The Science behind Micro-Injection

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Mauget

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Evolution of Stem Injection

- Mauget 1958
- Tree Tech 1983
- ArborSystems 1992
- ArborJet 2000
- Rainbow Scientific 2002

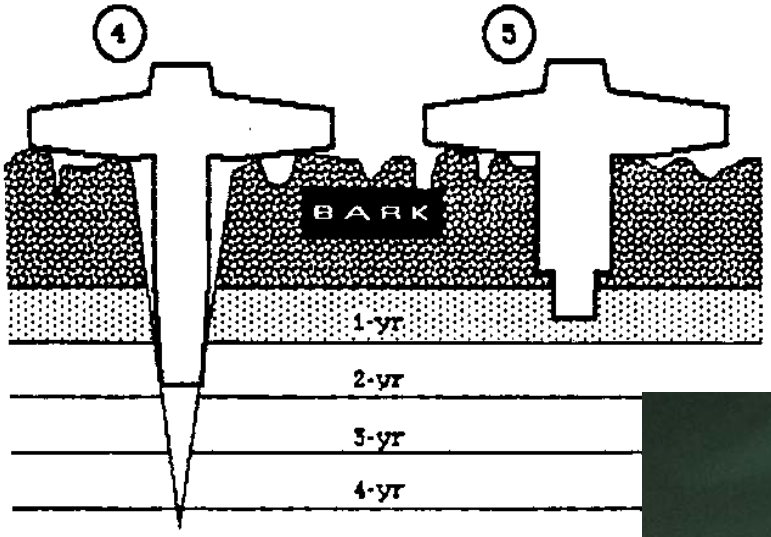
Development of Injection Devices

Dutch elm disease (1946) initiates practical search for internal delivery with fungicides/insecticides

- Macro Injection (>30 psi) Harness
- Micro Infusion (~6 psi) Mauget capsules
- Direct Inject (50+ psi) Wedgle Gun
- Micro Injection (10-40 psi) ArborJet systems

From “T’s” to Tubes and Plugs

Figures 4 and 5. Schematic views of "T"-shaped injectors seated in a trunk cross section during injection. 4. Most commonly used injectors block the outermost (1-yr) ring and deliver fluid to 3- and 4-year old wood (at the tip of the injection hole). 5. Shallow-pit injectors target highly conductive 1-year old wood.



Use of Cordless drill

Drill or Pressure Damage?

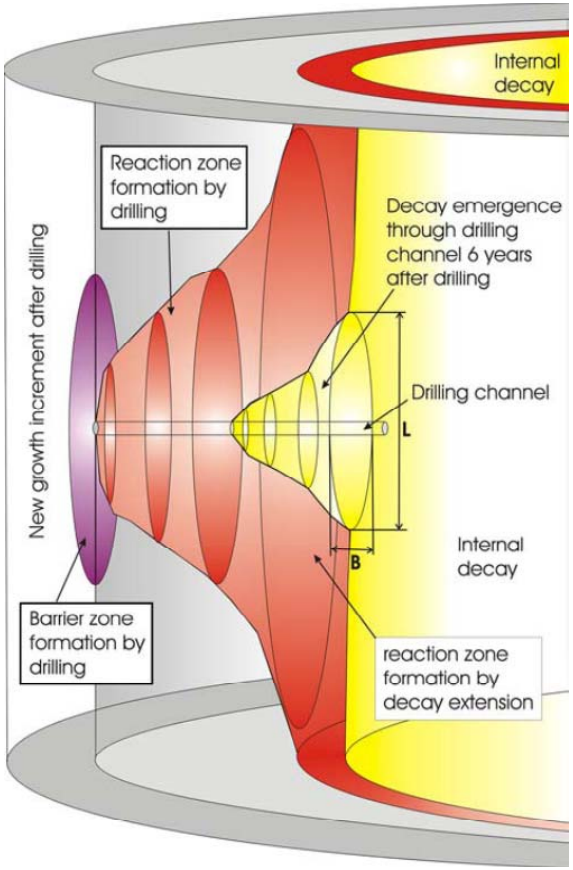
Shigo objected to discoloration from chemical injections. This led to formulation improvement.

Injection Wound Closure

Dan Neely (1983) at Morton Arboretum

- Circular wounds 9,12,17,25 mm into first annual growth ring, every 3” circumference.
- Oaks, sycamore, ash, tulip tree, honey locust
- Compared closure by radial growth, oaks faster than sycamore/ash or locust.
- Results suggest annual wounding involves small % total surface area (transport) and should not inhibit tree growth.

CODIT and Drill Wound Response

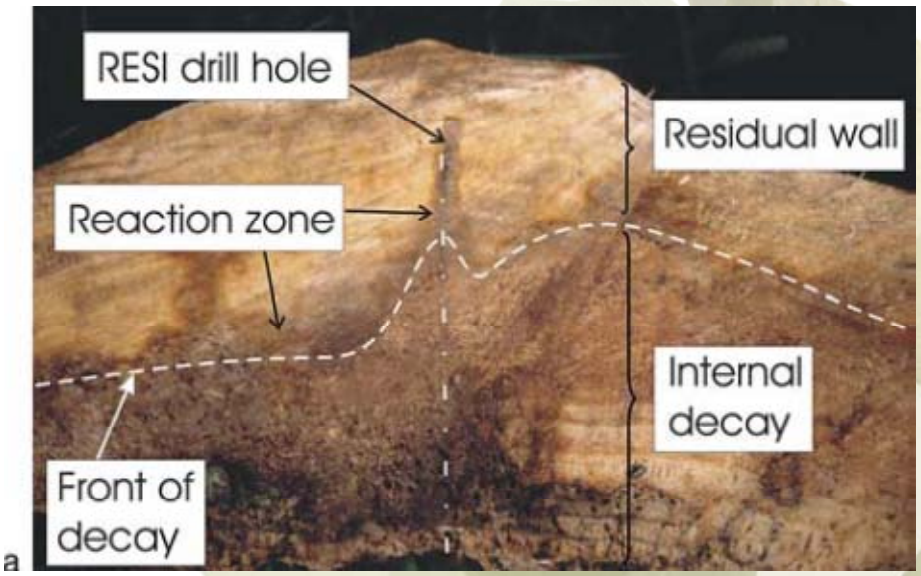


- "The Effects of Excessive Drilling Diagnosis on Decay Propagation in Trees"

  C. Mattheck, Trees (2006) 20: 224-228
- Poplar, Maple, Oak
- Drilled RESI 10 years prior to dissection and evaluation

CODIT and Drill Wound Response

- “In no case had the rot entered the drilling channel from outside and survived in the outer area of the hole.”



Black Poplar 7 years after drill inspection for Armillaria

- “Drilling did not cause any noticeable loss of vitality of the trees.”

Systemic Formulations

- Soluble, mobile, stable (storage)
- Effective (timing)
- Compatible (no phytotoxicity)
- Reasonable residual (internal stability) for target
- Ease of use (low risk)

Compana (1978)

Tree Injection Formulations

Xylem mobile necessary, but true systemics (xylem+phloem) have wider appl window

Imidacloprid – xylem only, no phloem activity

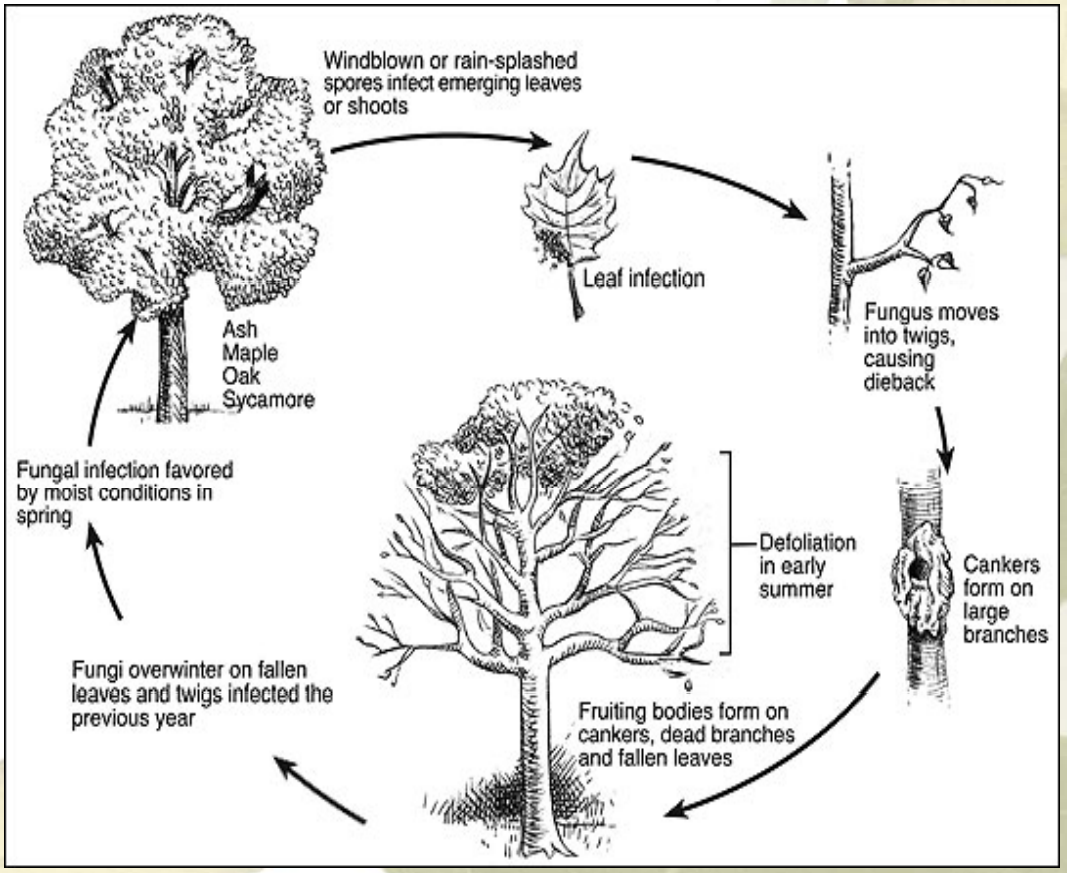
Potassium Phosphite – xylem + phloem active

Emamectin/ Abamectin – xylem + phloem active

Which Systemic and When?

Life Cycle “Window of Control”

- Chemical
- Distribution Time in the tree
- Dosage
- Site of Accumulation



Factors Effecting Length of Activity

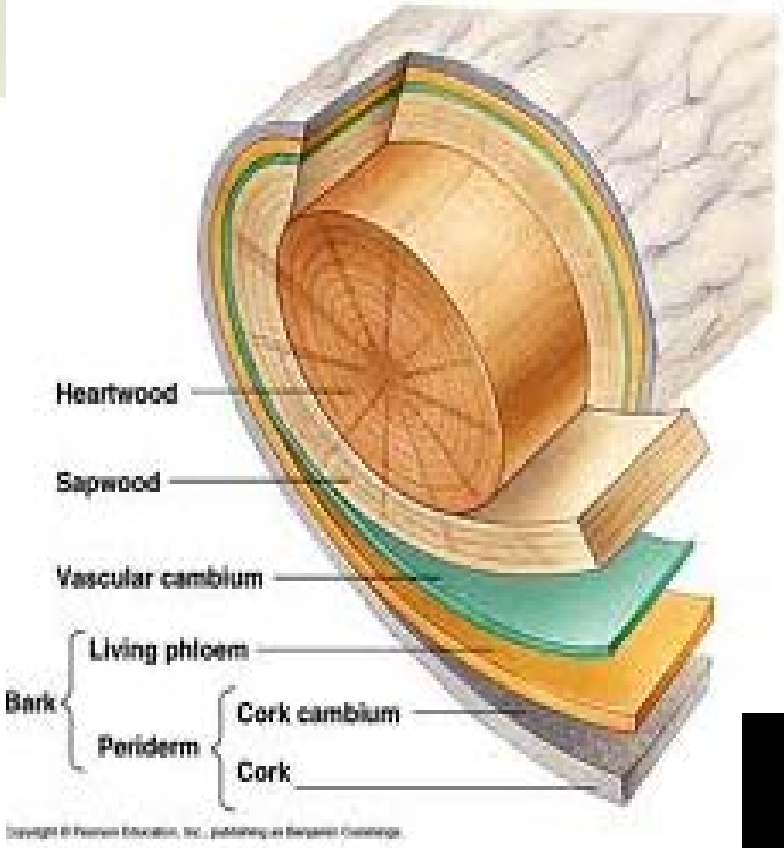
- Data with Soil or Foliar Applications
- Data w/ various AI's within tree vascular system limited
  - Imidacloprid use w/ Emerald Ash Borer
  - Abamectin / Emamectin use in Pines
  - Propiconazole movement in Oak for Wilt
- Chemical Properties Influential
- Tree as a Closed System

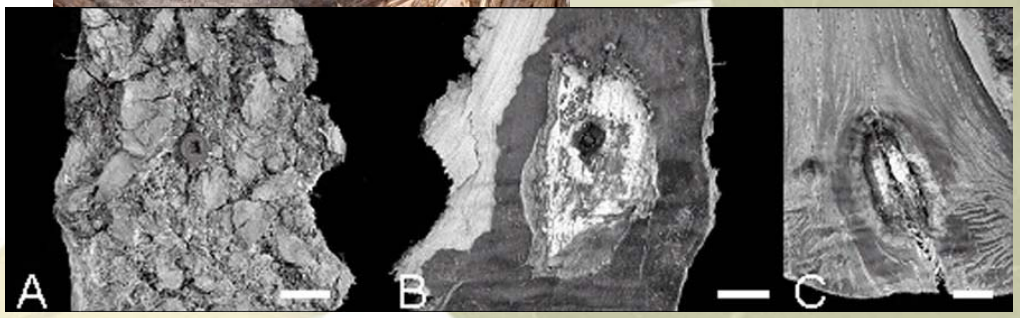
What does Applicator Want?

Speed / ease of use = more productivity/day (higher pressure)

- Less package waste
- Higher concentration formulations (less carry)
- Competitive Pricing
- Friendly Labels (no Restricted Use)

How Much Pressure?





- Be careful using high dosages
- Speed of injection can cause bark damage

Bark Sprays

Efficacy Dependent upon…

- Bark Thickness
- Correct Dosage
- Chemical Solubility
- Stability in Sunlight
- Residual for damage period

Bark Thickness

SOD Research shows oaks >18”dbh better to stem inject w K-phosphites because ¾ bark thickness

Coast live oak

White birch

Northern red oak

Safari Correct Dosage

Under-dosing common w/ Safari bark spray

Constant Flow Valve (CFV)

- CFV maintains gpm
- Auto shut-off
- Best for low volume spraying <2gpm

Safari 12oz/gallon

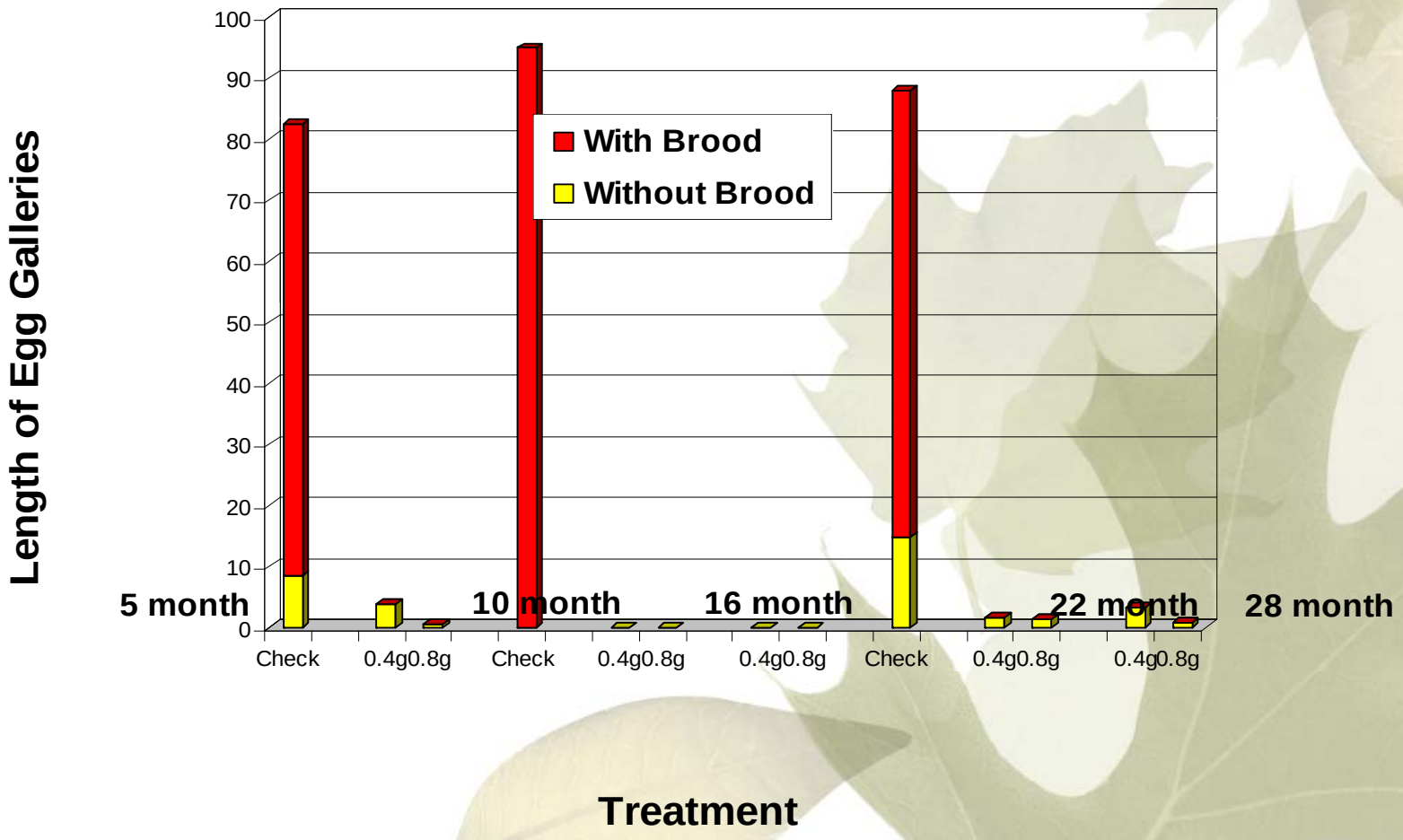
- 16 oz mix (2c) = 6”dbh

Conifer Bark Beetles

- Phloem feeders
- Not controlled w/ xylem-mobile systemics
- Traditional bark sprays (OP's, pyrethroids)
- New Data supports > 2yrs control
  - Abacide 2 Hp (abamectin 2%)
  - Expect amended registration in 2012

Abacide 2 Ips Bark Beetle Trial

Mean length egg galleries (with and without brood) constructed by Ips engraver beetles (per 1000 cm2) in loblolly pine bolts cut 5 to 28 months after injection with two rates of abamectin using the Tree IV Injection System; Lufkin, TX, 2008 - 2010.



Antibiotic Treatments Bacteria/Yellows Diseases

- 1967 tetracycline found to suppress MLO's
- Early 1970's OTC treated Palm Yellows
- Xylella fastidiosa (BLS) found in oaks, sycamore, elm, pecan and more.

Tetracycline found to be more soluble than Streptomycin for suppression of phloem inhabiting bacteria or phytoplasmas

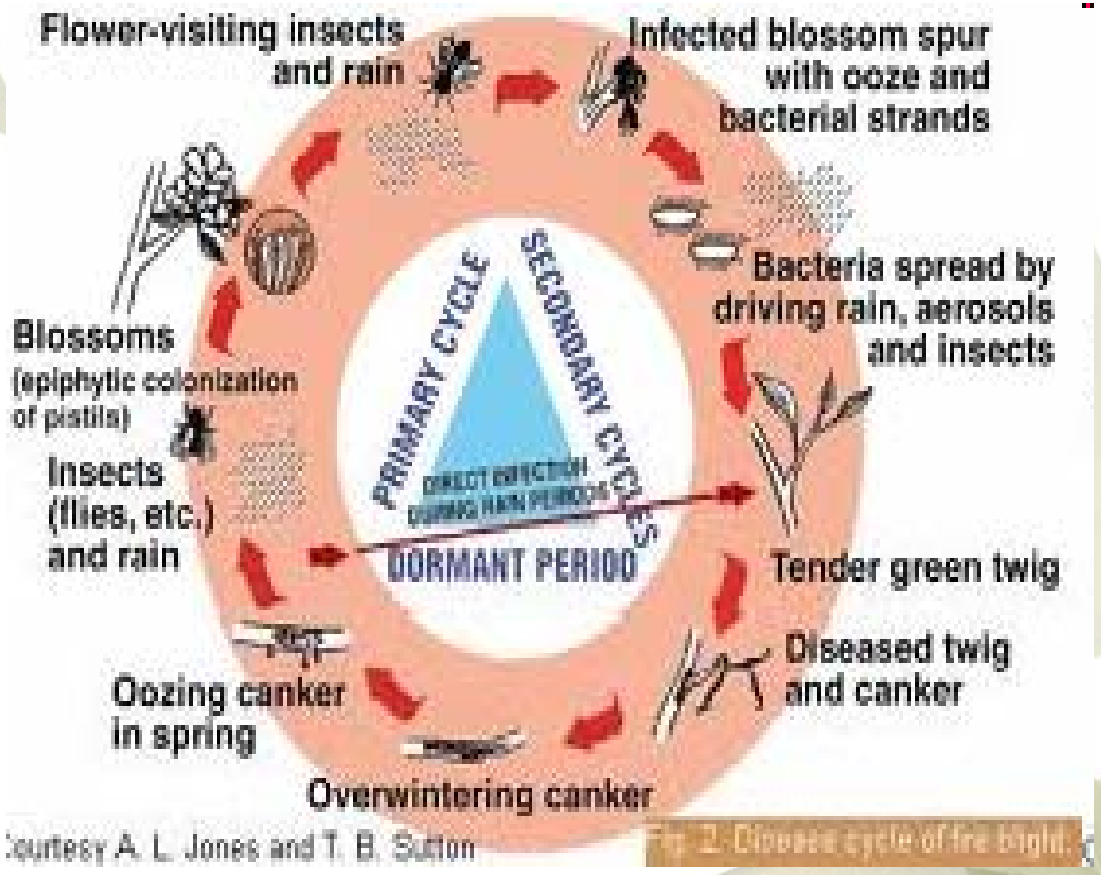
MycoJect Ultra

Oxytetracycline Hydrochloride 4.3%

CAUTION Signal Word

- Ready-to-use formulation
- 6mL Capsules
- Bacterial Leaf Scorch (oak, pecan, sycamore)
- Fireblight
- Effective for some phytoplasma disease suppression

Fireblight



Erwinia amylovora

- Primary infection
  - Bees to flowers
- Secondary infection
  - Ooze onto twigs and branches
- Hot temps stop infection spread

Fireblight

Cultural Management

- Prune out dead in dormant season
  - East coast is winter
  - West coast is summer

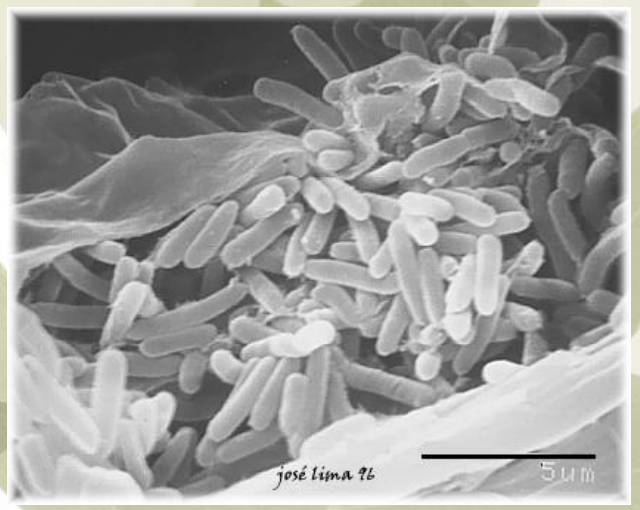
Chemical Management

- Foliar during bloom
  - Streptomycin
  - Residual 3-5 days
  - Primary Infection only
- Trunk injection prior to bloom
  - MycoJect Ultra (OTC HCl)
  - Residual up to 4 months
  - Primary/Secondary Infection

Bacterial Leaf Scorch

Xylella fastidiosa

- Xylem-limited bacterium
- Vectored by sharpshooter
- Related Pierce's Disease
- Olive, Oleander, Liquidamber, Oak, Sycamore



5 Strains of BLS in West

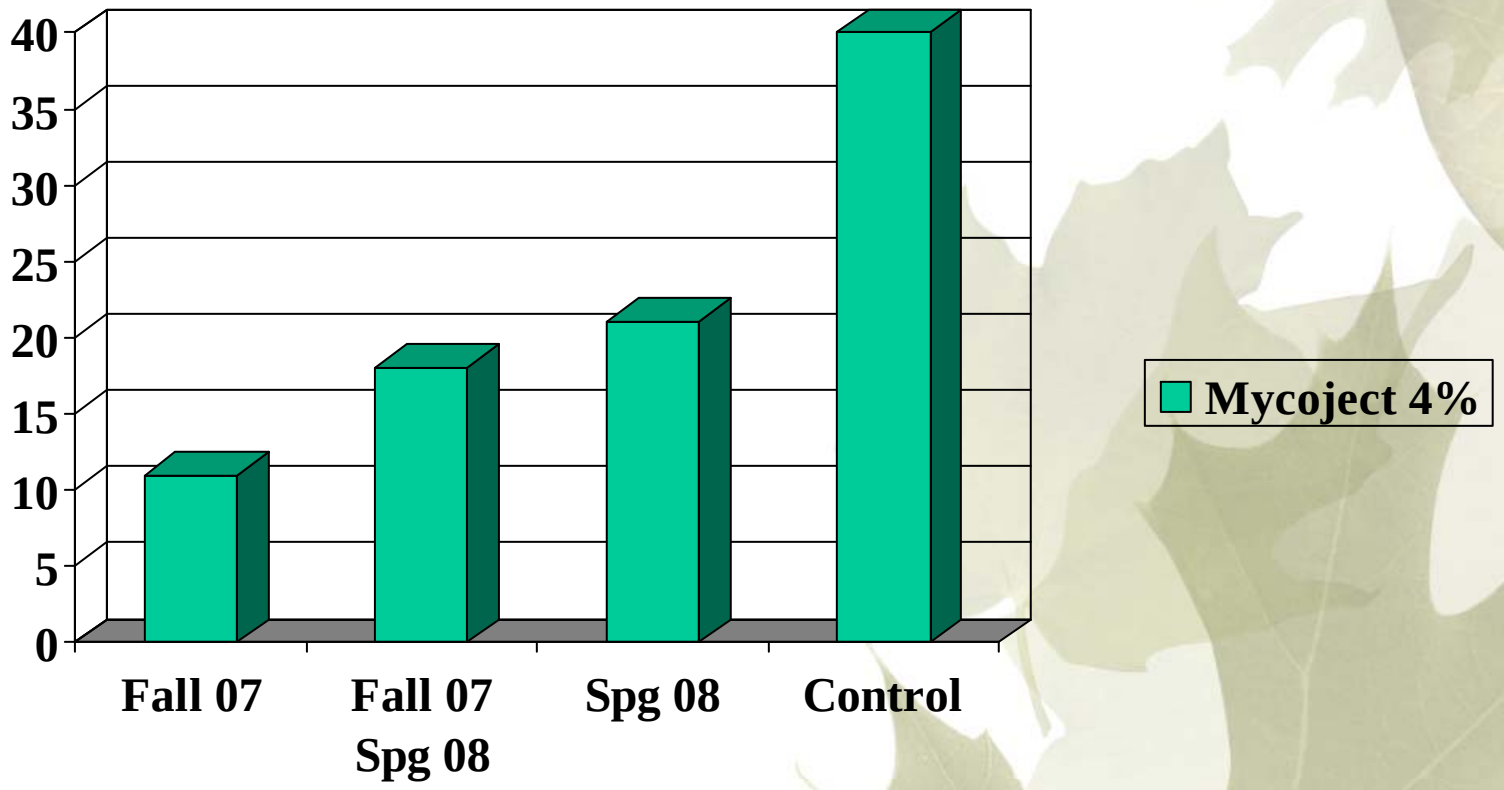
- PD Xf ‘fastidiosa
  - Western redbud, peach, magnolia
- ALS Xf ‘multiplex’
  - W redbud, ginko, crape myrtle, sweetgum, olive, purple plum
- Xf ‘sandyi’
- Xf ‘unknown’
  - Mulberry

Bacterial Leaf Scorch

- Marginal leaf burn
- July/ August
- Similar to water deficit, fert burn
- Lab confirmation
  - ELISA, PCR

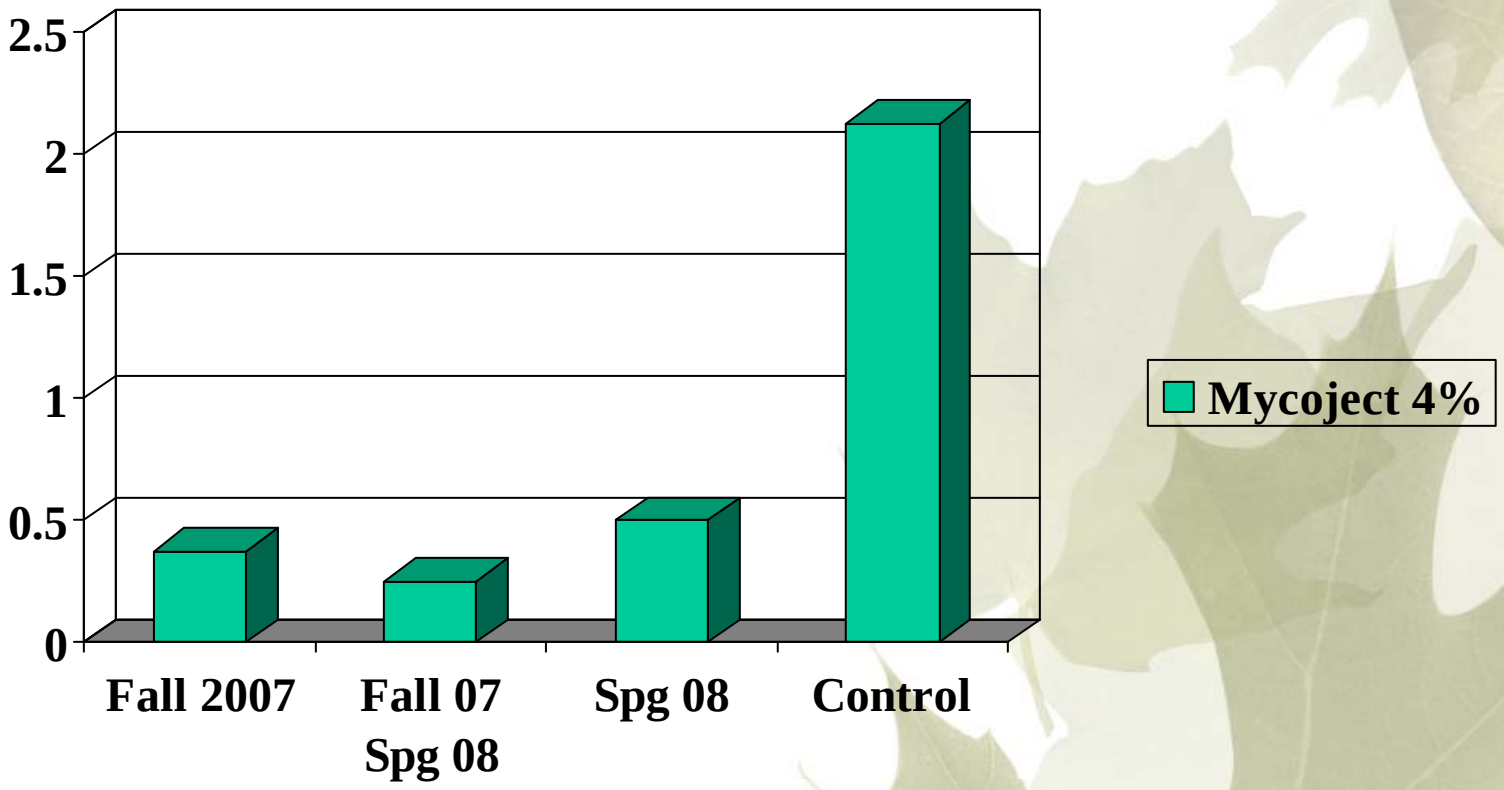
Mycoject Treated vs Control

Number Dead Branch Tips



City of Rancho Cucamonga

Percent Crown Thinning



0.5 = 5%; 1 = 10%; 2= 15%

City of Rancho Cucamonga

Bacterial Leaf Scorch

"Window of Control"

- Timing May – October
- May/Jun suppresses current yr symptoms
- Aug – Oct suppresses next season symptoms
- Imidicloprid for vector?

Liquid Loadable Chemistry

- Imicide Hp
- Stemix Plus
- Abacide 2 Hp
- ArborFos Hp
- Inject-a-Min's

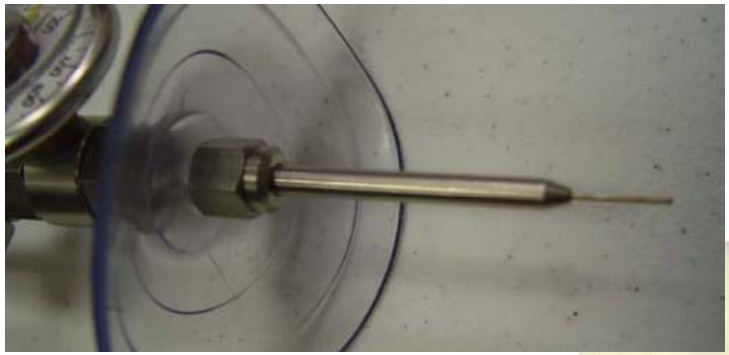
For use in Quik-Jet, Tree IV, and Viper too

Reloadable Devices

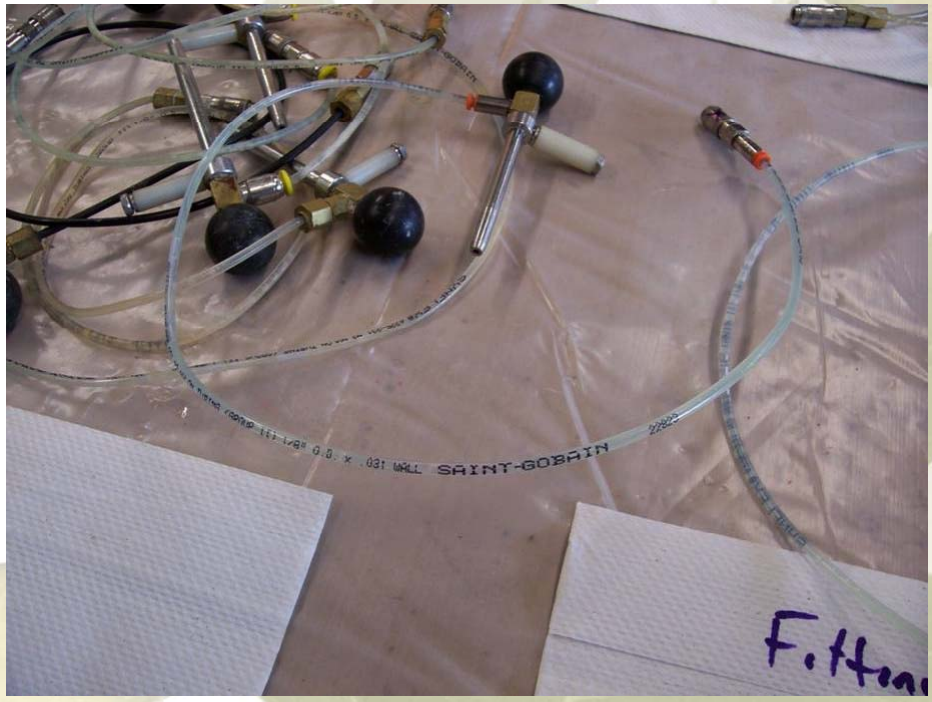
QUIK-Jet Syringe

Reloadable Devices

Viper or Air Hydraulic Gun



Modified Viper Tip for use in USDA Asian Longhorned Beetle Program with Imicide Hp (no ArborPlug used)



SmartShot Syringe

Mauget U.S. Distributor for Tree Logic Syringes

Capsules/ *SmartShot* Syringe

Closed-system Capsule, and

NEW Reloadable Syringe

SmartShot Syringe

2 Syringe Sizes

- 3mL/6mL
- 5mL/10mL

2 Nozzle Sizes

Short (7/64 bit)

Long (7/64 bit)

Closed System Loading

- Insert the syringe into the Draw-off unit
- Check Valve holds Prime, Prevents Leaking

Using the SmartShot Syringe

- Calculate # Injection Sites
  - Use Chalk to mark site
- Same spacing as caps
  - Every 6” around trunk
- Substitute cap dosage
  - 3mL cap use 3mL syringe setting

Which Syringe?

- Small 3mL/ 6mL
  - Imicide Hp, Abacide 2 Hp, Stemix Plus
- Large 5mL/10mL
  - ArborFos Hp

Pricing *SmartShot* Syringe

Draw-off Unit $175

3-Pak $295-310

Mauget Products:

- **Insecticides:**
  - Abacide 2
  - **Imicide**
  - Inject-A-Cide MSR
- **Fungicides:**
  - Arborfos
  - Tebuject 16
- **Micronutrients:**
  - Inject-A-Min Iron Zinc
  - Inject-A-Min Manganese
- **Fertilizers:**
  - Stemix Plus
- **Antibiotics:**
  - **MycoJect Ultra**
- ***NEW* Liter Chemistry**
  - Imicide Hp
  - Abacide 2 Hp
  - ArborFos Hp
  - *Soon* MycoJect Ultra Hp

Get Noticed!!

Mauget Applicator Database

- Register on Mauget Website
  - www.mauget.com
  - Click “applicator signup”
  - Mauget Cert No, Distributor, Products, Zipcode

Questions?

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