IPM of ants
(in citrus and elsewhere)

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General ant IPM

- Ants (collectively) are a top pest in many settings
- Direct and indirect impacts
- Difficult to manage
- Focus on physical barriers (into buildings) and pesticide applications in almost all settings
- Very few established guidelines beyond this

Pesticides

- Baits
  - Abamectin (avamectin “family”)
  - Hydramethylnon (gut poison)
  - IGRs (methoprene, pyriproxyfen)
- Contact insecticides
  - Sprays (rarely recommended) (chlorpyrifos, bifenthrin, fipronil)
  - Mound treatments (fipronil, acephate)

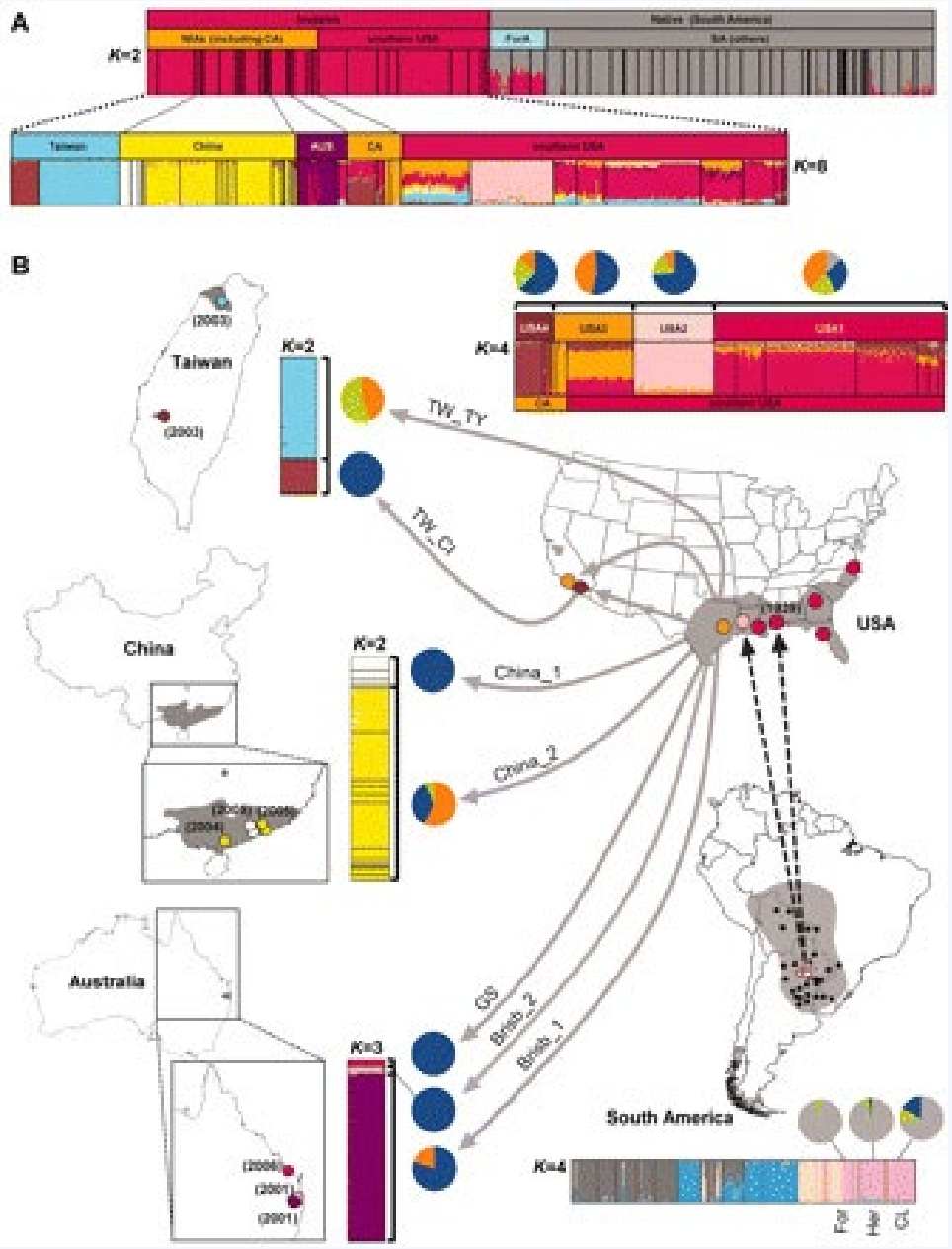
Need for more adaptive, complete ant IPM guidelines

- Fire ant IPM advances and work in citrus provide conceptual framework for improvements

- More options and information available than is presented in current ant IPM guidelines

The red imported fire ant, *Solenopsis invicta*

Worldwide introductions

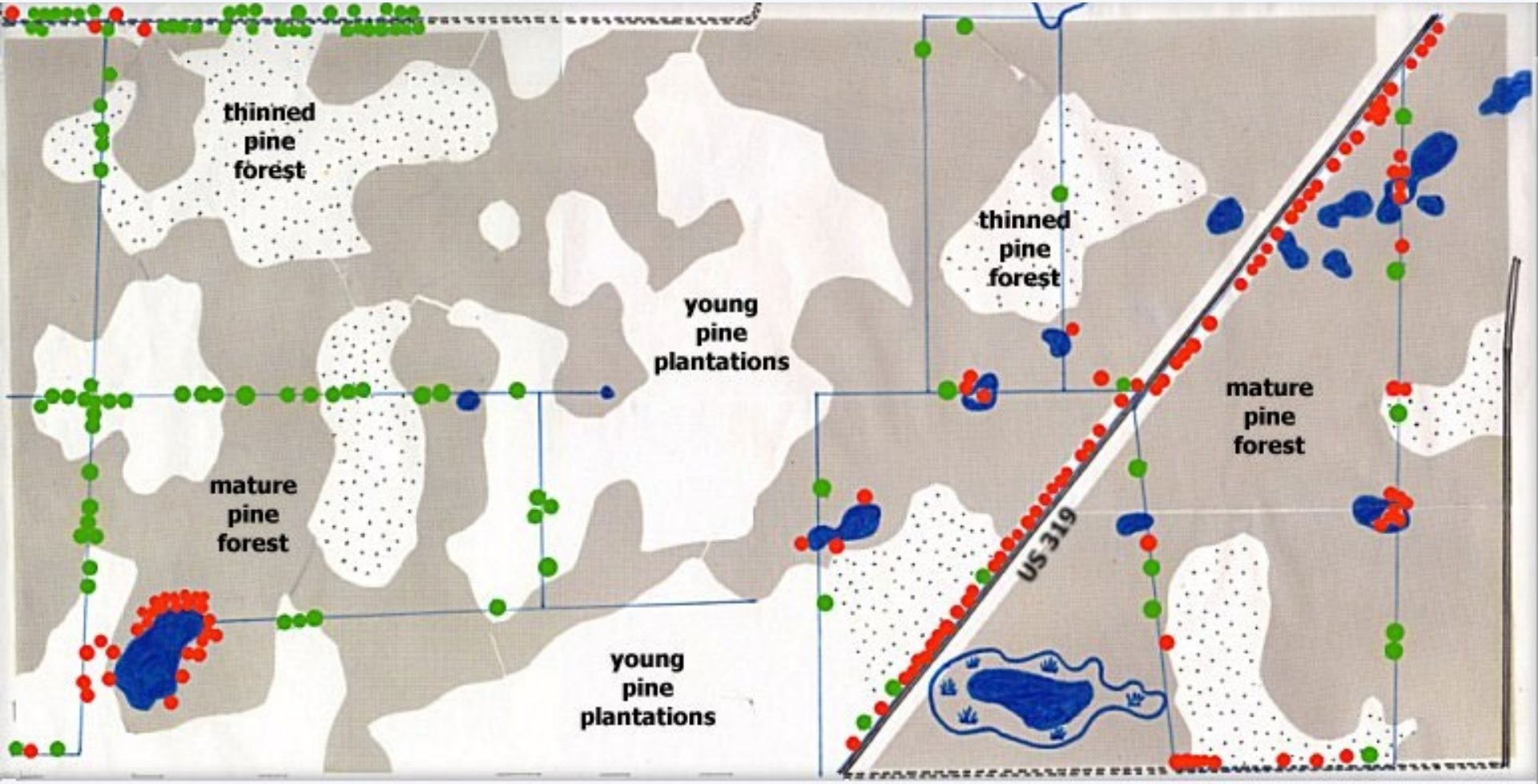


US introduction

Source populations (native range)

From Asunce et al. 2011, *Science*.

S. Invicta is found in human-disturbed sites



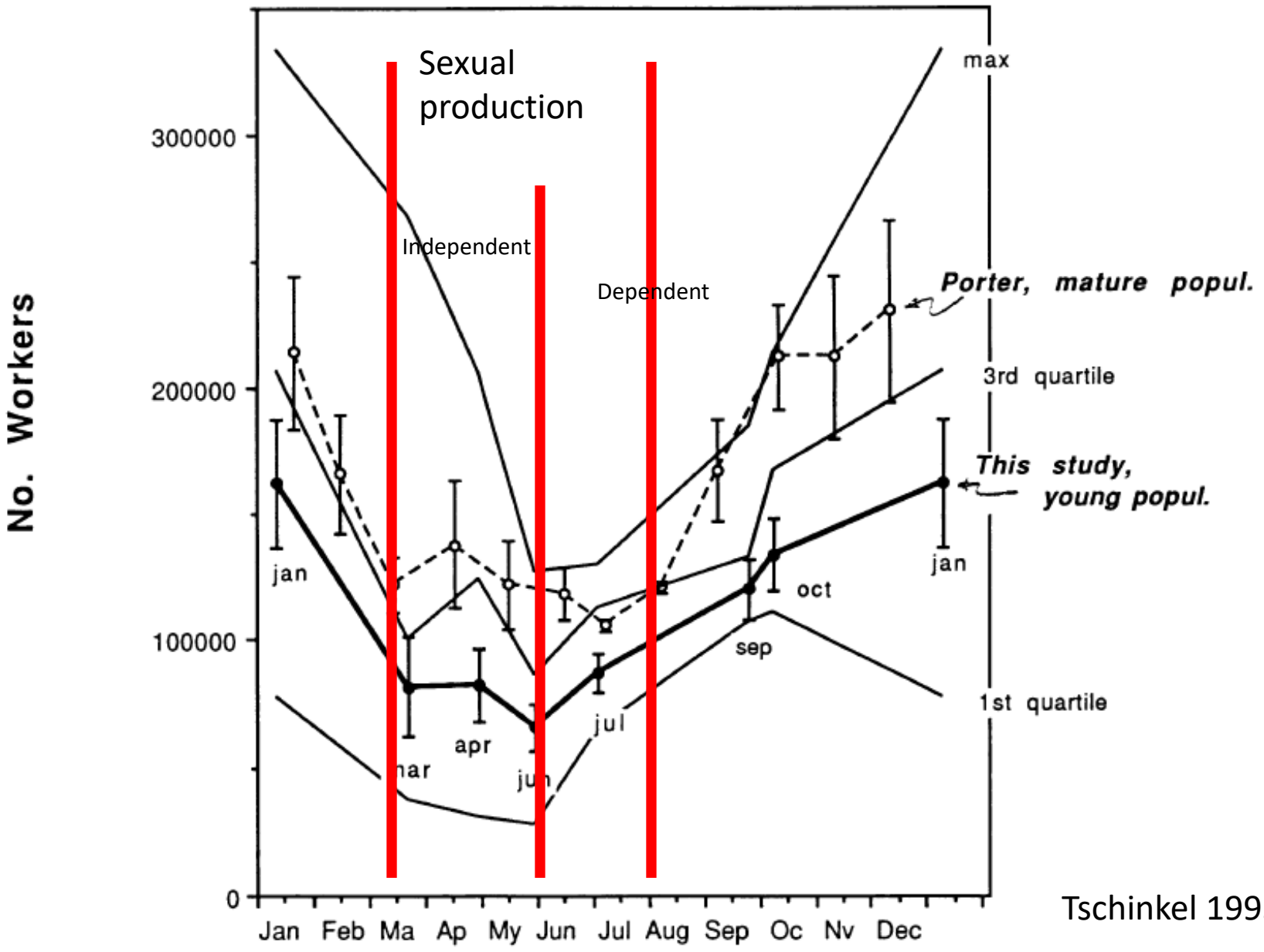
Transects = blue lines; S. invicta colonies= red; S. geminata colonies= green
Double dashed lines= graded dirt roads; Double solid lines= paved highway

The distribution of the exotic *Solenopsis invicta* and the native *S. geminata* in the sandhills region south of Tallahassee, Fl.

Occurrence across the landscape

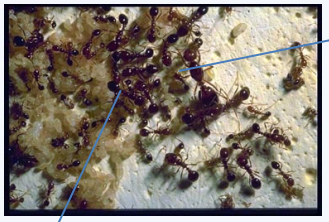
Here in moderate numbers

Seasonal cycle



Tschinkel 1993

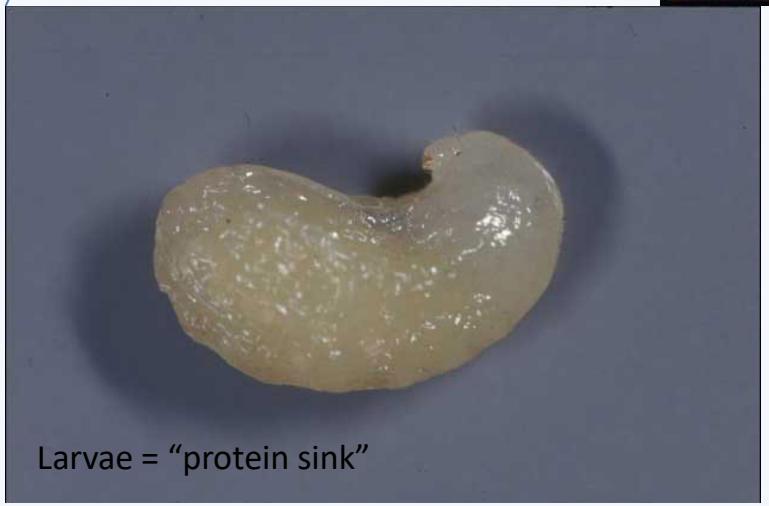
Colony hunger, feeding, and foraging cues

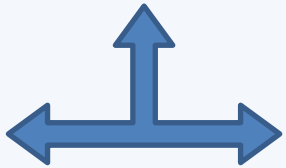


Foragers: all calories and nutrition into colony

Larvae: drive “colony hunger” for protein

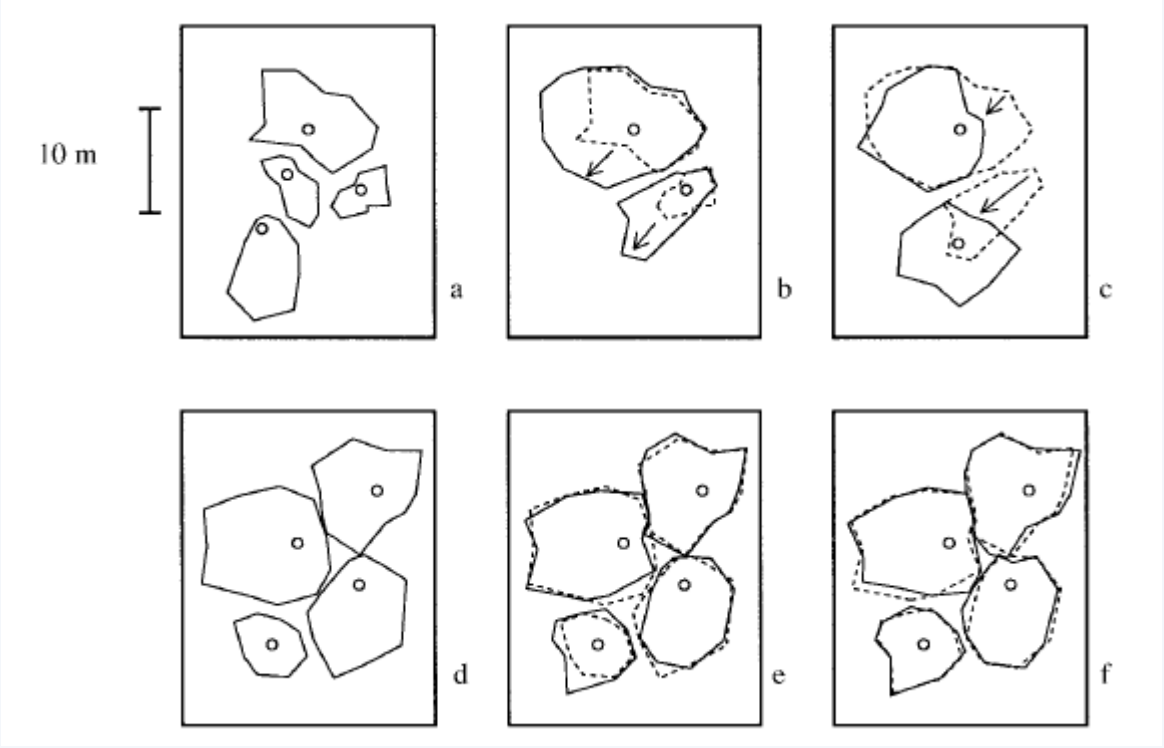
Kill larvae and most in-nest workers: disrupt hunger cues and foraging cues and foraging shuts down

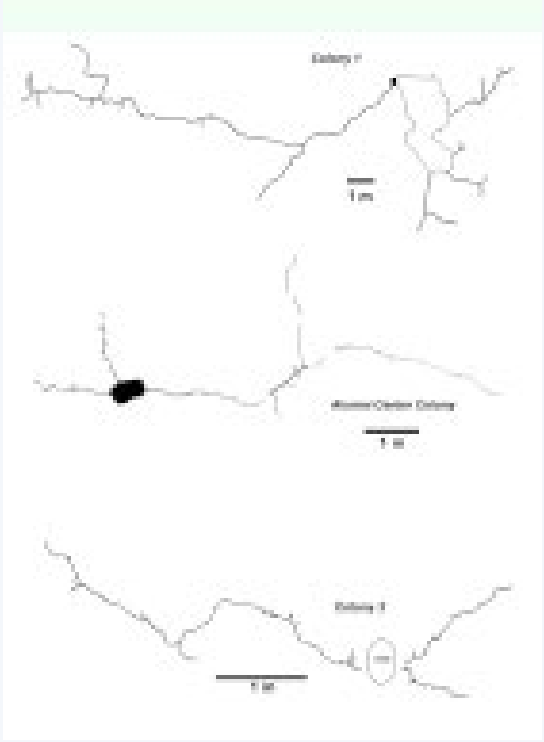




Fire ants are territorial (yes, even polygyne fire ants)

Fire ant territoriality: maintaining absolute territories



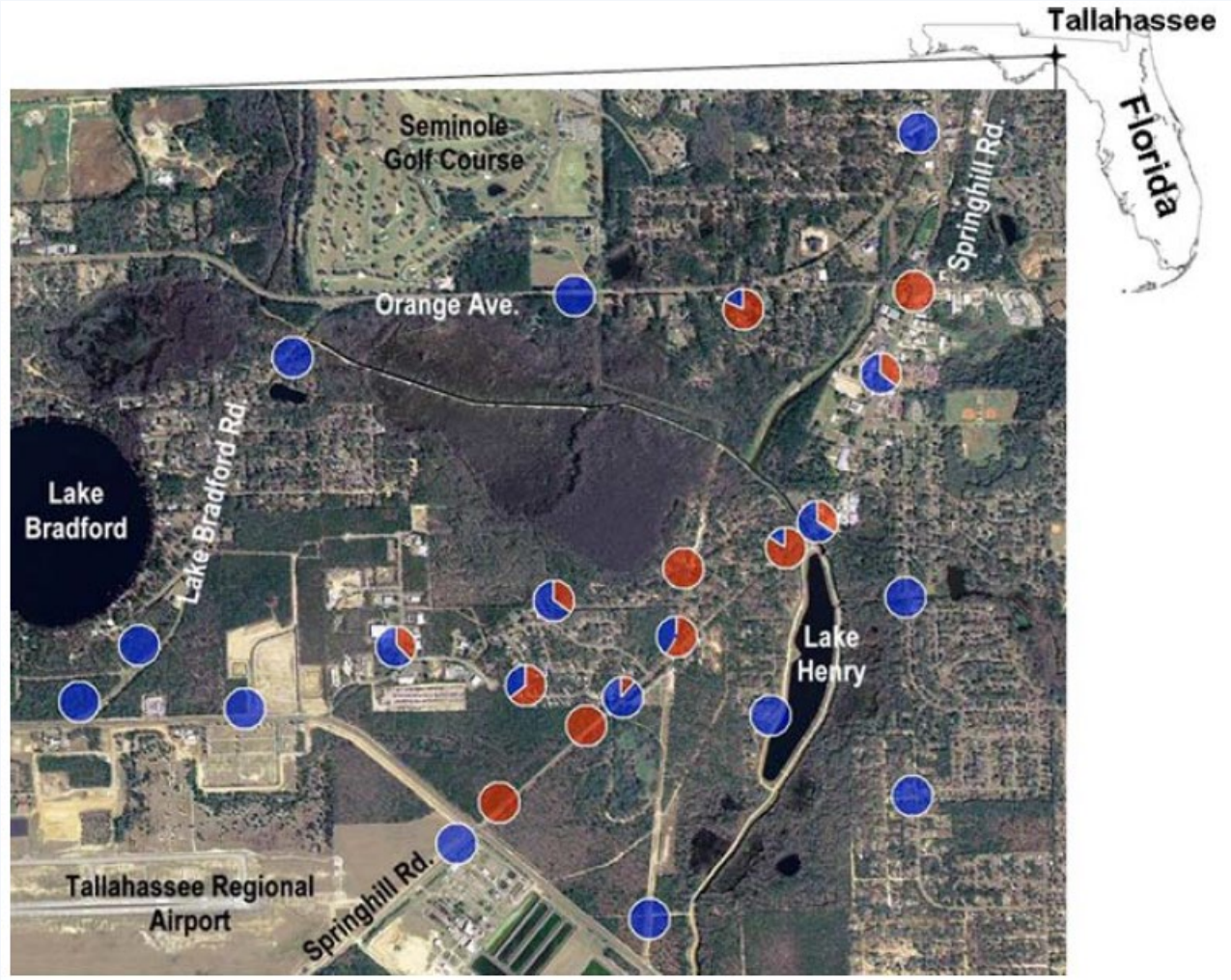


Colony territories are maintained by network of scouts (above ground) and rapidly recruit-able workers waiting in foraging tunnels (1-3 cm below ground)

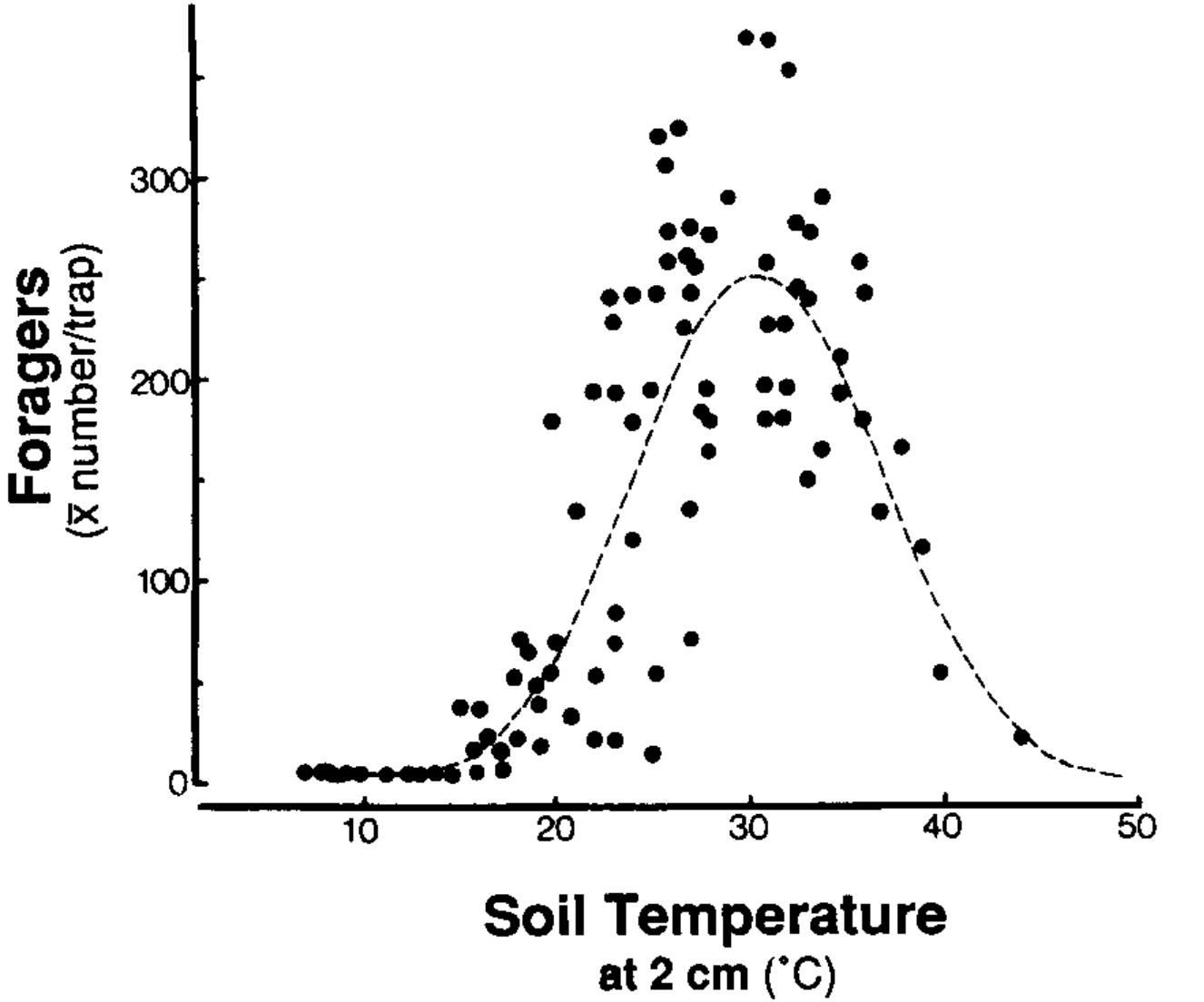
Remove a colony – another colony will (over time) take its place

Polygyny (multiple queen form)

- Higher density of mounds per unit area
- Smaller workers
- Multiple queens (up to hundreds) per colony
- Most often along roadsides due to soil depot practices



Fire ants forage most of the time



Soil temperature is the strongest correlate with foraging activity

Time of day, night/day, soil moisture, relative humidity, wind, rain are all unrelated to foraging

Season was correlated, likely due to temperature differences between seasons.

Porter and Tschinkel, 1987, Env. Entomol.

IPM site-specific, goal-oriented approaches to fire ant control:

Commonly used available management options

Chemical control approaches

Ant “elimination” protocol

Two step method:

1. Broadcast bait
   - Larger areas, only as needed
2. Individual mound treatments

Ant elimination protocol: contact insecticides for local eradication

- Fipronil granules, pyrethroid liquid, or granular formulation such as permethrin or bifenthrin spread over large areas (e.g. a yard or field)
- Widespread non-target impacts (all insects including pollinators, etc.)
- Cost ($), environmental, and human health limitations prevent widespread use
- Follow label instructions. Caution near waterways, etc.

Two step: 1. Broadcast baits

Broadcast baits available for use in many situations (including in some food production systems, like vine or tree fruits). The active ingredients in all of the products operate after ingestion by the target organism (fire ants). They are all slow-acting toxins, allowing the ants to share the baits within the colony, including with the brood (larvae and pupae) and queen(s).

Extinguish®
Active ingredient: (S)-Methoprene at 0.5% of product weight. (S)-Methoprene is an insect growth regulator.

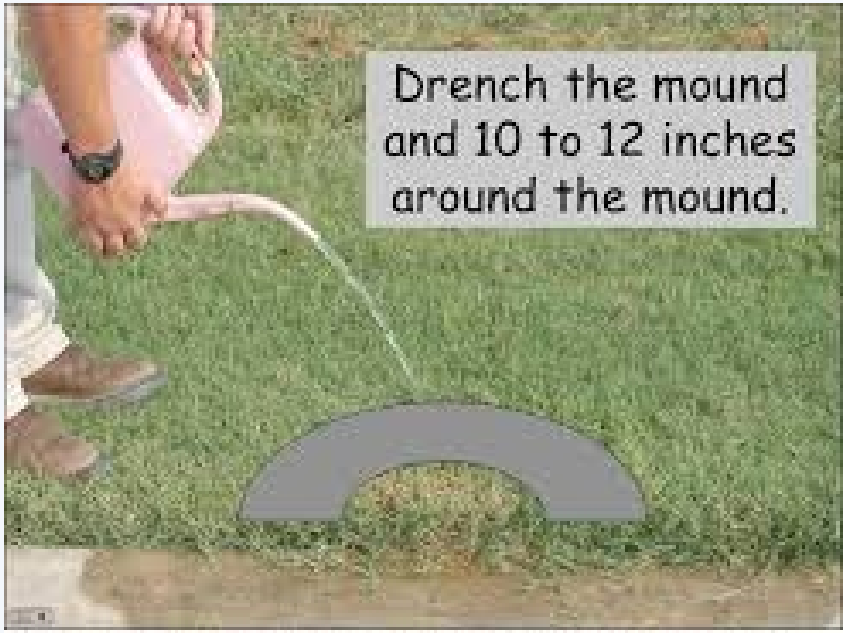
Clinch®
Active ingredient: Abamectin at 0.011% of product weight. Abamectin is a nerve poison.

Amdro® Pro
Active ingredient: hydramethylnon: tetrahydro-5,5-dimethyl-2(1H)-pyrimidionone (3-[4-(trifluoromethyl)phenyl]-1-(2-[4-(trifluoromethyl)phenyl]-ethenyl)-2-propenylidene) hydrazone at 0.73% of product weight. Hydramethylnon is a slow acting gut poison.

Broadcast bait recommendations and problems

- Follow label instructions (use a spreader) and may not be used in a number of situations
- Time of day of application matters (morning/evening usually best in SE US)
- Do not over-apply (more than 2-3 times/year)
- Low toxicity, effective control (90% reductions) over ~ 2-3 years
- Eventual development of bait-shyness, non-target impacts (other ants, roaches, crickets, grasshoppers)

Two step: 2. Mound treatments



When drenching a mound start by using about ¼ of the total volume to treat a 10 to 12 inch band around the outside of the mound. Then pour the rest of the drench directly on the mound.

Mound treatments

- Cost ($), environmental, and human health limitations prevent widespread use
- Follow label instructions. Caution near waterways, etc.
- May not contact much of the colony – colony moves and appears again nearby

Reality of current ant IPM

- Best case scenario: up to 90% reductions with pesticide applications
  - What happens when you over-use product?
  - What happens when you stop using product?

- New approaches needed (not necessarily new products)

New approaches

- Bait stations (subterranean and aboveground)
- Careful attention to time of day, season, and weather conditions when using baits
- Integration of non-toxic alternatives into areawide programs or as standalone options

Alternatives to synthetic insecticides?

insects

MDPI

Review

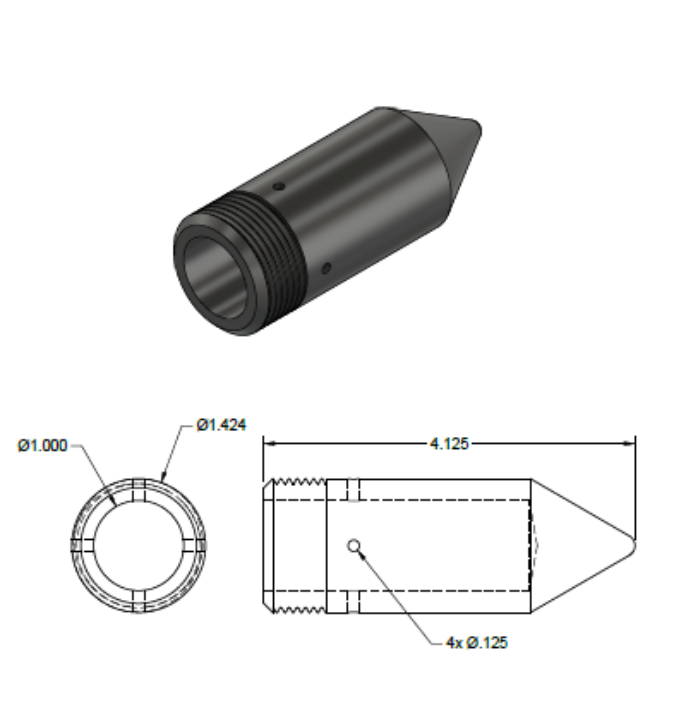
Naturally Occurring Compounds/Materials as Alternatives to Synthetic Chemical Insecticides for Use in Fire Ant Management

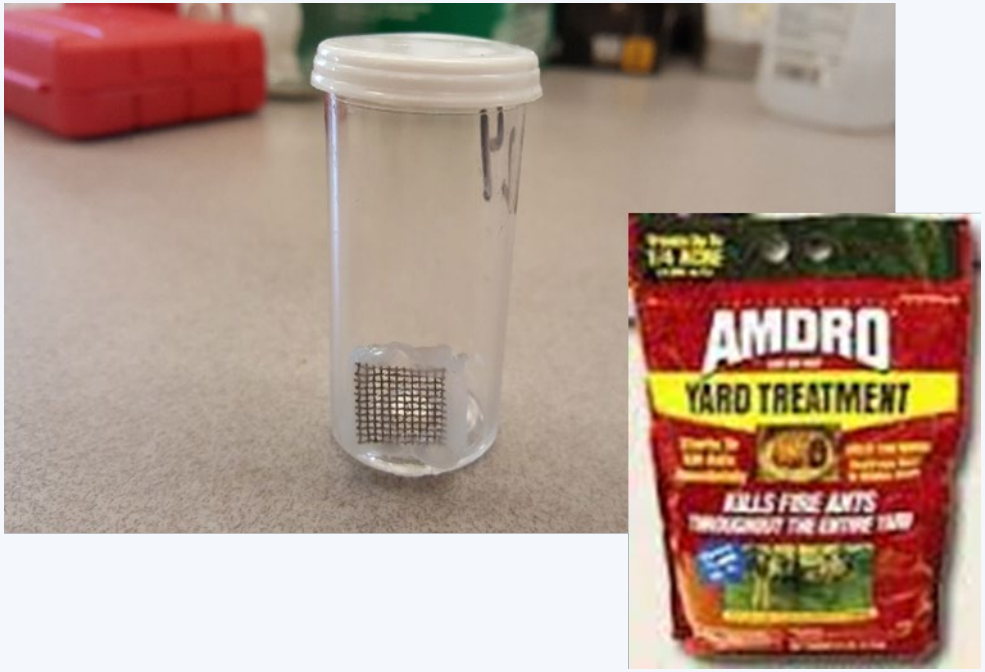
Jian Chen [1,*] and David H. Oi [2]

Summary: there are many materials that demonstrate repellency and/or toxicity but very few are sufficiently tested to draw any conclusions about real-world efficacy.

Example: citrus oil mixtures – often used by organic growers as mound treatments, but with mixed results

Subterranean baits





A hot water method for control of fire ants and other insects

NON-TOXIC, HIGHLY EFFECTIVE PEST CONTROL

Technology and method of controlling fire ants

Patent

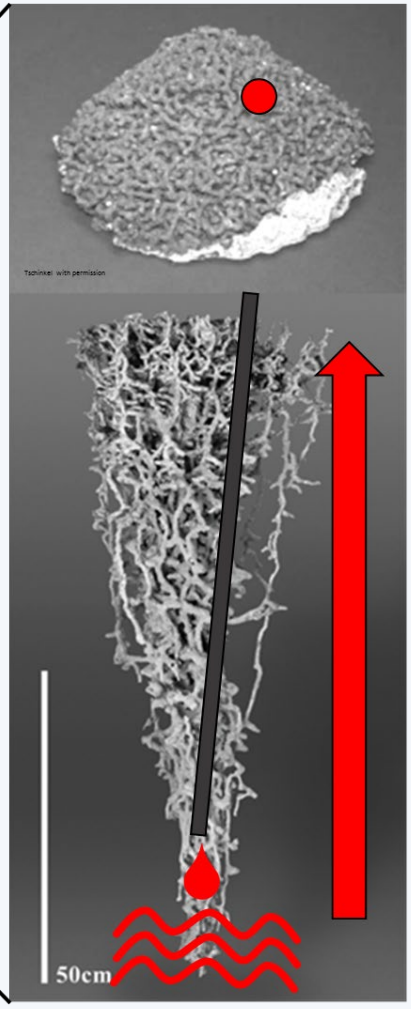
Environmentally safe insect control system. U.S. Patent No. 10,716,302. Inventor: Joshua R. King. Issued July 21, 2020.

The method

Utilize nest architecture to maximize exposure of ants to hot water belowground

Efficacy

- Effective immediately (no delay)
- 90-95% reduction of fire ant populations, equal or superior to pesticide control rates
- True, non-toxic alternative to pesticides



Hot water replaces mound treatments and may be a viable replacement for baits (areawide treatment) in some scenarios

- Non-toxic, low cost (if equipment is available) – can be used in any environment
- Highly effective and targeted
- Requires expertise (finding mounds, use of specialized equipment)
- Requires retreatment (same or more frequently than baiting) if areawide is the goal
- Can be fully integrated with baiting strategies (bait stations, broadcasting)

Landscaping

- Create shading
- Replace lawns with shrubbery

Mechanical removal

- Dig em’ up! (limited)
- Works best in cool months

Needs work!

- Every agroecosystem is different and requires adaptive ant management approaches if the goal is management