MANAGING SEED RETURN OF VOLUNTEER CANOLA IN SOYBEAN PRODUCTION

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Introduction & Objectives

Canola is the most abundant oilseed crop grown in Canada[1]. Volunteer canola, mainly derived from canola harvest losses, can be problematic throughout the Canadian prairies and other canola growing regions[2]. This weed can be especially problematic in soybean, a crop currently increasing in seeded acreage in Manitoba, Canada[3]. Like some canola varieties, soybean is genetically-engineered to be resistant to the herbicide glyphosate. Certified seedlot contamination with unwanted herbicide-resistance traits[4], pod drop and silique shatter (before and at harvest)[5], secondary dormancy, seed return from unmanaged volunteers in subsequent crops, and short crop rotations all contribute to seedbank persistence of volunteer canola (averaging 3-4 years)[2]. This study focused on the evaluation of weed management tools that may be used in combination with herbicides to manage volunteer canola in soybean production, with specific focus on their ability to reduce volunteer canola seed returned to the seedbank. The potential of the following factors for managing volunteer canola in soybean was evaluated: **(1)** soybean row spacing, **(2)** soybean seeding rate, **(3)** soil nitrogen, **(4)** inter-row management in 40 cm row soybean (inter-row mulch), and **(5)** inter-row management in 80 cm row soybean (inter-row mulch and tillage).

Materials & Methods

Soybean row-spacing (80, 40 or 20 cm) (**Fig. 1a-c**), soybean seeding rate (433,000 or 649,000 target plants ha^{-1}), additional soil nitrogen (0 or 26 kg N ha^{-1}, urea broadcast prior to seeding), inter-row mulch in 40 cm row soybean (no mulch, spring wheat (cv. kane) or fall rye (cv. hazlet)), and inter-row management in 80 cm row soybean (no mulch, spring wheat, fall rye, or tillage) (**Fig. 1d**) were evaluated at four site-years in Manitoba near Carman, Kelburn, and Melita in 2013 and 2014. These objectives were evaluated using a RCBD with four blocks per site. Canola (73-45 RR) was seeded across each block (perpendicular to soybean) at 80 seeds m^{-2} immediately prior to seeding soybean (23-10 RY) treatments at 433,000 target plants ha^{-1}. Wheat and rye inter-row mulches were planted with soybean and terminated at the 6-leaf stage using glyphosate. Volunteer canola seed return was determined by subtracting the number of seeds collected by the combine at harvest from the total number of seeds produced at canola BBCH 81.

A mixed model analysis approach (SAS 9.3) was used to test the objectives on the following response variables: soybean seed yield (Mg ha^{-1}), volunteer canola seed return (seeds m^{-2}), total seed production (seeds m^{-2}), biomass (Mg ha^{-1}) and thousand kernel weight (g). Treatment and site were considered fixed effects and experimental block was considered random. Prior to analysis, data were inspected for outliers and Gaussian distribution of residuals. Data were square root transformed to meet the assumptions of ANOVA when necessary. Single-degree-freedom estimates were used to test the 5 objectives by comparing specific treatments to their respective controls (leftmost bar in each column of panels in **Fig. 2**). All significant treatment/site interactions where due to differences in magnitude of the effect rather than direction, and as a result, data are presented as combined means among all sites.

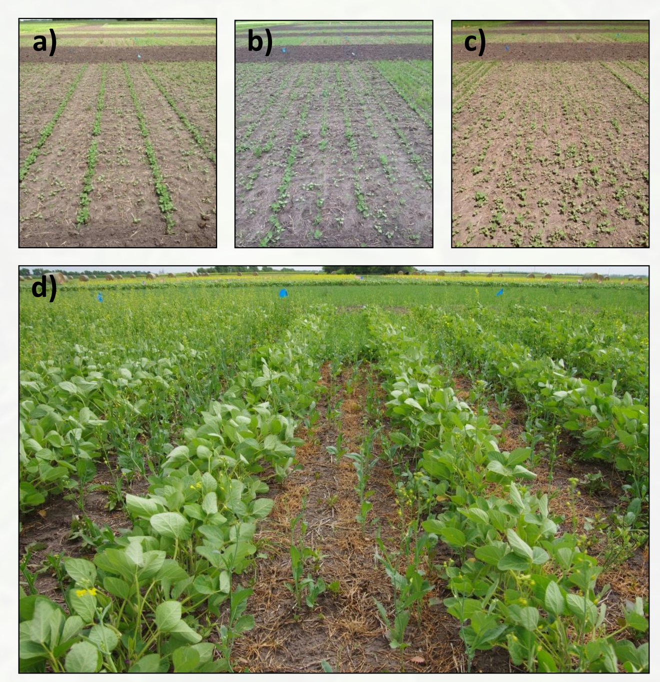

Figure 1. Soybean grown in 80, 40, and 20 cm rows (a, b & c, respectively), and 80 cm rows with a terminated fall rye inter-row mulch (d).

Results

Volunteer canola seed return was the most responsive variable to the tested factors and was influenced by row spacing, nitrogen (N), and terminated inter-row mulches. 40 cm soybean row-spacing returned 89% more volunteer canola seeds to the soil seedbank compared to the control (80 cm row-spacing), whereas the 20 cm row-spacing had no effect (**Fig. 2d**). When grown on soil supplemented with 26 kg N ha^{-1}, canola seed return increased by 75% and total seed production also increased by 37% (**Fig. 2c&d**). Additional soil N also tended to decrease soybean yield (**Fig. 2e**). The terminated spring wheat inter-row mulch, decreased volunteer canola seed return in 40 cm row soybean, whereas the spring-seeded fall rye mulch increased volunteer canola seed return in 80 cm row soybean (**Fig. 1d&2d**).

Inter-row tillage in 80 cm row soybean affected several response variables and resulted in a 2.63 Mg ha^{-1} increase in soybean yield, a 30% decrease in canola biomass, and a 6% increase in canola TKW, but did not affect volunteer canola seed return (**Fig. 1a-e**). Increasing the soybean seeding rate to 1.5X resulted in a 3.22 Mg ha^{-1} increase in soybean yield and a decrease in volunteer canola TKW (**Fig. 2a,e**), but also did not affect volunteer canola seed return.

Conclusions

- Increased soybean seeding rates can increase soybean yield under volunteer canola interference. The absence of effects on volunteer canola in this treatment shows how competitive this weed is in a cool season climate.
- Planting soybean on fields with lower levels of residual soil N may shift the competitive balance toward soybean and decrease the amount of volunteer canola seed returned to the soil seedbank.
- Inter-row tillage effectively increased soybean yield and decreased volunteer canola biomass, but not the total number of seeds produced or seed return, indicating high plasticity in volunteer canola plants.
- Spring-seeded inter-row mulches showed potential for influencing volunteer canola/soybean interference in conventional cropping systems.

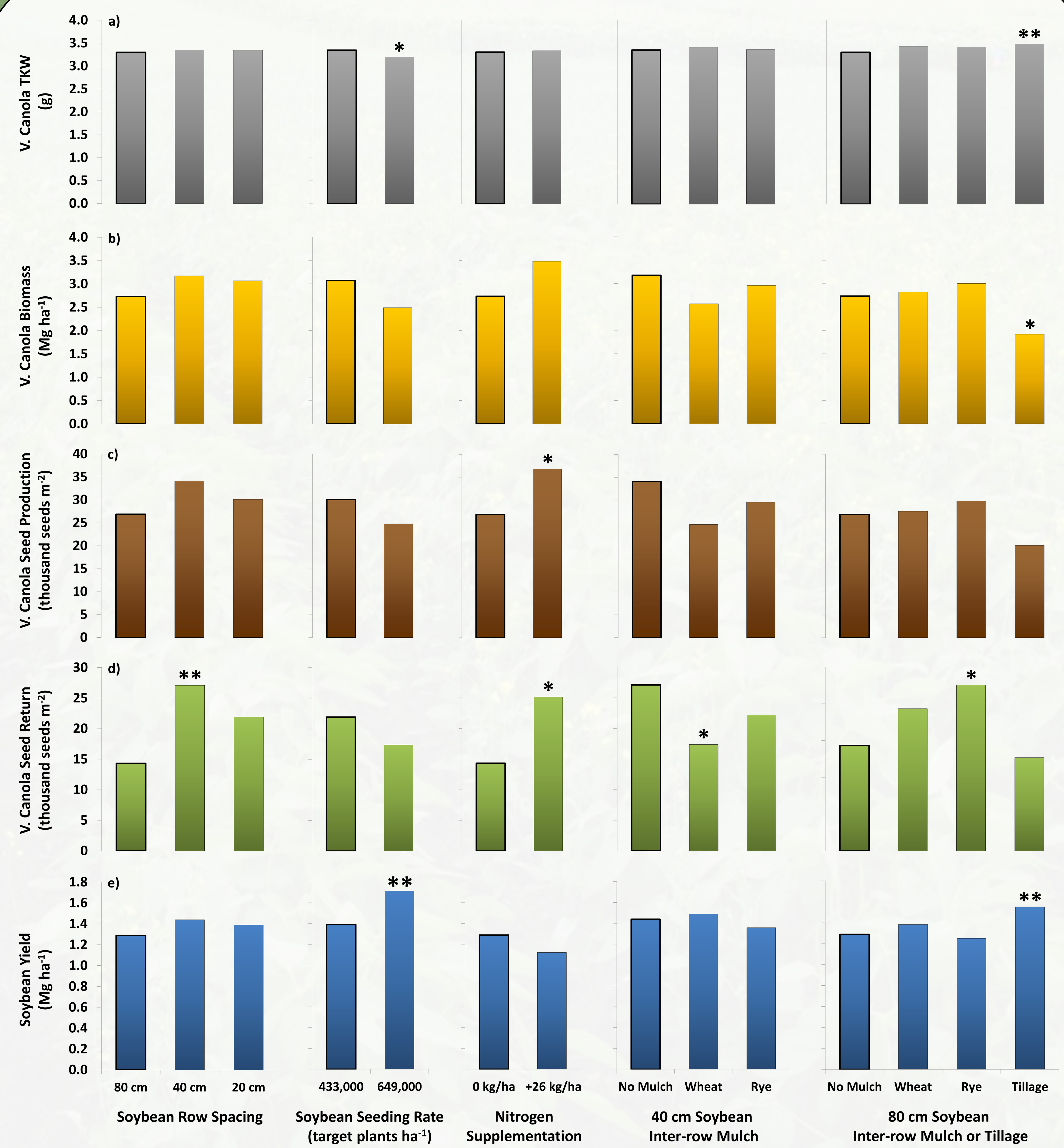

Figure 2. Volunteer canola TKW (a), biomass (b), total seed production (c), seed return (d), and soybean yield (e) for treatments separated by specific objective. Within columns, estimates were used to compare treatments (bars 2-4) to the respective control (leftmost bar) and significant differences are indicated by * ($P < 0.05$ to > 0.1) and ** ($P \leq 0.01$).

Acknowledgments

Ian N. Morrison Research Station, Carman, MB
Richardson Research Farm, Kelburn, MB
Western Agricultural Diversification Organization, Melita, MB

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