



Growth Response of Rice to Different Vapor Pressure Deficits and Diurnal Temperature Patterns

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INTRODUCTION

In arid and semi-arid areas, large diurnal temperature amplitudes and high evaporative demands are challenging rice cultivation. Since paddy rice is grown under flooded conditions, water temperature may have a larger impact on the growth of rice, particularly before booting stage, when the plant's meristem is below the water surface.



Also, vapor pressure deficit (VPD) affects the growth of rice due to changing canopy temperature and evaporative demand. Our greenhouse experiment aimed to determine responses of leaf and root growth of two rice varieties (IR64 and Sahel108) to three day/night water temperature regimes (constant temperature; warm day/cold night; cold day/warm night) under two VPD conditions (low and high).

RESULTS AND DISCUSSION

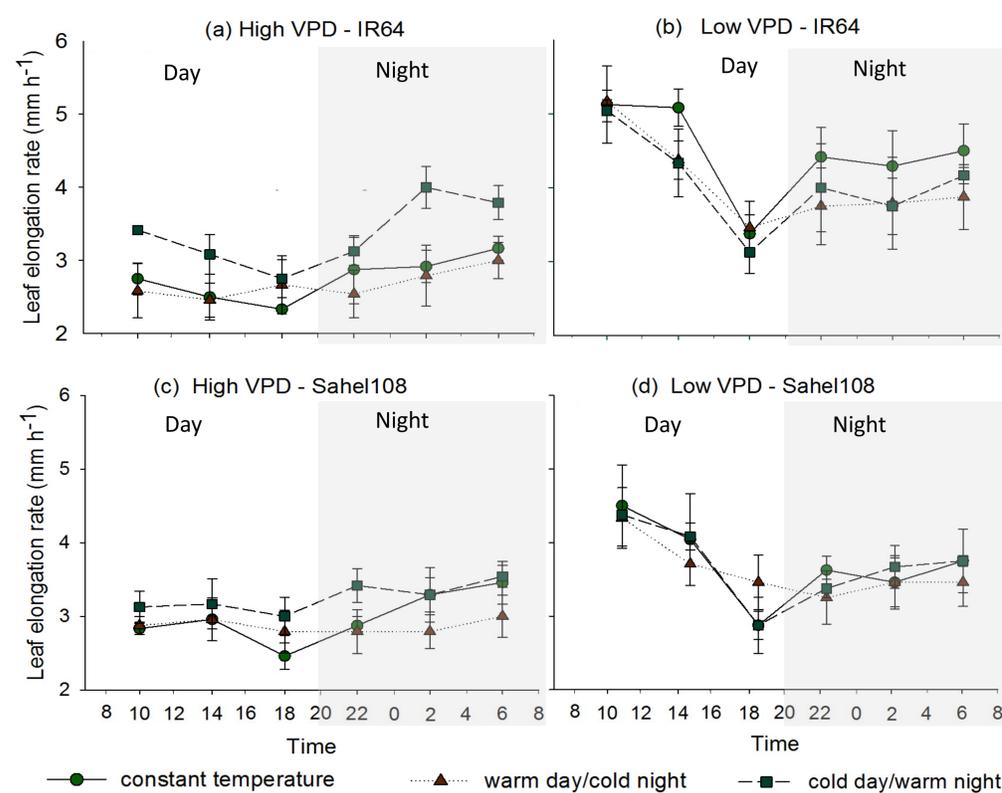


Fig. 1. The interactive effect of three water temperature regimes and two different VPD levels on leaf elongation rate of two rice varieties (IR64 and Sahel108).

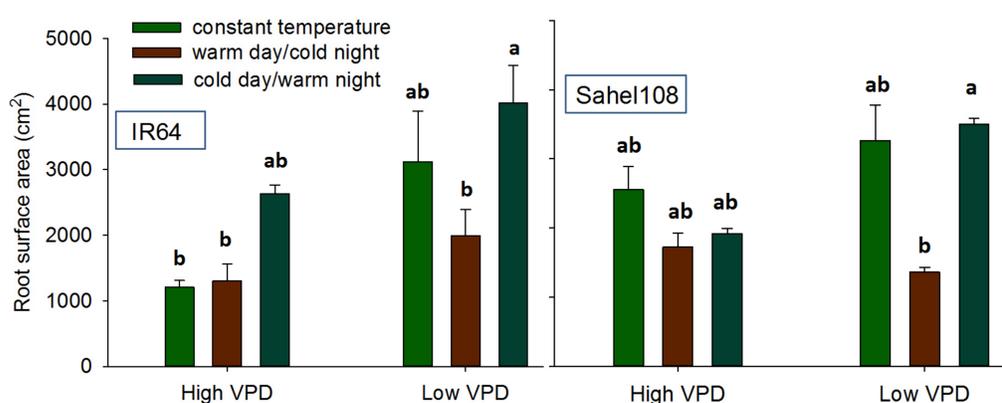


Fig. 3. Root surface area of two rice varieties under three diurnal root and meristem temperatures and two VPDs at 10 weeks after transplanting

- No significant effect of VPD on root growth was found.
- Under low VPD, warm day/cold night conditions led to a reduced root growth in both varieties.
- ➔ Cold day/warm night conditions largely increased root growth, which might enable rice plants to tolerate a high VPD during the day.

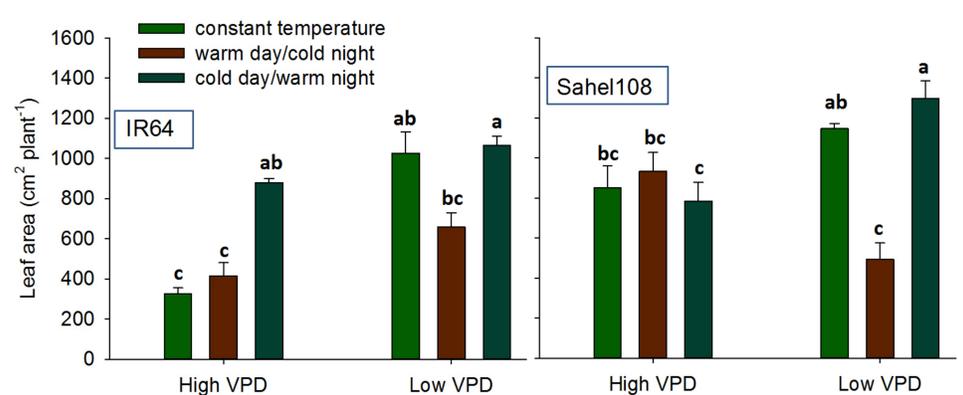


Fig. 2. Leaf area of two rice varieties under three diurnal root and meristem temperatures and two VPDs at 10 weeks after transplanting

- At low VPD, highest leaf elongation rate was found during the first half of daytime, whereas at high VPD, the rate was highest during the night and in the early morning.
- Low VPD increased leaf elongation rate of rice, but not always leaf area.
- Cold day/warm night conditions stimulated leaf growth at high VPD and largely increased leaf area of IR64.
- ➔ Since under high evaporative demand, rice leaves mainly grow during the night and in the early morning, night temperature can have a larger effect on plant growth than day temperature.

CONCLUSION

- ❖ Low VPD and cold day/warm night water temperature generally stimulated leaf growth.
- ❖ Under high VPD, leaf growth of rice was stronger at night.
- ❖ Water temperature had a larger effect on root growth than VPD alone and cold day/warm night water temperature promoted root growth.
- ❖ IR64 seems to be more sensitive to VPD and water temperature than Sahel108.

MATERIALS AND METHODS

Individual plants of two rice varieties (IR64 and Sahel108) were grown in pots containing one liter of the temperature-controlled nutrient solution (YOSHIDA). Three diurnal nutrient solution temperature regimes were established: constant temperature (23°C), warm day/cold night (28°C/18°C), and cold day/warm night (18°C/28°C). Growth chambers were designed to create two different VPD conditions (0.92 and 2.18 kPa). Photoperiod regime was set to 12/12h day/night with daytime from 8:00 to 20:00. Leaf elongation rate was measured for the 9-10th leaf in all treatments during 48h by using cameras (see the adjacent picture). Leaf area and root parameters were determined at 10 weeks after transplanting.

