Carryover of Common Corn and Soybean Herbicides to Various Cover Crop Species in Missouri

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INTRODUCTION

Interest in cover crops as an element of corn and soybean production systems in the Midwest has increased. This trend has led to the need for additional research to better understand certain aspects including the effect of previous corn and soybean herbicide programs on cover crop stand.

OBJECTIVE

Evaluate the effects of common corn and soybean herbicide programs on the stand and biomass of 8 different cover crop species seeded in the fall.

MATERIALS and METHODS

TRIAL LAYOUT

- Trials conducted in 2013 and 2014 at Bradford Research Center, Columbia, Missouri
- Corn and soybean planted June 12, 2013
- Corn planted May 19, and soybean June 3, 2014
- Soybean planted at 432,434 seed per hectare (ha); corn at 79,074 seed per ha
- Herbicide treatments listed in Tables 1 and 2

TABLE 1: Corn herbicide programs

Herbicide	Amount (kg/ha)
atrazine	2.27
clopyralid	0.283
flumetsulam	0.0283
isoxaflutole	0.177
mesotrione	0.107
nicosulfuron	0.0256
pyroxasulfone	0.085
rimsulfuron	0.0283
tembotrione	0.108
thiencarbozone	0.108
topramezone	0.027
acetolachlor + flumetsulam+clopyralid	0.99
mesotrione + glyphosate + s-metolachlor	2.27

TABLE 2: Soy herbicide programs

Herbicide	Amount (kg/ha)
sulfentrazone[a]	0.284
flumioxazin[a]	0.071
metribuzin[a]	0.227
sulfentrazone+cloransulam[a]	0.181
chlorimuron[a]	0.0425
fomesafen[b]	0.710
lactofen[b]	0.443
imazethapyr[b]	0.142
cloransulam[b]	0.017
chlorimuron+thifensulfuron[b]	0.0108
S-metolachlor[b]	0.754
acetochlor[b]	1.7
pyroxasulfone[b]	0.085
S-metolachlor+fomesafen[b]	1.13

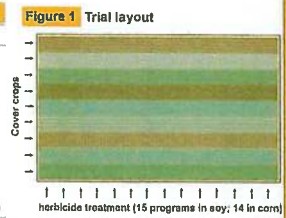
[a]Herbicide was applied as a Pre
[b]Herbicide was applied on weeds that were 10 to 15 cm in height

- Corn and soybean removed as forage in September
- 9 cover crop treatments (Table 3) were planted on September 10 each year
- Each plot was 3 x 27 m^2 and consisted of 16 rows of every cover crop with row spacing of 19 cm (Figure 1)
- Each treatment was replicated 4 times

TABLE 3: Species planted

Cover crop	Seeding rate
Winter wheat	112.1 kg/ha
Cereal rye	112.1 kg/ha
Tillage radish	6.7 kg/ha
Crimson clover	22.4 kg/ha
Winter oat	78.5 kg/ha
Austrian winter pea	58.0 kg/ha
Annual ryegrass	22.4 kg/ha
Hairy vetch	16.8 kg/ha
Vetch and rye mix	16.8 + 67.3 kg/ha

Figure 1 Trial layout



MATERIALS and METHODS (continued)

DATA COLLECTION and ANALYSIS

- Stand density counts were conducted in 2, 1/6 m^2 areas for each cover crop in every plot at 14 and 28 days after emergence (DAE).
- Stand counts from each plot were averaged, and then all replications of each treatment were averaged and multiplied by 6 to get the stand density per m^2.
- Tissues were harvested for each cover crop in a 1/3 m^2 area, dried, and weighed to measure biomass. Dry weights for each treatment were averaged and compared to that of the non-treated control.

RESULTS

INFLUENCE of SOYBEAN HERBICIDE CARRYOVER

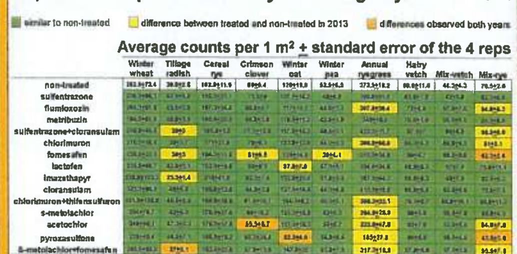
Cover crop stand density was affected more in 2013 than 2014 (Figures 2A and 2B)

Cover crop species affected in both years included:

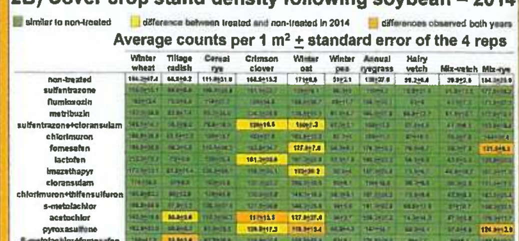
- tillage radish following *S*-metolachlor+fomesafen (Figure 2C)
- crimson clover following acetochlor
- winter oat following pyroxasulfone
- cereal rye & vetch mix following fomesafen and pyroxasulfone

Fig. 2 Cover crop stand density (28 DAE)

2A) Cover crop stand density following soybean – 2013


similar to non-treated
difference between treated and non-treated in 2013
differences observed both years
Average counts per 1 m² ± standard error of the 4 reps
Winter wheat
Tillage radish
Cereal rye
Crimson clover
Winter oat
Winter pea
Annual ryegrass
Hairy vetch
Mix-vetch
Mix-rye
non-treated
sulfentrazone
flumioxazin
metribuzin
sulfentrazone+cloransulam
chlorimuron
fomesafen
lactofen
imazethapyr
cloransulam
chlorimuron+thifensulfuron
s-metolachlor
acetochlor
pyroxasulfone
S-metolachlor+fomesafen

2B) Cover crop stand density following soybean – 2014


similar to non-treated
difference between treated and non-treated in 2014
differences observed both years
Average counts per 1 m² ± standard error of the 4 reps
Winter wheat
Tillage radish
Cereal rye
Crimson clover
Winter oat
Winter pea
Annual ryegrass
Hairy vetch
Mix-vetch
Mix-rye
non-treated
sulfentrazone
flumioxazin
metribuzin
sulfentrazone+cloransulam
chlorimuron
fomesafen
lactofen
imazethapyr
cloransulam
chlorimuron+thifensulfuron
s-metolachlor
acetochlor
pyroxasulfone
S-metolachlor+fomesafen

2C) Tillage radish following select herbicide treatments

RESULTS (continued)

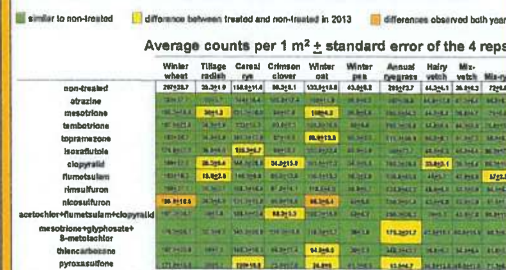
INFLUENCE of CORN HERBICIDE CARRYOVER

More cover crops were affected in 2013 than in 2014 (Figures 3A and 3B)

Cover crop species affected in both years included winter wheat and winter oat following nicosulfuron

Fig. 3 Cover crop stand density (28 DAE)

3A) Cover crop stand density following corn – 2013


similar to non-treated
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Average counts per 1 m² ± standard error of the 4 reps
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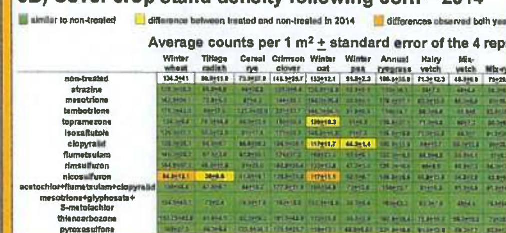
Tillage radish
Cereal rye
Crimson clover
Winter oat
Winter pea
Annual ryegrass
Hairy vetch
Mix-vetch
Mix-rye
non-treated
atrazine
mesotrione
tembotrione
topramezone
isoxaflutole
clopyralid
flumetsulam
rimsulfuron
nicosulfuron
acetochlor+flumetsulam+clopyralid
mesotrione+glyphosate+ S-metolachlor
thiencarbazone
pyroxasulfone

3B) Cover crop stand density following corn – 2014


similar to non-treated
difference between treated and non-treated in 2014
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Winter wheat
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mesotrione
tembotrione
topramezone
isoxaflutole
clopyralid
flumetsulam
rimsulfuron
nicosulfuron
acetochlor+flumetsulam+clopyralid
mesotrione+glyphosate+ S-metolachlor
thiencarbazone
pyroxasulfone

CONCLUSIONS

This data suggest that certain residual herbicides common in Midwest soybean and corn programs such as fomesafen and pyroxasulfone can reduce the stand of select cover crop species planted in the fall.

Cover crop stand densities showed more significant differences in 2013. Rain was likely a primary factor in the difference between 2013 and 2014 results. From April to October of 2014, Columbia, Missouri received 25 cm more rain than over the same span of 2013 (Figure 4). This precipitation may have impacted the concentration of herbicide left in the soil at time of cover crop planting.

Fig. 4 Rainfall at Columbia, Missouri, 2013-14