Practical aspects of managing BLD

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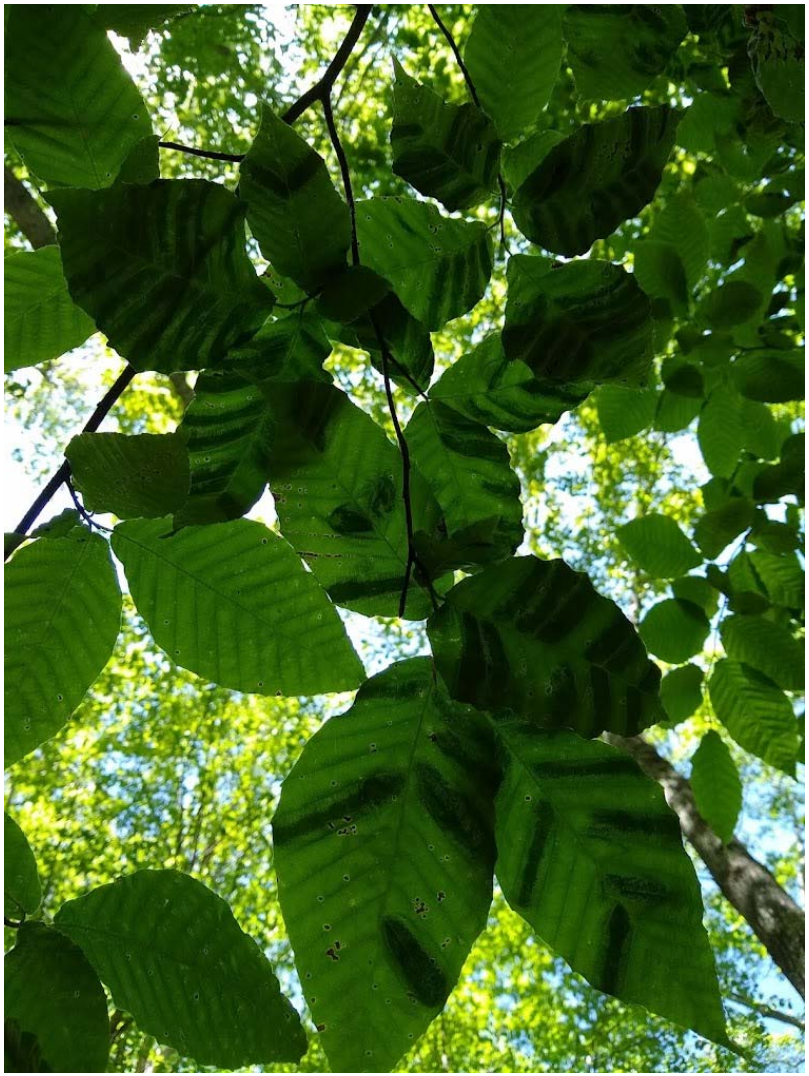
In partnership with Drs. James LaMondia, Nathaniel Mitkowski, Andrew Loyd, Heather Faubert, Rich Cartier, and special contributions from Dr. Dan Herms



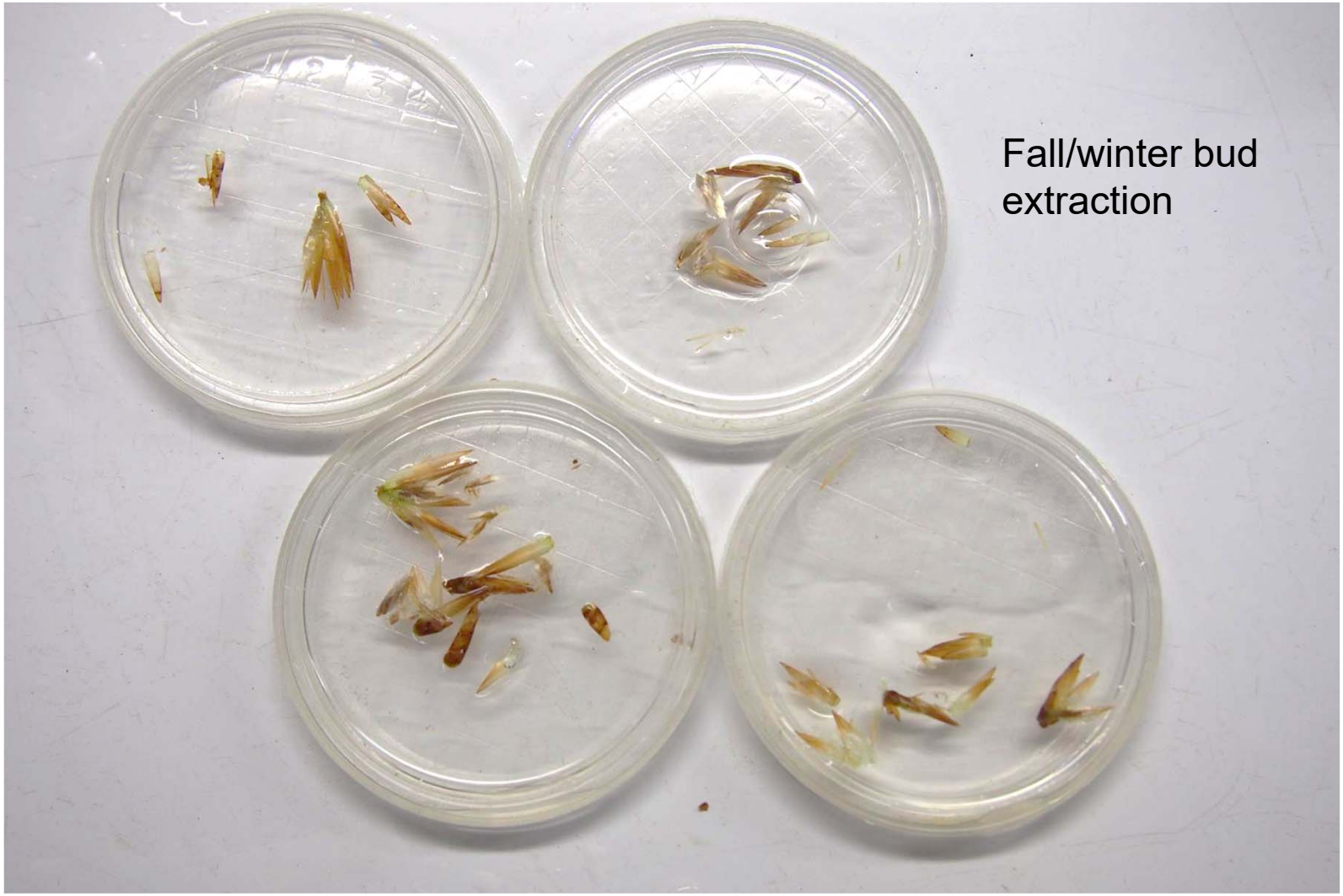
Damage takes place within overwintering dormant buds.

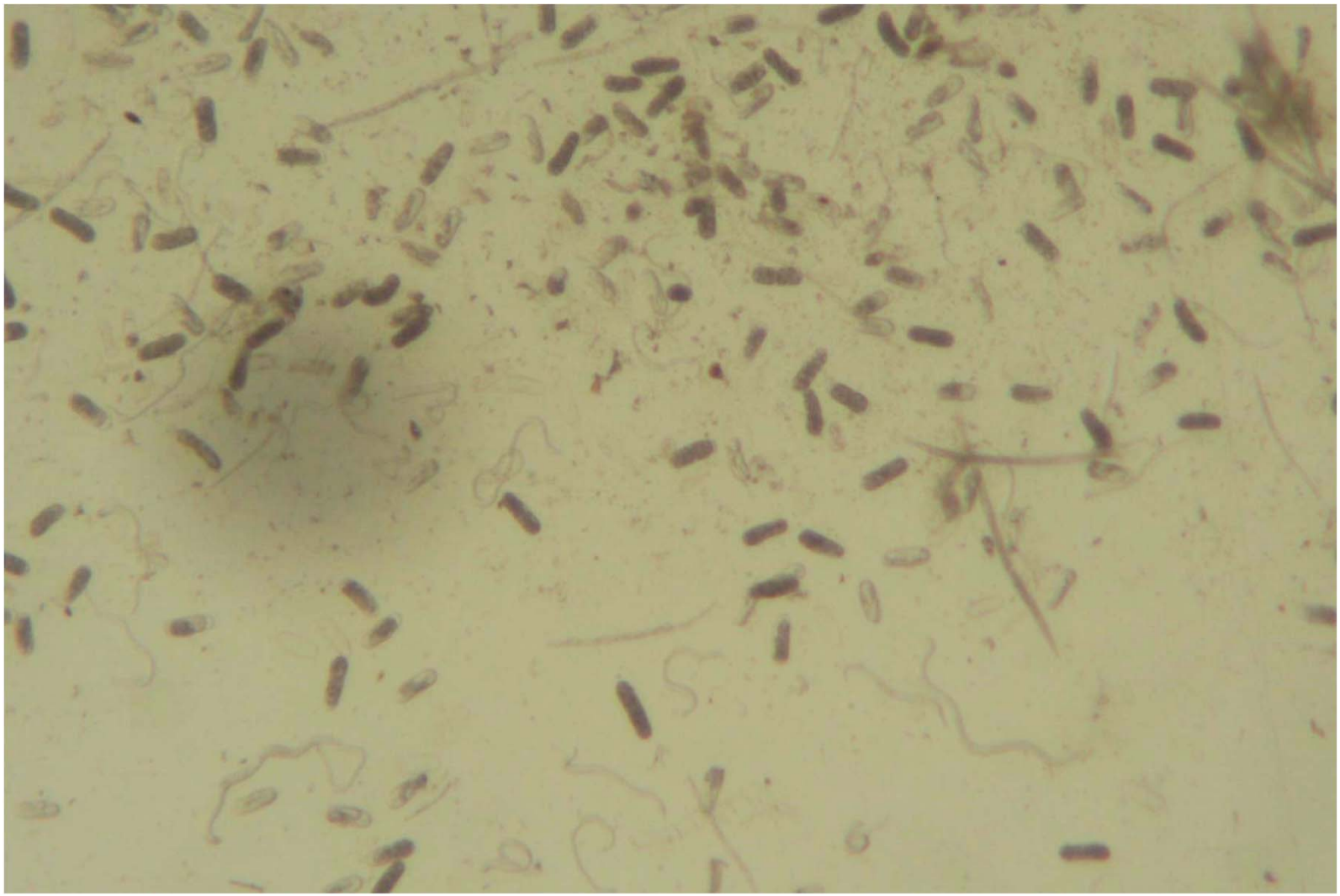
Leaf primordia expand to exhibit damage.

Therefore, treatments may protect *next year's* leaves. Current season's leaves do not improve appearance when nematodes are killed!

Some populations in European beech during summer of 2022 spontaneously collapsed – nematodes could not be extracted from leaves showing symptoms.

Therefore, winter sampling of dormant buds is required to assess the need for treatment!


Fall/winter bud
extraction



Candidate products tested (cast of characters)

Abamectin
Emamectin benzoate
Potassium phosphite
Oxamyl (Return formulation)
Fluopyram (alone or in combinations)

Sites: forest (RI, two sites; CT, one site)
landscape: New Haven, Madison

Abamectin
Emamectin benzoate

Require trunk injection

Known to affect some nematodes.
No observable effect in multiple trials with BLD

Phosphite can indirectly affect nematodes

cereal cyst nematode = *Heterodera avenae*
Maryland RKN = *Meloidogyne marylandae*

Indirectly affects nematode development via disruption of specialized feeding structures of plant tissues.

Oka, et al. 2007. Phytopathology 97: 396 – 404.

Phosphonate soil treatments improve health and suppress nematodes in American beech with beech leaf disease

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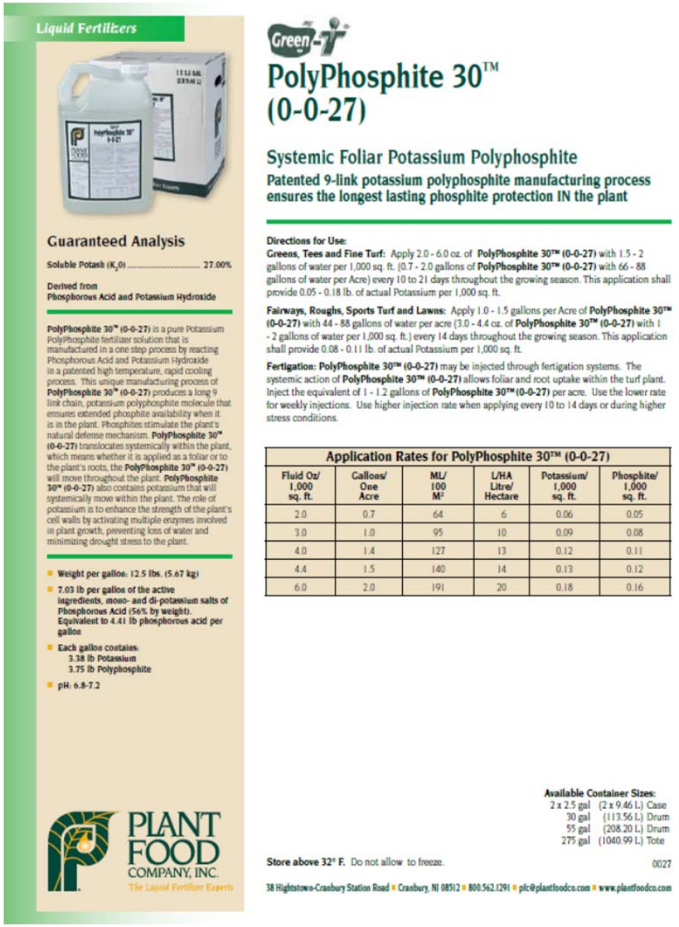
[1]The Davey Tree Expert Company, Kent, OH 44240
[2]Cleveland Metroparks, Parma, OH 44134
[3]ACRT Services, Stow, OH 44224

DAVEY®
Proven Solutions for a Growing World

Cleveland Metroparks®

PolyPhosphite 30™ (Plant Food Co.)

- Phosphonate (phosphite product)
  (same A.I. as Reliant and Agri-FOS)
- Phosphite stimulates tree defenses
- PP30 Marketed as a fertilizer for golf turf:
  potassium polyphosphite (0-0-27)
- PP30 is not registered as a pesticide
- No label for foliar or trunk application to trees



Liquid Fertilizers

Guaranteed Analysis

Soluble Potash (K_2O) 27.00%

Derived from
Phosphorous Acid and Potassium Hydroxide

PolyPhosphite 30™ (0-0-27) is a pure Potassium PolyPhosphite fertilizer solution that is manufactured in a one step process by reacting Phosphorous Acid and Potassium Hydroxide in a patented high temperature, rapid cooling process. This unique manufacturing process of PolyPhosphite 30™ (0-0-27) produces a long 9 link chain, potassium polyphosphite molecule that ensures extended phosphite availability when it is in the plant. Phosphites stimulate the plant's natural defense mechanism. PolyPhosphite 30™ (0-0-27) translocates systemically within the plant, which means whether it is applied as a foliar or to the plant's roots, the PolyPhosphite 30™ (0-0-27) will move throughout the plant. PolyPhosphite 30™ (0-0-27) also contains potassium that will systemically move within the plant. The role of potassium is to enhance the strength of the plant's cell walls by activating multiple enzymes involved in plant growth, preventing loss of water and minimizing drought stress to the plant.

- Weight per gallon: 12.5 lbs. (5.67 kg)
- 7.03 lb per gallon of the active ingredients, mono- and di-potassium salts of Phosphorous Acid (56% by weight). Equivalent to 4.41 lb phosphorous acid per gallon
- Each gallon contains:
  3.38 lb Potassium
  3.75 lb Polyphosphite
- pH: 6.8-7.2

PLANT FOOD COMPANY, INC.
The Liquid Fertilizer Experts

Green-it

PolyPhosphite 30™
(0-0-27)

Systemic Foliar Potassium Polyphosphite

Patented 9-link potassium polyphosphite manufacturing process ensures the longest lasting phosphite protection IN the plant

Directions for Use:

Greens, Tees and Fine Turf: Apply 2.0 - 6.0 oz. of PolyPhosphite 30™ (0-0-27) with 1.5 - 2 gallons of water per 1,000 sq. ft. (0.7 - 2.0 gallons of PolyPhosphite 30™ (0-0-27) with 66 - 88 gallons of water per Acre) every 10 to 21 days throughout the growing season. This application shall provide 0.05 - 0.18 lb. of actual Potassium per 1,000 sq. ft.

Fairways, Roughs, Sports Turf and Lawns: Apply 1.0 - 1.5 gallons per Acre of PolyPhosphite 30™ (0-0-27) with 44 - 88 gallons of water per acre (3.0 - 4.4 oz. of PolyPhosphite 30™ (0-0-27) with 1 - 2 gallons of water per 1,000 sq. ft.) every 14 days throughout the growing season. This application shall provide 0.08 - 0.11 lb. of actual Potassium per 1,000 sq. ft.

Fertigation: PolyPhosphite 30™ (0-0-27) may be injected through fertigation systems. The systemic action of PolyPhosphite 30™ (0-0-27) allows foliar and root uptake within the turf plant. Inject the equivalent of 1 - 1.2 gallons of PolyPhosphite 30™ (0-0-27) per acre. Use the lower rate for weekly injections. Use higher injection rate when applying every 10 to 14 days or during higher stress conditions.

Application Rates for PolyPhosphite 30™ (0-0-27)

Fluid Oz/ 1,000 sq. ft.	Gallons/ One Acre	ML/ 100 M²	L/HA Litre/ Hectare	Potassium/ 1,000 sq. ft.	Phosphite/ 1,000 sq. ft.
2.0	0.7	64	6	0.06	0.05
3.0	1.0	95	10	0.09	0.08
4.0	1.4	127	13	0.12	0.11
4.4	1.5	140	14	0.13	0.12
6.0	2.0	191	20	0.18	0.16

Available Container Sizes:
2 x 2.5 gal (2 x 9.46 L) Case
30 gal (113.56 L) Drum
55 gal (208.20 L) Drum
275 gal (1040.99 L) Tote

Store above 32° F. Do not allow to freeze. 0027

38 Hightstown-Cranbury Station Road ▪ Cranbury, NJ 08512 ▪ 800.562.1291 ▪ plc@plantfoodco.com ▪ www.plantfoodco.com

2 soil injection applications per season
early June and mid-August
PolyPhosphite 30,
    2 oz product + 14 oz water / inch DBH

Slightly higher than AGRI-FOS® rate for potassium phosphite directions for managing bleeding canker of beech

PP30 Soil Injection Study at Cleveland Metroparks

- Conducted: 2017-2022
- 40 trees: N = 20 treated / 20 untreated controls
- Trenching to sever root grafts
- 2 - 4 inch DBH saplings initially with mild symptoms
- 2 soil injections / inch at base of trunk
- Trees evaluated by each year August-September
- Nematodes sampled in October 2021-2022

Tree Health Assessment

- Canopy cover (0-100%)
- Dieback
  - Fine twig dieback
  - Main branch dieback

PP treatment protects against canopy loss

Significant differences apparent the first year after the start of treatments

Trend for improved results over time.

*Error bars are 95% CI (or +/- 1.96 SE)

Phosphite treatments decreased branch dieback

Application of potassium polyphosphate protected small branches from dying.

*Error bars are 95% CI (or +/- 1.96 SE)

Treated

Untreated

Fewer nematodes in leaves from treated trees

Reduction is 83 – 94% compared to the untreated group.

Application of fluopyram (Indemnify) as a root crown drench, Rhode Island, 2021


Same trial, applying oxamyl (Return) via trunk injection

Forest study, southern Connecticut, 2022

Oxamyl trunk injection
resulted in a
99% population
reduction

Forest study, southern Connecticut, 2022

Oxamyl soil drench response was inversely proportional to tree diameter.

This signifies that the effective dose seen with small diameter trees would have to be adjusted when treating larger diameter trees to compensate for the relationship between the amount of foliage into which the product is being diluted, relative to the trunk dbh. This relationship in beech trees is well known.

Forest study, southern Connecticut, 2022

Fluopyram applied as a basal trunk paint application was ineffective

Forest study, southern Connecticut, 2022

Potassium polyphosphite *may have* reduced populations by 45%.

The difference in population was not significantly different from the untreated check.

The differences between this trial and the Ohio studies could be attributed to the larger size of trees treated in CT, and possibly to differences in application timing.

Potassium phosphite

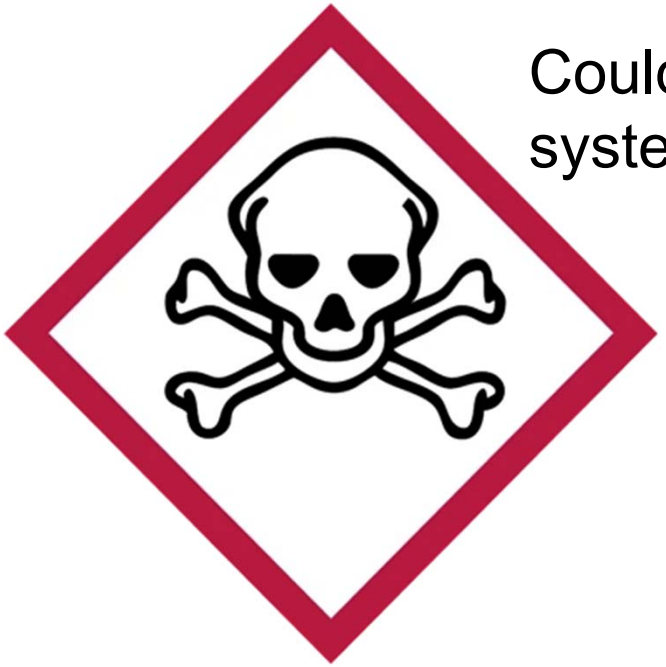
~45% population reduction
Have to wait to assess foliage health

Dosage may have to be adjusted on larger trees to compensate for tree diameter vs. foliage biomass relationship

Reasons why oxamyl will not be registered:

(1)

Oral LD_{50} is ~ 3 mg/kg in rodents



Could be mitigated through capsule system, like Inject-A-Cide B

Reasons why oxamyl will not be registered:

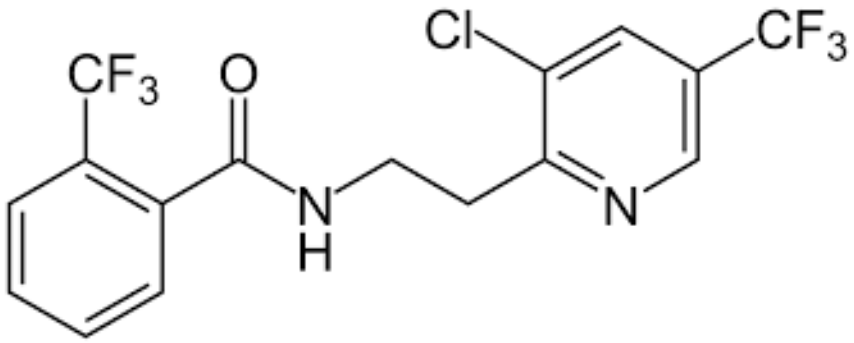
(2) Slime flux at trunk injection sites

Might be mitigated through surface and drill sterilization.

Beeches probably are not suitable for trunk injection, though.

Reasons why oxamyl will not be registered:

(3) Fluopyram as a foliar spray works!



Fluopyram is a succinate dehydrogenase inhibitor, blocking oxidative phosphorylation of <u>specific</u> fungi and nematodes

Broadform®

Intended for use by commercial applicators.
For use on ornamentals and crops in residential and commercial landscapes, interiorscapes, field grown and container crops in nurseries and greenhouses, lathhouses, shadehouses, and other enclosed structures.

ACTIVE INGREDIENT:

FLUOPYRAM*	21.40%
TRIFLOXYSTROBIN*	21.40%
OTHER INGREDIENTS:	57.20%
TOTAL:	100.00%

Contains 2.10 lbs fluopyram and 2.10 lbs trifloxystrobin per gallon
*(CAS Number **658066-35-4 and 141517-21-7**)

EPA Reg. No. 432-1537

Suspension Concentrate
Shake Well Before Use

KEEP OUT OF REACH OF CHILDREN
CAUTION

Luna EXPERIENCE®

Net Contents:
1/2 Gal. (64 fl. oz.)

GROUP 7 | 3 FUNGICIDE

Broad spectrum fungicide for control of plant diseases.

ACTIVE INGREDIENTS: FLUOPYRAM*	**17.6%**
TEBUCONAZOLE*	**17.6%**
OTHER INGREDIENTS:	**64.8%**
TOTAL:	**100.0%**

Contains 1.67 lbs FLUOPYRAM and 1.67 lbs TEBUCONAZOLE per gallon
*(CAS Numbers 658066-35-4 and 107534-96-3)

EPA Reg. No. 264-1091

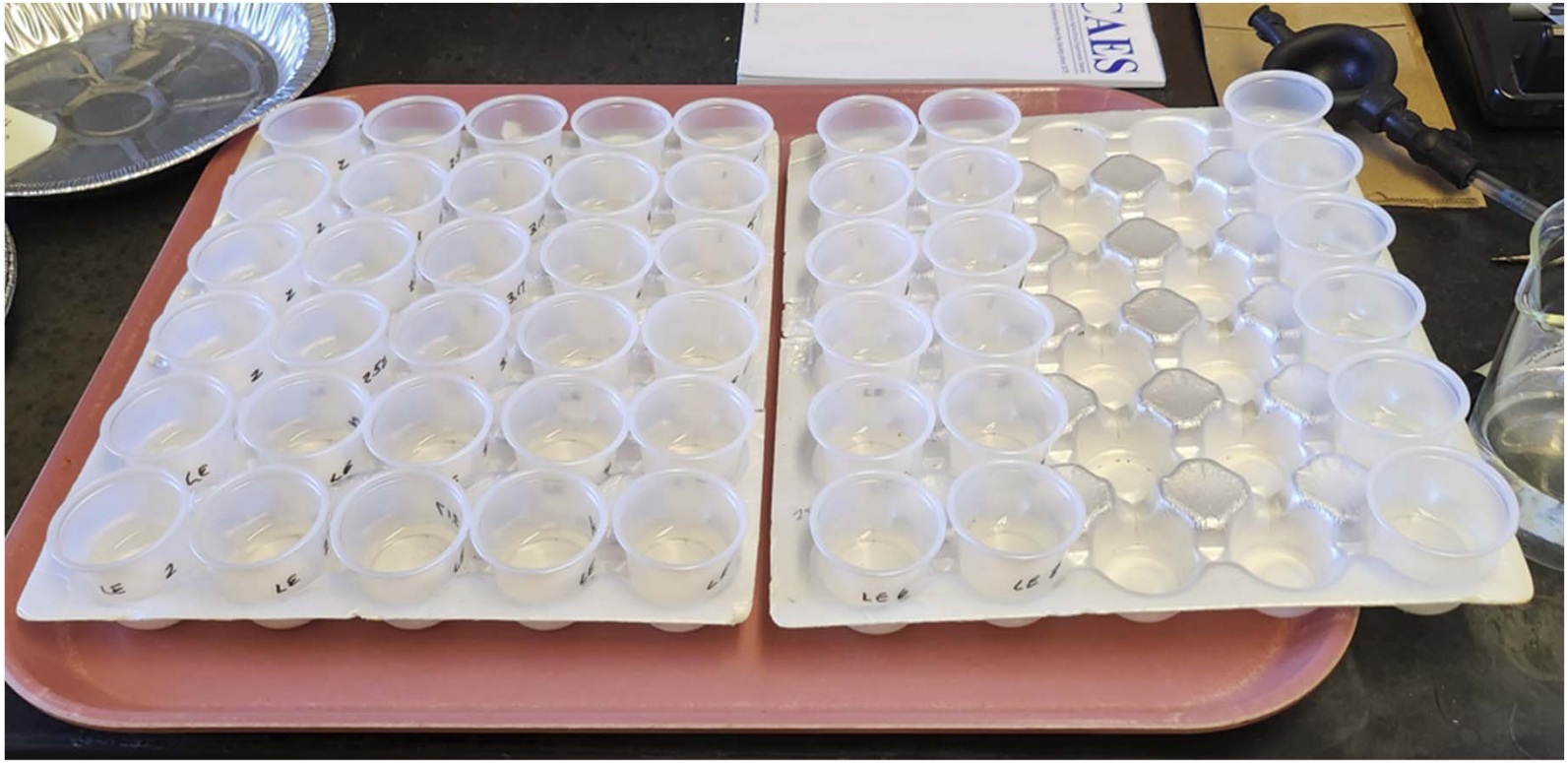
SUSPENSION CONCENTRATE

KEEP OUT OF REACH OF CHILDREN
CAUTION

180117C03 05/20

Spraying infested foliage with fluopyram-containing products results in a consistent, high degree of mortality of nematodes.

Data from Andrew Loyd, Bartlett Tree Care



Laboratory *in vitro* tests of nematodes extracted from highly infected foliage were conducted with fluopyram and fluopyram + tebuconazole.

EC50 = 1.2 ppm

EC90 = 2.2 ppm

Having these baseline toxicity data will allow detection of any future evolution of resistance to fluopyram.

Labeled rate = 149 ppm

Strategy for most effective use:

Apply once (maybe twice) when leaves have fully expanded. Luna Experience at 10 fl. oz. per 100 gallons ($57 – 75).

Monitor overwintering buds (dissection and water extraction, view with USB microscope) to be sure that spraying is warranted.

Summary

In four years, four effective treatments have been found

Potassium phosphite (applied as a “fertilizer”)

- any site, including forest trees
- dosage for larger trees needs fine tuning
- label (AGRI-FOS) needs to match use pattern

Fluopyram

- may be used on any ornamental landscape trees
- must be applied as a foliar spray

Monitor nematode populations now!

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