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EFFECT OF RIMSULFURON (SEVERAL TRADE NAMES) AND MESOTRIONE (CALLISTO) CARRYOVER IN SOIL ON SUGARBEET

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Mesotrione (Callisto), a triketone, is a preemergence or postemergence herbicide for use in corn. Mesotrione controls all major broadleaf weeds at substantially lower rates than most alternative herbicides, while providing the grower with excellent flexibility in application timing. Mesotrione is an effective alternative mode of action for controlling ALS and triazine resistant weeds.

Rimsulfuron (Matrix, Basis, Steadfast and others), a sulfonulurea, is a preemergence or postemergence herbicide used in corn and potato. Rimsulfuron effectively controls annual and perennial grasses and several broad-leaved weeds.

Mesotrione and rimsulfuron have been observed to persist from previous crops and cause injury to sugarbeet. Sugarbeet injury from rimsulfuron carryover has generally been observed following potato. Mesotrione is registered specifically in corn. Soil pH, along with soil "aging", has been shown to affect carryover with imidazolinone herbicides (Bresnahan et al. 2000;2001). For example, when a pesticide is applied in one year and aged over the winter it can become sorbed or sequestered depending on different soil properties and is unavailable for microbial degradation. Soil properties can vary within a field and can affect degradation and field dissipation rates (Mallawatantri and Mulla, 1992). A number of herbicides are sorbed then desorbed for microbial breakdown when soil pH is altered. Pesticides that persist in soil often become increasingly less available to microorganisms as indicated by markedly declining rates of biodegradation in field soil with the passage of time (Nam and Alexander, 1998). This decreased availability for degradation may result in carryover with subsequent damage to susceptible crops. Good soil management practices through pH measurement or manipulation can help to predict the possible persistence of the herbicide and influence crop rotation choices.

Soil sorption processes directly or indirectly control the amount of pesticides in solution, it appears that the "age" of the soil residue and pH of the soil would, therefore, also affect the potential leaching of pesticides. This research will assist in the ability to predict damaging soil carryover from mesotrione and rimsulfuron.

The objective of this study is to assess photo-degradation of mesotrione and rimsulfuron and its effect on the efficacy of the herbicide.

Experiments were established for rimsulfuron and mesotrione at Fargo and Crookston in experimental plots 11 feet wide and 30 feet long between July 15 and July 22, 2002. Mesotrione (Callisto) at 0, 3, 6 and 12 fluid oz/A and rimsulfuron (Matrix) at 0, 1.5, 3 and 6 fluid oz/A were applied on bare soil to the center 6.67 feet of each plot. Herbicides were applied in 17 gpa water at 40 psi through 8002 nozzles. Herbicide incorporation was with a rototiller set two inches deep. Herbicide treatments were left unincorporated, incorporated immediately or incorporated 24, 72 and 96 hours after application. 'Dekalb RR corn' was solid seeded with a grain drill across all plots. Corn was chopped with a flail shredder in September, 2002. All plots were tilled with a rototiller 1 week after chopping corn. Spring tillage was one pass in the same direction as herbicides were applied with a 'Kongskilde Triple K' field cultivator with rolling baskets. 'Hilleshog 8277' Roundup Ready sugarbeet was seeded 1.25 inches deep in 22 inch rows. Roundup Ultramax was applied to all plots at 1 qt/A early June and 2 qt/A mid-July for general weed control. Sugarbeet was counted in the center two rows of 30 foot long plots in early June, 2003. Eminent fungicide at 13 fl oz/A was applied to all plots mid-July and late August, 2003. Headline fungicide at 9 fl oz/A was applied to all plots early August, 2003. Sugarbeet was hand thinned to an eight inch spacing in June, 2003. Sugarbeet injury was evaluated in early and mid July, 2003. Sugarbeet from the center two rows of each plot was counted and harvested September. 2003.

Mesotrione was applied in 2002 to bare soil and left unincorporated or incorporated over time. Mesotrione caused no significant visible injury to sugarbeet seeded in 2003 (Data not shown). Sugarbeet sucrose %, root yield and extractable sucrose was not impacted by herbicide rate or incorporation times (Table 1).

Rimsulfuron applied to bare soil in 2002 caused visible injury to sugarbeet in 2003 (Table 2). Sugarbeet populations were significantly reduced by rimsulfuron at 0.047 lb/A with incorporation at 0 or 24 hours after application and at 0.094 lb/A with all

times of incorporation. Sugarbeet plots in September with unincorporated rimsulfuron at 0.094 lb/A had higher sugarbeet populations than plots where rimsulfuron was incorporated immediately after application.

Rimsulfuron carryover decreased percent sucrose across all sugarbeet plots when compared to the untreated control with the exception of plots treated with 0.023 lb/A with no incorporation (Table 3). Carryover of Rimsulfuron at 0.047 and 0.094 lb/A decreased sugarbeet root yield compared with untreated sugarbeet (Table 3). Rimsulfuron at 0.023 lb/A also decreased root yield with the exception of the unincorporated
treatments. Plots treated with incorporated rimsulfuron at 0.094 lb/A yielded on average 7.5 tons/A less than plots treated with unincorporated rimsulfuron at 0.094 lb/A. Extractable sucrose amount decreased as rimsulfuron rate increased. Plots treated with unincorporated rimsulfuron at 0.023 lb/A,yielded 6726 lb/A of extractable sucrose. Plots treated with rimsulfuron and incorporated 96 hrs after application yielded 5432 lb/A of extractable sucrose. A larger decrease was observed with 0.094 lb/A of rimsulfuron. Unincorporated treatments when compared to 96 hr treatments yielded 2,300 lb/A less extractable sucrose. Across all plots extractable sucrose decreased with rimsulfuron treated sugarbeet when compared to untreated controls.

The phytotoxicity of rimsulfuron carryover was less when treatments of rimsulfuron at 0.023, 0.047 and 0.094 lb/A were not soil incorporated. This suggests rimsulfuron may be photo-labile, and photo-degradation of rimsulfuron occurred after the final incorporation time. Vapor loss may also play a role in rimsulfuron efficacy. Sugarbeet injury increased as rimsulfuron application rate increased. Injury was more severe at the 0.094 lb/A rate than at the 0.023 lb/A rate. Increasing time between application and incorporation of rimsulfuron did not affect sugarbeet yield or injury which would suggest that degradation of the chemical is longer than 96 hrs..

Table 1. Mesotrione carryover to sugarbeet 2003 averaged over Crookston and Fargo

Treatment	Rate	Time to incorporation	Sucrose	Root yield	Extractable sucrose
	fl oz/A	hours	%	ton/A	lb/A
Mesotrione	3	No incorp	15.3	25.9	6913
Mesotrione	3	0	15.5	25.8	7032
Mesotrione	3	24	15.7	25.0	6902
Mesotrione	3	72	15.8	25.2	6971
Mesotrione	3	96	15.3	26.1	6950
Mesotrione	6	No incorp	15.3	26.1	6970
Mesotrione	6	0	15.6	25.3	6739
Mesotrione	6	24	16.0	24.5	6914
Mesotrione	6	72	15.7	25.6	7030
Mesotrione	6	96	15.3	26.1	6853
Mesotrione	12	No incorp	15.0	26.4	7353
Mesotrione	12	0	15.5	26.5	7252
Mesotrione	12	24	15.8	25.0	7044
Mesotrione	12	72	15.6	26.1	7145
Mesotrione	12	96	15.5	25.5	6960
Untreated	0		15.5	26.9	7308
CV%			3.1	5.9	6
LSD (0.05)			NS	NS	NS

Table 2. Effect of rimsulfuron carryover on sugarbeet injury and population in 2003 averaged over Crookston and Fargo

Treatment	Rate		Time to incorporation	Sugarbeet injury[1]	Sugarbeet June population	Sugarbeet Sept population
	fl oz/A	lb ai/A	hours	%	Plants/60 ft	
Rimsulfuron	1.5	0.023	No incorp	18	233	87
Rimsulfuron	1.5	0.023	0	36	232	86
Rimsulfuron	1.5	0.023	24	39	242	86
Rimsulfuron	1.5	0.023	72	40	238	85
Rimsulfuron	1.5	0.023	96	36	236	89
Rimsulfuron	3	0.047	No incorp	43	231	82
Rimsulfuron	3	0.047	0	55	217	77
Rimsulfuron	3	0.047	24	66	217	87
Rimsulfuron	3	0.047	72	57	233	85
Rimsulfuron	3	0.047	96	61	236	81
Rimsulfuron	6	0.094	No incorp	61	222	72
Rimsulfuron	6	0.094	0	80	196	40
Rimsulfuron	6	0.094	24	83	204	61
Rimsulfuron	6	0.094	72	83	223	56
Rimsulfuron	6	0.094	96	84	196	48
Untreated	0	0	------	0	242	88
CV%				29.5	9	23

LSD (0.05)	14	19	17

[1]averaged over two visual evaluation of injury

Table 3. Effect of rimsulfuron carryover on sugarbeet percent sucrose, root yield and extractable sucrose in 2003 averaged over Crookston and Fargo

Treatment	Rate		Time to incorporation	Sucrose	Root yield	Extractable sucrose	
	fl oz/A	lb ai/A	hours	%	ton/A	lb/A	
Rimsulfuron	1.5	0.023	No incorp	16.0	23.9	6726	
Rimsulfuron	1.5	0.023	0	15.9	21.7	6076	
Rimsulfuron	1.5	0.023	24	15.7	19.9	5542	
Rimsulfuron	1.5	0.023	72	15.4	20.2	5466	
Rimsulfuron	1.5	0.023	96	15.4	20.2	5432	
Rimsulfuron	3	0.047	No incorp	15.4	19.2	5217	
Rimsulfuron	3	0.047	0	15.4	17.9	4825	
Rimsulfuron	3	0.047	24	15.2	14.9	3996	
Rimsulfuron	3	0.047	72	15.3	15.7	4242	
Rimsulfuron	3	0.047	96	15.5	15.1	4129	
Rimsulfuron	6	0.094	No incorp	15.7	15.4	4298	
Rimsulfuron	6	0.094	0	15.2	8.9	2332	
Rimsulfuron	6	0.094	24	15.1	8.5	2299	
Rimsulfuron	6	0.094	72	15.0	6.7	1805	
Rimsulfuron	6	0.094	96	14.8	7.7	1998	
Untreated	0	0	-----	15.7	24.7	6390	
CV%				3.9	25.9	26	
LSD (0.05)				0.6	4.2	1130	

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