Portrait of the Dominant Weeds by Crop Type in the Montérégie Region of Quebec

Sandra Flores-Mejia, Ph.D.[1]; Gabriel Verret, B.Sc.[1]; Firmo Sousa, agr. B.Sc.[1]; Dana El-Ramahi, B.Sc.[1]; David Miville, agr. M.Sc.[2];
Amélie Picard, agr. M.Sc.[2]; Annie Marcoux, agr. M.Sc.[2]; Bérenger Bourgeois, Ph.D.[3] and Yosra Menchari, Ph.D.[3]

[1] Centre de recherche sur les grains, inc. (CÉROM), Saint-Mathieu-de-Beloeil, QC; [2]Laboratoire d'expertise et de diagnostic en phytoprotection (LEDP-MAPAQ), Québec, QC; [3] Université Laval, Québec, QC

Introduction

A comprehensive weed inventory was conducted from 2021 to 2023, in the Montérégie (see **Figure 1**), a major agricultural area that corresponds to 15 % of the total agricultural area in the province of Québec[1]. This inventory is the first of its kind to be conducted in the province since the 1980s[2].

The study's primary objective is to provide a comprehensive portrait of the current state of weed distribution, biology and ecology under present agricultural and climatic conditions. This will enable the identification of the most abundant and/or problematic weeds by crop type.

Objectives

1. Identify the weed species with the highest relative abundance index in the Montérégie, and by crop type.

2. Determine the patterns of weed biodiversity structure for field crops.

Materials and Methods

- The number of fields sampled in the region per crop was determined by proportional allocation, with the objectif of surveying a total of 500 fields. However, the participation in the project was on a voluntary basis.
- Field surveys were conducted during the summer, commencing four weeks after the last herbicide application, allowing for the identification of weeds of agricultural importance. Each field was assessed using ten quadrats (1m x 1m), which were distributed randomly across the field in an S-pattern.
- Within each quadrat, the percentage of weed coverage and the number of individual plants for each species was recorded. The data was then summarized using a relative abundance index, based on frequency, field uniformity and density[3] (**Figure 2**).
- The Shannon biodiversity index[4] was calculated for each site, and a cluster analysis was performed to determine the pattern of weed community structure for field crops and forage crops, using the average linkage method.

Frequency (F) = % of fields in which the weed species occurred.
Uniformity (U) = % of quadrats in which the weed species occurred.
Density (D) = Average density of species in which the weed species occurred.
Relative frequency for a species (RF_i) = F_i divided by the sum of F for all species, as %.
Relative uniformity for a species (RU_i) (all fields) = U_i divided by the sum of U for all species, as %.
Relative density for a species (RD_i) (all fields) = D_i divided by the sum of D for all species, as %.
Relative abundance (RA) = RF + RU + RD.

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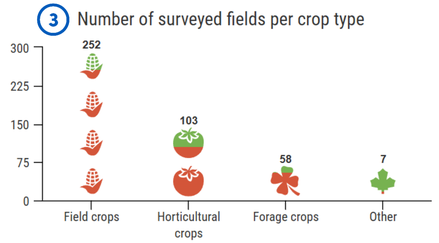
Results and Discussion

A total of 420 fields were surveyed across 43 different crops. **Figure 3** presents the overall summary of the surveyed fields per crop type.

3 Number of surveyed fields per crop type



A total of 213 distinct weed species were identified in the study. Horticultural crops had the highest total number of weed species (147), followed by field crops (138) and forage crops (131).

The three crops with the greatest number of weed species were: soybean (102), maize (92) and meadows (85).

The five species with the highest relative abundance (RA) index in the Montérégie region, across all crop types were (see **Figure 4**): lamb's-quarters (*Chenopodium album*, CHEAL), common dandelion (*Taraxacum officinale,* TAROF), annual ragweed (*Ambrosia artemisiifolia,* AMBEL), yellow foxtail (*Setaria pumila,* SETPU) and field horsetail (*Equisetum arvense,* EQUAR). These species were also the highest ranked weeds (based on RA values) for both soybean and corn (see **Figure 5**). CHEAL, AMBEL, and TAROF, also ranked in the top 5 weeds with the highest RA index for field crops, forage crops and horticultural crops (see **Table A**).

Table A. Summary of the weeds with the highest relative abundance values for field crops, forage crops and horticultural crops in Montérégie.

Culture	Ranking	Scientific name	EPPO code	Number of fields	Relative frequency (RF)	Relative uniformity (RU)	Relative density (RD)	Relative abundance (RA)
Field crops	1	*Chenopodium album*	CHEAL	165	7.9	13.1	18.4	39.3
	2	*Ambrosia artemisiifolia*	AMBEL	128	6.1	8.0	8.1	22.2
	3	*Equisetum arvense*	EQUAR	121	5.8	5.6	8.0	19.3
	4	*Setaria pumila*	SETPU	99	4.7	5.6	7.7	18.0
	5	*Taraxacum officinale*	TAROF	125	6.0	7.3	3.5	16.7
Forage crops	1	*Galinsoga quadriradiata*	GASCI	7	1.3	2.4	22.2	25.8
	2	*Taraxacum officinale*	TAROF	44	8.0	12.6	5.1	25.7
	3	*Chenopodium album*	CHEAL	31	5.6	8.3	10.9	24.8
	4	*Setaria pumila*	SETPU	13	2.4	2.7	7.9	13.0
	5	*Ambrosia artemisiifolia*	AMBEL	22	4.0	4.4	3.5	11.9
Horticultural crops	1	*Chenopodium album*	CHEAL	61	4.8	6.7	10.8	22.2
	2	*Taraxacum officinale*	TAROF	65	5.1	8.4	6.2	19.6
	3	*Ambrosia artemisiifolia*	AMBEL	44	3.4	5.1	7.8	16.4
	4	*Portulaca oleracea*	POROL	41	3.2	4.2	5.2	12.6
	5	*Oxybasis glauca*	CHEGL	32	2.5	2.6	5.6	10.7

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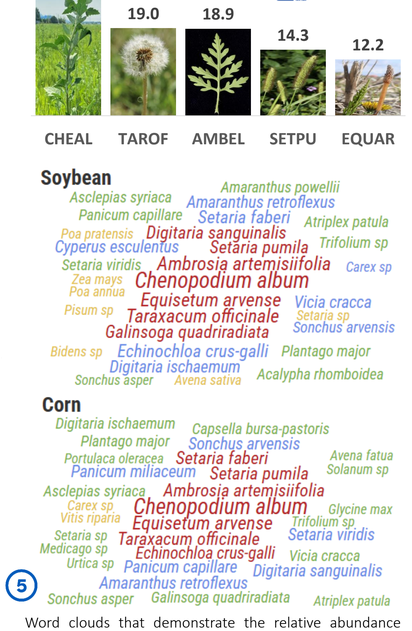


5 Word clouds that demonstrate the relative abundance (RA) of the main weeds in soybean and corn in the Montérégie region. The colours have been assigned according to the following scale: : yellow < 1, green 1< x ≤ 5, blue 5 < x ≤ 10, and red >10. It should be noted that the species in green and yellow are a random sub-sample of the full list.

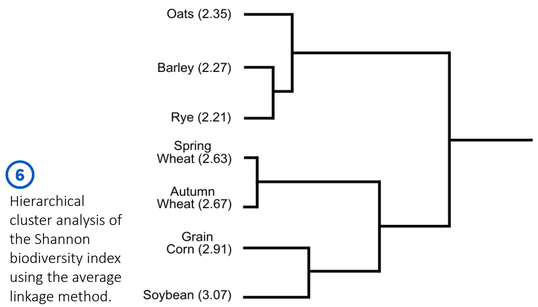
It is somewhat surprising that CHEAL seems to dominate the agricultural landscape in the Montérégie, given that it is not typically considered to be among the most problematic weeds. Indeed, the first glyphosate-resistant population was not confirmed until April 2024[5]. In comparison, TAROF, has been shown to dominate the landscape from very early in the season, and it could be difficult to control, mainly because of its deep taproots, its perennial life-cycle and its high fecundity[6].

AMBEL has been documented as a significant problem, particularly in soybean production, due to the presence of herbicide-resistant populations to groups: 2, 5, 2+5, 2+6, 2+9, 9, 9+14, 2+14 and 2+9+14, which have been confirmed in the Montérégie region[7].

The survey regarding the agricultural practices of the surveyed fields could help explain the dominance of these species in the agricultural landscape of the region.

Average weed biodiversity exhibited by field crops (2.59) was higher than that observed in forage crops (1.92). Cereal crops, including barley, rye and oats, were found to have the lowest average weed biodiversity (2.27). These were followed by spring wheat and winter wheat (2.65). As expected, corn and soybean were found to have highest average weed biodiversity (2.99) (see **Figure 6**).

These results underscore the important role that cereals could play in decreasing weed pressure when incorporated into the traditional corn-soybean rotation, typical of the Montérégie region.



6 Hierarchical cluster analysis of the Shannon biodiversity index using the average linkage method.

Conclusions

The results obtained provide the most recent and comprehensive portrait of weed dynamics in the Montérégie region, thus allowing for the identification of problematic agricultural weeds by crop type and the development of evidence-based weed management practices.

CHEAL, AMBEL, and TAROF were the three weed species that dominate the agricultural landscape in Montérégie.

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