Proline Fungicide on Corn Silage to Reduce Mycotoxins 2014

(Lanark SCIA Major Grant)

Purpose:

To assess use of a fungicide such as Proline® on corn silage to reduce mycotoxins in the stored feed and impact on corn silage yield. 2014 was the second year of this trial.

Methods:

Proline® fungicide was applied at the tasseling stage of the corn on 3 different farms in eastern Ontario in 2014. At harvest, silage weights and moisture were measured. A fresh sample of silage was also collected for mycotoxin analysis from each plot. All sites had a minimum of 2 replications untreated and 2 treated with Proline® fungicide.

Picture 1 shows the tassel stage of corn when the fungicide (s) were applied:

Photo courtesy of John Nanne, Pakenham

All corn silage samples were analyzed for the following mycotoxins:

Aflatoxin B1 (ppb)	Fumonisin B1 (ppm)
Aflatoxin B2 (ppb)	Fumonisin B2 (ppm)
Aflatoxin G1 (ppb)	Ochratoxin A (ppm)
Aflatoxin G2 (ppb)	T-2 (ppm)
Deoxynivalenol (DON) (ppm)	HT-2 (ppm)
3-Acetyl-Deoxynivalenol (ppm)	Zearalenone (ppm)
15-Acetyl-Deoxynivalenol (ppm)	

Results:

Toxin Analysis

The result from the toxin analysis are shown for 2014 in Table 1. In the 2014 corn silage samples, Aflatoxin B1 (ppb), Aflatoxin B2 (ppb), Aflatoxin G1 (ppb), Aflatoxin G2 (ppb) were all <0.1 or non-detectable. Similar to the 2013, the main toxin found was Deoxynivalenol (DON). DON is produced by the fusarium mould as in wheat and other cereals. Other mycotoxins found but at minimum levels were 3-Acetyl-Deoxynivalenol, 15-Acetyl-Deoxynivalenol, T-2, HT-2 and Zearalenone.

Table 1: Analysis of 2014 Corn Silage Samples for Mycotoxins.

Toxin / Co-operator	Deoxynivalenol (DON) (ppm)	3-Acetyl-Deoxynivalenol (ppm)	15-Acetyl-Deoxynivalenol (ppm)	Fumonisin B1 (ppm)	Fumonisin B2 (ppm)	Ochratoxin A (ppm)	T-2 (ppm)	HT-2 (ppm)	Zearalenone (ppm)
Pakenham	0.50	< 0.06	0.10	< 0.1	< 0.1	< 0.003	< 0.06	0.14	0.06
	0.18	< 0.06	0.12	< 0.1	< 0.1	< 0.003	< 0.06	< 0.06	< 0.03
	1.39	< 0.06	< 0.06	< 0.1	< 0.1	< 0.003	< 0.06	< 0.06	0.21
	0.40	< 0.06	< 0.06	< 0.1	< 0.1	< 0.003	< 0.06	< 0.06	0.07
Douglas	< 0.06	< 0.06	< 0.06	< 0.1	< 0.1	< 0.003	< 0.06	< 0.06	< 0.03
	0.19	< 0.06	0.14	< 0.1	< 0.1	< 0.003	< 0.06	< 0.06	< 0.03
	0.16	< 0.06	< 0.06	< 0.1	< 0.1	< 0.003	< 0.06	< 0.06	< 0.03
	0.14	< 0.06	0.10	< 0.1	< 0.1	< 0.003	< 0.06	< 0.06	< 0.03
Renfrew	0.14	< 0.06	< 0.06	< 0.1	< 0.1	< 0.003	< 0.06	< 0.06	< 0.03
	0.09	< 0.06	< 0.06	< 0.1	< 0.1	< 0.003	< 0.06	< 0.06	< 0.03
	0.82	< 0.06	< 0.06	< 0.1	< 0.1	< 0.003	< 0.06	< 0.06	< 0.03
	0.29	< 0.06	< 0.06	< 0.1	< 0.1	< 0.003	< 0.06	< 0.06	0.10

Table 2 and table 3 show the difference in the DON toxin levels between the untreated and Proline® treated plots for 2014 and 2013, respectively.

Table 2: Deoxynivalenol (DON) mycotoxins of check compared to Proline plots from 2014 Corn Silage Samples.

Co-operator	Fungicide	Deoxynivalenol (DON) (ppm)	Average Don (ppm)	Average Reduction
Pakenham	Check	1.39		
	Check	0.4	0.90	
	Proline	0.5		
	Proline	0.18	0.34	-62.0%
Douglas	Check	0.19		
	Check	0.16	0.18	
	Proline	0.00		
	Proline	0.14	0.07	-60.0%
Renfrew	Check	0.14		
	Check	0.82	0.48	
	Proline	0.09		
	Proline	0.29	0.19	-60.4%

Table 3: Analysis of 2013 Corn Silage Samples for Mycotoxins.

Field	Treatment	DON[a] (ppm)	% Change in DON	T-2 (ppm)	HT-2 (ppm)	Zearalenone (ppm)
A	Check	0.32		0.00	0.32	0.00
A	Proline	0.28	-12.5%	0.00	0.19	0.00
B	Check	0.50		0.03	0.07	0.05
B	Proline	0.17	-65.2%	0.00	0.02	0.00
C	Check	0.145[b]		0.00	0.17	0.00
C	Proline	0.28	89.7%	0.00	0.07	0.00
D	Check	0.85		0.02	0.10	0.02
D	Proline	0.03	-97.1%	0.00	0.14	0.00
E	Check	0.00		0.00	0.00	0.00
E	Proline	0.00		0.00	0.00	0.00
		Average	-21.3%			
E	Headline	0.17[c]		0.00	0.00	0.00

[a]Deoxynivalenol (DON) (ppm) [b]average of two checks; 1) 0.06 ppm & 2) 0.23 ppm [c]1 site, 1 year, 2 reps. (DON 0.12 & 0.22 ppm

Weather Conditions

Weather conditions, primarily rainfall impact on the growth of molds and the resulting mycotoxins produced by these molds during pollination and grain fill. Figures 1 & 2 show the Percent of Normal Rainfall for the months of July and August 2014 respectively. Figures 3 & 4 show the Percent of Normal Rainfall for the months of July and August 2013 respectively. The red circle indicates the area where the on-farm sites were for this project. In 2014, Figure 1 show that rainfall was above the norm for July2014 and although Figure 2 shows August 2014 as below the normal rainfall, most of the rainfall came in the early part of August. In 2013, rainfall was normal to slightly below normal for July and about normal rainfall for August (Figures 3 & 4)

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Figure 1: Rainfall Percent of Normal for July 2014

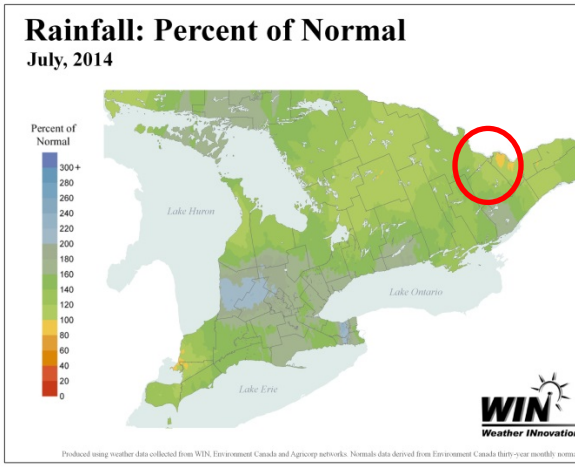

Figure 3: Rainfall Percent of Normal for July 2013

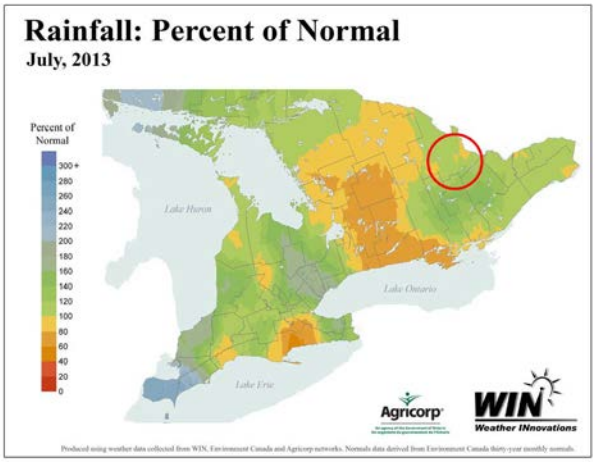

Figure 2: Rainfall Percent of Normal for August 2014

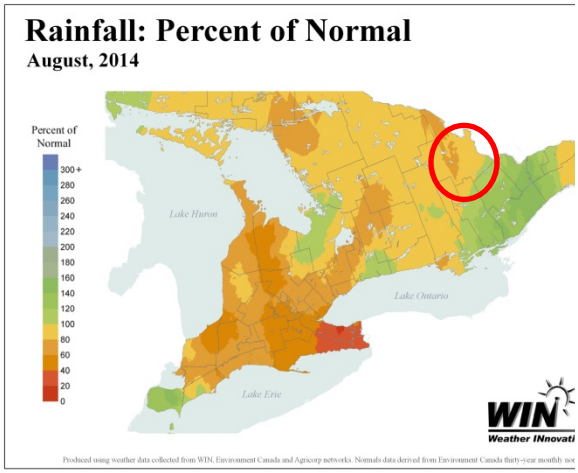

Figure 4: Rainfall Percent of Normal for August 2013

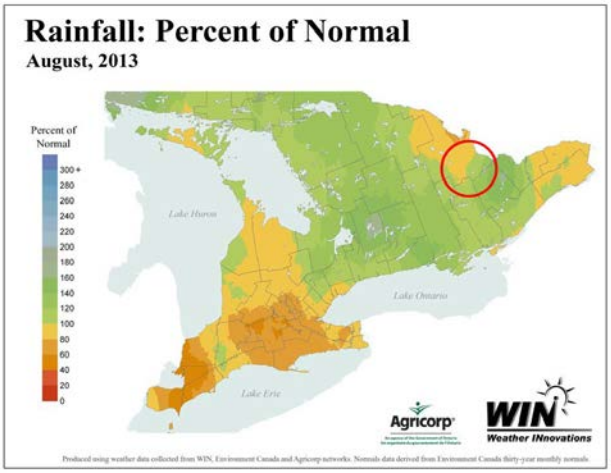

Table 4: 2014 yield response to the Proline® fungicide.

Cooperator	Treatment	# Reps	Yield (t/ac)	% Yield of Check
Renfrew	Check	2	23.8	-8.4%
	Proline	2	21.8	
Douglas	Check	2	17.1	10.5%
	Proline	2	18.9	
Pakenham	Check	2	16.1	33.3% [1]
	Proline	2	21.5	

[1] Note: Harvester plugged on rep.
Silage yield is in metric tonnes per acre adjusted to 65% moisture.

Table 5: 2013 Yield of the Fungicide treated and untreated at each farm site.

Site	Yield		% Difference in Yield	# of Reps.	Yield Headline	# of Reps.
	Check	Proline				
A	19.8	20.3	2.5%	2		
B	14.1	13.2	-6.2%	3		
C	16.7	18.3	9.3%	2		
D	17.7	16.6	-6.2%	4		
E	17.5	18.2	4.1%	3	16.1	2
		Average	0.7%			

Silage yield is in metric tonnes per acre adjusted to 65% moisture.

Summary:

Mycotoxin Reduction - Table 6 gives mycotoxin levels that livestock producers need to be concerned in the total ration of which corn silage may make up a portion of the total ration. Even at 'concern level' of 0.56 ppm, research has found that animal performance can be reduced (Mold and mycotoxin problems in livestock feeding, Department of Dairy and Animal Science, Pennsylvania State University).

Table 6: Mycotoxin Level in Total Ration (Dry Matter)

Mycotoxin	Concern Level	Potentially Harmful Cattle	Potentially Harmful Swine
Deoxynivalenol (DON) (ppm)	0.56	**2.5 - 6.0**	0.6 - 1.0
T-2 (ppm)	0.56	**0.7 - 1.5**	0.7 - 1.5
HT-2 (ppm)	0.25	**1.5 - 3.0**	1.5 - 3.0
Zearalenone (ppm)	0.25	**3.9 - 7.0**	0.6 - 3.0

Source: Mold and mycotoxin problems in livestock feeding, Department of Dairy and Animal Science, The Pennsylvania State University

In 2014, note that the untreated plots at the Pakenham and Renfrew sites had average DON levels above the 'concern level' of 0.56 ppm. Both these sites received above normal rainfall in August as opposed to the Douglas sites. With the above normal rainfall it would be expected to have greater fusarium disease pressure, resulting in the higher levels of DON.

In contrast, in 2013 it should be noted that 3 of the 5 sites had DON levels in the untreated plots was below the 'concern level' of 0.56 ppm. These low levels may be due to the normal to below normal rainfall in July and August of 2013.

Overall the average reduction in DON between the untreated and Proline® fungicide treated corn silage plots in 2014 was approximately 60%. In 2013, the drier year, the reduction in DON was 21.3%. It should be noted that in 2013 at site C, showed a lower DON level of the untreated than the Proline® fungicide treated. The value of 0.145 is an average of the two checks; 1) 0.06 ppm & 2) 0.23 ppm. The first sample of 0.06 DON ppm may have been an abnormality in the sample. At the other sites where there was DON was present in the untreated samples, the Proline® fungicide was able to reduce the DON level. In research trials conducted by Dr. Art Schaafsma et al, Proline® fungicide resulted up to a 50% reduction of DON in grain corn.

2013 Site E also compared Headline® fungicide. Headline® fungicide is registered for leaf disease control, but not registered for fusarium head blight suppression. It is interesting that the silage samples taken from the strips where the Headline® fungicide was applied had higher levels of DON then either the untreated or Proline® fungicide treated plots. Note, this was only 1 site and 1 year with two replications (DON 0.12 & 0.22 ppm). However, similar increases in DON levels have been found where Headline® fungicide was applied in Winter and Spring Wheat if applied too close to heading and therefore pollination.

The other mycotoxins found were 3-Acetyl-Deoxynivalenol, 15-Acetyl-Deoxynivalenol, T-2, HT-2 and Zearalenone. These mycotoxins were all below the level of concern for livestock.

Silage Yields – In 2014, again there was some variable yield response (Table 4) Note: the footnote - [1] Harvester plugged on rep. resulting in an error in calculating the yield response. As Table 5 shows that in 2013 on average, there was a slight increase in silage yield overall. Two sites however showed a decrease in yield and at Site E the Headline® fungicide treatment also showed a yield reduction. This may be due to some field variability or possibly the fungicide maybe induce a stress and resulting in a yield decrease.

Next Steps:

A third year of this trial would provide a better assessment of the use of a fungicide such as Proline® on corn silage to reduce mycotoxins in the stored feed and to access impact on corn silage yield over different environmental conditions. The plan is to repeat this trial in 2015.

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Location of Project Final Report:

Crop Advances, Ontario Soil & Crop Improvement Association at:

http://www.ontariosoilcrop.org/en/resources/cropadvances.htm