

SUMMARY OF HARPIN NEMATODE RESULTS

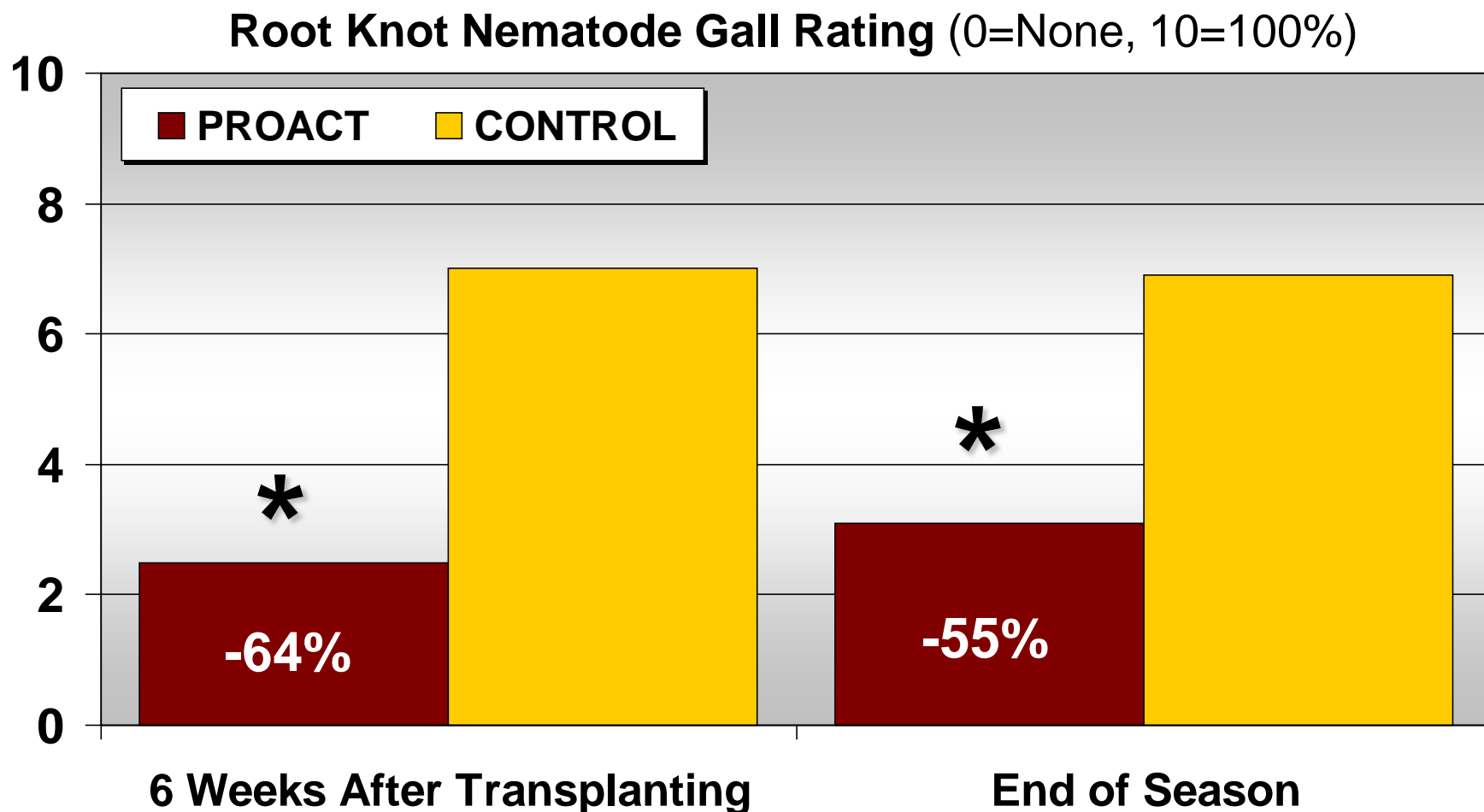
- Seed, foliar, and transgenic (not shown) treatment of plants with harpin protein offer favorable effects, including:
 - ✓ **Fewer nematodes per root weight** compared with untreated plants
 - ✓ **Greater plant biomass** compared with untreated plants
- Favorable results against nematodes have been documented in cotton, citrus, potato, cucurbits, tomato, turf, and other crops
 - ✓ Beneficial effects of harpins for plants exposed to nematodes are **not restricted to one or two crops**
 - ✓ Beneficial effects of harpins for plants exposed to nematodes are not dependent upon mode of application (foliar vs seed)





EVALUATION OF HARPIN_{αβ} PERFORMANCE ON ROOT KNOT NEMATODE IN TOMATO

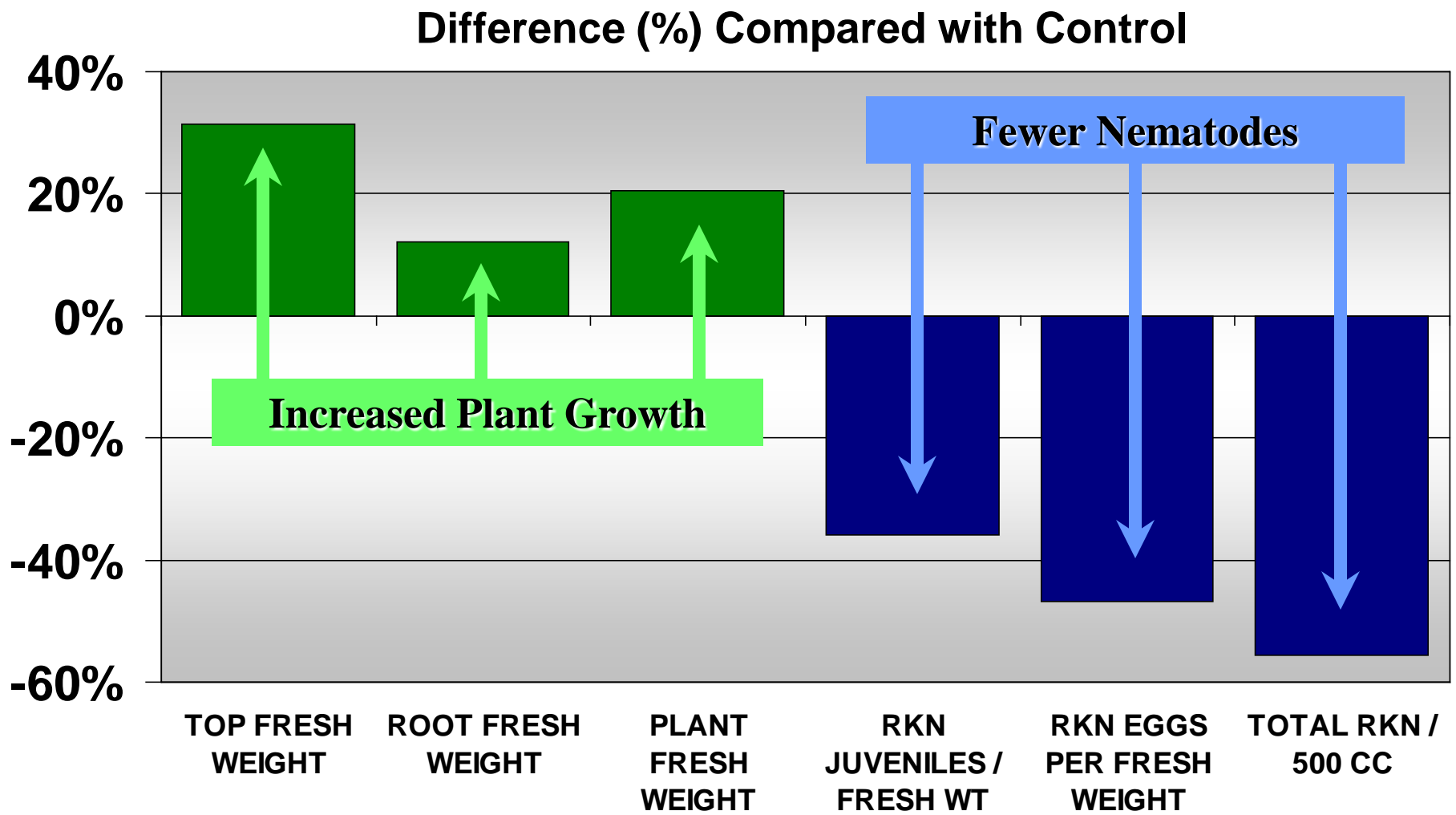
Auburn University, 2006



Harpin_{αβ} applied as pretransplant spray at 3 oz/100 gal fb 2 oz/A prebloom and repeated at 21-28 intervals; located at Sand Mountain Res. Stn., Crossville, AL, 2006; * indicates Harpin_{αβ} different from Control (P=0.05); trial 206059.



HARPIN_{αβ} IMPROVES CORN GROWTH AND REDUCES ROOT KNOT NEMATODES (RKN), 2007 TRIAL



Pioneer Hybrid 31N26 planted 7-17-07; 10 replicates; conducted as well controlled greenhouse trial; Harpin_{αβ} 0.5 oz/A applied as foliar spray at 26 DAP; Trial 207143.





HARPIN_{αβ} IMPROVES CORN GROWTH AND REDUCES ROOT KNOT NEMATODES (RKN), 2007 TRIAL

	<i>M. incognita</i> /500 cc		Yield Kg/Ha
	18 Apr	10 Sep	
NemOut	0%	-19%	11.9% b
Vydate C-LV	64%	-67%	30.4% a
Counter 15G	-54%	-74%	30.8% a
Lanate 90 SP	-54%	-47%	37.5% a
Temik 15G	-36%	-77%	38.6% a
N-Hibit	-18%	-63%	38.8% a
AERIS seed applied system	18%	-56%	42.4% a

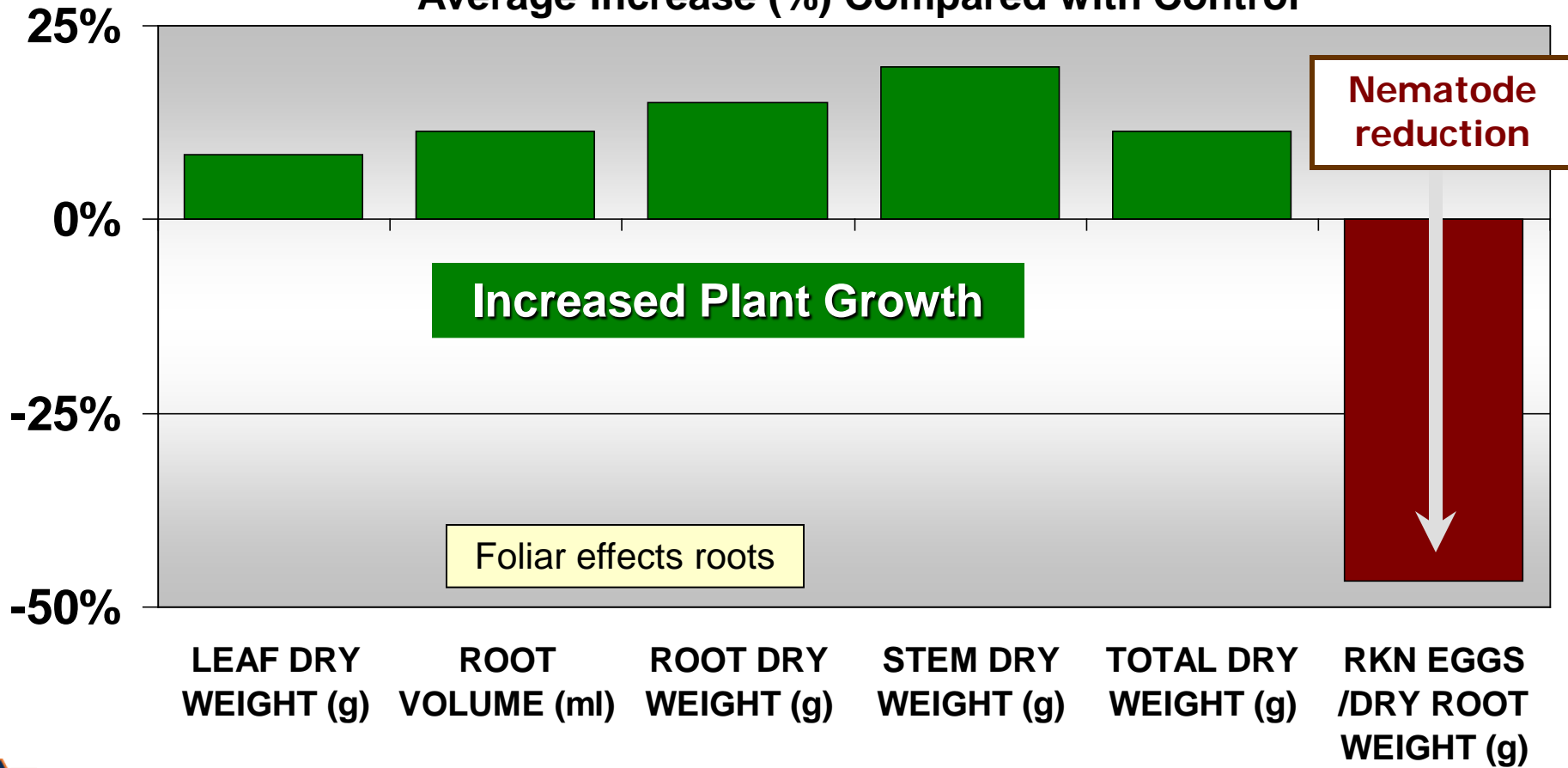
All treatments were applied to seed. Root knot nematode populations were determined at planting and at harvest. The table presents the increase relative to the untreated control. All treatments reduced nematode numbers relative to the untreated control, but differences were not statistically significant. All treatments, except NemOut, increased yield significantly over the untreated control.

‘SS 804 RR2’ planted 18 Apr 2007; 4 replicates; Harpin_{αβ} 3 oz/cwt applied as a seed treatment; Trial 207079, harvested 10 Sep 2007; Trial 207079. Numbers followed by the same letter are not statistically different, Fisher’s Protected LSD, P = 0.1.



SUMMARY: HARPIN_{αβ} IMPROVES SOYBEAN GROWTH AND REDUCES ROOT KNOT NEMATODE

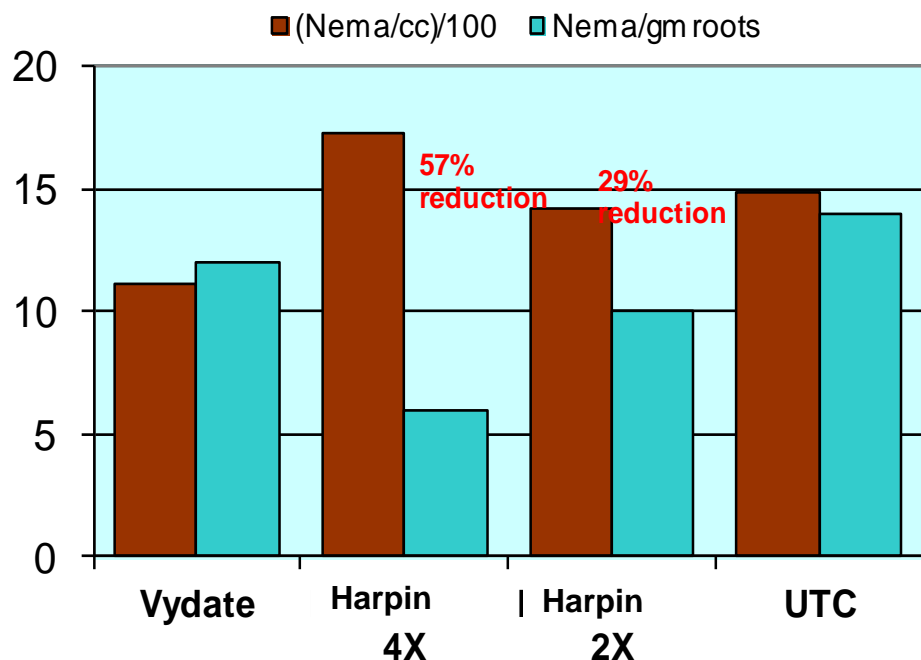
Average Increase (%) Compared with Control



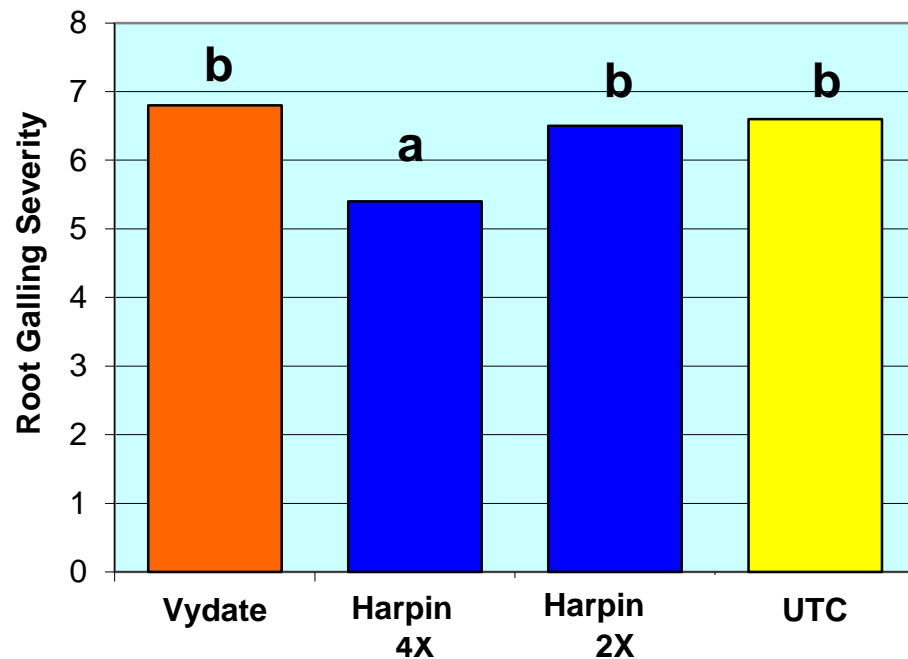
Harpin_{αβ} 1 oz/acre at 10 gpa applied at V-2. Average results from three replicated experiments. Each trial consisted of 10 replicates per treatment. **Auburn Univ.** (#204127), **Univ. Arkansas** (204128), and **Southern Illinois Univ.** (204126).

CONTROL OF NORTHERN ROOT KNOT NEMATODE ON 'MONONA' POTATOES WITH HARPIN

Cornell University, 2002



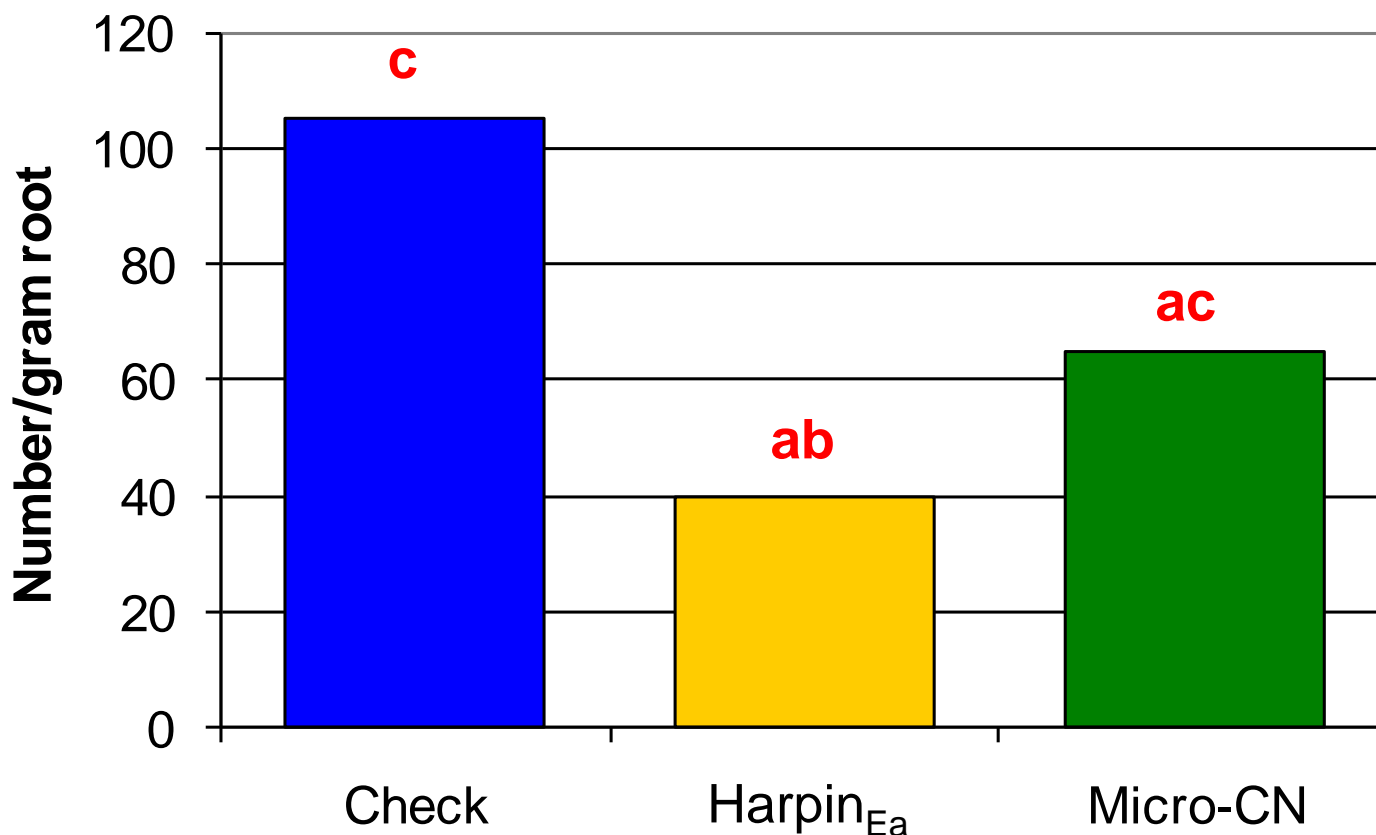
4 apps of Harpin_{Ea} resulted in a *57% reduction of nematodes in the roots* without reducing nematodes in the soil.



Four applications of Harpin resulted in a significant reduction of nematodes in the roots of lettuce grown in the soil following the potatoes. This is a test of the viability of nematode eggs.

SUMMARY: HARPIN_{Ea} USE IN POTATOES

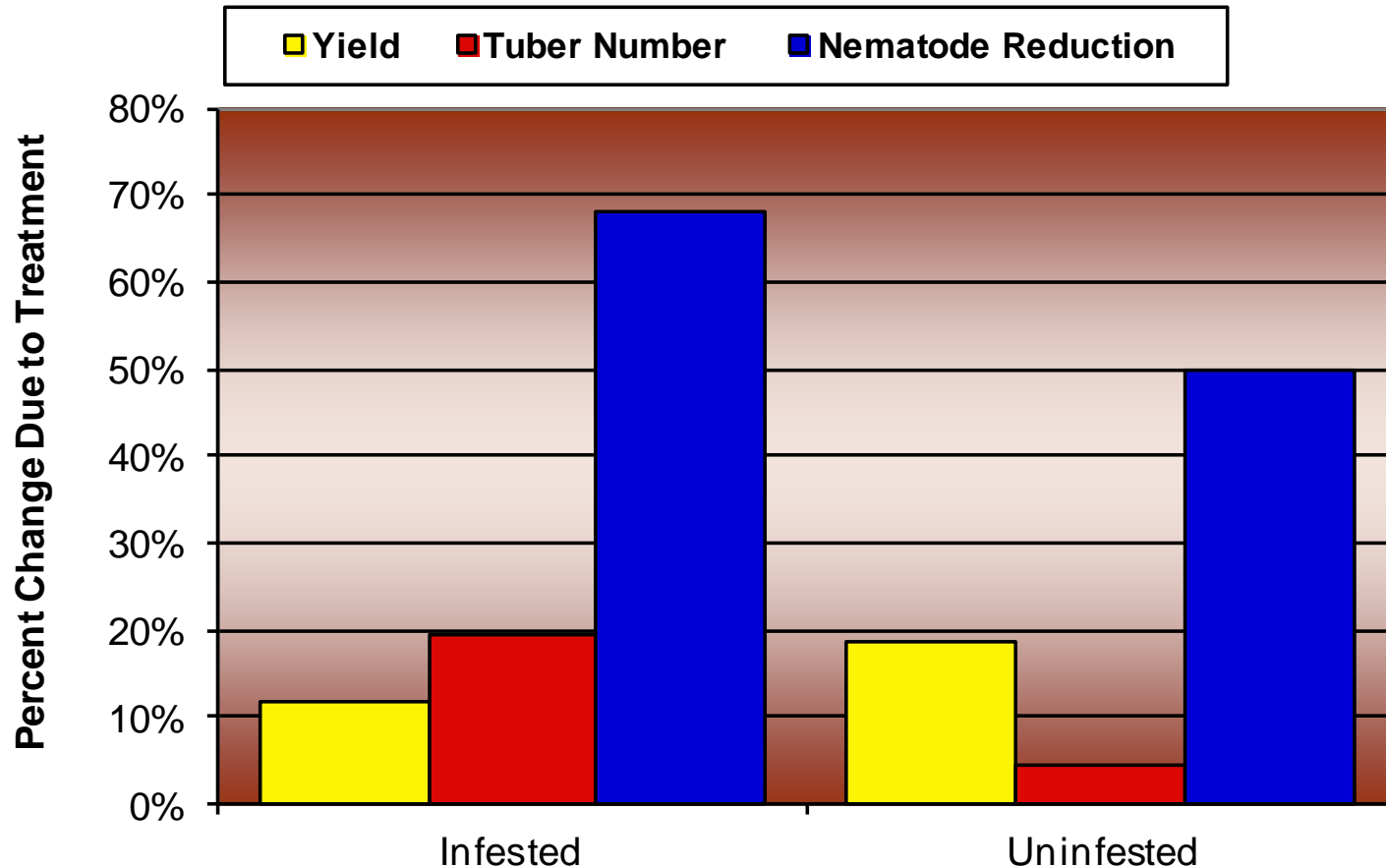
Root Lesion Nematodes: Michigan St Univ, 2001



Harpin_{Ea} resulted in a statistically significant 62% reduction in the number of root lesion nematodes found per gram of root tissue on July 9, 2001 (the only sample date).

CONTROL OF NORTHERN ROOT KNOT NEMATODE ON POTATOES WITH N-HIBIT

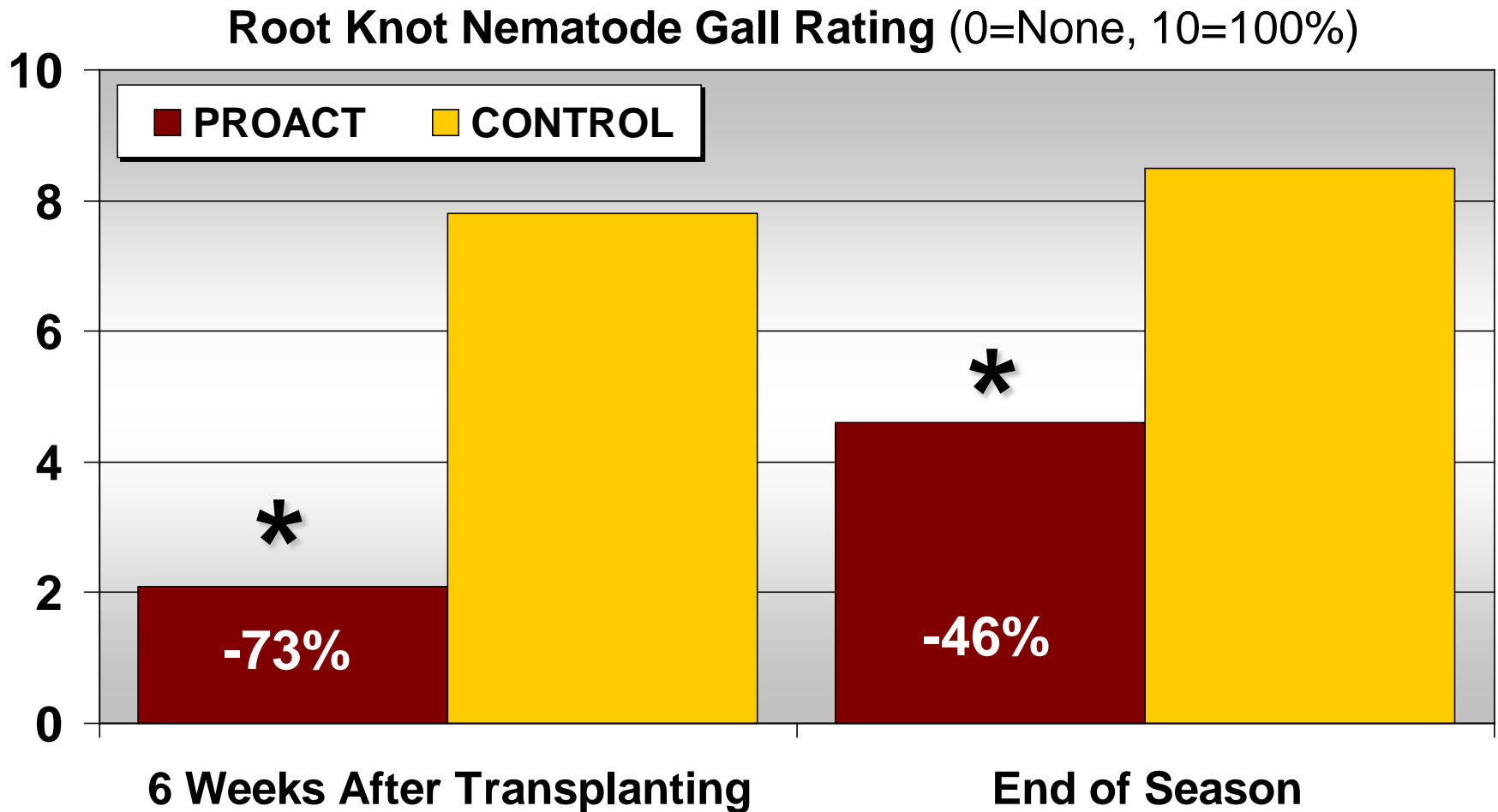
Cornell University, 2005



Harpin seed piece treatment resulted in increased yields, tuber numbers, and nematode reduction compared to the untreated controls, whether or not the soil was infested with nematodes.

EVALUATION OF HARPIN_{αβ} PERFORMANCE ON ROOT KNOT NEMATODE IN CANTALOUPE

Auburn University, 2006



Harpin_{αβ} applied as pretransplant spray at 3 oz/100 gal fb 2 oz/A prebloom and repeated at 21-28 intervals; located at Sand Mountain Res. Stn., Crossville, AL, 2006; * indicates Harpin_{αβ} different from Control (P=0.05); trial 206058.

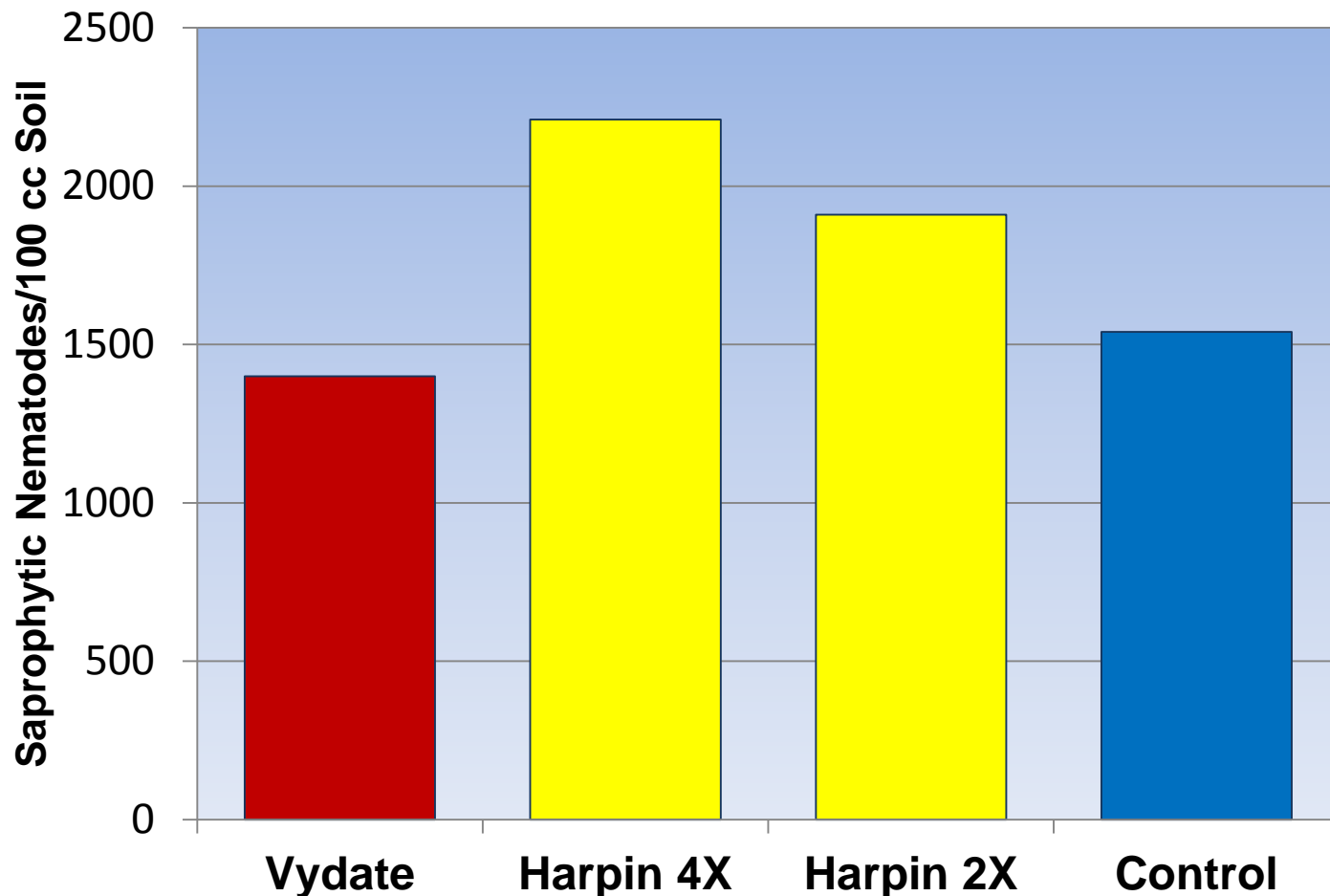
Examples of trials investigating harpin proteins on nematodes and plant growth

Crop	Year	Source	Harpin Use	Pest	Trial	Results
Cantaloupe	2006	Auburn Univ.	Foliar	RKN	Field	73% and 46% reduction in galling at 6-weeks after transplanting and harvest, respectively.
Citrus	2005	Texas A&M Univ.	Foliar	CN	GH	+27% plant height and stem diameter.
Cotton	2001	Univ. Florida	Foliar	RN	GH	42% reduction in eggs/root system; +26% biomass.
Cotton	2002	Univ. Arkansas	Seed Trt	RKN	GH	54% reduction in eggs per root system and +28% nodes.
Cotton	2004	Univ. Arkansas	Topical & Transgenic	RKN	GH	55% reduction in eggs/root wt, +14% and +18% nodes and root weight. Across 3 lines, 54% reduction in eggs/root wt.
Cotton	2005	Texas A&M Univ.	Seed Trt	RKN	Field	53% reduction in eggs/500 cc and +11% seed cotton.
Potato	2001	Michigan St.Univ.	Foliar	RLN	Field	62% reduction per gram root weight.
Potato	2002	Cornell University	Foliar	NRKN	Field	57% reduction per gram root weight.
Potato	2005	Cornell University	Seed Trt	NRKN	Field	68% reduction in NRKN per 100 cc.
Soybeans	2005	S. Illinois Univ/SIU	Seed Trt	SCN	GH	60% to 63% reduction in eggs/ root wt.
Soybeans	2005	Auburn, Univ. AR, and SIU	Foliar	RKN	GH	47% reduction in eggs/root weight and +8% to +20% leaf, shoot, and root weight.
Soybeans	2007	Purdue Univ.	Seed Trt	SCN	Field	40% reduction in juveniles and +5 bu/A yield.
Tomato	2006	Auburn Univ.	Foliar	RKN	Field	64% and 55% reduction in galling at 6-weeks after transplanting and harvest, respectively.

CN = Citrus Nematode, NRKN = Northern Root Knot Nematode, SCN = Soybean Cyst Nematode, RLN = Root Lesion Nematodes, RN = Reniform Nematode, and RKN = Root-Knot nematode. GH = Greenhouse

EFFECTS OF HARPIN_{Ea} ON BENEFICIAL NEMATODES

Trial 200220 – Potato – Cornell University



Beneficial nematodes increased in the harpin treated plots

HARPINS INCREASE YIELD

Summary:

1. Harpins have NO direct effect on nematodes. They affect the plant, eliciting a genetic response from the plant that affects nematodes. Plants already have a genetic means to deal with nematodes, but it needs to be elicited.
2. The activity is equal to most conventional nematicides. It appears to be supplemental to most other nematicides.
3. Unlike most conventional nematicides, harpins increase yield even in the absence of nematodes. Growers who use it will receive value whether or not they have a problem.
4. The SAR response is systemic so activity is not sensitive to mode of application. Seed treatments have the advantage of earlier plant response than foliar treatments.
5. The mode-of-action is not known, but is being determined at this time.