
Survey of Herbicide-Resistant Wild Oat (*Avena fatua* L.) in Two Townships in Saskatchewan

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Abstract

The objective of this study was to determine the nature and occurrence of herbicide resistance in wild oat in the Grassland and Parkland regions of Saskatchewan in 1997, based on a systematic survey of fields in two randomly selected townships. The survey found that: 1) over one-half of fields in both townships had populations resistant to Group 1, 2, and/or 8 herbicides; 2) fields in the Parkland township had higher mean levels of Group 1 resistance (% resistant seeds) than fields in the Grassland township, suggesting they were subjected to more Group-1 herbicide applications; and 3) single- (Groups 1, 2, or 8) and multiple-group resistance (1,2; 1,8; 2,8; 1,2,8) were exhibited in populations in fields in both townships. The proportion of fields with populations exhibiting Group 1 (single) resistance was higher, and Group 2 and Groups 1,2 resistance were lower in the Parkland compared to that in the Grassland township. In both townships, farmers with more land (within the township or total farmed) tended to have a greater proportion of that land infested with Group 1- or 2-resistant wild oat compared to those with less land. The nature of resistance in wild oat populations in Saskatchewan is more diverse, differences in distribution and abundance of resistant biotypes between Grassland and Parkland regions are generally less apparent, and occurrence of resistance is more prevalent than previously documented.

Introduction

A survey of 203 fields at high risk for herbicide-resistant (R) wild oat was conducted in Saskatchewan in 1996 (Beckie et al. 1998, 1999). One-half of these fields had populations with Group 1 herbicide resistance; 20% of Group 1-R populations also exhibited resistance to Group 2 herbicides, but only one population was resistant to the Group 8 herbicides, triallate and difenzoquat. R wild oat was more prevalent in the sub-humid Parkland than semi-arid Grassland region, which was attributed to differences in frequency of herbicide group use between regions.

The objectives of this study were to determine the nature and occurrence of resistance in wild oat in the Grassland and Parkland regions of Saskatchewan in 1997, based upon a systematic survey of fields in two randomly selected townships. Findings are compared to those previously documented in the province-wide survey conducted in 1996.

Methods

One township (6-mi sq.) was randomly selected in the Grassland region (Mixed Grassland and Moist Mixed Grassland ecoregions) and another in the Parkland region (Aspen Parkland and Boreal Transition ecoregions) of Saskatchewan (Figure 1). An ecoregion is an area of similar climate, natural vegetation and soils (Ecological Stratification Working Group 1995). Both

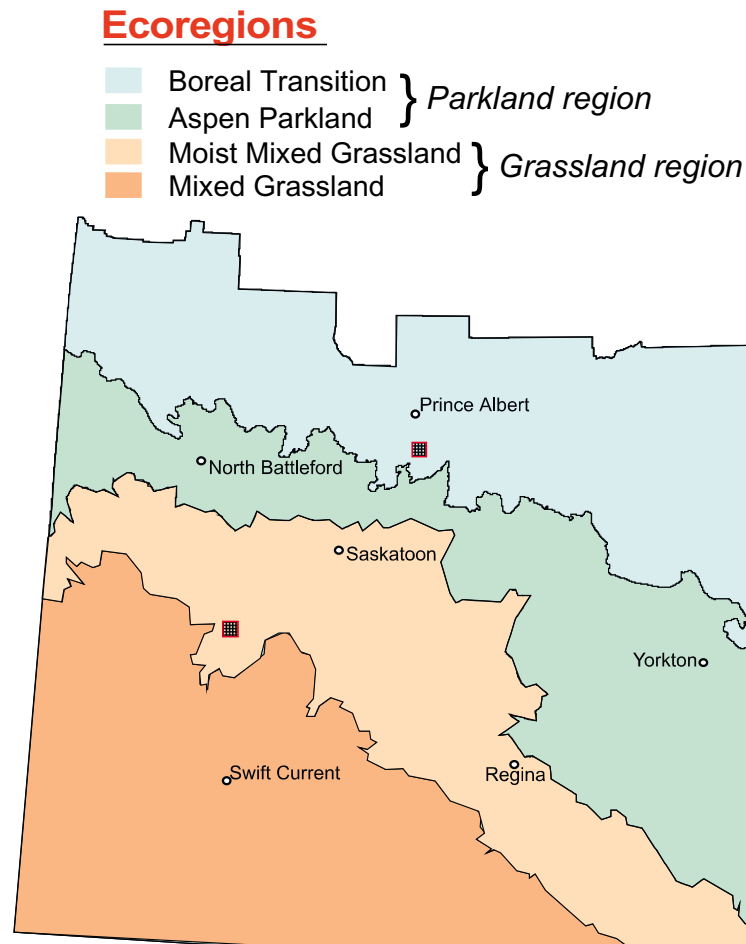


Figure 1. Location of surveyed townships in the Parkland and Grassland regions.

townships were located near the border separating the two ecoregions in their respective region. The township in the Grassland region is hereafter designated 'Grassland', and the township in the Parkland region is hereafter designated 'Parkland'.

A sampling unit was a quarter-section field (64 ha). Land in fallow (22%, Grassland township; 14%, Parkland township), forages, or oats were excluded from the survey. Cereal and pulse crops were mainly grown in the Grassland township; more oilseeds were grown in the Parkland township. Fields were surveyed prior to crop harvest, using the inverted W pattern (Thomas 1985). Seeds were collected from individual patches; if no patches were evident, a

Results and Discussion



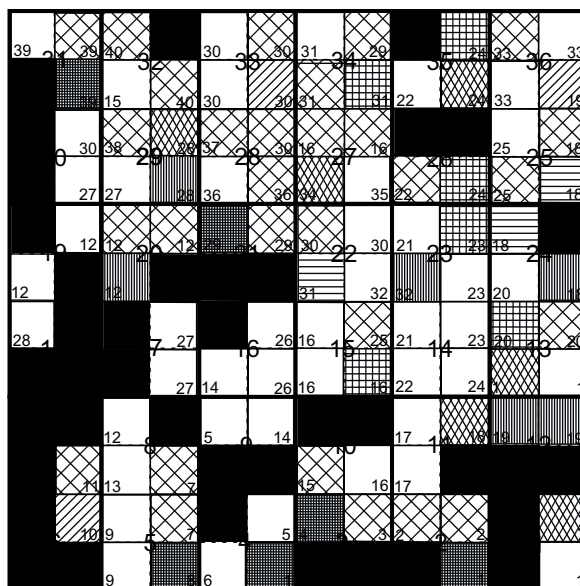


Figure 2. Pattern of resistance in wild oat in quarter-section fields in the Grassland (top) and Parkland (bottom) townships in 1997 (fields with the same number are farmed by the same person/family [AOPP=aryloxyphenoxy propionate; CHD=cyclohexanedione]).

Over one-half of fields in both townships had wild oat populations resistant to Group 1, 2, and/or 8 herbicides (Figure 2). Fields with:

- Group 1 resistance: 43%, Grassland; 48%, Parkland;
- Group 2 resistance: 30% Grassland; 17%, Parkland;
- Group 8 resistance: about 15% in both townships.

Based on 1996 survey results, more fields with Group 2-R wild oat in the Parkland vs. Grassland township was expected. Overall, occurrence of R wild oat is higher than previously documented, considering that fields in the 1996 survey were all identified as 'high risk'. Fields in the Parkland township had higher mean levels of Group 1 resistance (% R seeds) than fields in the Grassland township, suggesting they were subjected to more Group 1 applications. Single- (Groups 1, 2, or 8) and multiple-group resistance (1,2; 1,8; 2,8; 1,2,8) were exhibited in populations in fields in both townships. The proportion of fields with populations exhibiting Group 1 (single) resistance was higher, and Group 2 and Groups 1,2 resistance were lower in the Parkland compared to that in the Grassland township.

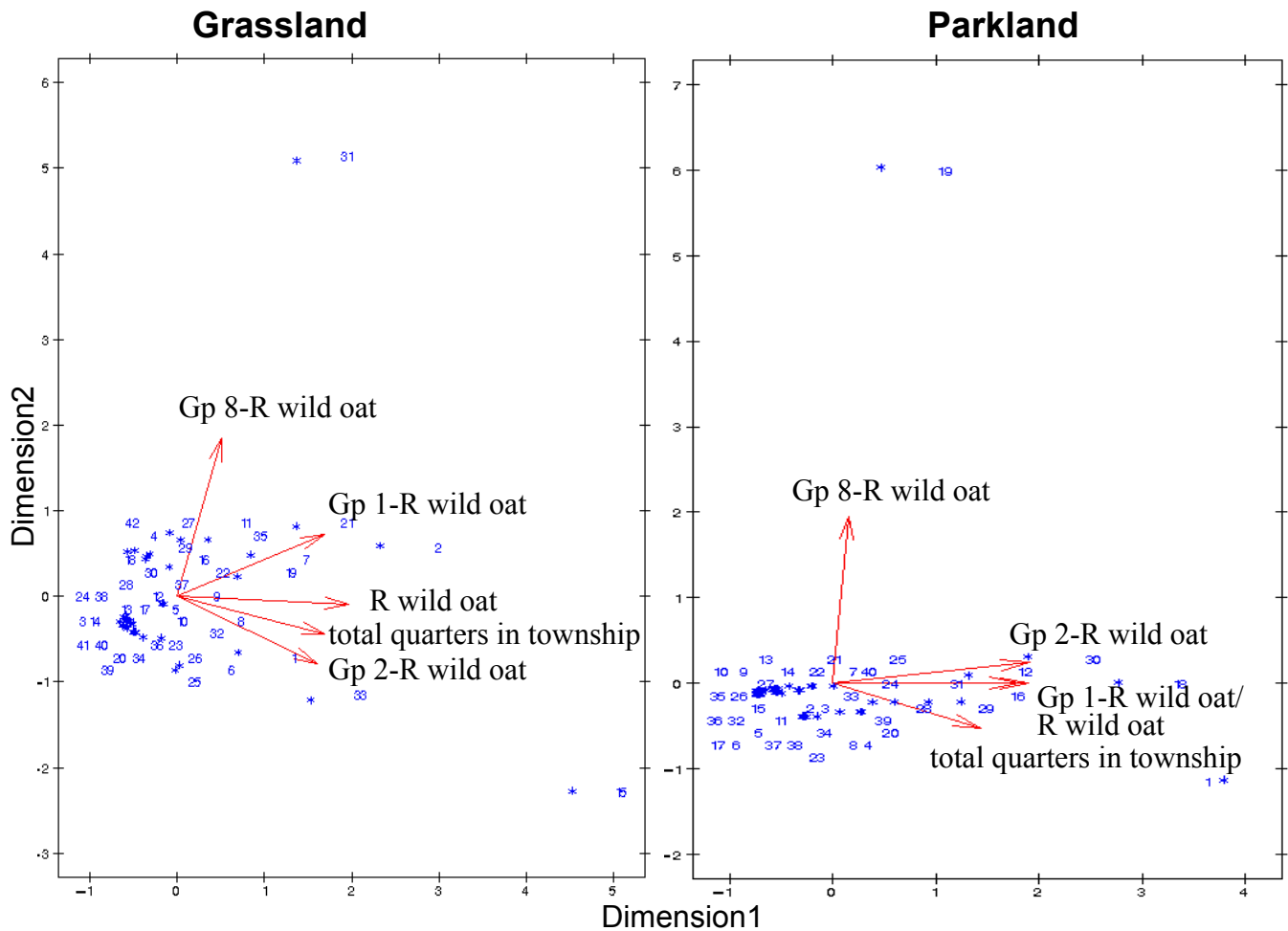


Figure 3. Grassland and parkland township biplot, representing a scattergram of the standardized component scores for the first two dimensions of the PCA analysis (each point represents a farmer).

Table 1. Standardized Scoring Coefficients* From the First Two Factors (Dimensions).

No. quarter-sections	Grassland township		Parkland township	
	Factor 1	Factor 2	Factor 1	Factor 2
Total, within township	.768	.080	.902	.291
R wild oat	.920	.298	.948	.618
Gp 1-R wild oat	.793	.360	.902	.617
Gp 2-R wild oat	.844	-.117	.496	.656
Gp 8-R wild oat	.097	.967	.370	.911

*The higher the coefficient, the stronger the association.

In both townships, PCA analysis indicated that farmers with more land – within the township (Figure 3, Table 1) or total farmed – tended to have a greater proportion of that land infested with Group 1- or 2-R wild oat compared to those with less land. These trends were apparent for

Dimension 1 (first principal component) of the biplots (vectors pointing in roughly the same direction represent those types of wild oat resistance that tend to be similarly prevalent in a given group of fields). Larger farms may have greater Group 1 and 2 herbicide use or greater incidence of R seed spread among fields. In fields farmed by the same person/family, the resistance pattern did not suggest uniformity among fields in the presence or absence of resistance, or in the type of herbicide group resistance. However, two-thirds of farmers with multiple fields in the Parkland township and having Group 1-R wild oat tended to have populations with this type of resistance in *all* their fields – presumably due to similar herbicide selection pressure and/or R seed spread among fields via equipment.

Results of this survey indicate that the nature of resistance in wild oat populations in Saskatchewan is more diverse, differences in distribution and abundance of resistant biotypes between Grassland and Parkland regions are generally less apparent, and occurrence of resistance is more prevalent than previously documented.

Acknowledgments

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