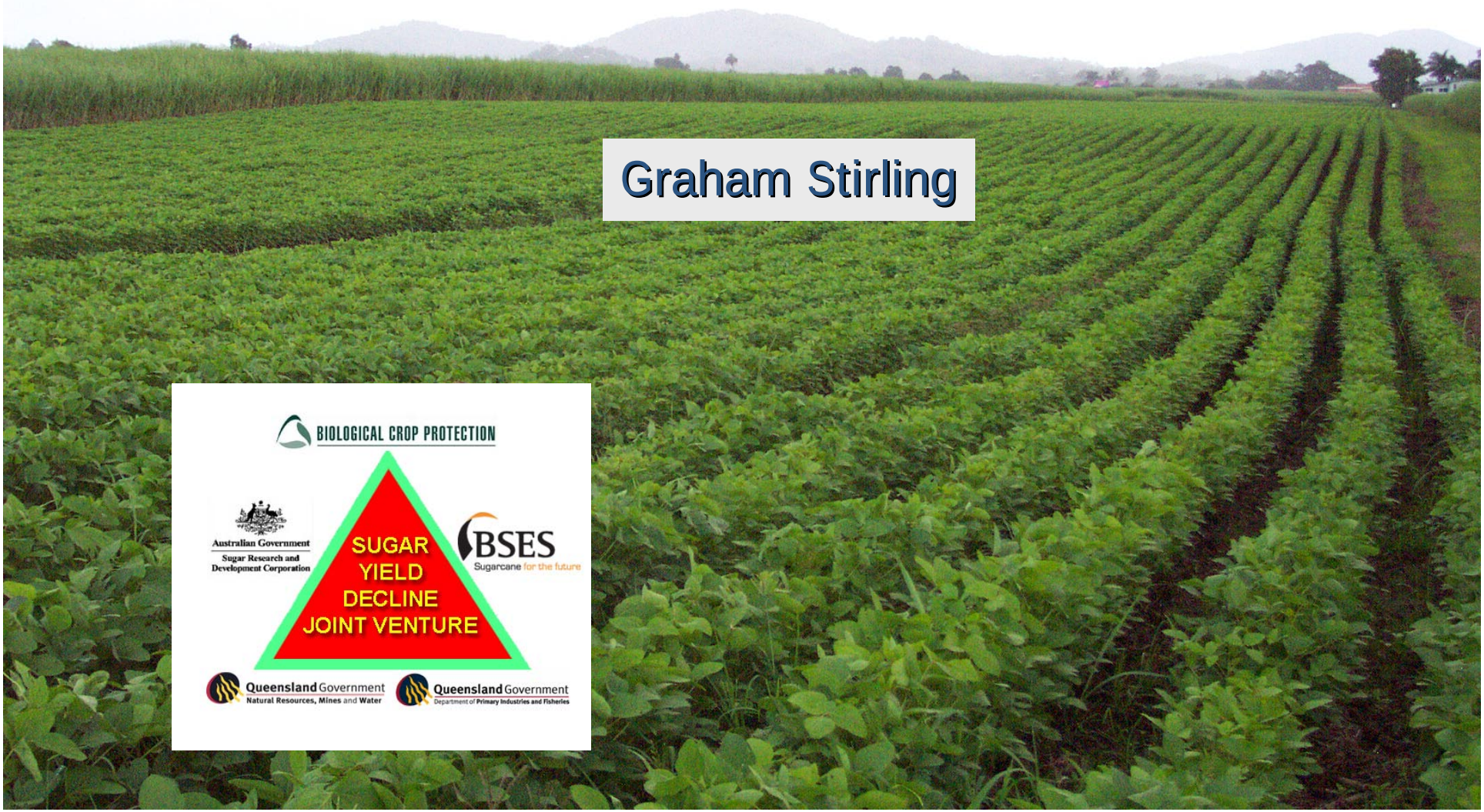
THE POTENTIAL FOR NEMATODE PROBLEMS IN AUSTRALIA'S DEVELOPING SOYBEAN INDUSTRY



Graham Stirling

BIOLOGICAL CROP PROTECTION

Australian Government
Sugar Research and Development Corporation

SUGAR YIELD DECLINE JOINT VENTURE

BSES
Sugarcane for the future

Queensland Government
Natural Resources, Mines and Water

Queensland Government
Department of Primary Industries and Fisheries

Nematodes have the potential to become serious pests of soybean

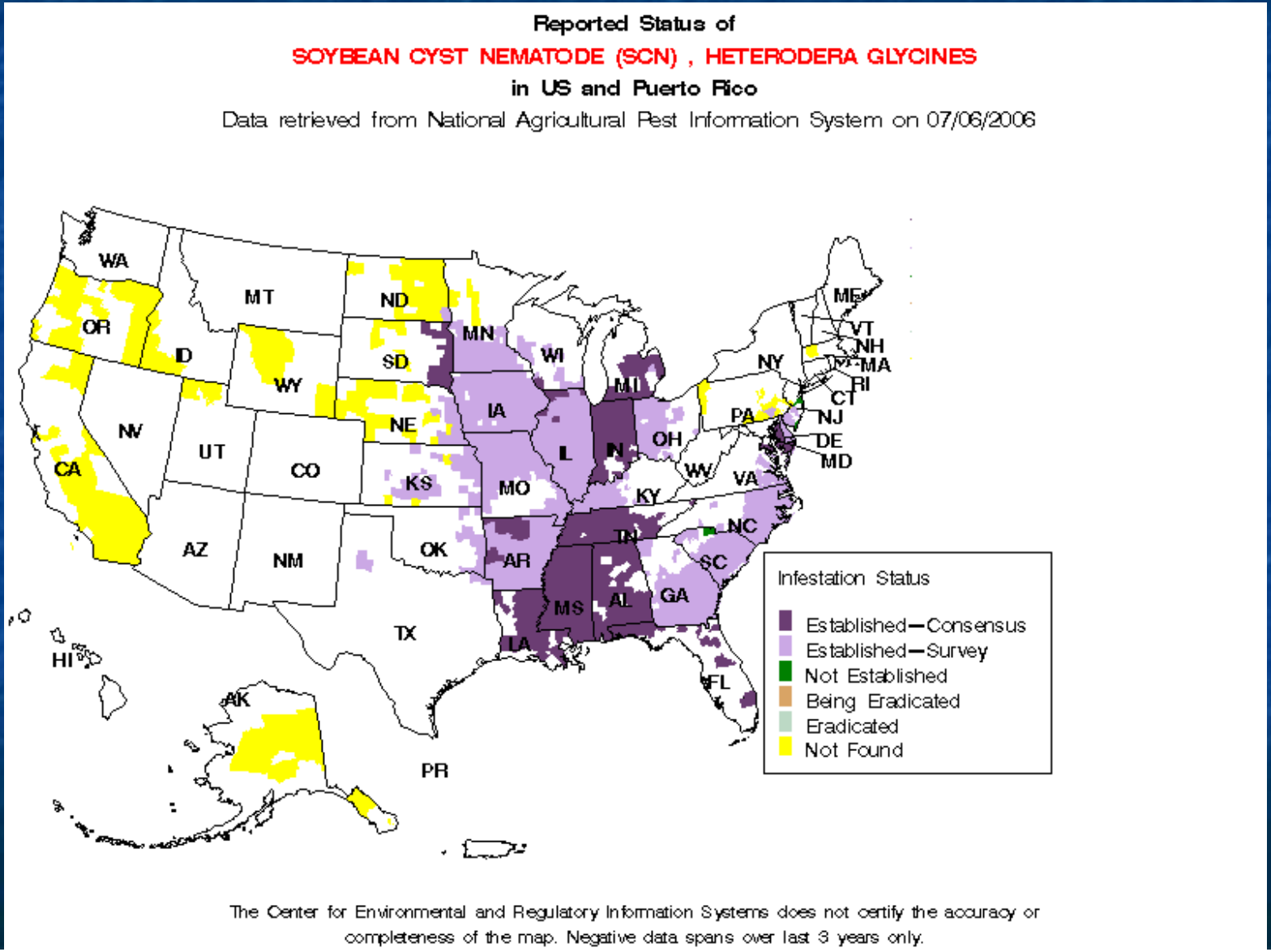
AIM OF TALK

- Create awareness of three important pests
  - Soybean cyst nematode
  - Reniform nematode
  - Root-knot nematode

SOYBEAN CYST NEMATODE

- The most important pest of soybean worldwide
- Native of Asia (China, Japan and Korea)
- Not yet found in Australia
- The current situation in the USA is a salutary lesson for the Australian soybean industry
  - SCN was introduced in the 1954 and has since spread to all soybean-producing states and to Canada

Distribution of Soybean Cyst Nematode in the USA



In the USA, yield losses from SCN are greater than for any other disease

Over the last 3 years, average losses were 2.8 million tonnes per year

(Wrather and Koenning 2006)

A major breeding program has been established to develop resistant cultivars

What can Australia do to protect itself?

- Recognise the quarantine risk
  - SCN is listed in the biosecurity plan for the grains industry
- Understand dissemination methods
  - Egg-containing females harden to form cysts
  - Cysts are an ideal survival mechanism and are easily tranported
- Traces of soil are the most likely source of entry
  - Seed
  - Farm machinery
  - Plant products
  - Shoes
- Growers visiting infested farms overseas need to be particularly vigilant

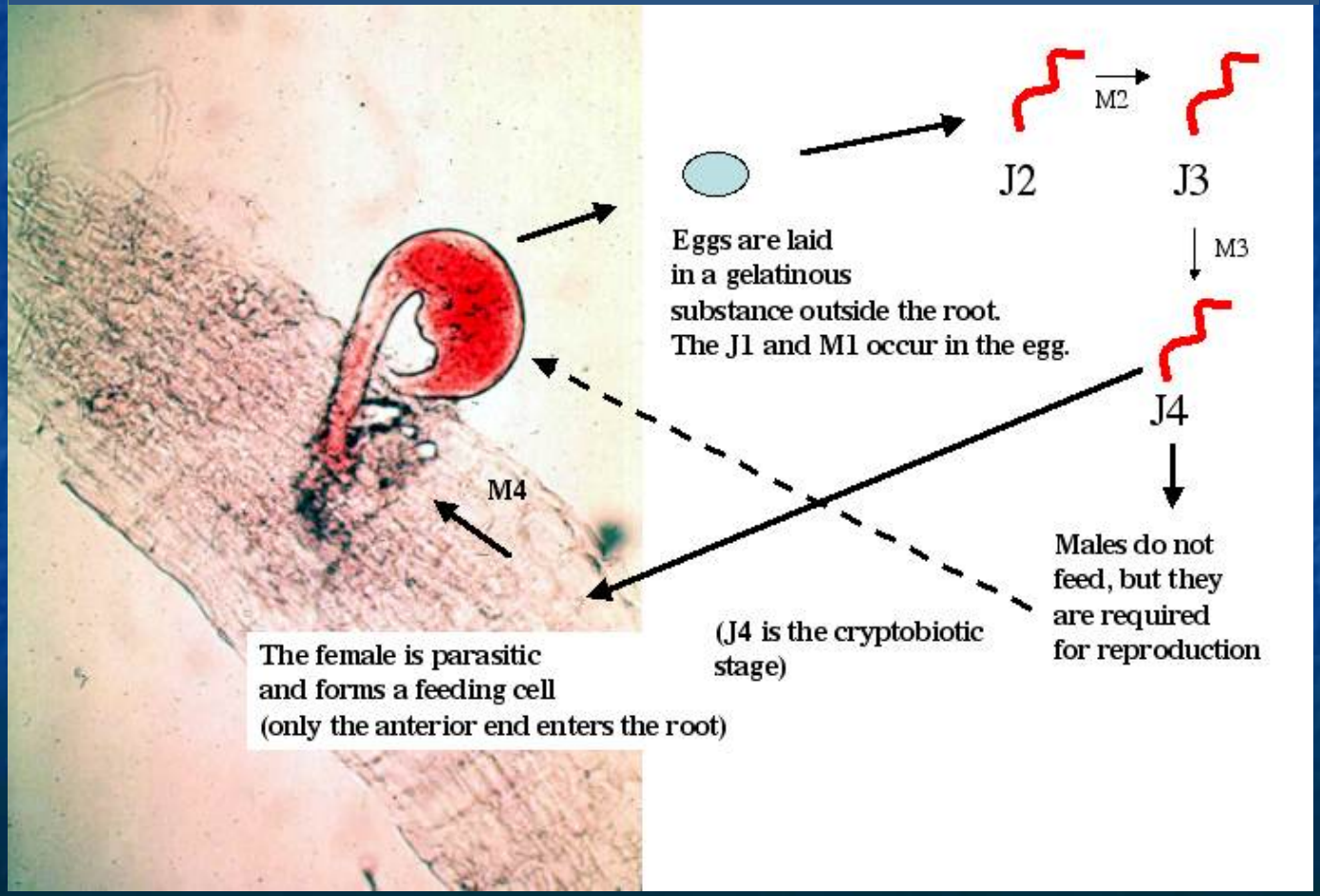
Detection of Soybean Cyst Nematode

The nematode is difficult to detect because yield losses can occur in fields with no obvious above-ground symptoms

Check for pin-head sized cysts on roots

RENIFORM NEMATODE

Differs from cyst and root-knot nematodes, as the female is only partly embedded in the root



The most damaging species on soybean is *Rotylenchulus reniformis*

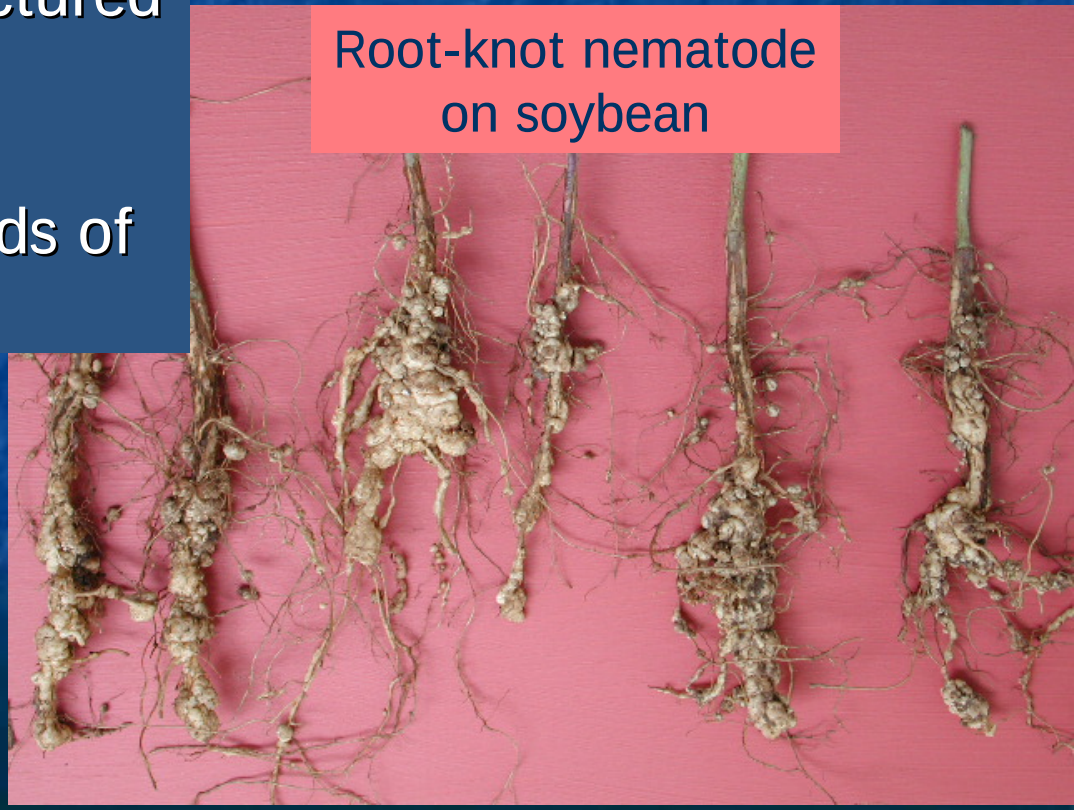
- Wide host range and common in tropical regions of the world
- In Australia, it is found in coastal areas north of Bowen
- Should not be confused with another species (*R. parvus*), which is widespread on sugarcane and other grasses

Likely impact of reniform nematode on soybean

- Causes stunting and yield loss in many countries
- Damage has been reported in several south-eastern states of the USA
- In north Queensland, the nematode occurs at low to moderate population densities on green manure crops of soybean and lablab
- Provided soybean is grown intermittently as a break crop in sugarcane, population densities are likely to remain below the damage threshold (about 100 nematodes /200 mL soil)

ROOT-KNOT NEMATODE

- Will never cause problems in clay, clay loam and alluvial soils
- Common on sugarcane in sand, sandy loams and well-structured volcanic soils
- Soybean is one of thousands of host plants



Root-knot nematode has the potential to cause problems on most legumes grown in rotation with sugarcane

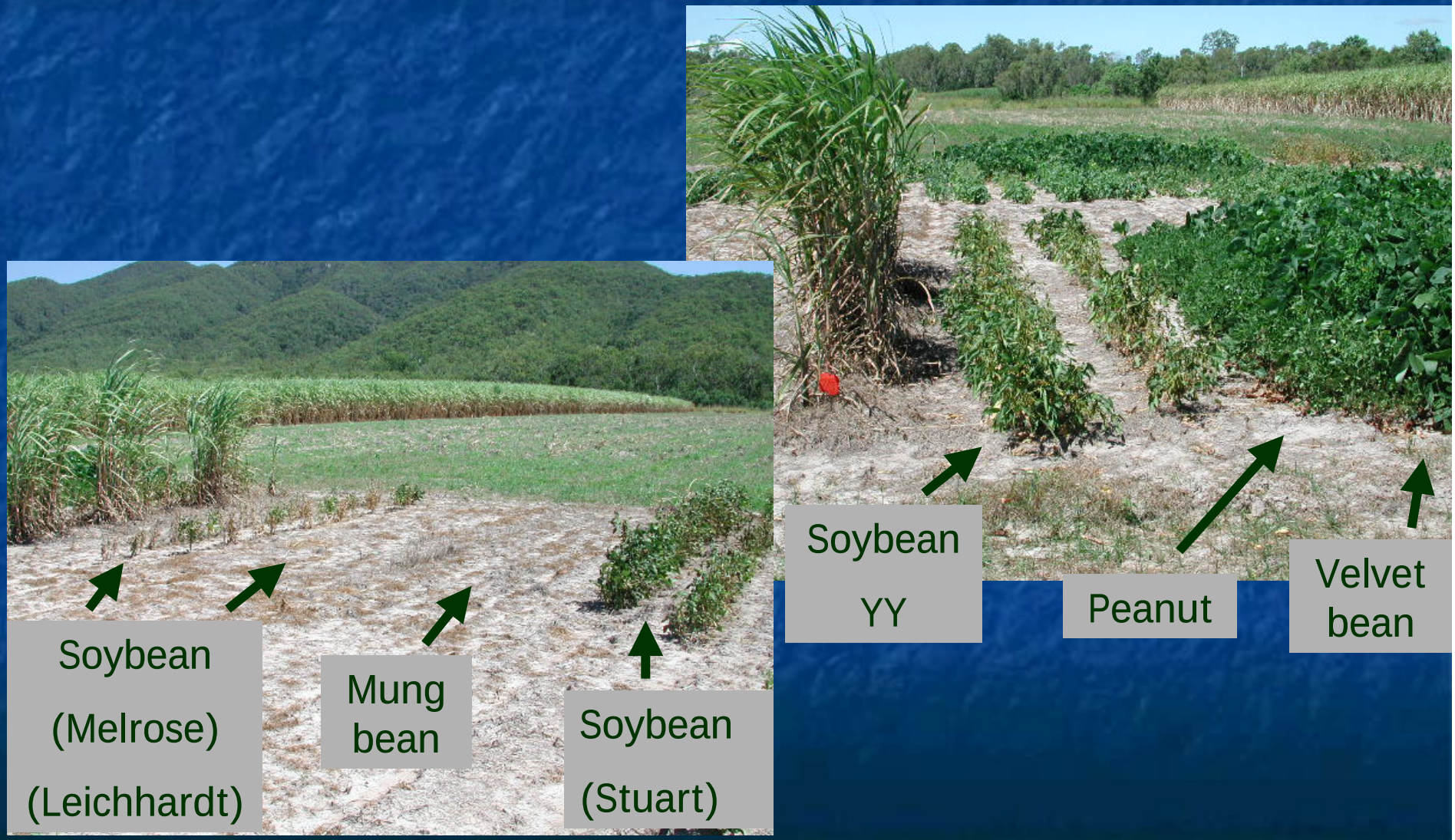
Field trial on the susceptibility of legumes to root-knot nematode

- Site at Oakenden (near Mackay)
  - Sandy soil with moderately high nematode infestation (393 root-knot nematodes/200 mL soil)
- 4 soybean cultivars and 5 other legumes
- Sugarcane harvested mid November 2003
- Two legume planting dates
  - 16 December 2003
  - 13 February 2004
- Treatments for comparison
  - Continuous sugarcane
  - Bare fallow (maintained with herbicide)

Symptoms on roots on 3 February 2004

(7 weeks after the first planting)

The first planting after 15 weeks



Galling and nematode populations at harvest

		First planting		Second planting	
		Galls	RKN	Galls	RKN
Mung bean		8.8	102	6.6	308
Lablab		8.3	2456	5.4	2117
Soybean	Leichhardt	7.1	1383	4.8	612
Soybean	Melrose	8.1	2094	4.3	836
Soybean	YY	7.3	1376	4.4	116
Soybean	Stuart	1.8	230	0	51
Cowpea	Meringa	0	424	0	88
Velvet bean		0	102	0	1
Peanut		0	37	0	1

First v. second planting

More severe galling and poorer growth in the first planting. .....Why?

- RKN populations declined by 98% in the 8 weeks from the first to second plantings
  - 16 December: 393
  - 13 February: 6
- Conditions were hot and wet (357 mm rain)
- RKN populations decline rapidly in a bare fallow under these conditions

The practical lesson

- A short bare fallow is a useful control measure for RKN
  - The soil must be warm and moist
  - Nutgrass and other weed hosts must be controlled

Note:

- Bare fallow is not as effective against other nematodes (e.g. lesion nematode)

RKN populations were unexpectedly low when mung bean was sampled at 15 weeks

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This is probably an example of the fallow effect

Nematode numbers were high at 7 weeks.

Plants then died and populations declined over the next 8 weeks

Host status of legumes

GOOD HOSTS

- Mung bean
- Lablab
- Most soybean cultivars

POOR HOSTS

(similar to bare fallow)

- Soybean cv. Stuart
- Peanut
- Cowpea cv. Meringa
- Velvet bean

The practical message

In sandy, RKN-infested soils

- Most legumes can be damaged by root-knot nematode
- Most legumes will carry-over high nematode populations to the next cane crop

- The best options are peanut and velvet bean
- Soybean cv. Stuart and cowpea cv. Meringa may be useful alternatives

- A bare fallow > 2 months after sugarcane harvest will minimise damage to the legume (but won't prevent carry-over of nematodes)

Reaction of soybean cultivars to different populations of root-knot nematode

- Mackay trial site
  - Mixture of *M. javanica* and *M. incognita*

- Leichhardt was susceptible and intolerant
- Stuart was relatively resistant and tolerant

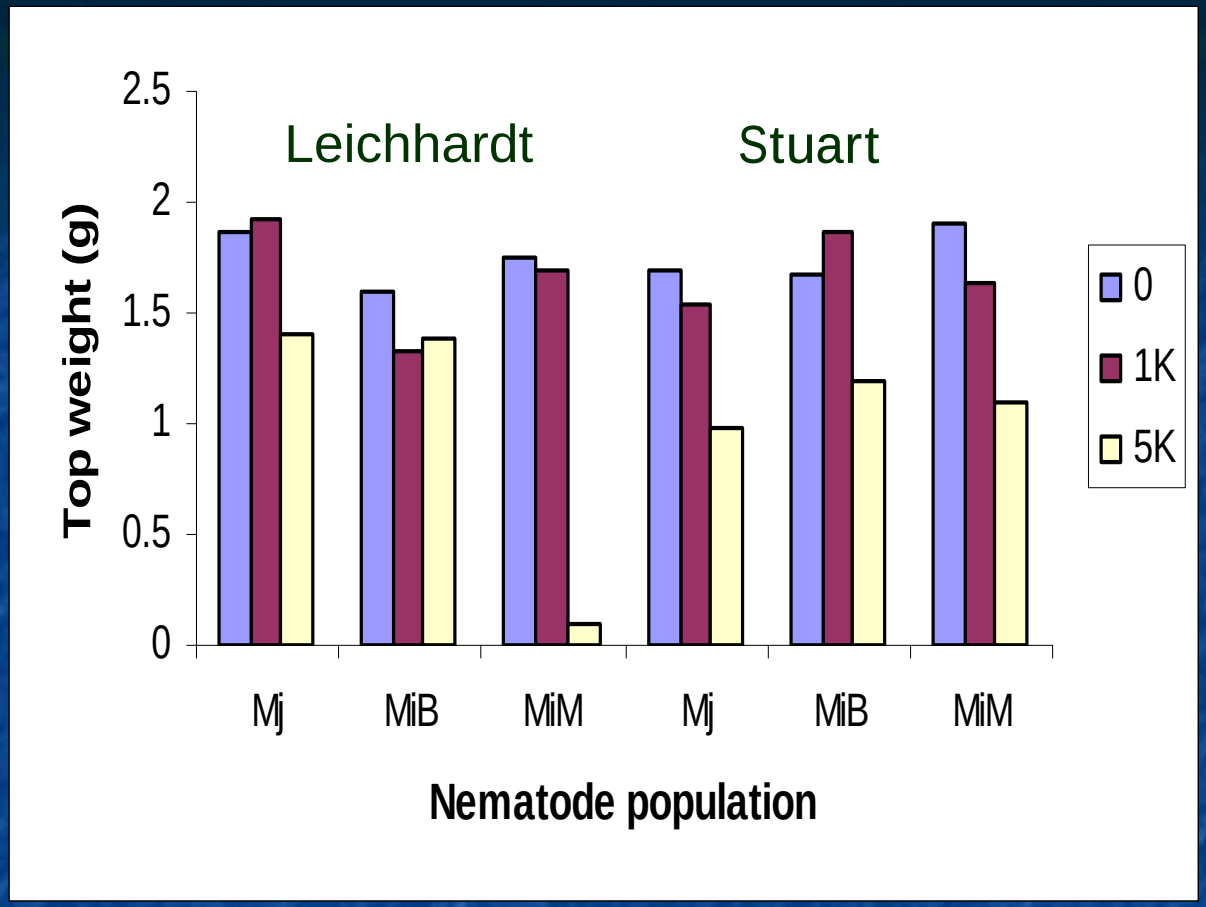
The reaction of these cultivars was tested in the glasshouse against different nematode populations

Glasshouse experiment

- 3 nematode populations
  - *M. javanica*
  - *M.incognita* (from Mackay trial site)
  - *M. incognita* (from Bundaberg)
- 2 varieties
  - Leichhardt and Stuart soybean
- 3 inoculum densities
  - 0, 1000 and 5,000 Root-knot nematodes/L soil

Reaction of soybean to the Mackay population of *M. incognita*

The reaction of the cultivars confirmed the result in the field



Biomass decreased as inoculum density increased (both cultivars, all nematode populations)

Leichhardt was markedly affected by *M. incognita* from Mackay but not by *M. incognita* from Bundaberg

Conclusions

- Soybean varieties may react differently to different populations of the same root-knot nematode species
- Any attempt to screen for resistance must include nematode populations from different localities and cropping histories
- In the absence of such information:
  - Growers should choose soybean varieties on the basis of previous performance in the local situation