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Special Research Report #135: Disease Management
Understanding Gerbera Powdery Mildew

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BACKGROUND

Gerbera daisies (*Gerbera jamesonii*) are grown as potted plants and fresh cut flowers and the latter is a $34.3 million industry in the U.S. Powdery mildew is the most common foliar disease of gerbera daisies; however, they are also susceptible to other foliar diseases including Botrytis blight. Powdery mildew may be caused by the fungi, *Golovinomyces* (*Erysiphe*) *cichoracearum* or *Podosphaera xanthii*. These fungi grow over the plant surface, appearing as white, talcum-like colonies. When infected, lower leaves may drop and stems and flowers may display signs of the pathogen during severe infections (Fig. 1A,B). Spores (conidia) (Fig. 1C) of the fungus are carried by air currents and dispersed by water splash. They are responsible for epidemic initiation and secondary spread of powdery mildew in the greenhouse. The widely grown gerbera cultivars are susceptible to powdery mildew. Currently, this disease is managed using frequent fungicide applications. Although scouting of the gerbera crop for early signs of powdery mildew may be useful to initiate fungicide applications, it is time-consuming and difficult, especially for large-scale growers. Thus, an understanding of the effects of various environmental factors on spore release and disease development could provide a framework for an integrated pest management approach that may reduce the number of fungicide sprays needed to produce a healthy and marketable crop. A reduction in the number of fungicide sprays through better timing of applications is desirable because they can be costly and pose a potential human health and environmental risk.

Fig. 1. Colonies of powdery mildew (caused by Podosphaera xanthii) on A, leaves and B, flower of gerbera. C, chain of P. xanthii conidia (arrows) growing from the surface of a gerbera leaf.

MATERIALS & METHODS

This research investigated gerbera powdery mildew caused by *P. xanthii*. The goal of this study was to (1) determine the influence of environmental conditions, including temperature, relative humidity, leaf wetness, and worker activity, on airborne concentrations of *P. xanthii* conidia and (2) determine the severity of powdery mildew disease on potted gerbera plants grown in a glass and a polyethylene research greenhouses at Michigan State University.

Plant Material: 7-week-old 'Festival Dark Eye Golden Yellow' gerbera plugs, a cultivar highly susceptible to powdery mildew, were transplanted into 6-inch plastic pots containing a commercial soilless potting mix composed of 40% perlite and 60% sphagnum peat moss (Baccto Professional Planting Mix, Michigan Peat Company, Houston, TX). Plants were placed with pots touching each other on three adjacent benches in each of two research greenhouses; one was a glass greenhouse and one was polyethylene. Plant growth and flowering were promoted with a 14-hour photoperiod. Plants were periodically cut to maintain vigor and were hand-watered using a hose and breaker. Care was taken to avoid wetting the foliage.

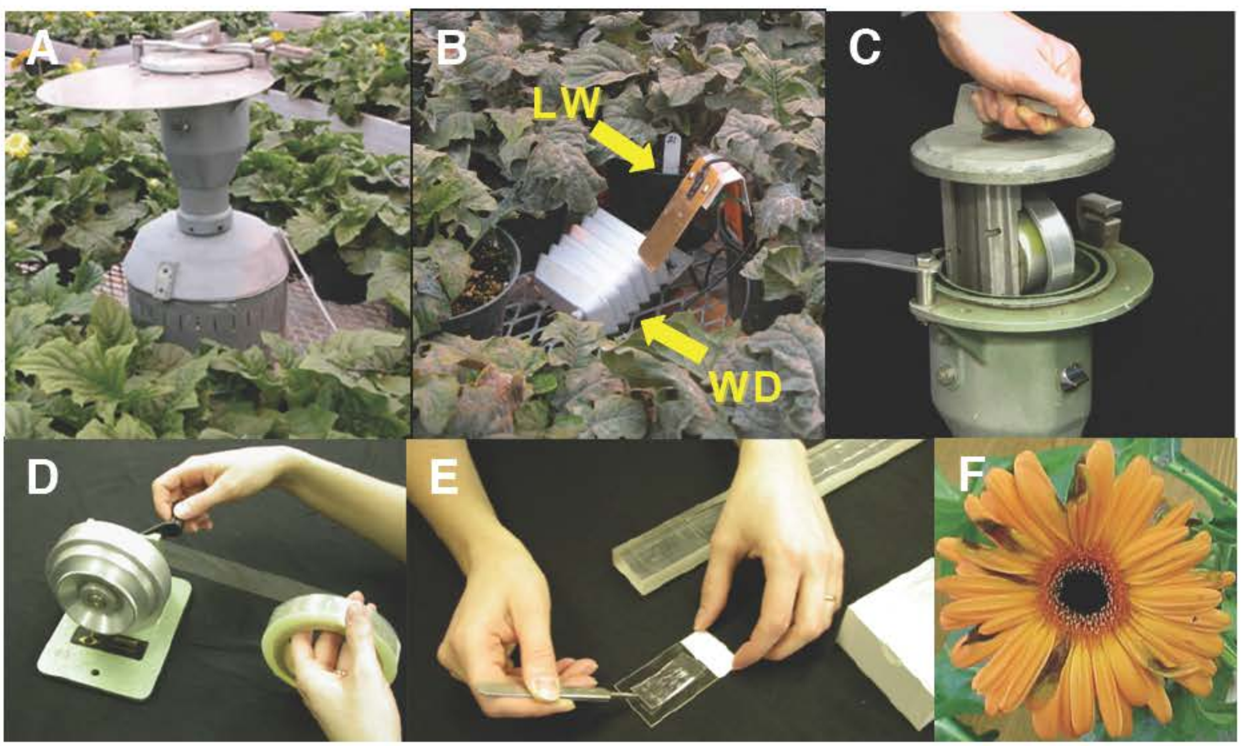

Fig. 2. A, spore trap, B, leaf wetness sensor (LW) and WatchDog (WD) in a greenhouse with infected gerbera plants. C, removing the reel from the trap. D, preparing the reel with a week's worth of transparent film tape. E, mounting a length of tape representing 48 hours onto a microscope slide. F, infected flower of gerbera 'Festival Dark Eye Golden Yellow.'

Spore trapping: Concentrations of airborne conidia of *P. xanthii* in the greenhouses of infected gerbera were monitored using 7-day volumetric spore traps (Burkard Manufacturing Company Ltd., Rickmansworth, Hertfordshire, UK) (Fig. 2A). The traps continuously sampled the air and collected powdery mildew conidia into the traps where they were embedded on a transparent film tape coated with an adhesive mixture mounted on a reel (Fig. 2C,D). The reels and tapes were removed and taken to the lab for processing. Tapes were cut into lengths representing 48 hours, marked for hourly intervals, and mounted on microscope slides (Fig. 2E). Using a microscope (x100), numbers of powdery mildew conidia present in each hour were counted.

Collecting environmental and disease data: Throughout the spore sampling experiment, temperature and relative humidity data were collected using a WatchDog 450 Data Logger (Spectrum Technologies Inc., Plainsfield, IL) and an external leaf wetness sensor set at a 45° angle in the plant canopy facing north (Fig. 2B). Before entering greenhouses, personnel documented date, time of day, and activity performed (applying pesticides, watering, pruning, assessing plant status). Plants were inoculated by placing one severely infected gerbera plant (~100% of foliage with pathogen signs) with actively sporulating *P. xanthii* colonies in the center of each greenhouse bench adjacent to healthy gerbera plants. Data were statistically analyzed to determine if there were any correlations between temperature, humidity and numbers of airborne conidia.

Severity of powdery mildew disease on gerbera plants was assessed weekly based on a visual estimation and rated on a scale of 1 to 10, where 1=no disease, 2=trace to 10%, 3=11-20%, 4=21-30%, 5=31-40%, 6=41-50%, 7=51-60%, 8=61-70%, 9=71-80%, and 10=81-100% of foliage infected. Ratings were conducted more frequently in the glasshouse because disease progressed more quickly. Data were statistically analyzed.

RESULTS

Spore Trapping: In the glasshouse, infected plants were observed before the first spore was detected, suggesting that even low airborne conidial concentrations are sufficient to initiate disease development (Fig. 3). In the polyethylene greenhouse, the first spore was detected before the first disease rating occurred. Peak concentrations of airborne powdery mildew spores were detected in both greenhouses when almost all of the plant foliage displayed signs of the pathogen (Fig. 3). A daily periodicity was observed where more conidia were trapped during the day than at night. Peak concentrations were observed at approximately 8 AM - 4 PM and 9 AM - 2 PM in the glass and polyethylene greenhouses, respectively (Fig. 4). Within this time-frame, spore numbers peaked twice in each greenhouse; with a peak in the morning (~9 AM) and a peak in the afternoon (3 PM) (Fig. 3).

Collecting environmental and disease data: Powdery mildew colonies were observed on gerbera within 20 days after exposure to inoculum in the glass greenhouse and 25 days after exposure in the polyethylene greenhouse. By 52 and 119 days after exposure to inoculum in the glass and polyethylene greenhouses, respectively, 100% of the foliage was covered with *P. xanthii* mycelia growth and spores.

In both greenhouses, the increase in disease severity was positively related to relative humidity (disease severity increased as relative humidity increased). An increase in disease severity was negatively related to the total hours of leaf wetness in the week before rating plants for disease. Disease severity was negatively related with average temperature only in the glasshouse. This may have been the result of temperatures being warmer in the polyethylene greenhouse. Leaf wetness was unfavorable for development of powdery mildew (disease negatively related to leaf wetness). Worker activity, which corresponded in a higher probability of spore release (Fig. 4A,E), may have resulted in increased air turbulence which has been shown to influence conidial dispersal for

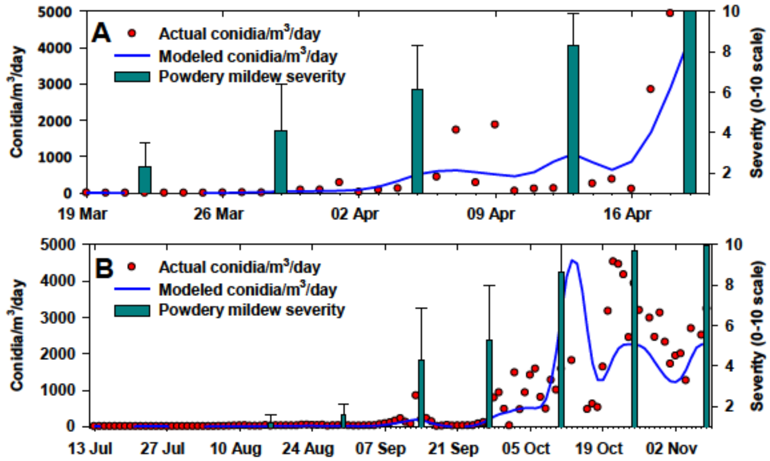

Fig. 3. Daily concentrations of airborne powdery mildew conidia and average disease severity ratings (1=healthy, 10=81-100% diseased) in A, a glasshouse and B, a polyethylene greenhouse.

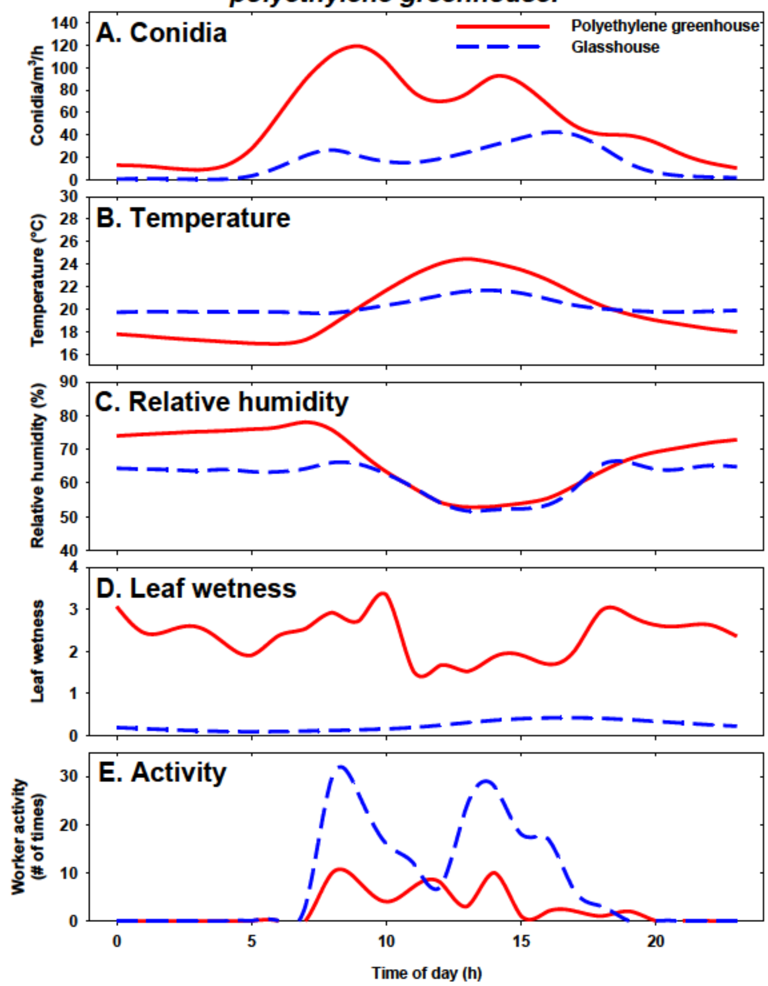

Fig. 4. Daily changes in A, numbers of airborne powdery mildew conidia, B, temperature, C, relative humidity, D, leaf wetness, and E, worker activity in a glasshouse (blue line) and a polyethylene (red line) greenhouse.

other powdery mildews.

CONCLUSIONS

Conidia were not detected for about the first 20 days after the addition of inoculum source plants until signs of the pathogen were present on the nonsource plants. Spores were detected from that point forward until the experiment was terminated. Thus, it appears that visual scouting for signs of the disease is more effective than spore sampling as a trigger to initiate fungicide applications. Significant increases in disease severity were observed from week to week. This suggests that more frequent scouting is necessary if fungicide sprays are to be applied before the disease is established.

INDUSTRY IMPACT

Management of gerbera powdery mildew should follow recommendations of wide plant spacings and adequate ventilation to reduce relative humidity in the microclimate. This creates a less favorable environment for disease progression. These recommendations would also be useful in managing Botrytis blight of gerbera. Treatments with fungicides on a regular basis to control primary infections are generally necessary to prevent disease progression, resulting in unmarketable plants. Frequent scouting and fungicide applications are recommended for management of powdery mildew on gerbera.

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