

Effects of adjuvants and simulated rain on the efficacy of the Engame formulation of glyphosate



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INTRODUCTION

Engame is a glyphosate formulation that contains glyphosate acid, and a propriety blend of urea and sulfuric acid (AMADS). AMADS has synergistic properties with glyphosate resulting in increased efficacy over formulations consisting of glyphosate salts and surfactants. Engame should be applied with a surfactant.

Surfactants improve glyphosate activity under certain conditions. Surfactant efficacy in increasing weed control with glyphosate or other herbicides varies with the type of surfactant, herbicide, and formulation, with the weed species and growth stage under evaluation, and with the duration of the rain free period.

Rainfastness may be defined as the minimum time between postemergence herbicide applications and a rainfall event that allows for maximum expression of herbicide activity. Timing is critical with postemergence herbicides like glyphosate in which uptake is slow or herbicide can be readily washed from the plant surface. Glyphosate activity can be reduced up to 80 % when rainfall occurs within 4 hours of treatment. Only when the rain-free period was extended to 72h was loss of glyphosate activity prevented. The efficient uptake of Roundup has been correlated with rainfastness. Thus, the greater efficacy of Engame compared to other glyphosate products may result in faster uptake and translocation.

The objectives of this study were to compare the efficacy of Engame, Engame with surfactants and Roundup Ultramax for control of prickly sida and seedling johnsongrass, and to determine the effect of simulated rainfall on these formulations.

MATERIALS AND METHODS

Prickly sida and johnsongrass were established from seed and yellow nutsedge from tubers. Herbicide treatments were applied at the 4-leaf stage with a pneumatic track sprayer with Teejet 8002 flat fan tips delivering 187 L ha⁻¹ water at 179 kPa. Engame, Engame plus Flame, and Roundup Ultramax were applied at a rate of 890 g ae of glyphosate ha⁻¹ to prickly sida and yellow nutsedge, and at a rate of 560 g ae ha⁻¹ to johnsongrass. Rainfall was applied with a pressure regulated simulator at a constant rate of 6-cm h⁻¹ for ten minutes. Plants were evaluated qualitatively for visible injury expressed as growth reduction relative to untreated plants (control) at 2 weeks after treatment. Data were recorded as percentage injury where 0 percent control was no injury and 100 percent of control was complete kill. A randomized complete block design with 4 replications was used in the simulated rain studies and the experiment was repeated.

RESULTS AND DISCUSSION

Engame activity on johnsongrass and yellow nutsedge was enhanced by inclusion of surfactants (Table 1) to the spray solution. However, Engame activity on prickly sida without surfactant was greater than with surfactant at rates greater than 0.125 kg ha⁻¹ (Table 1). Flame surfactant provided the greatest enhancement of Engame activity of the surfactants tested (Table 1), an observation most evident at low to moderate Engame rates. On johnsongrass, the relative enhancement of control for 0.062 kg ha⁻¹ Engame was Flame > LI 700 > Induce = Breakthru = Phase. At higher rates, surfactant effects could not be distinguished from one another. A similar pattern of surfactant enhancement of Engame activity was observed on yellow nutsedge (Table 1) although the level of control of yellow nutsedge was less than johnsongrass at equivalent rates of Engame. However, control of prickly sida was greater without surfactant especially at 0.25 and 0.5 kg ha⁻¹ Engame.

The efficacy of glyphosate formulations, Engame, Engame plus Flame, and Roundup Ultramax, following rainfall events are presented in Table 2. Johnsongrass control was greater than 90 % for Engame and Engame plus Flame compared to 65 % with Roundup Ultramax for plants not receiving rain (Table 2). A precipitation delay of 30 minutes following glyphosate application reduced control of johnsongrass from 93 to 38 % with Engame and from 66 to 22 % for Roundup Ultramax. However, when Flame was added to Engame, johnsongrass control only decreased from 98 to 82 % for the same rain delay, and 54 % control was observed even when the rain delay was only 5 minutes. These results indicated that uptake of glyphosate in Roundup Ultramax and Engame was insufficient between the 5 and 30 minute rain-free periods to provide control and perhaps was subject to wash-off. In addition, the efficacy of the Engame plus Flame treatment was greater than Roundup Ultramax on a glyphosate acid equivalent basis, and probably resulted from increased uptake and translocation of glyphosate.

Prickly sida control was nearly equivalent among the glyphosate formulations without rain and exceeded 91 % (Table 2). These results indicate that, in the absence of rain, the products performed similarly. However, for Roundup Ultramax, control decreased from 93 % without rain to 17, 38, 56, 64 and 68 % at 15, 30, 60, 90 and 120 minutes rain delay after treatment, respectively. Rain had much less of an effect on Engame and Engame plus Flame control of prickly sida for the same rain delays (Table 2). Control of prickly sida was 67 to 83 % for 15 and 120 minutes rain delay for Engame and 53 to 80 % for Engame plus Flame. Control of prickly sida for each rain delay period was numerically greater for Engame compared to Engame plus Flame. The presence of Flame may have facilitated greater removal of glyphosate during the rain event.

The results indicate that glyphosate activity was affected by weed species, formulation, surfactant and simulated rainfall. The rapid subcellular and subcuticular damage caused by Engame likely provides greater uptake of glyphosate into leaves.

Table 1. Effect of adjuvants on Engame injury to johnsongrass, prickly sida and yellow nutsedge at 2 WAT

Surfactant	Concentration (%)	ENGAME (kg ha ⁻¹)																								
		0.07					0.14					0.28					0.56					1.12				
		% Control																								
		Johnsongrass					Prickly sida					Yellow Nutsedge														
Breakthru	0.1	30	67	99	99	99	13	35	70	87	93	0	5	28	52	62										
LI700	0.25	57	99	99	99	99	3	28	65	87	98	0	8	35	62	75										
Induce	0.25	38	92	99	99	99	8	30	63	88	90	0	5	27	57	68										
Phase	0.5	27	88	99	99	99	8	63	83	90	90	0	13	22	55	73										
Flame	0.25	99	99	99	99	99	33	63	87	93	98	2	25	45	72	87										
Flame	0.5	99	99	99	99	99	23	70	87	95	97	5	25	63	87	82										
Flame	1.0	99	99	99	99	99	13	48	75	93	98	15	17	63	72	87										
None	---	3	33	93	99	99	2	42	95	93	98	0	5	28	45	60										
LSD		20	12	3	2	2	11	14	11	6	4	5	10	16	19	20										

Means of % control were compared using Fisher's Protected LSD test (P = 0.05).

Table 2. Effect of simulated rain on the activity of Engame, Engame plus Flame surfactant and Roundup Ultramax on injury to johnsongrass, prickly sida, and yellow nutsedge at 2 WAT.

Herbicide	Duration of rain free period(minutes) following herbicide application																																
	5			10			15			30			No Rain			15			30			60			90			120			No Rain		
	% Control																																
		Johnsongrass									Prickly sida									Yellow Nutsedge													
Engame	17	28	28	38	93	67	69	82	83	83	91	57	60	60	65	67	72																
Engame + Flame	54	73	77	82	98	53	68	71	77	80	97	73	80	77	75	75	92																
Roundup Ultramax	16	19	18	22	66	17	38	56	64	68	93	52	52	52	50	50	57																
LSD	-----16-----					-----14-----					-----17-----																						

Means of % control were compared using Fisher's Protected LSD test (P = 0.05).

CONCLUSIONS

- ❖ Flame provided the best enhancement of Engame activity of the surfactants tested.
- ❖ Flame greatly improved the rainfastness of Engame on johnsongrass.
- ❖ Engame, and Engame plus Flame were more active than Roundup Ultramax on johnsongrass without rain.
- ❖ Engame, and Engame plus Flame were more active than Roundup Ultramax on yellow nutsedge with or without rain.
- ❖ Engame, and Engame plus Flame were more active than Roundup Ultramax on prickly sida at low rates but were equivalent at higher rates with or without rain.