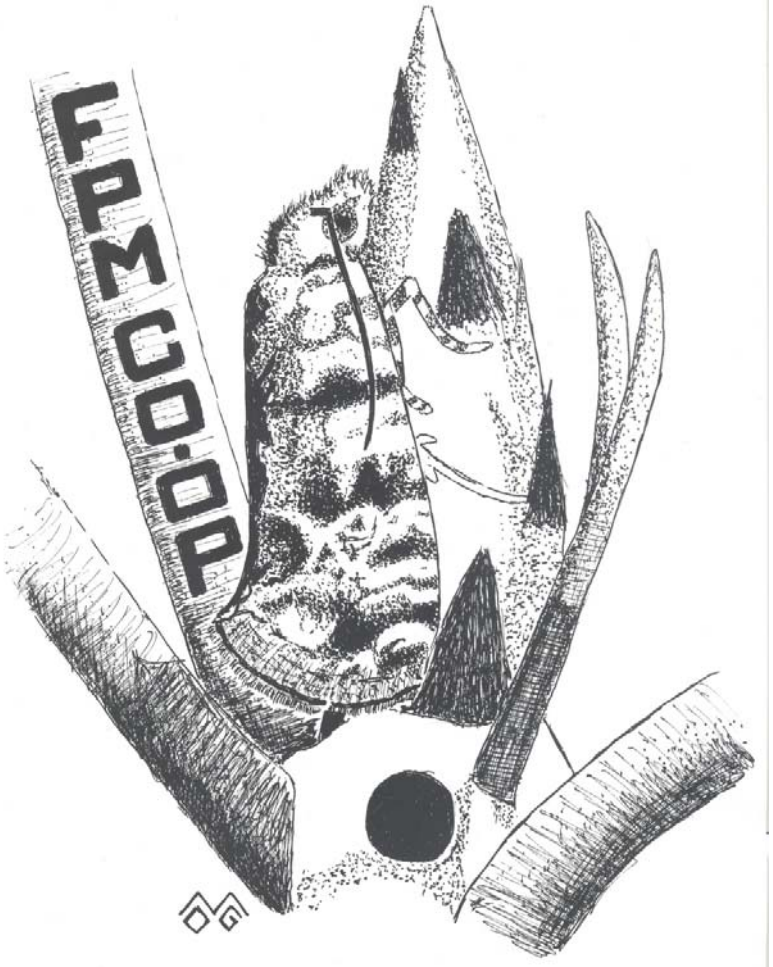
Emamectin Benzoate: TREE-äge™



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&

Texas Forest Service,

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Lufkin, Texas

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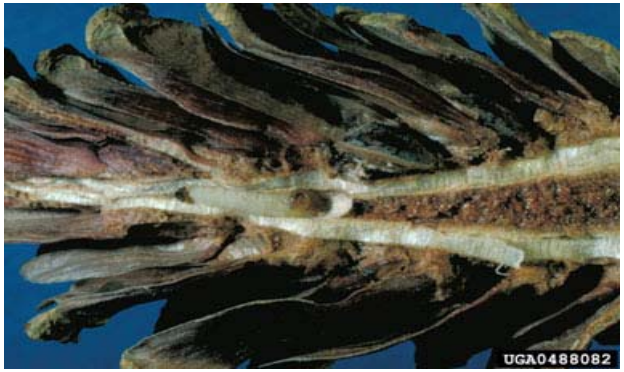
Systemic Insecticide Injection Studies

Thrips

Seed bug



Seedworm

Midge

Bark beetle

Seed bug

Coneworm

Cone beetle

Aerial Insecticide Applications

Airblast Insecticide Applications

Limitations of Foliar Sprays

- Expensive
- Becoming difficult to find aerial applicators
- Short treatment duration, e.g. several (3 – 6) treatments required per year
- Worker exposure
- Drift
- Potential for non-target (bees, parasites & predators) mortality

Potential Advantages of Tree Injections

- Full dose administered to tree; reduce pesticide load in orchard
- Treatments allocated to most susceptible and/or valuable clones
- No exposure to customer, minimal to applicator
- No drift or non-target effects
- Wide treatment window
- Long treatment duration (2 or more years); no photo or microbial degredation of chemical

Systemic Insecticide Injection
1996 - 2009

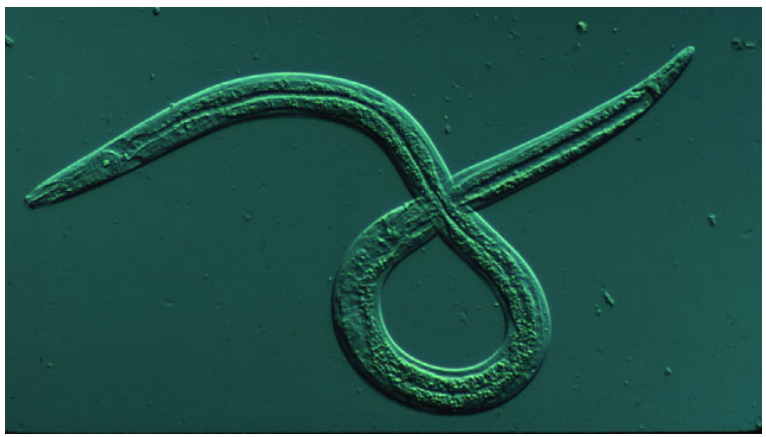
Objectives

Evaluate trunk injection of systemic insecticides as alternatives to:

1) aerial sprays for the control of cone and seed insects in pine and hardwood seed orchards.
2) trunk sprays for protection against bark beetles.

Japan – Pinewood Nematode

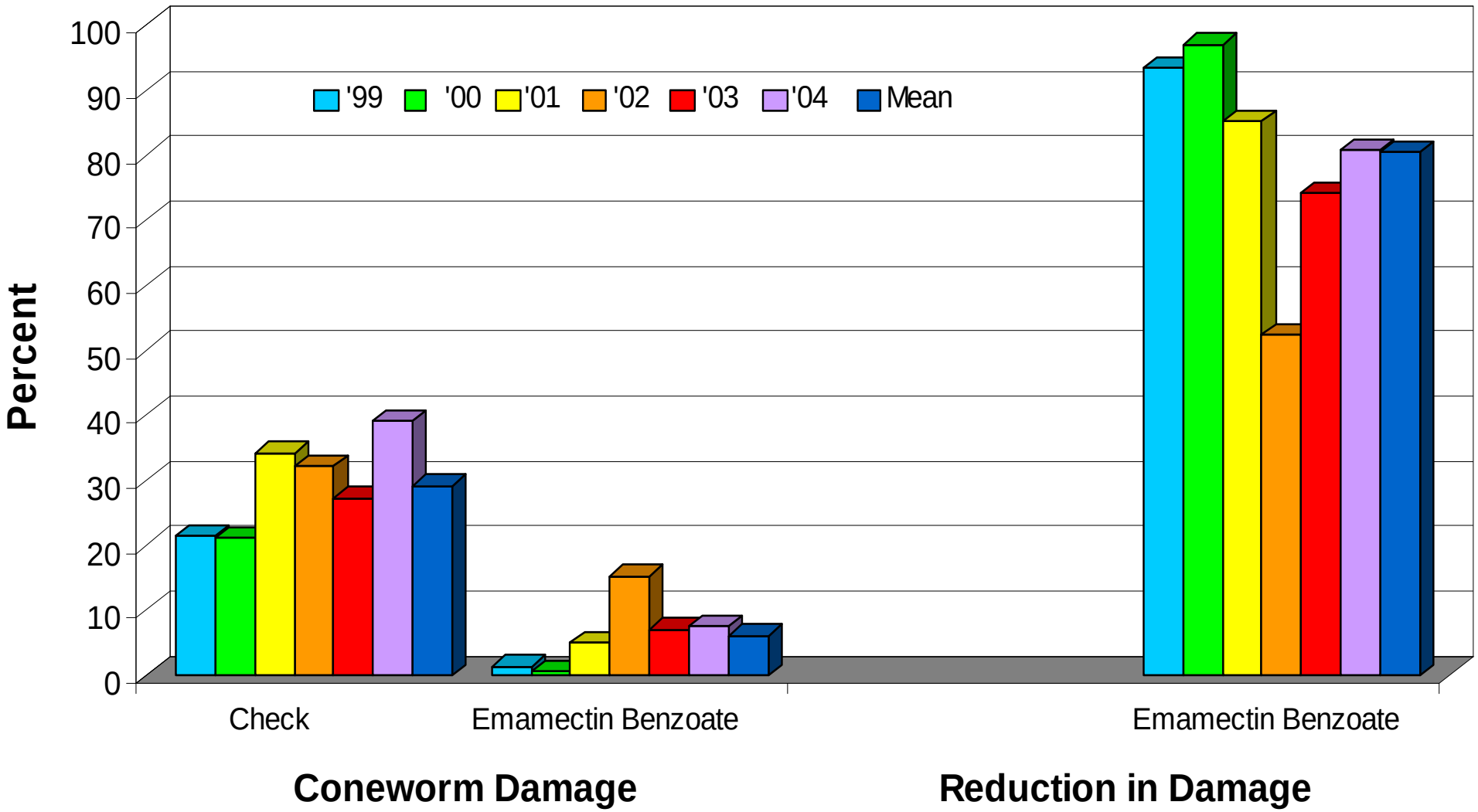
- **1995 - Pines treated with 4% emamectin benzoate (Shot-wan) in Japan for protection against pine wilt disease caused by pinewood nematode.**
- **Treatment provided 100% protection for at least 3 years (1995 – 1997).**



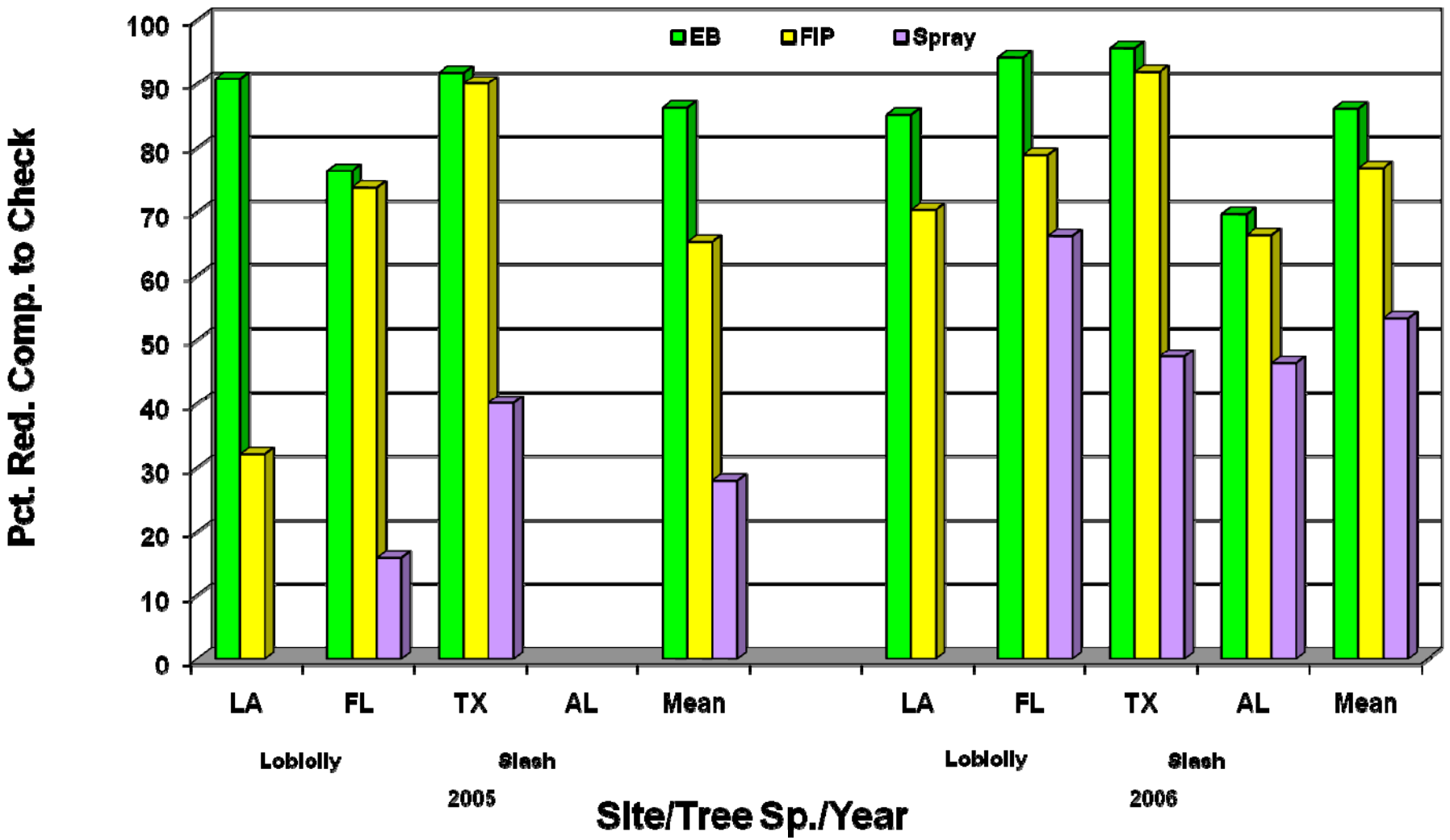
What is Emamectin Benzoate (TREE-äge)?

- Developed from avermectin, a product of a naturally occurring soil-born bacteria, ***Streptomyces avermitilis.*** It was discovered in 1984.
- Acts on insect nerves to suppress muscle contraction, resulting in insect paralysis and death.
- After injection into a tree, emamectin benzoate appears to be stored in the tree's sugars and proteins, and released as the tree uses it's stored energy. This results in extended tree protection (3 or more years).

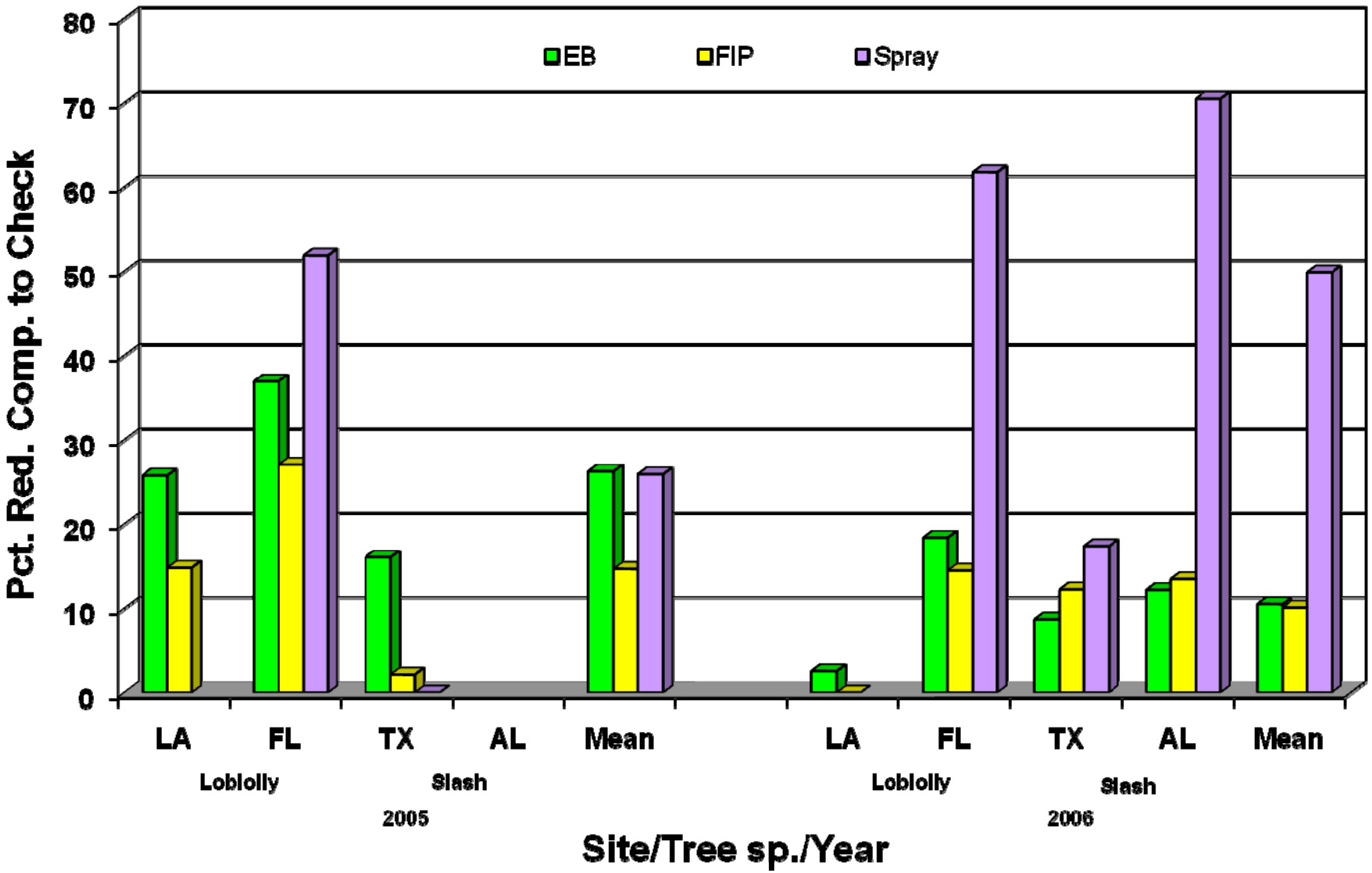
Loblolly Pine Cone Mortality Due to Coneworms (*Dioryctria* spp.) & Percent Reduction Due to EB Treatment, MSSO, TX: 1999 - 2004



Percent reduction in coneworm (*Dioryctria* spp.) damage compared to check in 2005 & 2006



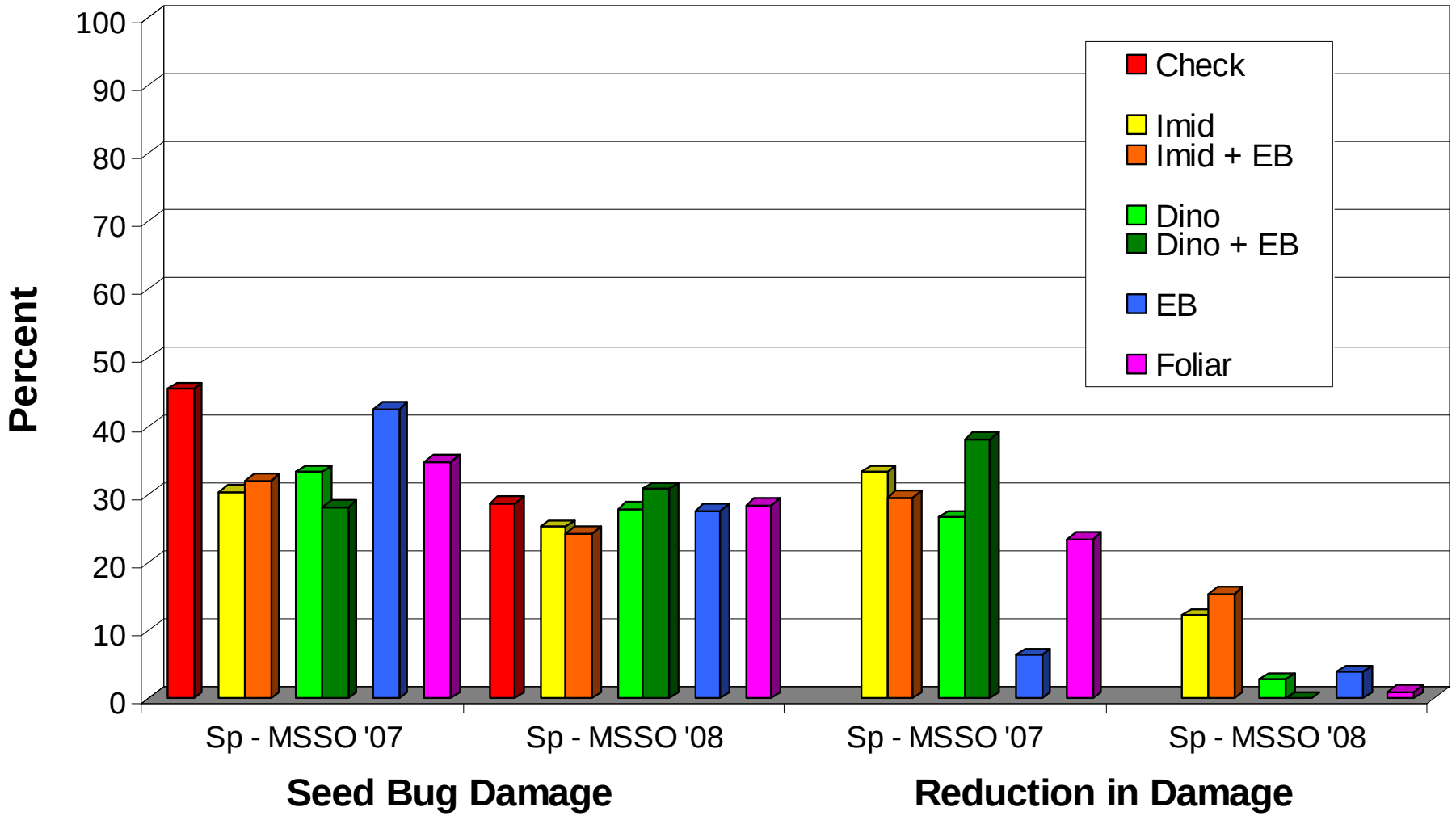
Percent reduction in seed bug (*Leptoglossus* sp. & *Tetyra* sp.) damage compared to check in 2005 & 2006



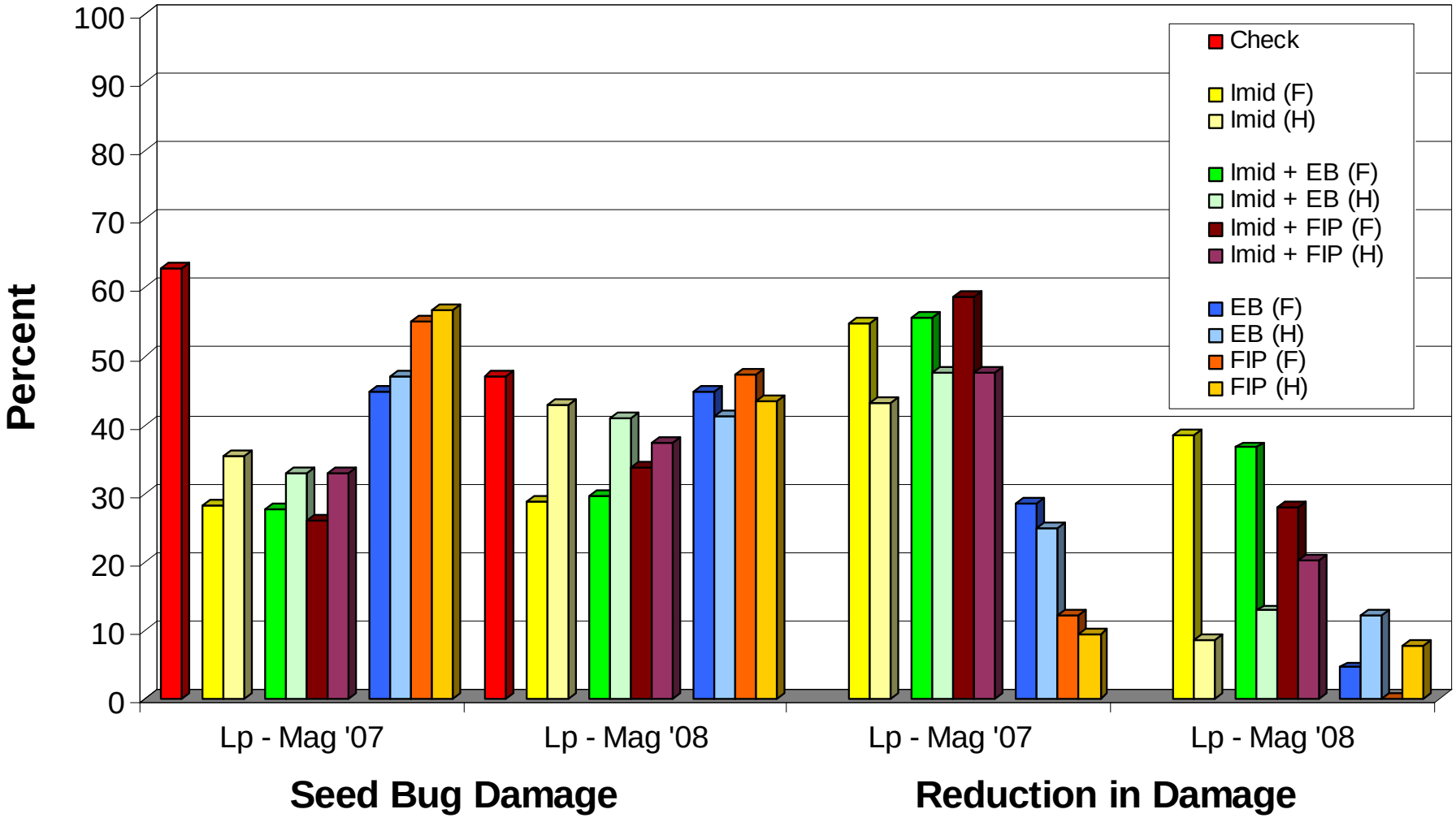
Research Efforts in 2007 & 2008

- **Objective – Evaluate potential products for protection of seed crops against pine seed bugs.**
- **Seed orchard trees were injected with imidacloprid or dinotefuran alone or combined with emamectin benzoate or fipronil in 2007 at Magnolia, AR and Magnolia Springs, TX.**
- **Evaluate cone and seed crops for coneworm and seed bug damage, respectively, in 2007 and 2008.**
- **Determine effect of injection treatments on seed germination.**

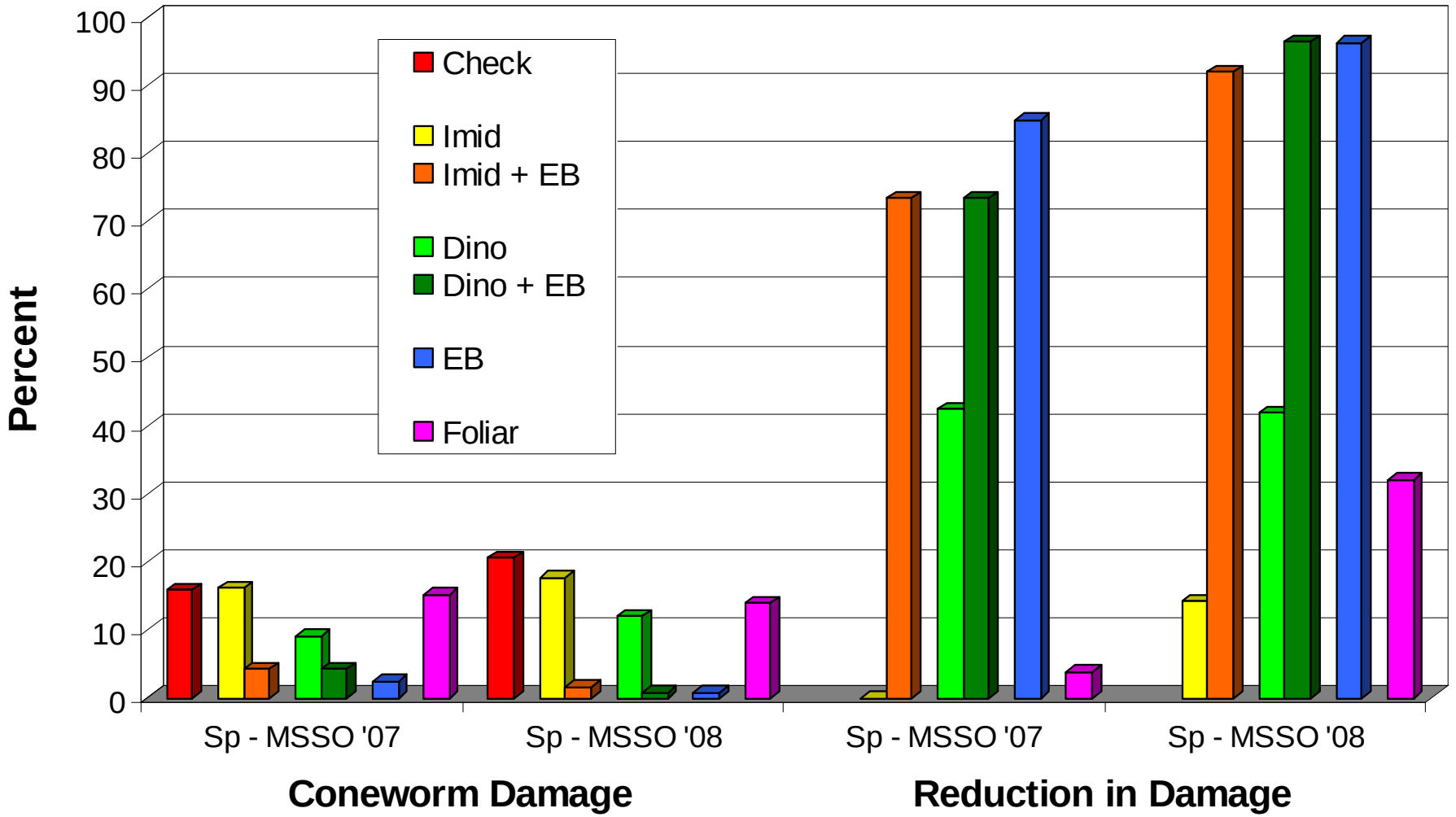
Percent seed bug (*Leptoglossus* and *Tetyra* sp.) damage to second year cones, Magnolia Springs, TX 2007 & 2008.



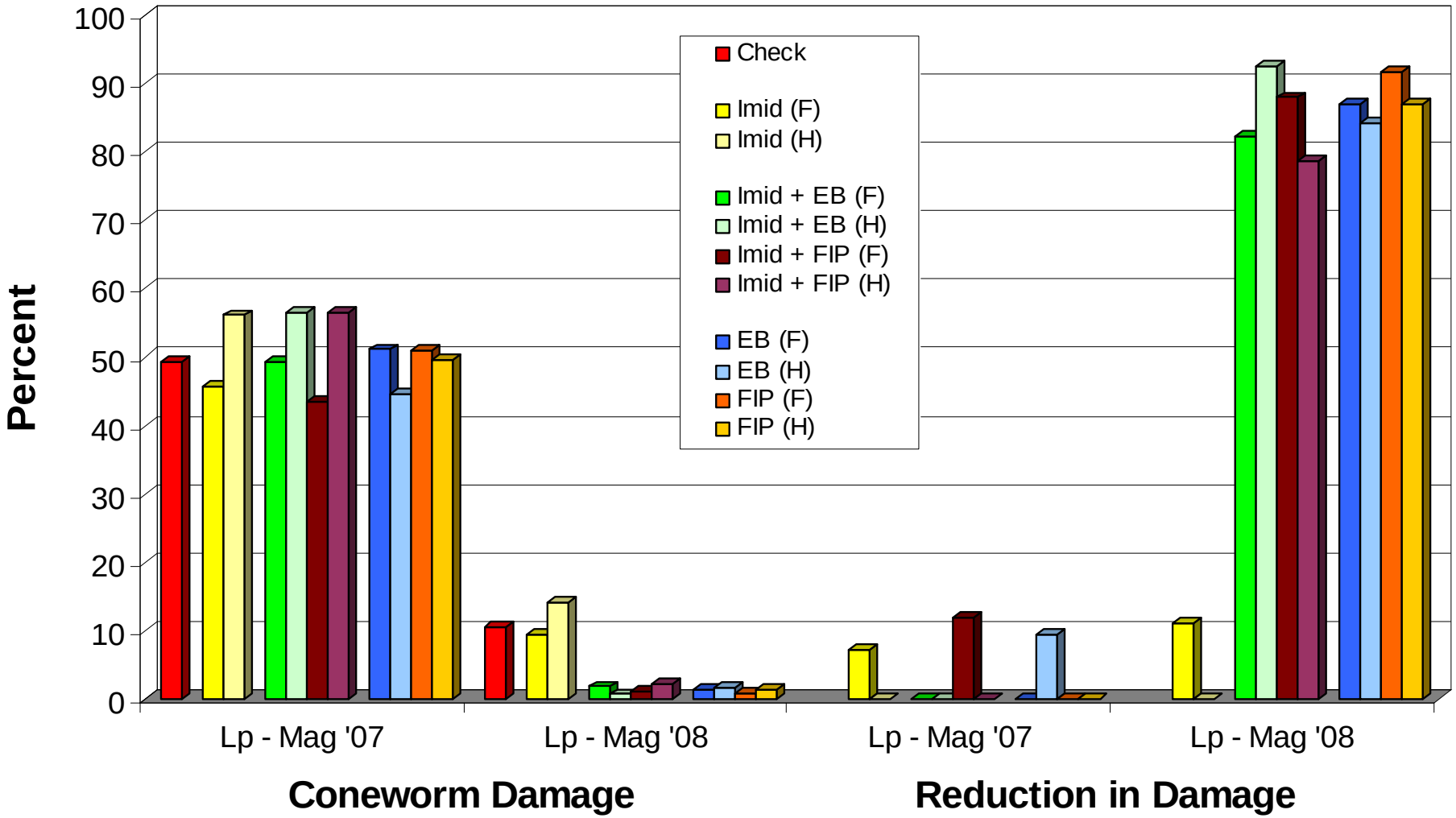
Percent seed bug (*Leptoglossus* and *Tetyra* sp.) damage to second year cones, Magnolia, AR 2007 & 2008.



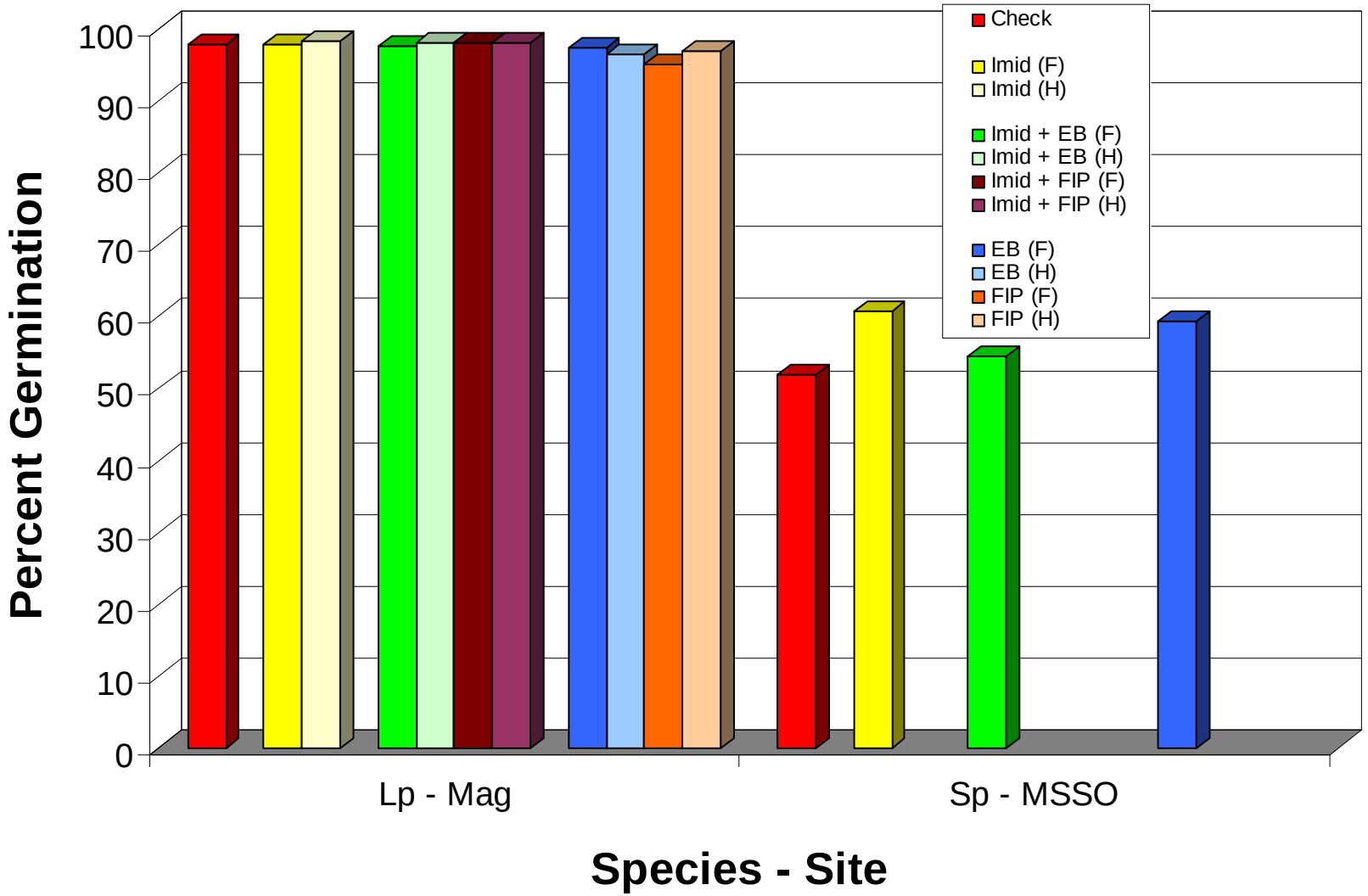
Percent coneworm (*Dioryctria* spp.) damage and reduction in damage compared to check, Magnolia Springs,TX 2007 & 2008.



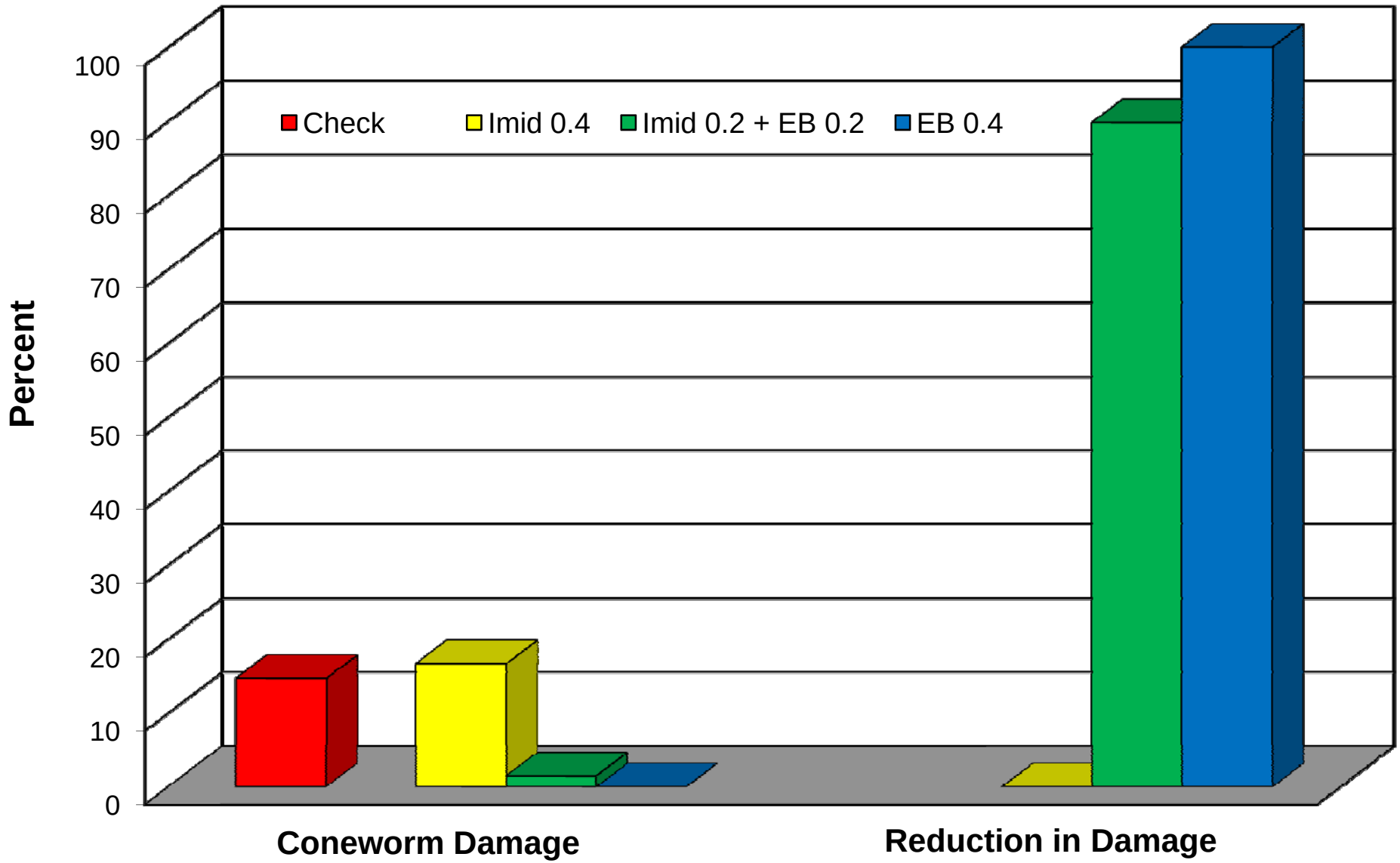
Percent coneworm (*Dioryctria* spp.) damage and reduction in damage compared to check, Magnolia, AR 2007 & 2008.



Percent germination of loblolly and slash pine seed from second year cones, Magnolia, AR and MSSO, TX, 2007.



Loblolly Pine Cone Mortality Due to Coneworms (*Dioryctria* spp.) & Percent Reduction Due to Fall Treatments, Yulee, FL: 2009



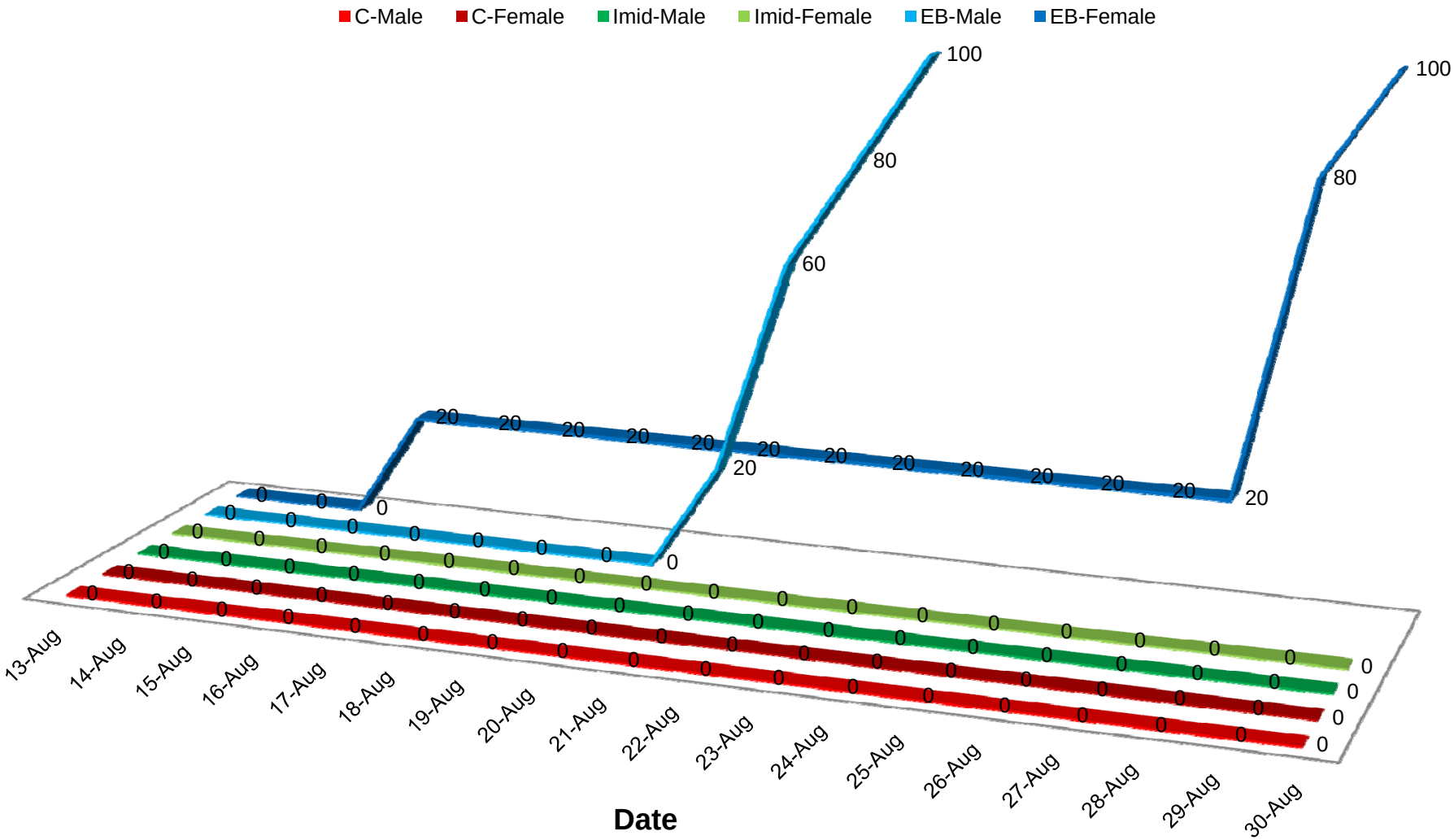
Research Efforts in 2010

- **Establish new trial at Magnolia, AR to evaluate Fall vs. Spring and single vs. double injections of imidacloprid.**

- **Establish new trial at Woodville, TX to evaluate potential of seven insecticides for control of seed bugs.**
  - **imidacloprid**
  - **fipronil**
  - **azadiractin**
  - **indoxacarb**
  - **dinotefuran**
  - **abamectin**
  - **chlorantraniliprole**
  - **emamectin benzoate (std.)**

- **Evaluate injections alone or combined with sprays(?)**

Effects of EB and Imidacloprid on Mortality of Pales Weevil
After feeding on white pine twigs, Blacksburg, VA - 2003



Conifer Bark Beetles of Economic Importance

Small southern pine engraver

Ips avulsus

Southern Pine Beetle

Dendroctonus frontalis

Mountain Pine Beetle

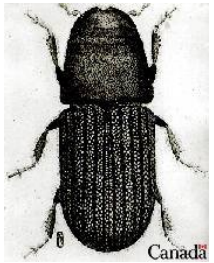
Dendroctonus ponderosae

Eastern five-spined Ips

Ips grandicollis

Pine engraver

Ips pini



Western Pine Beetle

Dendroctonus brevicomis

Six-spined engraver beetle

Ips calligraphus

Black Turpentine Beetle

Dendroctonus terebrans

Spruce Beetle

Dendroctonus rufipennis

Effects of emamectin benzoate on *Ips* engraver beetle colonization of loblolly pine logs 1 month after injection - 2004

Check

EB @ 1 month

Systemic Injection for Bark Beetles: 2004 - 2008

Objective

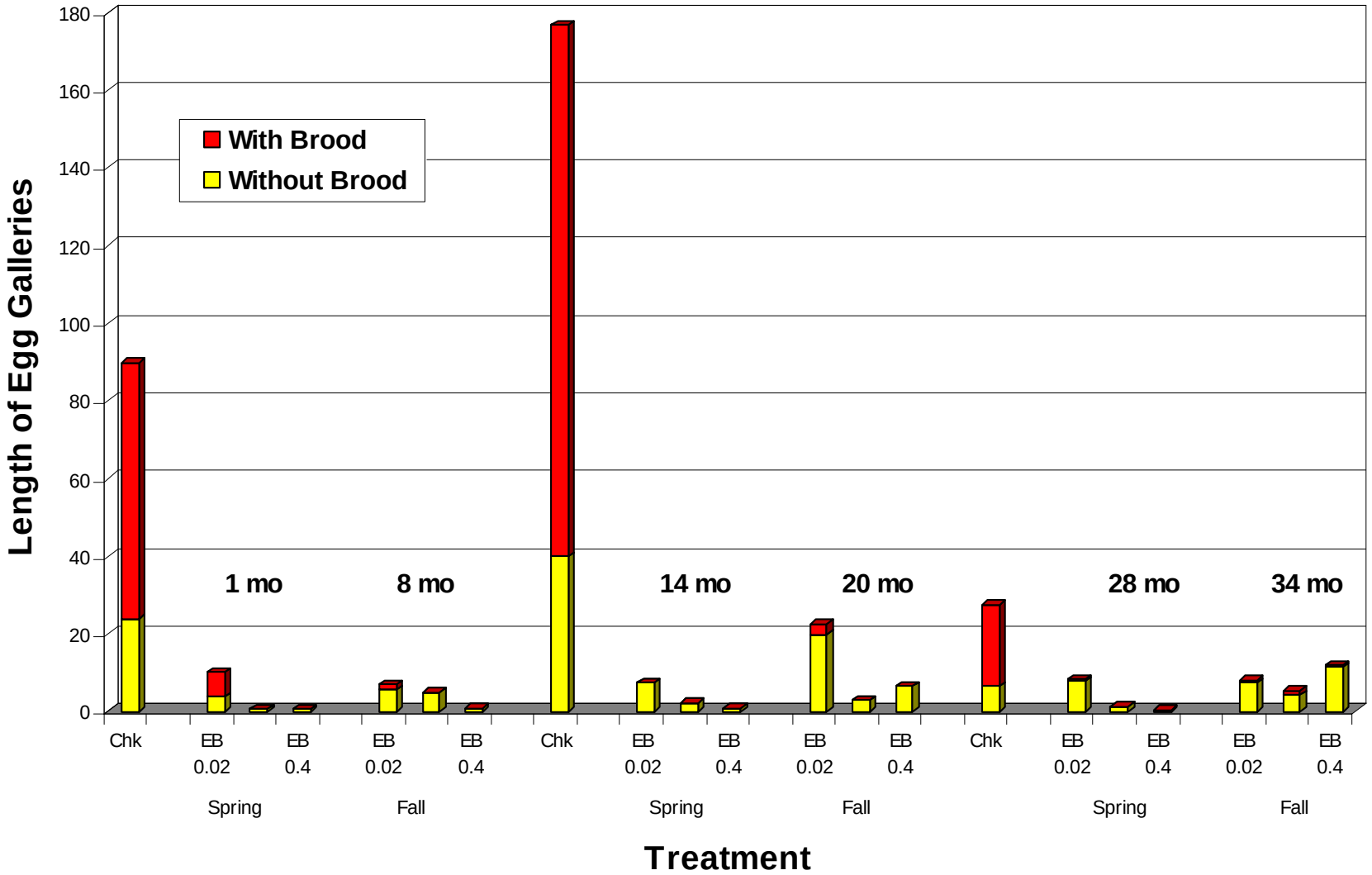
- Evaluate and register alternative to bole sprays for protection of trees against bark beetles in seed orchards and residential sites.

Research Efforts 2006 - 2009

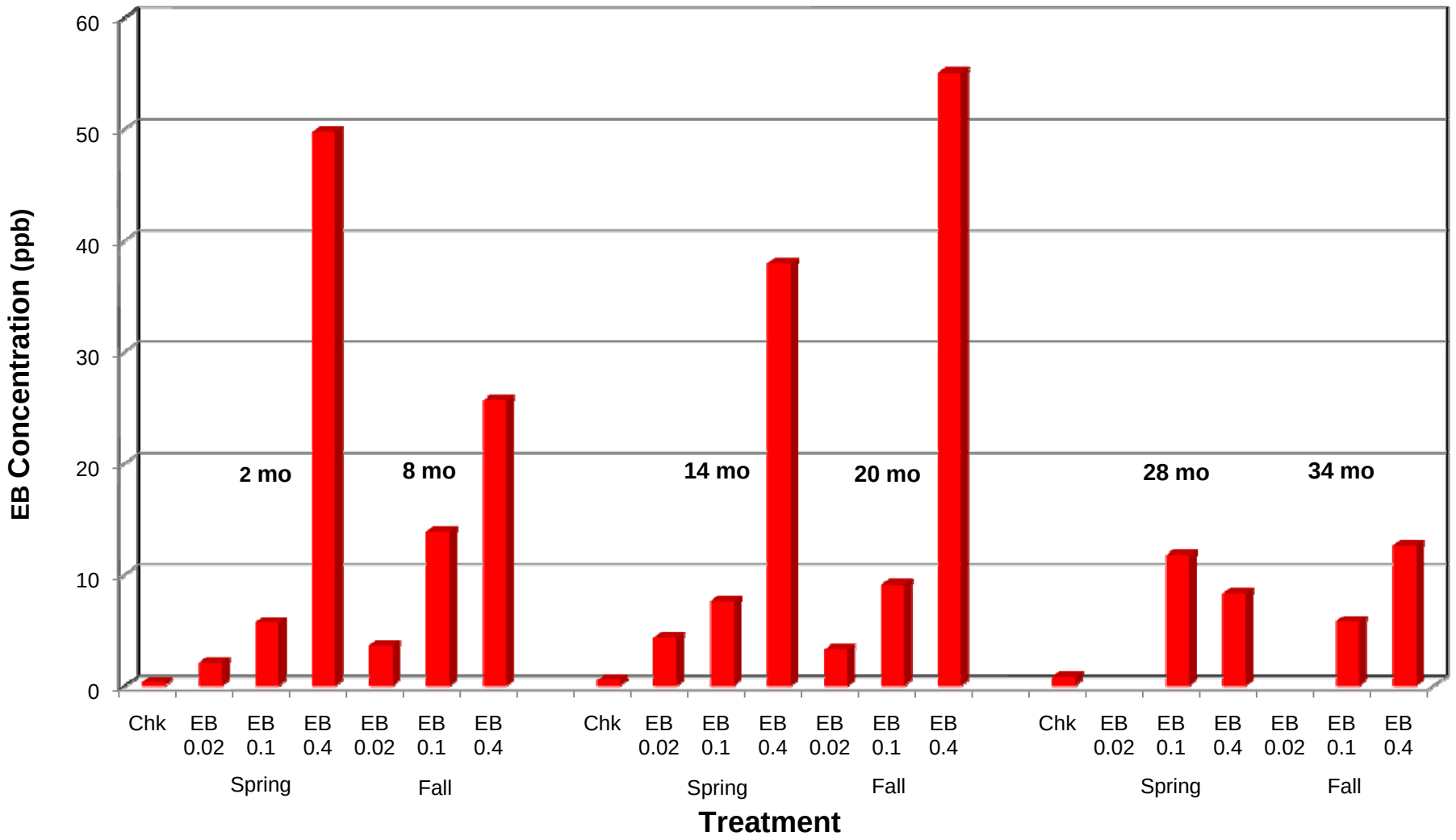
Ips & *Dendroctonus* Trials

- **Evaluating emamectin benazoate (EB) applied at different seasons and rates against *Ips* and cerambycids.**
- **Analyze concentrations of EB in plant tissues (foliage, phloem, xylem & cones) to determine relationship to efficacy and environmental fate.**
- **Evaluating 7 injection systems and determine efficacy of EB against *Ips* in TX.**
- **Evaluate effects of EB against SPB (AL), WPB (CA), and MPB (ID & CO).**

Effects and duration of EB rates on *Ips* galleries length and brood development in loblolly pine logs: 2006 - 2007.



Emamectin benzoate concentrations (ppb) in phloem tissue at different intervals (2, 8, 14, 20, 28 & 34 months) after injection.



Injection System Evaluation

Quick-jet

M3

Portle

Sidewinder

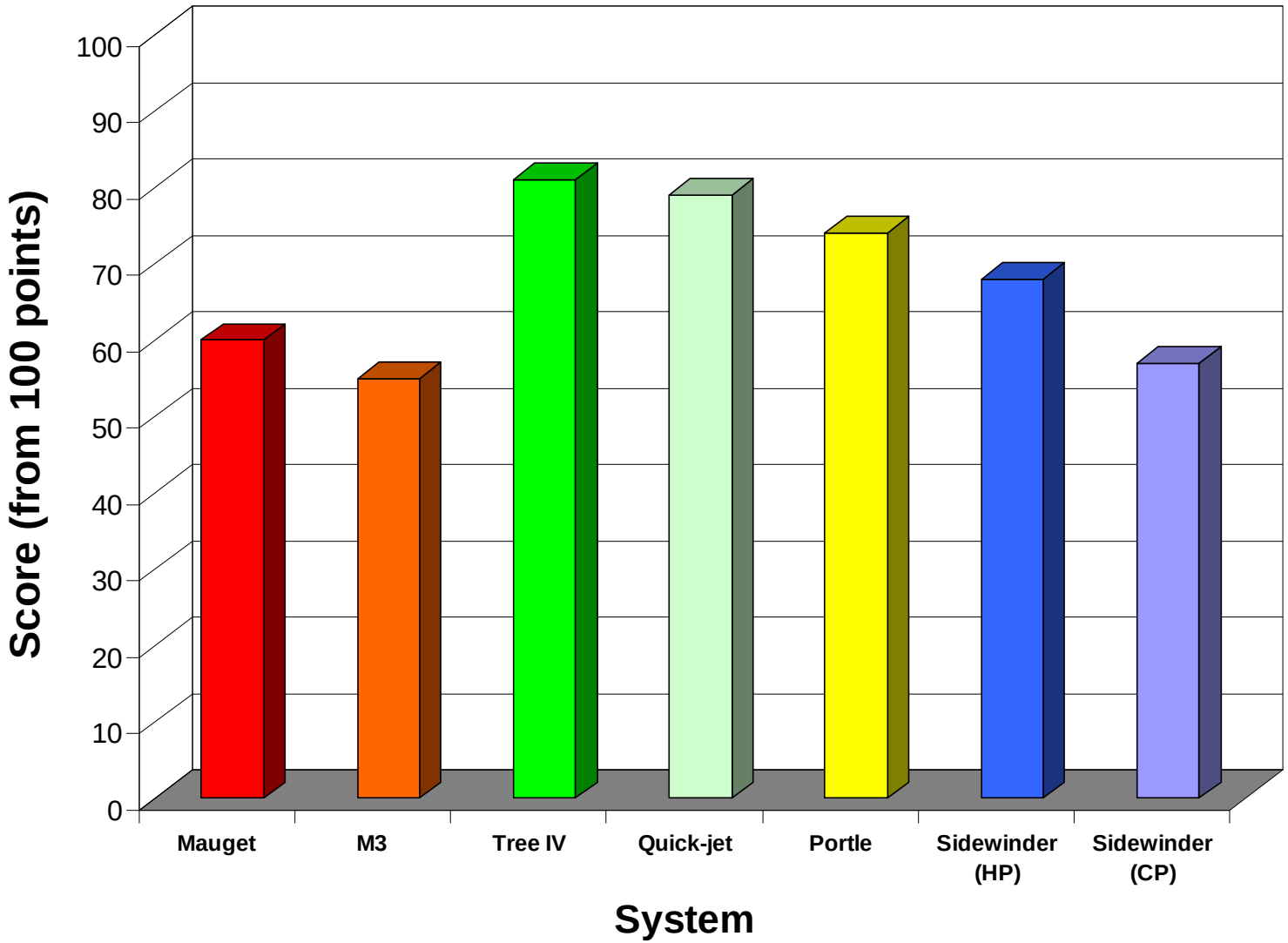
Mauget

Tree IV

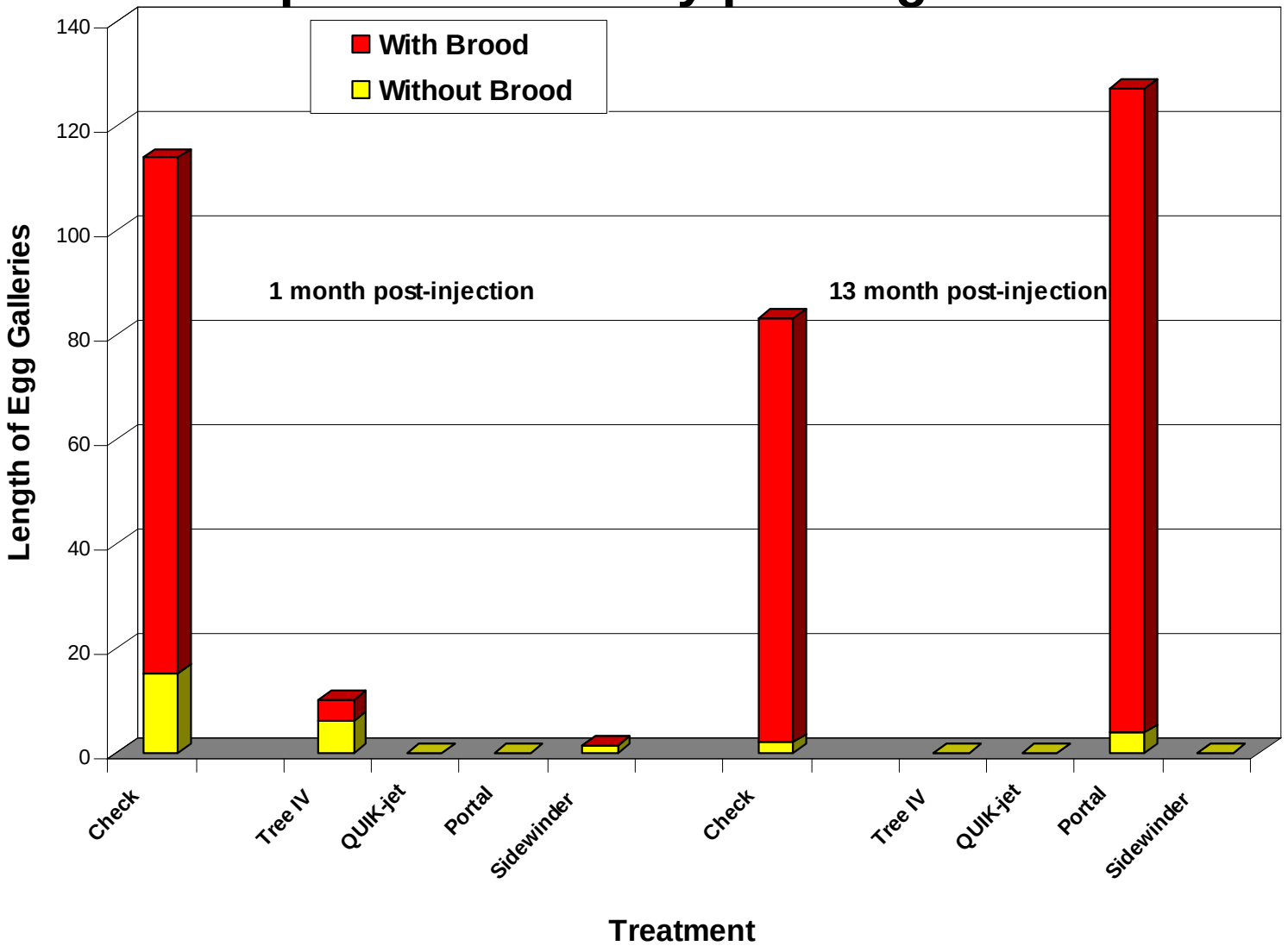
Rating Criteria

1) System cost (10 pts)
2) Need for peripheral parts (plugs, needles, battery chargers) (5 pts)
3) System capacity (volume of product) (3 pts)
4) Is system disposable or reusable? (2 pts)
5) Does chemical come prepackaged; can you inject product undiluted or is it necessary to dilute with water? (5 pts)
6) Time and ease to fill system with chemical product (5 pts)
7) Time and ease to install system on tree (5 pts)
8) Number of injection points required per tree (5 pts)
9) Can the system be left alone on tree or does the applicator need to manually operate system continuously? (5 pts)
10) Time and ease to inject X amount of product. (10 pts)
11) Cumulative time applicator spends at each tree. (10 pts)
12) Potential for chemical exposure. (10 pts)
13) Time and ease to clean system. (10 pts)
14) Weather restrictions (moisture, temperature) (5 pts)
15) Effectiveness of treatment 1 month after treatment (10 pts)

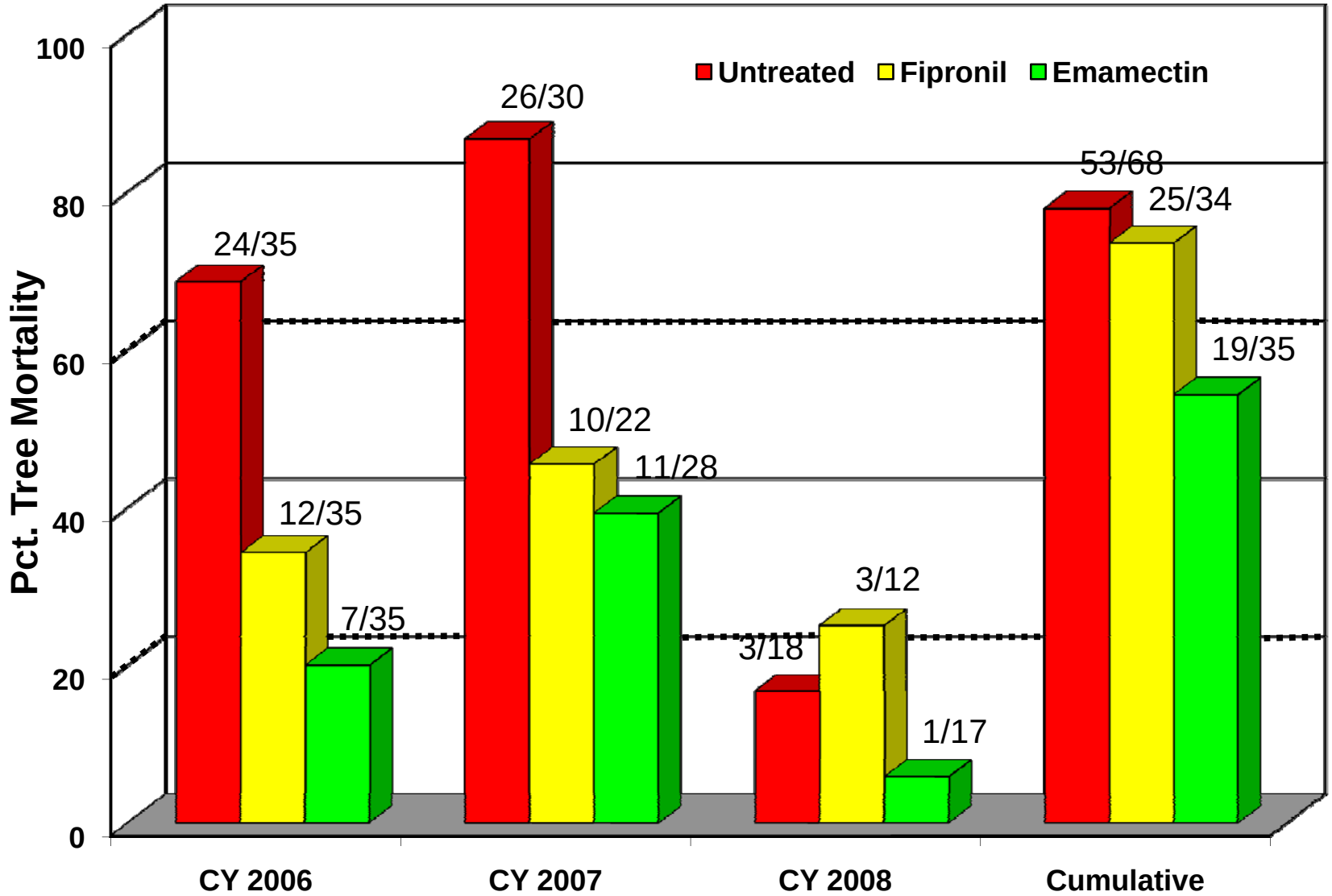
Final Rating Score for Seven Injection Systems



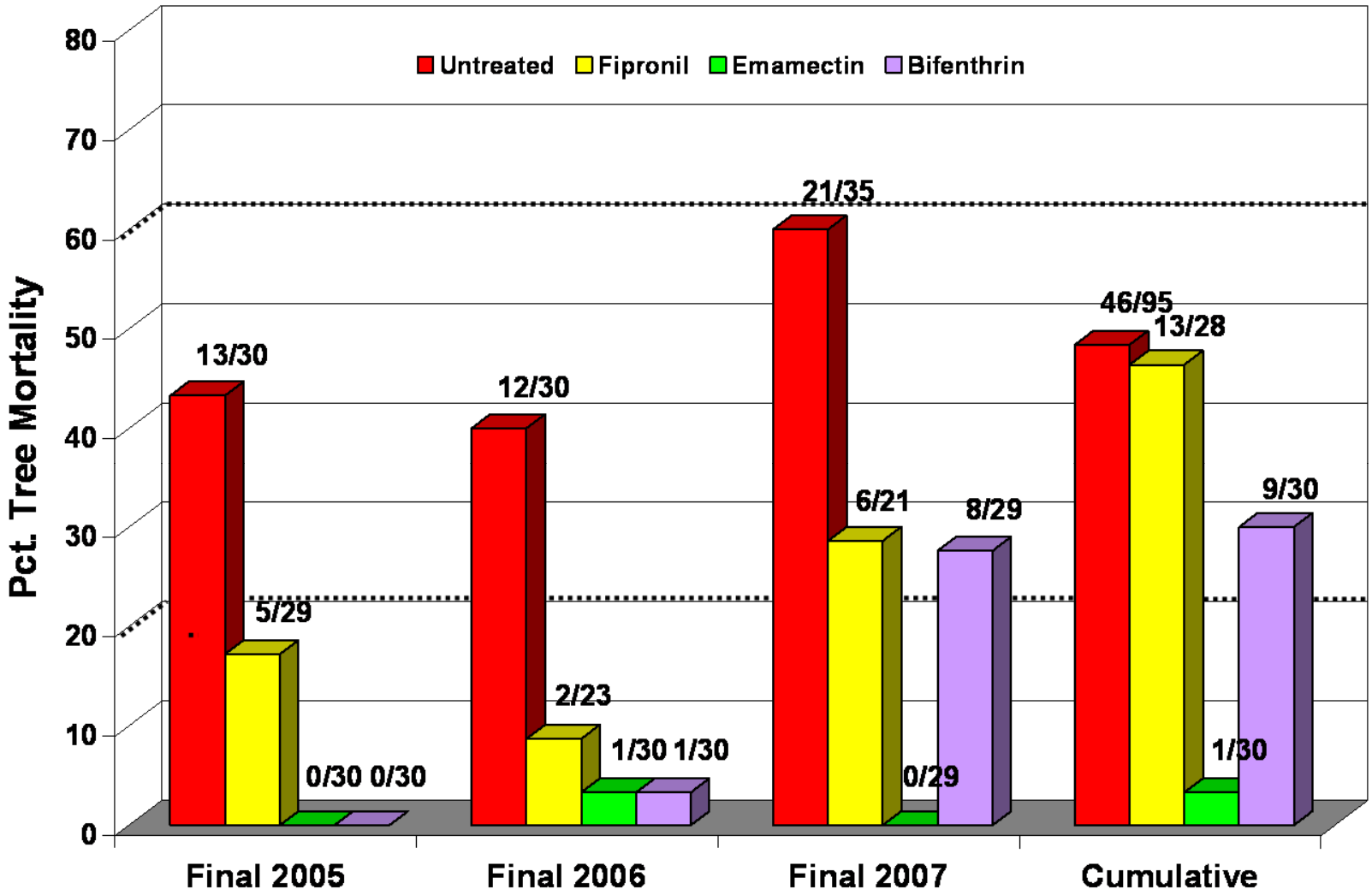
Effects and duration of EB applied by different injection systems on *Ips* galleries length and brood development in loblolly pine logs : 2007 - 2008.



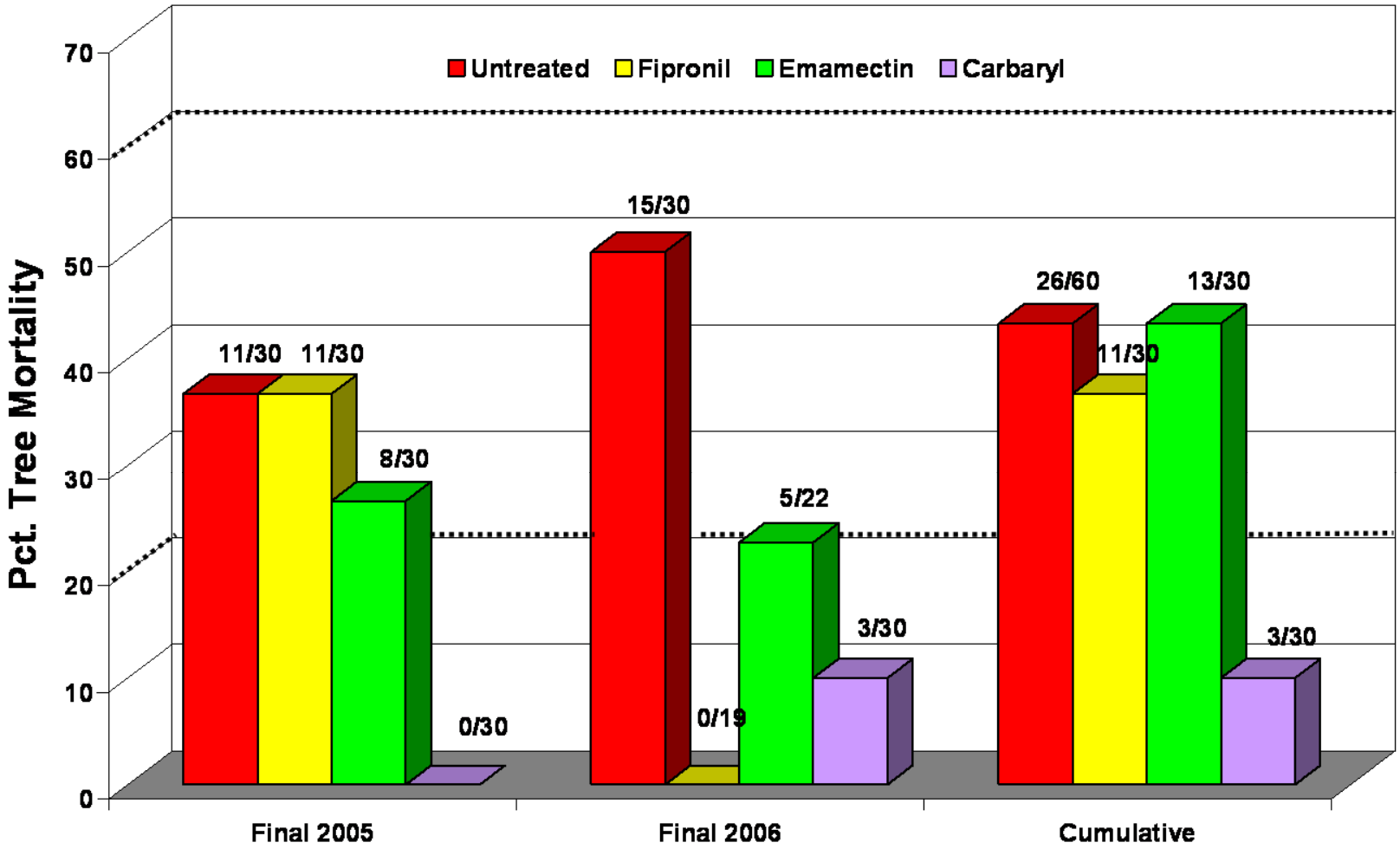
Effect of injection treatments on mortality of loblolly pine by southern pine beetle; Talladega N.F., Oakmulgee R.D., AL: 2006, 2007 & 2008



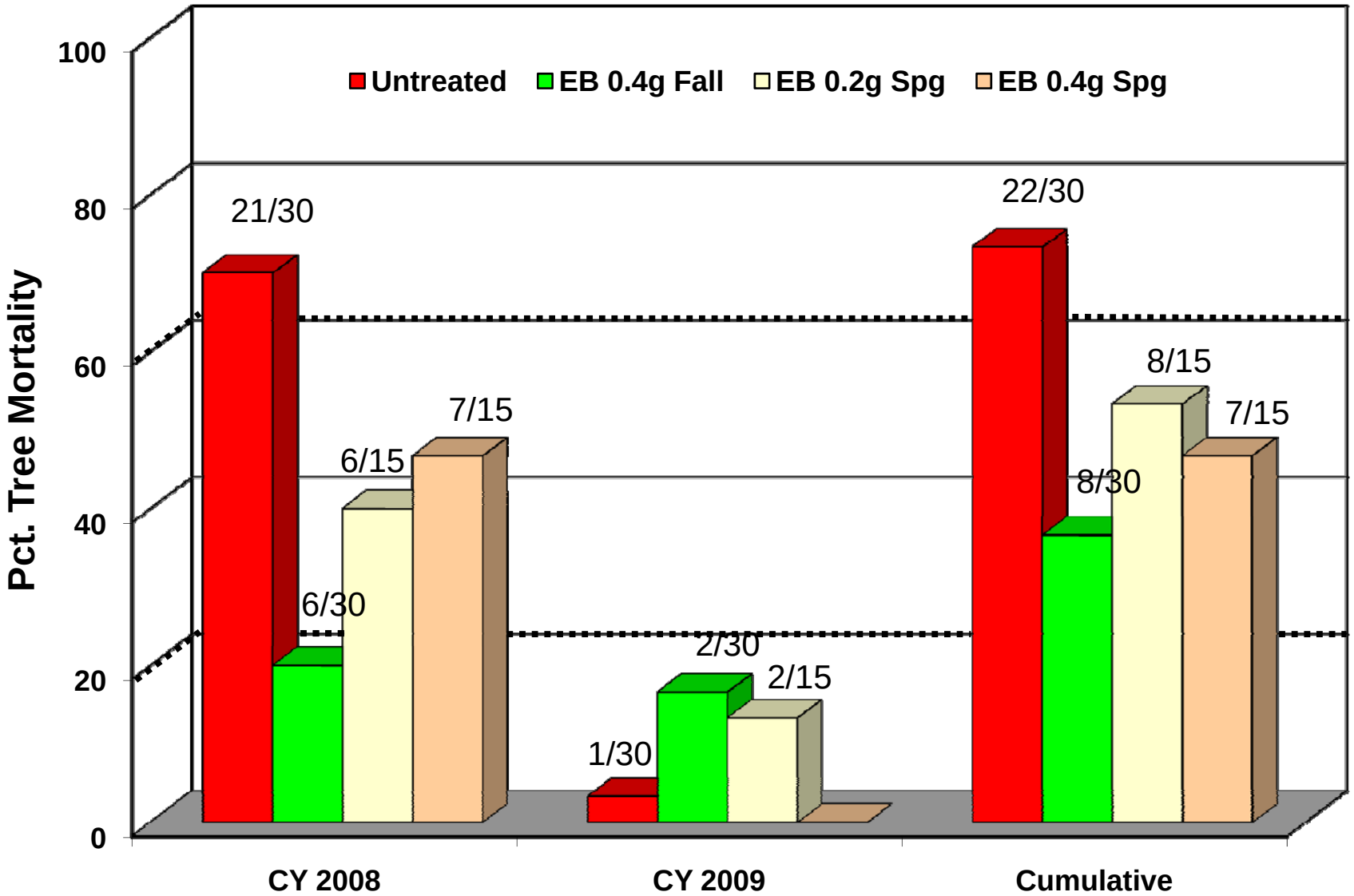
Effect of injection treatments on mortality of ponderosa pine by western pine beetle; SPI land, Calaveras Co., CA: 2005 - 2007



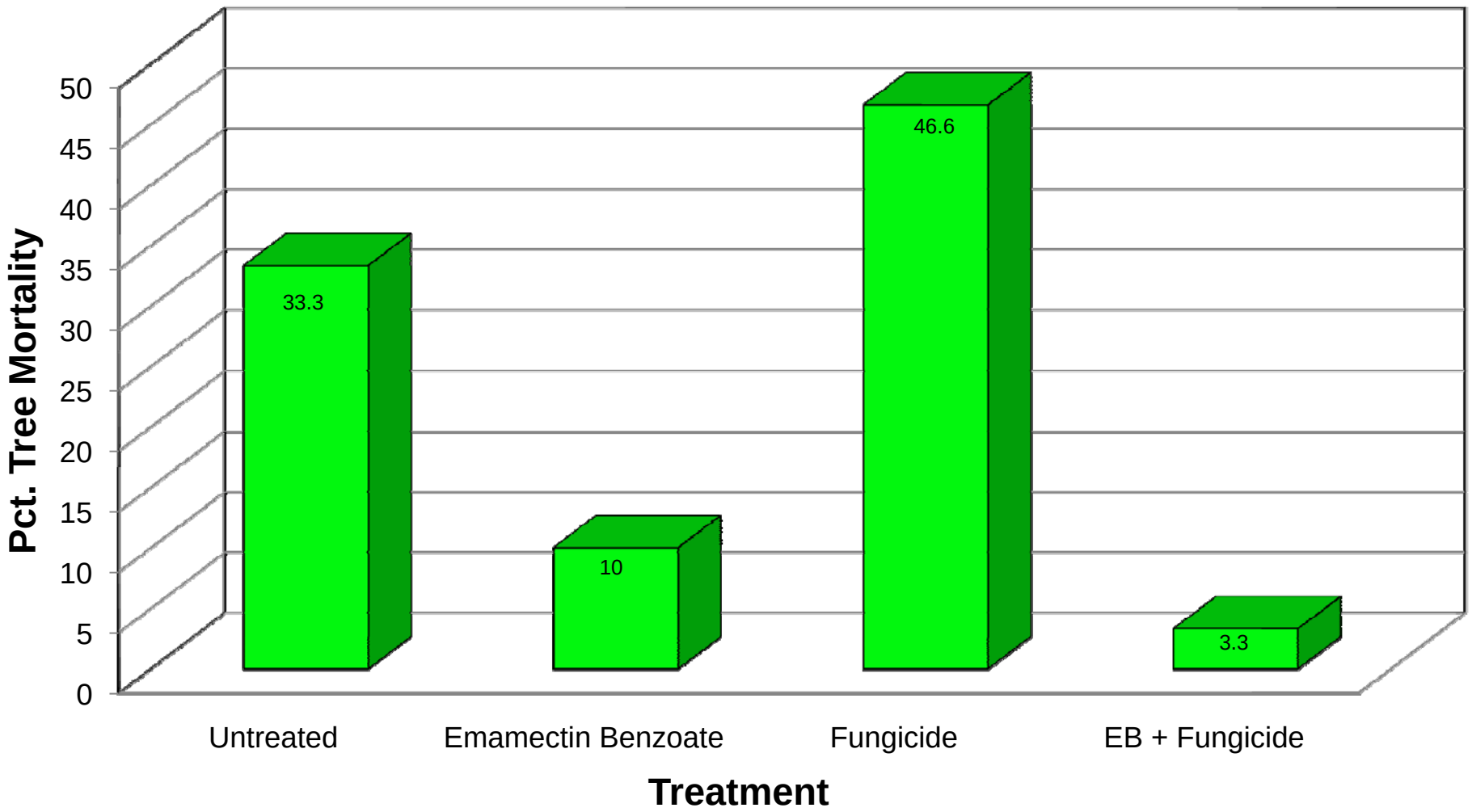
Effect of injection treatments on mortality of lodgepole pine by mountain pine beetle; Challis N.F., Yankee R.D., ID: 2005 - 2006



Effect of injection treatments on mortality of lodgepole pine by mountain pine beetle; CO: 2008-2009



Effect of injection treatments on mortality of loblolly pine by southern pine beetle; Talladega N.F., Oakmulgee R.D., AL: 2009

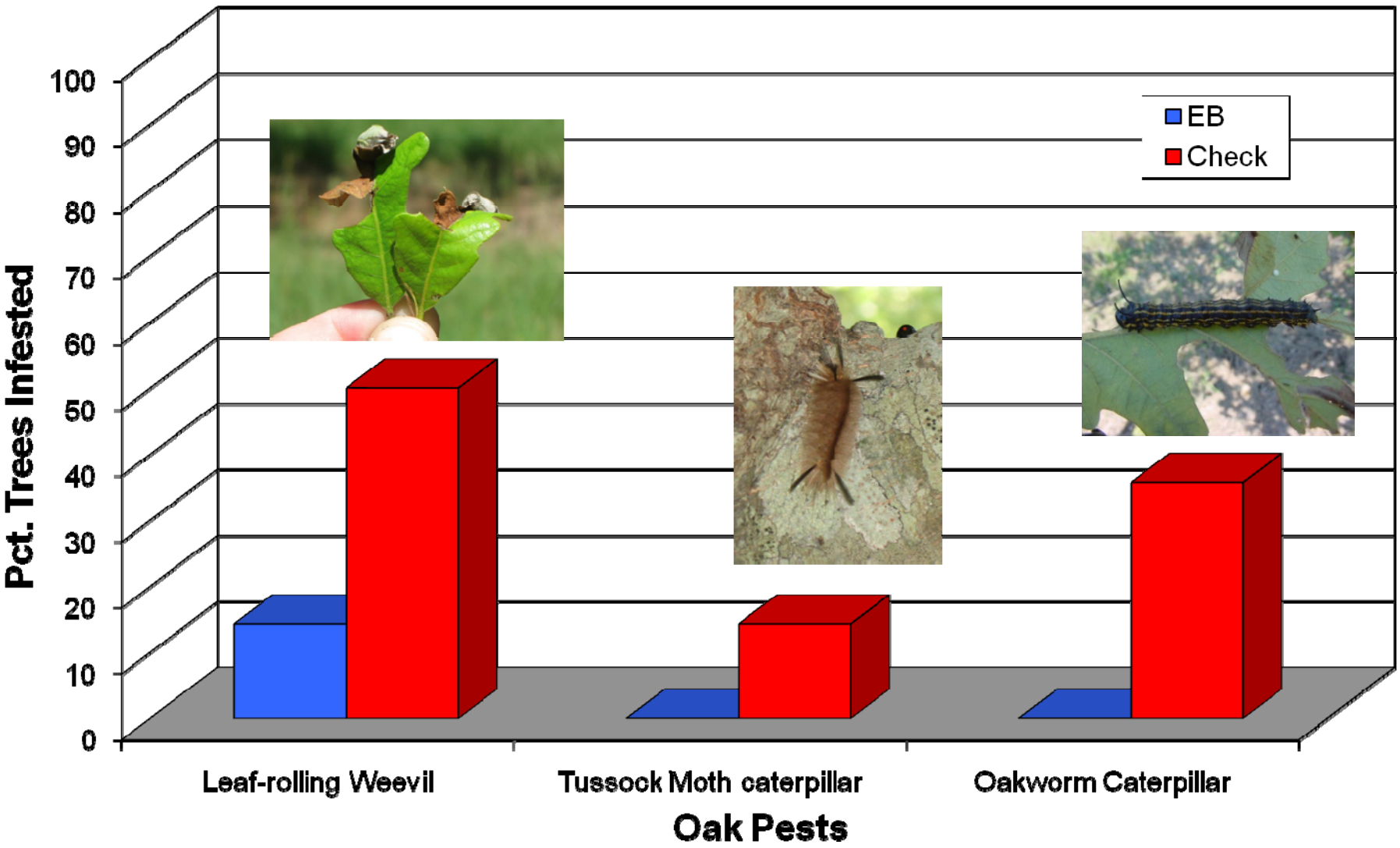


Systemic Injection for Oak Pests: 2009

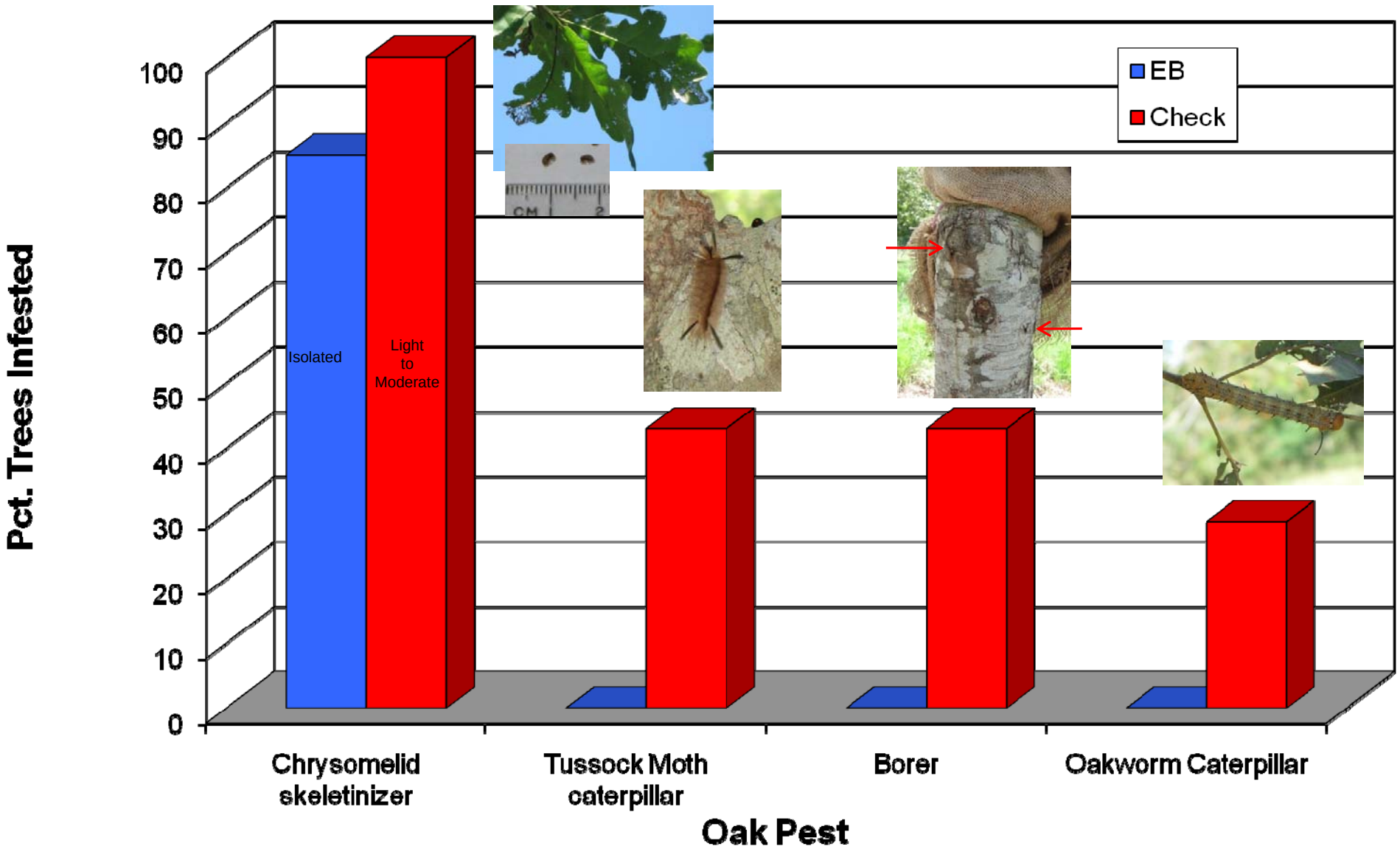
Objective

- **Evaluate emamectin benzoate (TREE-äge) for protection of oaks against potential pests, including wood borers and defoliators.**

Effect of emamectin benzoate injection on occurrence of oak pests on burr oak; Hudson, TX 2009



Effect of emamectin benzoate injection on occurrence of oak pests on cherrybark oak; Hudson, TX 2009



Status of Product Registration

- A request was submitted to EPA for full registration (Section 3) of emamectin benzoate (TREE-äge™) in January 2008.
- 24C (Special Local Need) registrations have been approved in IL, IN, KY, MD, MI, MN, MO, OH, PA, VA, WI & WV for use against emerald ash borer.
- EPA was expected to make a decision on the full registration by July 2009. However, concerns about effects on pollinators has delayed the decision until November 2009.

TREE-äge Proposed Pest Targets

- Pine Wood Nematode

Lepidoptera

- Pine Coneworm
- Western Spruce Budworm
- Winter Moth
- Bagworm
- Fall Webworm
- Gypsy Moth
- Tent Caterpillars
- Clearwing Borers
- Leaf Miners
- Oakworm Caterpillar

Hymenoptera

- Erythrina Gall Wasp
- Sawfly

Coleoptera

- Emerald Ash Borer
- Bronze Birch Borer
- Two Lined Chestnut Borer
- Longhorn Borers
- Bark Beetles (Scolytids)
- White Pine Weevil

Mites

- Mites – Eur., Spruce, 2 spotted
- Eryiophid Mites

Related Research in 2009

- **Evaluate efficacy of emamectin benzoate for protection of afghan pines from chalcid wasps, El Paso, TX.**

- **Evaluate efficacy of emamectin benzoate for protection of western soapberry from soapberry borer, *Agrilus prionurus*, Houston and Dallas, TX.**

- **Evaluate efficacy of emamectin benzoate for protection of willow oaks from wood borers and horntails, Hudson, TX.**

Related Research in 2009

- **Evaluate efficacy of emamectin benzoate alone or combine with fungicide for protection of pines from root beetles (*Hylastes* spp.) and *Leptographium* fungi, Auburn, AL.**

Acknowledgements

- Cooperative research with I. Brown, S. Clarke, D. Doccola, C. Doolittle, L. Eckhardt, G. Eldridge, C. Fettig, C. Jorgensen, S. Munson, L. Rankin, S. Salom, G. Severson, T. Slichter, S. Smith, & J. Tule.

- W. Upton, B. Kavanagh, J. Burns, L. Myslivec, D. Hollowell, V. Cizek, B. Pope, J. Childers provided field and lab assistance.

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- This research was supported, in part, by the Forest Pest Management Cooperative; as well as donations and gifts from Arborjet, Inc., BASF, Fort Dodge, Mauget and Syngenta Crop Protection.

"Got him, Byron! It's something in the *Vespula* genus, all right—and oooooweeeee does he look mad!"

Questions?

Thank you for your attention!