

Weed Control with Bio-herbicides

Principle investigators: Dr. Hannah Mathers and Luke Case

Introduction.

This study was designed to continue from the 2009 to 2012 tests with two objectives: 1) determine the efficacy and duration of weed control of different alleopathic plant extracts and other organic herbicides in field, treated on two types of mulch; and 2) assess the phytotoxicity of these different controls in field. Only efficacy data will be presented as phytotoxicity was minimal. All experimental products developed at Ohio State University for this study have not been named as patents are pending. Any interest regarding commercialization of these products should be addressed to: Melissa Kelly, Technology Licensing Analyst, Technology Commercialization and Knowledge Transfer, 1524 North High Street Columbus, OH 43201.

Materials and Methods.

Field Studies.

The research began on June 27, 2013 and evaluations were conducted on July 17, 2013 (37 DAT), July 29, 2013 (49 DAT), August 15, 2013 (65 DAT) and September 20, 2013 (105 DAT). A controlled release fertilizer (CRF) Osmocote Pro 17-5-11 fertilizer as a top-dress application was used in the field evaluations. We established 3 X 3 ft. plots /treatment /replication that were mulched with pine nuggets at 2" deep and 3 X 3 ft. plots that were mulched with a ½ cup of wood stove pellets plots/ treatment/ replication. Mulch is commonly used in landscape beds throughout the US. The plots were established at Waterman Farm, Columbus, OH. Supplemental irrigation was provided in the first two weeks during establishment; however, all irrigation was discontinued after two weeks and only normal precipitation was provided. June and July were wetter than normal months in Columbus, OH with increases of 1.39 inches in June and 2.08 inches in July over the 30 year average. August was 0.62 inches and September 1.36 inches drier than the 30 year average. To observe phytotoxicity one tree, Freeman Maple (*Acer Xfreemanii*, J. Frank Schmidt Nursery, Boring, OR) were used in each plot. The alleopathic chemicals were created using a provisional patented method prepared from five types of plants. For the remainder of the article these solutions will be known as BH1, BH2, BH3, BH4 and BH5 (Table 2). A spray volume of 93 L/ha was used and applied with a CO₂-pressurized backpack sprayer equipped with 8002 evs flat fan nozzles spaced 41 cm apart.

Natural blow-in of weed seeds and the existing propagule bank of perennial weeds such as Quackgrass (*Elytrigia repens*), Canada thistle (*Cirsium arvense*) and bindweed (*Convolvulus arvensis*) occurred and exerted high weed pressures in all plots (Fig. 1). Efficacy was rated on a scale of 0-10, with 10 being perfect weed control, 0 no control and ≥ 7 commercially acceptable. There were 13 treatments evaluated with five

replications per treatment. Two commercial bio-herbicide products were also evaluated as comparisons to the five alleopathic chemicals we created. The two commercial bio-products were 20% acetic acid, WeedPharm™ at 10% v/v (Pharm Solutions Inc., Port Townsend, WA) and Fiesta, Iron HEDTA 26.52% (Neudorff North America) (W. Neudorff GmbH KG, Germany) at 10% v/v (Table 2). Each of these and the alleopathic plant extracts (Table 2) were applied either directly onto the bark mulch already spread on the ground or to the wood pellets in a retractable roof house. After the wood pellets were sprayed and let dry for 24 hours, they were bagged and ½ cup of each was applied to the ground of the 3 X 3 ft. field plots. One synthetic herbicide, FreeHand was also used as a comparison for efficacy. FreeHand was applied at 150 lb/ac over the top of the mulched beds. Three controls were implemented one for each mulch type with no chemical addition and a blank check (no mulch/no chemical).



Fig. 1. August 15, 2013, Waterman Farms, Columbus, OH, bio-herbicide trial showing extreme weed pressure present at the site.

Results and discussion.

Only one of the ½ cup of wood pellet mulch treatments was providing commercially acceptable weed control at 37 DAT. The synthetic herbicide FreeHand, at 37 DAT provided a rating of 7.6 (Table 2). All the other ½ cup wood pellet mulched plots at 37 DAT were providing little efficacy over the wood pellet control (1.0) (Table 2). BH4, Weed Pharm + Fiesta and Fiesta, however, were significantly better in efficacy versus the untreated pellet control (Table 2). At 49 DAT even the FreeHand at 150 lb/ac with ½ cup wood pellet mulched plots were no longer commercially acceptable (5.6) (Table 2). Although, BH3, BH4 and FreeHand were still providing statistically better

control than the untreated pine nugget control plots (Table 2). By 65 DAT averaged over the five replications, FreeHand was providing no weed control (0) with the ½ cup mulched plots (Table 2) (Fig. 4). This poor performance with FreeHand which has a residual life of 150 days is an indication of the severe weed pressure in the 2013 Bio-Herbicide Waterman Farm plot (Fig. 1).

All treatments with the 2" pine nugget at 37 and 49 DAT were commercially acceptable and were not statistically better than the untreated pine nugget plots (Table 2). It seems at 49 DAT much of the weed control is being provided by the two inches of pine nuggets. At 65 DAT, however, seven treatments are below commercially acceptable efficacy. FreeHand is the only treatment statistically similar to the control (Table 2). Five treatments at 65 DAT, four of which were alleopathic plant extracts are commercially acceptable, BH2, BH3, BH4, Fiesta 10% and BH4 + BH5 (Table 2). At 65 DAT all pellet treatments were now offering no control (Table 2). By 105 DAT only three treatments evaluated provided efficacy ratings at or above commercially acceptable ≥ 7 BH2 (Fig. 2 A), BH4 (Fig. 2 A) and BH4 + BH5 (Fig. 3) (Table 2).



A



B

Fig. 2. A. (left) BH4 (left side of photo A) and BH2 (right side of photo A) both have a rating of 7.0 when picture was taken, September 23, 2013 (3 MAT) at Waterman Farms, Columbus, OH, bio-herbicide trial. **B.** Control with pine nuggets 3MAT (rating 2.8).



Fig. 3. (left) BH4 + BH5 (rating of 7.0) when picture was taken, September 23, 2013 (3 MAT) at Waterman Farms, Columbus, OH, bio-herbicide trial.



Fig. 4. (above) 65 DAT Waterman Farm, Columbus, OH, FreeHand at 150 lb/ac applied over the top of 2" of pine nuggets. Picture taken August 15, 2013.

Table 2. Five alleopathic bio-herbicides compared to other organic herbicides and one synthetic applied on 2" of pine nuggets (PN) or ½ cup of wood pellets (Pellets) evaluated over four dates at Ohio State University Waterman Farm, Columbus, OH. The trial was initiated on June 27, 2013.

Treatment	37 DAT ^z				49 DAT				65 DAT				105 DAT			
	PN ^y		Pellets		PN		Pellets		PN		Pellets		PN		Pellets	
BH1	8.4 ^{xw}	abc	3.8	bcde	8.4	ab	4.4	abc	5.4	bcd	1.8	a	5.4	ab	0.0	
BH2	9.2	a	3.2	bcde	8.6	ab	2.8	abcd	7.8	a	0.0	b	7.0	a	0.0	
BH3	8.4	abc	3.8	bcde	8.2	ab	4.8	ab	7.0	abc	0.0	b	5.4	ab	0.0	
BH4	8.8	abc	4.8	abc	8.2	ab	3.0	ab	6.8	abc	0.0	b	7.0	a	0.0	
WeedPharm 10% + Fiesta 10%	8.8	abc	5.6	ab	8.2	ab	4.2	abcd	6.0	abc	0.0	b	3.8	bcd	0.0	
WeedPharm 10% + BH2	8.2	bc	4.4	bc	8.2	ab	3.0	abcd	4.8	cd	0.0	b	4.8	abc	0.0	
10% Fiesta	9.0	ab	4.8	abc	9.2	a	2.8	abcd	7.2	ab	0.4	b	5.4	ab	0.0	
BH4 + BH5	8.4	abc	3.8	bcde	8.8	ab	2.6	abcd	6.8	abc	0.0	b	7.0	a	0.0	
WeedPharm 10%	8.4	abc	3.4	bcde	7.6	b	2.4	abcd	5.8	abc	0.0	b	5.6	ab	0.0	
FreeHand 150 lb/ac	8.6	abc	7.6	a	8.2	ab	5.4	a	2.0	e	0.0	b	2.0	d	0.0	
Control-Pellets			1.0	e			1.6	cd			0.0	b			0.0	
Contol-PN	8.6	abc			8.6	ab			3.0	e			2.8	cd		
Control (no mulch?)	8.0	c	2.0	cde	7.6	b	2.2	bcd	1.6	e	0.0	b	2.0	d	0.0	

z = Days after treatment

y = PN: pine nugget mulch; Pellets: 1/4 cup of hardwood pellets

w = Treatment ratings followed by the same letter under the same mulch are not significantly different for that date based on lsmeans ($\alpha = 0.05$)

x = Visual ratings based on a 0-10 scale with 0 being no weed control and 10 perfect weed control with ≥ 7 commercially acceptable

Conclusions

Horticultural vinegar (WeedPharm) performed very well in past trials that ran to 50 DAT and this was also true in this 2013 trial. However, vinegar (WeedPharm) was unable to stay commercially acceptable to 65 DAT even when combined with Fiesta or BH2. The rates of alleopathic extracts used in the 2013 trial were much lower than in previous studies. Even at these low rates three treatments were providing commercially acceptable control at 105 DAT, *BH2*, BH4 and BH4 + BH5. This was the first year evaluating BH5. In future studies BH5 should be evaluated further in combinations or alone. Over all dates the best treatment was the BH2 on 2" of pine nuggets. Fiesta did provide good weed control up to 65 DAT on 2" of pine.