved the growth, fruit yield and quality traits in both seed priming and foliar application. Compared to foliar spraying, seed priming was significantly more effective. The use of seed priming will greatly help preserve the environment and reduce production costs due to the small consumption of chemical substances and its ease of use. The combination of seed priming and foliar spraying had a significant effect on all the measured parameters compared to the control, and the concentration of 0.75 μM was more significant and increased seed germination, seedling growth, fruit yield and the amount of vitamin C in the fruit extract.

Keywords: Brassinosteriod, Foliar spraying, Seed priming, Solanum lycopersicum.

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Declaration of conflict of interest