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Postharvest Disease of Zinnia: A New Threat to Cut Flower Production

Fulya Baysal-Gurel, PhD
Tennessee State University

Summary

A survey of U.S. zinnia growers found a range of production systems, zinnia cultivars, and growing conditions, almost all of which may be susceptible or conducive to zinnia melt-down disease. Concern amongst this broad cross section of the industry highlights the need for further research on this problematic disease, which will be conducted over the 2018 growing season.

ASCFG Zinnia Research Project Survey Result

In total, 29 responses were received, and the findings represent only the opinions expressed by cut flower growers in the survey. The responses were received from Connecticut (1), Georgia (3), Illinois (2), Iowa (1), Louisiana (1), Maine (1), Maryland (1), Massachusetts (1), Mississippi (2), New Jersey (4), New York (1), North Carolina (3), Ohio (2), Tennessee (2), Texas (1), Utah (1), and Virginia (1) in the United States, and Ontario (1) in Canada (Figure 1).

Most of the respondents grew their zinnias in open fields (in ground) (83.3%). Just over 13% produced zinnias in hoophouses, and approximately 3% used greenhouse systems. More than half of the respondents (58.6%) reported postharvest disease of zinnia (zinnia melt-down) somewhat reduced salable quantity or quality of their zinnia crop. Only 10% of the respondents reported that zinnia melt-down caused major reduction on their salable zinnia crops, and over 30% of the respondents had no problem with zinnia melt-down issue but mentioned their concerns about the disease.

According to survey responses, the postharvest disease of zinnia was observed in Connecticut between July-August in 2016; Georgia between June-July beginning in 2012 until 2017; Illinois in August starting from 2009 until 2016; Louisiana between June-November in 2016; Mississippi in August 2016; North Carolina in May from 2015 until 2017; Tennessee between July-Aug in 2015 and 2016; Virginia between July-September from 2014 until 2016; and Ontario, Canada in July 2016.

Cut flower growers surveyed indicated that the cultivars 'Benary Giant' (42.9%), 'Queen Red Lime' (14.3%), 'Oklahoma' (14.3%), 'Queen Lime Blush' (4.8%), 'Cactus' (4.8%), 'Uproar Rose' (4.8%), 'Zowie' (4.8%), 'Whirlygig' (2.4%), 'Mazurkia' (2.4%), 'Peppermint Stick' (2.4%) and 'Persian Carpet' (2.4%) faced problems with zinnia melt-down issue (Figure 2).

Most of the growers surveyed indicated that they purchased seeds from a commercial supplier (93.3%), with only 6.7% of the growers purchasing zinnia seedlings from a commercial supplier. Only 3.4% of the growers indicated that zinnia seeds or seedlings were tested for the presence of plant pathogens by the seed/seedling producers, and another 3.4% indicated that they sent them to a lab for testing. Just over 10% of growers indicated that zinnia seeds were treated for the plant pathogens by the seed company or themselves with either fungicide or Clorox treatments.

Wells (51.5%), city water (21.2%), ponds or lakes (9.1%), rainwater (9.1), rivers or streams (6.1%) and ditches (3.0%) were the sources of the growers' irrigation water. The growers were not using treated irrigation water to eliminate microorganisms except those who used city water. The majority (75%) of the growers used drip irrigation system in their production.

According to survey responses, only 7% of the growers indicated that no other crops were grown in the same area with zinnias; 34.9% indicated other cut flowers, 30.2% indicated herbs, and 27.9% indicated vegetables were grown in the same area with zinnias.

Of the 29 respondents, 31% used sanitizers (bleach, soap or alcohol swabs) daily or weekly for their cutting tools; 41% used sanitizers (bleach or soap) daily or weekly for their buckets, harvest bins and storage containers; 17% used sanitizers (bleach or vinegar) weekly for hard surfaces; 31% used sanitizers (a drop of bleach, Chrysal gerb pill or chlorine tablets) as needed for water; 17% used sanitizers (bleach, hydrogen peroxide or hot water) as needed for trays/pots.

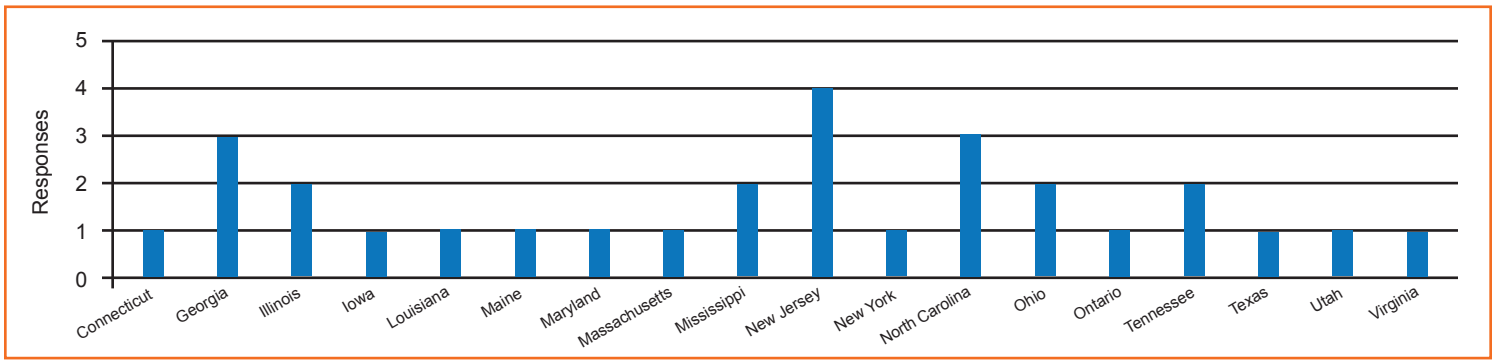

Figure 1. Survey responses from the U.S. and Canada.

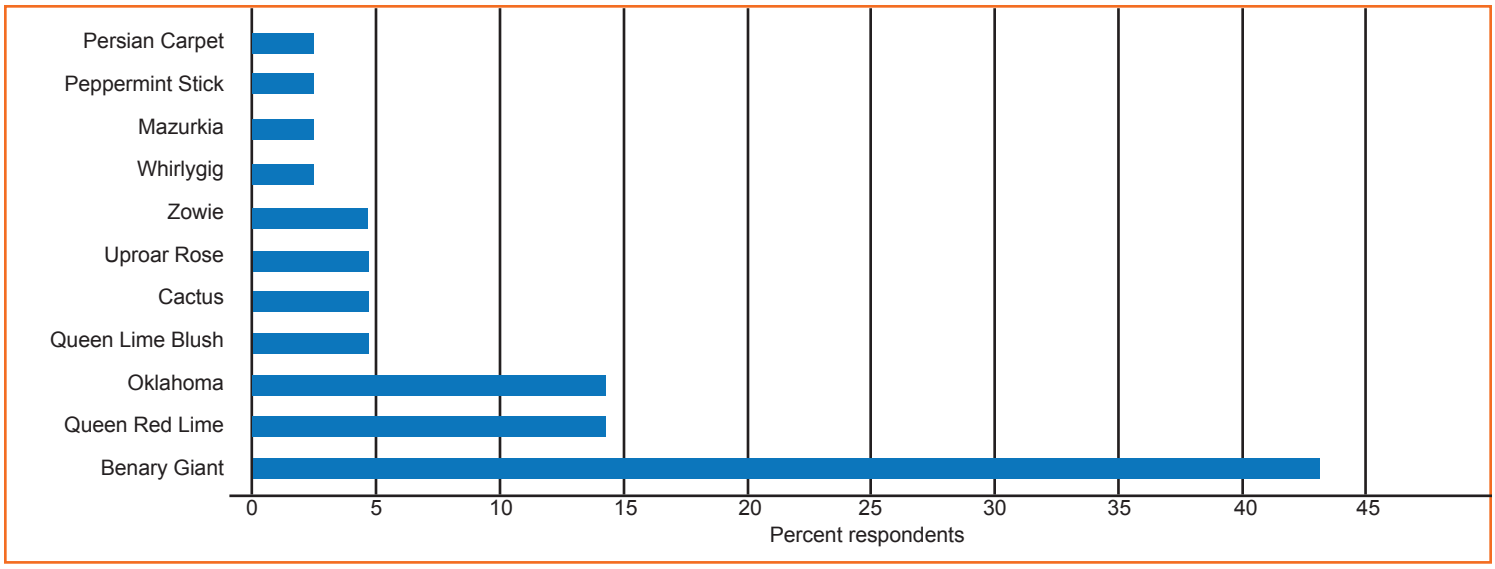

Figure 2. List of zinnia cultivars with zinnia melt-down problem.

The cut flower growers surveyed indicated that they used rotation (33.8%); 23.1% used cover crop/green manure; 18.5% always had a complete cleanout after each crop; 10.8% had complete cleanout only if there had been a serious problem in the previous crop; 4.6% provide a crop-free period; 3.1% conduct solarization in planting consecutive plants.

More than half of the respondents (58.7%) indicated that the environmental conditions were high temperature and high humidity when they had zinnia melt-down issue. More than half of the respondents (53.3%) believed that growing in the field, hoophouse, and greenhouses were likely starting points of their zinnia melt-down issue; 26.7% believed that postharvest was likely to be the starting points, 13.3% believed it to be seedling production; and 6.7% believed that seed production to be likely starting points of zinnia melt-down issue.

Future Direction

Zinnia samples will be requested in 2018 from the ASCFG community (APHIS permit and sample shipment instruction will be provided by Dr. Baysal-Gurel) and Tennessee growers will be visited monthly starting in June through September 2018.

Diagnosis will be done on cut zinnia flowers using diagnostic tools including but not limited to culturing, microscopy, chemical and pathogenicity tests, serology (ELISA, immunostrip tests), conventional PCR, and sequencing. This objective will also result in the development of a comprehensive pathogen collection that will be used in future research. Based on diagnostic results, the possible sources (seed, transplants, irrigation water, bucket water, rainwater, and soil) will be screened and tested using the same diagnostic tools.

Please contact Dr. Fulya Baysal-Gurel via at fbaysalg@tnstate.edu or (931) 815-5143 if you would like to participate on this project by sending zinnia samples.

Fulya Baysal-Gurel, PhD
Assistant Professor
Tennessee State University
Otis Floyd Nursery Research Center
472 Cadillac Lane, McMinnville, TN 37110
Office phone: 931-815-5143; Fax: 931-668-3134
e-mail: fbaysalg@tnstate.edu

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Identification of *Fusarium commune* causing meltdown issue in zinnia cut flowers

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Ravi Bika and Fulya Baysal-Gurel

Tennessee State University, Otis L. Floyd Nursery Research Center, McMinnville, Tennessee

Commercial cut flower growers in the eastern and southeastern United States have for many years experienced a postharvest issue with zinnias, commonly called "zinnia meltdown". The most frequent symptom is bent stems, usually just below the flower head. Meltdown reduces yields of cut flower stems, and therefore, income for the grower. The project started in 2017 with an online survey that reported 29 responses from 17 states: Connecticut (1), Georgia (3), Illinois (2), Iowa (1), Louisiana (1), Maine (1), Maryland (1), Massachusetts (1), Mississippi (2), New Jersey (4), New York (1), North Carolina (3), Ohio (2), Tennessee (2), Texas (1), Utah (1), and Virginia (1), as well as Ontario (1) in Canada. According to the survey results, 'Benary's Giant' was the series most susceptible to the zinnia meltdown issue.

The next step was to identify possible causes of zinnia meltdown. Fifteen zinnia cut stems with flowers exhibiting meltdown symptom were collected from a flower farm in Lincoln County, Tennessee. Small sections of zinnia stems and leaves were isolated from the symptomatic zinnia samples and plated on potato dextrose agar (PDA) and *Fusarium*-selective media. The plates were incubated for five to seven days in laboratory ambiance (21 °C, 60% RH and 12-h fluorescent light and dark cycle).

The morphological characterization (pigmentation, growth pattern, shape and size of micro and macro conidia) and molecular analysis confirmed that *Fusarium commune* was the causal agent for zinnia meltdown issue.

To confirm the pathogen '*F. commune'*, a pathogenicity study was performed on three zinnia cultivars: 'Benary's Giant Golden Yellow', 'Benary's Giant Pink', and 'Benary's Giant Lime' at vegetative stage (two weeks after transplantation) or flower bud stage (one month after transplantation).

The fungal conidial suspension (inoculum) was prepared by flooding a 10-14 day old culture of *F. commune*. Three different methods of inoculation were tested on the vegetative and flower bud stages: drench (25 mL of conidial suspension was applied to the substrate near zinnia plant root area); stem injection (30 µL of conidial suspension was injected into zinnia stem using a 1-mL syringe with a disposable needle); and foliar spray (conidial suspension was sprayed on zinnia plant [including leaves, stem and flower bud] until runoff using a handheld sprayer). Control plants received sterile distilled water.

Zinnia stems were harvested when the outer petals of the flowers were fully expanded, and displayed under laboratory conditions. Similar symptoms, such as stem bending just below the flower, were observed on inoculated zinnia cut flowers of all three cultivars two days after harvesting.

Fusarium commune was re-isolated from the infected flower stems of all three cultivars of zinnia, but not from the non-inoculated zinnia flower stems. We observed that the zinnia stem colonization by *F. commune* was statistically similar in all three tested cultivars regardless of plant growth stage and method of inoculation. The typical meltdown issue observed in zinnia cut flowers in postharvest condition might have been due to vascular occlusion; the microconidia of *F. commune* may form a cluster in vascular tissue, hindering the water uptake that can lead to bending of the stem below the flower during postharvest vase life.

In conclusion, the morphological and molecular analysis, as well as pathogenicity tests, confirmed that *Fusarium commune* is the causal organism for zinnia meltdown in Tennessee. The next steps in this project would be to screen cultivars for sensitivity to *F. commune*, and identify possible sources, such as irrigation water, transplants, soils etc. of *F. commune* in the zinnia production area. Additionally, we are still accepting infected zinnia samples from other states, and conducting pathogenecity studies on the zinnia meltdown issue.

So, what can be done to prevent zinnia meltdown? Control methods are still being developed, but growers report that it helps to be sure buckets and cutters are clean, and fresh solutions are used. Growers report success with using commercial hydration or slow-release chlorine right after harvest.

For more information, please contact
Dr. Fulya Baysal-Gurel (fbaysalg@tnstate.edu).