

## **Comparison of the impact of BMP rates of atrazine tank mixed with several broadleaf herbicides in field corn at Rochester, MN, in 2007 and 2008.**

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The Minnesota Department of Agriculture has developed voluntary Best Management Practices (BMP) for the use of atrazine in areas where it is frequently detected in ground and surface waters. The purpose of these BMPs is to prevent the degradation of water resources while maintaining atrazine's effectiveness as part of an integrated weed management program. The objectives of this trial were: 1) To evaluate weed control of herbicide programs with and without atrazine applied at BMP rates, 2) To evaluate performance of herbicides used as replacements for atrazine and 3) To evaluate crop safety and economics of potential replacements in field corn in southeastern Minnesota.

In 2007, the research site was a Lawler loam series with a pH of 7.0 and soil test P and K levels of 16 ppm and 160 ppm, respectively. Spring fertilizer was broadcast ahead of planting on April 13, at a rate of 99-23-60-24 (N-P-K-S). The area was side dressed with an additional 30 lb/A of N on June 7. The field was spring disked twice and field cultivated once prior to planting. The corn hybrid, Pioneer 38H65, was planted on April 27, 2007 at a depth of 1.5 inches in 30 inch rows at 32,000 seeds per acre. Evaluations of the plots were taken on May 30, June 4, June 11, and June 28 and August 10, 2007. In 2008, the research site was a Lawler loam series with a pH of 6.7, organic matter 3.2%, and soil test P and K levels of 22 ppm and 126 ppm, respectively. Spring fertilizer was broadcast ahead of planting on April 16, at a rate of 120-36-86-28 (N-P-K-S). The area was side dressed with an additional 35 lb/A of N on June 25. The field was fall chisel plowed, spring disked once and field cultivated once prior to planting. The corn hybrid, DeKalb DKC50-19 101RM, was planted on May 9, 2008, at a depth of 2.0 inches in 30 inch rows at 35,000 seeds per acre. Evaluations of the plots were taken on June 9, 18, July 1 and 30, 2008.

A randomized complete block design was used with four replications. Preemergence (PRE) and postemergence (POST) treatments were applied with a tractor-mounted sprayer delivering 20 gpa at 32 psi using Turbo Tee 11002 nozzles. Application dates, environmental conditions, and weed stages are listed below in Tables 1 and 2. The center two rows of each plot were machine harvested on September 26, 2007 and on November 3, 2008.

### **CONCLUSIONS**

In 2007, soil applied atrazine (Bicep Lite II Mag) applied at recommended BMP rates for SE Minnesota resulted in no improvement of broadleaf weed control compared to the no atrazine control of Dual II Mag (data not shown). Postemergence programs that included atrazine at 0.5 lb/A, which is lower than the BMP rate of 0.8 lb/A for SE Minnesota, significantly improved postemergence weed control.

In 2007 and 2008, giant ragweed control was improved when postemergence treatments included atrazine. In 2008, Callisto + either Buctril or Clarity provided similar giant ragweed control as Callisto + atrazine; however, Callisto + Buctril resulted in 20% injury to corn. Hornet + atrazine or Callisto at the reduced rate of 1 oz/A provided significantly greater giant ragweed control than Hornet applied alone. Hornet + Callisto provided greater control than Hornet + atrazine, 97% compared to 91%, respectively. In 2008, Clarity + Callisto provided weed control equivalent to Clarity + atrazine.

In 2007 and 2008, common waterhemp and common lambsquarters control were similar for Callisto and Callisto plus atrazine. Hornet + atrazine and Clarity + atrazine provided greater control of common waterhemp and common lambsquarters control in 2007. In 2008, common waterhemp control was improved significantly with the addition of the BMP rate of atrazine or Callisto to Hornet, as compared to Hornet alone. Also, common waterhemp control with Hornet + Callisto at 1 oz/A was significantly greater than with atrazine, 94 compared to 80%, respectively.

Corn grain yields were greater for both Callisto + atrazine and Hornet + atrazine when compared to their non-atrazine partners in 2007. Due to plot variability in 2008, corn yields were not significantly different at the  $P \leq 0.10$ .

BMP rates of atrazine can improve the effectiveness of Callisto, Hornet and Clarity on certain weeds and increase grain yields. The data from 2008 would indicate that Buctril, Callisto, and Clarity may be potential replacements for atrazine. However more research is necessary and crop safety is a concern with Buctril. (University of Minnesota Extension, Regional Office – Rochester).

**Table 1. Application dates, conditions and plant stages in 2007.**

Date	April 27	May 23
<b>Treatment</b>	PRE	POST
<b>Temperature (F)</b>		
Air	71	70
soil	62.1	69.4
<b>Relative Humidity (%)</b>	34	70
<b>Wind (mph)</b>	10	23
<b>Soil moisture</b>	adequate	excessive
<b>Corn</b>		
stage	--	3 collar
height (inch)	--	4.0
<b>Giant Ragweed</b>		
weed density (ft <sup>2</sup> )	--	24.9
height (inch)	--	1.6
<b>Common Lambsquarters</b>		
weed density (ft <sup>2</sup> )	--	4
height (inch)	--	1.1
<b>Common Waterhemp</b>		
weed density (ft <sup>2</sup> )	--	3.5
height (inch)	--	1.1
<b>Giant Foxtail</b>		
weed density (ft <sup>2</sup> )	--	1.5
height (inch)	--	1.3
<b>Velvetleaf</b>		
weed density (ft <sup>2</sup> )	--	1.5
height (inch)	--	2.0
<b>Rainfall after each application (inch)</b>		
week 1	0.52	2.04
week 2	0.52	1.28
week 3	0.34	0.38

**Table 2. Application dates, conditions and plant stages in 2008.**

Date	5/9	6/2
<b>Treatment</b>	PRE	POST I
<b>Temperature (F)</b>		
air	61	72
soil	61	62
<b>Relative Humidity (%)</b>	32	57
<b>Wind (mph)</b>	9	8
<b>Soil moisture</b>	Adequate	Excessive
<b>Corn</b>		
stage		V1-V2
height (inch)		3.5
<b>Giant Ragweed</b>		
weed density (ft <sup>2</sup> )		1.8
height (inch)		2.6
<b>Common Lambsquarters</b>		
weed density (ft <sup>2</sup> )		21.5
height (inch)		1.3
<b>Common Waterhemp</b>		
weed density (ft <sup>2</sup> )		89.4
height (inch)		0.7
<b>Giant Foxtail</b>		
weed density (ft <sup>2</sup> )		3
height (inch)		1.7
<b>Rainfall after each application (inch)</b>		
week 1	1.07	4.79
week 2	0.08	3.52
week 3	2.15	0.00

**Table 3. Performance of herbicide systems for giant ragweed control in field corn on May 30, June 4, 11, 28, and August 10 at Rochester, MN in 2007.**

Treatment	Rate	Giant Ragweed Control					Yield 15.5%	
		5/30	6/4	6/11	6/28	8/10		
	(rate/A)	(%)					(bu/A)	
<b>PRE</b>								
Dual II Mag	1 pt	0	0	0	0	0	5	
Bicep Lite II Mag	2.3 pt	0	0	0	0	0	4	
<b>PRE / POST I</b>								
Dual II Mag / Callisto + COC + 28% UAN	1 pt / 3 fl oz + 1% v/v + 2.5% v/v	73	88	82	87	84	124	
Dual II Mag / Callisto + Aatrex + COC + 28% UAN	1 pt / 3 fl oz + 16 fl oz + 1% v/v + 2.5% v/v	95	96	94	96	95	159	
Dual II Mag / Hornet + COC + 28% UAN	1 pt / 3 oz + 1% v/v + 2.5% v/v	76	78	73	89	81	109	
Dual II Mag / Hornet + Aatrex + COC + 28% UAN	1 pt / 3 oz + 16 fl oz + 1% v/v + 2.5% v/v	92	93	90	92	93	142	
Dual II Mag / Clarity + 28% UAN	1 pt / 1 pt + 2.5% v/v	76	85	79	77	74	97	
Dual II Mag / Clarity + Aatrex + 28% UAN	1 pt / 1 pt + 16 fl oz + 2.5% v/v	93	94	88	90	86	120	
		<b>LSD (P=0.10)</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>25</b>

**Table 4. Performance of herbicide systems for giant ragweed control in field corn on June 9, 18, July 1 and 30 at Rochester, MN, in 2008.**

Treatment	Rate	Giant Ragweed Control				Yield	
		6/9	6/18	7/1	7/30		
	(rate/A)	(%)				(bu/A)	
<b>PRE / POST I</b>							
Dual II Mag / Callisto + COC + 28% UAN	1 pt / 3 fl oz + 1% v/v + 2.5% v/v	71	84	86	86	187	
Dual II Mag / Callisto + Aatrex + COC + 28% UAN	1 pt / 3 fl oz + 16 fl oz + 1% v/v + 2.5% v/v	90	96	96	98	227	
Dual II Mag / Callisto + Buctril + COC + 28% UAN	1 pt / 3 fl oz + 6 fl oz + 1% v/v + 2.5% v/v	95	96	96	96	234	
Dual II Mag / Callisto + Clarity + COC + 28% UAN	1 pt / 3 fl oz + 4 fl oz + 1% v/v + 2.5% v/v	78	96	96	99	234	
Dual II Mag / Hornet + COC + 28% UAN	1 pt / 3 oz wt + 1% v/v + 2.5% v/v	75	83	92	86	194	
Dual II Mag / Hornet + Aatrex + COC + 28% UAN	1 pt / 3 oz wt + 16 fl oz + 1% v/v + 2.5% v/v	90	95	96	91	216	
Dual II Mag / Hornet + Callisto + COC + 28% UAN	1 pt / 3 oz wt + 1 fl oz + 1% v/v + 2.5% v/v	80	92	92	97	212	
Dual II Mag / Clarity + 28% UAN	1 pt / 1 pt + 2.5% v/v	72	92	89	92	209	
Dual II Mag / Clarity + Aatrex + 28% UAN	1 pt / 1 pt + 16 fl oz + 2.5% v/v	91	97	95	97	230	
Dual II Mag / Clarity + Callisto + COC + 28% UAN	1 pt / 1 pt + 1 fl oz + 1% v/v + 2.5% v/v	78	97	95	97	218	
		<b>LSD (P=0.10)</b>	<b>4</b>	<b>4</b>	<b>5</b>	<b>3</b>	<b>NS</b>

**Table 5. Performance of herbicide systems for common lambsquarters control in field corn on May 3, June 4, 11, 28, and August 10 at Rochester, MN in 2007.**

Treatment	Rate	Common Lambsquarters Control					Yield 15.5%
		5/30	6/4	6/11	6/28	8/10	
	(rate/A)	(%)					(bu/A)
<b>PRE</b>							
Dual II Mag	1 pt	30	40	0	0	0	5
Bicep Lite II Mag	2.3 pt	36	40	0	0	0	4
<b>PRE / POST I</b>							
Dual II Mag / Callisto + COC + 28% UAN	1 pt / 3 fl oz + 1% v/v + 2.5% v/v	85	93	99	99	99	124
Dual II Mag / Callisto + Aatrex + COC + 28% UAN	1 pt / 3 fl oz + 16 fl oz + 1% v/v + 2.5% v/v	99	99	99	99	99	159
Dual II Mag / Hornet + COC + 28% UAN	1 pt / 3 oz + 1% v/v + 2.5% v/v	70	78	70	71	68	109
Dual II Mag / Hornet + Aatrex + COC + 28% UAN	1 pt / 3 oz + 16 fl oz + 1% v/v + 2.5% v/v	98	99	99	99	99	142
Dual II Mag / Clarity + 28% UAN	1 pt / 1 pt + 2.5% v/v	75	73	77	81	74	97
Dual II Mag / Clarity + Aatrex + 28% UAN	1 pt / 1 pt + 16 fl oz + 2.5% v/v	97	98	99	99	99	120
	<b>LSD (P=0.10)</b>	<b>4</b>	<b>6</b>	<b>4</b>	<b>4</b>	<b>3</b>	<b>25</b>

**Table 6. Performance of herbicide systems for common lambsquarter control in field corn on June 9, 18, July 1 and 30 at Rochester, MN, in 2008.**

Treatment	Rate	Common Lambsquarter Control				Yield
		6/9	6/18	7/1	7/30	
	(rate/A)	(%)				(bu/A)
<b>PRE / POST I</b>						
Dual II Mag / Callisto + COC + 28% UAN	1 pt / 3 fl oz + 1% v/v + 2.5% v/v	81	99	99	98	187
Dual II Mag / Callisto + Aatrex + COC + 28% UAN	1 pt / 3 fl oz + 16 fl oz + 1% v/v + 2.5 % v/v	96	99	99	99	227
Dual II Mag / Callisto + Buctril + COC + 28% UAN	1 pt / 3 fl oz + 6 fl oz + 1% v/v + 2.5% v/v	97	99	99	97	234
Dual II Mag / Callisto + Clarity + COC + 28% UAN	1 pt / 3 fl oz + 4 fl oz + 1% v/v + 2.5% v/v	80	99	99	99	234
Dual II Mag / Hornet + COC + 28% UAN	1 pt / 3 oz wt + 1% v/v + 2.5% v/v	76	95	97	98	194
Dual II Mag / Hornet + Aatrex + COC + 28% UAN	1 pt / 3 oz wt + 16 fl oz + 1% v/v + 2.5% v/v	94	99	99	98	216
Dual II Mag / Hornet + Callisto + COC + 28% UAN	1 pt / 3 oz wt + 1 fl oz + 1% v/v + 2.5% v/v	78	99	99	99	212
Dual II Mag / Clarity + 28% UAN	1 pt / 1 pt + 2.5% v/v	74	95	96	99	209
Dual II Mag / Clarity + Aatrex + 28% UAN	1 pt / 1 pt + 16 fl oz + 2.5% v/v	92	99	99	99	230
Dual II Mag / Clarity + Callisto + COC + 28% UAN	1 pt / 1 pt + 1 fl oz + 1% v/v + 2.5% v/v	81	99	99	99	218
	<b>LSD (P=0.10)</b>	<b>5</b>	<b>2</b>	<b>2</b>	<b>NS</b>	<b>NS</b>

**Table 7. Performance of herbicide systems for common waterhemp control in field corn on May 30, June 4, 11, 28, and August 10 at Rochester, MN in 2007.**

Treatment	Rate	Common Waterhemp Control					Yield 15.5%
		5/30	6/4	6/11	6/28	8/10	
	(rate/A)	(%)					(bu/A)
<b>PRE</b>							
Dual II Mag	1 pt	40	70	0	0	0	5
Bicep Lite II Mag	2.3 pt	40	73	0	0	0	4
<b>PRE / POST I</b>							
Dual II Mag / Callisto + COC + 28% UAN	1 pt / 3 fl oz + 1% v/v + 2.5% v/v	96	92	97	90	94	124
Dual II Mag / Callisto + Aatrex + COC + 28% UAN	1 pt / 3 fl oz + 16 fl oz + 1% v/v + 2.5% v/v	99	99	99	98	98	159
Dual II Mag / Hornet + COC + 28% UAN	1 pt / 3 oz + 1% v/v + 2.5% v/v	81	91	78	82	70	109
Dual II Mag / Hornet + Aatrex + COC + 28% UAN	1 pt / 3 oz + 16 fl oz + 1% v/v + 2.5% v/v	87	95	86	83	86	142
Dual II Mag / Clarity + 28% UAN	1 pt / 1 pt + 2.5% v/v	83	92	84	87	73	97
Dual II Mag / Clarity + Aatrex + 28% UAN	1 pt / 1 pt + 16 fl oz + 2.5% v/v	96	94	87	88	88	120
	<b>LSD (P=0.10)</b>	<b>4</b>	<b>5</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>25</b>

**Table 8. Performance of herbicide systems for common waterhemp control in field corn on June 9, 18, July 1 and 30 at Rochester, MN, in 2008.**

Treatment	Rate	Common Waterhemp Control				Yield
		6/9	6/18	7/1	7/30	
	(rate/A)	(%)				(bu/A)
<b>PRE / POST I</b>						
Dual II Mag / Callisto + COC + 28% UAN	1 pt / 3 fl oz + 1% v/v + 2.5% v/v	83	99	98	93	187
Dual II Mag / Callisto + Aatrex + COC + 28% UAN	1 pt / 3 fl oz + 16 fl oz + 1% v/v + 2.5% v/v	92	99	98	94	227
Dual II Mag / Callisto + Buctril + COC + 28% UAN	1 pt / 3 fl oz + 6 fl oz + 1% v/v + 2.5% v/v	97	99	98	95	234
Dual II Mag / Callisto + Clarity + COC + 28% UAN	1 pt / 3 fl oz + 4 fl oz + 1% v/v + 2.5% v/v	78	99	97	95	234
Dual II Mag / Hornet + COC + 28% UAN	1 pt / 3 oz wt + 1% v/v + 2.5% v/v	63	71	50	41	194
Dual II Mag / Hornet + Aatrex + COC + 28% UAN	1 pt / 3 oz wt + 16 fl oz + 1% v/v + 2.5% v/v	81	87	84	80	216
Dual II Mag / Hornet + Callisto + COC + 28% UAN	1 pt / 3 oz wt + 1 fl oz + 1% v/v + 2.5% v/v	74	99	98	94	212
Dual II Mag / Clarity + 28% UAN	1 pt / 1 pt + 2.5% v/v	76	97	92	91	209
Dual II Mag / Clarity + Aatrex + 28% UAN	1 pt / 1 pt + 16 fl oz + 2.5% v/v	96	99	94	92	230
Dual II Mag / Clarity + Callisto + COC + 28% UAN	1 pt / 1 pt + 1 fl oz + 1% v/v + 2.5% v/v	86	99	96	92	218
	<b>LSD (P=0.10)</b>	<b>7</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>NS</b>

**Table 9. Corn injury on June 9 and additional cost per acre over base herbicide program at Rochester, MN, in 2008.**

Treatment	Rate (rate/A)	Injury 6/9	Economics <sup>1</sup>	
			(\$/A additional cost over base program)	
<b>PRE / POST I</b>				
Dual II Mag / Callisto + COC + 28% UAN	1 pt / 3 fl oz + 1% v/v + 2.5% v/v	0		
Dual II Mag / Callisto + Aatrex + COC + 28% UAN	1 pt / 3 fl oz + 16 fl oz + 1% v/v + 2.5 % v/v	1		<b>+ 1.50</b>
Dual II Mag / Callisto + Buctril + COC + 28% UAN	1 pt / 3 fl oz + 6 fl oz + 1% v/v + 2.5% v/v	20		<b>+ 3.40</b>
Dual II Mag / Callisto + Clarity + COC + 28% UAN	1 pt / 3 fl oz + 4 fl oz + 1% v/v + 2.5% v/v	0		<b>+ 3.30</b>
Dual II Mag / Hornet + COC + 28% UAN	1 pt / 3 oz wt + 1% v/v + 2.5% v/v	0		
Dual II Mag / Hornet + Aatrex + COC + 28% UAN	1 pt / 3 oz wt + 16 fl oz + 1% v/v + 2.5% v/v	0		<b>+1.50</b>
Dual II Mag / Hornet + Callisto + COC + 28% UAN	1 pt / 3 oz wt + 1 fl oz + 1% v/v + 2.5% v/v	0		<b>+5.00</b>
Dual II Mag / Clarity + 28% UAN	1 pt / 1 pt + 2.5% v/v	0		
Dual II Mag / Clarity + Aatrex + 28% UAN	1 pt / 1 pt + 16 fl oz + 2.5% v/v	0		<b>+1.50</b>
Dual II Mag / Clarity + Callisto + COC + 28% UAN	1 pt / 1 pt + 1 fl oz + 1% v/v + 2.5% v/v	0		<b>+6.20</b>
<b>LSD (P=0.10)</b>		<b>1</b>		

1. Aatrex @ 16 oz = \$1.50, Buctril @ 6 oz = \$3.40, Callisto @ 1 oz/A = \$5.00, Clarity @ 4 oz = \$3.30.

**Table 10. Performance and comparison of herbicide systems with and without atrazine in field corn at Rochester, MN, in 2007 and 2008**

Treatment	Rate(s)	Injury <sup>1</sup> (%)	Giant Ragweed <sup>1</sup>		Common Waterhemp <sup>1</sup>		Common Lambsquarters <sup>1</sup>		Yield	
			----- % control -----		----- % control -----		----- % control -----		Bu/A	
<b>POSTEMERGENCE<sup>2</sup></b>	<b>(rate/A)</b>	<b>2008</b>	<b>2007</b>	<b>2008</b>	<b>2007</b>	<b>2008</b>	<b>2007</b>	<b>2008</b>	<b>2007</b>	<b>2008</b>
Callisto	3 fl oz	0	84	86	94	93	99	98	124	187
Callisto + atrazine	3 fl oz + 16 fl oz	1	95	98	98	94	99	99	159	227
Callisto + Buctril	3 fl oz + 6 fl oz	20	---	96	---	95	---	97	---	234
Callisto + Clarity	3 fl oz + 4 fl oz	0	---	99	---	95	---	99	---	234
Hornet	3 oz	0	81	86	70	41	68	98	109	194
Hornet + atrazine	3 oz + 16 fl oz	0	93	91	86	80	99	98	142	216
Hornet + Callisto	3 oz + 1 fl oz	0	---	97	---	94	---	99	---	212
Clarity	1 pt	0	74	92	73	91	74	99	97	209
Clarity + atrazine	1 pt + 16 fl oz	0	86	97	88	92	99	99	120	230
Clarity + Callisto	1 pt + 1 fl oz	0	---	97	---	92	--	99	---	218
<b>LSD (P=.10)</b>		<b>1</b>	<b>3</b>	<b>3</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>NS</b>	<b>25</b>	<b>NS</b>

1. Injury only occurred in 2008. Injury rating taken on 6/9/2008. Weed control rating 8/10/2007 and 7/30/2008.

2. All treatments had Dual II Magnum applied preemergence at 1 pt per acre.

