

## DUAL AND DUAL MAGNUM ON SUGARBEET

Alan G. Dexter and John L. Luecke

Extension Sugarbeet Specialist and Sugarbeet Research Specialist

Dual (metolachlor) was tested on sugarbeet in eastern North Dakota and Minnesota from 1985 through 1989. Testing was discontinued in 1989 due to a pesticide regulatory law called the Delaney Clause. Dual caused non-cancerous tumors in test animals when administered at high rates. Dual also was found at higher concentrations in sugarbeet pulp and molasses than in fresh sugarbeet roots. The Delaney Clause stated that any pesticide could not be registered if that pesticide caused tumors (benign or malignant) and accumulated in products made from the fresh agricultural product. Thus, Dual could not be registered on sugarbeet since concentrations in pulp and molasses were higher than in the fresh beet. Concentrations of Dual in pulp and molasses, even though higher than in the fresh beet, were still low enough that test animals were not affected by those levels and concentrations in sugar were non-detectable. The Delaney Clause was revoked in August, 1996 allowing the possibility of a label for Dual on sugarbeet. Dual Magnum was tested on sugarbeet from 1997 until the present. The active ingredient in Dual and Dual Magnum is metolachlor but a less active isomer of metolachlor has been removed from Dual Magnum. Thus, Dual Magnum is used at active ingredient rates about 33% less than the old Dual. The more active isomer is designated as s-metolachlor. Dual Magnum (s-metolachlor) was registered on sugarbeet in Spring, 2003.

Sugarbeet injury from Dual Magnum in research plots in 2003 was more than had been observed in the previous 11 years of research with Dual or Dual Magnum. Sugarbeet injury was also common in commercial sugarbeet fields in 2003 with greater injury in American Crystal factory districts and less injury in the Minn-Dak Farmers Cooperative and the Southern Minnesota Beet Sugar Cooperative. Responses to the 2003 annual survey of sugarbeet growers indicated that about 36% of Dual Magnum treated fields were moderately injured and 17% were severely injured, averaged over all factory districts.

The purpose of this paper is to review 2003 research with Dual and Dual Magnum. Data is averaged over years and locations but details on methods and materials are not included to save space and time. Rates of Dual and Dual Magnum are given in pounds of active ingredient per acre rather than product per acre since Dual and Dual Magnum had different formulations.

**Table 1. Dual and Dual Magnum on sugarbeet in eastern North Dakota and Minnesota from 1985 through 2003.**

Year	Treatment	Rate lb/A	Location- years	Average sugarbeet injury %	Injury range %
1985-1989	Dual (PPI)	3	24	10	0 to 38
1997-2002	Dual Magnum (PPI)	2	5	6	0 to 14
2003	Dual Magnum (PPI)	1.9	9	44	20 to 73

Dual was applied preplant incorporated (PPI) at 3 lb/A from 1985 through 1989 and Dual Magnum was applied PPI at 1.9 or 2 lb/A from 1997 through 2003. Dual at 3 lb/A would be equivalent to Dual Magnum at 1.9 lb/A. The average sugarbeet injury from Dual from 1985 through 1989 evaluated visually was 10% and the highest observed injury was 38% (Table 1). The average sugarbeet injury from Dual Magnum from 1997 through 2002 was 6% and the highest observed injury was 14%. Results in 2003 with Dual Magnum were much different than in previous years. The average injury was 44% and injury ranged from 20 to 73% at the nine locations.

**Table 2. Roundup Ready sugarbeet injury and yield from plots at St. Thomas kept nearly weed-free with Roundup, cultivation, and hand weeding in 2003.**

Treatment	Rate lb/A	Sugarbeet injury %	Extractable sucrose lb/A
Nortron (PRE)	3.5	0	7360

Ethotron (PRE)	3.5	0	7210
Etho (Pre)	3.5	0	6910
Dual Magnum (PPI)	1.9	38	5790
LSD (0.05)		6	680

All the ethofumesate formulations, Nortron, Ethotron and Etho, did not cause visible sugarbeet injury and sugarbeet yield from ethofumesate-treated plots was similar (Table 2). Sugarbeet treated with Dual Magnum had 38% injury and yield was less than from sugarbeet treated with ethofumesate. On average, sugarbeet treated with Dual Magnum yielded 1370 lb/A less sucrose than sugarbeet treated with ethofumesate.

**Table 3. Sugarbeet injury observed at locations in 1987, 1988, 1989, 1999 and 2003 and associated environmental conditions.**

Location	PPI treatment	Rate	Seeding date	Sugb inj	Seeding to cot-2 lf	Days with rain	Rain, Seeding to cot-2 lf	Soil texture	OM
		lb/A		%	days		inches		%
Fargo	Dual Mag	1.9	5/21/99	0	19	5	2.0	silty clay	5.5
Amenia	Dual	3.0	4/28/89	8	27	5	1.6	silt loam	3.4
Crookston	Dual	3.0	4/26/88	8	28	8	1.4	silt loam	4.2
Crookston	Dual	3.0	4/23/87	15	22	3	0.8	silt loam	4.2
Hillsboro	Dual	3.0	5/4/87	38	24	9	3.3	silty clay	5.6
Crookston	Dual Mag	1.9	4/29/03	64	27	10	3.2	silty clay loam	3.1

Sugarbeet injury at the six locations varied from 0 to 64% (Table 3). The Fargo-1999 site had the least injury. The Fargo-1999 site also had the latest seeding date and took a relatively short 19 days from seeding to the cotyledon to two-leaf stage. Rain was plentiful in 1999 with five rain events totaling 2.0 inches in the 19 days after seeding. This suggests that conditions that favor quick emergence and growth; such as warm, moist soil; will reduce the risk of sugarbeet injury from Dual Magnum.

The Crookston-2003 site had the greatest sugarbeet injury from Dual Magnum (Table 3). Sugarbeet at Crookston-2003 were seeded early and took a relatively long 27 days from seeding to the cotyledon to two-leaf stage. Rain in 2003 was frequent with ten rain events totaling 3.2 inches in the 27 days after seeding. This suggests that conditions that favor rapid seed imbibition but slow emergence, such as moist, cool soils, would increase the risk of sugarbeet injury from Dual Magnum.

Soil texture and organic matter did not appear to be well correlated with sugarbeet injury (Table 3). Sugarbeet at Hillsboro-1987 were injured 38% by Dual and Hillsboro-1987 plots were on a silty-clay soil with 5.6% organic matter. Sugarbeet injury at Amenia-1989 was only 8% on a lighter silt-loam soil with 3.4% organic matter. Sugarbeet at Hillsboro -1987 took a relatively long 24 days from seeding to the cotyledon to two-leaf stage and nine rain events with a total of 3.3 inches of rain fell in the 24 days after seeding.

Slow emergence and growth did not always result in severe sugarbeet injury. Sugarbeet at Crookston-1988 took 28 days from seeding to the cotyledon to two-leaf stage and observed injury was only 8% (Table 3). Rain fell frequently in eight events but the total rain was only 1.4 inches in the 28 days after seeding. Perhaps the amount of rain was not sufficient to fully activate the Dual and cause sugarbeet injury. However, at Crookston-1987, total rain between seeding and the cotyledon to two-leaf stage was only 0.8 inch and observed sugarbeet injury was 15%, more than at Crookston-1988.

The observed environmental conditions do not fully explain variation in sugarbeet injury from Dual Magnum in various years and locations (Table 3). However, cool soil that slows sugarbeet emergence plus abundant rainfall apparently increases the risk of sugarbeet injury from Dual Magnum.

**Table 4. Sugarbeet injury from Dual Magnum at 1.9 lb/A locations in 2003 and associated environmental conditions.**

	$\frac{(\text{Sugb injury} + \text{stand loss})}{2}$	Seeding date	Seeding to cot-2 lf	Days with rain	Rain, Seeding to cot-2 lf	Soil texture	OM
	%		days		inches		%
Wahpeton	21	4/25	22	11	2.5	Silt loam	4.4

Tintah	22	4/28	24	14	3.0	Loam	4.4
Fargo	30	5/13	20	9	1.1	Silty clay	5.4
Amenia	30	4/23	26	10	3.1	Silt loam	3.9
Morris	30	4/28	23	-	-	Silt loam	5.7
Glasston	34	5/1	25	11	3.0	Silty clay loam	5.8
St. Thomas	35	5/1	25	11	3.0	Silt loam	4.3
Crookston	42	4/29	27	10	3.2	Silty clay loam	3.1

The sugarbeet injury data in [Table 4](#) is the average of a visual rating of sugarbeet injury and percent stand loss comparing Dual-treated rows to adjacent untreated rows in 2003. Sugarbeet at all locations were injured significantly. The southern locations like Tintah and Wahpeton were injured less than the more northern locations like St. Thomas, Glasston and Crookston. However, this was not universally true since the most southern location, Morris, was in the middle of the injury range. Rainfall data was not available for Morris. Seeding dates were early, from April 23 to May 1, except for Fargo on May 13. Fargo had the shortest time from seeding to the cotyledon to two-leaf sugarbeet stage as would be expected with the latest seeding but Fargo did not have the least sugarbeet injury.

All locations had numerous rain events between seeding and the cotyledon to two-leaf stage. Generally, injury was greater with more days between seeding and the cotyledon to two-leaf stage but Amenia, with a relatively long 26 day period, is in the middle of the injury range.

Soil texture and organic matter did not correlate well with sugarbeet injury. Sugarbeet injury appeared to be somewhat related to days from seeding to the cotyledon to two-leaf sugarbeet stage but the relationship is not perfect. Numerous rain events plus slow sugarbeet development from seeding until the cotyledon to two-leaf sugarbeet stage probably increased herbicide uptake and increased sugarbeet injury in 2003 compared to previous years.

Preemergence (PRE) Dual Magnum was not compared to preplant incorporated (PPI) Dual Magnum in 2003 research. PRE Dual was compared to PPI Dual in 1986 and 1987 at several locations in eastern North Dakota and Minnesota and a summary of the data is presented in [Table 5](#).

**Table 5. PRE Dual compared to PPI Dual in 1986 and 1987.**

Treatment	Rate	12 loc Sugb inj (range)	7 loc Rrpw cntl (range)	10 loc Fxtl cntl (range)
	lb/A	%	%	%
Dual (PRE)	3	4 (0-14)	68 (18-92)	64 (6-93)
Dual (PPI)	2	5 (0-28)	78 (51-95)	89 (70-95)
Dual (PPI)	3	12 (0-38)	90 (79-99)	94 (80-98)
LSD (0.05)		3	4	6

PRE Dual at 3 lb/A gave similar sugarbeet injury and less weed control than PPI Dual at 2 lb/A ([Table 5](#)). The poorest observed weed control from PRE Dual was worse than the poorest control from PPI Dual even though the rate of PPI Dual was one-third lower. PPI Dual at 3 lb/A caused more sugarbeet injury and gave better weed control than PRE Dual at 3 lb/A or PPI Dual at 2 lb/A. Rainfall in 1986 and 1987 was limited and this partially explains the poor performance by PRE Dual in those years.

PRE Dual Magnum, on average, will give less sugarbeet injury than PPI Dual Magnum. This was observed in past research and in several commercial sugarbeet fields in 2003. However, PRE Dual Magnum may give poor weed control if rain after application is not sufficient to fully activate the Dual Magnum.

**Table 6. Dual Magnum used PPI and as a lay-by treatment in 1997.**

Treatment	Rate	Sugarbeet injury	Redroot pigweed cntl
	lb/A	%	%

Dual Magnum (PPI)	1.9	14	100
Dual Magnum (2-6 lf)	1.9	0	13
Dual Magnum (2-6 lf)	2.6	0	71
LSD (0.05)		7	12

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PPI Dual Magnum at 1.9 lb/A gave better weed control and more sugarbeet injury than lay-by Dual Magnum applied when sugarbeet plants had two to six leaves ([Table 6](#)). Dual Magnum applied to sugarbeet after the plants have two to four leaves will not generally cause significant sugarbeet injury. Dual Magnum applied to cotyledon to two-leaf sugarbeet may cause significant sugarbeet injury. Dual Magnum will not control emerged weeds so excellent weed control prior to a lay-by application is important. Lay-by Dual Magnum will control late emerging weeds if an activating rain falls after application.

#### SUMMARY

Sugarbeet injury from Dual Magnum was more severe in 2003 than in any of the previous 11 years of testing of Dual and Dual Magnum. An unusually cold spring, early sugarbeet seeding, and frequent rain events probably slowed sugarbeet emergence, increased uptake of Dual Magnum by the sugarbeet plants and caused more sugarbeet injury than previously observed. PRE and lay-by Dual Magnum caused less sugarbeet injury than PPI Dual Magnum. Fall-applied Dual Magnum will give less sugarbeet injury than spring-applied Dual Magnum. However, PPI Dual Magnum often will give better weed control than PRE, lay-by or fall-applied Dual Magnum, especially in dry spring conditions.

Field observations in 2003 suggest that shallow sugarbeet seeding and increasing the seeding rate will reduce the damage from Dual Magnum. Sugarbeet plants that are injured by Dual Magnum, but survive, often will recover better than expected. Increased seeding rate may allow an adequate remaining sugarbeet stand even if Dual Magnum reduces the final sugarbeet population.

Sugarbeet injury from Dual Magnum was unusually severe in 2003. However, similar weather after seeding in the future probably will result in similar sugarbeet injury. Shallow seeding and increasing seeding rate will reduce but not eliminate losses in sugarbeet yield due to injury.