# Phosphine and protectant resistance in stored grain insects: *status and implications for Australia*

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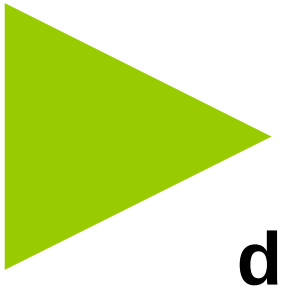
# The challenge: nil tolerance* to...

- Pests – *live insects, other invertebrates*

* Nil tolerance – none in a representative sample, or certified absolute absence

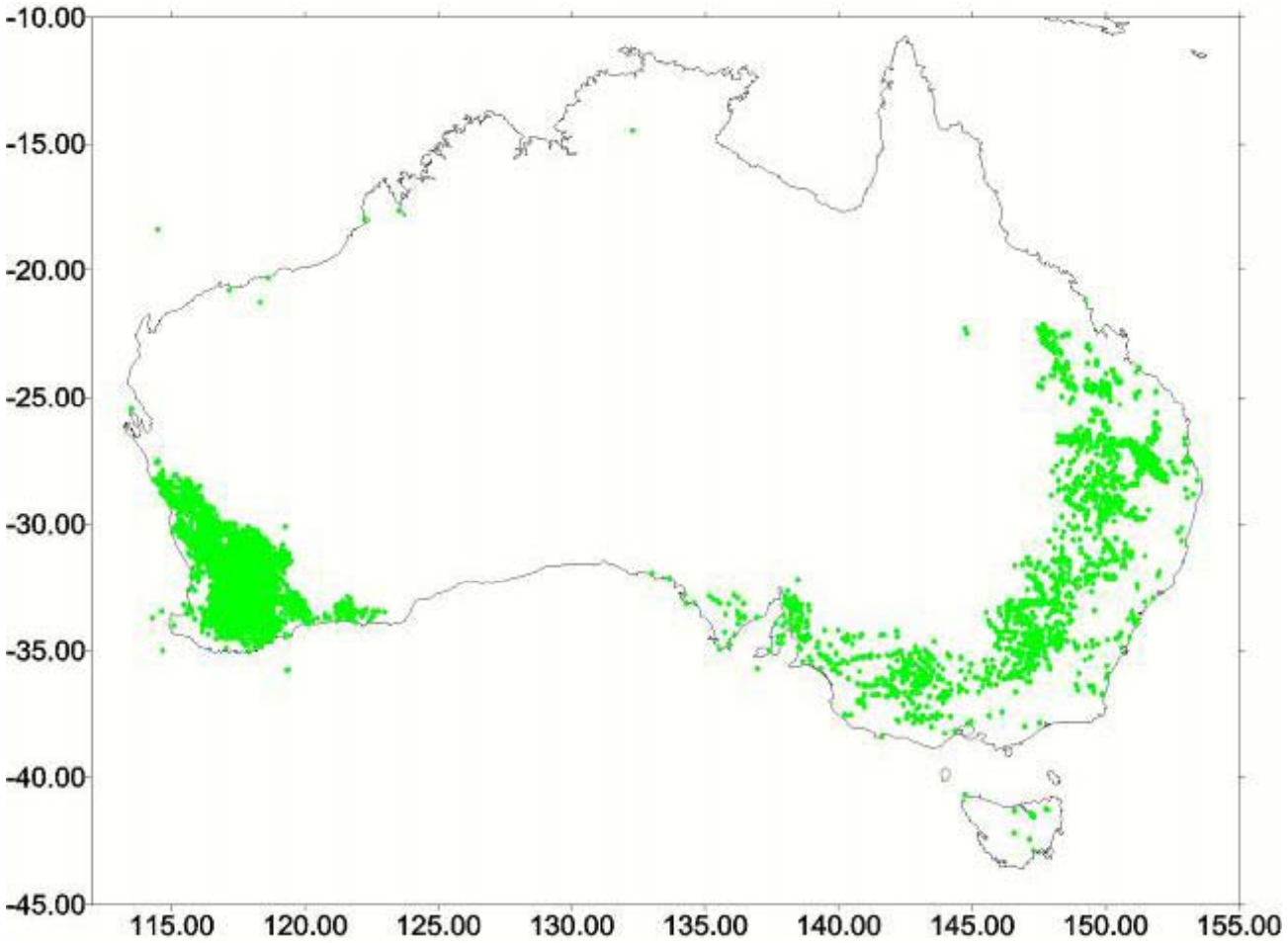
# Greater demands on industry

***more regulations***
***wider scope***
***boosted enforcement***
***greater penalties***

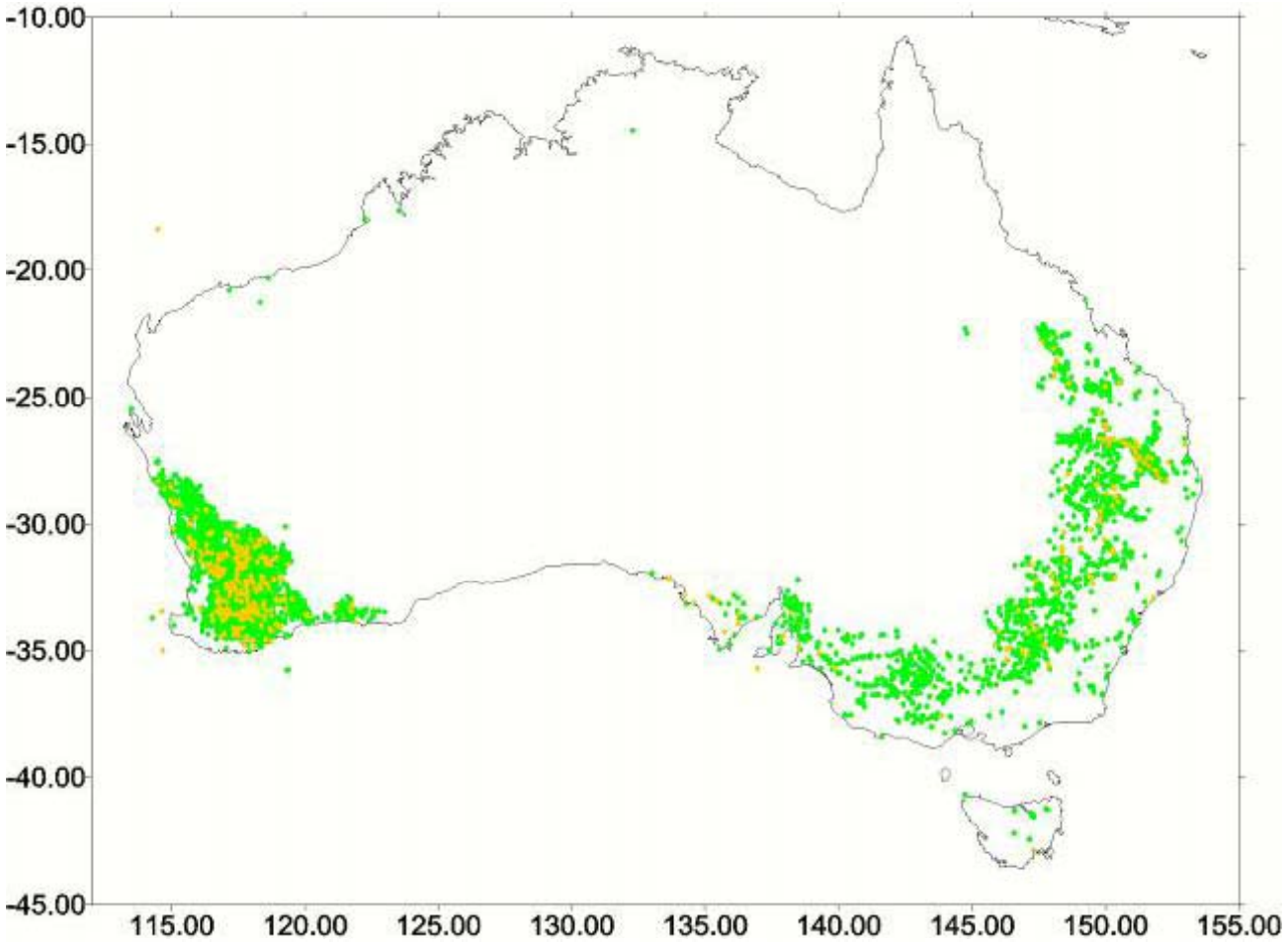


**food must be safe**
***and***
**industry must demonstrate it's safe**

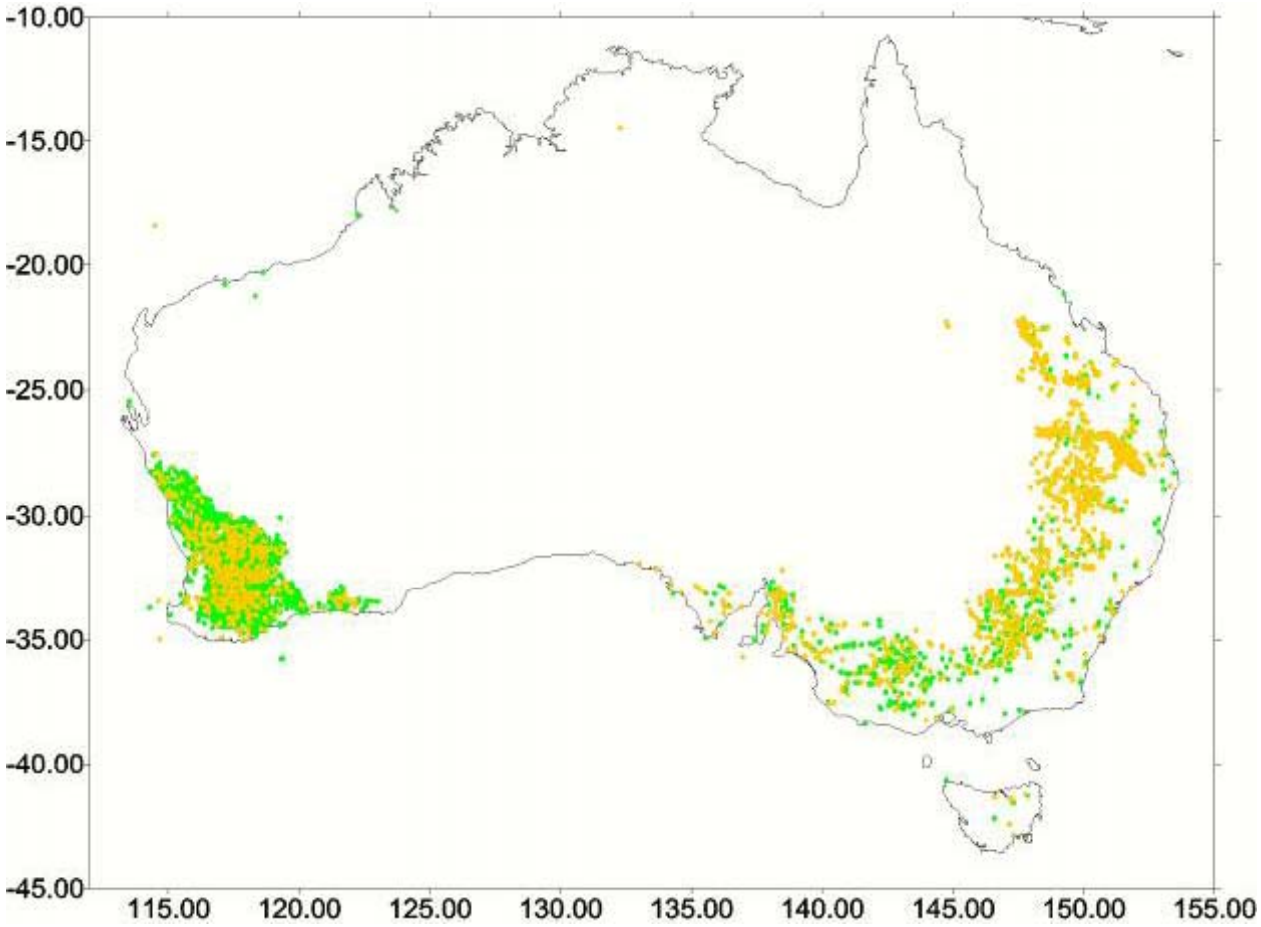
# Sites sampled over last 25 years



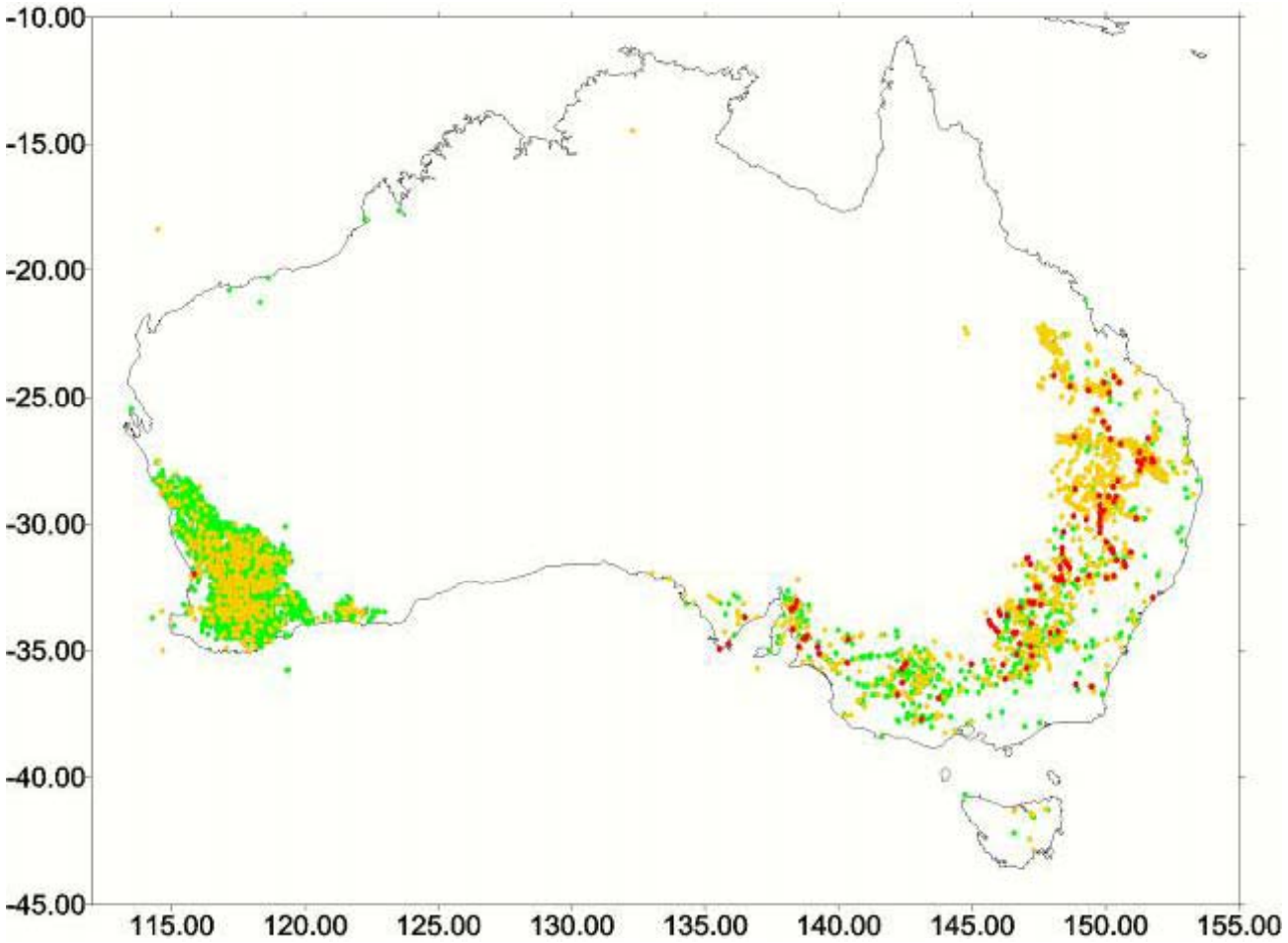
# Distribution of weak resistance – 1998



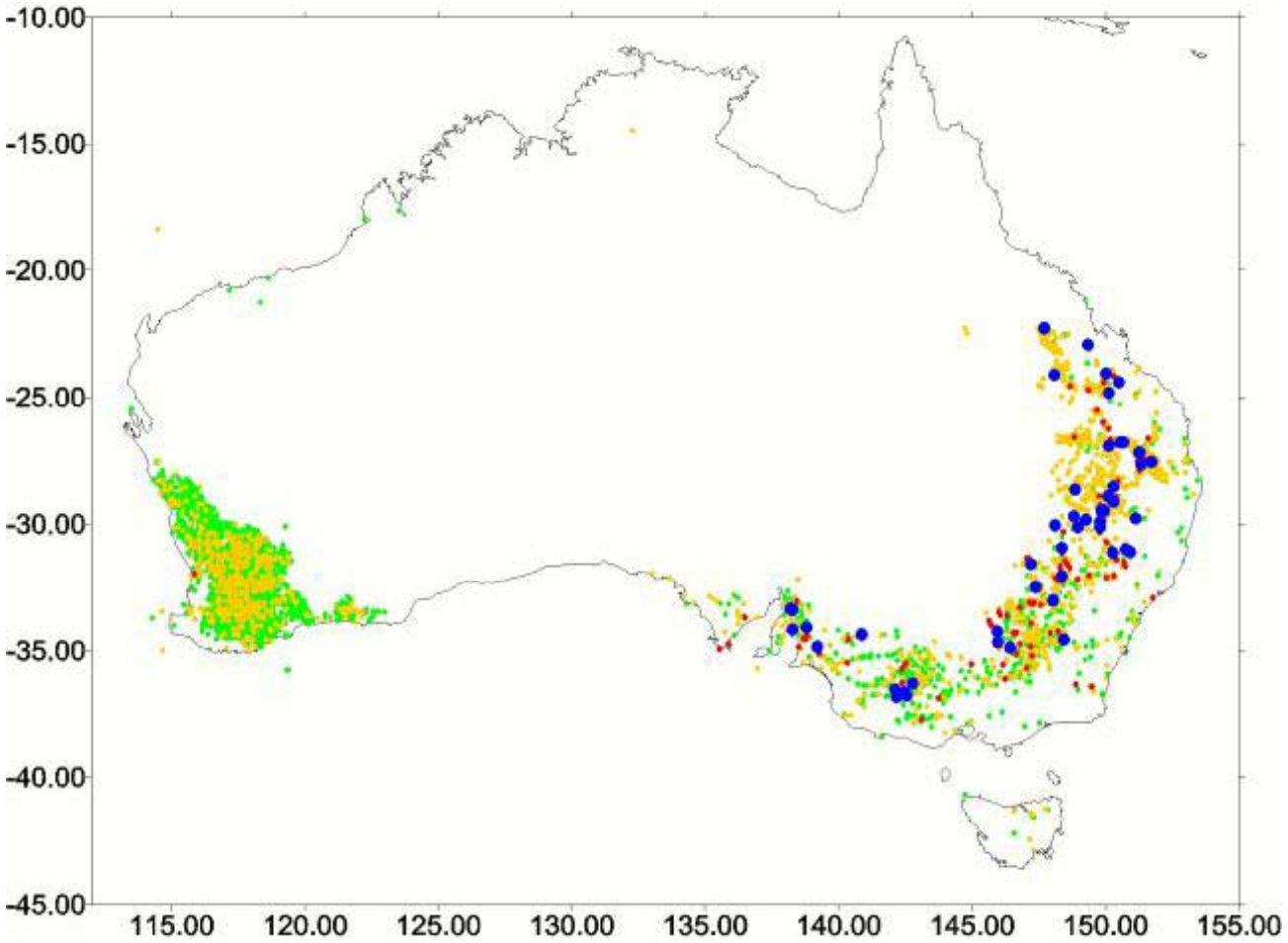
# Distribution of weak resistance – 2008



# Distribution of strong resistance – 2003

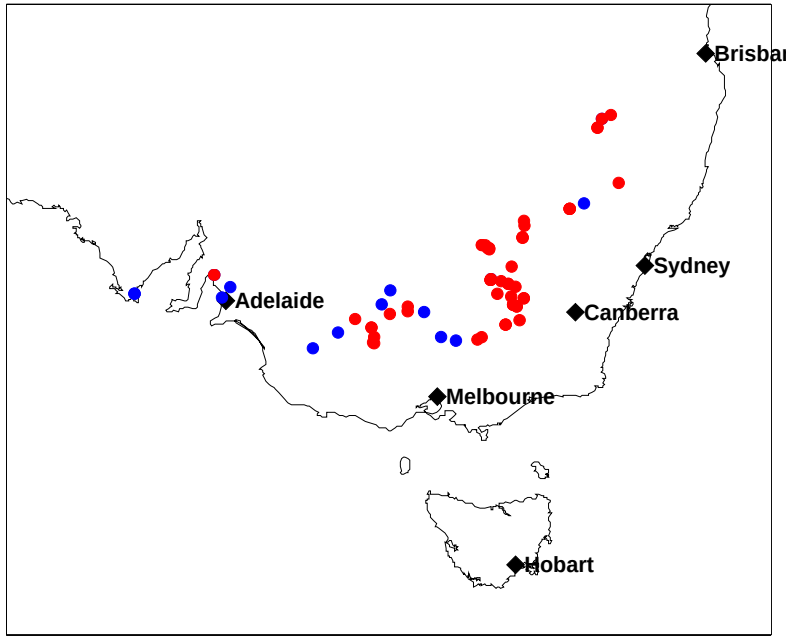


# Distribution of very strong resistance – 2008



# Protectants – Southern Region

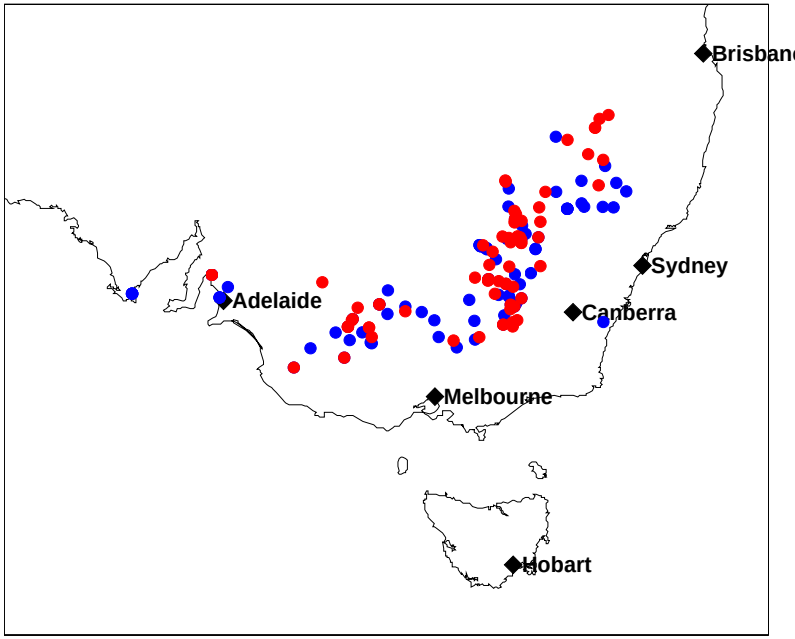
## Methoprene




78% resistance

44% resistant to 6x label rate

## Deltamethrin




47% resistance

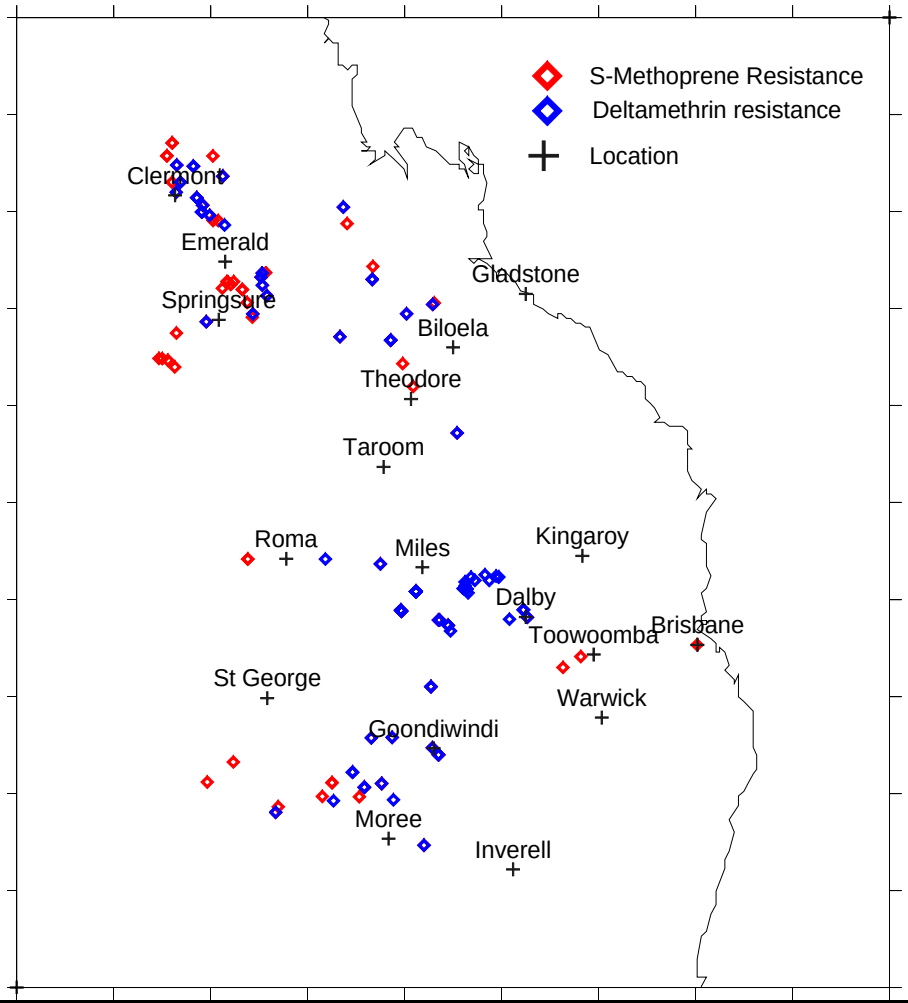
# Protectants – Northern Region

## Methoprene resistance

- 82% on farms
- 93% in central storage

## Deltamethrin resistance

- 63% on farm
- 79% in central storage



# Strong resistance phenotype happens when…

- 80% frequency of Weak R
- under-dosing/low concentrations
- repeat fumigations - 6




# What does this mean for the grain industry?

- risk of losing phosphine and protectants is real
- the life of phosphine and protectants is limited
- marketing strategies may need to change

# What can we do about resistance?

- **Develop replacements**
  - protectants: Spinosad……. ?
  - phosphine - no practical alternative

    (CO2, sulfuryl fluoride, ethyl formate, COS, cyanide)
- **Monitor and research – understand**
  - doesn't solve problem
- **Manage resistance**
  - plan/strategy/code of practice
  - needs all of industry involved

# Resistance management strategy

*Options?*

- **Reduce selection pressure**
  - limit number of fumigations
  - use non-chemical alternatives
    - cooling and hygiene
- **Destroy resistant insects**
  - make every fumigation count
    - sealed silos/high rates
  - alternative chemicals
    - fumigants
    - protectants

# Resistance management strategy – major components

1. Strict **hygiene**, **cool** grain
2. **Limit $PH_3$ fumigations: 3**/parcel of grain
3. **Sealed silos**
4. Use recommended concentration and exposure period for Strong-R insects
   - **monitor gas concentrations**
5. Use **alternative** fumigant /protectant
6. **Fumigation decisions based on monitoring insect populations** (stage 2)

# Cooperative Research Centre for National Plant Biosecurity Ltd

**Thank you**