

Glyphosate tank-mixed with insecticides or fungicides. Ramsdale, Brad K., Sam J. Lockhart, and Calvin G. Messersmith. The experiment was conducted to examine the influence of various insecticides and fungicides on glyphosate efficacy. Bioassay species were seeded side-by-side with a small grain drill with one drill pass of each species per replicate, and plots 10 ft wide were laid out perpendicular to the strips so that each plot contained the seeded assay species. Treatments were applied at 8.5 gpa with a CO₂-pressurized bicycle-wheel-type plot sprayer equipped with four 8001 flat-fan nozzles at 20-inch spacing. Experimental design was a randomized complete block with four replicates. Glyphosate was applied at a reduced rate of 0.06 lb ae/A to better detect treatment effects on herbicide efficacy. As recommended on glyphosate labels, ammonium sulfate (AMS) was added either alone at 1% w/v or as a component of Class Act Next Generation (Class Act NG), which was added at 2.5% v/v. Insecticides and fungicides were applied at labeled rates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

Location	Fargo	Carrington	Minot
Planting date	May 22	May 21	May 15 – 28*
Treatment date	June 25	June 26	June 26
Air temperature (F)	75	76	83
Relative humidity (%)	75	45	55
Wind (mph)	5-8	3-5	5
Sky (% clouds)	75	0	10
Oat			
growth stage	tillering	tillering	tillering
height (inch)	8-12	8-10	6-8
Proso millet			
growth stage	tillering	tillering	3-6 leaf
height (inch)	6-8	8-10	2-6
Barley			
growth stage	tillering	tillering	tillering
height (inch)	8-12	8-10	8-10
Flax			
height (inch)	6-8	---	3-8
Wheat			
growth stage	---	tillering	---
height (inch)	---	8-10	---

* Flax – May 15, barley – May 21, proso millet – May 28, and oat – May 28.

Glyphosate as Roundup Custom was influenced less by insecticides and fungicides than Roundup UltraMax and Touchdown formulations. The surfactant in Class Act NG applied with Roundup Custom may have minimized the influence of the tank-mixed pesticides. Overall, pesticides formulated as emulsifiable concentrates, particularly dimethoate and chlorpyrifos, were occasionally synergistic to the reduced glyphosate rate. Flowable formulations of pesticides were occasionally antagonistic to glyphosate; most notable was the fungicide azoxystrobin. (This material is based upon work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Agreement No. 00-34361-9038. Dept. of Plant Sciences, North Dakota State University, Fargo)

Table 1. Glyphosate with insecticides fungicides at Minot, ND. (Ramsdale, Lockhart, and Messersmith)

Treatment ^a	Product rate lb/A	July 10				July 24		
		Flax (%)	Proso		Barley (%)	Flax (%)	Oat (%)	Barley (%)
			Flax (%)	Oat (%)				
<u>Glyt-C + Class Act NG</u>		0.06 + 2.5%						
alone	-	55	85	95	96	50	96	96
+ esfenvalerate (I)	0.05	48	75	96	89	43	98	92
+ carbaryl (I)	1.5	56	82	96	91	50	97	91
+ lambda-cyhalothrin (I)	0.03	50	77	96	95	50	96	96
+ zeta-cypermethrin (I)	0.05	65	87	98	96	63	99	95
+ chlorpyrifos (I)	1	52	83	98	94	47	96	95
+ dimethoate (I)	0.5	73	89	99	94	65	97	95
+ azoxystrobin (F)	0.25	52	80	97	92	48	96	87
+ pyraclostrobin (F)	0.15	59	82	98	95	55	98	94
+ propiconazole (F)	0.13	48	78	98	91	47	98	92
LSD (0.05)		8	6	NS	NS	12	NS	NS
<u>Glyt-UM + AMS</u>		0.06 + 1%						
alone	-	55	83	94	89	50	91	88
+ esfenvalerate (I)	0.05	43	77	89	82	38	89	82
+ carbaryl (I)	1.5	56	75	92	86	47	89	86
+ lambda-cyhalothrin (I)	0.03	50	78	90	83	42	86	82
+ zeta-cypermethrin (I)	0.05	57	78	92	85	57	92	86
+ chlorpyrifos (I)	1	50	70	88	84	43	86	89
+ dimethoate (I)	0.5	58	80	92	86	52	96	87
+ azoxystrobin (F)	0.25	37	68	78	75	28	72	72
+ pyraclostrobin (F)	0.15	58	78	90	86	55	89	83
+ propiconazole (F)	0.13	53	81	95	88	50	94	86
LSD (0.05)		9	7	7	7	10	9	10
<u>Glyt-TD + AMS</u>		0.06 + 1%						
alone	-	33	65	78	81	18	72	75
+ esfenvalerate (I)	0.05	47	67	96	92	37	86	91
+ carbaryl (I)	1.5	43	67	95	88	35	87	86
+ lambda-cyhalothrin (I)	0.03	30	60	89	91	18	77	88
+ zeta-cypermethrin (I)	0.05	45	75	96	96	37	91	95
+ chlorpyrifos (I)	1	58	81	99	94	43	99	97
+ dimethoate (I)	0.5	65	82	98	93	53	96	96
+ azoxystrobin (F)	0.25	37	62	76	77	17	68	72
+ pyraclostrobin (F)	0.15	52	75	97	93	43	93	95
+ propiconazole (F)	0.13	73	88	99	97	65	99	99
LSD (0.05)		12	7	7	7	14	9	11

^a Glyt-C = Roundup Custom; Glyt-UM = Roundup UltraMax; Glyt-TD = Touchdown; (I) = insecticide; (F) = fungicide; esfenvalerate = Asana XL; carbaryl = Sevin XLR Plus; lambda-cyhalothrin = Warrior; zeta-cypermethrin = Mustang; chlorpyrifos = Lorsban 4E; dimethoate = Dimethoate 400; azoxystrobin = Quadris; pyraclostrobin = Headline; propiconazole = Tilt.

Table 2. Glyphosate with insecticides fungicides at Fargo, ND. (Ramsdale, Lockhart, and Messersmith)

Treatment ^a	Product rate lb/A	July 9				July 23			
		Flax	Barley	Oat	Proso millet	Flax	Barley	Oat	Proso millet
		(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
<u>Glyt-C + Class Act NG</u>		0.06 + 2.5%							
alone	-	49	91	96	98	40	95	96	93
+ esfenvalerate (I)	0.05	51	95	96	98	45	98	98	94
+ carbaryl (I)	1.5	51	96	98	99	40	97	98	93
+ lambda-cyhalothrin (I)	0.03	55	97	97	98	51	98	98	95
+ zeta-cypermethrin (I)	0.05	51	95	98	99	51	99	99	97
+ chlorpyrifos (I)	1	56	95	97	99	53	99	99	97
+ dimethoate (I)	0.5	54	99	99	99	50	98	99	96
+ azoxystrobin (F)	0.25	49	96	98	98	48	98	99	95
+ pyraclostrobin (F)	0.15	55	96	99	99	53	99	99	95
+ propiconazole (F)	0.13	58	96	99	99	59	99	99	97
LSD (0.05)		NS	3	NS	NS	11	NS	NS	NS
<u>Glyt-UM + AMS</u>		0.06 + 1%							
alone	-	41	87	88	95	30	84	86	83
+ esfenvalerate (I)	0.05	50	91	95	98	48	93	95	95
+ carbaryl (I)	1.5	46	91	92	96	39	89	95	89
+ lambda-cyhalothrin (I)	0.03	45	92	94	98	41	93	95	90
+ zeta-cypermethrin (I)	0.05	49	91	91	98	38	91	91	89
+ chlorpyrifos (I)	1	58	97	98	99	54	99	99	97
+ dimethoate (I)	0.5	56	97	97	99	54	99	98	96
+ azoxystrobin (F)	0.25	31	86	83	91	19	84	80	84
+ pyraclostrobin (F)	0.15	54	98	97	99	55	99	99	95
+ propiconazole (F)	0.13	54	96	95	98	51	97	98	97
LSD (0.05)		6	5	4	4	10	5	5	4
<u>Glyt-TD + AMS</u>		0.06 + 1%							
alone	-	40	90	83	93	24	91	79	84
+ esfenvalerate (I)	0.05	57	96	95	99	53	98	96	94
+ carbaryl (I)	1.5	48	90	90	97	33	91	94	91
+ lambda-cyhalothrin (I)	0.03	39	89	85	91	23	90	84	86
+ zeta-cypermethrin (I)	0.05	50	95	91	98	33	94	92	92
+ chlorpyrifos (I)	1	56	98	98	99	50	99	98	97
+ dimethoate (I)	0.5	55	96	97	99	46	97	97	96
+ azoxystrobin (F)	0.25	35	85	83	91	18	84	80	84
+ pyraclostrobin (F)	0.15	54	96	97	99	48	98	99	96
+ propiconazole (F)	0.13	56	97	95	99	53	98	96	97
LSD (0.05)		7	4	5	5	11	6	5	4

^a Glyt-C = Roundup Custom; Glyt-UM = Roundup UltraMax; Glyt-TD = Touchdown; (I) = insecticide; (F) = fungicide; esfenvalerate = Asana XL; carbaryl = Sevin XLR Plus; lambda-cyhalothrin = Warrior; zeta-cypermethrin = Mustang; chlorpyrifos = Lorsban 4E; dimethoate = Dimethoate 400; azoxystrobin = Quadris; pyraclostrobin = Headline; propiconazole = Tilt.

Table 3. Glyphosate with insecticides fungicides at Carrington, ND. (Ramsdale, Lockhart, and Messersmith)

Treatment ^a	Product rate lb/A	July 10				July 24			
		Wheat	Barley	Proso		Wheat	Barley	Proso	
		(%)	(%)	millet (%)	Oat (%)	(%)	(%)	millet (%)	Oat (%)
<u>Glyt-C + Class Act NG</u>		0.06 + 2.5%							
alone	-	90	95	85	89	95	99	90	94
+ esfenvalerate (I)	0.05	91	93	84	88	96	99	87	90
+ carbaryl (I)	1.5	87	89	80	86	87	95	81	87
+ lambda-cyhalothrin (I)	0.03	93	95	88	93	97	98	93	97
+ zeta-cypermethrin (I)	0.05	93	94	91	92	99	99	94	97
+ chlorpyrifos (I)	1	89	92	84	90	91	96	88	93
+ dimethoate (I)	0.5	93	94	91	92	98	99	95	96
+ azoxystrobin (F)	0.25	90	93	88	90	96	99	94	97
+ pyraclostrobin (F)	0.15	93	96	90	90	98	99	93	97
+ propiconazole (F)	0.13	91	93	86	88	97	98	88	92
LSD (0.05)		4	3	NS	NS	4	3	6	5
<u>Glyt-UM + AMS</u>		0.06 + 1%							
alone	-	91	91	87	88	92	98	92	93
+ esfenvalerate (I)	0.05	91	88	76	76	94	95	78	80
+ carbaryl (I)	1.5	89	87	80	80	83	91	82	82
+ lambda-cyhalothrin (I)	0.03	89	91	82	83	92	96	84	86
+ zeta-cypermethrin (I)	0.05	88	91	87	88	93	98	91	93
+ chlorpyrifos (I)	1	92	94	84	90	97	98	89	90
+ dimethoate (I)	0.5	92	92	86	88	96	99	91	88
+ azoxystrobin (F)	0.25	78	81	68	71	76	85	66	66
+ pyraclostrobin (F)	0.15	92	94	86	91	92	98	89	92
+ propiconazole (F)	0.13	87	89	86	89	93	97	89	92
LSD (0.05)		3	4	5	7	9	4	7	7
<u>Glyt-TD + AMS</u>		0.06 + 1%							
alone	-	90	91	86	87	92	98	90	87
+ esfenvalerate (I)	0.05	92	91	88	92	95	99	90	94
+ carbaryl (I)	1.5	88	89	79	83	91	96	77	83
+ lambda-cyhalothrin (I)	0.03	90	92	89	92	91	94	91	95
+ zeta-cypermethrin (I)	0.05	93	94	92	94	94	98	94	98
+ chlorpyrifos (I)	1	93	94	91	94	93	99	93	97
+ dimethoate (I)	0.5	94	95	92	94	96	99	93	97
+ azoxystrobin (F)	0.25	86	89	85	91	87	95	92	96
+ pyraclostrobin (F)	0.15	94	95	88	90	99	99	91	94
+ propiconazole (F)	0.13	91	93	88	90	97	99	89	94
LSD (0.05)		5	NS	NS	NS	NS	NS	NS	9

^a Glyt-C = Roundup Custom; Glyt-UM = Roundup UltraMax; Glyt-TD = Touchdown; (I) = insecticide; (F) = fungicide; esfenvalerate = Asana XL; carbaryl = Sevin XLR Plus; lambda-cyhalothrin = Warrior; zeta-cypermethrin = Mustang; chlorpyrifos = Lorsban 4E; dimethoate = Dimethoate 400; azoxystrobin = Quadris; pyraclostrobin = Headline; propiconazole = Tilt.