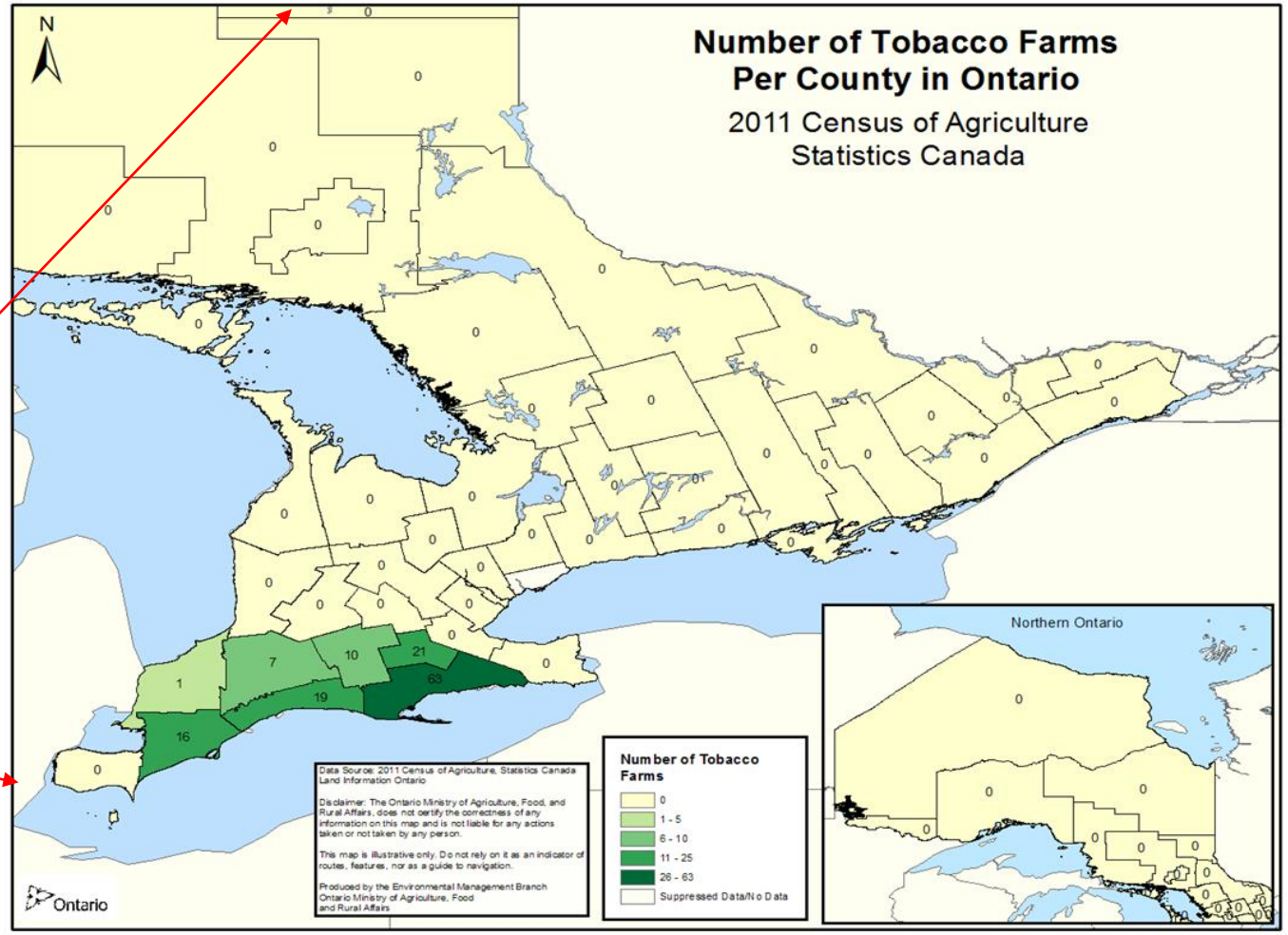
Evaluation of Fungicides for Control of Pole Rot (*Rhizopus arrhizus*) on Flue-Cured Tobacco

AL-AMERY M[1].; SAUDE C.[1]; RICHMOND M.[2] ; SHEARER A.D.[1]; THIESSEN A.[1]

1-Canadian Tobacco Research, Tillsonburg, Ontario, N4G 4H5.

2-Universiy of Tennessee Institute of Agriculture Knoxville, Tennessee 37996.

Canadian Tobacco Production



Canadian Tobacco Production

- 2022 Total Production – Southwestern Ontario
  19,628,362 kg (43,273,130 lbs).
  18,757,277 kg of flue-cured tobacco.
  871,085 kg of non-flue-cured (black or dark).

- 6,463 hectares (15,970 acres).

- 149 tobacco producers.

https://www.fin.gov.on.ca/en/tax/tt/rawleaf.html

Tobacco Pole Rot

Rhizopus arrhizus

- A saprophyte fungus= Feeds on dead organic matter.
- Ubiquitous= Present everywhere.
- Relatively easy to find in soil and all types of decaying matter

Tobacco Pole Rot

Rhizopus arrhizus

- Reported since 1950.

- Losses:

1971 = 3 million dollars (CAD); 1972 = 2 million (CAD); 1973= 2.2 million dollars (about 1 to 2 % of total crop value).

- Presently, losses due to Pole Rot are difficult to estimate, however, and according to the percentage mentioned it can be around $1-2M (CAD).

Tobacco Pole Rot

Pole Rot Development and Progress in Kilns (Barns)

A. In the Kilns, tobacco leaves maintained at temperature below 41°C (106°F) and relative humidity >80% undergo enzymatic activity that induces decomposition of chlorophyll and facilitate *Rhizopus arrhizus* growth.

Tobacco Pole Rot

Pole Rot Development and Progress in Kilns

B. During the yellowing stage of curing, infection starts on the basal portion of the leaf and extend to the lamina.

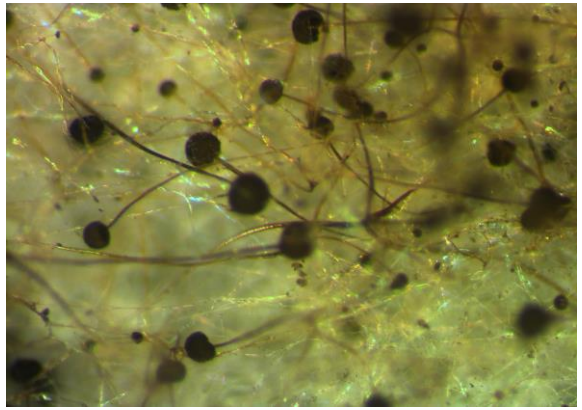
C. The fast-growing fungus initially forms white cottony mycelia that change from white to dark as a spores are produced.

Tobacco Pole Rot

Pole Rot Development and Progress in Kilns

D. Infection is localized in pockets in the kilns however, in severe cases the disease can occur across the top of bins or top of racks.

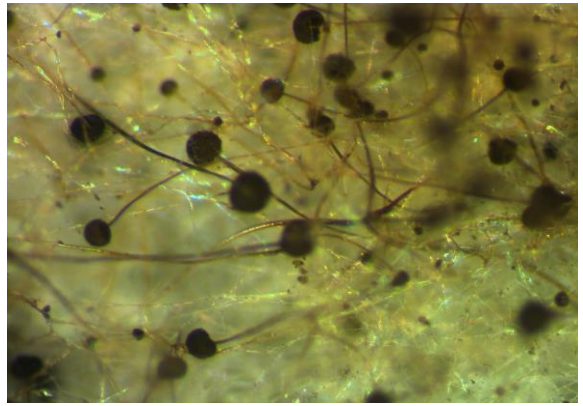
Tobacco Pole Rot



Pole Rot Development and Progress in Kilns

E. *Rhizopus arrhizus* is enhanced by leaf injury from harvesting, tying or pinning, and by high humidity accompanied by normal yellowing temperatures.

Tobacco Pole Rot



Pole Rot Development and Progress in Kilns

F. *Rhizopus arrhizus* is reduced if it exposed to temperatures above 43ºC (110ºF). However, It may still be viable after the high heat of steam drying process and may carry over from year to year on bins, pins and in surfaces.

Tobacco Pole Rot

Factors that contribute to Pole Rot increases

- Improved production practices leading to more leaf yield and heavier kiln loading.

- Leaf injury from harvesting equipment and pins that are used in bins.

Current Recommendations

- Disinfect sticks, racks, bins, pins and kilns with 1% sodium hypochlorite solution.

- Start the fan or burner in stick kilns the day after filling and carefully monitor for any sign of overheating.

- Try to minimize the time spent yellowing by advancing through yellowing as quickly as possible and yellowing at high temperature as possible, up to 41º C (106ºF).

We need to answer two questions

- Can fungicides applied in the field be effective in management of Pole Rot in the kilns?

- Are there any cultivars that are less susceptible to Pole Rot?

Evaluation of Fungicide for Control of Pole Rot (*Rhizopus arrhizus*)

Objectives

- 1- To evaluate fungicides applied in the field to determine the effect of treatments when the treated leaves were inoculated with *R.arrhizus*.

- 2-Assess susceptibility of selected tobacco cultivars when inoculated with *R. arrhizus*.

Materials & Methods

Field experiment: Evaluation of fungicides (CTH14)

No.	Treatments	Product name	Rate	PHI (Days)
1.	UTC	Not treated		
2.	Quadris Flowable	(a.i. azoxystrobin)	1.2 L/ha.	21
3.	Luna Tranquility	(a.i. fluopyram+Tri floxystrobin).	800 mL/ha.	7
4.	Scholar 230 SC	(a.i. fludioxonil)	870 mL/ha	7
5.	Double Nickel LC	(a.i. Bacillus amyloliquefaciens strain D747).	12.5 L/ha	7
6.	Quadris®Flowable +Double Nickel LC	(a.i. azoxystrobin) +(a.i. Bacillus amyloliquefaciens strain D747).	870 mL/ha + 12.5 L/ha	7

Materials & Methods

1-Field Experiment: Treatments

- Treatments were applied using a CO_2 backpack sprayer calibrated to deliver 450 L of water/ha at 41 PSI using 5 TX18 nozzles per row.
- Plants were harvested by hand once per run totaling two runs. Leaves from each leaf position were used as each treatment's replication during the curing experiment.
- The uppermost 9 leaves were harvested with 3 leaves each at the top middle and lower position of the plant.

Materials & Methods

Field experiment: Cultivars evaluation

Cultivars CTH14, CT157, and CT572 were evaluated.

- Plants of these cultivars were not treated with fungicides in the field. They were harvested the same way as the plants in the fungicides experiment.
- Plants were inoculated with the same inoculum concentration of *R.arrhizus* used in fungicide experiment.

Materials & Methods

Curing experiment

- Harvested leaves from the fungicides and cultivars experiments were inoculated with *R. arrhizus.*
- Inoculated leaves were then placed in a chamber set to mimic kiln's curing condition: temperature 30-35°C(85-95 F) and 90-100% RH.
- Inculcated leaves were evaluated after 5 and 7 days and data from seven days after inoculation (DAI) were statistically analyzed.

Effects of Treatments on *Rhizopus arrhizus* Infection of Tobacco Leaves Seven Days After Inoculation

Treatment (rate)	# Leaves Infected	% Leaves Infected
Control	23	35.50
Double Nickel	21	26.55
Quadris Flowable	**19**	**24.79**
Quadris+ Double Nickle	**13**	**17.56**
Luna Tranquility	26	33.52
Scholar	23	34.52
P	0.695	0.565

Effects of Treatments on *Rhizopus arrhizus* Infection of Tobacco Cultivars Seven Days After Inoculation

Cultivars	# Leaves Infected	% Leaves Infected
CTH14	**23**	**35.5**
CT157	32	45.41
CT572	32	42.77
P	0.669	0.817

Summary

Fungicide experiment

- No statistically significant differences were found in infected leaf count or percentage for all fungicides treated leaves.

- Potential reduction in leaf infection was observed when using Quadris (azoxystrobin), and Quadris (azoxystrobin) +Double Nickle (*Bacillus amyloliqefaciens* strain D747) across multiple evaluations.

Summary

Cultivars experiment

- No statistically significant differences were found in infected leaf count or percentage. Considering all cultivars were equally susceptible to *R. arrhizus* . However, CTH14 was numerically lower compared to the other cultivars.
- Higher *R. arrhizus* inoculum concentration than typical field conditions was used. Therefore, the tested fungicides might be more effective in controlling *R. arrhizus* in real-world scenarios under lower pathogen pressure.
- Growers can use azoxystrobin registered for the control of Blue Mold and Target Spot in Canada to manage Pole Rot in the kiln.

Acknowledgements

- CTRF Foundation Advisory Committee and Board of Directors.
- Cooperating tobacco growers.
- Manufactures for providing research products.
- CTRF team.
- Thank you for your attention.

Questions or comments?