

Use of Leaf Temperature to Assess the Response of Geranium following Exposure to Soil Pathogens



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ABSTRACT

Most geraniums (*Pelargonium x hortorum*) infected with soil pathogens are either asymptomatic or recover when the plants are grown under optimum conditions, it can be difficult to diagnose infection. Early response of geranium plants cv. “Maverick Red” exposed to soil pathogens was assessed by measuring changes in leaf temperature. Differences between air temperature and leaf temperature were noticed 7 days after exposure to pathogens.

Differences were greatest between week 3 and week 4. No marked difference in disease severity was observed among most of the treatments; although plants treated with *P. ultimum* exhibited more stunted growth in comparison to other treatments.

Differences in temperature disappeared 6 weeks after exposure and plants showed similar growth patterns thereafter.. Therefore, leaf temperature measurements are a versatile non-destructive way of rapidly examining whether plants are under stress when incited by soil pathogens.

INTRODUCTION

- Geranium [*(Pelargonium x hortorum* (L. H. Bailey))] is a popular ornamental produced in many greenhouses in the United States.
- Many water molds (species of *Phytophthora* and *Pythium*) infect geranium and cause problems such as root and crown rot, and damping-off (Moorman, 2001).
- Over-watering, poor drainage, and lack of sanitation practices are some of the conditions in greenhouses that generally favor the survival and spread of water molds (Benson & Broembsen, 2001).

PURPOSE

To study the relationship between infection, symptom development, and if changes in leaf temperature in response to various treatments could be detected.

MATERIALS and METHODS

- Seed of geranium, cv. Maverick Red, were grown in Oasis cubes for 10-14 days.
- Six plant pathogens (three *Phytophthora* spp., two *Pythium* spp., and *Verticillium dahliae*) were cultured on PDA for one week.
- Seedlings were removed and individually transplanted into 4” pots containing soilless medium infested with one of the 6 pathogens.
- Infrared surface temperature probes, thermocouples, humidity probes, light, and short-wave radiation sensors were used to measure environmental conditions and leaf surface temperature.
- Watering, fertilization, insect control and general plant maintenance were done as needed.
- Plants were arranged on greenhouse benches in a randomized complete block design with 4 blocks and 2 reps per block.
- Analysis of Variance (ANOVA) was implemented using the GLM procedure.
- Temperature and other parameters were measured daily, and plants were periodically inspected for symptom development.

RESULTS

- During week 1, no differences in leaf temperature were observed among treatments (Fig. 1). Moreover, the leaf temperature for various treatments was not different from that of room temperature.
- By week 2, there was an increase in leaf temperature compared to week 1 in all treatments including the control, with the plants treated with *P. ultimum* and *Phytophthora citrophthora* having higher leaf temperatures in comparison to other treatments (Fig. 1).
- From day 15 onward following inoculation, leaf temperatures for plants infected with *P. ultimum* were significantly higher than that of the control (Fig. 2), and other treatments.
- Visible disease symptoms in the form of chlorosis and stunted growth were not evident until 22 days after inoculation. By week 4, plants infected with *P. ultimum* were the smallest and had significantly lower shoot mass than all other treatments (Fig. 3 & Fig. 4B).
- Roots were washed and weighed 4 weeks after inoculation (WAI). The root system for *P. ultimum*-treated geranium were decomposing and showed extensive damage and had the smallest size compared to the control (Fig. 4A).

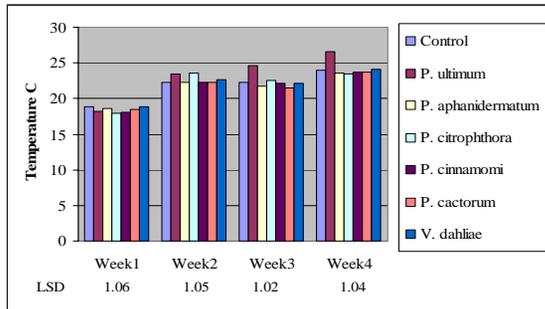


Fig 1 Effect of treatments on leaf temperature over time

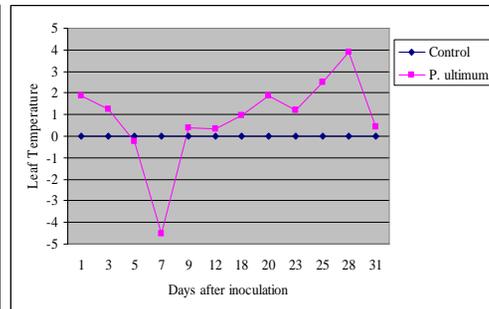


Fig 2 Change in leaf temperature in response to treatment with *P. ultimum* of over time

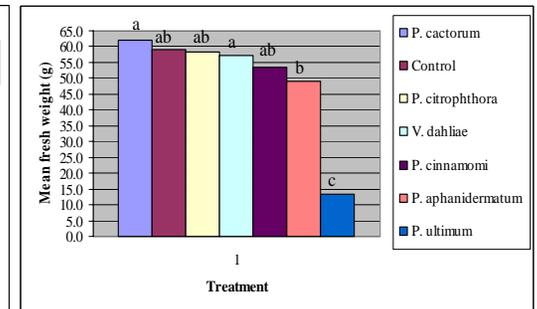


Fig. 3 Effect of treatments on shoot fresh weight 4 WAI



Fig. 4 Comparison of disease development and growth patterns between *P. ultimum* and control treatment on root (A) and shoot (B) systems



DISCUSSION

- In this study, geranium, cv. Maverick Red, was exposed to a number of soil pathogens commonly associated with greenhouse production. Environmental sensors were used to measure leaf temperature in addition to other parameters.
- The objective was to determine if plant response to infection could be assessed by monitoring the change in leaf temperature, as a sign of stress, before disease symptoms could be visually detected.
- Differences in leaf temperature among treatments were noticeable by week 3 and they were the highest in week 4.
- No marked difference in disease severity was observed among most of the treatments except with treatments that involved *P. ultimum*. Plants treated with *P. ultimum* were chlorotic and stunted in comparison to other treatments. Differences in temperature leveled off 6 WAI with all treatments and plants recovered except for *P. ultimum*.
- Change in plant temperature, as an indication of stress, can be used as a measurement in order to detect early infection with weak plant pathogens such as Pythium and Phytophthora. Such early detection of plant response is important as many of these plants when grown under optimal greenhouse conditions, tend to mask the effect of the pathogens and recover with little symptoms that are seen only on the lowest leaves. As a result, the effect of the pathogen can be negligible or largely minimized though it might be present

Literature Cited

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