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Hilling promotes flooding stress recovery by prompting photosynthesis resumption and biomass gain in tomato plants

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INTRODUCTION & AIM

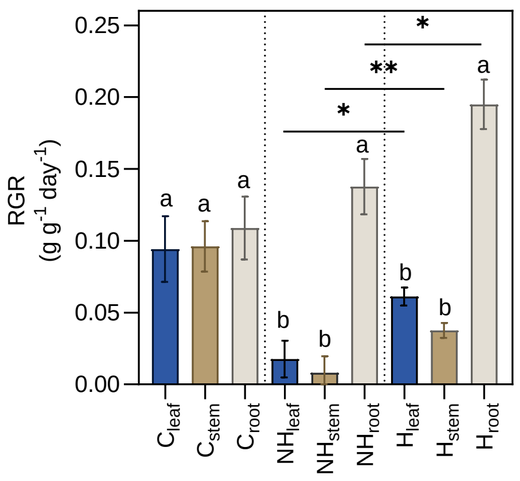
The ability of tomato plants to withstand flooding depends on how quickly they recover after the stress ends. Flooding causes damage to the plants' primary roots and replacing the damaged root system with new roots after the floodwaters recede is crucial. We looked at how promoting the growth of new roots through hilling affects growth and photosynthesis resumption in tomato plants after flooding. After a period of partial submersion, we drained the water and allowed plants to recover with (H) or without hilling treatment (NH).

METHODS

Hilling treatment (H) consisted of applying moistened soil to the base of a group of plants immediately after water drainage to prevent new roots from drying out. Another group of plants was left with their stems exposed to the air (NH). Control plants (C) were kept under the same conditions but were watered regularly. We measured various parameters, including biomass allocation, nitrogen concentration in leaves, transpiration rate, stomatal conductance, net CO_2 assimilation rate, and chlorophyll fluorescence, throughout the post-flooding period in C, H, and NH plants over a six-day recovery period.

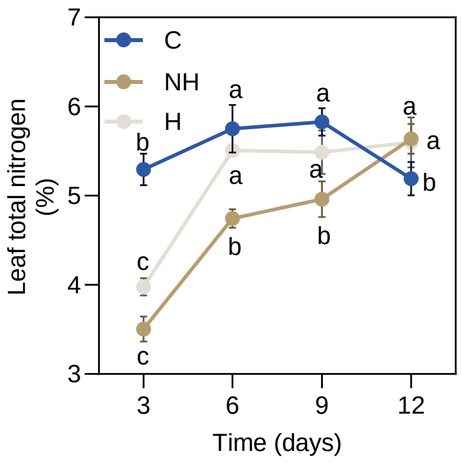
We tested the hypothesis that hilling can speed up the recovery of photosynthetic performance in tomato plants. We measured leaf gas exchange parameters and photochemical efficiency of PSII (F_v/F_m) to determine if hilling can promote adventitious root growth. We found that H plants showed a higher level of transpiration and stomatal conductance after four days of water drainage (Fig. A. B), a higher net CO_2 assimilation rate (Fig. C), and complete F_v/F_m (Fig. D) recovery after just two days. This indicates that root system regeneration speeds up tomato photosynthesis recovery.

RESULTS & DISCUSSION



The daily dry mass accumulation (RGR) in control (C) plants was almost equal for leaves, stem and roots, while in hilled (H) and no-hilled (NH) plants, biomass accumulated almost exclusively in roots, indicating a redirection of photosynthates towards belowground organs. However, H plants had much higher RGR in leaves and stem than NH plants. This shows that the earlier an adventitious root system forms, the earlier aerial biomass starts to recover.

Leaf nitrogen content recovered more rapidly in H plants after flooding and reached the level of C plants three days earlier than NH plants. This suggests that the enhancement of adventitious rooting by hilling benefits water and nutrient uptake.



CONCLUSION

Our findings suggest that promoting root growth is crucial to aid recovery from flooding in tomato plants, as promoting stem-borne new root growth with hilling technique speeds up photosynthesis and biomass gain.