Can Tillage and Agronomy be Integrated with Herbicide Application to Control Resistant Weeds?

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Abstract

The prevalence of group 2 resistant broadleaved weeds threatens successful lentil production on the Canadian Great Plains. The objective of this study was to develop an integrated weed management strategy combining physical, cultural and chemical weed control methods for lentil producers dealing with group 2 resistant wild mustard. The study was conducted for 3 years between 2011 and 2013 at 2 locations at Saskatoon and Scott, Saskatchewan. It was a randomized two way factorial with weed control method and seeding rate as the main effects. Weed control treatments tested consisted of a control treated with a glyphosate burnoff, saflufenacil (Heat ™) herbicide, rotary hoeing, half rate metribuzin (Sencor ™) herbicide, a fully integrated treatment, and a full herbicide treatment. Three seeding rates representing 1, 2, and 4 times the recommended seeding rate were tested (130, 260, and 520 plants m^{-2}). Increasing seeding rate consistently lowered mustard biomass at both locations. The full herbicide treatment provided the greatest reduction in mustard biomass followed by the integrated treatment. The integrated treatment relied more on increased seeding rate to reduce mustard biomass and produce yield, and at the highest seeding rate it was able to provide equivalent yield to the full herbicide system. The results of this study show that an integrated system utilizing an increased seeding rate can control resistant weeds and maintain yields to a similar level as a strategy that relies only on herbicides for weed control.

Introduction

Reliance on ALS inhibitor (Group 2) herbicides has resulted in the occurrence of herbicide resistant weed populations on much of the prime lentil producing acres in Saskatchewan. Group 2 resistant weeds, including wild mustard, are threatening successful lentil production in Saskatchewan. Integrated weed management (IWM) provides an alternative strategy to reliance on herbicides. By integrating cultural and mechanical tactics with chemical control a more robust system that is less likely to select for resistant weeds is created. Despite the success of IWM systems in other crops and the economic and rotational importance of lentil in Saskatchewan, no research has studied an IWM system for lentil.

Materials and Methods

Lentil c.v. CDC Impala, an IMI tolerant extra small red lentil variety, was seeded at the University of Saskatchewan Kernen and Agriculture and Agri-Food Canada Scott research farm locations. Tame mustard c.v. Xceed was cross seeded at 100 seeds m^{-2} to provide uniform

distribution of a wild mustard analogue. The experimental design was a 2 way randomized factorial with seeding rate and weed control treatment as the main effects. The targeted seeding rates were 130, 260 and 520 seeds m^{-2} (1, 2 and 4X recommended seeding rate). Weed control treatments were based on recommended application rates and were as follows:
Control: Glyphosate
Heat: Glyphosate + Saflufenacil (Heat™)
Hoe: Glyphosate + Rotary Hoe
Half Sencor: Glyphosate + Half Rate Metribuzin (Sencor™)
Integrated: Glyphosate + Saflufenacil + Half Rate Metribuzin + Rotary Hoe
Full Herbicide: Glyphosate + Saflufenacil + Full Rate Metribuzin
Crop and weed biomass were taken at crop physiological maturity. This experiment was conducted over three years between 2011 and 2013

Data were analyzed using the mixed procedure of SAS. Site and rep were considered random factors.

Results and Discussion

Mustard biomass data was analyzed separately by location, but all years within locations were pooled. The interaction of seeding rate and weed control treatment was significant at the Saskatoon location (Figure 1). At Saskatoon the Hoe and Heat only treatments did not provide biomass reduction greater than the Control at any seeding rate. At the recommended seeding rate the Integrated treatment had significantly greater biomass than the Full Herbicide treatment. When the integrated treatment at the 2X and 4X was contrasted with the Full Herbicide treatment at the recommended rate it was found to be statistically equal. At the Scott location only the main effects of seeding rate and weed control treatment were significant. Seeding rate decreased mustard biomass (Figure 2). The Full Herbicide treatment resulted in the lowest mustard biomass. The Integrated treatment had the next lowest mustard biomass but was not statistically lower than the Half Sencor or the Heat treatments (Figure 3). These biomass values are averaged across all three seeding rates, therefore the integrated treatment at the increased seeding rates would have lower mustard biomass than what is represented in this figure.

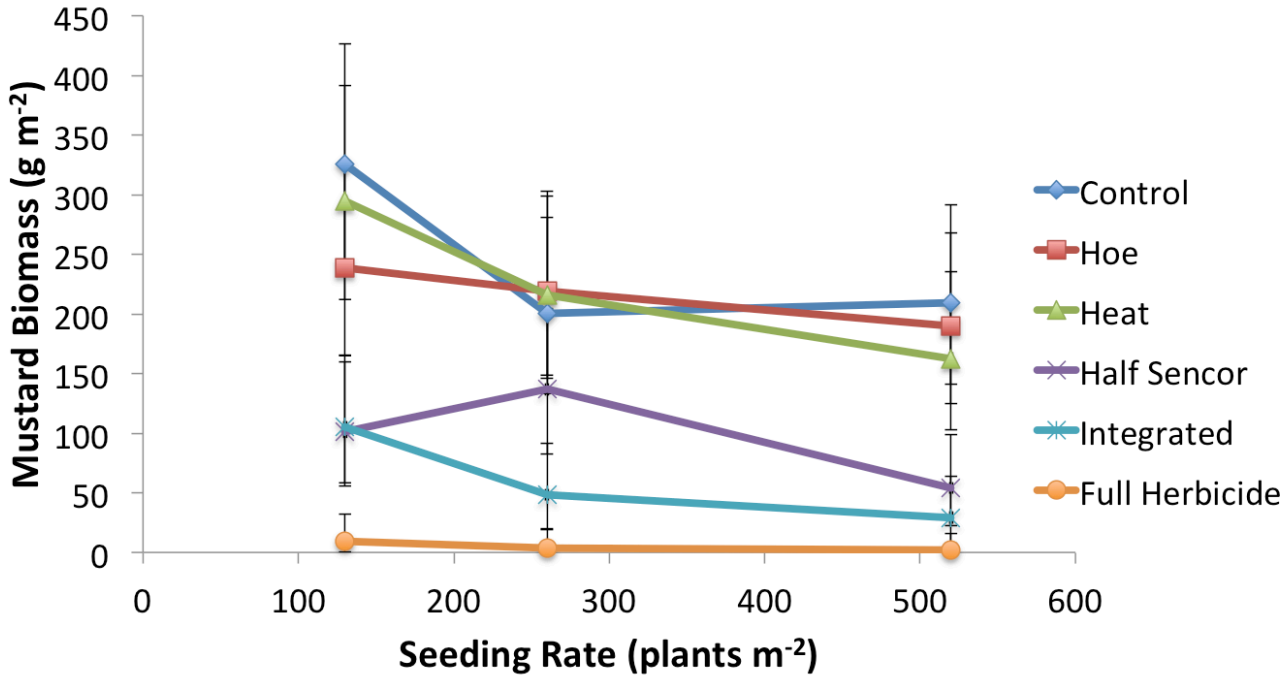

Figure 1 Interaction of weed control method and seeding rate on mustard biomass at Saskatoon. Average of 3 site-years ($p<0.05$).

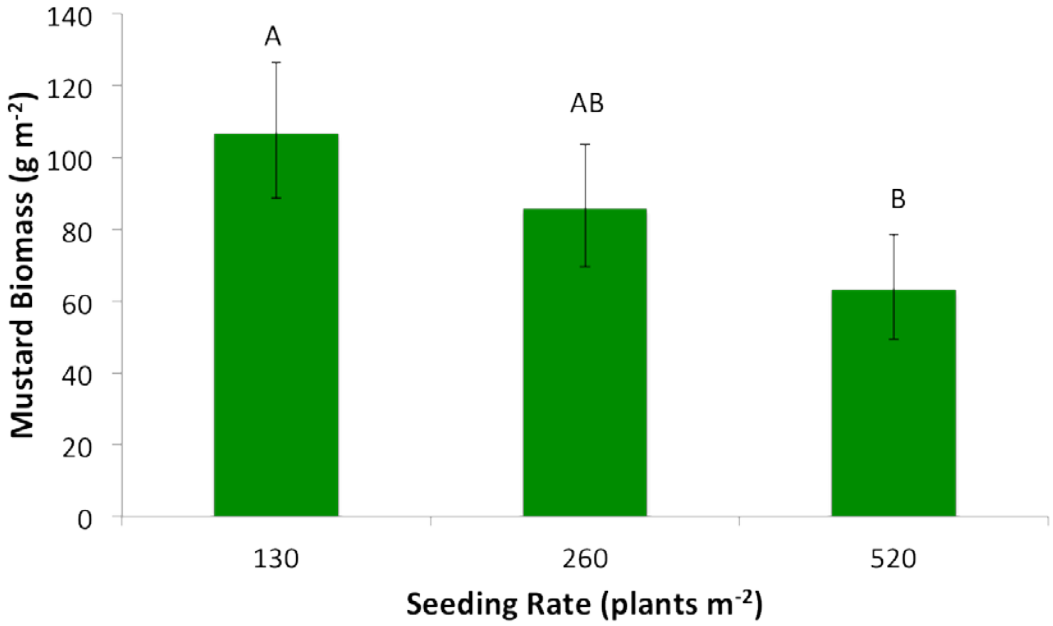

Figure 2 Influence of seeding rate on mustard biomass at Scott. Average of 2 site-years ($p<0.05$).

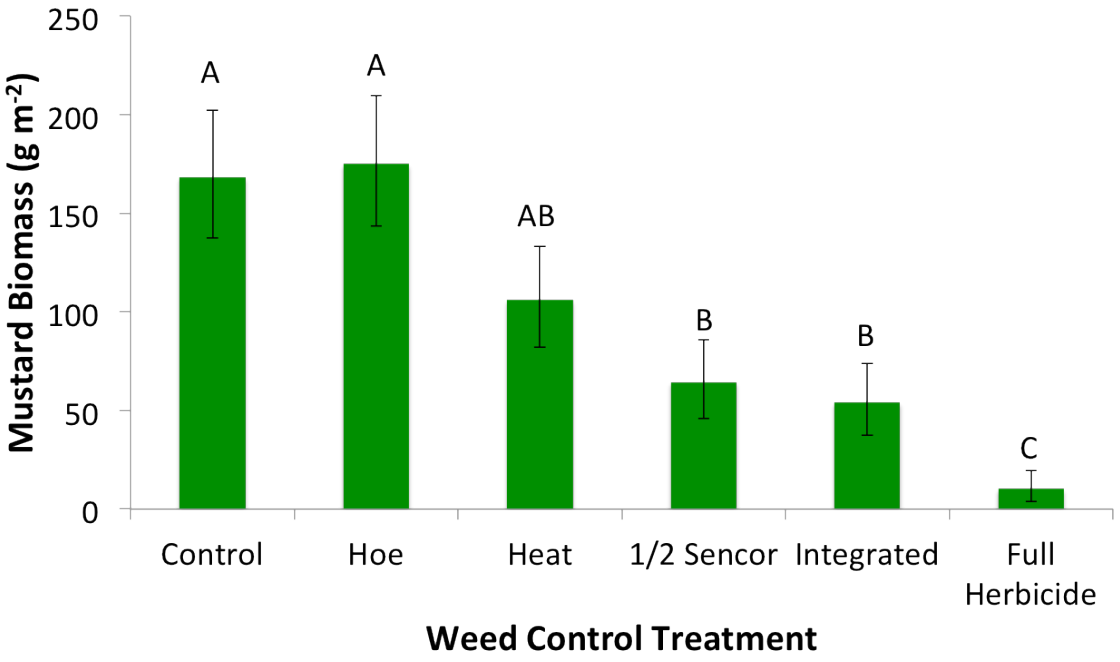

Figure 3 Influence of weed control treatment on mustard biomass at Scott. Average of 2 site-years ($p<0.05$).

Yield data was collected for 4 site years of the study. Three of the site years experienced relatively normal weather conditions and it was possible to combine this data for analysis. The other site year experienced greater than double the 30 year average precipitation and its yield data was vastly different and could not be combined with the other 3 site years. In the 3 site years that were combined the interaction of seeding rate and weed control was significant (Figure 4). Here it was observed that the integrated treatment yielded significantly less than the full herbicide treatment at the recommended seeding rate. However at the 4X seeding rate the integrated treatment yielded equal to the full herbicide treatment. Similar to the mustard biomass response we observe that the integrated treatment has a positive response to increasing seeding rate. In the site year that experienced double the 30 year average precipitation neither of the main effects significantly effected lentil yield (data not shown). Although this result may seem unimportant it shows that increasing seeding rate did not have the expected result of reducing yield due to factors such as increased lodging and disease pressure in a wet year.

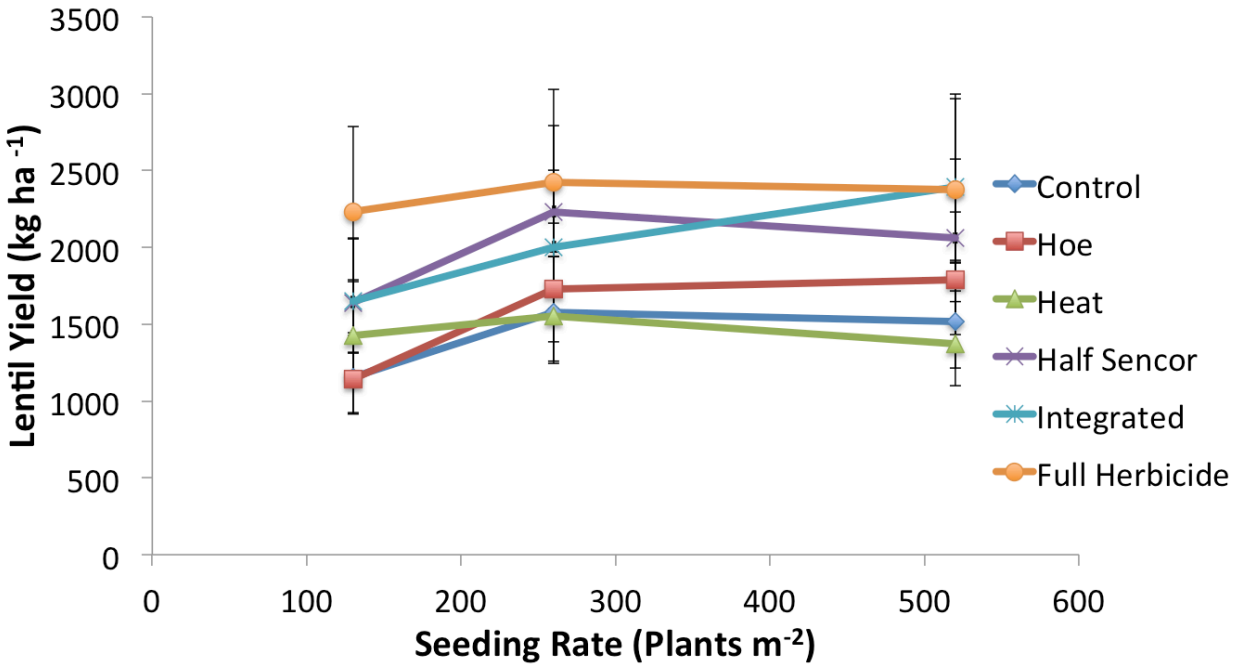

Figure 4 – Seeding rate and weed control treatment had interactive effect on lentil yield in years with near average precipitation. Average of 3 site-years ($p<0.05$).

Conclusions

The results of the study suggest that current recommended seeding rates in the extra-small seed size class in lentil are too low to optimize weed control and achieve maximum yield. Optimum seeding rate is a function of the weed control method selected by the producer. The study demonstrates that integrated weed management systems can achieve acceptable weed control and maintain yield to the level of that achieved in a system that relies solely on herbicides.

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