

## **RESEARCH REPORT: ONTARIO FORAGE COUNCIL**

**Project Title:** Weed and Disease Survey in Forage Crops

**CORD IV Project Number: 8893**

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**Executive Summary:** Pest surveys provide valuable benchmark data that can identify production-limiting species and help to prioritize management tools in cropping systems. This inaugural survey of weeds and diseases in Ontario forage crops was conducted in 2007. The first documented occurrence of Brown Root Rot (*Phoma sclerotoides*) was detected in 70% of samples collected. It is possible that this disease is a significant contributor to winter kill. Its detection should provide motivation for bringing resistant alfalfa varieties to the Ontario marketplace.

Seventy three different weed species were detected through the field survey. Of those 73 species, 14 were considered poisonous according to the Canadian Poisonous Plant Information System ([www.cbif.gc.ca/pls/pp/poison](http://www.cbif.gc.ca/pls/pp/poison)), though many of these species occurred at low enough levels so as to have no negative impact on livestock production. Although lambsquarters has been cited to cause nitrate poisoning in livestock and was the second most abundant species found in our survey, the risk of nitrate poisoning it poses is equivalent to that of an annual forage crop such as cereal green feed or forage sorghum.

Predominant weed species found in new seeding stands were different compared to established stands. Documentation of this difference is important for identifying possible control options since stand establishment is greatly affected by weed competition. Results of this survey provide a list of predominant species to target for evaluating new, safer, reduced risk products for weed management in new seeding stands.

Nutritive quality of weed species tested at the request of participants was similar to that of the forage species being grown. Palatability of the weed species was not considered. All weed species that underwent nutritional analysis had higher moisture contents than the forage species sampled. This may increase

drying time and therefore increase the risk of weathering or reduced forage quality due to processing the forage crop when it is not dry enough.

**Methodology, Weed Survey:** From May to August, 2007, 132 forage crop fields were surveyed. These 132 fields were sampled from 5 general geographic areas of the province, focusing on counties with the highest forage crop acreage (refer to [www.ontario.ca/crops](http://www.ontario.ca/crops) under “statistics” for a list of counties and corresponding forage crop acres within each of the surveyed regions). Twenty random locations in each field were scouted. New seedling and established forage crop fields were surveyed. Species were ranked according to their “relative abundance”. Relative abundance was calculated by adding the relative frequency, relative field uniformity and relative field density. Refer to the glossary for an explanation of each term.

**Results – Weed Survey:**

- 73 different weed species were document in the 132 fields surveyed (Table 1)
- Dandelion was the most prominent species in all regions, but other prominent species varied from region to region (Table 2).
- Predominant species were different in new seeding versus established stands. Annual species dominated new forage stands, whereas perennial weeds dominated established forage stands (Table 3).
- Fourteen poisonous weed species (19% of total) were detected (Table 4).

**Table 1.** Rank of 73 Weed Species found in Ontario Forage Crops (both established and seedling stands) surveyed from May to August of 2007 and based on Relative Abundance.

Rank	Species	Relative Abundance
1	Dandelion	54%
2	Lamb'squarters	17%
3	common ragweed	11%
4	Chickweed	10%
5	Broad-leaved plantain	10%
6	Shephard's purse	9%
7	Quackgrass	8%
8	Tufted vetch	7%
9	Mouse-eared chickweed	6%
10	Redroot pigweed	6%
11	Green foxtail	6%
12	Wild buckwheat	6%
13	Spreading atriplex	6%
14	Barnyardgrass	6%
15	Prickly lettuce	5%
16	Eastern black nightshade	5%
17	White cockle	5%
18	Woodsorrel spp.	5%
19	Lady's thumb	5%
20	Yellow foxtail	4%
21	Witchgrass	4%

<b>Rank</b>	<b>Species</b>	<b>Relative Abundance</b>
22	Field Horsetail	4%
23	Yellow nutsedge	4%
24	Cinquefoil spp.	4%
25	Nipplewart	4%
26	Speedwell spp.	4%
27	Common milkweed	4%
28	Bluegrass spp.	4%
29	Canada Thistle	4%
30	Smooth crab grass	4%
31	Velvetleaf	4%
32	Goldenrod	3%
33	Narrow-leaved plantain	3%
34	Annual fleabane	3%
35	Grass-leaved stitchwort	3%
36	Stinkweed	3%
37	Spiny annual sow thistle	3%
38	Wire-stemmed muhly	3%
39	Wild mustard	2%
40	Pineappleweed	2%
41	Wild carrot	2%
42	Green pigweed	2%
43	Philadelphia fleabane	2%
44	Fall panicum	2%
45	Prostrate knotweed	2%
46	Bull Thistle	2%
47	Common burdock	2%
48	Common mullein	2%
49	Field bindweed	2%
50	Hairy Galinsoga	2%
51	Curled dock	1%
52	Black medick	1%
53	Night flowering catchfly	1%
54	Perennial sow thistle	1%
55	Cleavers	1%
56	Tansy	1%
57	Field violet	1%
58	Ox-eyed daisy	1%
59	Wormseed mustard	1%
60	Wild Oats	1%
61	Toadflax	< 1%
62	Stinking mayweed	< 1%
63	Bladder Campion	< 1%
64	Common mallow	< 1%
65	Black-eyed Susan	< 1%
66	Yellow evening-primrose	< 1%
67	Nodding thistle	< 1%
68	Three seeded mercury	< 1%
69	Giant foxtail	< 1%
70	Yarrow	< 1%
71	Yellow Rocket	< 1%

Rank	Species	Relative Abundance
72	Cyprus spurge	< 1%
73	Volunteer Barley	< 1%

**Table 2.** Top 10 abundant weed species for each geographic region surveyed in the province from May to August of 2007.

RANK	CENTRAL	EASTERN	NORTHERN	SOUTHERN	WESTERN
1	Dandelion	Dandelion	Dandelion	Dandelion	Dandelion
2	Lambsquarter	Eastern black nightshade	Chickweed	Lambsquarter	Chickweed
3	Common Ragweed	Quackgrass	Tufted Vetch	Broad-leaved plantain	Speedwell spp.
4	Redroot pigweed	Tufted Vetch	Tansy	Chickweed	Green foxtail
5	Spreading atriplex	Lambsquarter	White Cockle	Yellow foxtail	Bluegrass (Poa spp.)
6	Green foxtail	Prickly lettuce	Black Medick	Smooth crab grass	Quackgrass
7	Bluegrass (Poa spp.)	Shephard's purse	Night flowering catchfly	Barnyardgrass	Nipplewart
8	Broad-leaved plantain	Goldenrod	Quackgrass	Shephard's purse	Shephard's purse
9	White Cockle	Broad-leaved plantain	Broad-leaved plantain	Common Ragweed	Lambsquarter
10	Narrow-leaved plantain	Cinquefoil	Field Horsetail	Lady's thumb	Canada thistle

**Table 3.** Top 20 weed species found predominantly in Ontario seedling forage crops (first year stands) versus established forage crop stands (two or more years old) in fields surveyed from May to August of 2007.

Rank	Common Name – Seedling Crop	Common Name – Established Crop
1	Ragweed, Common	Dandelion
2	Lambsquarters	Broad-leaved plantain
3	Eastern Black Nightshade	Chickweed
4	Oxalis spp.	Shephard's purse
5	Green Foxtail	Mouse-eared chickweed
6	Yellow Nutsedge	Quackgrass
7	Prickly Lettuce	Tufted vetch
8	Redroot pigweed	Spreading atriplex
9	Smooth crabgrass	Barnyardgrass
10	Lady's Thumb	Annual fleabane
11	Witchgrass	Canada Thistle
12	Wild buckwheat	Cinquefoil (Potentilla spp.)
13	Velvetleaf	White Cockle
14	Yellow Foxtail	Field Horsetail
15	Fall Panicum	Milkweed, common

Rank	Common Name – Seedling Crop	Common Name – Established Crop
16	Wild Mustard	Bluegrass (Poa spp.)
17	Green Pigweed	Narrow-leaved plantain
18	Smooth bedstraw	Goldenrod
19	Nodding Thistle	Bull thistle
20	Volunteer Barley	Wire-stemmed muhly

**Table 4.** Poisonous weed species, their relative abundance, known toxic properties and rank amongst forage crop fields surveyed.

SPECIES	ABUNDANCE	TOXIC PROPERTIES*	RANK**
Lambsquarters	17%	Nitrates, Soluble oxalates	2
Redroot pigweed	6%	Nitrates, Soluble oxalates	10
Prickly lettuce	5%	Unknown	15
Eastern Black Nightshade	4%	Glycoalkaloids	17
Field horsetail	4%	Unknown	22
Common milkweed	4%	Glycosides	27
Stinkweed	3%	Glucosinolates	36
Wild mustard	2%	Glucosinolates	39
Tansy	1%	Unknown	56
Wormseed mustard	< 1%	Glucosinolates	59
Toadflax	< 1%	Unknown	61
Black-eyed Susan	< 1%	Unknown	65
Yellow Rocket	< 1%	Glucosinolates	71
Cypress spurge	< 1%	unknown	72

\*According to the Canadian Poisonous Plant Information System [www.cbif.gc.ca/pls/pp/poison](http://www.cbif.gc.ca/pls/pp/poison)

\*\* Rank amongst the 73 identified species found in 132 surveyed fields in Ontario.

## Methodology, Disease Survey:

### Brown Root Rot:

Alfalfa field samples were collected in Ontario from the Woodstock/Niagara region in the west to the Ottawa region in the east. Twenty whole plant samples (root and shoot) were taken randomly from each field. The plants were stored in a cooler, transported to a wash tub where the root material was washed off with water, then packed in brown paper bags and sent to Dr. Gary Bergstrom (Professor) in the Department of Plant Pathology at Cornell University in Ithaca, New York for processing and identification.

**Aphanomyces:** In 2007 time and resources were spent formulating an appropriate sampling protocol for aphanomyces and finding a laboratory that could process the samples in a timely manner. Regrettably, a facility that could process our samples was not found. It is our intent to sample for aphanomyces in the future once a capable testing facility is found.

## **Results, Brown Root Rot:**

Of the samples processed, the Brown Root Rot pathogen was detected in 70 % of the fields. Brown Root Rot found in these positive fields varied from 5% (very low) to 30% (moderate-high) of the roots or crowns being infected. Although these results are preliminary they support the U.S. data which suggest that the disease is widespread in alfalfa production systems in the region but undiagnosed. The next step is confirmation by molecular techniques of these preliminary results.

This is the first time that Brown Root Rot has been detected in Ontario. It is an increasing disease issue in the U.S. and management strategies have focused on developing resistant alfalfa varieties; however the development of resistant alfalfa varieties for Ontario has not been done since the disease has previously been thought not to exist. Although, other management strategies such as avoiding late or excessive fall harvest (reduce plant stress going into winter), maintaining proper soil fertility and rotating out of alfalfa for at least three years can help reduce losses and increase stand longevity, the ability to plant resistant varieties will have the greatest impact on minimizing losses due to this disease.

**Management Questionnaire:** Each producer involved in the survey was given a questionnaire aimed at evaluating common management practices used in forage production. The response rate was 45%. The results are shown below.

- 1) Soil type Classification:
  - a. Sand (10%)
  - b. Sandy Loam (20%)
  - c. Heavy Clay (15%)
  - d. Clay Loam (25%)
  - e. Loam (20%)
  - f. Silt Loam (10%)
  
- 2) Forage species planted:
  - a. Alfalfa/timothy (80%)
  - b. Alfalfa/bromegrass (5%)
  - c. Alfalfa/timothy/bromegrass (10%)
  - d. Alfalfa/bromegrass/orchardgrass/ryegrass (10%)
  
- 3) Crop grown prior to forage crop
  - a. Corn (65%)
  - b. Soybean (30%)
  - c. Barley (5%)

- 4) What time of year did you plant this forage crop:
  - a. Late April (45%)
  - b. Early May (45%)
  - c. Late May (10%)
  
- 5) How many tillage passes do you use prior to planting your new forage stand:
  - a. No-till (20%)
  - b. Two tillage passes, fall then spring (20%)
  - c. Three tillage passes, fall then two in spring (60%)
  
- 6) Do you apply manure prior to planting your forage crops:
  - a. No (60%)
  - b. Yes (40%)
    - i. 50% Liquid
    - ii. 50% Solid
  
- 7) Do you apply a herbicide in the year of stand establishment to control weeds:
  - a. No (40%)
  - b. Yes (60%)
    - i. 2,4-DB (75%)
    - ii. MCPB/MCPA (17%)
    - iii. 2,4-DB + MCPA (8%)
  
- 8) How many cuts will you take from
  - a. Established Stands
    - i. 2 cuts (45%)
    - ii. 3 cuts (50%)
    - iii. 4 cuts (5%)
  - b. New Seeding Stands
    - i. 1 cut (67%)
    - ii. 2 cuts (33%)
  
- 9) How late will you harvest your last cut
  - a. August (70%)
  - b. Early September (15%)
  - c. Late September (10%)
  - d. Early October (5%)

## Conclusions: Impact to Ontario Forage Production

- 1) Brown Root Rot was detected in Ontario for the first time. Diseases such as Brown Root Rot, which weaken the crown root can be significant contributors to winter kill. Resistant varieties are a key management strategy for Brown Root Rot. The availability of resistant varieties to the Ontario marketplace has been limited since the disease was not believed to exist. Confirmation of this disease should provide motivation to seed manufacturers to bring resistant varieties into the Ontario marketplace.
- 2) Nineteen percent of all weeds identified (14 species) have caused document cases of livestock poisoning. Fortunately, many of the poisonous species were found at very low levels and are unlikely to cause any adverse affects to livestock production. Effective management options for those species considered poisonous and found at relatively high levels must be made a priority for weed management research in forage crops.
- 3) Weed species found in first year forage stands are completely different than those found in established stands. Annual and winter annual weed species dominate new seeding forage stands whereas perennial weeds tend to dominate established stands. Weed competition in the year of forage stand establishment is critical for maximizing forage yields. This survey identified the most prominent annual species found in new seeding forage stands (Table 3) and provides focus for research efforts.
- 4) Regional variations in weed spectrum were identified and will allow for effective priority setting of weed management research in forage crops.
- 5) Basic production information collected through a management questionnaire provides insight into production practices.

### Milestones (Schedule C):

Milestone	Completion Date
A) Identify grower participants for the survey	August, 2006
B) Formulate Management Questionnaire	December, 2006
C) Collect Data from participating grower fields	August, 2007
D) Analysis of brown root rot samples and collect questionnaire information	November, 2007
E) Final Report	December 1, 2007

### Communication Update:

- Article published in Crop Talk Ontario (November 2007). Articles being drafted for inclusion in Country Guide and Ontario Farmer this winter.

- Results of survey to be presented at this years Forage Focus Conference (Dec 4 - Napanee and Dec 5 – Shakespeare)
- Scientific paper currently in the draft stages to be submitted to Weed Science.

**Budget:** Refer to Appendix A attached with copies of all invoiced expenses.

**Glossary:**

**Frequency:** Is the number of fields that a particular species occurred expressed as a percentage of the total fields surveyed.

**Relative Frequency:** Is the frequency value for a species divided by the sum of frequency values for all species, expressed as a percentage.

**Uniformity (all fields):** The number of quadrats in which a particular species occurred, expressed as a percentage of all the quadrats surveyed.

**Relative Uniformity (all fields):** Is the uniformity value for a species divided by the sum of all uniformity values for all species, expressed as a percentage.

**Density (all fields):** A measure of the number of plants of each species counted in a square metre. The density values in a single field are averaged over all fields surveyed.

**Relative Density (all fields):** Is the field density value for a species divided by the sum of field density values for all species, expressed as a percentage.