

## Weed Communities in Organic and "Conventional" Wheat Fields

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### ABSTRACT

Weed communities were assessed in organic wheat fields and in nearby fields managed with chemical inputs ("conventional"). The weed species that were most abundant (green foxtail, wild buckwheat, Russian thistle, redroot pigweed, stinkweed) were common to both systems, and to both years of the study. Wild oat and kochia were relatively more abundant in "conventional" fields; lamb's-quarters and wild mustard were relatively more abundant in organic fields. Organic fields had, on average, 1.6 times the number of species and 3 times the number of individual weeds compared to nearby "conventional" fields. Producers that managed fields organically used summerfallow and tillage to the same extent as their "conventional" neighbours. Organic wheat fields were seeded later than "conventional" fields. The crop rotation for organic fields was more likely to include legumes and cereals other than wheat; "conventional" fields were more likely to be monocrop wheat or to include canola or mustard. Producers of organic wheat perceive a greater range of weed control options than their "conventional" neighbours, and a majority do not consider their difficulties with weeds to have increased since they adopted an organic system.

### INTRODUCTION

Organic systems are perceived by some as healthier for the environment, the producer and the consumer. Others counter that the increased summerfallow and tillage that are required for weed management degrade the soil resource. Very little hard data exist on organic weed management or on weeds in organic systems.

Investigations of weed communities in Saskatchewan and Manitoba have concluded that climatic gradients are the major determinants of species composition, and that management factors are of little importance (Dale and Thomas 1987, Thomas and Dale 1991). Management practices in these studies were similar.

The objectives of this study were to document the weed communities in organic fields, to determine if weed communities in organic fields differed from those under "conventional" management, and to determine how weed management in organic systems differed from that in "conventional" systems.

## METHODS

We conducted surveys in 1991 and 1992. In each year we selected 40 organic producers in the dark brown soil zone of Saskatchewan. Each organic producer was paired with a neighbour who was not using an organic production system. A single wheat field was selected on each farm. Each field was sampled for weeds using 20 0.25 m<sup>2</sup> quadrats, according to the method described by Thomas (1985). The number of annual plants or perennial shoots of each species was determined in each quadrat. Weed counts were taken in late summer and thus reflect the effect of management decisions made by the farmer in growing the surveyed crop. Each producer was asked to complete a questionnaire on weed management.

Weed survey and questionnaire data were summarized for each management system (organic or "conventional"). Quantitative data such as seeding rate, seeding date, crop yield, crop grade and % dockage were compared by paired t-tests. Weed and management data were subjected to canonical correspondence analysis (CCA), using CANOCO (ter Braak 1992). CCA is an iterative ordination and regression technique which reduces the variation in species data in a fashion constrained by the environmental data. It presents a clear indication of the relationship of species to environment.

The weed flora over the two years included 55 species. In 1991 we eliminated one field survey, at the request of the farmer. The remaining 159 fields were summarized by management system, year, rural municipality (an indicator of geographic effect), seeding date, seeding rate, and whether the surveyed crop was grown on stubble or fallow. The species data were summarized as the density of each weed in each field. These were subjected to square-root transformation in the analysis. The results from CCA are shown in an ordination biplot of species scores and centroids of environmental factors. Species with a weight less than 0.005 of the total were considered unimportant, and are not shown.

## RESULTS AND DISCUSSION

Weed communities. Organic wheat fields, like their "conventional" counterparts, varied tremendously in weediness. Some had few weeds; some had many. On average, the organic fields had a greater number of weed species, averaging 9 per surveyed field, compared to 5 species per neighbouring field. Weed numbers were higher in 1992 than in 1991. Organic wheat fields averaged 180 and 82 weed plants per m<sup>2</sup>, respectively in 1992 and 1991. "Conventional" fields averaged 58 and 29 weeds per m<sup>2</sup>.

The weeds found in more than 60% of "conventional" fields were green foxtail, wild oat, and wild buckwheat. These species, plus Russian thistle, stinkweed, lamb's-quarters, and redroot pigweed were found in more than 60% of organic fields. Approximately half of all individuals, in both systems and in both years, were green foxtail.

The numbers of wild oat, green foxtail and wild buckwheat in organic fields were, on average, one to two times as many as in "conventional" fields. Some species were much

more common in organic fields. The number of wild mustard in organic fields, on average, was 37 times the number in "conventional" fields. The numbers of lamb's-quarters and Canada thistle in organic fields were, on average, 17 and 10 times the number in "conventional" fields, respectively.

Differences in weed communities were larger between years than they were between organic and "conventional" systems (Figure 1). Year differences are strongly correlated with the first axis ( $r^2 = 0.87$ ); system differences are strongly correlated with the second axis ( $r^2 = 0.83$ ). Other management variables were not strongly correlated with these axes ( $r^2 < 0.5$ ). Thus, year and system were greater determinants of the weed community than location, seeding date, seeding rate, or whether the field had previously been fallowed. Lamb's-quarters, Canada thistle and wild mustard were associated with an organic system. No weeds were especially associated with the "conventional" system.

**Weed management.** Organic producers, on average, seeded their wheat on May 23, a week later than their neighbours. On average, they seeded 83 kg/ha of wheat, 11 kg/ha more than their neighbours. Organic producers seeded Columbus or specialty wheats more often than their neighbours. They seeded Katepwa and Laura less often than their neighbours.

A five-year history of the surveyed field showed that organic and "conventional" producers used similar amounts of summerfallow (36% vs 33%). "Conventional" producers grew more wheat (48% vs 31%) and canola or mustard (5% vs 0%). Organic producers grew more cereals other than wheat (19% vs 12%) and more legumes (14% vs 1%).

Tillage levels in both systems were similar. Organic producers, on average, used 0.7 passes with a discer, 2.3 passes with a cultivator, and 0.8 other tillage passes in summerfallow. Their neighbours, on average used 0.1 passes with a discer, 3.1 passes with a cultivator, and 0.7 other tillage passes. For pre-seeding tillage, both organic producers averaged 0.2 passes with a discer, 0.6 passes with a cultivator and 0.6 other tillage passes. Their neighbours averaged 0.2, 0.7 and 0.7, respectively.

Producers were asked to identify techniques that they used to limit weed problems. Organic producers identified an average of three techniques each, most commonly including delayed seeding (60%), "out-of-crop" tillage (43%), "in-crop" tillage (39%), rotations (32%), increased seeding rates (27%), summerfallow (17%), and a variety of creative alternatives. Neighbouring farmers identified herbicides (95%), as important tools, but felt they had fewer non-chemical techniques. They identified, on averaged, only half as many non-chemical techniques as their organic neighbours. Most commonly these included "out-of-crop" tillage (60%), summerfallow (30%) and delayed seeding (24%). Asked if their difficulties with weeds increased after adopting organic methods, 80% of organic producers said "no".

Producers reported similar yields:  $1900 \pm 700$  kg/ha for organic fields and  $2200 \pm 500$  kg/ha for "conventional" fields ( $p = 0.08$ ). The grade of wheat produced was also similar:  $2.8 \pm 1.1$  for organic producers and  $3.1 \pm 0.9$  for "conventional" fields ( $p = 0.10$ ). Organic producers reported an average of 3% dockage, or approximately 1% higher than their neighbours.

## SUMMARY

This study found that weed communities in organic and "conventional" wheat fields were similar. The most common weed species were the same in each. These species were found in organic fields at one to two times the density of "conventional" fields. Some weed species, such as wild mustard, lamb's-quarters and Canada thistle, are much more abundant in organic fields. Additional information of these weed species may be of special interest to organic producers. Overall, weed numbers in organic fields were approximately 3 times those in "conventional" fields. The diversity of the weed flora was greater in organic fields.

Weed management in organic fields did not involve greater use of summerfallow, or greater tillage. Organic producers recognize a greater number of weed management techniques than their neighbours. They seed earlier and heavier, and make greater use of crop diversity, especially in the use of legumes.

Organic producers do not perceive greater weed problems. They achieve similar wheat yields and similar grades. Their dockage is not prohibitive.

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## LITERATURE CITED

- Dale, M. R. T. and A. G. Thomas, 1987. The structure of weed communities in Saskatchewan fields. *Weed Sci.* 35: 348.
- ter Braak, C. J. F., 1992. CANOCO - a FORTRAN Program for canonical community ordination. Microcomputer Power, Ithaca, New York, USA.
- Thomas, A. G. (1985). Weed survey system used in Saskatchewan for cereal and oilseed crops. *Weed Sci.* 33: 34.

Thomas, A. G. and M.R.T. Dale, 1991. Weed community structure in spring seeded crops in Manitoba. *Can.J.Plant Sci.* 71:1069.

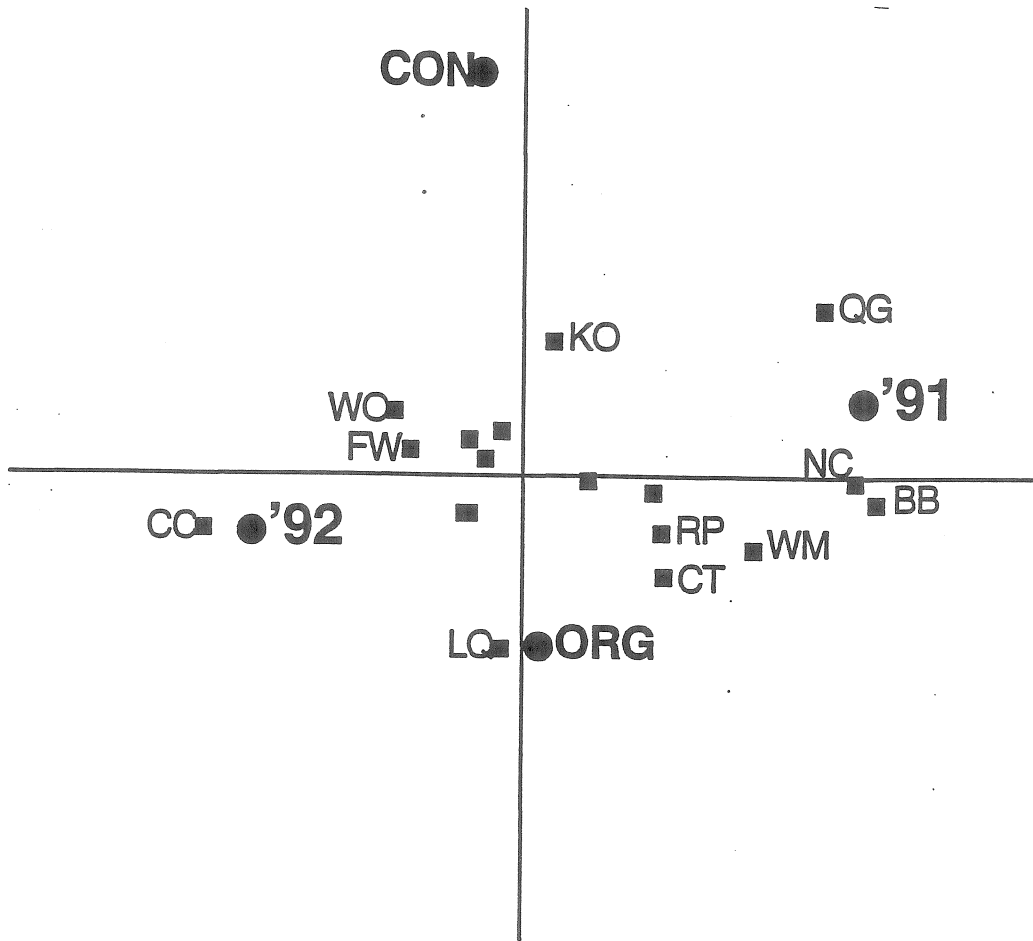


Figure 1. Ordination biplot of weed species and environmental factors (Org = organic; Con = "conventional"; KO = kochia; QC = quack grass; NC = night-flowering catchfly; BB = bluebur; WM = wild mustard; CT = Canada thistle; RP = redroot pigweed; FW = flixweed; WO = wild oat; CC = cow cockle; LQ =lamb's-quarters, species near the centre of the figure are not different among treatments)