

Effects of Nitrate and Ammonium Nitrogen on Severity of Fusarium Foot and Root Rot and on Yield of Greenhouse Tomatoes

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ABSTRACT

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In the presence of adequate lime, nitrate nitrogen and ammonium nitrogen had similar effects on the incidence of Fusarium foot and root rot (*Fusarium oxysporum* f. sp. *radicis-lycopersici*) of tomato cultivar MR 13 grown in sterilized reinfested greenhouse soil. The disease differs in this respect from wilt caused by *F. oxysporum* f. sp. *lycopersici*.

Fertilizers have marked effects on the severity of plant diseases, sometimes decreasing and sometimes increasing it. Especially important is nitrogen (N) and the form in which it is applied (2). In foot and root rot disease of tomato (*Lycopersicon esculentum*, Mill.) caused by *Fusarium oxysporum* f. sp. *radicis-lycopersici* (3), Sonoda (9) found no significant differences in disease severity indexes (DSI) in potted plants fertilized with ammonium or nitrate nitrogen. Lime added with either N source failed to reduce DSI. The fungicides benomyl and captafol, introduced as additional soil factors, both tended to be phytotoxic. The lowest DSI was obtained with nitrate N + lime + benomyl and was associated with a very poor yield, whereas ammonium N alone gave the highest DSI but also one of the higher yields.

Lime with nitrate N also alleviated wilt symptoms of tomato and chrysanthemum caused by *F. oxysporum* f. sp. *lycopersici* Snyder & Hans. (6,10) and *F. oxysporum* f. sp. *calistephi* Snyder & Hans. (1,11), respectively.

Tomato foot and root rot is widespread and serious in the commercial greenhouses of Essex County in southwestern Ontario (5) and in Ohio (8). Control is elusive, as is identification of other than a few factors that predispose crops to the disease (W. R. Jarvis and H. J. Thorpe, unpublished). At the Harrow Research Station, we consistently fail to induce widespread plant death on the scale seen in the local commercial greenhouses even though we can readily induce sublethal stem and root lesions.

The work reported here examines the effects of nitrate N and ammonium N, in equivalent amounts, on incidence of stem and root symptoms and on yield of a

groundbed-grown crop of tomatoes with adequate calcium.

MATERIALS AND METHODS

The tomato cultivar MR 13 was grown in a heated greenhouse according to local management practices and to the recommendations of the Ontario Ministry of Agriculture and Food (7). Seeds were sown in late November and the potted plants were transplanted in early January into a steam-sterilized groundbed infested by *F. oxysporum* Schlecht. f. sp. *radicis-lycopersici* Jarvis & Shoemaker (3). A suspension of microconidia was sprinkled on the newly sterilized soil at the rate of $3.6 \times 10^5/m^2$, a procedure developed from the work of Rowe et al (8). The crop was transplanted into the infested soil 5 days later and grown to fruiting for 134 days.

Two fertilizer programs were applied at weekly intervals to double-row randomized plots throughout the growing season. Both regimens attempted to substitute the nitrogen in the standard recommended schedule (6)—one with only ammonium N and the other with only nitrate N. In the ammonium N program, the chemicals were ammonium sulfate, dipotassium phosphate, potassium sulfate, and calcium carbonate; in the nitrate N program, the materials were calcium nitrate, dipotassium sulfate, and potassium nitrate. Although N supply was equivalent, there was a certain imbalance in the other ions, notably potassium and sulfate. Notwithstanding, plants in both treatments grew very well and showed no obvious nutritional defects.

Lime in the form of calcitic limestone was incorporated into the groundbed before sterilization at the rate of 25 kg/100 m², together with 3 kg of MgSO₄/100 m² and one bale of horticultural peat (0.17 m³) per 10.7 m². An adequate level of lime was maintained by regular application of calcium in the fertilizer schedules. Magnesium sulfate was supplied through-

out the season as necessary.

Each N treatment was applied to seven double-row plots of 14 plants, randomized over the house. There were appropriate guard rows and guard plants, which received fertilizers according to the recommendations of the Ontario Ministry of Agriculture and Food (7). Picking began 79 days after transplanting and continued twice a week for 55 days. Cumulative fruit yields were recorded.

At 144 days, the stems were severed about 25 cm above ground, the roots were dug out and washed, and the bases of the stems were split open in order to assess disease severity. Root rot and foot rot were assessed on each plant on arbitrary 0-5 scales (4). For root rot, 0 = no symptoms and 5 = complete loss of the primary and adventitious root systems. For foot rot, 0 = no symptoms and 5 = complete rotting of the base of the stem and loss of the taproot.

The data were examined by standard analysis of variance procedures.

RESULTS

All 98 plants in each treatment had appreciable stem rot and root rot but none showed typical wilt and none died. A number, however, had thin stems at the top of the plant characteristic of the disease. The plants otherwise showed no nutritional defects, and the fruit was of excellent quality in both treatments.

For the ammonium N and nitrate N treatments, respectively, mean yields (kg/plant) were 3.47 and 3.62, mean root rot indexes were 2.5 and 2.4, and mean stem rot indexes were 2.9 and 2.7. There were no significant differences ($P=0.05$) in any respect. A random sample of 98 of the guard-row plants, which had received a standard fertilizer program, showed no difference in severity of stem rot from that of the plants that had received the two special fertilizer programs.

DISCUSSION

Our results agree with those that Sonoda (9) obtained with potted plants, ie, ammonium N and nitrate N, with adequate lime, have no markedly different effects on yield and disease severity. This contrasts with the vascular wilt disease of tomato and chrysanthemum caused by *F. oxysporum* f. sp. *lycopersici* and *F. oxysporum* f. sp. *calistephi* (1,6,10,11), respectively, in which nitrate N, especially with adequate lime, is associated with lower levels of disease.

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