WHAT ARE PREMIUM HERBICIDES?

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Almost all of the active ingredients (AIs) used to selectively control broadleaf weeds in turfgrass are synthetic auxins (auxin mimics). Some of these AIs have been around for 50 years or more (Table 1). Herbicides that contain synthetic auxins like 2,4-D, MCPP, and/or dicamba have stood the test of time. In fact, almost every company that produces herbicides has their version of 2,4-D + MCPP + dicamba (three-way). Triplet SF is an industry standard three-way formulation.

The reasons three-way herbicides are so popular are at least three-fold:

1. The AIs are relatively low cost
2. The AIs complement each other and effectively control a broad spectrum of common broadleaf weeds (see Table 2)
3. Three-way herbicides are safe on most turfgrass species. Through decades of use, turfgrass managers have realized the usefulness of 2,4-D + MCPP + dicamba, but this use has helped them to realize which weeds those particular AIs don't control well. Over time, weeds not controlled by this three-way herbicide have been deemed "difficult to control." This is not to say that weeds like ground ivy, wild violet, goosegrass, and yellow nutsedge are necessarily super weeds, it simply means that a three-way herbicide is not the best choice for control.

TABLE 1 SYNTHETIC AUXIN HERBICIDES

CHEMICAL FAMILY	ACTIVE INGREDIENT	FIRST USE IN TURF
Phenoxy carboxylic acids	2,4-D	1940s
	2,4-DP (dichlorprop)	1960s
	MCPA	1970s
	MCPP (mecoprop)	1960s
	Dicamba	1960s
Pyridine carboxylic acids	Clopyralid	1980s
	Triclopyr	1980s
	Fluroxypyr	2000s
Quinoline carboxylic acid	Quinclorac	2000s
Arylpicolinic acid	Halauxifen-methyl	2010s

TABLE 2 HERBICIDE ACTIVITY ON BROADLEAF WEEDS – THREE-WAY

ACTIVE INGREDIENT	DANDELION	WHITE CLOVER	PLANTAINS	GROUND IVY	WILD VIOLET
2,4-D	★★★★	★	★★★	★★	★
MCPA	★★★	★	★★★	★★	★
MCPP	★	★★★	★★	★	★
Dicamba	★	★★★★	★	★	★
2,4-D + MCPP + Dicamba	★★★★	★★★★	★★★★	★★	★

TABLE 3 HERBICIDE ACTIVITY ON BROADLEAF WEEDS – NON-THREE-WAY

ACTIVE INGREDIENT	DANDELION	WHITE CLOVER	PLANTAINS	GROUND IVY	WILD VIOLET
Quinclorac	★★	★★★★	★★★	★★	★
Triclopyr	★★	★	★★	★★★	★★★
Fluroxypyr	★★	★★★★	★★	★★★	★
Clopyralid	★★	★★★★	★★★★	★	★

SO THE QUESTION IS: Can herbicides (combination of AIs) be produced that provide a broader spectrum of effective control than the typical three-way?

ANSWER: YES – In fact, they exist. These herbicides, simply put, are premium herbicides.

WHY PAY MORE FOR A PREMIUM HERBICIDE?

The added cost of chemistry is minuscule compared to a callback. Additionally, callbacks decrease customer satisfaction which result in lower retention rates. With instant access to information and reviews, a company cannot afford any negative reviews, so many LCOs choose a premium herbicide to start. Imagine a backyard full of wild violet. It is treated with a typical three-way herbicide, the plants exhibit some injury, but all of it recovers and continues as a weed in the yard. Another trip is made to the lawn after a call from the client and the treatment is applied again with similar results. Wild violet certainly is one of the most complained-about weed species at least in northern climates. However, the application of a three-way could simply be a waste of time, product, and, therefore, money. Furthermore, if an unplanned return is carried out to apply the same herbicide, often after the wild violet has fully recovered, then more money is wasted (if effective control is not achieved).

THIS SCENARIO IS COMMON. There are ways to increase the chances of success when dealing with difficult weeds like wild violet:

1 IMPROVE APPLICATION TIMING

Research has shown that a fall-timed herbicide application is a better timing than spring. In the fall, plants are moving sugars to vegetative parts and roots to prepare for the colder months when growth is mostly halted. In the spring, plants are focused on above-ground growth to produce foliage for photosynthesis to resume. Herbicides can move with sugars and, therefore, to new growth. A spring-timed application can provide a lot of visual injury above-ground to susceptible plants, but doesn't affect below-ground growth as much. These plants often have enough stored sugars to push up new foliage. On the flip side, a fall-timed herbicide application will not provide as much visual injury, but, relatively, moves more to vegetative parts to cause injury in storage organs that are needed to get through the winter. A fall-timed herbicide application can provide better control of many perennial weeds than a spring-timed herbicide application. This doesn't mean that a spring-timed herbicide application isn't worthwhile. In fact, while weeds are growing fast in the spring, so is the turfgrass which can aid in weed control through competition while weeds are injured. The point is, however, having a plan of attack for difficult weeds is important – this may involve communicating with clients that a spring-timed application may not kill an entire population, but a fall-timed application will finish the job.

2 REPEAT THE APPLICATION

Repeat applications in the spring can be very effective when timed well. This is like kicking a weed while it is down – it causes susceptible plants to be injured for a longer period of time and, more often than not, to actually die. The key is not letting the weed completely recover, which can happen quickly in the spring. A good reapplication interval in the spring may be closer to 14 days than 21 days. Sure, the downside is that you are applying a herbicide twice and you must return to the site a separate time – however, this is better than making one application, difficult weeds fully recovering, and either wasting that single application or being called back to make another application when the weeds have fully recovered.

3 CHOOSE THE HERBICIDE WELL

If you see yellow nutsedge or crabgrass in a lawn, you are not going to grab a three-way herbicide to apply because it provides no control of those weeds (a sedge and a grass). Likewise, if you are dealing with ground ivy or wild violet, for instance, you shouldn't reach for a herbicide that is weak or mostly ineffective against those weeds (Table 2). For better control of sites with these weeds, you are much better off using a herbicide that has better activity on wild violet or ground ivy (Table 3). You may choose to have a premium herbicide ready in a backpack for run-ins with difficult weeds or you may choose to always use a premium herbicide which may save some time because there is no switching or extra filling. In the end, most premium herbicides can provide the excellent broad-spectrum control of many weeds and incorporate new chemistries, like pyridines (Table 1), to provide better control of the many difficult to control broadleaf weeds. Escalade® 2 is an easy choice here.

4 INCREASE THE HEALTH OF THE TURF

Overall turf health isn't always controlled by the person treating the weeds with herbicides, but typically some parts are within our control. It is often underestimated how much competition from surrounding plants can aid in effective control of weeds. All plants in a community are competing for space, water, and nutrients. Doing many of the seemingly small things well can be a bigger part of maintaining a healthy weed-free lawn than many think. Proper irrigation, fertility, and mowing are three areas that, if you have control of any of them, can help you in the war against weeds. Legumes like white clover and black medic can fix nitrogen from the atmosphere with the help of bacteria that live on the nodules of their roots. Turfgrass relies on nitrogen as it is made available from organic material in the soil and/or as it is applied by the turf manager. Fertility is available to all plants in the community, but it helps, at the very least, to level the playing field for all plants in the community. Irrigation can work in the same way, but many weeds thrive in wet or dry areas. Turfgrass plants have relatively deep roots and, subsequently, can survive or even thrive in dryer soils when some

weeds may not, especially annual plants that do not put much energy into root production. This can be exploited during certain times of the year by timing irrigation well. Mowing turfgrass a bit higher can increase density of the turfgrass system which can help it to outcompete weeds that have infiltrated and keep germinating weeds from surviving and becoming a part of the stand. These cultural practices won't eliminate weeds on their own, but putting them together with the sound practices aforementioned can help turf managers build a stout integrated pest management plan.

HOW ELSE HAVE HERBICIDES EVOLVED?

Broadleaf herbicides have more recently begun to incorporate inhibitors of PPO (Table 4). These AIs are for the most part contact AIs, which mean they do not get translocated in plants. They, instead, are cell membrane disruptors of any parts of plants that they contact. They provide a very fast response on susceptible plants. Different inhibitors of PPOs provide different benefits. For instance, sulfentrazone is primarily a sedge-active AI and, when mixed with other broadleaf herbicides, primarily adds sedge control to the list of controlled weeds. Carfentrazone, flumioxazin (Sure Power®), and pyraflufen-ethyl (4-Speed™ XT) are often mixed with translocating broadleaf herbicides to increase speed of activity and help to breakdown the cuticles of weeds (cell membrane disruptors) to help the other active ingredients successfully enter plants, which can increase the successful movement to target sites. The addition of these AIs to broad spectrum broadleaf herbicides have increased spectrum of control, speed of visual weed injury, and increased efficacy by helping to breakdown plant cuticles.

Three-way herbicides have changed to include pyridines like triclopyr and fluroxypyr to help with increased activity on difficult weeds and better translocation. These herbicides have continued to change over time and now include PPO inhibitors like carfentrazone, sulfentrazone, and flumioxazin to further control difficult weeds, to increase speed of activity and to help break down waxy cuticles of plants that protect them from other AIs entering and moving to target sites for effective control. Although these premium herbicides are often more expensive than the typical three-way herbicides, they can actually save end-users money. They can provide savings by controlling difficult weeds that three-way herbicides have only revealed as difficult to control. This is done by increasing activity on common weeds and providing more complete control, increasing speed of activity and, thereby, controlling weeds faster. Overall this increases the satisfaction of customers, which can increase the likelihood of retaining loyal customers.

WHY DO SIMILAR AIs, MOLECULES WITH SIMILAR STRUCTURES, DIFFER IN WEED CONTROL EFFICACY AMONG SPECIES?

It is interesting that molecules, such as pyridines (triclopyr, clopyralid, and fluroxypyr), can differ in their ability to control specific weeds. Actually, all of the synthetic auxin mimics in Table 1 are relatively similar in structure, yet they differ, sometimes vastly, in their activity on certain species. It is important to understand that a herbicide, after it is applied, must come in contact with a weed, must enter the plant, and then must finally be transported to the target site to do its intended job of killing the weed. All along the way, any of these processes can be thwarted. As herbicide droplets travel from a nozzle to a leaf, wind can move them off-target. Once a herbicide droplet lands on a leaf, it could be suspended on hairs and subsequently dried and it could be suspended on thick waxy cuticles that protect the plant not only from losing water but from entrance of foreign substances. Once inside the plant, the herbicide can be metabolized and transformed into a metabolite that no longer works as intended. It can be placed into a vacuole where it is inactive while some of it makes it, finally, to the target-site. Once at the target-site, some species may be more or less sensitive to the herbicide as target-sites among plant species can be variable. Interestingly, AIs with similar structures are absorbed, translocated, and metabolized differently within different plant species. All of these differences are not well-understood. The scientific community continues to research the mechanisms' variable activity – for example, legumes, like white clover, are more susceptible to clopyralid than triclopyr and triclopyr translocates better in poison ivy than clopyralid or fluroxypyr. However, there are many mechanisms that are not easily observable among many herbicides and within many plant species. Although we've learned much, there is much more to learn.

TABLE 4 INHIBITORS OF PPO

CHEMICAL FAMILY	ACTIVE INGREDIENT	FIRST USE IN TURF
Triazolinones	Sulfentrazone	2000s
	Carfentrazone	2000s
Phenylpyrazole	Pyraflufen-ethyl	2000s
N-phenylphthalimide	Flumioxazin	2010s