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EFFICACY OF CONVENTIONAL AND ORGANIC FUNGICIDES FOR MANAGING BASIL DOWNY MILDEW, LONG ISLAND

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Fungicides are an important tool for managing downy mildew in sweet basil. Varieties with a good level of suppression are not commercially available yet. The disease is difficult to avoid in field-grown crops in most of the eastern USA, including the northeastern region, due to the abundance of spores produced on affected leaves that are capable of being dispersed by wind long distances. Basil downy mildew has developed in the region every summer since 2008, the first summer it was in the USA.

Replicated experiments have been conducted since 2010 under field conditions at the Cornell University research facility on Long Island to evaluate fungicides for conventionally- and organically-produced crops. Plots were single beds with one or two staggered rows of basil (variety Italian Large Leaf) at 9-inch plant spacing. Naturally-occurring inoculum was relied on. Fungicides were applied with a backpack sprayer beginning before or after symptoms were found in the field, which included basil planted before the experiments to serve as a spreader row. A boom with drop nozzles was used in 2012, 2013 and 2014 to improve coverage achieved with just a nozzle over the top of plants. Most fungicide treatments were applied on a weekly schedule. Percent affected leaves (with sporulation of the pathogen visible on the underside) was assessed rather than severity (except in 2010) because any amount of symptoms renders a leaf unmarketable. No harvesting was done to the plants. Flowers were clipped as needed to maintain vegetative growth.

In 2010, basil was transplanted into plots on 10 Aug, symptoms of downy mildew were first observed on 16 Aug on one leaf in a spreader row, applications were started on 24 Aug, and symptoms were first observed in plots on 20 Sep, which was after the fourth application. In 2011, basil was transplanted into plots on 10 Aug, applications were started on 11 Aug, downy mildew symptoms were first observed on 19 Aug in the spreader row, and symptoms were first observed in plots on 25 Aug, which was after the third application. There was a hurricane (28 Aug) and several atypical intensive rain events during the 2011 growing season on Long Island. In 2012, basil was transplanted into plots on 23 Jul, applications were started on 7 Aug, and downy mildew symptoms were first observed in plots on 16 Aug, which was after the second application. In 2013, basil was transplanted into plots on 15 Jul, downy mildew symptoms were first observed in plots on 6 Aug, and applications were started on 7 Aug. In 2014, basil was transplanted into plots on 14 Jul, foliar applications were started on 29 Jul (some

treatments received soil drench applications before that), and symptoms were first observed in plots on 25 Aug.

Conventional fungicides. Products currently registered and labeled for use on basil in the USA are Ranman (cyazofamid; FRAC code 21), Revus (mandipropamid; FRAC 40), Quadris (azoxystrobin; FRAC 11), Ridomil Gold SL (mefenoxam; FRAC 4), and phosphorous acid fungicides (FRAC 33). Ridomil Gold and Quadris are the only ones not labeled specifically for downy mildew and not permitted to be used in a greenhouse. Ridomil Gold is labeled to be applied to soil for damping-off. It has excellent systemic activity and thus will be taken up by roots and moved to leaves. There are several phosphorous acid (phosphanate) fungicides labeled for this disease, including ProPhyt, Fosphite, Fungi-Phite, Rampart, pHorsephite, and K-Phite.

Products evaluated singly were Ranman, Revus, K-Phite, ProPhyt, Previcur Flex*, Presidio*, Zampro*, and Zorvec* (*product not registered or labeled for this use). Combination programs were also tested.

When tested singly, the most effective fungicides in the 2013 experiment were Zampro*, Revus, Zorvec*, and Ranman (*not registered yet). ProPhyt was also effective. Presidio was ineffective. Only Zorvec and Zampro were effective in the 2012 experiment. This partly reflects the stringent assessment used: when assessing percent leaves affected, the severity of disease on the leaves is not taken into consideration in the assessment. Best control (90-98%) was obtained with combination programs that were applied on a preventive, weekly schedule using a boom with drop nozzles in 2014. The programs included Ridomil, Quadris, Ranman, Revus, and K-Phite or Quadris, Ranman, Revus, and Zorvec. K-Phite was applied at lowest label rate with all applications of the other fungicides based on the current opinion that this is the best use pattern for phosphorous acid fungicides.

Organic fungicides. Actinovate AG (active ingredient is *Streptomyces lydicus*), Double Nickel 55 (*Bacillus amyloliquefaciens*), MilStop (potassium bicarbonate), Regalia (extract of *Reynoutria sachalinensis*), Trilogy (neem oil), and OxiDate (hydrogen dioxide) are OMRI-listed fungicides labeled for use on herbs and for suppressing foliar diseases including downy mildew. MilStop, Regalia, and OxiDate are labeled for use outdoors and in greenhouses. The Actinovate, Double Nickel and Trilogy labels do not have a statement prohibiting use in greenhouses. Double Nickel label has directions for greenhouse use for soil-borne pathogens. Products evaluated singly were Actinovate, Oxidate, Regalia, BioGuard*, Companion*, Organocide*, Sporatec*, Sonata*, and Timorex Gold* (*product not registered or not labeled for this use). Combination programs were also tested.

All of the products evaluated provided little to no control based on percentage of leaves with symptoms, which is a rigorous assessment measure, but realistic reflecting the level of control needed to produce a marketable crop. All products tested singly were applied on a preventive, 7-day schedule with the exception of OxiDate, which was

applied twice weekly in 2011. Applications were made with a single nozzle boom over the top of plants in 2010 and 2011, when the focus of evaluations was on products approved for organic production and other biopesticides. However, control of downy mildew was not achieved with the organic products tested singly in 2012 and the combination program tested in 2013 and 2014, which were all applied with a boom with three nozzles per plant, two of which were drops. The combination program consisted of Regalia applied to soil followed by Actinovate alternated with Trilogy applied to foliage. The foliage sprays were made twice weekly in 2014, and started 24 days before symptoms were found in the experiment. This combination program was also tested on a moderately resistant variety, Eleonora; but using this integrated program (fungicides applied to a resistant variety) did not result in successful control.

Conclusion. Downy mildew is a challenging disease to manage in basil with fungicides. This is partly due to the fact there is no tolerance for any amount of disease on leafy herb crops. Important to success of control with fungicides is using a preventive spray program and achieving good spray coverage, such as by using a boom with drop nozzles as well as a nozzle over the top of plants. In the replicated fungicide evaluations conducted in New York, downy mildew was controlled well by applying targeted, mobile fungicides in alternation (primarily Revus and Ranman) on a 7-day interval. Least symptoms were seen with the program that included a phosphorous acid fungicide at low rate in each application. None of the organic fungicides evaluated singly or combined in a program with a twice weekly application schedule provided sufficient control of downy mildew. This at least partly reflects the difficulty of delivering fungicide spray directly to the underside of basil leaves.

For more information about downy mildew of basil plus photographs, go to:
<http://vegetablemdonline.ppath.cornell.edu/NewsArticles/BasilDowny.html>