Environmental Horticulture Program Research Summaries

IR-4 Environmental Horticulture Program
Fatty Acid Herbicide Efficacy

Bluegrass, Annual (*Poa annua*)
Chickweed (*Stellaria media*)
Crabgrass (*Digitaria sp.)*
Crabgrass, Smooth (*Digitaria ischaemum*)
Horsetail, Field (*Equisetum arense*)
Pigweed, Redroot (*Amaranthus retroflexus*)
Spurge, Spotted/Prostrate (*Chamaesyce maculata*)

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Date: March 22, 2024

Acknowledgements
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This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award numbers 2015-34383-23710, 2017-34383-27100, 2019-34383-29973, 2020-34383-32455 and 2021-343830-34848 with substantial cooperation and support from the State Agricultural Experiment Stations and USDA-ARS.

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Abstract

Fatty acid herbicides represent potential alternatives for managing glyphosate resistant weeds as well as an option for less environmental impacts for post emergent weed management. However, optimal use patterns have not been fully established. From 2020 to 2023, five different fatty acid herbicides were examined with and without adjuvants to determine optimal use patterns to manage grassy and broadleaf weeds as directed applications. The two different active ingredients screened were pelargonic acid (Axxe and Scythe) and the combination of caprylic acid + capric acid (FireWorxx, HomePlate, and Suppress). The weeds studied were annual bluegrass, (*Poa annua*), chickweed (*Stellaria media*), crabgrass (*Digitaria sp.*), smooth crabgrass (*Digitaria ischaemum*), field horsetail (*Equisetum arense*), redroot pigweed (*Amaranthus retroflexus*), and spotted/prostrate spurge (*Chamaesyce maculata*). Not all products were screened against all weeds, and no herbicide-weed combination was tested in three or more trials. Either solo or in combination with adjuvants, FireWorxx and Suppress provided excellent efficacy of smooth crabgrass, field horsetail, redroot pigweed and spotted spurge. Scythe provided great to excellent efficacy of these same weeds. HomePlate provided excellent efficacy for annual bluegrass and chickweed but variable efficacy for crabgrass. Axxe exhibited good to great efficacy for these same weeds.

Introduction

Fatty acid herbicides represent potential alternatives for managing glyphosate resistant weeds as well as an option for less environmental impacts for post emergent weed management. While these herbicides are registered as general burndown products, their best use patterns have not been fully established for growers to apply them for optimal efficacy. This project was established at the 2019 Workshop as a regional project to examine how best to utilize fatty acid herbicides and whether the addition of adjuvants could improve efficacy.

Materials and Methods

This research project spanned several years with slightly different objectives each year. The first year comprised baseline research examining volume of finished solution applied per acre along with screening different fatty acid herbicides. The second year narrowed the fatty acid herbicide list but combined them with adjuvants to determine whether efficacy could be improved. Years 3 and 4 furthered the adjuvant research with various weeds. The protocols used were 20-018, 21-018, 22-024, and 23-024. For more detailed materials and methods, including application rates for various products, please visit https://www.ir4project.org/ehc/ehc-registration-support-research/env-hort-researcher-resources/#Protocols to view and download these protocols.

Axxe, FireWorxx, HomePlate, Scythe, and Suppress were supplied to researchers (See list of researchers in Appendix 1) by their respective manufacturers.

Results and Summary

Efficacy

Five different fatty acid herbicides were examined with and without adjuvants to determine optimal use patterns to manage grassy and broadleaf weeds as directed applications. The two different active ingredients screened were pelargonic acid (Axxe and Sythe) and the combination of caprylic acid + capric acid (FireWorxx, HomePlate, and Suppress). The weeds studied were annual bluegrass, (*Poa annua*), chickweed (*Stellaria media*), crabgrass (*Digitaria sp.*), smooth crabgrass (*Digitaria ischaemum*), field horsetail (*Equisetum arense*), redroot pigweed (*Amaranthus retroflexus*), and spotted/prostrate spurge (*Chamaesyce maculata*). Not all products were screened against all weeds, and no herbicide-weed combination was tested in three or more trials. Either solo or in combination with adjuvants, FireWorxx and Suppress provided excellent efficacy of smooth crabgrass, field horsetail, redroot pigweed and spotted spurge (Table 1. Scythe provided great to excellent efficacy of these same weeds. HomePlate provided excellent efficacy for annual bluegrass and chickweed but variable efficacy for crabgrass. Axxe exhibited good to great efficacy for these same weeds. For outcomes related to specific fatty acid herbicide plus adjuvant combinations, refer to results from individual experiments (Table 2 - Table 11).

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Table 1. Average efficacy rating for fatty acid based herbicides.

Product (Active Ingredients)	Bluegrass, Annual (*Poa annua*)	Chickweed (*Stellaria media*)	Crabgrass (*Digitaria sp.*)	Crabgrass, Smooth (*Digitaria ischaemum*)	Horsetail, Field (*Equisetum arense*)	Pigweed, Redroot (*Amaranthus retroflexus*)	Spurge, Spotted/ Prostrate (*Chamaesyce maculata*)
Axxe (pelargonic acid)	3.0 (3 - 3) n1	4.0 (3 - 5) n2	3.5 (2 - 5) n2	1.0 (1 - 1) n1	1.0 (1 - 1) n1	1.0 (1 - 1) n1	3.0 (1 - 5) n2
FireWorxx 80 (caprylic acid (44%) + capric acid (36%))				5.0 (5 - 5) n1	5.0 (5 - 5) n1	5.0 (5 - 5) n1	5.0 (5 - 5) n1
HomePlate (caprylic acid + capric acid)	5.0 (5 - 5) n1	5.0 (5 - 5) n2	3.5 (2 - 5) n2				
Scythe (pelargonic acid)				5.0 (5 - 5) n1	4.0 (4 - 4) n1	4.0 (4 - 4) n1	5.0 (5 - 5) n1
Suppress T&O Herbicide (caprylic acid (47%) + capric acid (32%))				5.0 (5 - 5) n1	5.0 (5 - 5) n1	5.0 (5 - 5) n1	5.0 (5 - 5) n1

Average rating on a scale of 1 – 5 with 1 = 0 to about 70% efficacy and 5 = 100 efficacy or equivalent to non-inoculated control; minimum to maximum rating; number of trials. A rating of 2 or lower is considered unacceptable. A rating of 3 or higher is considered commercially acceptable.

In 2020, Senesac screened four fatty acid herbicides [Axxe (pelargonic acid), Fireworxx (caprylic acid + capric acid), Scythe (pelargonic acid) and Suppress (Caprylic acid + capric acid)] for their efficacy to manage four common weeds [smooth crabgrass, redroot pigweed, spotted spurge, and horsetail]. Each was applied at two rates and at three different volumes per acre.

Although Axxe and Scythe have the same active ingredient, Axxe did not provide sufficient efficacy for any of the weed species, while Scythe provided effective management up to 7 days after treatment with the higher rates and at the highest application volume (crabgrass 9% rate at 50 and 100 GPA; pigweed 9% rate at 100GPA; spurge 9% rate at 50 and 100 GPA; horsetail 9% rate at 100 GPA). Fireworxx and Suppress provided similar levels of efficacy across weed species with higher efficacy with increasing rate and application volume. The most effective rate and application volume for both products was 9% at 100 GPA. However, 9% at 50 GPA provided good management of smooth crabgrass and spotted spurge for both Fireworxx and Suppress, while Fireworxx also managed pigweed and horsetail at the same rate and volume.

Table 2. Efficacy of Axxe, Fireworxx, Scythe, and Suppress for smooth crabgrass (*Digitaria ishaemum*), Senesac, 2020.

Treatment	Rate (%)	Applic. Vol. (GPA)	1 DAT	2 DAT	3 DAT	7 DAT	14 DAT	28 DAT
Untreated	~	~	0	0	0	0	0	0
Axxe	3	25	0	0	0	0	0	0
Axxe	3	50	10	9	10	10	10	8
Axxe	3	100	10	10	10	10	10	2
Axxe	9	25	10	8	20	22	24	4
Axxe	9	50	30	36	48	50	38	6
Axxe	9	100	30	46	48	56	30	16
Fireworxx	3	25	10	10	10	10	10	6
Fireworxx	3	50	42	42	52	20	10	0
Fireworxx	3	100	84	84	84	10	10	14
Fireworxx	9	25	32	32	32	26	20	12
Fireworxx	9	50	90	90	90	28	28	20
Fireworxx	9	100	98	98	98	26	24	20
Scythe	3	25	20	20	20	20	22	18
Scythe	3	50	38	38	38	20	22	26
Scythe	3	100	76	76	76	30	14	10
Scythe	9	25	36	36	36	28	24	36
Scythe	9	50	90	90	90	28	28	26
Scythe	9	100	100	100	92	76	66	42
Suppress	3	25	20	20	20	10	10	8
Suppress	3	50	30	30	30	12	10	0
Suppress	3	100	90	90	90	30	20	26
Suppress	9	25	56	56	56	24	24	12
Suppress	9	50	86	86	86	26	20	4
Suppress	9	100	100	100	100	36	30	22
Fisher's LSD @ 0.05			*5*	*5*	*8*	*6*	*9*	*16*

Table 3. Efficacy of Axxe, Fireworxx, Scythe, and Suppress for redroot pigweed (*Amaranthus retroflexus*), Senesac, 2020.

Treatment	Rate (%)	Applic. Vol. (GPA)	1 DAT	2 DAT	3 DAT	7 DAT	14 DAT	28 DAT
Untreated	~	~	0	0	0	0	0	0
Axxe	3	25	0	0	0	0	10	4
Axxe	3	50	2	5	6	4	4	0
Axxe	3	100	0	0	0	0	0	0
Axxe	9	25	10	10	14	14	30	18
Axxe	9	50	22	28	30	46	36	20
Axxe	9	100	24	36	30	50	42	32
Fireworxx	3	25	4	6	6	6	12	4
Fireworxx	3	50	22	22	22	22	24	0
Fireworxx	3	100	72	76	72	46	34	30
Fireworxx	9	25	30	30	30	30	36	26
Fireworxx	9	50	94	94	94	92	80	80
Fireworxx	9	100	98	98	98	98	94	92
Scythe	3	25	8	8	8	10	18	14
Scythe	3	50	18	28	28	30	52	50
Scythe	3	100	30	30	30	26	26	22
Scythe	9	25	24	24	24	26	26	24
Scythe	9	50	76	76	76	46	46	42
Scythe	9	100	92	92	92	98	98	92
Suppress	3	25	10	10	12	10	16	12
Suppress	3	50	20	20	20	24	16	12
Suppress	3	100	70	70	70	80	68	50
Suppress	9	25	44	46	56	52	52	20
Suppress	9	50	56	64	66	34	34	20
Suppress	9	100	100	100	100	100	100	94
Fisher's LSD @ 0.05			*9*	*12*	*11*	*14*	*14*	*17*

Table 4. Efficacy of Axxe, Fireworxx, Scythe, and Suppress for spotted spurge (*Chaemacyse maculata*), Senesac, 2020.

Treatment	Rate (%)	Applic. Vol. (GPA)	1 DAT	2 DAT	3 DAT	7 DAT	14 DAT	28 DAT
Untreated	~	~	0	0	0	0	0	0
Axxe	3	25	0	4	0	0	4	0
Axxe	3	50	8	6	12	12	16	0
Axxe	3	100	10	10	24	24	20	4
Axxe	9	25	14	24	36	36	34	4
Axxe	9	50	38	42	52	54	40	16
Axxe	9	100	44	60	62	66	46	18
Fireworxx	3	25	0	0	2	10	12	6
Fireworxx	3	50	64	64	64	66	66	0
Fireworxx	3	100	100	100	100	98	98	86
Fireworxx	9	25	70	70	70	66	64	42
Fireworxx	9	50	100	100	100	94	98	98
Fireworxx	9	100	100	100	100	100	100	98
Scythe	3	25	46	46	46	38	36	26
Scythe	3	50	60	60	60	68	68	58
Scythe	3	100	78	78	78	82	82	70
Scythe	9	25	84	84	84	84	84	50
Scythe	9	50	100	100	100	100	100	96
Scythe	9	100	100	100	100	100	100	100
Suppress	3	25	82	82	82	64	64	52
Suppress	3	50	78	78	78	68	68	50
Suppress	3	100	100	100	100	94	86	88
Suppress	9	25	74	78	80	84	84	60
Suppress	9	50	98	98	98	96	94	92
Suppress	9	100	100	100	100	100	100	100
Fisher's LSD @ 0.05			*12*	*11*	*11*	*14*	*16*	*20*

Table 5. Efficacy of Axxe, Fireworxx, Scythe, and Suppress for field horsetail (*Equisetum arvense*), Senesac, 2020.

Treatment	Rate (%)	Applic. Vol. (GPA)	1 DAT	2 DAT	3 DAT	7 DAT	14 DAT	28 DAT
Untreated	~	~	0	0	0	0	0	0
Axxe	3	25	0	0	0	0	8	8
Axxe	3	50	2	2	2	0	4	4
Axxe	3	100	2	0	0	0	0	0
Axxe	9	25	0	4	6	4	10	4
Axxe	9	50	10	10	10	12	16	10
Axxe	9	100	0	10	10	10	30	10
Fireworxx	3	25	4	4	4	4	4	4
Fireworxx	3	50	28	28	28	10	12	12
Fireworxx	3	100	44	44	44	42	42	30
Fireworxx	9	25	28	28	30	30	24	4
Fireworxx	9	50	78	78	78	76	76	4
Fireworxx	9	100	100	100	100	100	82	10
Scythe	3	25	0	0	0	0	2	0
Scythe	3	50	6	8	8	10	10	52
Scythe	3	100	6	6	6	14	14	22
Scythe	9	25	8	8	8	8	8	10
Scythe	9	50	34	34	34	34	44	0
Scythe	9	100	98	98	98	90	90	36
Suppress	3	25	0	0	0	0	0	0
Suppress	3	50	10	10	10	10	10	20
Suppress	3	100	58	58	58	58	50	2
Suppress	9	25	80	80	80	80	80	44
Suppress	9	50	80	80	80	84	84	72
Suppress	9	100	100	100	100	94	94	26
Fisher's LSD @ 0.05			*10*	*10*	*10*	*9*	*12*	*22*

To determine whether adding adjuvants could improve efficacy, Senesac in 2021 examined Axxe (pelargonic acid) and Homeplate (caprylic acid + capric acid) alone with a single application post emergent application, two post emergent applications 7 days apart or in combination with six adjuvants: Induce (non-ionic surfactant), methylated seed oil, Aero-Dyne Amic (organosiliccone surfactant), crop oil concentrate, NuFilm (spreader sticker) and BioLink (acidifier). Each herbicide + surfactant combination was applied at 50 gallons per acre (GPA), the volume where there was good efficacy generally but not complete weed management, using a rate of 9%. Unlike in the 2020 experiment, Axxe provided some burndown of crabgrass, and all adjuvants increased percent control slightly, but none provided effective management 7 days after treatment. Homeplate was similar in that there was good initial burndown with and without surfactants and that Aero-Dyne-Amic, Crop Oil Concentrate and Biolink provided an increase in percent control, but none provided effective management 7 days after application. For chickweed, the addition of surfactants improved performance of Axxe significantly so that good control was achieved at 7 days after treatments with the Aero-Dyne-Amic, NuFilm and Biolink tank mixes. Homeplate provided highly effective management through 7 days; however, all additives except Induce increased efficacy. For annual bluegrass, initial knockdown was 93% for Axxe and 100% for Homeplate, but percent control declined in Both by 7 DAT. With Methylated Seed Oil and Aero-Dyne-Amic, efficacy increased to aceptable levels for Axxe. For Homeplate, Aero-Dyne-Amic, Crop Oil Concentrate and NuFilm improved efficacy through 7 days after treatment. A second application of Homeplate provided excellent Management of annual bluegrass.

Table 6. Efficacy of Axxe and Homeplate with and without adjuvants for crabgrass, Senesac, 2021.

Treatment	Additive	Timing*	PERCENT CONTROL							
			1 DAT	2 DAT	3 DAT	7 DAT	1 DAT2	2 DAT2	3 DAT2	7 DAT 2
Untreated	No Additive	Post	0	0	0	0	0	0	0	0
Axxe	No Additive	Post	85	83	75	43				
Axxe	No Additive	Post+7DAT	85	83	78	35	68	65	73	43
Axxe	Nonionic Surfactant (Induce) 0.25%	Post	90	83	78	38				
Axxe	Methylated Seed Oil 1.0%	Post	95	90	90	70				
Axxe	Organosilicone Surfactant (Aero-Dyne-Amic) 0.25%	Post	89	86	80	40				
Axxe	Crop Oil Concentrate (Crop Oll) 1.0%	Post	95	88	83	50				
Axxe	Spreader-sticker (NuFilm-P) 0.125%	Post	98	88	80	48				
Axxe	Acidifier (Biolink) 1.0%	Post	95	90	85	58				
Homeplate	No Additive	Post	98	88	80	50				
Homeplate	No Additive	Post+7DAT	90	85	78	40	90	95	93	78
Homeplate	Nonionic Surfactant (Induce) 0.25%	Post	95	89	86	35				
Homeplate	Methylated Seed Oil 1.0%	Post	90	88	85	35				
Homeplate	Organosilicone Surfactant (Aero-Dyne-Amic) 0.25%	Post	98	90	90	60				
Homeplate	Crop Oil Concentrate (Crop Oll) 1.0%	Post	96	95	88	55				
Homeplate	Spreader-sticker (NuFilm-P) 0.125%	Post	99	93	93	48				
Homeplate	Acidifier (Biolink) 1.0%	Post	96	90	88	73				
	Fisher's LSD @ 0.05		*6*	*7*	*10*	*16*	*10*	*8*	*6*	*12*

Table 7. Efficacy of Axxe and Homeplate with and without adjuvants for chickweed, Senesac, 2021.

Treatment	Additive	Timing	PERCENT CONTROL							
			1 DAT	2 DAT	3 DAT	7 DAT	1 DAT2	2 DAT2	3 DAT2	7 DAT2
Untreated	No Additive	Post	0	0	0	0	0	0	0	0
Axxe	No Additive	Post	88	85	80	45				
Axxe	No Additive	Post+7DAT	85	88	83	40	58	55	65	38
Axxe	Nonionic Surfactant (Induce) 0.25%	Post	90	88	85	58				
Axxe	Methylated Seed Oil 1.0%	Post	94	94	94	78				
Axxe	Organosilicone Surfactant (Aero-Dyne-Amic) 0.25%	Post	95	93	88	83				
Axxe	Crop Oil Concentrate (Crop Oll) 1.0%	Post	90	93	88	68				
Axxe	Spreader-sticker (NuFilm-P) 0.125%	Post	94	94	93	83				
Axxe	Acidifier (Biolink) 1.0%	Post	98	94	93	85				
Homeplate	No Additive	Post	100	93	90	78				
Homeplate	No Additive	Post+7DAT	100	95	90	88	100	100	100	100
Homeplate	Nonionic Surfactant (Induce) 0.25%	Post	100	100	98	88				
Homeplate	Methylated Seed Oil 1.0%	Post	100	100	100	98				
Homeplate	Organosilicone Surfactant (Aero-Dyne-Amic) 0.25%	Post	100	100	100	100				
Homeplate	Crop Oil Concentrate (Crop Oll) 1.0%	Post	100	100	100	100				
Homeplate	Spreader-sticker (NuFilm-P) 0.125%	Post	100	100	100	98				
Homeplate	Acidifier (Biolink) 1.0%	Post	100	100	100	100				
		Fisher's LSD @ 0.05	*4*	*6*	*6*	*15*	*5*	*6*	*6*	*13*

Table 8. Efficacy of Axxe and Homeplate with and without adjuvants for annual bluegrass, Senesac, 2021.

Treatment	Additive	Timing*	PERCENT CONTROL							
			1 DAT	2 DAT	3 DAT	7 DAT	1 DAT2	2 DAT2	3 DAT2	7 DAT2
Untreated	No Additive	Post	0	0	0	0	0	0	0	0
Axxe	No Additive	Post	93	88	78	28				
Axxe	No Additive	Post+7DAT	100	90	80	30	78	78	75	45
Axxe	Nonionic Surfactant (Induce) 0.25%	Post	100	93	90	35				
Axxe	Methylated Seed Oil 1.0%	Post	100	95	95	88				
Axxe	Organosilicone Surfactant (Aero-Dyne-Amic) 0.25%	Post	99	93	90	80				
Axxe	Crop Oil Concentrate (Crop Oll) 1.0%	Post	100	95	90	55				
Axxe	Spreader-sticker (NuFilm-P) 0.125%	Post	100	95	83	43				
Axxe	Acidifier (Biolink) 1.0%	Post	100	95	95	58				
Homeplate	No Additive	Post	100	93	88	43				
Homeplate	No Additive	Post + 7DAT	100	95	88	50	98	100	100	100
Homeplate	Nonionic Surfactant (Induce) 0.25%	Post	100	100	100	55				
Homeplate	Methylated Seed Oil 1.0%	Post	100	100	100	78				
Homeplate	Organosilicone Surfactant (Aero-Dyne-Amic) 0.25%	Post	100	100	100	93				
Homeplate	Crop Oil Concentrate (Crop Oll) 1.0%	Post	100	100	100	95				
Homeplate	Spreader-sticker (NuFilm-P) 0.125%	Post	100	100	100	83				
Homeplate	Acidifier (Biolink) 1.0%	Post	100	100	94	78				
	Fisher's LSD @ 0.05		*2*	*5*	*8*	*21*	*10*	*10*	*6*	*19*

In 2022, Senesac examined Axxe (pelargonic acid) and Homeplate (caprylic acid + capric acid) alone with a single application post emergent application, two post emergent applications 7 days apart or in combination with four adjuvants: Induce (non-ionic surfactant) Methylated Seed Oil, Crop Oil Concentrate and BioLink (acidifier) at two rates. Each treatment was applied at 50 gallons per acre (GPA). In this experiment, Senesac assessed all treatments 14 days after the first application. For chickweed, two applications of Axxe provided better percent control than the single application of Axxe solo or together with any of these adjuvants. For Homeplate, two applications of Homeplate 1 week apart provided better efficacy than the single application. The addition of surfactant exhibited higher efficacy than the single solo application and was statistically similar to two applications. For crabgrass, the best results were obtained with two applications of either Axxe or Homeplate (which was better than the performance in 2021) and the single application of Axxe plus Methylated Seed Oil. None of the other herbicide plus adjuvant combinations provided sufficient efficacy.

Table 9. Efficacy of Axxe and Homeplate with and without adjuvants for chickweed, Senesac, 2022.

			PERCENT CONTROL					
Treatment	**Additive**	**Timing***	1 DAT	3 DAT	7 DAT	1 DAT2	3 DAT2	7 DAT2
Untreated	No Additive	Post	0	0	0	0	0	0
Axxe	No Additive	Post	90	80	84			68
Axxe	No Additive	Post + 7DAT	90	80	83	96	100	93
Axxe	Nonionic Surfactant (Induce) 0.25%	Post	80	80	78			60
Axxe	Methylated Seed Oil 1.0%	Post	90	83	83			60
Axxe	Crop Oil Concentrate (Crop Oll) 1.0%	Post	90	90	80			48
Axxe	Acidifier (Biolink) 2.0%	Post	70	70	75			68
Axxe	Acidifier (Biolink) 1.0%	Post	95	95	91			85
Homeplate	No Additive	Post	95	94	94			80
Homeplate	No Additive	Post + 7DAT	95	95	95	100	100	100
Homeplate	Nonionic Surfactant (Induce) 0.25%	Post	95	100	95			93
Homeplate	Methylated Seed Oil 1.0%	Post	95	95	95			98
Homeplate	Crop Oil Concentrate (Crop Oll) 1.0%	Post	95	100	100			98
Homeplate	Acidifier (Biolink) 2.0%	Post	95	100	98			98
Homeplate	Acidifier (Biolink) 1.0%	Post	95	100	98			100
	Fisher's LSD @ 0.05		*<1*	*6*	*9*	*5*	*na*	*27*

Table 10. Efficacy of Axxe and Homeplate with and without adjuvants for crabgrass, Senesac, 2022.

Treatment	Additive	Timing*	PERCENT CONTROL					
			1 DAT	3 DAT	7 DAT	1 DAT2	3 DAT2	7 DAT2
Untreated	No Additive	Post	0	0	0	0	0	0
Axxe	No Additive	Post	90	80	85			43
Axxe	No Additive	Post + 7DAT	90	80	88	93	100	85
Axxe	Nonionic Surfactant (Induce) 0.25%	Post	80	75	65			33
Axxe	Methylated Seed Oil 1.0%	Post	95	85	94			88
Axxe	Crop Oil Concentrate (Crop Oll) 1.0%	Post	90	90	85			30
Axxe	Acidifier (Biolink) 2.0%	Post	70	60	30			15
Axxe	Acidifier (Biolink) 1.0%	Post	95	91	73			35
Homeplate	No Additive	Post	95	91	94			25
Homeplate	No Additive	Post + 7DAT	95	90	95	95	100	85
Homeplate	Nonionic Surfactant (Induce) 0.25%	Post	95	90	85			45
Homeplate	Methylated Seed Oil 1.0%	Post	95	90	85			40
Homeplate	Crop Oil Concentrate (Crop Oll) 1.0%	Post	95	90	93			45
Homeplate	Acidifier (Biolink) 2.0%	Post	95	90	85			45
Homeplate	Acidifier (Biolink) 1.0%	Post	95	95	85			53
	Fisher's LSD @ 0.05		*na*	*3*	*8*	*3*	*na*	*16*

In 2023, Marble examined the spotted spurge efficacy of Axxe (pelargonic acid) and FireWorxx (caprylic acid + capric acid) applied alone or in combination with 4 adjuvants: Induce (non-ionic surfactant) Methylated Seed Oil, Crop Oil Concentrate and BioLink (acidifier) at two rates. Generally, there were no statistical differences in performance between the solor treatments and the combination treatments. However, FireWorxx applied with either concentration of Biolink exhibited a numerical decline in efficacy.

Table 11. Postemergence control of spotted spurge (*Chamaesyce maculata*) following applications of selected herbicides and adjuvants, Marble, 2023.

Herbicide[y]	Adjuvant (v:v)	Timing[x]	Control rating (0 to 10)[z]								
			1 DAT1	2DAT1	3DAT1	7DAT1	1DAT2	2DAT2	3DAT2	7DAT2	14DAT2
Non-treated	None	None	0.0 C[w]	0.0 C	0.0 C	0.0	0.0	0.0	0.0	0.0 C	0.0 D
Axxe	None	0 DAT	7.8 B	10.0 A	10.0 A	10.0	10.0	10.0	10.0	9.6 AB	9.8 A
Axxe	None	0 and 7 DAT1	8.2 AB	9.8 B	9.8 B	10.0	10.0	10.0	10.0	9.8 AB	9.6 AB
Axxe	Induce (0.25%)	0 DAT	8.0 AB	10.0 A	10.0 A	10.0	10.0	10.0	10.0	9.6 AB	8.8 ABC
Axxe	Methylated Seed Oil (1%)	0 DAT	8.0 AB	10.0 A	10.0 A	10.0	10.0	10.0	10.0	9.2 AB	10.0 A
Axxe	Crop Oil (1%)	0 DAT	8.6 A	10.0 A	10.0 A	10.0	10.0	10.0	10.0	10.0 A	9.4 AB
Axxe	Biolink (2%)	0 DAT	8.4 AB	10.0 A	10.0 A	10.0	10.0	10.0	10.0	8.8 AB	9.6 AB
Axxe	Biolink (1%)	0 DAT	8.0 AB	10.0 A	10.0 A	10.0	10.0	10.0	10.0	9.2 AB	9.0 ABC
FireWorxx	None	0 DAT	7.8 B	10.0 A	10.0 A	10.0	10.0	10.0	10.0	9.6 AB	8.4 ABC
FireWorxx	None	0 and 7 DAT1	8.6 A	10.0 A	10.0 A	10.0	10.0	10.0	10.0	10.0 A	10.0 A
FireWorxx	Induce (0.25%)	0 DAT	7.8 B	10.0 A	10.0 A	10.0	10.0	10.0	10.0	10.0 A	9.6 AB
FireWorxx	Methylated Seed Oil (1%)	0 DAT	8.2 AB	10.0 A	10.0 A	10.0	10.0	10.0	10.0	10 A	10.0 A
FireWorxx	Crop Oil (1%)	0 DAT	7.8 B	10.0 A	10.0 A	10.0	10.0	10.0	10.0	9.8 AB	10.0 A
FireWorxx	Biolink (2%)	0 DAT	8.4 AB	10.0 A	10.0 A	10.0	10.0	10.0	10.0	8.6 B	7.6 BC
FireWorxx	Biolink (1%)	0 DAT	8.4 AB	10.0 A	10.0 A	10.0	10.0	10.0	10.0	8.6 B	7.0 C

[z]Spurge control was assessed visually on a 0 to 10 scale where 0 = no control and 10 = dead plant or complete kill. DAT1 = days after the first treatment and DAT2 = days after the second treatment.

[y]All herbicides were applied at a 9% v:v rate using a CO2 backpack sprayer calibrated at 75 gpa application volume.

[x]Treatments were either applied once at 0 DAT (August 23, 2023) or applied twice (August 23 and 31, 2023 or 7 DAT1) as indicated.

[w]Means within a column followed by the same letter are not significantly different (LSD, 0.05). Means followed by no lettering were instances in which there was zero variance in the data (all ratings of 0 or 10) and were not subjected to ANOVA.

Table 12. Detailed Summary of Efficacy Screening with Fatty Acid Herbicides

Note: Table entries are sorted by crop Latin name. Only those trials with research reports received by 2/19/2024 are listed below.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	lState	Year	Application Type	Results
34625	Axxe (Pelargonic acid)	Pigweed, Redroot (Amaranthus retroflexus)	None (None)	Field Container	Senesac	NY	2020	Directed	Unsatisfactory control of redroot pigweed with 3% rate and poor to fair with the 9% rate. Application volumes had no to little effect at the 3% rate, but increasing volume tended to improve efficacy (25 50, 100 gal per acre).
34629	Axxe (Pelargonic acid)	Spurge, Spotted/Prostrate (Chamaesyce maculata)	None (None)	Field Container	Marble	FL	2023	Over the top	Excellent efficacy through 14 days after second application of 9% v:v, with and without adjuvants (Induce, methylated seed oil, crop oil, and Biolink).
34629	Axxe (Pelargonic acid)	Spurge, Spotted/Prostrate (Chamaesyce maculata)	None (None)	Field Container	Senesac	NY	2020	Over the top	Unsatisfactory control of spotted spurge with the 3% rate and poor to fair with the 9% rate. Efficacy improved with increasing application volume (25, 50 100 gal per acre).
34621	Axxe (Pelargonic acid)	Crabgrass, Smooth (Digitaria ischaemum)	None (None)	Field Container	Senesac	NY	2020	Directed	Unsatisfactory control of smooth crabgrass with the 3% rate, poor to fair with 9% rates. Application volumes had no to little effect at the 3% rate, but increasing volume tended to improve efficacy (25 50, 100 gal per acre).
34967	Axxe (Pelargonic acid)	Crabgrass (Digitaria sp.)	None (None)	Field Container	Senesac	NY	2021	Over the top	Mediocre efficacy at 9% without surfactants; methylated seed oil improved efficacy through 7 DAT. A second application without any additives did not sufficiently improve efficacy.
34967	Axxe (Pelargonic acid)	Crabgrass (Digitaria sp.)	None (None)	Field Container	Senesac	NY	2022	Over the top	Best efficacy was obtained with two consecutive applications 7 days apart at 9% v:v and with a single application plus methylated seed oil at 1.0%. Crop oil concentrat at 1% did not alter efficacy, while nonionic surfactat at 0.25% and acidifier at 2% red
34633	Axxe (Pelargonic acid)	Horsetail, Field (Equisetum arense)	None (None)	Field Container	Senesac	NY	2020	Over the top	Unsatisfactory control of field horsetail with the 3% rate and poor to fair with the 9% rate. No efficacy trends with increasing application volume (25, 50 100 gal per acre).
34968	Axxe (Pelargonic acid)	Bluegrass, Annual (Poa annua)	None (None)	Field Container	Senesac	NY	2021	Over the top	Good efficacy at 9% without surfactants through 5 DAT; all surfactants (Induce, methylated seed oil, Aero-Dyne-Amic, Crop Oil, NuFilm-P) and Biolink acidifier increased efficacy, with just methylated seed oil and Aero-Dyne-Amic providing good control at 7

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	lState	Year	Application Type	Results
34969	Axxe (Pelargonic acid)	Chickweed (Stellaria media)	None (None)	Field Container	Senesac	NY	2021	Over the top	Good efficacy at 9% without surfactants through 5 DAT; all surfactants (Induce, methylated seed oil, Aero-Dyne-Amic, Crop Oil, NuFilm-P) and Biolink acidifier improved efficacy, with Aero-Dyne-Amic, NuFilm, and Biolink providing good control at 7 DAT. How
34969	Axxe (Pelargonic acid)	Chickweed (Stellaria media)	None (None)	Field Container	Senesac	NY	2022	Over the top	Best efficacy was obtained with two consecutive applications 7 days apart at 9% v:v. The next best treatment was the addition of acidifier at 1%. None of the other treatments improved efficacy or provided sufficient efficacy two weeks after initial applic
34626	Fireworxx 80 (Caprylic acid (44%) + capric acid (36%))	Pigweed, Redroot (Amaranthus retroflexus)	None (None)	Field Container	Senesac	NY	2020	Directed	Good to excellent control of redroot pigweed with the 9% rate applied at 50 and 100 gpa and moderate efficacy at the 3% rate applied at 100 gpa. Efficacy improved with increasing application volume.
34630	Fireworxx 80 (Caprylic acid (44%) + capric acid (36%))	Spurge, Spotted/Prostrate (Chamaesyce maculata)	None (None)	Field Container	Marble	FL	2023	Over the top	Great to excellent efficacy through 14 days after second application of 9% v:v with and without Induce, methylated seed oil, and crop oil. Good efficacy was observed through 14 day after second application when combined with Biolink.
34630	Fireworxx 80 (Caprylic acid (44%) + capric acid (36%))	Spurge, Spotted/Prostrate (Chamaesyce maculata)	None (None)	Field Container	Senesac	NY	2020	Over the top	Excellent control of spotted spurge with the 9% rate applied at 50 and 100 gpa and with the 3% rate applied at 100 gal per acre; increasing application volume increased efficacy.
34622	Fireworxx 80 (Caprylic acid (44%) + capric acid (36%))	Crabgrass, Smooth (Digitaria ischaemum)	None (None)	Field Container	Senesac	NY	2020	Directed	Good to excellent control of smooth crabgrass with the 9% rate applied at 50 and 100 gpa and moderate efficacy at the 3% rate applied at 100 gpa. Efficacy improved with increasing application volume.
34634	Fireworxx 80 (Caprylic acid (44%) + capric acid (36%))	Horsetail, Field (Equisetum arense)	None (None)	Field Container	Senesac	NY	2020	Over the top	Excellent control of field horsetail with the 9% rate applied at 100 gpa; at the 3% rate, efficacy improved with increased application volume.
34970	Homeplate (caprylic acid + capric acid)	Crabgrass (Digitaria sp.)	None (None)	Field Container	Senesac	NY	2021	Over the top	Mediocre efficacy at 9% without surfactants; methylated seed oi increased efficacy through 7 DAT. A second application without any additives did not sufficiently improve efficacy.
34970	Homeplate (caprylic acid + capric acid)	Crabgrass (Digitaria sp.)	None (None)	Field Container	Senesac	NY	2022	Over the top	Best efficacy was obtained with two consecutive applications 7 days apart at 9% v:v. All additives (nonionic sufactant, methylated seed oil, corp oil concentrate and acidifier improved efficacy at 2 WAT, but not to the same level as two weekly application

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	lState	Year	Application Type	Results
34971	Homeplate (caprylic acid + capric acid)	Bluegrass, Annual (Poa annua)	None (None)	Field Container	Senesac	NY	2021	Over the top	Great efficacy at 9% without surfactants; all surfactants (Induce, methylated seed oil, Aero-Dyne-Amic, Crop Oil, NuFilm-P) and Biolink acidifier increased efficacy with Aero-Dyne-Amic, and Crop Oil providing great efficacy through 7 DAT. A second applica
34972	Homeplate (caprylic acid + capric acid)	Chickweed (Stellaria media)	None (None)	Field Container	Senesac	NY	2021	Over the top	Good efficacy at 9% without surfactants; all surfactants (Induce, methylated seed oil, Aero-Dyne-Amic, Crop Oil, NuFilm-P) and Biolink acidifier increased efficacy with methylated seed oil, Aero-Dyne-Amic, Crop Oil NuFilm, and Biol-Link providing excellen
34972	Homeplate (caprylic acid + capric acid)	Chickweed (Stellaria media)	None (None)	Field Container	Senesac	NY	2022	Over the top	Best efficacy was obtained with two consecutive applications 7 days apart at 9% v:v and with the addition of acidifier at 1%. All additives (nonionic sufactant, methylated seed oil, corp oil concentrate and acidifier at 2% improved efficacy at 2 WAT over
34627	Scythe (Pelargonic acid)	Pigweed, Redroot (Amaranthus retroflexus)	None (None)	Field Container	Senesac	NY	2020	Directed	Fair to great control of redroot pigweed with the 9% rate applied at 50 and 100 gpa; the 3% rate did not provide sufficient management. Efficacy improved with increasing application volume.
34631	Scythe (Pelargonic acid)	Spurge, Spotted/Prostrate (Chamaesyce maculata)	None (None)	Field Container	Senesac	NY	2020	Over the top	Good to excellent control of spotted spurge with the 9% rate applied at 25, 50 and 100 gpa; mediocre to fair efficacy with the 3% rate. Efficacy improved with increasing application volume.
34623	Scythe (Pelargonic acid)	Crabgrass, Smooth (Digitaria ischaemum)	None (None)	Field Container	Senesac	NY	2020	Directed	Good to excellent control of smooth crabgrass with the 9% rate applied at 50 and 100 gpa and moderate efficacy at the 3% rate applied at 100 gpa. Efficacy improved with increasing application volume.
34635	Scythe (Pelargonic acid)	Horsetail, Field (Equisetum arense)	None (None)	Field Container	Senesac	NY	2020	Over the top	Great control of field horsetail with the 9% rate applied at 100 gpa; no other rate or application volume exhibited sufficient efficacy.
34628	Suppress T&O Herbicide (Caprylic acid (47%) + capric acid (32%))	Pigweed, Redroot (Amaranthus retroflexus)	None (None)	Field Container	Senesac	NY	2020	Directed	Excellent control of redroot pigwee with the 9% rate applied at 100 gpa and mediocre efficacy with the 3% rate applicated at 100 gpa. Increasing application volume improved efficacy.
34632	Suppress T&O Herbicide (Caprylic acid (47%) + capric acid (32%))	Spurge, Spotted/Prostrate (Chamaesyce maculata)	None (None)	Field Container	Senesac	NY	2020	Over the top	Fair to excellent control of smooth crabgras with the 9% rate applied at 25, 50 and 100 gpa and with the 3% rate applicated at 50 and 100 gpa. Increasing application volume improved efficacy.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	lState	Year	Application Type	Results
34624	Suppress T&O Herbicide (Caprylic acid (47%) + capric acid (32%))	Crabgrass, Smooth (Digitaria ischaemum)	None (None)	Field Container	Senesac	NY	2020	Directed	Good to excellent control of smooth crabgras with the 9% rate applied at 50 and 100 gpa and with the 3% rate applicated at 100 gpa. Increasing application volume improved efficacy.
34636	Suppress T&O Herbicide (Caprylic acid (47%) + capric acid (32%))	Horsetail, Field (Equisetum arense)	None (None)	Field Container	Senesac	NY	2020	Over the top	Good to excellent control of smooth crabgras with the 9% rate applied at 25, 50 and 100 gpa; the 3% rate did not provide effective management. Increasing application volume improved efficacy.

Appendix 1: Contributing Researchers

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