KOCHIA CONTROL WITH ROUNDUP POWERMAX3 AND SURFACTANTS

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Summary

1. Apply Roundup PowerMax at full rates for control of kochia. Growers may consider mixing Roundup PowerMax3 with ethofumesate at 4 fl oz per acre and Spin-Aid (rate dependent on sugarbeet stage and environmental conditions) on dime-size kochia glyphosate sensitive or resistant kochia or Roundup PowerMax3 and ethofumesate at 12 fl oz per acre on glyphosate sensitive kochia greater than 1-inch in size.
2. Tallow amine adjuvant mixed with Roundup PowerMax3 controlled or tended to control kochia better than nonionic surfactant with PowerMax3.
3. We observed greater kochia control when Level Best Pro tallow amine surfactant was applied at 0.5% v/v with Roundup PowerMax3 as compared to Level Best Pro at 0.25 % v/v

Introduction

Glyphosate tolerant kochia was widespread in sugarbeet production in 2023. Conversation with Agriculturalists suggest kochia might have been too large for control with Roundup PowerMax3 by the time it was identified in fields. Some growers using maximum labeled glyphosate rates and a tallow amine surfactant reported improved kochia control as compared to glyphosate alone or glyphosate with non-ionic surfactant (NIS).

Surfactants are molecules with hydrophilic (water-attracting) and hydrophobic (water-repellent) regions. This dual nature enables surfactants to reduce the interfacial tension between immiscible liquids or between liquids and solids. This is especially important with hydrophilic herbicides such as Roundup PowerMax3.

Ethoxylated tallow amine (ETA) surfactant was a component in the original glyphosate (Roundup) formulation. It was viewed by most old time weed scientists as the best glyphosate formulation ever produced. Dr. Kirk Howatt, NDSU Weed Control specialist, reported weed control with tallow amine surfactants is best with glyphosate and that they are not as efficacious with other herbicides. The objectives of this experiment was to consider kochia control from Roundup PowerMax3 alone with surfactants or Roundup PowerMax3 mixed with Spin-Aid and surfactants.

Materials and Methods

Two greenhouse experiments were conducted in 2024. A tray was filled with PROMIX general purpose greenhouse media (Premier Horticulture, Inc., Quakertown, PA) and seeded with kochia collected from a field near Kragnes, MN in 2023. Two kochia seedlings were transplanted into 4 × 4-inch pots filled with the same general purpose greenhouse media. Kochia was grown at 75 to 85F under natural light supplemented with a 16 h photoperiod of artificial light until they were approximately 3-inch in height. Roundup PowerMax3 at 25 fl oz per acre alone with surfactants or Roundup PowerMax3 mixed with Spin-Aid plus surfactants gave over 90% kochia control and did not differentiate between treatments. In the second experiment, Roundup PowerMax3 was applied at 15 fl oz per acre across treatments, allowing a better understanding of the virtues of surfactants.

Herbicide treatments (Table 1) were applied using a spray booth (Generation III, DeVries Manufacturing, Hollandale, MN) equipped with a TeeJet® 8002E nozzle calibrated to deliver 15 gpa spray solution at 25 psi and 3 mph. Visible kochia control (0% to 100%, 100% indicating complete control) was evaluated approximately 3, 7, and 14 days after treatment (DAT). Experimental design was randomized complete block with four replications. Data were analyzed with the ANOVA procedure of ARM, version 2024.0 software package.

Table 1. Herbicide treatment, rate, and kochia size, NDSU greenhouse, 2024.

Num	Treatment	Rate	Kochia size
		(fl oz + % v/v)	(inch)
1	Control		3
2	Roundup PowerMax3	25 or 15	3
3	Roundup PowerMax3 + nonionic surfactant[a]	25 or 15 + 0.25%	3
4	Roundup PowerMax3 + tallow amine surfactant[b]	25 or 15 + 0.25%	3
5	Roundup PowerMax3 + tallow amine surfactant	25 or 15 + 0.5%	3
6	Roundup PowerMax3 + Spin-Aid	25 or 15 + 32	3
7	Roundup PowerMax3 + Spin-Aid + tallow amine surfactant	25 or 15 + 32 + 0.25%	3

[a]Prefer 90 nonionic surfactant, CHS Inc., Inver Grove Heights, MN
[b]Level Best Pro, CHS Inc., Inver Grove Heights, MN

Results

Roundup PowerMax3 treatments at 25 fl oz/a provided kochia control greater than 90% 11 DAT (Table 2). Thus, we conducted the second experiment using Roundup PowerMax3 at 15 fl oz/A. We want our producers to use full glyphosate rates on small kochia. A sublethal rate applied over large kochia is a researchers way of differentiating between treatments, in this case surfactants.

Surfactants with Roundup PowerMax3 or Roundup PowerMax3 and Spin-Aid improved or tended to improve kochia control compared to Roundup PowerMax3 or Roundup PowerMax3 and Spin-Aid alone, 11 and 17 DAT (Table 3, Figure 2). Kochia control, across evaluation timing, numerically was best when tallow amine surfactant was mixed with Roundup PowerMax3 (Figure 1, Figure 2). PowerMax3 plus Level Best Pro at 0.5% v/v (2 quart per 100 gallon of water) controlled kochia better than PowerMax3 plus Level Best Pro at 0.25% v/v (1 quart per 100 gallon of water).

Table 2. Kochia control in response to Roundup PowerMax3 with adjuvants, greenhouse, 2024

Num	Treatment	Rate	4 DAT	7 DAT	11 DAT
		(fl oz + % v/v)	%	%	%
1	Control		0 d	0 d	0 d
2	Roundup PowerMax3	15	59 c	81 bc	96 abc
3	Roundup PowerMax3 + nonionic surfactant[a]	25 + 0.25%	68 ab	93 a	97 ab
4	Roundup PowerMax3 + tallow amine surfactant[b]	25 + 0.25%	65 abc	84 abc	98 ab
5	Roundup PowerMax3 + tallow amine surfactant	25 + 0.5%	60 bc	90 ab	99 a
6	Roundup PowerMax3 + Spin-Aid	25 + 32	73 a	84 abc	93 c
7	Roundup PowerMax3 + Spin-Aid + tallow amine surfactant	25 + 32 + 0.25%	65 abc	80 c	95 bc
	LSD (0.10)		8	9	4

[a]Prefer 90 nonionic surfactant, CHS Inc., Inver Grove Heights, MN
[b]Level Best Pro, CHS Inc., Inver Grove Heights, MN

Spin-Aid mixed with Roundup PowerMax3 did not improve control compared to Roundup PowerMax3 alone. We have been evaluating Spin-Aid for kochia control in the field in 2023 and in the greenhouse in 2023-24. We have observed kochia control with Spin-Aid is best when timed to small glyphosate sensitive or glyphosate resistant kochia; Spin-Aid application on 5-lf, dime-size kochia and following with one or two repeat applications on 5 to 7 day intervals. These data indicate there is no benefit from mixing Spin-Aid with Roundup PowerMax3 for control of escape glyphosate sensitive kochia, up to 3-inch tall. Further, we observed improvement of kochia control following the addition of Level Best Pro with Spin-Aid and Roundup PowerMax3, however, improvement in kochia control was not as dramatic as with Roundup PowerMax3 alone.

Table 3. Kochia control in response to Roundup PowerMax3 with adjuvants, greenhouse, 2024

Num	Treatment	Rate	4 DAT	7 DAT	11 DAT	17 DAT
		(fl oz + % v/v)	%	%	%	%
1	Control		0 e	0 c	0 d	0 e
2	Roundup PowerMax3	15	25 d	40 b	55 c	51 c
3	Roundup PowerMax3 + nonionic surfactant[a]	15 + 0.25%	38 c	44 b	63 bc	58 bc
4	Roundup PowerMax3 + tallow amine surfactant[b]	15 + 0.25%	50 b	53 b	69 b	70 b
5	Roundup PowerMax3 + tallow amine surfactant	15 + 0.5%	68 a	73 a	89 a	90 a
6	Roundup PowerMax3 + Spin-Aid	15 + 32	28 cd	45 b	64 bc	65 bc
7	Roundup PowerMax3 + Spin-Aid + tallow amine surfactant	15 + 32 + 0.25%	29 cd	46 b	68 b	70 b
	LSD (0.10)		12	13	10	13

[a]Prefer 90 nonionic surfactant, CHS Inc., Inver Grove Heights, MN
[b]Level Best Pro, CHS Inc., Inver Grove Heights, MN

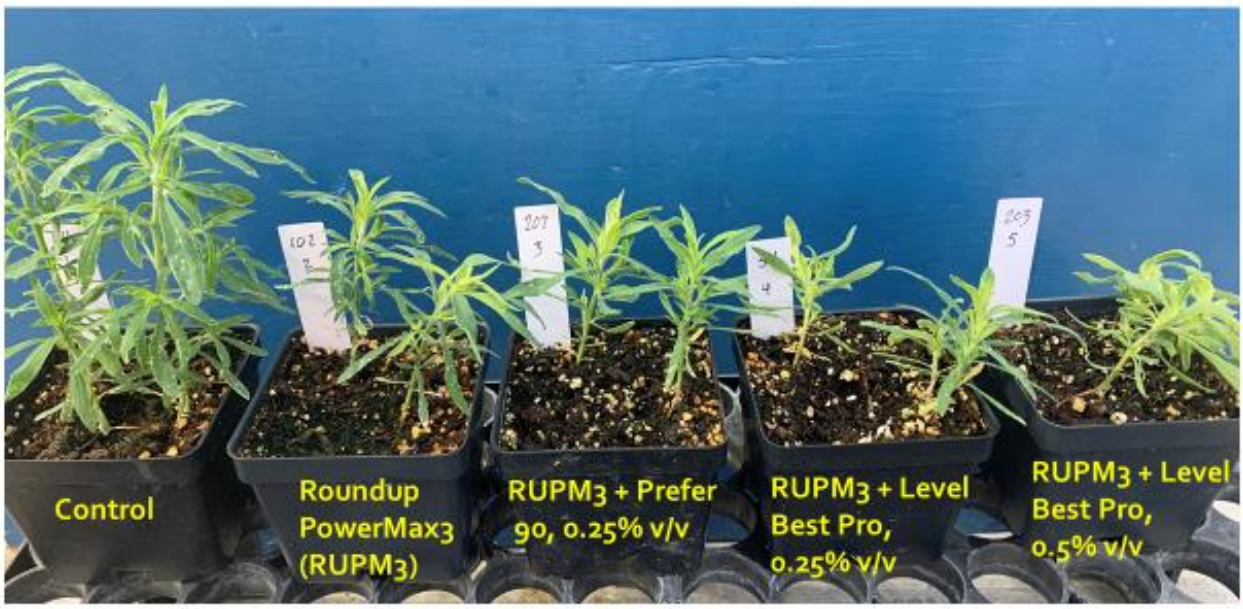

Figure 1. Kochia control from Roundup PowerMax3 alone or with surfactants, 4 DAT, greenhouse, 2024.

Summary
Glyphosate resistant and susceptible populations in the countryside challenge kochia control. In general, we observe more glyphosate resistant kochia in proximity to rail road tracks and glyphosate sensitive kochia along fence lines. We recommend growers identifying kochia as their most important weed control challenge use ethofumesate PRE or spray Gramoxone when kochia has emerged but before sugarbeet have emerged. Gramoxone is durable, inexpensive, and efficacious even with cool weather conditions.

Two- or three-times Spin-Aid at rate commensurate with sugarbeet size and environmental conditions and mixed with ethofumesate is an effective kochia control strategy. However, kochia must be small; application targeting 5-leaf or dime-size kochia.

We recommend full rates if growers choose to use glyphosate. Glyphosate should always be applied with ammonium sulfate water conditioner (liquid or solid) and extra surfactant. These research indicate a tallow amine surfactant at 0.5% v/v is more effective with Roundup PowerMax3 than Prefer 90 nonionic surfactant with Roundup PowerMax3.

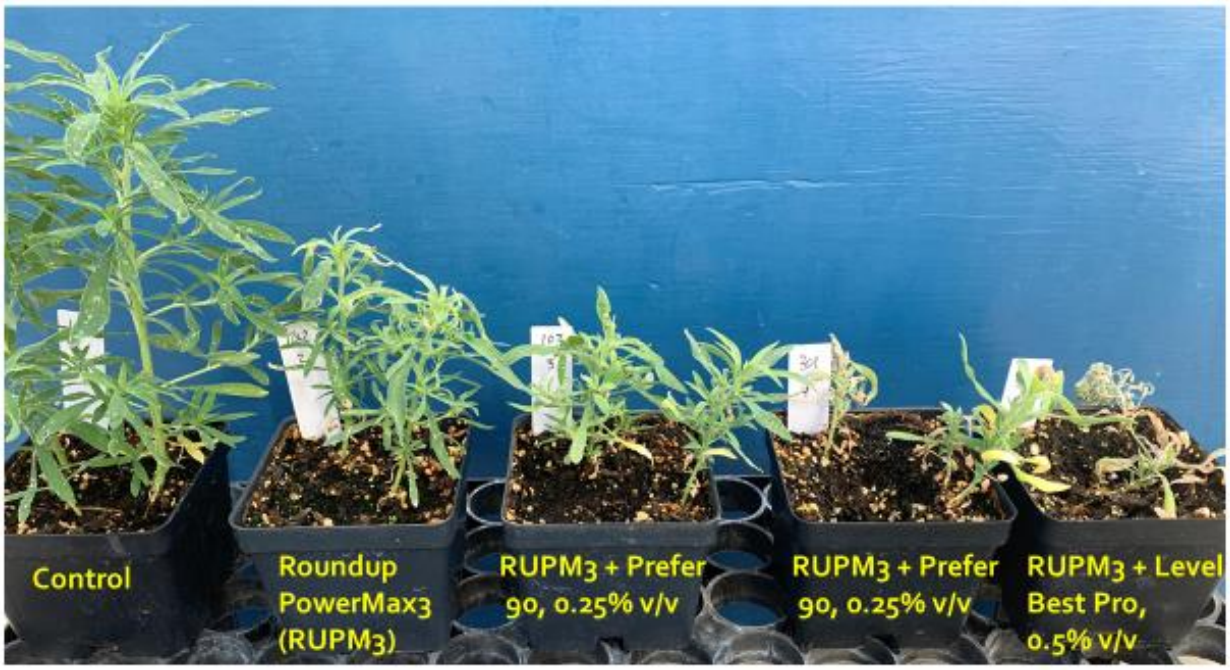

Figure 2. Kochia control from Roundup PowerMax3 alone or with surfactants, 11 DAT, greenhouse, 2024.