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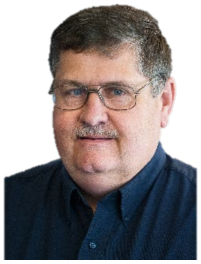

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Thermal Inversions & Herbicide Vapor Drift in Greenhouses

Greenhouses and high tunnels offer plants protection from outside elements like wind and rain, but this protection is not always absolute. As growers we rely on a system of vents, louvers, and fans to bring in outside air to reduce humidity and temperature in the growing environment. It is through this movement of air that a grower may unwittingly compromise the health and quality of their growing crops.

Greenhouse operations are dotting the rural landscapes as farm families look for new opportunities to diversify their farm and increase farm income. Often these greenhouses are in areas where agronomic crops are king, and a greenhouse is often just a poly-covered island in a sea of corn or soybeans. Crop farmers rely on a host of chemistries to mitigate weed pressure to ensure high yields and profitability, but their usage of some chemistries may cause significant impact on floriculture crops if they become exposed to herbicide drift or vapor drift emanating from a treated field located nearby.

Herbicide drift can be characterized as particle (spray) drift when the physical spray or droplets move offsite and into a crop canopy resulting in plant injury. When spray drift is observed, the field where the herbicide originated from is usually near the greenhouse. Often the injury symptoms are very directional in their appearance and the impacted greenhouse crops are largely located on the side of the greenhouse where the spraying took place. Usually herbicide drift issues can easily be prevented by encouraging applicators to leave a buffer, use drift control agents, use a lower operating pressure, or by employing different spray tips or nozzles The greenhouse grower may also need to shut the vents or roll-up the sides until after the spray application has been completed.

Vapor drift however is often a little more difficult to protect your crops from since the chemical vapor can drift over great distances and may enter your structure through the ventilation system as a gas resulting in widespread plant injury/damage.

Historically the auxin-type herbicide 2,4-D ester was viewed as the main chemistry on the market that could cause significant plant injury in protective culture due to its capacity to volatize when applied under warm environmental conditions.

Recently the development of dicamba and glyphosate resistant soybeans has led to increased reports of damage in floriculture and vegetable greenhouses from dicamba and glyphosate use in soybean fields. According to a University of Tennessee Institute of Agriculture Study when dicamba formulations are tank-mixed with glyphosate it drops the pH of the spray solution below 5.0. The label for dicamba cautions growers that a solution pH below 5.0 increases the likelihood of volatilization of the dicamba chemistry by causing it to disassociate into the more volatile acid form. In its volatile or gaseous state dicamba can drift long distances which can potentially injure sensitive horticultural crops.

Temperature inversions create an invisible barrier that prevents pesticide vapor from moving and dissipating into the upper atmosphere. Herbicides in their gaseous state blockaded by the temperature inversion may drift long distances away from the application site before causing plant injury. Often the soybean field where the dicamba has been applied is not in plain sight of the greenhouse range

Figure 1: Vapor Drift from auxin-type herbicide to Zinnia in a greenhouse located amidst several agronomic farming operations (Photo – Tom Ford Penn State Extension)

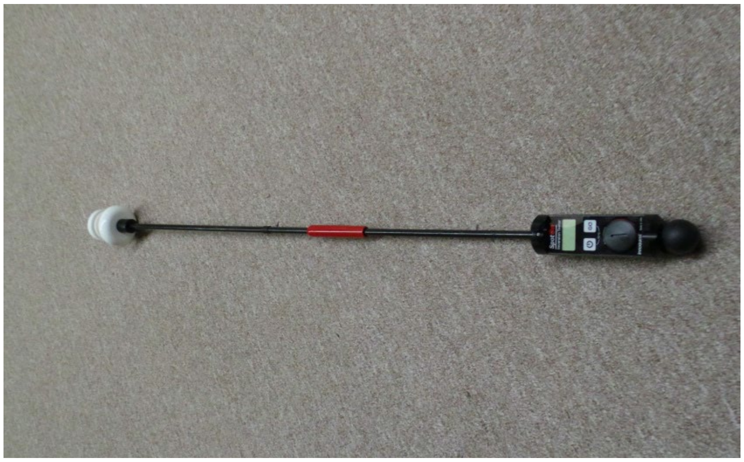

Figure 2: Thermal Inversion Tester for use in determining if temperature inversions exist prior to spraying. (Photo – Tom Ford Penn State Extension)

Figure 3: Vapor Drift from auxin-type herbicide to Delphinium in a high tunnel located amidst several agronomic farming operations (Photo – Tom Ford Penn State Extension)

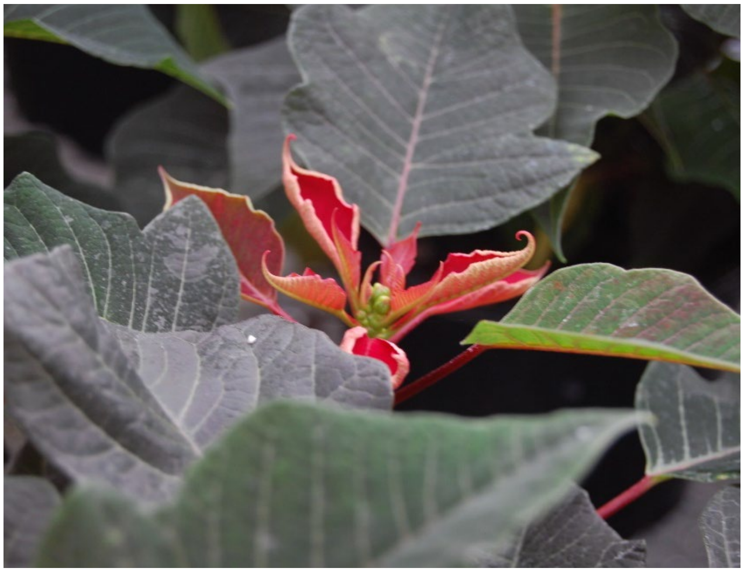

Figure 4: Vapor Drift from 2,4-D ester herbicide to Poinsettia in a greenhouse located amidst several agronomic farming operations (Photo – Tom Ford Penn State Extension)

Figure 5: Vapor Drift from 2,4-D ester herbicide to Poinsettia in a greenhouse located amidst several agronomic farming operations (Photo – Tom Ford Penn State Extension)

or vegetable operation so if injury occurs it seems somewhat perplexing.

Temperature inversions themselves are invisible, but there may be visible cues (fog or lingering smoke from woodstoves) that indicate that a temperature inversion is in place. During the growing season however, growers may not see fog or lingering smoke from a woodstove, to indicate that a temperature inversion is occurring. As a rule, temperature inversions can be detected most mornings until around 10:00 a.m. when they begin to dissipate. As the day progresses and the temperature cools, a new temperature inversion may begin to form. In some cases, a temperature inversion may begin to form as early as 2:30 p.m. and then remain in place until 10:00 a.m. the next morning. If the atmosphere is relatively dry and there is no woodstove activity there may be no visible cues for a farmer to note when they begin to spray their field with an auxin-type herbicide.

Due to the preponderance of vapor drift injury claims on horticultural crops a meter has been developed that can determine if a temperature inversion is in place and if it is safe to spray. As a rule, when you move away from the ground your air temperature should cool or drop. If the temperature gets warmer as you move away from the ground, then a low-level thermal inversion exists. It is during these low-level thermal inversions that a volatile herbicide can be pushed a half mile or more from the spray site with a half-mile an hour wind.

The thermal inversion tester that I utilize, measures the air temperature at boom height (1 meter) and at 3 meters in height. If the temperature at 3 meters in height is warmer than the temperature at boom height a thermal (temperature) inversion is considered to exist. While I recommend that field crop farmers purchase and use a thermal inversion tester as means to govern when to apply volatile herbicides, I have also been encouraging greenhouse and vegetable growers to purchase one to mitigate risk.

In a recent case, auxin-type injury was observed in a greenhouse due to vapor drift after an herbicide application in the area. A complaint was subsequently lodged with the local regulatory authorities to investigate to see if a misapplication of a pesticide had occurred. The regulatory inspector focused their attention primarily on adjacent landowners and their pesticide records but could never determine exactly what had transpired. If the applicator that had applied the herbicide that day had utilized a thermal inversion tester, they would have known that a temperature inversion was in place and that they should halt their plans to spray immediately.

In the case of this greenhouse operator, if he observed someone operating spray equipment nearby and utilized a thermal inversion tester, he could have warned the neighboring property owner that it was unsafe to spray due to the presence of a thermal inversion. At the very least, this grower could have provided this documentation to the regulatory personnel during their post-injury investigation.

Without any information to support that a thermal inversion was in place at the time of the spray application, the grower had no choice but to either absorb the crop loss or to pass this loss onto his insurance company when no fault could be determined by the regulatory agency.

Auxin-type herbicides like 2,4-D and dicamba are not particularly forgiving when they injure floriculture crops. In the most grievous case that I have observed 2,4-D ester was applied a great distance away from a greenhouse. As the grower recalled, it was a warm autumn day; the greenhouse vents were open, and the outdoor temperature stood at a balmy 84^0 F. The poinsettia crop was potted, pinched, and primed for bract development. The faint odor of an herbicide lingered in the community, but the grower did not see anyone spraying nearby.

The grower relayed to me that the injury was subtle at first, but as the bracts formed and the color developed the distinctive distortion symptoms associated with an auxin-type herbicide injury became clearly apparent. The grower new instantaneously when the herbicide exposure had happened, but he had no way to prove it.

The loss of one greenhouse filled with poinsettias is tough economically on any operation, but a far greater loss to this operator was the potential loss of several long-standing customers that had purchased poinsettias from him for the past 15 years. His failure to deliver on contracts even though it was not his own fault cost him customers that he would have to fight hard to replace. A small investment in a thermal inversion tester may not have prevented the injury, but it could have made it easier to explain what had occurred.

Reference

Rowsey, Ginger. “Research Suggests Glyphosate Lowers PH of Dicamba Spray Mixtures Below Acceptable Levels.” *Research Suggests Glyphosate Lowers PH of Dicamba Spray Mixtures Below Acceptable Levels*, ag.tennessee.edu/news/Pages/NR-2019-08-MuellerSteckelDicambaResearch.aspx.

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