

Developing a practical guide to grower decision-making in herbicide drift and carryover situations in sugar beet.



SUGAR BEET RESEARCH

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Introduction

Each spring consultants and scientists respond to a number of field calls regarding herbicide drift and/or carryover from other crops. In Idaho and Oregon, the early stages of sugar beet growth coincide with post emergence weed control in small grains and preemergence herbicide applications in potatoes. Herbicides commonly used in these crops are among the common culprits in drift cases. In addition, cases of carryover are frequent when growers move to unfamiliar ground, whether rented or newly acquired, where the crop history can be unclear. In both types of cases growers typically face three options: 1) Conduct a tissue analysis to ID herbicides and concentrations, 2) Terminate the crop and either replant or plant to alternative crop, 3) Allow the crop to finish out the season.

Trials were conducted from 2022-2024 looking at several modes of action affecting sugar beets under both herbicide carryover and drift situations.



Photo 1. Visualization of plot yields and root disfigurement of herbicide carryover plots 30 days prior to harvest at Nyssa (ASC) in 2022.

Table 1. Residue analysis of carryover soil samples at UI and ASC sites in 2022.

Herbicide	Trade Name	ppb	
		ASC	UI
untreated	--	--	--
rimsulfuron	Matrix® SG	ND	ND
metribuzin	Tricor® 4F	21.7 ²	ND
imazamox	Raptor®	<5	ND
terbacil	Sinbar®	165	89.7
flumioxazin	Valor SX®	ND	ND
pendimethalin	Prowl® H ₂ O	36.4	25.1
mesotrione	Callisto®	ND	ND

¹Limit of detection (LOD) = LOD for Matrix® SG is 0.3 ppb, for Tricor® 4F is 6 ppb, for Raptor® is 1 ppb, for Sinbar® is 3 ppb, for Valor SX® is 2 ppb, for Prowl® H₂O is 5 ppb, and for Callisto® is 3 ppb. ND = Not detected; does not constitute complete absence of residue.

Research Objectives

- Evaluate the risk and impact of carryover from specimen herbicides from HRAC groups 2, 3, 5, 14, & 27 on sugar beet yield and quality.
- Evaluate the response of sugar beet and potential recovery from herbicide drift from specimen herbicides from HRAC groups 2, 4, & 5 on sugar beet yield and quality.
- Establish a relationship between herbicide residue levels and potential sugar beet yield or quality loss.

Methodology

Carryover. Trials were conducted at two sites in Oregon (ASC and OSU (data not shown)) and one in Idaho (UI). Treatments were applied to bare soil approximately one year prior to planting sugar beets using a CO₂ powered backpack sprayer and incorporated with 1" of water. Plots were tested for herbicide residues at the time of planting (1 year later) and samples sent to South Dakota Agricultural Labs for residue analysis (Table 1).

Drift. Trials were conducted at two sites in Idaho (ASC and UI). Sugar beets were planted in spring at 4.5 inch spacing (64,152 seeds/A). Simulated drift treatments were applied directly to plots when the sugar beets reached the 2-leaf stage using a CO₂ powered backpack sprayer. Plant samples were collected 14 DAT and sent to South Dakota Agricultural Labs for residue analysis (Table 3).

In both sets of trials, stand counts, visual injury (data not shown), and mid-season biomass, data were collected throughout the season. In September, the two center rows of each plot were harvested, weighed, and two 25 lb samples collected for measurement of sugar content and quality parameters.

Results

Carryover. Carryover from herbicides mainly affected sugar beet yield and not sucrose content or any quality parameters. Sinbar® decreased sugar beet yield significantly at both Idaho sites. Raptor® and Tricor® 4F had significant negative impacts on yield at the ASC site (Table 2).

Table 2. Sugar beet health and quality indicators from plots with herbicide carryover at two sites in 2022.

Treatments	UI				ASC			
	Stand beets/A	Biomass ¹ lbs/A	Yield T/A	Sucrose %	Stand beets/A	Biomass lbs/A	Yield T/A	Sucrose %
Untreated	21,087 a ²	3,953 a	31.00 b	14.90	45,381 ab	3,146	41.75 a	15.93
Matrix® SG	19,899 a	4,182 a	34.00 ab	15.00	53,460 a	3,964	42.16 a	15.97
Tricor® 4F	21,978 a	3,837 a	35.00 ab	15.10	22,723 c	2,177	32.03 bc	15.60
Raptor®	21,087 a	5,046 a	38.00 ab	15.1	7,841 d	1,119	12.92 d	15.22
Sinbar®	10,395 b	2,031 b	19.00 c	14.70	10,930 cd	1,494	26.76 c	15.52
Valor SX®	20,642 a	4,416 a	34.00 ab	14.80	39,442 b	3,098	41.85 a	15.93
Prowl® H ₂ O	24,206 a	4,850 a	40.00 a	15.20	43,481 ab	2,443	38.98 ab	16.08
Callisto®	26,433 a	5,008 a	38.00 ab	15.10	44,431 ab	2,409	44.6 a	15.52
LSD				NS	58.24	NS	7.04	NS
Prob (P>F)	.01	<.001	<.001	.320	<.001	.1070	<.001	.3366

¹Biomass taken from 10 feet of row at the 10-leaf stage.

²Means within a column followed by the same letter are not statistically different (Levene's LSD (P=.05)).

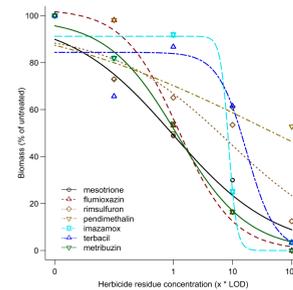


Figure 1. Relationship between herbicide residue and potential sugar beet total biomass reduction from greenhouse bioassay. LOD = limit of detection.

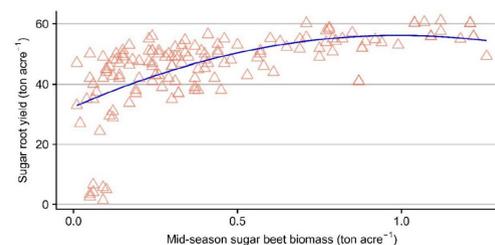


Figure 2. Relationship between mid-season biomass and sugar beet root yield as collected from herbicide drift trials at Nampa (ASC) and Kimberly (UI) in 2024.

Table 3. Residual sample results from tissue samples taken 14 days after drift treatments in 2024.

Treatment	Nampa (ASC)	Kimberly (UI)
Untreated	--	--
Matrix® SG @ 3.125%	>0.4	ND
Matrix® SG @ 6.25%	>0.4	ND
Matrix® SG @ 12.5%	2.6	ND
Matrix® SG @ 25%	3.9	0.48
Harmony® SG @ 3.125%	9.3	ND
Harmony® SG @ 6.25%	20	ND
Harmony® SG @ 12.5%	59	0.75
Harmony® SG @ 25%	160	1.4
Starane® Ultra @ 3.125%	19.3	16
Starane® Ultra @ 6.25%	23.5	20.3
Starane® Ultra @ 12.5%	51.6	51.6
Starane® Ultra @ 25%	119	80.6
Tricor® 4F @ 3.125%	27.8	23.8
Tricor® 4F @ 6.25%	80.9	53.4
Tricor® 4F @ 12.5%	146	97.2
Tricor® 4F @ 25%	363	190

¹LOD=Limit of detection; LOD for Matrix® SG is 0.4 ppb, LOD for Harmony® SG is 0.4 ppb, LOD for Starane® Ultra is 1 ppb, LOD for Tricor® 4F is 3 ppb. ND = Not detected.
²Percentage of field use rate; Matrix® SG = 1.5 oz/A, Harmony® SG = 0.6 oz/A, Starane® Ultra = 6.4 fl oz/A, Tricor® 4F = 16 oz/A.



Photo 2. Visualization of plot yields and root effects from plots treated with herbicide "drift" at Nampa (ASC) in 2024.

Drift. All treatments caused significant visible injury compared to untreated check which increased as rates increased. Harmony® SG decreased yield the most followed by Matrix® SG.

In both trials several treatments yielded similar to the untreated check (Tables 2&4) indicating potential recovery of sugar beet from drift or carryover of certain chemistries.

Table 4. Sugar beet health and quality indicators from plots with herbicide drift at two sites in 2024.

Treatments	UI				ASC			
	Stand beets/A	Biomass ¹ lbs/A	Yield T/A	Sucrose %	Stand beets/A	Biomass lbs/A	Yield T/A	Sucrose %
Untreated	40,392	660 abc ²	45.66	18.57	37,422 ab	2,280 a	58.03 ab	17.78 abc
Matrix® SG @ 3.125%	39,789	1,000 a	49.16	18.34	38,016 ab	1,920 ab	52.74 cde	17.64 a-d
Matrix® SG @ 6.25%	49,005	720 abc	46.62	18.22	38,016 ab	1,640 b	54.26 bcd	17.86 ab
Matrix® SG @ 12.5%	44,847	980 a	47.33	18.26	39,204 ab	740 cd	48.74 ef	17.72 a-d
Matrix® SG @ 25%	40,095	820 ab	47.97	18.17	38,610 ab	340 e	46.93 f	17.58 a-d
Harmony® SG @ 3.125%	41,654	580 a-d	47.04	18.49	24,354 c	260 ef	34.79 g	17.35 cd
Harmony® SG @ 6.25%	41,877	980 a	48.29	27.07	12,474 d	240 f	32.57 g	16.6 e
Harmony® SG @ 12.5%	42,768	520 bcd	45.15	18.14	0 e	160 g	4.63 h	15.87 f
Harmony® SG @ 25%	36,383	680 abc	38.2	17.75	0 e	120 h	3.02 h	14.73 g
Starane® Ultra @ 3.125%	45,738	580 a-d	46.17	18.13	38,016 ab	1,840 ab	59.62 a	17.64 a-d
Starane® Ultra @ 6.25%	39,501	480 bcd	45.66	17.7	39,798 ab	1,760 ab	54.14 bcd	17.39 bcd
Starane® Ultra @ 12.5%	43,659	520 bcd	44.58	18.29	40,392 a	1,560 b	53.33 b-e	17.55 a-d
Starane® Ultra @ 25%	40,392	560 a-d	41.2	18.41	42,174 a	1,440 b	51.38 def	17.28 d
Tricor® 4F @ 3.125%	44,550	380 cd	45.79	18.15	40,392 a	1,400 b	56.84 abc	17.92 a
Tricor® 4F @ 6.25%	38,313	260 de	44.96	18.2	39,798 ab	760 c	53.79 b-e	17.71 a-d
Tricor® 4F @ 12.5%	43,362	80 e	41.67	17.91	39,204 ab	560 d	52.41 cde	17.82 abc
Tricor® 4F @ 25%	30,294	60 e	37.42	17.99	34,452 b	300 ef	49.42 def	17.96 a
LSD	NS	0.103-0.229	NS	NS	5,926.3	0.021-0.315	5.157	0.483
Prob (P>F)	.0567	<.001	.1611	.4693	<.001	<.001	<.001	<.001

¹Biomass taken from 10 feet of row at the 4-leaf stage.

²Means within a column followed by the same letter are not statistically different (Levene's LSD (P=.05)).

Data from greenhouse trials conducted in tandem indicate herbicide residues in plant tissues could be a potential indicator for determining end-of-season yields (Figure 1).

Mid-season biomass data from the drift trials also suggests potential to predict end-of-season yield using in-field biomass collections as early as the 4-6 leaf stage (Figure 2).