Over-Expressing mirRNA164 to Improve the Light Sensitive of Perennial, a Possible Way to Enhance the Shade Tolerance of Plants

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Introduction

Perennial ryegrass (*Lolium perenne*) is one of the most widely used forage and turf grasses in the world due to its desirable agronomic qualities. Illumination is an indispensable environmental condition for all plants. Photosynthesis is the most important life activity in plants. Light intensity can affect the growth, development, morphogenesis and reproduction of plants.

Objective

To identify the function of the miRNA164 gene in the Perennial ryegrass under different intensity.

Materials and Treatments

Plant Materials

Three types of Perennial ryegrass 'Citation Fore' (Pure Seed, Canby, OR, United States), pv164(miR164 transgenic plants), m164(mimic miR164 transgenic plants) and WT (wild type plants).

Treatments

The growth chamber was set as the following: relative humidity 70%, 25/20℃, and a 14-h photoperiod with 10000lux (photosynthetically active radiation). A week later, half of the adapted grasses were transferred to a new growth chamber (same model) with higher light intensity (40000lux), and another half of the adapted grasses were transferred to another growth chamber (same model) with lower light intensity (5000lux).

Results



Fig. 1 Three types of perennial ryegrass under the low light (5000 lux) after 28 days.



Fig.2 Three types of perennial ryegrass under the high light (40000 lux) after 28 days.

Phenotype

There is no obvious difference among these three types of Perennial ryegrass exposed to low and identical light intensity. But two main differences can be observed in the case of high light. Firstly, the WT plants are shorter and wider, compared to the m164 plants and pv164 plants. And the pv164 plants are the tallest. Second, The leaves of m164 plants are more curly, narrow and erect than that of WT plants and pv164 plants under identical light intensity.

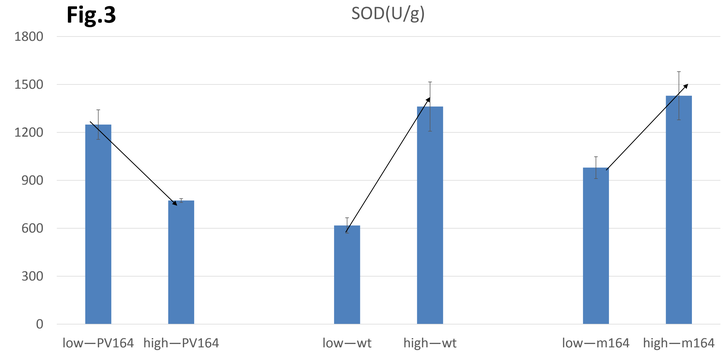
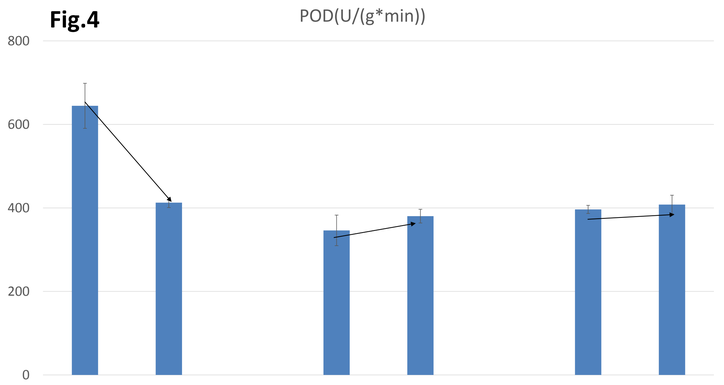


Fig. 3 The SOD activities of these three types of perennial ryegrass under low light and high light after 28 days.

SOD

The SOD activity of the pv164 plants exposed to high light is less than that under low light. On the contrary, the SOD activities of the m164 plants and the WT plants exposed to high light are more than that under the low light (fig.3).



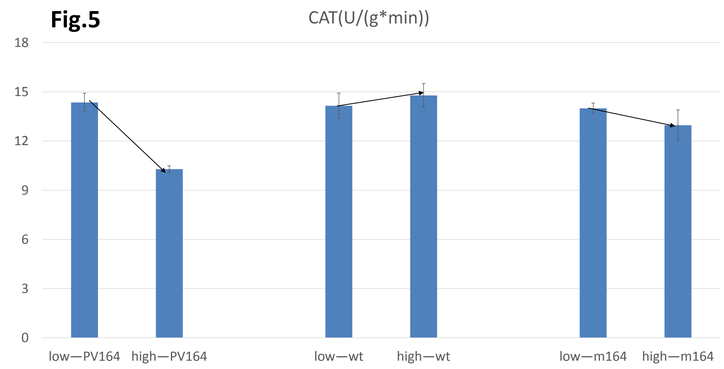
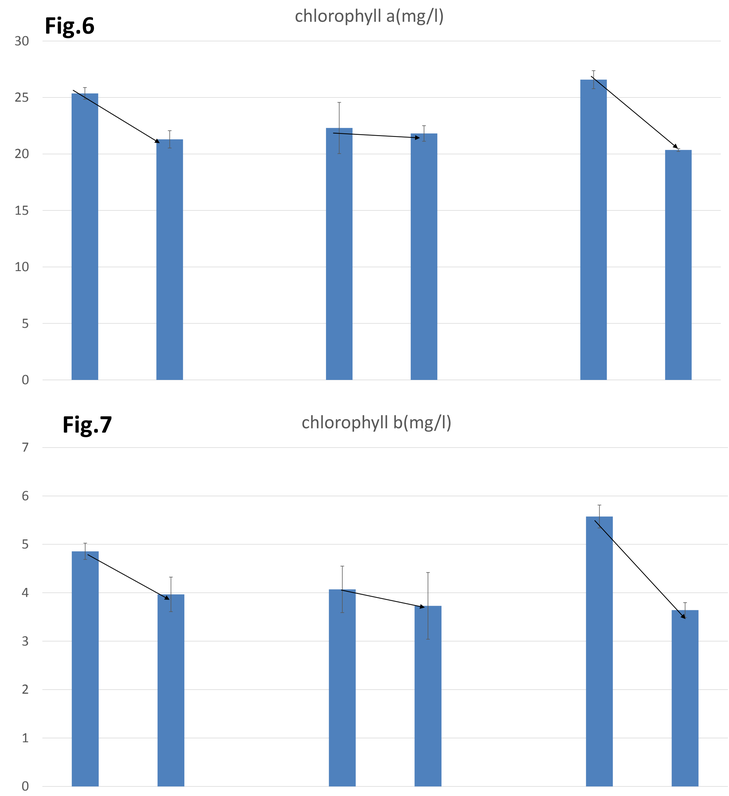


Fig. 4 The POD activities of these three types of perennial ryegrass under low light and high after 28 days.
Fig. 5 The CAT activities of these three types of perennial ryegrass under low light and high light after 28 days.

POD and CAT

Similarly, the POD activity and CAT activity of the pv164 plants exposed to high light are less than that under low light. But, different from the SOD activity, the POD activity and CAT activity of the m164 plants and the WT plants exposed to high light are nearly same as that under low light (fig.4-5).



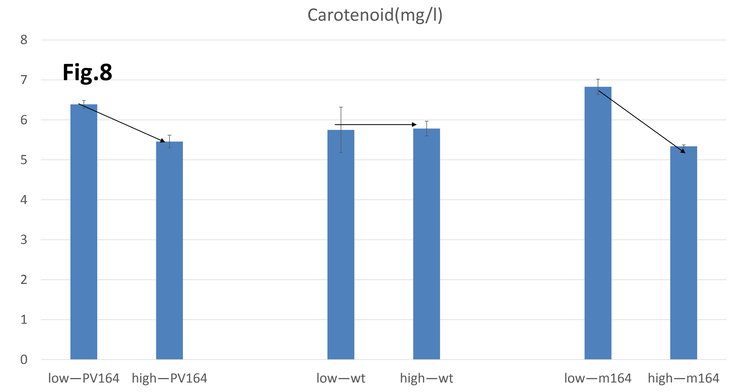


Fig. 6 The chlorophyll a contents of these three types of perennial ryegrass under low light (5000 lux) and high light (20000 lux) after 28 days.
Fig. 7 The chlorophyll b contents of these three types of perennial ryegrass under low light (5000 lux) and high light (20000 lux) after 28 days.
Fig. 8 The carotenoid contents of these three types of perennial ryegrass under low light (5000 lux) and high light (20000 lux) after 28 days.

Chlorophyll and Carotenoid

Interestingly, the chlorophyll a contents, chlorophyll b contents and carotenoid contents of the pv164 plants and m164 plants exposed to high light are less than that under low light. But there is no difference between low light and high light for the WT plants.

Discussions

The photoprotection of plants is resulted from high light, Over-Expressing miRNA164 could improve the Light Sensitive of Perennial, which leads to more reactive oxygen species and more SOD, CAT and POD required to eliminate reactive oxygen.

The miRNA164 could influence the synthesis of chlorophyll, but the reasons why the changes of chlorophyll between the over—expression miR164 and mimic miR164 are the same remain to be studied.