WISCONSIN POTATO AND VEGETABLE WEED MANAGEMENT UPDATE

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At the risk of gloom-and-doom, let's cut to the chase: traditional weed management as we've known it has been significantly challenged in recent years and the future isn't looking much brighter.

So why the dark clouds on the horizon? There are several reasons but for the sake of driving the situation home, let's focus on the top three:

1) Herbicide resistance among weeds is out of control. Globally, herbicide resistance has now been documented in 259 weed species and with 23 of 26 herbicide sites of action (Heap, 2019, www.weedscience.org). This year University of Illinois colleagues documented waterhemp resistance to the site of action that includes s-metolachlor, the active ingredient in Dual and several other herbicide trade names commonly used in potato and vegetable production. Why is this noteworthy? This is the first time where a broadleaf weed has been found to be resistant to that important herbicide group, and to make matters much worse, waterhemp has now been found to be resistant to seven herbicide sites of action.
2) Weed species that are almost always found with herbicide resistance have spread at an amazing pace across Wisconsin. Waterhemp is the unfortunate poster child for the spread of herbicide resistant weeds. My colleagues in the UW-Madison Agronomy Department have now found waterhemp in 61 of Wisconsin's 72 counties with glyphosate and other herbicide resistance traits common across those populations.
3) We haven't seen a new herbicide site of action since 1988 and that won't change soon. Hence the "recycling" of some of the first commercial herbicides from the 1940's with 2,4-D and dicamba in herbicide-resistant soybean and other crops to address weed resistance. Even if a new herbicide site of action were to be discovered, it takes at least 10 years and hundreds of millions of dollars to get from the lab bench to a label.

Without new herbicides on the way and the potential to lose control with our existing tools, where do we go? Our solutions are going to be vastly different and creative, and hopefully practically integrated into current management programs in smooth transition and without significant economic impact.

We're focused on strategies that require few if any additional inputs, including grower time, but instead focus on overemphasizing inherent crop traits that improve competitiveness with weeds. In contrast, most integrated weed management work to date has included adding inputs, like cultivation, cover crops, or more herbicides. So, what traits are valuable in our potato and vegetable crops in terms of competitiveness with weeds? We're looking for:

- Rapid and uniform crop emergence. This not only gives the crop a head start in the race against weeds but also decreases the time needed to get to a point where post-emergent herbicides and cultivation are less injurious. In our current situation crops like carrot and potato emerge slowly and rather inconsistently. We're changing that equation by adding very low doses of natural plant growth regulators that stimulate growth as either seed

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treatments or applied to young crop foliage. These plant hormones already occur in all plants – we're just tweaking them.

- Planting timing that not only optimizes yield but also early crop canopy closure. Each crop has a "sweet spot" for temperature and photoperiod that enhances early-season growth. Our recent work with carrot is a great example – shifting the planting timing two weeks later enhanced early carrot emergence and growth so much that very few weeds survived, and yield wasn't compromised compared to earlier plantings.
- Planting populations and configurations that lead to earlier canopy closure while maintaining or increasing crop yield. If you could increase your marketable crop yield by 10 to 20% without increasing water, fertilizer, pest management, time or other inputs, would you take it? Probably so if there weren't significant side effects. We've been able to do that in crops like carrot by adding two rows to each bed, in essence filling in areas that are still fertilized, water and sprayed to get to a competitive closed canopy earlier. Side effects could include increased risk of foliar diseases with less air movement in the canopy, and most significantly, equipment changes for the seeder and harvester. These significant changes will need to be balanced with the need to control herbicide resistant weeds with fewer tools – we're right up against that breaking point.
- Competitive crop varieties. From the standpoint of added energy and time, it can't get more efficient than just filling the planter with a more competitive variety that still has suitable end use characteristics. We've evaluated this extensively in potato with varieties dating back to some of the original Russet Burbanks from the late 1800's to recent introductions. The general trend was that older varieties tended to have faster developing and more complete plant canopies, likely a result of breeding for many years for higher yield at the cost (intentional or unintentional) of above-ground growth. In related work in carrot, breeders are now doing both – selecting for disease-resistant heavy top growth that outcompetes weeds as well as high yield and quality.

Our work "recycling" traditional herbicides from agronomic crops to specialty crop continues in addition to the work outlined above. In the past few years, we've conducted herbicide research on over two dozen crops. And, we've had some successes, such as new registrations for Zidua and Sonalan in potato, and we expect more in the near future. However, we also need to be prepared to integrate some of the more innovative strategies outlined above for a long-term solution.

Pesticide labels change often. As always, read and follow the label prior to any pesticide use.