Improving Drought Stress Tolerance in Broccoli (Brassica oleracea var. italica L.) through the Soil Bacteria. Variovorax paradoxus YNA59 Treatment

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In recent years, drought is increasing worldwide due to abnormal climate. Lack of moisture in crops causes ABA accumulation, closing stomata, reducing gas exchange, and inhibiting photosynthesis. Prolonged drought stress leads to the generation of ROS (Reactive Oxygen Species). Excessive ROS damage DNA, inhibit protein synthesis, oxidize photosynthetic pigments, and peroxidate membrane lipids. The purpose of this study was to improve drought stress tolerance of broccoli using Variovorax paradoxus YNA59, which reduce drought stress by producing EPS and antioxidant enzyme. The Variovorax paradoxus YNA59 used in this experiment was isolated from the rhizosphere of broccoli on the Daehaw-myeon, Pyeongchang-gun, Gangwon-do, Republic of Korea. Half of two-week-old broccoli was treated with 20mL of 5-day-old culture media of YNA59, which was the highest growth period, and the others were treated 20mL of D.W for 3 days. After each treatment, each treatment were divided the well-watered treatment (70‒80%) and the drought stress (35‒45%) treatment again to set a different condition water status. Well-watered treatment delivered 200mL water per week and drought stress treatment delivered 50mL water per week. On the 7th and 14th day of treatment, growth (height, leaf length, leaf width, number of leaves, fresh weight) and chlorophyll content were measured, and some samples were got NBT (Nitrotetrazolium Blue Chloride), DAB (3,3’-Diaminobenzidine) staining to visualize oxidative damage (O_2^•–, H_2O_2) in plant leaves. After freeze-drying and milling, ABA content was quantified using GC-MS. There was no significant difference in growth in both control and YNA59-inoculated broccoli on the 7th day of drought. On the 14th day of drought, the height was not significantly different, but in the well-watered treatment of both control group and YNA59-inoculated group of the leaf length, leaf width, and fresh weight increased by 3.7%, 9.13%, 14.9%, and in the drought treatment increased by 10%, 15.7%, and 23.3%. Chlorophyll contents also increased by 3%, 10% respectively in the well-watered and drought stress treatment of the YNA59-inoculated group compared to the control group. In addition, the ABA content of the plants in the well-watered and drought treatment was decreased by 44.2%, 33% in 7days respectively, and was decreased 17.2%, 15.7% in the 14days, in the YNA59-inoculated broccoli. Afterwards, NBT (Nitrotetrazolium Blue Chloride) and DAB (3,3’- Diaminobenzidine) staining also showed much darker stains which mean oxidative damage of O_2^•– and H_2O_2 in the control group than in the YNA59-inoculated group. Therefore, soil microorganism Variovorax paradoxus YNA59 is thought to improve the drought stress tolerance. (This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2017R1D1A1B04035601.).)

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