Residual Weed Populations in Saskatchewan - 1976 to 2003

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Abstract

The comparison of the relative abundance of weeds in Saskatchewan in 2003 with results from previous provincial surveys enables the identification of recent shifts in species ranks, life form density and relative abundance. In 2003, 2046 fields of spring wheat, barley, durum, oat, canary seed, canola, flax, mustard, lentil and pea were surveyed. These fields were selected using a stratified random sampling procedure based on ecodistricts. In each field, weeds were counted in 20 quadrats (50 by 50 cm) in late summer. Weed data are summarized using a relative abundance index based on frequency, field uniformity and density. Green foxtail was the most abundant weed, wild oats ranked second, wild buckwheat third and Canada thistle fourth. The results from the 2003 survey are compared to results from surveys of 1178 fields in 1995, 1149 fields in 1986 and 4423 fields in 1976-1979. Twelve species have been ranked amongst the top 20 most abundant species in each survey. Seven species, ranked in the top 20 species in the 1970's and/or 1986, have since declined: rose, prostrate pigweed, night-flowering catchfly, cow cockle, bluebur, pale smartweed, flixweed. Six species have appeared in the top 20 list for the first time in 1995 and/or 2003: cleavers, barnyard grass, wheat, dandelion, quack grass, canola. Relative abundance of annual grass and perennials has increased, while relative abundance of annual broad-leaved species and facultative winter annuals has decreased. Densities of all life forms have decreased since the 1970's.

Introduction

Eight years have past since the last provincial weed survey in Saskatchewan was conducted in 1995 (Thomas et al. 1996). Numerous changes in the agricultural industry have presented the need for a new survey with updated information. For example, the last survey was conducted before the widespread adoption of herbicide-resistant canola varieties. The weed abundance and management data from the previous survey have provided an important baseline on residual weed populations in canola prior to the widespread adoption of herbicide-tolerant varieties and the associated farm management practices. The survey in 2003 provides the information for an assessment of the impact of the adoption of this technology on weed communities in canola.

The weed survey data can be used to document the changes in the distribution and abundance of weeds that have occurred since previous provincial surveys in 1995 (Thomas et al. 1996), 1986 (Thomas et al. 1987) and 1976 to 1979 (Thomas and Wise 1983). Individual weeds or groups of species identified as increasing in abundance can be targeted for attention by various agencies involved in weed science. The trends identified by the weed surveys are important to the

research, industry, and extension communities for developing weed management recommendations for producers.

This paper presents the top twenty species identified in the 2003 Saskatchewan provincial weed survey and compares the relative abundance of weeds in Saskatchewan in 2003 with results from the 1995, 1986 and 1976-1979 provincial surveys. Also, shifts in life form density and relative abundance are identified.

Methods

In 2003, 2046 fields of spring wheat, barley, durum, oat, canary seed, canola, flax, mustard, lentil and pea were surveyed (Leeson et al. 2003). These fields were selected using a stratified random sampling procedure based on ecodistricts (Acton et al. 1998). The number of fields in an ecodistrict was allocated in proportion to the seeded area of the selected crops in the ecodistrict, relative to the total area seeded to selected crops in all ecodistricts.

Weeds were counted in 20 quadrats (50 by 50 cm) per field after any in-crop management had been applied (residual populations). The quadrats were placed in an inverted W pattern starting 100 paces into the field. Five locations, 20 paces apart, were sampled along each arm of the pattern. For perennial grass species such as quack grass and perennial herbaceous species such as Canada thistle, the number of shoots rather than the number of plants was counted. For annual grasses, such as wild oats, and clumped perennials, such as foxtail barley, a rooted individual was counted as a single plant whatever the number of tillers. Volunteer crop plants were counted as weeds.

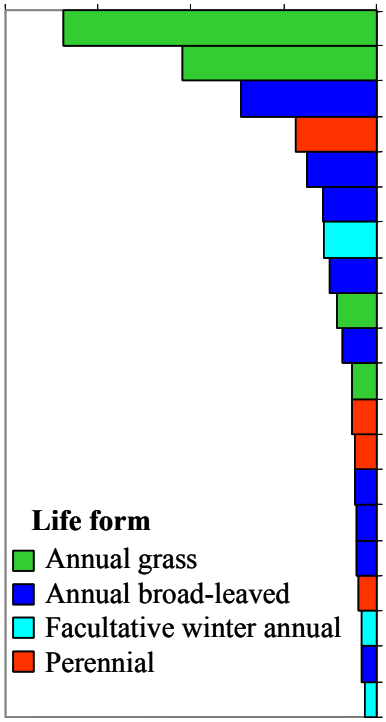
Weed data were summarized using a relative abundance index based on frequency, uniformity and density (Thomas 1985). Frequency is reported as the percent of fields in which the species occurred, while uniformity is reported as the percent of quadrats in which the species occurred. The density value used in the calculation of relative abundance is the average density of the species in all fields. To calculate relative abundance of a species, the species frequency, uniformity and density are converted to relative values by dividing by the sum all species for each value. These three relative values are summed to give relative abundance of the species, a score out of 300. An occurrence density value is also given and is calculated as the average for only the fields where the weed occurred.

The twenty most abundant species in the 2003 weed survey were compared to the top twenty species from surveys of 1178 fields in 1995 (Thomas et al. 1996), 1149 fields in 1986 (Thomas et al. 1987) and 4423 fields in the 1970's (1976-1979) (Thomas and Wise 1983). The top 20 species from each survey were grouped into four life forms: annual grass, annual broad-leaved, facultative winter annual, perennial. The average density for all the species within a life form group and the proportion of the total relative abundance accounted for by the species in a group were determined.

Results and Discussion

In the 2003 survey, green foxtail was the most abundant weed, wild oats ranked second, wild buckwheat third and Canada thistle fourth (Fig. 1). These species were also the most frequently occurring weeds; they were found in 35 to 51% of the fields and had a uniformity of 7 to 18%.

The remaining species had a uniformity of 5% or less. The perennial species, dandelion, field horsetail and perennial sow-thistle had a uniformity of 1-2%. The percent uniformity values can be used as an estimate of the area in the province with these species present after in-crop management has been applied. Green foxtail had the highest average occurrence density. Volunteer crops, wheat, canola and flax, had occurrence densities between 5 and 9 plants m^{-2}.



Weed Species	Frequency (%)	Uniformity (%)	Density* (m^{-2})
Green foxtail	43.5	17.9	24.4
Wild oats	50.9	16.7	7.4
Wild buckwheat	50.8	13.0	2.7
Canada thistle	34.8	6.9	2.1
Lamb's-quarters	22.0	5.2	5.9
Redroot pigweed	17.3	3.4	6.6
Stinkweed	18.0	3.7	5.5
Kochia	16.9	3.7	4.2
Spring wheat/durum	10.7	3.2	7.7
Russian thistle	11.8	2.8	4.5
Barnyard grass	8.7	1.7	5.1
Dandelion	12.5	1.9	1.2
Field horsetail	7.9	1.7	3.6
Cleavers	9.3	1.7	2.1
Wild mustard	8.2	1.6	3.2
Canola (Argentine)	6.7	1.5	5.4
Perennial sow-thistle	9.6	1.2	1.3
Shepherd's-purse	6.7	1.2	2.4
Flax	3.5	1.3	9.4
Narrow-leaved hawk's-beard	5.6	0.9	1.8

*Average density in occurrence fields

Figure 1. The relative abundance of the top 20 species in the 2003 Saskatchewan weed survey.

Shifts have occurred in the relative abundance of the top twenty species (Table 1). Twelve species have been present in the top twenty in each survey since the 1970's (shown in italics in Table 2). The same species have been in the top three since surveys in the 1970's. Seven species in the top twenty in the 1970's and/or 1986 have declined: rose species, prostrate pigweed, night-flowering catchfly, cow cockle, bluebur, pale smartweed and flixweed. Six species have appeared in the top twenty for the first time in 1995 or 2003: cleavers, barnyard grass, wheat, dandelion, quack grass, canola. Species that increased the most since the previous survey in 1995 include barnyard grass, spring wheat/durum and narrow-leaved hawk's-beard.

The composition of weed community has remained similar since the 1970's but densities have decreased (Fig. 2). Similar observations were made in Alberta and Manitoba (Leeson et al. 2002a, 2002b). The largest decreases in density since 1995 were observed in facultative winter annuals and perennials. The proportion of the relative abundance accounted for by annual grasses and perennials has increased since the 1970's. The relative abundance of perennials peaked in 1995. The relative abundance of annual broad-leaved species and facultative winter

annuals has decreased. The change in relative abundance of annual broad-leaved species was largest from 1970's to 1995. The change in relative abundance of facultative winter annuals was largest from 1986 to 2003.

Table 1. Change in Relative Abundance Rank of Top 20 Species.

	Change in Relative Abundance Rank			
	1970's to 1986	1986 to 1995	1995 to 2003	1970's to 2003
Annual grass				
Barnyard grass	-3	5	17	19
Spring wheat/durum	-5	10	10	15
*Wild oats**	1	0	0	1
Green foxtail	0	0	0	0
Annual broad-leaved				
Cleavers	17	9	2	28
Flax	20	-7	5	18
Canola	4	10	-3	11
Kochia	-13	17	5	9
Chickweed	10	-4	-4	2
Redroot pigweed	0	-3	4	1
Lamb's-quarters	1	-1	1	1
Wild buckwheat	-1	0	0	-1
Hemp-nettle	5	-6	-2	-3
Thyme-leaved spurge	7	3	-15	-5
Russian thistle	-1	-2	-2	-5
Wild mustard	-2	2	-7	-7
Pale smartweed	3	-9	-2	-8
Cow cockle	-1	-11	-6	-18
Prostrate pigweed	16	-21	-16	-21
Facultative winter annuals				
Narrow-leaved hawk's-beard	-8	-1	9	0
Shepherd's-purse	8	-3	-7	-2
Stinkweed	0	0	-3	-3
Flixweed	-7	-6	5	-8
Bluebur	-3	-12	-1	-16
Night-flowering catchfly	-12	-5	-1	-18
Perennials				
Dandelion	-13	22	2	11
Quack grass	5	12	-7	10
Canada thistle	1	5	1	7
Field horsetail	6	-4	4	6
Perennial sow-thistle	-4	7	-10	-7
Rose species	-5	-10	-16	-31

* Species in italics have maintained a position in the top 20 since 1970's.

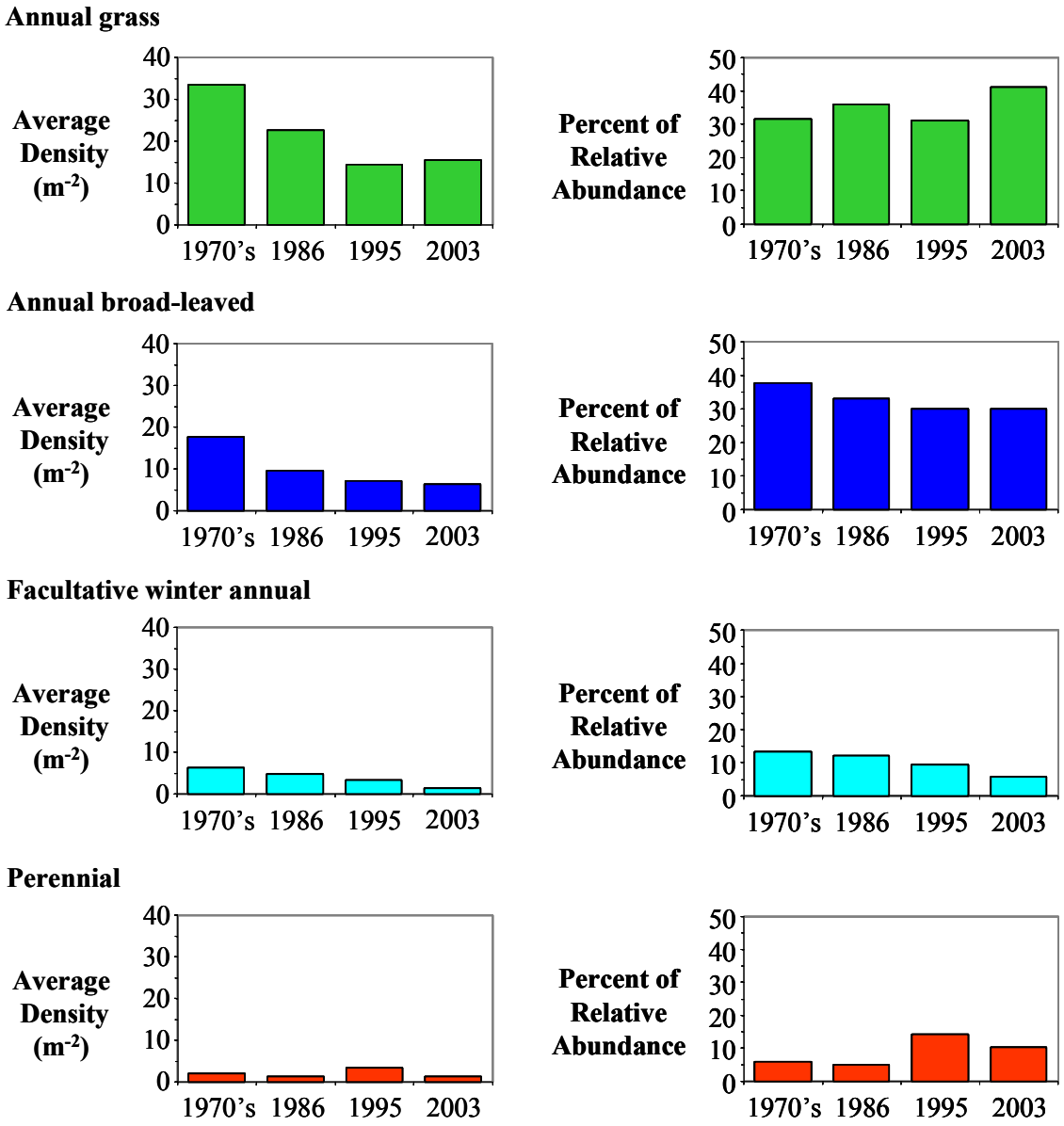


Figure 2. Shifts in density and relative abundance in top twenty species by life form.

The observed changes in the data need to be interpreted in conjunction with changes in management practices. Management information is currently being obtained from questionnaires completed by producers who participated in the 2003 survey. This information will increase our understanding of noted shifts in relative abundance and density of both individual species and life forms.

Acknowledgements

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References

Acton, D. F., G. A. Padbury, and C. T. Stushnoff. 1998. The Ecoregions of Saskatchewan. Hignell Printing Limited, Winnipeg, Manitoba. 205 pp.

Leeson, J. Y., A. G. Thomas, T. Andrews, K. R. Brown and R. C. Van Acker. 2002a. Manitoba weed survey of cereal and oilseed crops in 2002. Weed Survey Series Publication 02-2. Agriculture and Agri-Food Canada, Research Centre, Saskatoon, Saskatchewan. 191 pp.

Leeson, J. Y., A. G. Thomas and L. M. Hall. 2002b. Alberta weed survey of cereal, oilseed and pulse crops in 2001. Weed Survey Series Publication 02-1. Agriculture and Agri-Food Canada, Research Centre, Saskatoon, Saskatchewan. 263 pp.

Leeson, J. Y., A. G. Thomas and C. Brenzil. 2003. Weed survey of Saskatchewan cereal, oilseed and pulse crops in 2003. Weed Survey Series Publication 03-1. Agriculture and Agri-Food Canada, Research Centre, Saskatoon, Saskatchewan. 342 pp.

Thomas, A. G. 1985. Weed survey system used in Saskatchewan for cereal and oilseed crops. Weed Science 33: 34-43.

Thomas, A. G. and R. F. Wise. 1983. Weed surveys of Saskatchewan cereal and oilseed crops from 1976 to 1979. Weed Survey Series Publication 83-6. Agriculture Canada, Research Station, Regina, Saskatchewan. 260 pp.

Thomas, A. G. and R. F. Wise. 1987. Weed survey of Saskatchewan cereal and oilseed crops (1986). Weed Survey Series Publication 87-1. Agriculture Canada, Research Station, Regina, Saskatchewan. 251 pp.

Thomas, A. G., R. F. Wise, B. L. Frick and L. T. Juras. 1996. Saskatchewan weed survey of cereal, oilseed and pulse crops in 1995. Weed Survey Series Publication 96-1. Agriculture and Agri-Food Canada, Research Centre, Saskatoon, Saskatchewan. 419 pp.