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Cranberry Research Report 2017: Defining new approaches to weed management in cranberry

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Cranberry Research Report

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Supported by The Cranberry Institute, Cape Cod Cranberry Growers' Association, and Ocean Spray Cranberries, Inc.

Title: **Defining new approaches to weed management in cranberry.**

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Cooperators
Research Associate Dr. Katherine Ghantous, UMass Cranberry Station technicians, and growers, etc. who are directly involved in the project.

RESEARCH OBJECTIVES

1. Screening novel herbicides
    A. Preemergence (PRE) germination tests to evaluate control of:
        - dodder seeds
        - Perennial grass seeds: broomsedge (BS), deer-tongue grass (DTG), and little bluestem (LBS)
    B. Postemergence (POST) greenhouse tests to evaluate control of perennial grasses (BS, DTG, and LBS)
    C. Postemergence field tests with herbicides to evaluate control of dodder
2. Investigate QuinStar mechanism of delayed efficacy against dodder (Year 2).

SUMMARY OF ACCOMPLISHMENTS:

Preemergence dodder germination test - screening novel herbicides

Studies were conducted twice in the greenhouse. Sets of dodder seeds (100 per treatment) had dormancy broken by mechanically scarification (Ghantous and Sandler 2012). After scarification, a set of seeds was sprinkled onto the surface of a 4-in pot filled with a 25% peat:75% sand mix, and covered with a dusting of sand. Each pot received a single preemergence herbicide treatment (Table 1) and treatments were replicated four times. Treatments were applied by CO_2-powered backpack sprayer, and herbicides were delivered in the equivalent of 400 gallons of water per acre to simulate application by chemigation. Pots

were taken outside of the greenhouse to be sprayed, and returned to the greenhouse after treatment. Pots were evaluated every other day for 4 weeks after treatment, and emerged seedlings were counted and removed from pots. The entire experiment was conducted twice (Run 1 treated 7/5/16 and Run 2 was treated10/1/16).

Table 1. Herbicide treatments for preemergence dodder screening

	Herbicide Name	**AI**	**Maker**	Rate
1	Bicyclopyrone	Bicyclopyrone	Syngenta	50 g/ha
2	Zeus XC	Sulfentrazone	FMC	8-12 oz/a
3	Kerb	Pronamide	Dow	1.8 pts/a
4	Zidua	Pyroxasulfone	BASF	2.75 oz/a
5	Untreated	N/A (not applicable)	N/A	N/A

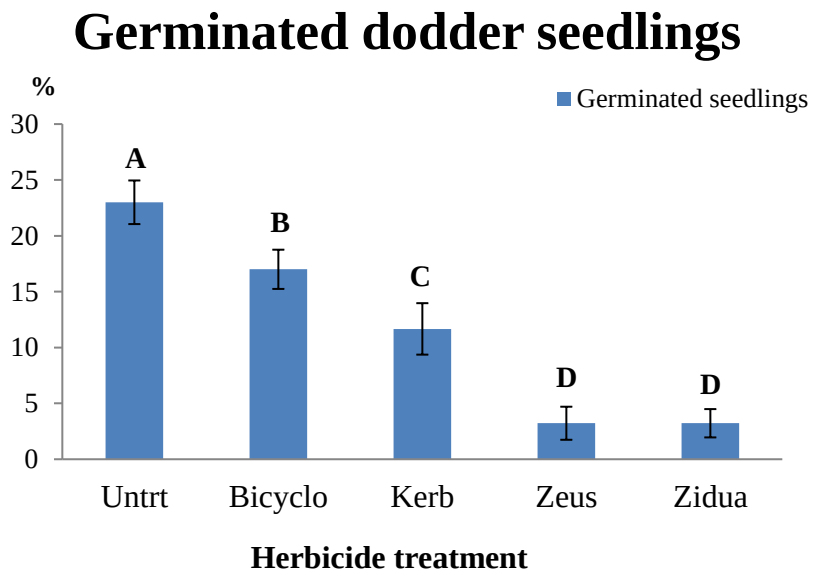

Figure 1. Average percentage of dodder seedlings that germinated after preemergence herbicide treatments ±SE. Means are averaged across two runs of the study (N=8). Means with dissimilar letters are statistically different (Duncan Multiple Range Test, $P \leq 0.05$).

All four herbicides screened significantly reduced the percentage of dodder seedling that germinated compared to the untreated. Zeus and Zidua were the most effective, followed by Kerb and then Bicyclopyrone. Despite the fact that more seeds germinated in the Kerb treatments that the Zeus or Zidua treatments, it was noted that the Kerb seedlings were very abnormal (stunted and thick, see Fig. 2). Based on our previous experience with dodder, we presume that despite germinating, these seedlings would not develop normally and parasitize a host.

Actively growing potted cranberry plants were treated with PRE herbicides during dodder Run 2. No injury was noted except for the tips of runners in Zeus treatments (appeared to brown and desiccated, see Fig. 3).

Figure 2. Stunted and abnormal seedlings from seeds treated with Kerb preemergence (left) vs healthy seedlings from untreated seeds.

Figure 3. Cranberry runner tips showing injury approximately 4 weeks after being treated with Zeus XC.

Preemergence perennial grasses germination test

A set of LBS (0.5 g; approx. 300 seeds), BS (0.10g; approx. 300 seeds), or DTG (100 counted) seeds was sprinkled onto the surface of a 4-in pot filled with a 25% peat:75% sand mix, and covered with a thin layer of the potting mixture. According to package instructions, DTG seeds were cold stratified for 6 weeks prior to planting.Each pot received a single preemergence herbicide treatment (Table 2) and treatments were replicated four times. Treatments were applied by CO_2-powered backpack sprayer, and herbicides were delivered in the equivalent of 400 gallons of water per acre to simulate application by chemigation as described above. Grasses were visually evaluated for 5 weeks; seedlings were counted, dried, and weighed. The entire study was conducted twice. Run 1 was treated 7/5/16 and harvested 8/10/16, and Run 2 was treated 7/12/16 and harvested 8/16/16.

Table 2. Herbicide treatments for preemergence grasses screening

	Herbicide Name	**AI**	**Maker**	Rate
1	Bicyclopyrone	Bicyclopyrone	Syngenta	50 g/ha
2	Zeus XC	Sulfentrazone	FMC	8-12 oz/a
3	Kerb	Pronamide	Dow	1.8 pts/a
4	QuinStar	Quinclorac	Albaugh	8.4 oz/a
5	Devrinol 2-XT	Napropamide	UPI	18 qt/a
6	Untreated	N/A	N/A	N/A

Devrinol and Kerb were the most effective herbicides for PRE grass control. Both reduced both the number of grass seedlings which germinated (Table 3), as well as the biomass of grasses that did germinate (Table 4). QuinStar showed efficacy reducing the biomass of BS (run 1 only) and LBS, but not DTG. QuinStar did not reduce the number of seedling which germinated except LBS (Run 2 only). Zeus XC reduced the biomass of LBS and DTG, and reduced germination of DTG and BS (Run 2 only).

All treatments were a single application. Further testing with Kerb should be done to look at the effects of two applications (this use will be permitted on future label). Further testing with Zeus XC and QuinStar should be conducted, looking into more long-term effects of treatments on grasses.

Table 3. Mean biomass ± SE (g) of grasses 5 weeks after seeds were treated with preemergence herbicides reported by grass species and study run (N=4). Bolded numbers highlighted in grey are statistically different from the untreated control within each column (Dunnett's Test, $P \leq 0.05$). Numbers in italics in grey boxes are significant at $P \leq 0.10$.

	BS		LBS		DTG	
	Run 1	Run 2	Run 1	Run 2	Run 1	Run 2
Untreated	0.26 ± 0.04	0.09 ± 0.01	0.60 ± 0.03	0.55 ± 0.05	0.60 ± 0.02	0.67 ± 0.06
Bicyclopyrone	0.19 ± 0.04	0.11 ± 0.04	**0.47 ± 0.03**	**0.31 ± 0.05**	0.57 ± 0.04	0.51 ± 0.05
Devrinol	**0.00 ± 0.0**	**0.00 ± 0.00**	**0.04 ± 0.02**	**0.02 ± 0.01**	x*	**0.00 ± 0.00**
Kerb	**0.10 ± 0.03**	*0.01 ± 0.01*	**0.07 ± 0.02**	**0.22 ± 0.03**	**0.02 ± 0.01**	**0.03 ± 0.02**
QuinStar	**0.13 ± 0.02**	0.14 ± 0.02	**0.44 ± 0.05**	**0.16 ± 0.02**	0.58 ± 0.04	0.57 ± 0.01
Zeus XC	0.20 ± 0.02	0.05 ± 0.01	**0.47 ± 0.04**	**0.23 ± 0.01**	**0.49 ± 0.03**	**0.33 ± 0.05**

**DTG Run 1 pots were accidentally omitted from the Devrinol treatment*

Table 4. Mean number of seedlings ± SE (g) of grasses 5 weeks after seeds were treated with preemergence herbicides, reported by grass species and study run (N=4). Bolded numbers highlighted in grey are statistically different from the untreated control within each column (Dunnett's Test, $P \leq 0.05$). Numbers in italics in grey boxes are significant at $P \leq 0.10$.

	BS		LBS		DTG	
	Run 1	Run 2	Run 1	Run 2	Run 1	Run 2
Untreated	56.5 ± 4.7	83.0 ± 11.2	71.3 ± 3.2	61.8 ± 3.4	60.3 ± 3.2	71.0 ± 0.7
Bicyclopyrone	50.0 ± 9.0	68.8 ± 5.8	60.5 ± 2.4	54.8 ± 8.1	64.3 ± 12.7	70.0 ± 0.4
Devrinol	**2.3 ± 1.7**	**0.0 ± 0.0**	**4.3 ± 1.4**	**6.5 ± 2.3**	x*	**0.0 ± 0.0**
Kerb	**32.0 ± 5.5**	**2.8 ± 1.6**	**10.8 ± 3.5**	**35.0 ± 6.8**	**1.5 ± .07**	**6.0 ± 3.0**
QuinStar	39.3 ± 6.2	72.3 ± 4.4	64.5 ± 5.6	**34.5 ± 3.1**	59.0 ± 8.1	76.3 ± 1.4
Zeus XC	45.3 ± 4.0	**30.5 ± 4.1**	60.5 ± 3.3	46.3 ± 1.6	*38.3 ± 2.7*	**54.8 ± 6.1**

**DTG Run 1 pots were accidentally omitted from the Devrinol treatment*

Postemergence Grass Studies - screening novel herbicides

A set of LBS (0.5 g, approx. 300 seeds), BS (0.10g, approx. 300 seeds), or DTG (50 counted) seeds was sprinkled onto the surface of a pot filled with a peat/sand mix, and covered with a thin layer of the potting mixture. DTG seeds were cold stratified for 6 weeks prior to planting. Grasses were grown to a height of 4+ inches before treatments. Each pot received a single postemergence herbicide treatment (Table 5) and treatments were replicated four times. Treatments were applied by CO_2-powered backpack sprayer. Herbicides were delivered in the equivalent of 400 gallons of water per acre to simulate application by chemigation (chem) or in 30 gallons per acre to simulate a broadcast application (BC) as noted in the Table 5. Grasses

were visually evaluated for 8 weeks after treatment. The biomass was harvested from each pot, then dried and weighed. The entire study was conducted twice. Run 1 was treated 7/5/16 and harvested 8/31/16, and Run 2 was treated 7/12/16 and harvested 9/1/16.

Table 5. Herbicide treatments for postemergence grasses screening. Treatments 6, 7, and 8 were for DTG only.

	Herbicide Name	**AI**	**Maker**	Rate	
1	Untreated	N/A	N/A	N/A	
2	Aim	Carfentrazone	FMC	2 oz/a	Chem
3	Armezon	Topramezone	BASF	1 oz/a	Chem
4	Bicyclopyrone	Bicyclopyrone	Syngenta	50 g/ha	Chem
5	QuinStar	Quinclorac	Albaugh	8.4 oz/a	Chem
6*	Callisto	Mesotrione	Syngenta	8 oz/a	Chem
7*	Intensity	Clethodim	Loveland	16 oz/a	BC
8*	Poast	Sethoxydim	BASF	1.5 oz/a	BC

Similar to results seen in past studies with different grass species, the grass herbicides Poast (sethoxydim) and Intensity (clethodim) effectively reduced DTG biomass. QuinStar significantly reduced LBS biomass, but not BS or DTG. It can take several weeks or longer for QuinStar damage to appear for some weed species, and it is possible that if the study period was longer that more damage would have occurred. Callisto damage of DTG has been observed in the field, but was not observed during this study. Higher efficacy may have been seen if treatments were applied twice instead of once. Armezon reduced the biomass of LBS compared to untreated plants.

We screened Aim as a chemigation application. The pending label for this product does not have chemigation listed. This product is likely more effective as a broadcast application in lower volumes of water.

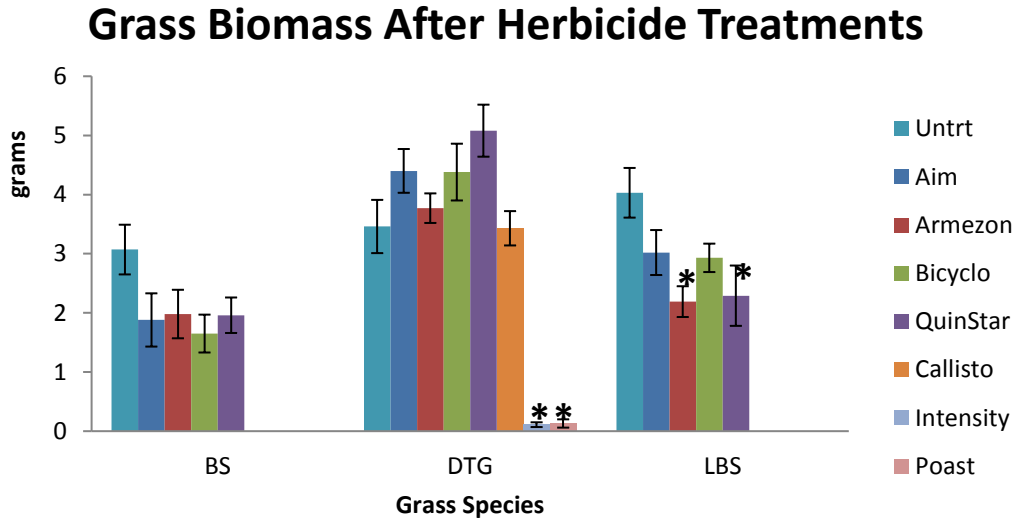

Figure 3. Average biomass (g) BS, DTG, and LBS biomass 8 weeks after herbicide treatments ±SE. Means are averaged across two runs of the study (N=8). Means with stars are statistically different from untreated grass within a species (Dunnett's, $P \leq 0.05$).

Postemergence dodder test

Plots 0.25-m^2 were established on a commercial cranberry farm (Carver, MA) with a dodder infestation. Plots were treated on 7/19/16 (Armezon, bicyclopyrone, Pursuit, or untreated), and treatment were replicated three times. The bog on which the study was located had been over fertilized, resulting in patchy rank vines and very little fruit produced. There was too little fruit, and it was too variable, to evaluate effects of herbicides on yield. No visual cranberry vine injury was noted for any treatments, except for some reddening of vines treated with Pursuit. Dodder in the Armezon treated plots appeared to become stringy, but continued to flower and make seeds. Pursuit-treated dodder showed injury and seed production was reduced. Ongoing Pursuit crop safety studies are being conducted on State Bog.

Conclusions

- Kerb and Zeus - potential for PRE control of both dodder and perennial grasses.
- Zidua - potential for dodder PRE control.
- Armezon - some potential for POST control of grasses.
- Aim – needs to screened for non-chemigation application
- QuinStar – potential for grass control
- Crop safety –
    - Zeus caused minor injury to actively growing cranberry, but may be safe for early season applications. This product should be screened on vines in spring growth stages.
    - Aim - high levels of crop injury were observed for a 7/19 application. Applying at the correct cranberry growth stage may be important for avoiding crop injury. Crop safety studies are needed.

QuinStar mechanism of delayed efficacy against dodder (Year 2)

A continuing a field study (initiated in 2015) looking at QuinStar interaction with cranberry over time, the study plots were re-treated in 2016 at the maximum label rate (8.4 oz/A, applied twice). Treatments are: untreated, treated in Year 1 only (treated 2015 only), Treated in Years 1 and 2 only (treated 2015 and 2016), or treated in Years 1, 2, and 3 (treated 2015, 2016, and to be treated in 2017). Treatments are replicated four times.

Plots were treated 6/6/16 and 7/11/16. Fruit was collected from a 1-ft^2 area of each plot on 9/13/16. Cranberry tissue was collected from a 0.25-m^2 area of each plot 9/13/16 – 9/16/16, separated by stem type, leave were then separated from stems, and frozen. Frozen tissue was processed by Ocean Spray (OS) in 2015 prior to herbicide extraction. The milling equipment is no longer available for use at OS, so we anticipate grinding the samples at UMass Amherst campus (pending appropriate equipment is identified) before residue analysis will be done by OS. We plan to apply Year 3 treatments in 2017, and again collect tissue at the end of the season.