2026 Oil-Based Herbicide Tank Mix Impact on Enlist One, Cobra, and Liberty ULTRA Efficacy on Waterhemp in Soybean

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Objectives were to evaluate the potential impact of oil-based residual tank mixes on post-emergence waterhemp and green foxtail control. Growers should always read and follow label recommendations.

MATERIALS AND METHODS

Study was conducted on a moderate infestation of waterhemp and green foxtail near Renville, Minnesota, in 2026. Soil was a fine-textured webster-clay loam soil with 5.4% organic matter and a 6.6 soil pH. Spring tillage was a field cultivator at 3" depth. Becks 1860E3 soybean was seeded 1.25 inches deep on 30-inch row spacings at 130,000 seeds per acre on May 6 and emerged May 18. Postemergence treatments were applied on June 5 (Table 1). All treatments were applied with a bicycle sprayer in a 20 GPA spray solution through AIXR11002 air-induction flat fan nozzles pressurized with CO_2 at 42 psi to the center two rows of four row plots 30 feet in length.

Waterhemp control was evaluated June 8, June 11, June 18, and July 1 (Table 2). Green foxtail control was evaluated June 11, June 18, and July 1. Soybean injury was evaluated June 8, June 11, and June 18 (Table 3). Evaluations were a visual estimate of percent fresh weight reduction in center two treated rows compared to adjacent untreated strips. Experiment design was a randomized complete block with 3 replications. Generally, adjuvants are recommended for post-emergence products to enhance performance, for the sake of this study, all adjuvants were removed to better focus on any activity from the tank mix.

Data were analyzed with GLM procedure of SAS (Statistical Analysis Software, SAS Academic Studio July 8, 2026, SAS Institute, Inc.) at alpha=0.10 or alpha=0.01 denoted in each tables' lowest row and differences are determined with 90% or 99% confidence respectively; meaning, if the study were repeated 100 times that 90 (or 99) times out of 100, we would expect treatments that are statistically different, or similar, (based on LSD value) to continue to be different, or similar, at that confidence level.

Table 1. Application information for Renville oil-based herbicide tank mix trial in 2026.

Application Code	A
Date	June 5
Time of Day	2:30 PM
Air Temperature (F)	85
Relative Humidity (%)	44
Wind Velocity (mph)	3
Wind Direction	W
Soil Temperature (F at 6")	72
Soil Moisture	Good
Cloud Cover (%)	80
Crop Growth Stage (avg.)	V2
Pest Height	Waterhemp – 5"; Green Foxtail – 4"

RESULTS AND DISCUSSION

<u>2,4-D (ENLIST ONE) IN WATERHEMP AND GREEN FOXTAIL</u>

WATERHEMP: At the A+3 evaluation, Treatment 3 (+Dual II) was statistically better than the other treatments, meaning the Dual II Magnum appeared to help with the initial knockdown of waterhemp, however, the Dual II Magnum herbicidal activity did not provide overall enhanced control in later evaluations (Table 2). There was no statistical significance between treatments at the A+6 evaluation timing. At the A+13 evaluation timing, Treatment 6 (+Zidua SC) was better than treatments 1, 2, 3, and 5. Treatments 4 (+Outlook) and 6 were statistically similar.

Treatment 2 (+Section Three) was outperformed by all other treatments, which supports previous research that there is antagonism, when tank mixing a Group 1 (clethodim/ACCase) and Group 4 (2, 4-D/growth regulator). At the final evaluation, A+26, Treatments 5 (+Warrant) and 6 (+Zidua SC) were better than 2 (+Section Three) and 3 (+Dual). Dual's decreased control at the later evaluation is likely due to the reduced residual impact of Dual II Magnum on the suspected resistant waterhemp population at the location where the study was conducted.

GREEN FOXTAIL: At the A+6 evaluation, Treatment 2 (+Section Three) was significantly better than all other treatments (Table 2). This is excepted as Section Three is a grass selective herbicide. Treatment 4 (+Outlook) provided less control than Section Three, but better control compared to the other four treatments. The A+13 evaluation also showed that Section Three was significantly better than the other treatments. Treatment 1 (Enlist One alone) was the worst performing, which was expected as Enlist One does not have any herbicidal activity on grass. The final evaluation showed the same top two treatments.

Table 2. 2,4-D (Enlist One) and oil-based herbicide tank mix waterhemp and green foxtail control.

#	Treatment	Rate (fl oz/A)	% Waterhemp Control				% Green Foxtail Control		
			A+3	A+6	A+13	A+26	A+6	A+13	A+26
1	Enlist One	32	27	20	63	60	0	0	0
2	Enlist One+Section Three	32+6	27	17	57	33	89	91	92
3	Enlist One+Dual II Magnum	32+16	33	22	63	43	23	27	20
4	Enlist One+Outlook	32+12	27	20	67	60	53	50	53
5	Enlist One+Warrant	32+40	25	23	63	67	23	13	13
6	Enlist One+Zidua SC	32+4	27	23	70	73	10	27	23
LSD (0.05)			**5**	**NS**	**6.4**	**26.3**	**29.8**	**45**	**43.7**

GLUFOSINATE (LIBERTY ULTRA) IN WATERHEMP AND GREEN FOXTAIL

WATERHEMP: There were no differences in waterhemp control with the Liberty ULTRA tank mixes (Table 3).

GREEN FOXTAIL: At the A+6 evaluation, there were no differences. At the A+13 evaluation, Treatments 1 (Liberty ULTRA alone), 2 (+Section Three), 4 (+Outlook), and 6 (+Zidua SC) were significantly better than Treatment 3 (+Dual) (Table 3). However, there were no differences at A+26. The variation of grass pressure within the study area may have been a factor during evaluations. Tank mixed oil-based herbicides neither enhance nor reduce activity of Liberty ULTRA on green foxtail. A grower should follow label recommendations, adding AMS and targeting hot and humid weather conditions, for the best Liberty ULTRA grass control.

Table 3. Glufosinate (Liberty Ultra) and oil-based herbicide tank mix waterhemp and green foxtail control.

#	Treatment	Rate (fl oz/A)	% Waterhemp Control				% Green Foxtail Control		
			A+3	A+6	A+13	A+26	A+6	A+13	A+26
1	Liberty ULTRA	24	50	50	65	40	99	97	92
2	Liberty ULTRA+ Section Three	24+6	52	63	73	40	98	97	97
3	Liberty ULTRA+Dual II Mag	24+16	52	53	53	27	95	88	88
4	Liberty ULTRA+Outlook	24+12	55	53	57	20	98	96	95
5	Liberty ULTRA+Warrant	24+40	48	50	60	27	96	95	95
6	Libery ULTRA+Zidua SC	24+4	53	60	63	50	98	97	97
LSD (0.1)			**NS**	**NS**	**NS**	**NS**	**NS**	**7.7**	**NS**

LACTOFEN (COBRA) IN WATERHEMP AND GREEN FOXTAIL

WATERHEMP: The A+3 evaluation had no differences (Table 4). However, at the A+6 evaluation timing, Treatment 3 (+Dual) was significantly better than Treatment 1 (Cobra alone). Generally, tank mixes with greater waterhemp control, also had greater crop injury. There were no differences at A+13 or A+26 evaluation timings.

GREEN FOXTAIL: At the A+6 evaluation, Treatments 2 (+Section Three) and 3 (+Dual) were significantly better than Treatments 4 (+Outlook) and 5 (+Warrant) (Table 4). The A+13 and A+26, showed similar findings.

CROP INJURY: As expected, when spraying Cobra (Lactofen), soybean injury, to some degree, occurred for all treatments (Table 5). At the A+3 evaluation, Treatment 3 (+Dual) had significantly greater injury than all other treatments. At the A+6 evaluation, Treatments 3 (+Dual), 4 (+Outlook), and 6 (+Zidua SC) had significantly greater injury than Cobra alone, 2 (+Section Three), and 5 (+Warrant). By the A+13 evaluation, only Cobra + Dual continued to have statistically significant crop injury, however, reduce by 20% from the A+3 timing. Generally, a producer including an oil-based residual herbicide in a post tank mix with Cobra herbicide, or any PPO product, should consider the oil-based adjuvant as a substitute for the recommended COC or oil-based adjuvant to avoid enhancing injury.

Table 4. Lactofen (Cobra) and oil-based herbicide tank mix waterhemp and green foxtail control.

#	Treatment	Rate (fl oz/A)	% Waterhemp Control				% Green Foxtail Control		
			A+3	A+6	A+13	A+26	A+6	A+13	A+26
1	Cobra	10	93	92	90	77	63	58	50
2	Cobra+Section Three	10+6	93	93	97	90	97	95	88
3	Cobra+Dual II Magnum	10+16	93	97	96	90	85	78	67
4	Cobra+Outlook	10+12	95	95	100	83	40	37	17
5	Cobra+Warrant	10+40	93	96	100	90	48	40	17
6	Cobra+Zidua SC	10+4	95	94	97	90	58	43	13
LSD (0.1)			**NS**	**4.3**	**NS**	**NS**	**36.5**	**33.9**	**28.6**

Table 5. Lactofen (Cobra) and oil-based herbicide tank mix soybean injury.

#	Treatment	Rate (fl oz/A)	% Soybean Injury		
			A+3	A+6	A+13
1	Cobra	10	18	17	2
2	Cobra+Section Three	10+6	13	17	2
3	Cobra+Dual II Magnum	10+16	30	27	10
4	Cobra+Outlook	10+12	20	23	7
5	Cobra+Warrant	10+40	15	12	7
6	Cobra+Zidua SC	10+4	17	23	8
LSD (0.1)			**7.5**	**6**	**5.7**

CONCLUSION

2,4-D (Enlist One) can be a great option for growers looking to control smaller sized waterhemp with cooler temperatures and lower humidity. Enlist One can be confidently paired with residual lay-by products, but it is best to avoid tank mixing with Group 1 ACCase Inhibitors, like clethodim (Section Three) to avoid antagonism.

Glufosinate (Liberty ULTRA) may be a more ideal option for later season postemergence applications when the likelihood of increased temperatures and humidity is greater and AMS is added. Growers can confidently pair it with any of these residual lay-by products, including Group 1 ACCase Inhibitors, like Section Three.

Lactofen (Cobra) had the greatest waterhemp control compared to Enlist One and Liberty Ultra. However, it is important to note that there is a greater risk of enhanced crop injury with tank mixes. Growers should consider removing oil-based adjuvants when including an oil-based residual herbicide in the tank mix to mitigate enhanced injury. A grower must balance the trade-off of waterhemp control and crop injury when determining to use PPOs.

In all three actives, Dual II Magnum was the most likely to increase initial control of waterhemp and grass, and crop injury. Warrant and Outlook can cause some necrosis, but the injury was short lived and not likely to impact yield. Outlook and Zidua SC both had consistent efficacy and safety across evaluated tank mixes.

Label recommendations should always be considered and followed.

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