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Nitrogen Fertilization of the Host Plant Influences Production and Pathogenicity of *Botrytis cinerea* Secondary Inoculum

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ABSTRACT

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The influence of nitrogen (N) nutrition on a plant's susceptibility to *Botrytis* spp. and other pathogens is well documented. However, little is known of possible effects on sporulation of the pathogen on diseased tissue and on the pathogenicity of resulting secondary inoculum. To address this question, sporulation by two strains of *Botrytis cinerea* was quantified on tomato plants produced under different N irrigation regimes with inputs of NO_3^- at 0.5 to 45 mmol liter^{-1} (mM). Sporulation decreased significantly ($P < 0.05$) with increasing N fertilization up to NO_3^- at 15 to 30 mM. The secondary inoculum was collected and used to inoculate pruning wounds on tomato plants produced under a standard fertilization regime. Pathogenicity of the spores was significantly influenced by the nutritional status of their production substrate. Disease severity was highest with spores produced on plants with very low or very high N fertilization (NO_3^- at 0.5 or 30 mM). It was lowest for inoculum from plants with moderate levels of N fertilization. These results suggest that it may be possible to find an optimum level of N fertilization to reduce the production of secondary inoculum and its pathogenicity to tomato.

Additional keywords: gray mold, *Solanum lycopersicum*.

Sporulation is essential for the reproduction and spread of many fungi. For those that are airborne plant pathogens, the kinetics and abundance of spore production play a key role in the development of epidemics (10,33). Fungal sporulation can be influenced by many factors, including the availability of nutrients (7,15,34,60). Some fungi have specific carbon (C) and nitrogen (N) requirements whereas, for others, sporulation is triggered by nutrient depletion (9,12). For most fungi, the specific substrate also influences spore production. Much information has been generated to optimize substrate composition for mass producing fungi of industrial interest such as biocontrol agents against plant pathogens (17,50) and insects (19,24,26,44). The effects of culture conditions and host substrate on initial spore production have also been documented for certain plant-pathogenic fungi (21,32, 35,42). Surprisingly little information is available on possible effects of plant fertilization on subsequent sporulation of pathogens, although it is known to modify the concentration of nutrients available to plant pathogens and to affect plant susceptibility (23).

The composition and type of nutrient substrate has also been shown to affect the pathogenicity of spores produced in vitro by plant-pathogenic *Colletotrichum truncate*, *Fusarium avenaceum*, and *Phytophthora infestans* (43,54,58); and the entomopathogen *Beauveria bassiana* (4). Aggressiveness may be attenuated when spores are produced under conditions of nutrient stress, as exemplified by *Bipolaris sorokiniana* conidia (2), or increased with increasing availability of key nutrients such as glucose, as exemplified by *Botrytis cinerea* (38). However, to our knowledge, no information is available on effects of plant fertilization on the pathogenicity of fungal spores produced on diseased tissues.

B. cinerea, the causal agent of gray mold, is responsible for severe losses in many crops, including tomato (36,45,53). In favorable conditions, this fungus can produce a large quantity of spores on diseased tissue (35) that are easily dispersed and have a key role in the development of gray mold epidemics (8). The control of gray mold is highly dependent on fungicide applications, and much research is dedicated to developing alternative control methods (13). A possible alternative could consist of reducing sporulation with the help of biocontrol agents (27) or the use of UV-filtering films (35). Another possibility to reduce sporulation might be through the manipulation of plant fertilization. Several studies have shown that high N nutrition of the host plant promotes the sporulation of several fungi, including *B. cinerea* on sweet basil (55). Although no information is available for the sporulation of *B. cinerea* on tomato, previous studies have shown that high N nutrition reduces the susceptibility of the plant (22,31,52). Furthermore, we were unable to find information regarding the effect of N fertilization of plants on the pathogenicity of resulting secondary inoculum of *B. cinerea*.

The objectives of this study were to (i) assess the effects of N nutrition of tomato on sporulation of *B. cinerea* on diseased tissue and on pathogenicity of the resulting secondary inoculum and (ii) to correlate these effects with modifications in plant tissue composition.

MATERIALS AND METHODS

Production of plants under different N fertilization regimes. Tomato plants (*Solanum lycopersicum* var. *esculentum* 'Swanson') were grown from seed in 1-cm^3 rock wool cubes in a heated greenhouse and transferred 10 days after sowing to rock wool blocks as previously described (33). The plants were irrigated with a standard commercial greenhouse nutrient solution the first

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* The *e*-Xtra logo stands for "electronic extra" and indicates that the online version contains two supplemental tables. Figure 2 appears in color online.

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