2013 Evaluation of Spray Materials for Thinning/Weeding Lettuce

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Background: There has been interest in developing automated weeding and thinning machines for vegetables for many years. The first efforts were made on sugar beets in the 1940's which eventually led to the development of the beet thinner by the John Deere Company in the 1970's. In the same vein, there has been interest in the development of machines to mechanically weed vegetables. This technology was greatly facilitated by the development of high speed computers in recent years that allowed a microprocessor to analyze images captured by electronic cameras. Computers controlled the implements that removed the unwanted plants; many implements were developed to remove the unwanted crop plants/weeds such as swinging blades, rotating blades, flames and spinning chains. The development of the removal of unwanted plants with a spray in the last two to three years has been widely accepted by growers due to its precision and lack of moving parts (see photo 1). At present there are several companies that manufacture automated thinners that remove unwanted plants by spraying a chemical: Ag Mechtronix (Silver City, New Mexico), Blue River Technology (Mountain View, CA), and Ramsey Highlander/Oraka Technologies (Gonzales, CA). An effective spray material is critical to reap the benefits of this technology; the spray material must be able to remove the unwanted plants under a variety of conditions such as cold temperatures and wet plants.

This trial tested four organically acceptable materials and four conventional materials. The materials were applied in cool conditions shortly after dawn when the plants were still wet with dew. This time was chose because it has been observed to be the most difficult conditions for spray materials to effectively remove unwanted lettuce plants in thinning operations, as well as any weeds that may be associated with the lettuce plants.

Methods: The trial was conducted at the Hartnell East Campus Research Facility. The lettuce variety Green Towers was seeded in two rows 40-inch wide beds on September 9 and germinated on September 10 with sprinkler irrigation. There was good emergence of malva, purslane, hairy nightshade, groundsel, sow thistle and shepherd's purse along with the lettuce. Weeds and lettuce were treated one time at either 14 or 21 days following germination on September 25 and October 2, respectively. The organic materials tested were BioLink Herbicide, Final San-O, Weed Pharm and Weed Zap; conventional materials tested were Scythe, Shark, NpHuric, and 14-0-05. Lettuce plants at 14 had 1-2 true leaves and at 21 had 2-3 true leaves. The time of application of these materials was chosen to bracket the typical time that growers thin lettuce using the automated thinners. Plots were one 40 inch bed wide by 15 feet long and replicated four times in a randomized complete block design. Materials were applied with one pass of a one wand with one 8008E nozzle at 20 psi. The material was applied in the equivalent of 20 gallons of water per acre. Weather at the time of application was clear and the temperatures were 65 °F on September 25 and 63 °F on October 2; dew was present on the plants at the time of application (see photo 2).

Results: The results of the application that was made at 14 days after the first germination water was applied to the lettuce are shown in Table 1. Of the organic materials, BioLink Herbicide had the best lettuce and weed control (see photo 4). Weed Pharm provided the next best control of lettuce plants but was weak controlling malva (see photo 6). Of the conventional materials tested, Shark provided the best lettuce and weed control (see photo 9). The next best lettuce control was provided by Scythe and 14-0-0-5 (see photos 8 & 11).

The results of the application that was made at 21 days after the first germination water are shown in Table 2. The reevaluation of the 14 day applications are also shown in Table 2. The basic trends observed in the first evaluation are also seen on this evaluation date. For all materials, the 21 day application did not provide as good of control as making the application at 14 days. We increased the percent of NpHuric on the second application from 20% to 30%, but it did not improve the level of control.

It is assumed that the cool wet conditions reduced the efficacy of many of the materials except for Shark; BioLink Herbicide provided the second best control under the conditions that the applications were made. It is probable that many of the materials tested would have performed better under dry, warmer conditions; however, as stated above, the purpose of this trial was to test them under these suboptimal conditions.

Photos of the plot of the 14 days after germination water applications on October 2

1 – Example of lettuce thinning with spray application (blue area) from a commercial field

2 – Dew present on plants at application

3 – Over view of plot

4 - BioLink herbicide

5 – Final San O

6 – Weed Pharm

7 – Weed Zap

8 – Scythe

9 – Shark

10 – NpHuric 11 – 14-0-0-5 12 – Untreated

Table 1. Lettuce plant, malva and overall weed control rating of the 14 day after germination water application on September 30 (5 days after 14 day application)

Control Material	Rate	Adjuvant	Rate	Lettuce Control rating[1]	Malva Control rating[1]	Overall Weed Control rating[1]
Organic						
BioLink Herbicide	12% v/v	BioLink Spreader	4 oz/100 gal	9.8	9.1	9.3
Final San-O	20% v/v	Oroboost	100 oz/100 gal	3.5	1.8	4.3
Weed Pharm	100% v/v	Oroboost	100 oz/100 gal	7.0	3.3	6.8
Weed Zap	5% v/v	Oroboost	100 oz/100 gal	3.5	2.8	7.8
Conventional						
Scythe	9% v/v	DynAmic	0.25% v/v	8.1	6.5	8.0
Shark	1.0 oz/A	DynAmic	0.25% v/v	10.0	10.0	9.8
NpHuric	20% v/v	DynAmic	0.25% v/v	4.0	3.0	6.3
14-0-0-5	20 gal/A	DynAmic	0.25% v/v	8.1	4.0	6.6
Untreated	---	---	---	0.0	0.0	0.0
Pr>Treat				<0.0001	<0.0001	<0.0001
LSD (0.05)				1.2	1.3	2.0

1 – lettuce plant and weed control rating: 0 = no control to 10 = complete control

Table 2. Lettuce plant, malva and overall weed control rating on October 7 (5 days after 21 day application)

Control Material	Rate	Adjuvant	Rate	Timing	Lettuce Control rating[1]	Malva Control rating[1]	Overall Weed Control rating[1]	Live Lettuce Plants[2]
Organic								
BioLink Herbicide	12% v/v	BioLink Spreader	4 oz/100 gal	14 days	9.9	9.4	9.1	0.0
BioLink Herbicide	12% v/v	BioLink Spreader	4 oz/100 gal	21 days	8.6	7.9	8.0	3.3
Final San-O	20% v/v	Oroboost	100 oz/100 gal	14 days	3.5	3.0	3.3	22.8
Final San-O	20% v/v	Oroboost	100 oz/100 gal	21 days	1.3	1.5	1.8	38.0
Weed Pharm	100% v/v	Oroboost	100 oz/100 gal	14 days	6.3	4.5	4.8	9.5
Weed Pharm	100% v/v	Oroboost	100 oz/100 gal	21 days	4.5	3.8	3.5	23.8
Weed Zap	5% v/v	Oroboost	100 oz/100 gal	14 days	6.0	6.3	6.5	12.5
Weed Zap	5% v/v	Oroboost	100 oz/100 gal	21 days	2.8	2.8	3.5	29.5
Conventional								
Scythe	9% v/v	DynAmic	0.25% v/v	14 days	8.8	7.3	7.3	3.0
Scythe	9% v/v	DynAmic	0.25% v/v	21 days	6.5	4.8	5.5	13.0
Shark	1.0 oz/A	DynAmic	0.25% v/v	14 days	10.0	10.0	9.5	0.0
Shark	1.0 oz/A	DynAmic	0.25% v/v	21 days	9.8	9.8	9.4	0.5
NpHuric	20% v/v	DynAmic	0.25% v/v	14 days	4.8	4.8	5.3	42.5
NpHuric	30% v/v	DynAmic	0.25% v/v	21 days	3.5	3.8	3.8	22.8
14-0-0-5	20 gal/A	DynAmic	0.25% v/v	14 days	7.3	6.0	6.3	9.8
14-0-0-5	20 gal/A	DynAmic	0.25% v/v	21 days	3.8	3.3	3.3	25.0
Untreated	---	---	---	---	0.0	0.0	0.0	41.8
Pr>Treat					<0.0001	<0.0001	<0.0001	<0.0001
LSD (0.05)					1.6	1.1	1.1	18.3

1 – lettuce plant and weed control rating: 0 = no control to 10 = complete control; 2 – number of lettuce plants per 5 linear feet of row