DEPARTMENT OF AGRICULTURE

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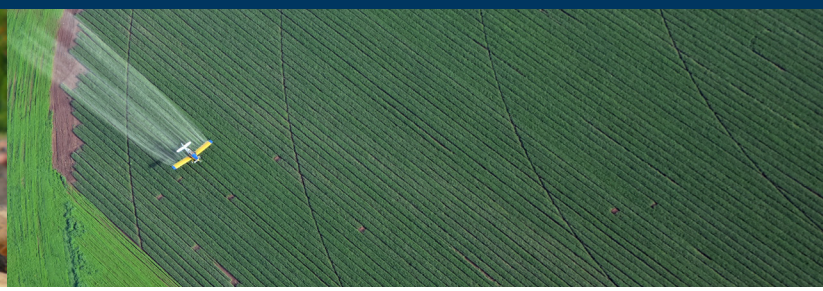

Potato Fungicide Best Management Practices to Prevent Drift and Minimize Volatilization

The Minnesota Department of Agriculture (MDA), along with University of Minnesota Extension and other interested parties, has developed Best Management Practices (BMPs) to prevent pesticide drift when applying liquid fungicides to potatoes. These BMPs are designed to prevent fungicide drift, minimize volatilization, and protect bystanders and off-target areas .

The BMPs (see table) include:

- Mandatory application requirements on product labels
- Voluntary practices to prevent drift and minimize volatilization

The BMPs are designed to address airborne fungicide exposure concerns for applicators, bystanders, and residents near potato fields treated by groundboom or aerial equipment. The BMPs also address prevention of drift to nearby sensitive plants, crops, and wildlife.

As with other pesticides, potato fungicide applications can result in offsite movement (drift) if not done properly. Following label directions and these BMPs can reduce and prevent drift under a variety of application and weather scenarios. All drift from a treatment area is considered illegal, and properly reported incidents will be investigated by the MDA. Fungicide volatilization from soil and plants can also result in offsite movement. Offsite movement can be minimized by applying fungicides during appropriate weather conditions, by using properly calibrated equipment, by employing proper application techniques, and by other practices.

Fungicides vary in their potential impacts on human health and the environment. Acute inhalation, skin, and eye irritation hazards are a concern, as are possible chronic health hazards such as cancer. Applicators are responsible for protecting themselves and bystanders from fungicide exposures. Non-target terrestrial and aquatic animals are also vulnerable to fungicides lost from fields. These BMPs and application requirements on product labels are designed to protect human health and the environment, even with repeated applications that can occur in a growing season.

Citizens in Minnesota have expressed concerns about the presence of potato fungicides and other pesticides in the air. Such detections may be indicative of drift or volatilization from agricultural or lawn and garden use, and can lead to misuse complaints, applicator investigations, and financial penalties. Risk evaluation suggests that fungicide concentrations were below United States Environmental Protection Agency (EPA) levels of concern.

State and federal law allow for restrictions on the use of a fungicide to address unreasonable adverse impacts on humans or the environment. Adopting the BMPs for use of fungicides in potato production – as part of an Integrated Pest Management Plan – can help growers maintain access to these chemicals as important and diverse tools for crop disease management.

Best Management Practices for Potato Fungicide Use

- The primary purpose of the BMPs is to address exposure concerns for applicators, bystanders and residents near agricultural fields.
- From a practical standpoint, the BMPs are intended to prevent drift of potato fungicides. BMPs also encourage adoption of an Integrated Pest Management program to reduce costs, prevent development of fungicide resistance, and protect human health and the environment.

Integrated Pest Management (IPM)

Work with professionals to establish an IPM program focusing on cultural and biological control options and using treatment thresholds if available.

See “Additional Information & Resources” for more information on cultural, biological and chemical practices to minimize disease pressure on potatoes in the field.

Adoption of BMPs begins by carefully reading product labels and following all application requirements, including use rates, wind-speed limits, application setbacks, and other requirements. Then, select one or more voluntary practices to further prevent drift and minimize volatilization. Producers, crop consultants, agronomist, and educators should select options most appropriate for a given farming operation, proximity to human and animal populations, soil types and geography, and cultural practices. The MDA encourages development of Integrated Pest Management Plans for every Minnesota farm (see "Additional Information and Resources" for more information). **Always read the product label. Label use requirements are legally enforceable.**

Potato Fungicide Best Management Practices to Prevent Drift and Minimize Volatilization

Core Practice*	Description	Benefit
1. Establish an IPM program to minimize fungicide use. **Apply fungicides only when necessary.** (see cultural, biological and chemical practices to minimize disease pressure on potatoes in the field on page 4)	• Work with professionals to establish an IPM program focusing on cultural and biological control options and using treatment thresholds if available. • Scout fields and apply appropriate fungicides only when necessary[1], then follow all label directions to limit the potential for drift and volatilization. • Use all available local agriculture weather networks and disease prediction models to properly time fungicide applications. • Walk fields often to look for early signs of disease in vulnerable locations. • Follow recommended rates, application schedules, and don't exceed per acre maximum use rates. Products may have state-specific maximums for local disease management needs. • Utilize MN/ND Late Blight Alert[2] and NDSU NDAWN Potato Blight App[3] to make fungicide application decisions.	Early disease detection and understanding of weather conditions allows for more effective and better-timed fungicide applications. Label application timing limits annual fungicide use, thereby reducing the potential for offsite movement and human exposure.
2. Review labels for drift management requirements, "Spray Drift Precautions," and "Aerial Drift Reduction Advisory Information."	• Each fungicide label must be reviewed for enforceable language related to drift. • Some popular potato fungicides have specific drift reduction requirements such as outer nozzle distances on aircraft wingspans, and spray direction/angle relative to the air stream. • Some labels also carry non-mandatory drift reduction recommendations.	Compliance with label directions ensures that drift is appropriately mitigated in accordance with EPA's risk assessments. Advisory drift reduction recommendations further mitigate the potential for drift.
3. Apply fungicides within ideal range of weather conditions.	• **Wind** -Apply when wind speeds are between 2 and 10 mph[4]. Wind speeds less than 2 mph may indicate a temperature inversion[5]. Inversions occur when air close to the ground is cooler than the air above the canopy. Pesticide spray droplets can be suspended in this air layer for a prolonged time and drift off target. Inversions usually occur between 2 hours before sunset until 1 hour after sunrise. • **Relative humidity and Temperature** – Spray droplets evaporate as they move through the air, becoming smaller and more drift prone. This occurs more for applications made under low relative humidity (<50%) and high temperatures. Utilize a larger droplet size under these conditions6.	Applying in correct environmental conditions can maximize efficacy and mean the difference between offsite drift (and potential exposure concerns, misuse claims and enforcement investigations) and no drift!
4. Select spray equipment and calibrations that reduce drift and evaporation.	• **Droplet Size** -Choose low-drift nozzles that operate at low pressures, produce medium to coarse droplet sizes[7] (volume mean diameter (VMD) = 200 to 400 microns), and minimize fine droplets (<200 microns). To ensure good coverage when applying contact (non-systemic) fungicides with coarse droplets, increase the spray volume (GPA). Use a droplet size that balances drift prevention and efficacy. • **Pressure** -Low pressure increases VMD of spray droplets. Apply at recommended nozzle pressure to optimize VMD of spray droplets. For aerial applications, consider solid stream nozzles operated at medium pressures to reduce fine droplets. • **For Aerial Applications** - Nozzle type, orifice size, spray pressure, flight speed, and nozzle angle relative to the airstream affect droplet size. • **Spacing and orientation** -For groundbooms, consider using wide angle nozzles and use a low boom height[8]. For aerial applications, choose controlled droplet booms and a boom length <65-75% of wing length or 85% of rotor width[9]. • **GPS Systems** –Use GPS systems for accurate sprays.	These practices improve spray distribution by improving crop canopy penetration which reduces drift potential by giving wind less opportunity to affect spray droplets. Small droplets are more prone to drift and evaporation! Droplets < 300 microns can drift 42 feet in 5 mph winds, while larger, 600 micron droplets might drift 11 feet under similar conditions. GPS systems can assist with application buffer compliance, application overlap and gaps, and reducing fungicide waste.
5. Minimize volatilization of applied fungicide.	• Choose fungicides with low vapor pressures. Fungicides with vapor pressures $\geq 10^{-5}$ mm Hg are considered to exhibit intermediate to high volatility under field conditions. Volatility potential increases as temperature increases. • Consider using adjuvants that reduce drift and evaporation, and that minimize volatilization.	Minimizing volatilization of fungicides (from plant and soil surface) protects offsite impacts to humans and the environment.
6. Calibrate application equipment periodically to prevent drift. Conduct pattern testing.	• Sprayer calibration is important to establish optimum use of fungicide for disease control without waste, drift and volatilization. The most important drift-reduction components of calibration involve measurement of droplet size along with accuracy of spray placement. • Attend calibration workshops, webinars, and clinics[9,10,11] to facilitate adoption of best practices for aerial sprays. Pattern testing ensures distribution of fungicide across the swatch is uniform and that non-target areas are not subject to drift. • Avoid high application speeds/rapid speed changes	Calibration ensures that all efforts undertaken in selection of fungicide and nozzles, operating pressures, spray patterns, etc. will actually contribute to drift reduction and minimizing volatilization.

*For other practices related to the use of pesticides used on crops grown in rotation with potatoes, refer to MDA's www.mda.state.mn.us/bmps See "Additional Information & References" for access to more information on all recommended practices.

Additional Information & Resources

This information accompanies the State of Minnesota's Drift and Volatilization Reduction Best Management Practices (BMPs) for agricultural fungicides. The information and references are not additional BMPs; rather, they provide more detailed guidance to support a producer's management program for the proper use of all fungicides and are provided in support of the BMPs.

BMP References

[1] University of Main Cooperative Extension. Field Scouting: A Tool for Potato Pest Management.

[2] Minnesota/North Dakota Late Blight Alert. Potato Late Blight, Early Blight, and P-Days.

[3] North Dakota State University. NDAWN Potato Blight App.

[4] North Dakota State University. 2017. Reducing spray drift.

[5] University of Nebraska Extension, 2019. Spray Drift of Pesticides.

[6] University of Florida. 2019. Managing Pesticide Drift. Publication PI232.

[7] Virginia Cooperative Extension. "Nozzles: Selection and Sizing" Publication 442-032 (2009).

[8] North Dakota Extension Service. 7/2017. Selecting spray nozzles to reduce particle drift. FS 919.

[9] Center for Integrated Pest Management. Aerial Application.

[10] National Agricultural Aviation Association. Operation S.A.F.E.

[11] Minnesota Agricultural Aviation Association. Aerial Applicators Recertification Webinar.

Additional references for preventing drift and minimizing volatilization

- USDA. 2017. Droplet Spectrum: Online models and smartphone apps help aerial sprayers estimate spray droplet size based on various input parameters like nozzle size, orientation, spray pressure and airspeed.
- University of Minnesota Extension, Pesticide safety and certification information.
- EPA, Introduction to pesticide drift.
- Ohio State University. 2016. Selecting the Best Nozzle for the Job. FABE-528.
- Arizona Coop Ext. 2012. Nozzles and Droplets: What Do the Colors Mean?

Drift Complaints, Enforcement and Penalties

The Minnesota Department of Agriculture (MDA) is the state agency responsible for investigating pesticide misuse complaints and enforcement of regulations. Complaints to the MDA must be submitted in writing according to state law. A Pesticide Misuse Complaint Form is available on the MDA website. To discuss your complaint before filing a written complaint, contact the MDA at 651-201-6333 between 8:00 AM and 4:00 PM Monday through Friday. If you need to speak with someone about a Non-Emergency situation, after normal business hours, contact the Minnesota Duty Officer at 800-422-0798. In the case of an Emergency, call 911.

Federal and State Regulatory Program Activities

Anticipate changes in the regulatory status of drift reduction/ mitigation and compliance by doing the following:

- Check product labels for changes in application requirements or recommended mitigation practices.
- Follow updates on EPA's activities in "Drift Reduction Technology".
- Register with FieldWatch and consult FieldWatch map to locate pesticide-sensitive crops and beehives near application sites.

Integrated Pest Management Practices to Minimize Disease Pressure on Potatoes in the Field

CULTURAL

In addition to implementing BMPs to prevent drift and minimize volatilization, various cultural practices can be used to limit disease pressure on potatoes. Below is a brief overview of some important cultural practices that aid in potato disease management.

Crop rotation[a]: Rotating potatoes with other crops reduces the amount of inoculum in the soil and can lessen the impact of some diseases. Diverse rotations can enhance soil fertility, improve soil structure, and reduce pest problems, conserve soil moisture. Potatoes should be planted no more than once every three years.

Disease resistant varieties[b]: When possible, plant disease resistant potato varieties.

Personally inspect[c] and buy certified seed[d]: Purchasing clean and certified seed can help limit the amount of inoculum introduced to the field. If more than 5% of a seed lot contains disease it should not be used.

Sanitation practices[e]: Clean and disinfect equipment, tools, trucks and storages. Limit movement of machinery and personnel between operations. People entering fields should wear boots and clothing that can be disinfected between fields.

Properly manage nutrient needs[f]: Healthy plants resist pathogens. Both under-fertilization and over-fertilization can create favorable environments for disease outbreak. Nutrient applications should be based on the soil nutrient levels and crop needs. Soil sample on a regular basis.

Remove cull piles, eliminate volunteer potatoes, and remove weeds[g]. Cull piles, volunteer potatoes and weeds, especially solanaceous weeds, can host harmful diseases. Implement host elimination strategies combining various mechanical and herbicidal practices.

Limit leaf tissue moisture[h]: Plant diseases such as late blight require 12 hours of a leaf wetness for infection to occur. Avoid excessive and/or nighttime irrigation

Limit soil compaction[i]: Compacted soil leads to poor drainage, which increases surface water and potentially runoff. Some management techniques include, but are not limited to: managing traffic, minimizing axle load, maintaining proper tire inflation pressure, and avoid entering wet fields.

Maintain field records[j]: Having detailed records of disease occurrence in a field will allow for more effective fungicide management in future years. Before the growing season, evaluate potential microclimates where disease pressure may be the highest. Avoid planting potatoes in these locations. Maintain records of where initial disease outbreaks occur and incorporate that information into disease management plans.

BIOLOGICAL

Biological control options should be considered whenever available. Formulations of some biocontrol agents such as Bacillus subtilis are commercially available for use on potato crop.

CHEMICAL

Use the correct fungicides for diseases present. Rotate fungicides used. Repeated use of fungicides with the same site of action can lead to fungicide resistance. Understand which fungicides are effective on the targeted disease(s) and rotate between fungicide chemistries throughout the growing season. For more information, consult the Fungicide Resistance Action Committee website, www.frac.info/ Before applying fungicides, check with local agronomist or extension educators concerning fungicide resistance issues. Consult MN/ND pest alerts for additional information.

Use fungicides only when necessary. Fungicides can be harmful to entomopathogenic fungi that help in natural control of pests such as aphids.

IPM REFERENCES

[a] University of California Davis. Potato Pest Management Guidelines - Crop Rotation.

[b] Michigan State University. 2019. Michigan Potato Research Report.

[c] University of Maine Cooperative Extension. Bulletin #2412. Selecting, cutting, and handling potato seed.

[d] Minnesota Department of Agriculture. Potato Inspection.

[e] University of Idaho Extension. 2011. Cleaning and disinfecting potato equipment and storage facilities.

[f] University of Minnesota. Potato fertilization on irrigated soils.

[g] Michigan State University Extension 2015. Potato late blight recommendations for 2015.

[h] North Dakota State University. 2017. Late blight in potatoes.

[i] University of Minnesota Extension. Soil compaction.

[j] Oregon State University. Integrated Pest Management Strategic Plan for Potatoes in Oregon, Washington and Idaho.

All referenced websites were accessed in December 2020.