Weed suppression by integrating cultural tactics in western Canadian soybean production

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Introduction

Soybean [*Glycine max* (L.) Merr.] seeded area in western Canada has grown by 36% in the past decade[1]. As a warm-season species, soybean is at a competitive disadvantage when growing with cool-season weeds in this short-season environment[2]. Soybean production in western Canada faces the additional challenge of volunteer canola (*Brassica napus* L.) interference due to similar herbicide resistance traits in these crop species and unique overlap in the predominant area where these crops are grown[3,4]. The presence of other glyphosate-resistant weeds, such as kochia [*Bassia scoparia* (L.) A.J. Scott][5], can also make weed management challenging in soybean production. Further research is warranted to identify optimal integration of cultural tactics for weed suppression in soybean grown in western Canada.

Objective:

- Determine the impact of (***a***) presence vs. absence of a fall rye cover crop, (***b***) bushy vs. slender soybean cultivar, (***c***) narrow vs. wide soybean row spacing, and (***d***) 1X vs. 1.5X recommended soybean target densities on weed suppression and soybean productivity in western Canada.

Materials & Methods

Small-plot field experiment

- Split-block randomized complete block design
  - **6 site-years** (**Fig. 1**)
    - Lethbridge, AB irrigated – 2020 & 2021
    - Indian Head, SK rainfed – 2021 & 2022
    - Carman, MB rainfed – 2021 & 2022
  - **4 replications**
- 5-way factorial treatment structure
  - Factor 1: Shoulder-season **fall rye cover crop**
    - With vs. without (**Panel 1**)
    - Terminated with preplant burndown 1–2 days before planting
  - Factor 2: **Soybean cultivar** (cultivar names protected)
    - bushy vs. slender
  - Factor 3: **Soybean row spacing**
    - narrow (19–25 cm) vs. wide (61–76 cm)
  - Factor 4: **Soybean target density**
    - 400,000 vs. 600,000 plants ha^{-1} (1X vs. 1.5X)
  - Factor 5: **Weed interference** (split-block)
    - Weedy vs. weed-free
      - Weedy (W) = no herbicide postemergence
      - Weed-free (WF) = glyphosate postemergence
- Herbicides:
  - Preplant: glyphosate + carfentrazone @ 900 + 28 g ae/ai ha^{-1}
  - Postemergence: glyphosate @ 900 g ae ha^{-1} (VC/V1 & V3/V4)
- Response variables:
  - Weed biomass
  - WF soybean yield
  - Soybean yield loss (YL) (**Eq. 1**)
- Statistical analyses
  - PROC GLIMMIX in SAS 9.4[6]
    - Analyzed by split-block
    - Fixed = factors 1–4
    - Random = site-year & replicate nested in site-year

Equation 1.

$$\text{YL}\ (\%) = \frac{(\text{WF yield} - \text{W yield})}{\text{WF yield}} \times 100$$

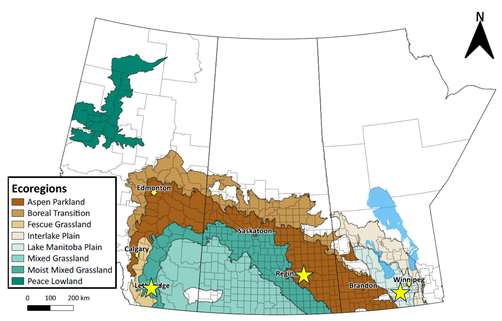


Figure 1. Experiment locations.

Results

Table 1. Weed-free (WF) soybean yield, yield loss due to weeds, and weed biomass for the main factors of fall rye cover crop (CC), soybean cultivar, row spacing, and target density among six site-years in western Canada.

Main factor	Factor level	WF yield	Yield loss	Weed biomass
		kg ha^{-1}	%	kg ha^{-1}
Fall rye CC	Without	2,831	36.6	1,380
	With	2,728	37.6	1,109
	P-value	***0.0059***	*0.4287*	***0.0028***
Soybean cultivar	Slender	2,716	37.7	1,337
	Bushy	2,843	36.5	1,145
	P-value	***0.0007***	*0.3766*	***0.0330***
Soybean row spacing	61–76 cm	2,628	39.0	1,379
	19–25 cm	2,930	35.2	1,110
	P-value	***< 0.0001***	***0.0051***	***0.0029***
Soybean target density	400,000 plants ha^{-1}	2,699	39.2	1,342
	600,000 plants ha^{-1}	2,859	35.0	1,140
	P-value	***< 0.0001***	***0.0024***	***0.0251***

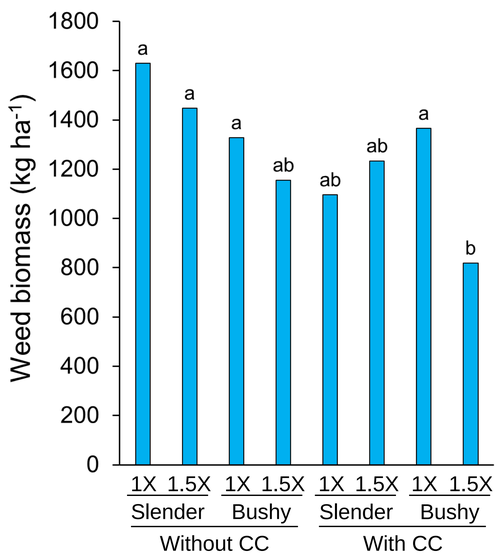
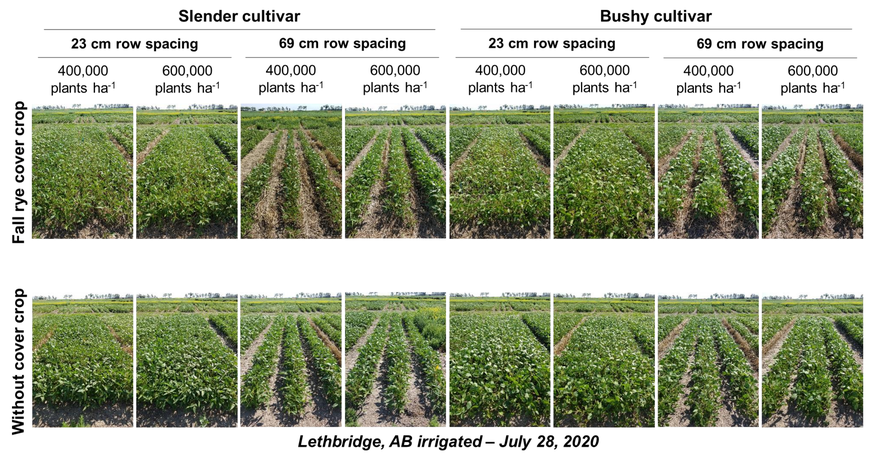


Figure 2. Weed biomass in response to integrating a fall rye cover crop (CC; without vs. with), soybean cultivar (slender vs. bushy), and target density (1X vs. 1.5X recommended) among six site-years in western Canada.



Panel 1. Weed-free subplot photos of one replicate of the Lethbridge, AB irrigated (2020) experiment showing the combinations of fall rye cover crop (without vs with), soybean cultivar (slender vs. bushy), row spacing (23 vs. 69 cm), and target density (400,000 vs. 600,000 plants ha^{-1}).

Main Findings

- Fall rye CC ↓ weed biomass by 20% and ↓ weed-free yield by 4% (**Table 1**).
- Bushy cultivar ↓ weed biomass by 14% and ↑ weed-free yield by 5% compared with slender.
- Narrow row spacing ↓ weed biomass by 20%, ↑ weed-free yield by 11% and ↓ yield losses due to weed interference by 4% compared with wide.
- 1.5X target densities ↓ weed biomass by 15%, ↑ weed-free yield by 7% and ↓ yield losses due to weed interference by 4% compared with 1X.
- Planting a bushy cultivar targeting 600,000 plants ha^{-1} into a terminated fall rye cover crop suppressed weeds to half that of the slender cultivar at 400,000 target plants ha^{-1} without a cover crop (**Fig. 2**).
  - No interactions of the main factors were significant (α = 0.05) except that shown in **Fig. 2**.

In conclusion, implementing these cultural tactics together in an integrated weed management program suppressed weeds effectively in soybean grown in western Canada, however, the fall rye cover crop decreased weed-free soybean yield by 4% overall.

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References

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