



Drone Fungicide Applications in Corn

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Introduction

Foliar fungicide applications occur commonly in corn to manage foliar diseases such as gray leaf spot (Figure 1). University of Kentucky research indicates that the most effective application timing for both foliar disease control and yield benefits is at tasseling/early silking (VT/R1). Because of the height of corn at this growth stage, these applications are typically applied aerially, with fixed wing or helicopter aircraft. However, many Kentucky fields are small and surrounded by trees or other obstacles to aircraft, so fungicide application is not an option in these areas.

Drone technology has improved in recent years and has also become more accessible. In Kentucky, commercial drone fungicide application is now an option in several areas. Drones specifically designed to apply products can potentially be used to apply fungicide in fields that are not accessible to other aircraft. This publication describes experiments to determine if drone fungicide applications can reduce foliar diseases in corn and discusses factors to consider when using drone technology to apply fungicides.

Drone Fungicide Research

In 2019, UK county Extension agents in Adair, Green, and Taylor counties worked with farmers to locate corn fields for drone fungicide application experiments. One 10-acre field was selected per county, each divided into randomized, replicated strips of non-sprayed and fungicide-sprayed experimental plots. A commercial drone applicator was contracted to apply the fungicide Trivapro at 13.7 fl oz/A at the VT/R1 growth stage in each field with a DJI model drone (Figure 2). Prior to application, water-sensitive spray cards were placed on the ear leaves of plants in plots to be treated with fungicide in order to measure application coverage.

Foliar disease was rated in each trial at the dough (R4) growth stage. Yield was collected from each location, and disease and yield data from each location were analyzed.

Weather conditions and planting date varied among locations and influenced disease severity, with two locations having low levels of foliar disease. However, in all locations drone fungicide application reduced the foliar disease gray leaf spot (Table 1). Coverage from drone fungicide applications was also adequate, based on the water-sensitive papers and from resulting reductions in disease severity.

In the Taylor County location, drone-applied fungicide resulted in a significant increase in yield (Table 1). This yield increase is likely due to the reduction of gray leaf spot in the experimental plots. Other locations did not see significant yield gains due to fungicide application, likely because of the low levels of disease pressure in those trials.

Factors to Consider for Drone Fungicide Applications

In our study, drone fungicide applications reduced gray leaf spot in corn and provided adequate fungicide coverage. Where disease was severe, the fungicide application protected yield, resulting in



Figure 1. Gray leaf spot is an annually important disease in Kentucky that is commonly managed through foliar fungicide applications. Kiersten Wise



Figure 2. Drone used to apply fungicide in 2019 Adair County corn trial. Nick Roy

a significant yield increase. This study indicates that drone fungicide applications may be a viable application method for Kentucky farmers, especially in areas where aerial and ground application are

Table 1. Effect of drone fungicide application on gray leaf spot severity in three counties in Kentucky in 2019.

County	Treatment	Gray leaf spot severity (%)	Yield (bu/A) @15.5% moisture
Adair	No fungicide	4.08 a	239.2
	Trivapro, 13.7 fl oz/A	0.37 b	242.1
	<i>P</i> > <i>F</i>	<0.0001	0.8441
Green	No fungicide	1.12 b	128.8
	Trivapro, 13.7 fl oz/A	3.04 a	130.5
	<i>P</i> > <i>F</i>	<0.0001	0.8928
Taylor	No fungicide	22.9 a	251.8 b
	Trivapro, 13.7 fl oz/A	11.3 b	274.6 a
	<i>P</i> > <i>F</i>	<0.0001	0.0209

Note: Gray leaf spot severity is rated as the percent of disease present on the ear leaf at the dough (R4) growth stage. Numbers followed by different letters within a county are statistically different according to least square means tests.

difficult or not available. Farmers considering using commercial drone applicators or investing in drone fungicide application equipment for their own use should consider the following.

Regulations

Regulations governing the use of drones are continually adapting to a new age of increased air flight. Review current FAA guidelines and license requirements and EPA guidance on aerial pesticide application prior to purchasing drone application equipment.

Costs

Commercial application: As of 2020, commercial drone fungicide application costs are similar to other aerial application methods.

Self-application: If you are interested in purchasing a drone for your own use, it is important to recognize that the initial purchase cost does not represent the entire cost of operating a drone efficiently. Current drone owners have found that several additional investments are needed to operate, transport, and store drones safely and efficiently. In some cases, the cost of these additional necessary items may be equal to or greater than the cost of the drone itself. An incomplete list of potential items drone owners/operators may find useful include:

- Additional batteries
- A generator for charging batteries in the field
- Collection of frequent wear parts
- Barrels and pumps for water storage and to pre-mix pesticides
- PPE equipment, eye wash station, safety shower
- A boxed-in trailer to transport drone and supplies
- ATV or smaller/less expensive drone to mark field boundaries
- Accessories to extend the range of the drone

- Communication device to maintain communications between pilot and visual observer(s)
- A ladder to assist in maintaining visual line of sight
- Expenses related to legal operation of drone and pesticide application
- Opportunity costs: Consider how your time operating the drone may be used more effectively. Factor your time into the economic costs of purchasing drone equipment vs. using a commercial drone applicator (or other application method) to apply fungicide to fields.
- Operating a drone for agricultural spraying requires at least two people to work efficiently and safely, and to ensure operations are compliant with FAA regulations, including visual line-of-sight regulations. It also helps to have two people for marking the field, changing batteries, reloading pesticide, etc.

Drone Selection

Several drone models are capable of crop applications now. These vary in tank capacity, boom width, battery capability, etc. Drone manufacturers may provide information on the time it takes to apply pesticides to a given area. However, the number of acres that can be covered by drone in a day will vary based on the unit, experience of the applicator, and other factors. Drone equipment should be chosen based on the ability to get replacement parts and/or repairs if needed. Considerations may be warranted as to where parts are inventoried. **Current owners of application drones have reported that it may take up to two weeks to receive parts that are shipped from other countries.** Reliable customer service and training options should also be factors to consider before investing in units.

Insurance

Typically, general farm insurance policies do not cover aircraft, such as drones. Additional policies may be needed for liability and insuring the drone. Contact your insurance provider to determine what policies are needed before purchasing drone equipment.

Other Uses for Application Drones

Drone application technology is developing quickly. There will likely be additional uses for drone application, including herbicide and other pesticide applications. Some current owners of drones in Kentucky have also purchased seed spreader attachments for their drones to broadcast cover crop seed in standing crops. The success of using drones for other application uses is dependent on many factors. Contact your county Extension agent with any questions about optimizing drone applications in your area.

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