Nitrate fertilization increases kiwifruit plant tolerance to Pseudomonas syringae pv. actinidiae

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Introduction

Pseudomonas syringae pv. actinidiae (Psa) is the pathogen responsible for the kiwifruit bacterial canker (KBC), for which no curative methods have been developed yet. The source of nitrogen (N) may have consequences on overall plant nutritional status, which in turn may also affect the plant’s predisposition for pathogen infection. However, the lack of knowledge on how kiwifruit plants (Actinidia spp.) respond to infection by Psa when grown under different N supplies hinders the possibilities to use N supply in integrated approaches to diminish disease severity. The aim of this study was to understand how nitrate (NO₃⁻) and ammonia (NH₄⁺) modulate plant defence mechanisms against Psa, paving the way for the development of novel N fertilization regimens that increase plant resilience to the pathogen, or that ensure plant growth and productivity even with Psa infection.

Results and Discussion

Photosynthetic capacity of plants under NH₄⁺ supply decreased along the experimental trial.

Supplementation with NO₃⁻ led to lower Psa endophytic population in plant tissues, whereas NH₄⁺ and Mix led to higher infection rate.

NH₄⁺ induced the expression of genes related to plant stress (PR1) and secondary metabolism (LOX, PAL and SAM). Genes related with N metabolism were differently regulated depending on the N source: whereas GLU1 and GDH1 were overexpressed with NH₄⁺ and Mix, NO₃⁻ led to overexpression of GAD1.

Methods

1. A. chinensis var. delicosa cv. ‘Hayward’ where grown for 21 days in a hydroponics system with nutritive solutions differing in the type of N supply: 214 μM NO₃⁻, 214 μM NH₄⁺ or a mixture of both (Mix - 107 μM NO₃⁻ + 107 μM ppm NH₄⁺).
2. Psa was inoculated onto plant leaves by rubbing the abaxial surface with an infected swab.
3. Fourteen days post inoculation (dpi) plants were sampled for the analysis of: photosynthetic capacity, Psa endophytic population, total N, mineral composition and gene expression.

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Conclusions

NO₃⁻ led to higher Psa colonization and maintenance of plant photosynthetic capacity, having potential to be included in integrated pest management strategies against Psa.

NO₃⁻ could have increased plant tolerance to the pathogen by improving P, K, Mg, Ca and Mn nutrition.

The higher levels of total N in NH₄⁺ and Mix-supplied plants may have underpinned the increased Psa colonization observed with these treatments.