What part will crop pollination play in future agriculture?

Saul Cunningham

Fenner School of Environment & Society

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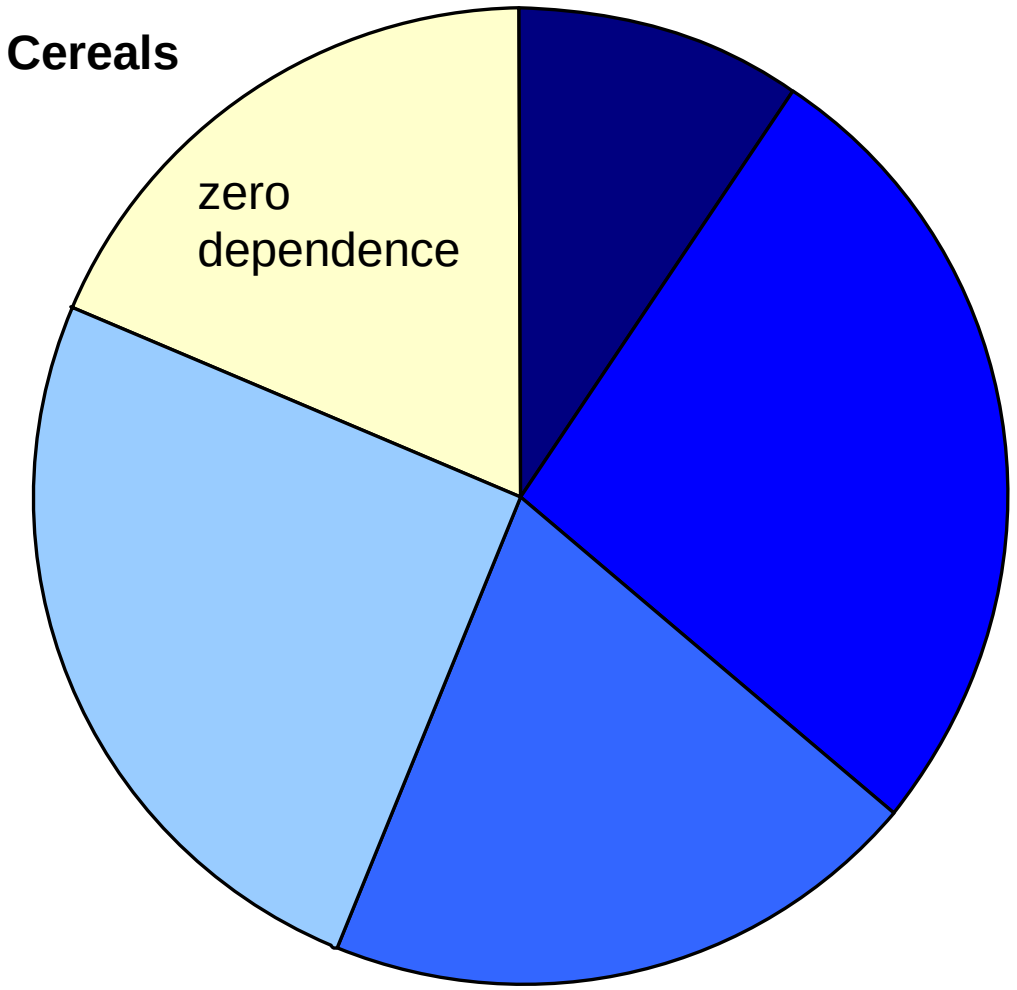
What proportion of crops need pollinators?

Data: survey of 75 top food crops in terms of world trade



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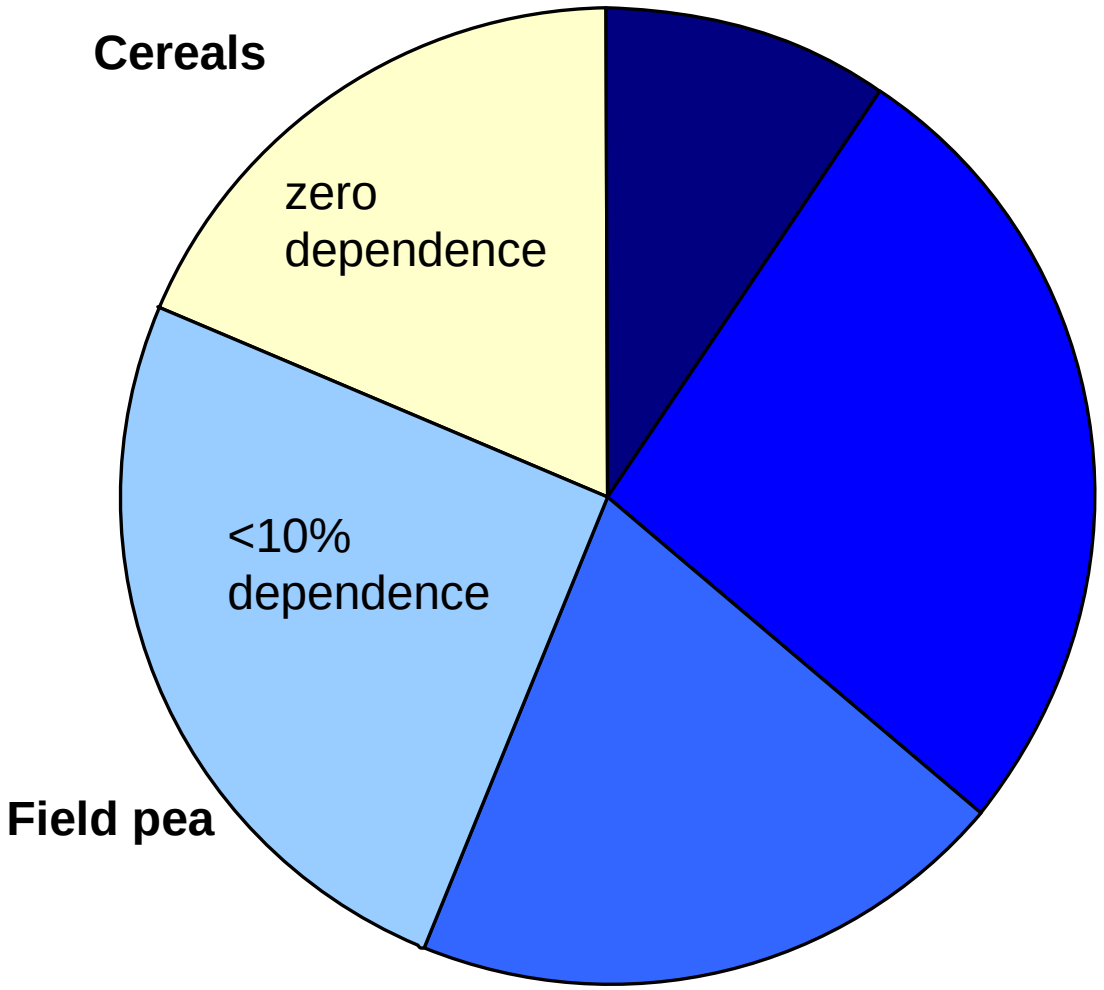

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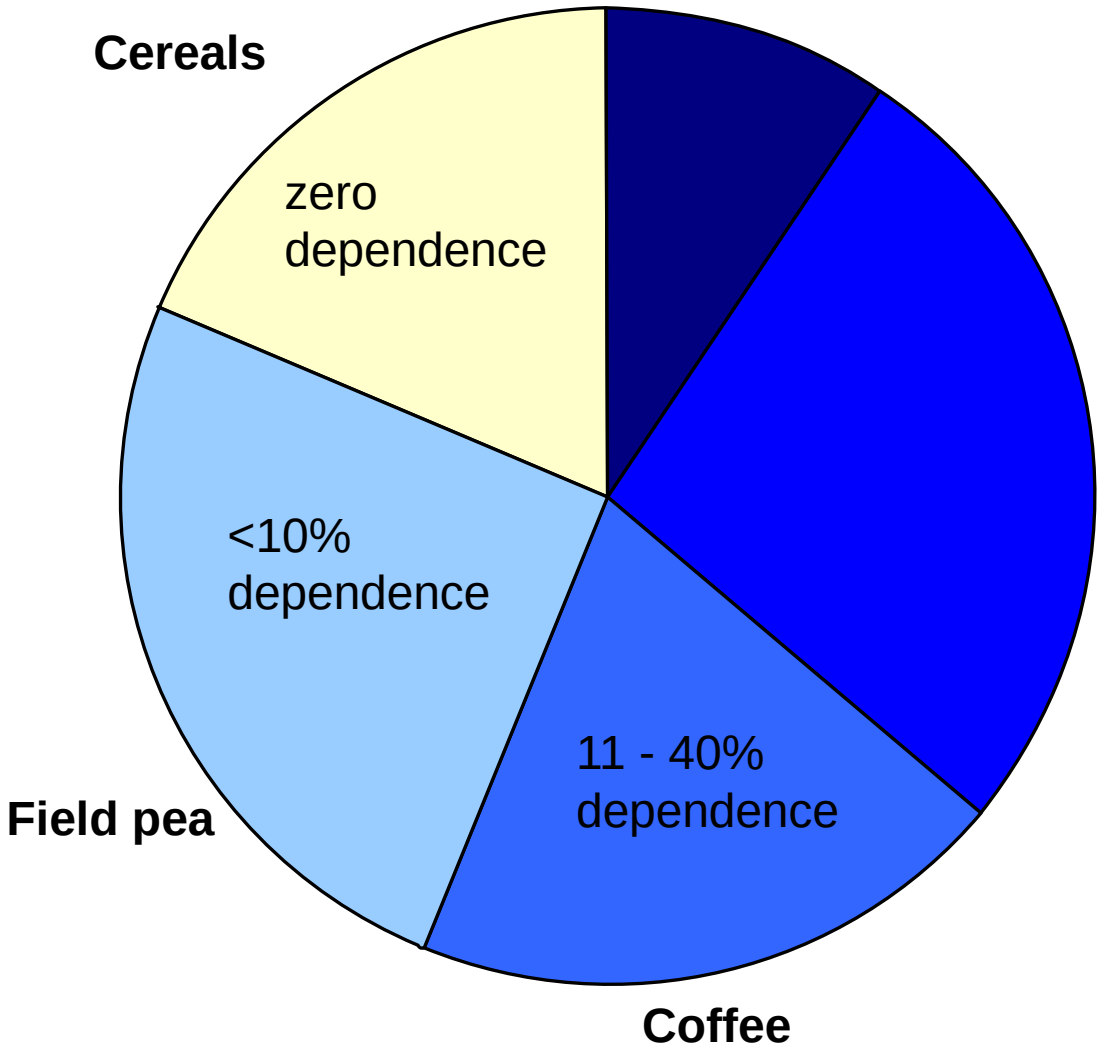

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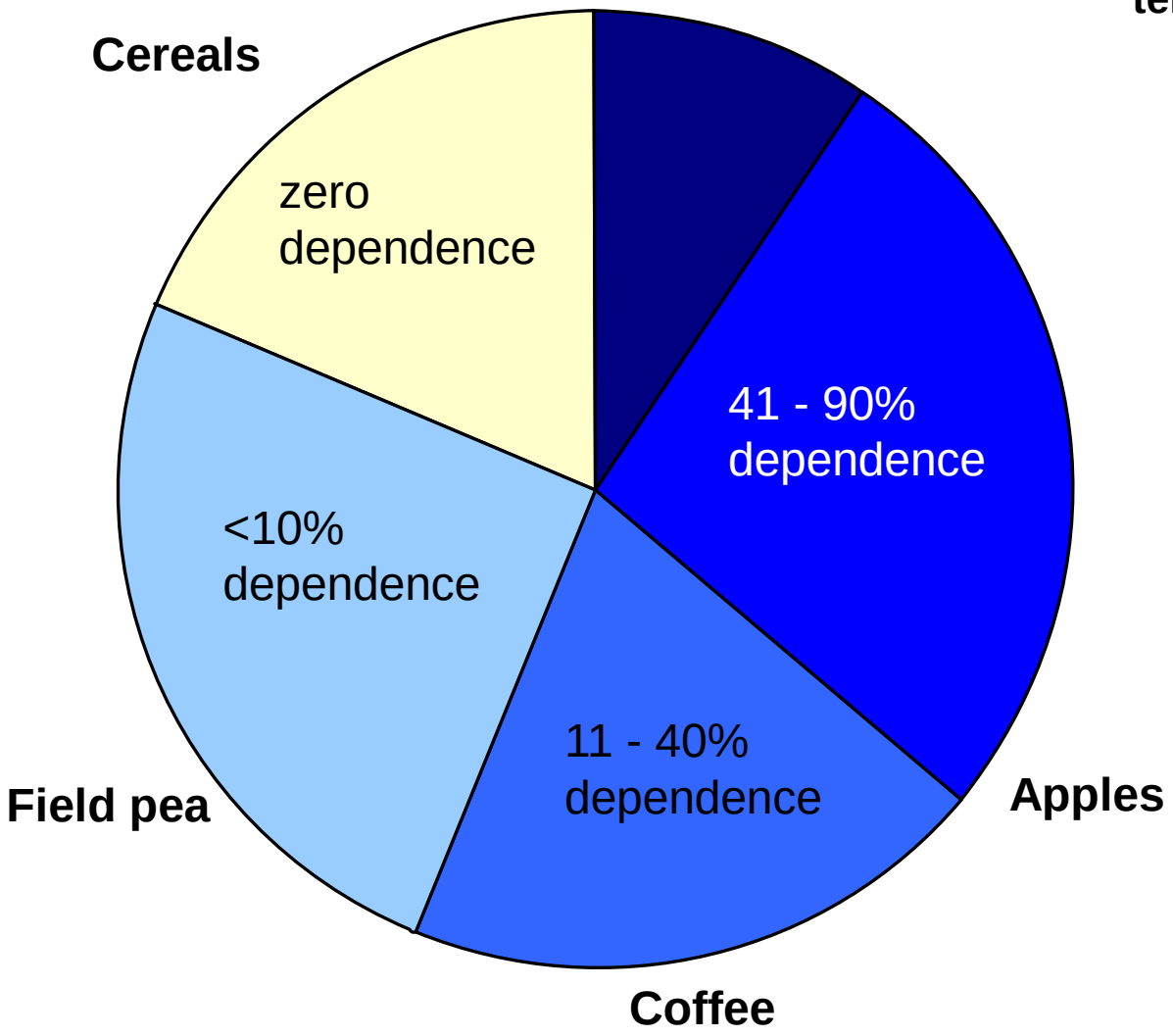

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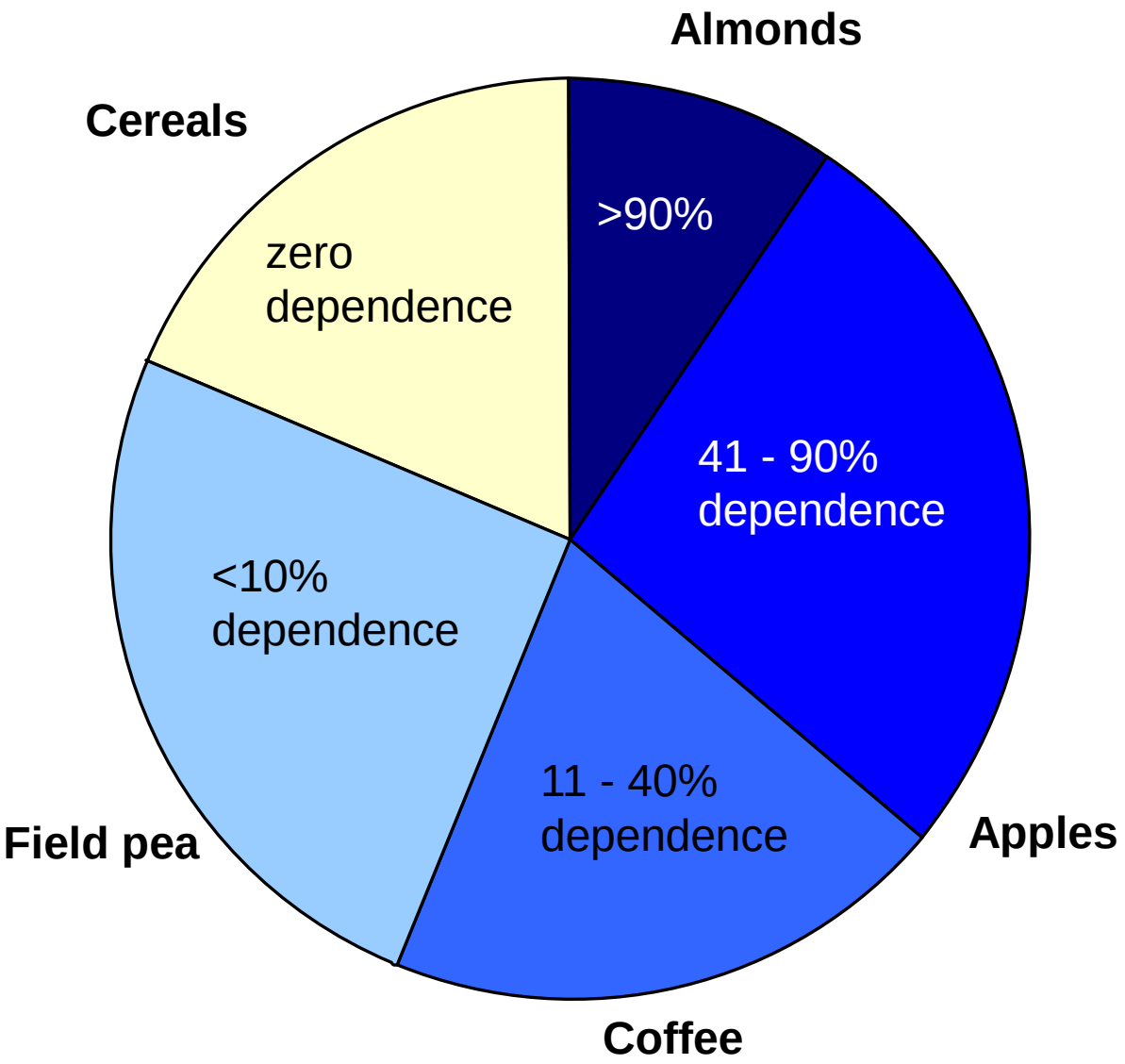
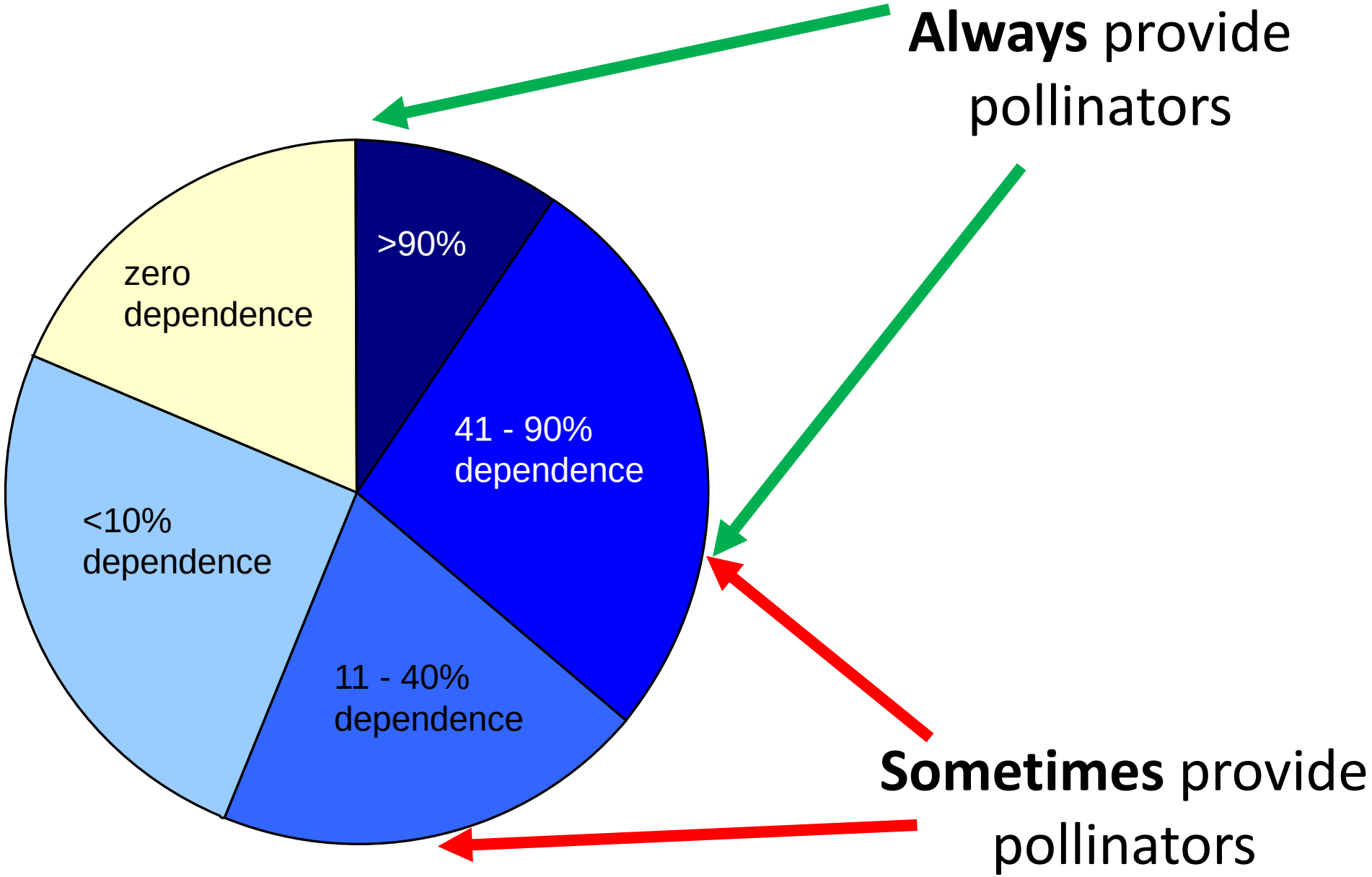


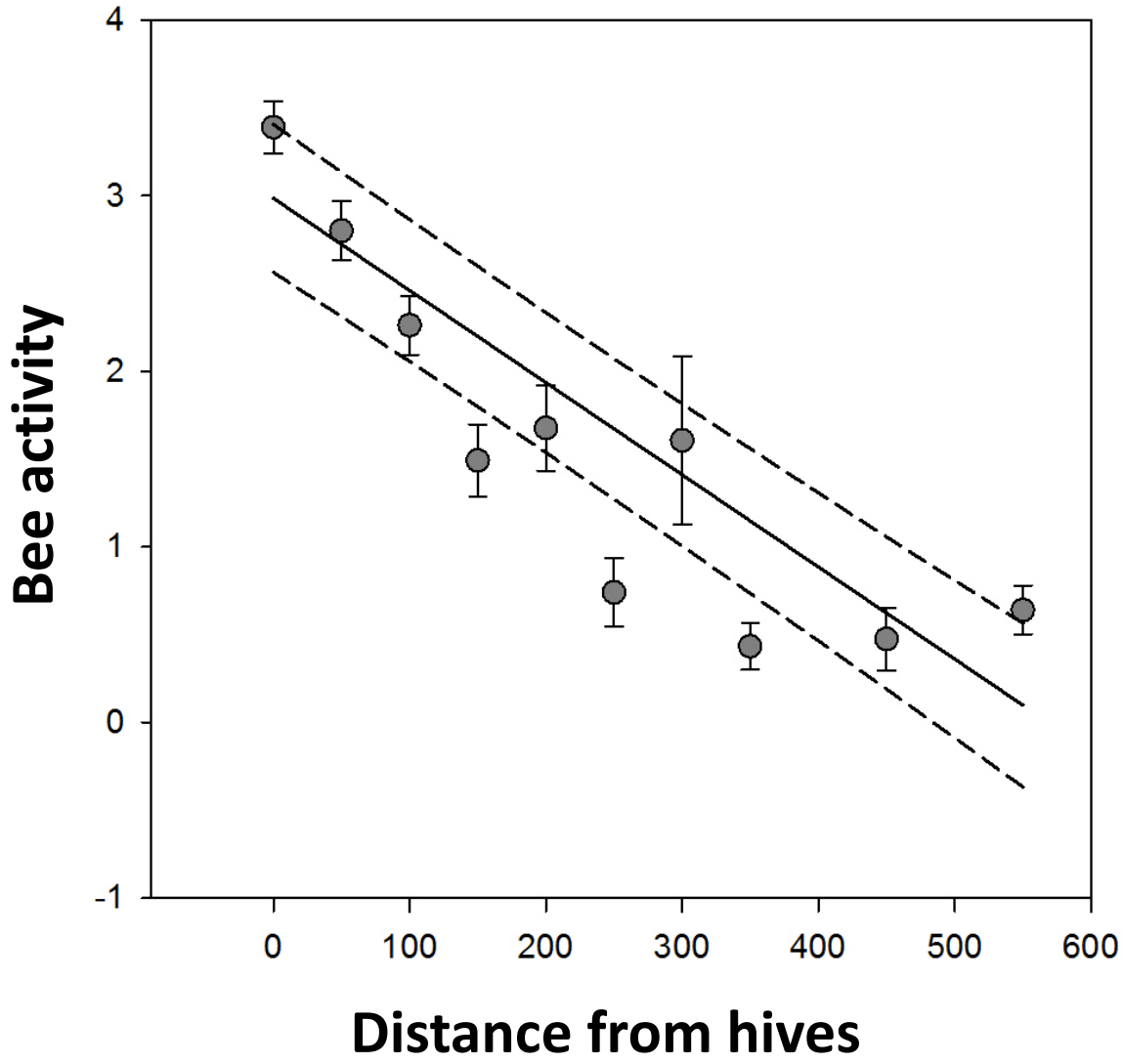
- Wide range of dependence
- 75% have some dependence
- Can depend on variety and environment
- Data is poor -- more recent studies have revised estimates for many crops, usually upwards


Always provide pollinators
>90%
41 - 90% dependence
11 - 40% dependence
<10% dependence
zero dependence
Sometimes provide pollinators

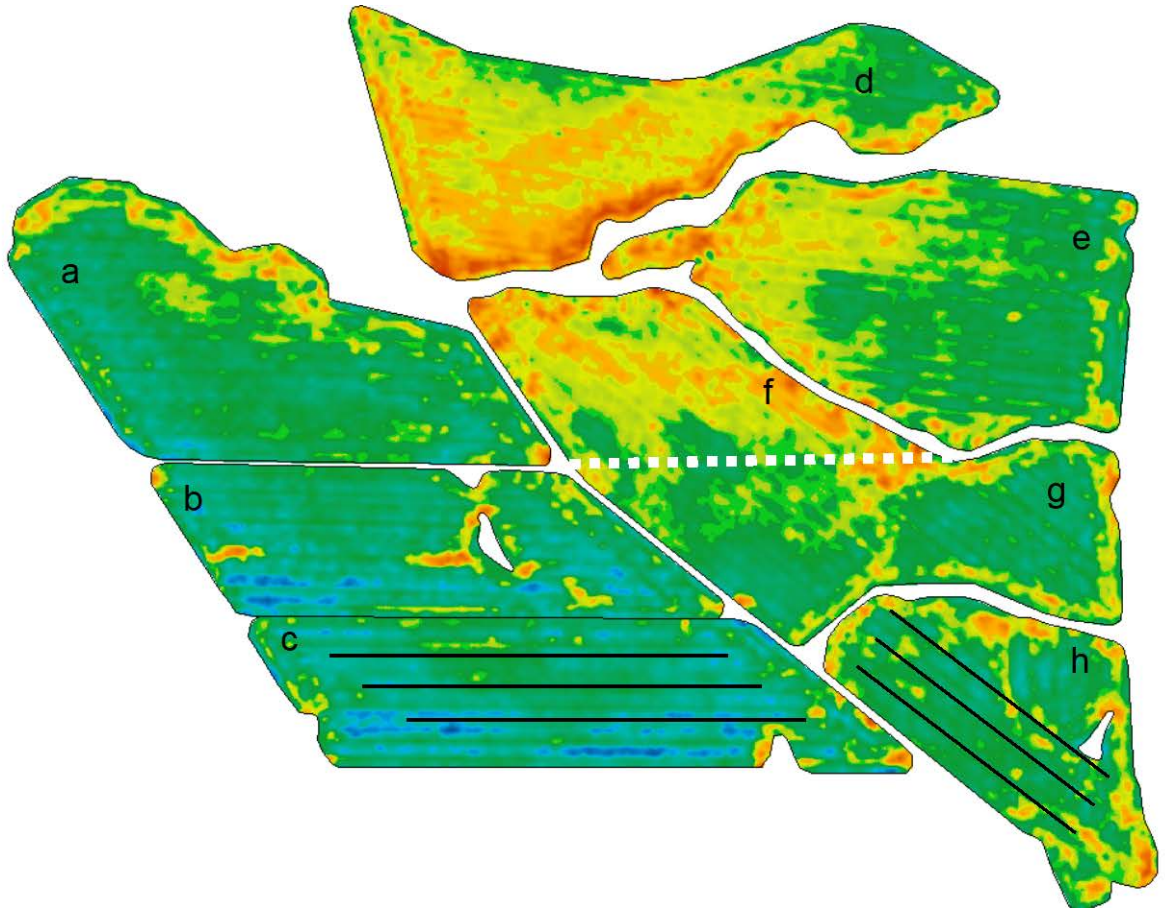
Faba beans – a “sometimes” crop

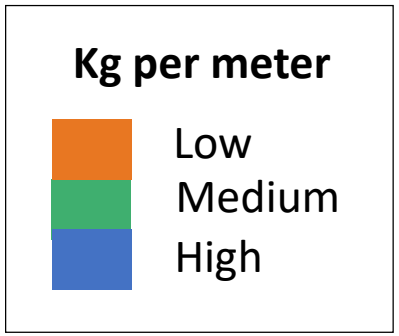
Cunningham et al 2013 ***Field Crops Research***


Danny Le Feuvre

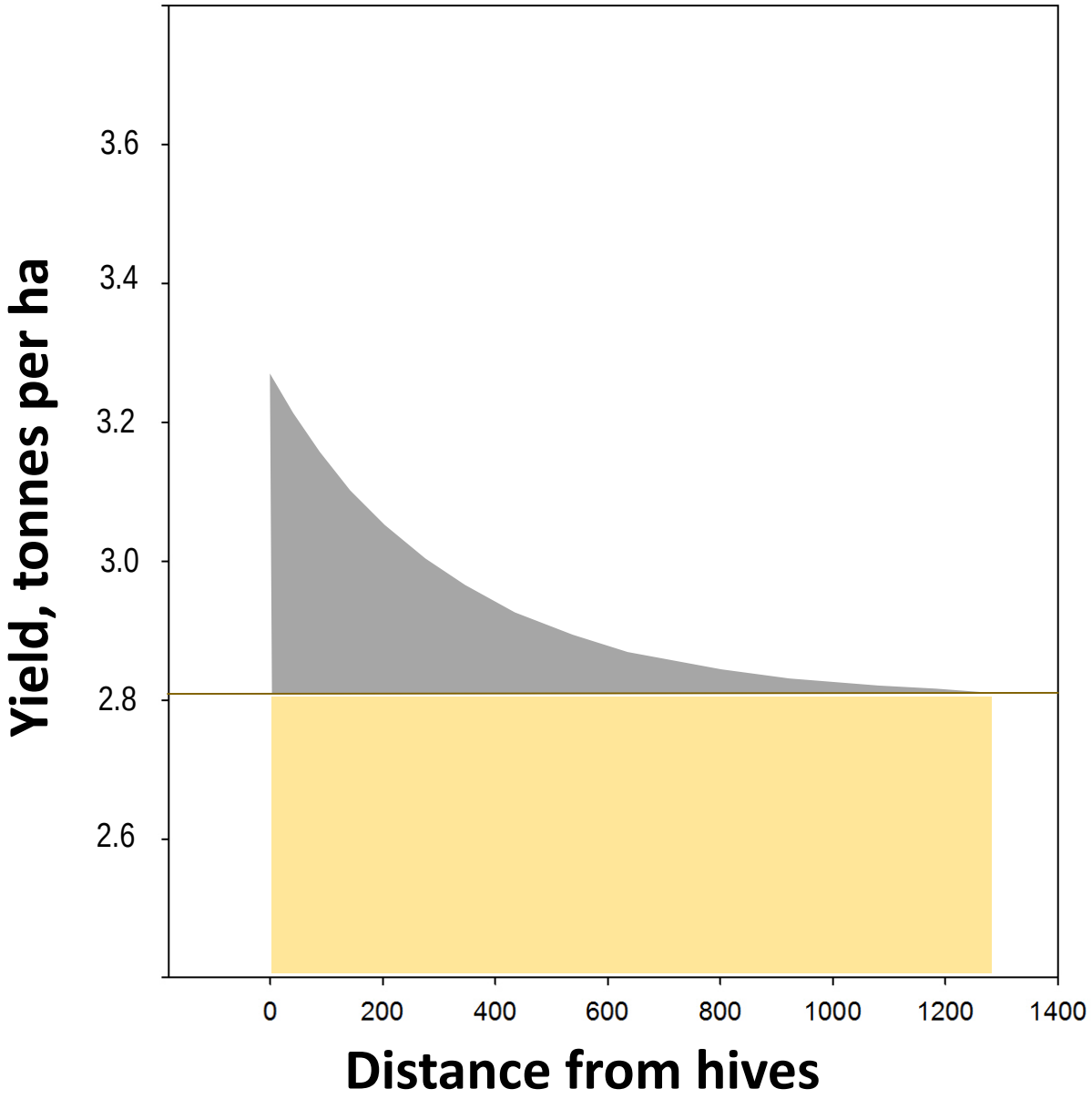

Bee activity
4
3
2
1
0
-1
0
100
200
300
400
500
600
Distance from hives

Yield mapping





- Black lines are bee placements
- Replication: 17 fields

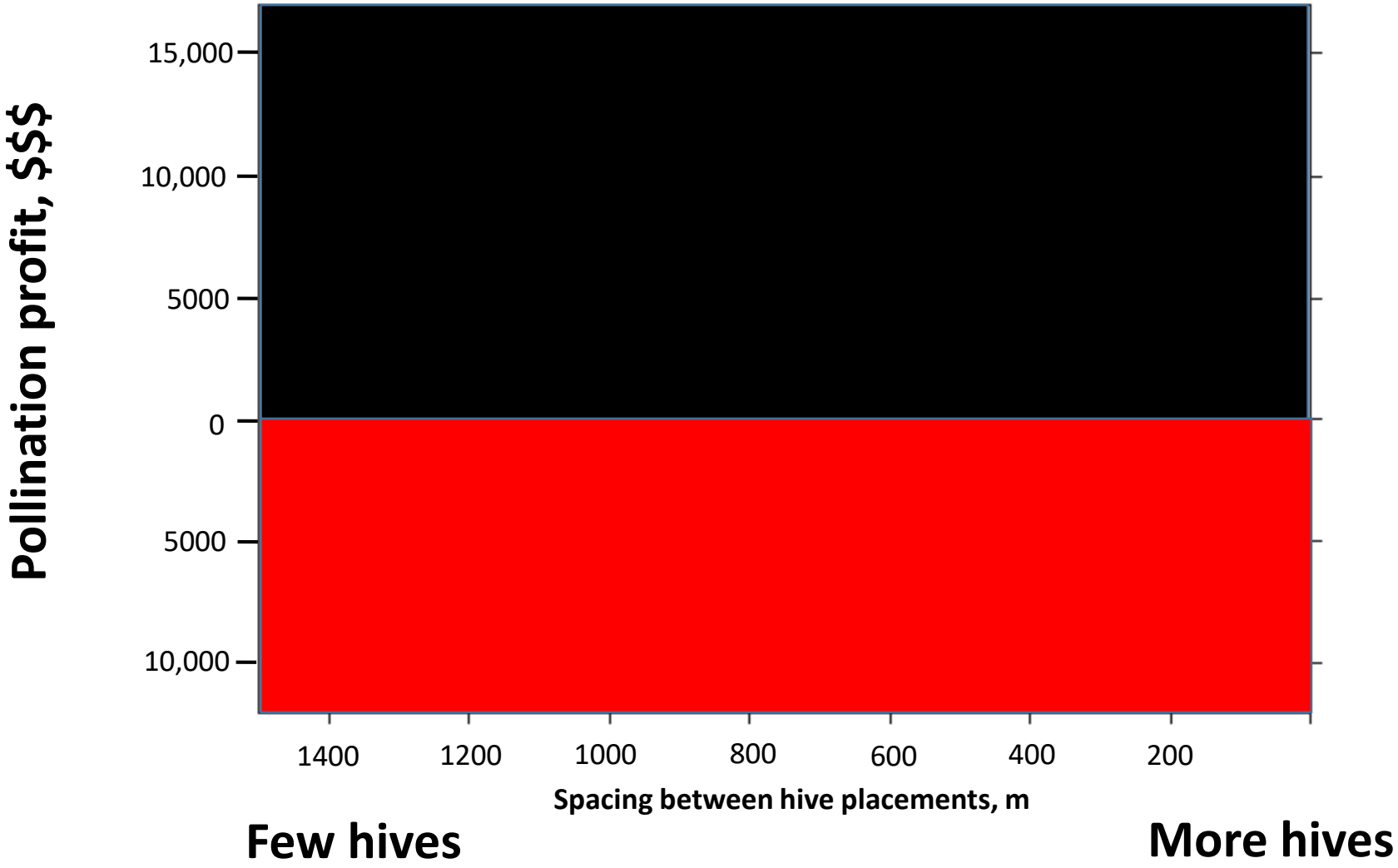


Bottom line

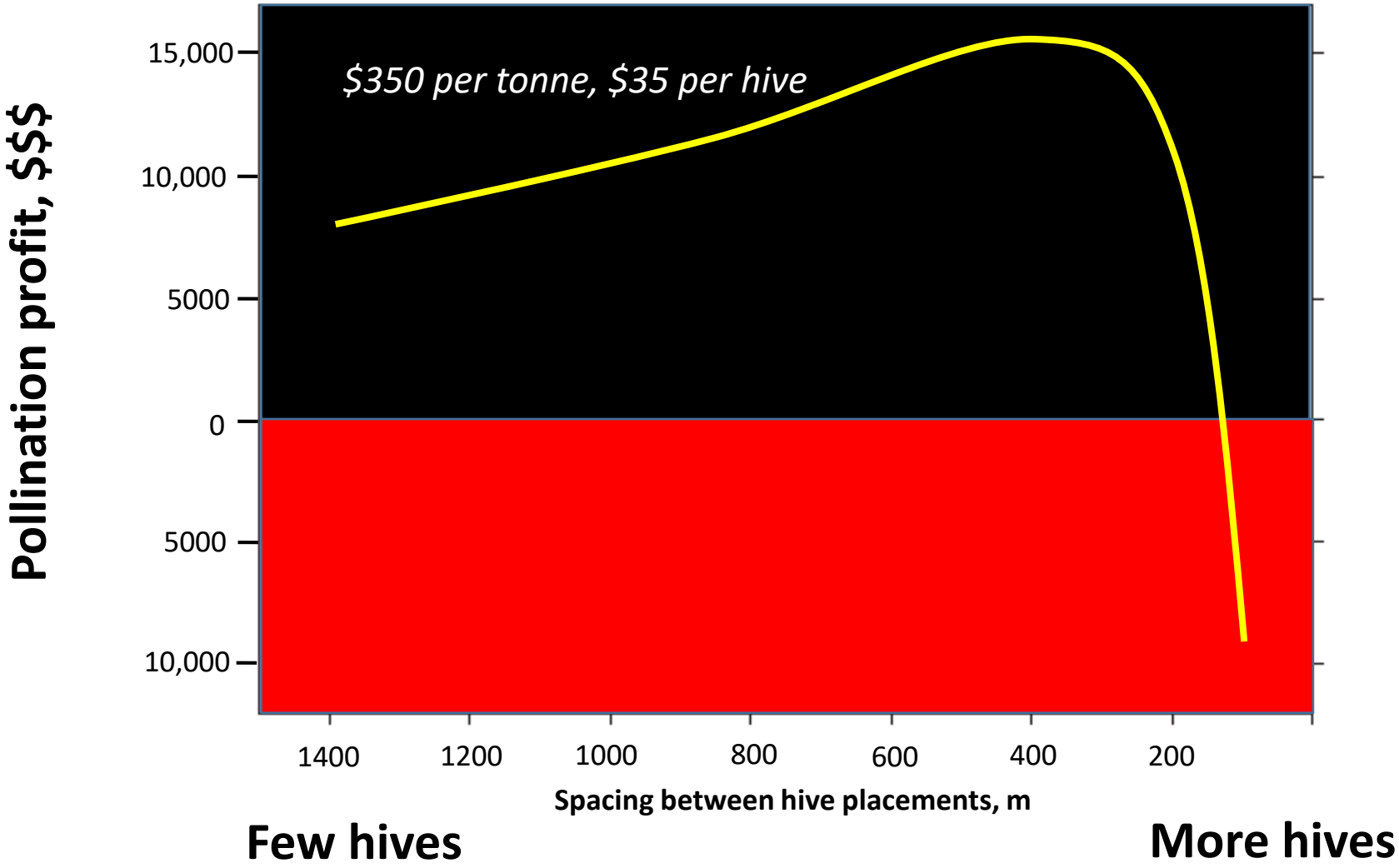
17% yield improvement

90% within 770m of hives

Cost/benefit analysis for 300 ha of Faba



Cost/benefit analysis for 300 ha of Faba



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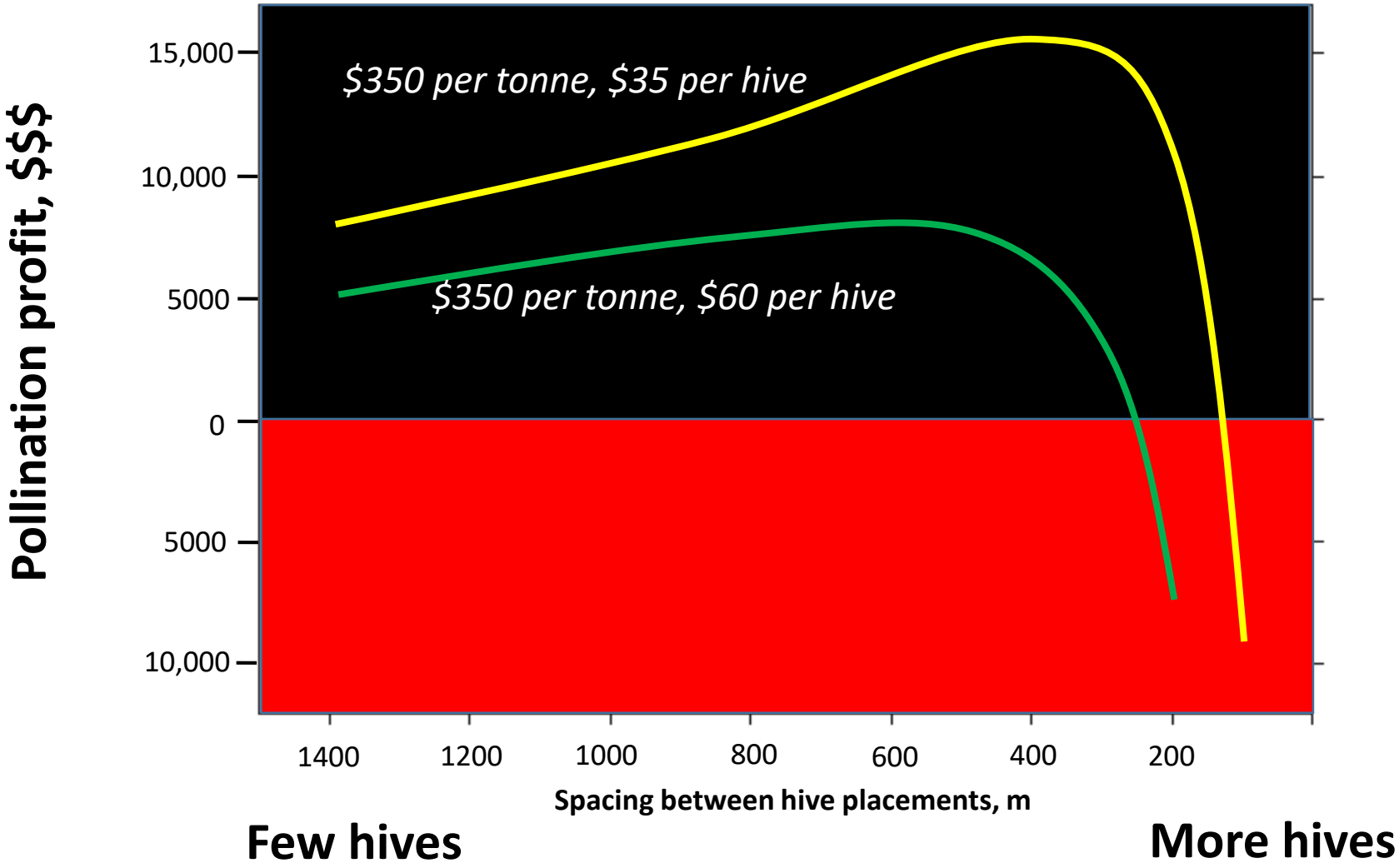

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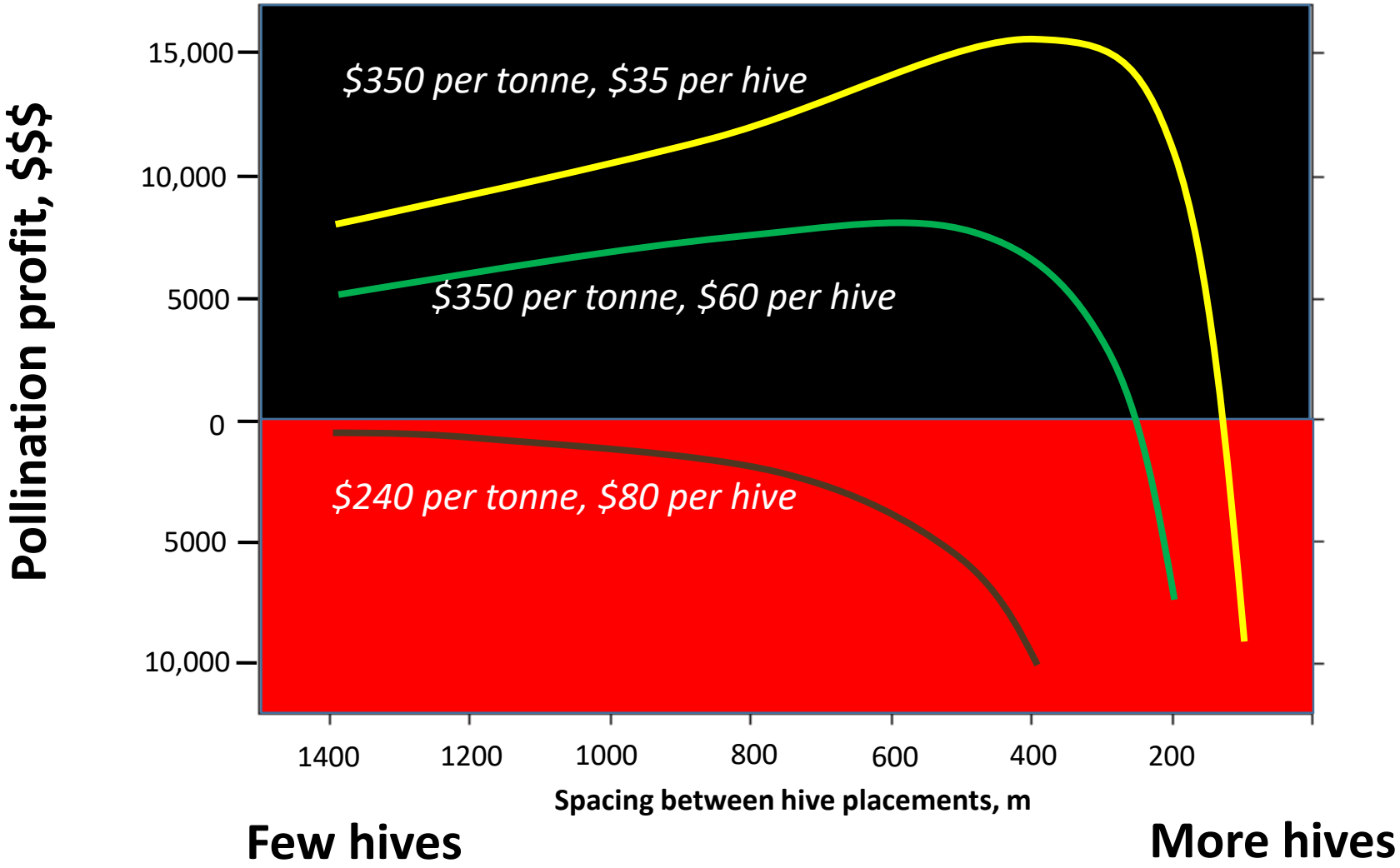


Message

- Clear evidence that putting honeybees on to faba beans increases yield
- But still not all growers do it!

  UNDERPOLLINATION

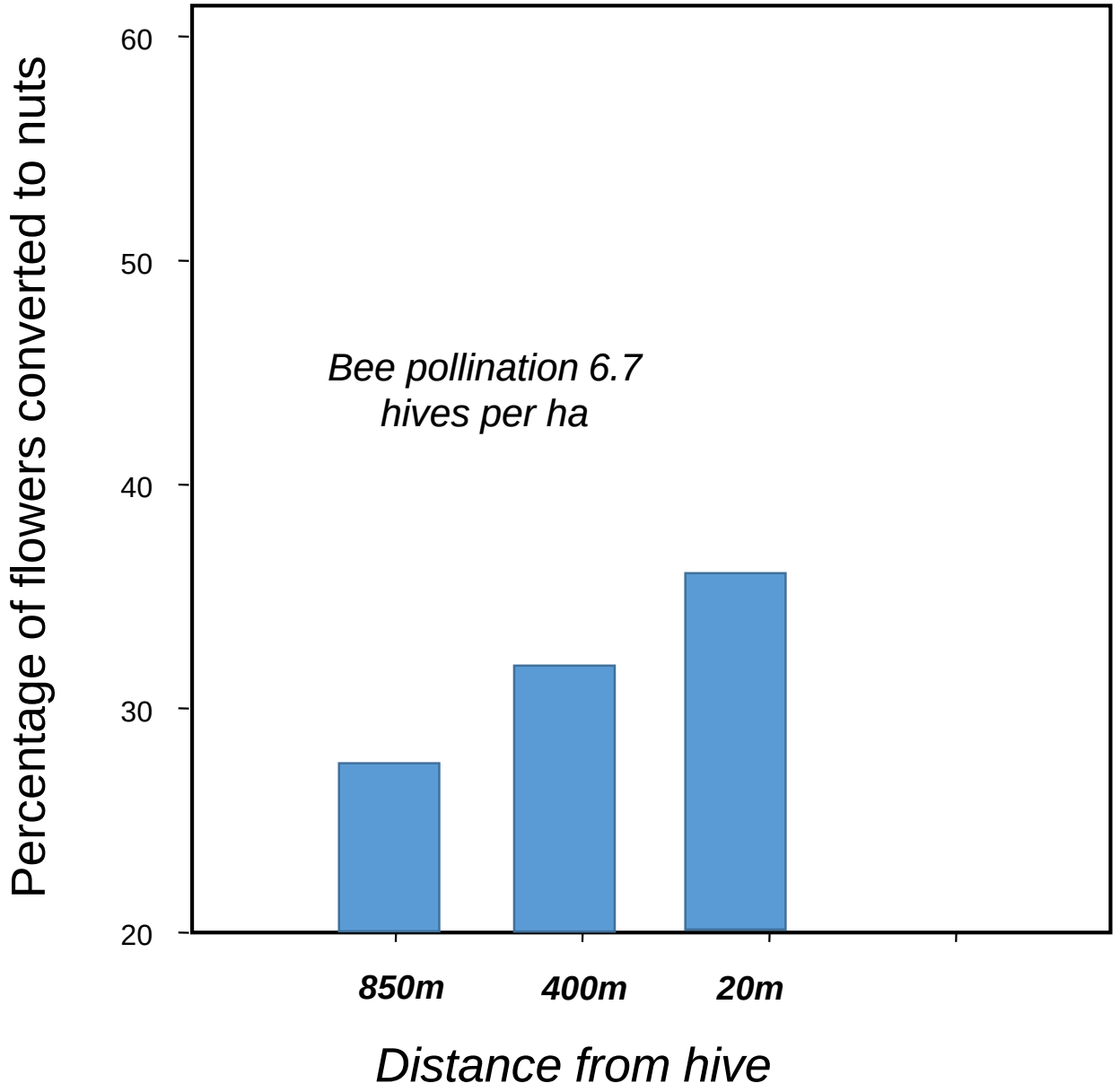
Almonds

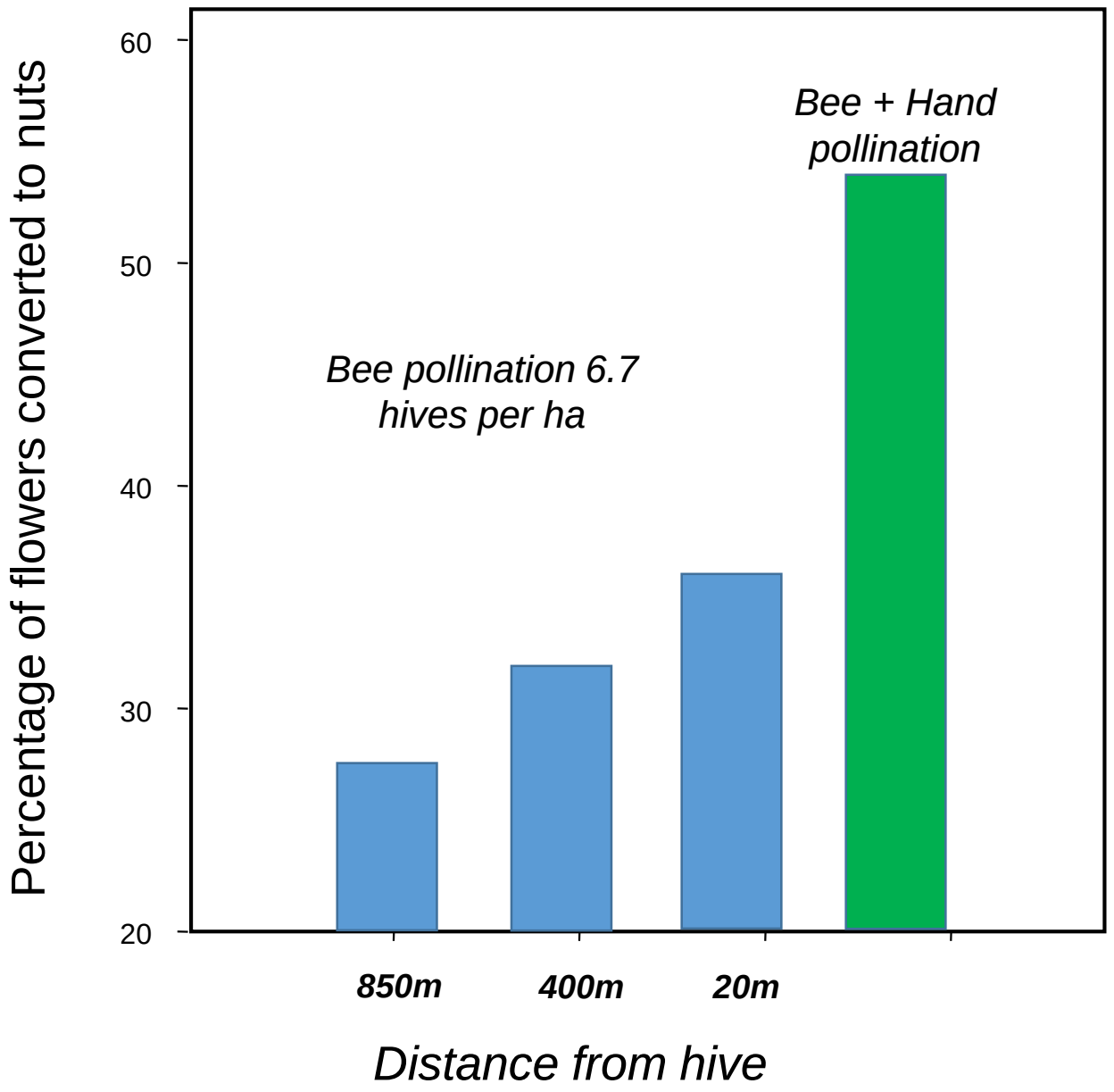
- An “always” crop
- Huge demand for honeybee hives

200k hives across eastern Australia

Maximum pollination

Standard pollination,
6.7 hives per ha


Percentage of flowers converted to nuts
60
50
40
30
20
Bee pollination 6.7
hives per ha
850m
400m
20m
Distance from hive

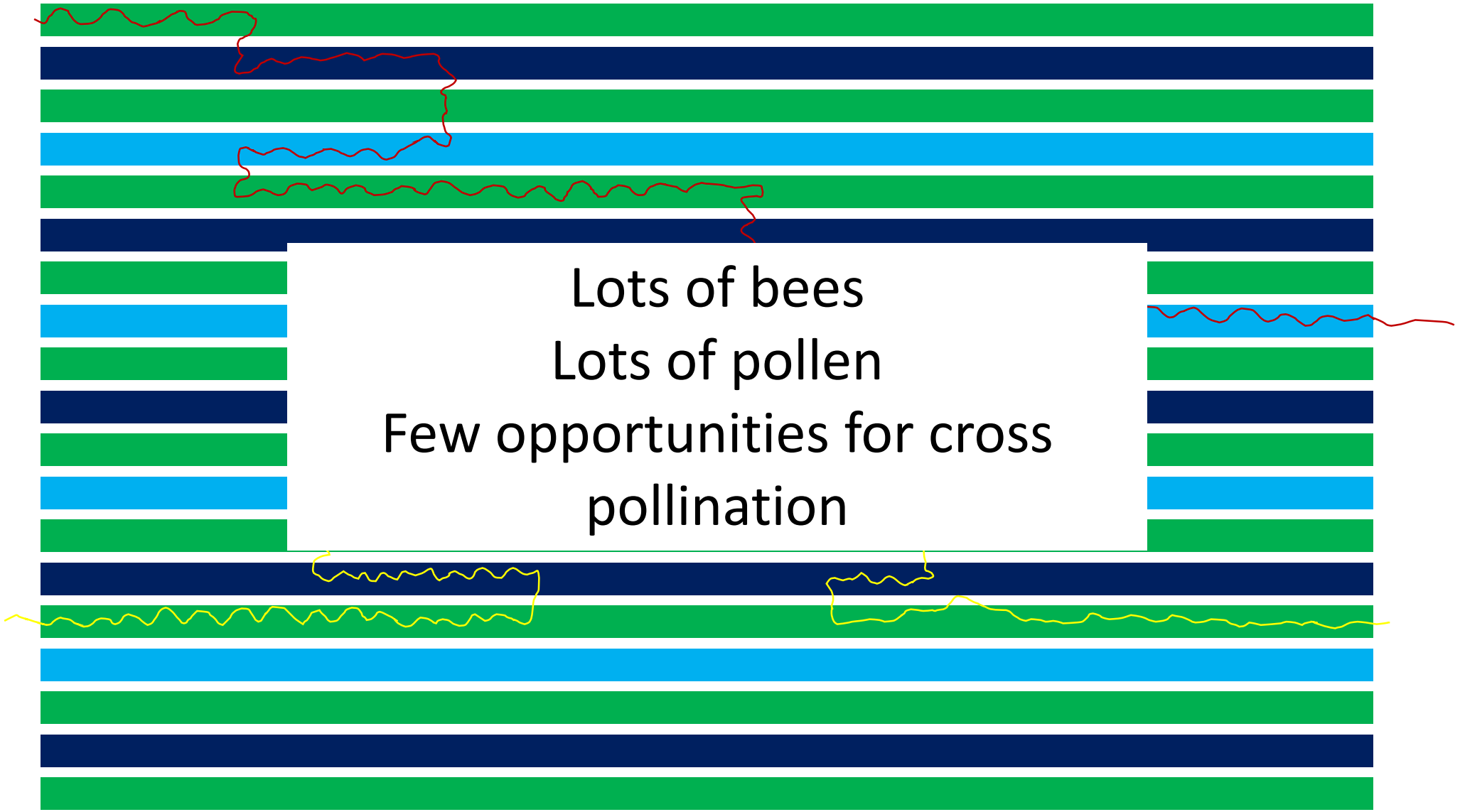

Percentage of flowers converted to nuts
60
50
40
30
20
Bee + Hand pollination
Bee pollination 6.7 hives per ha
850m
400m
20m
Distance from hive

Slides removed because data yet to be published

Message

- Even in the most intensively pollinated crop in Australia, we still see

UNDERPOLLINATION


Lots of bees
Lots of pollen
Few opportunities for cross pollination

Why underpollination?

- We've made systems that are hard to pollinate
- We've lost too many wild pollinators from our farming systems
- Growers are poorly advised on pollination needs (compared with other inputs, like water, fertilizer)
- Insecticides create a trust problem – eroding the relationship between growers and beekeepers

Removing bees from the system?

Regional Agenda | Artificial Intelligence and Robotics | Retail, Consumer Goods and Lifestyle | Environment and Natural Resource Security

Walmart has patented autonomous robot bees

Walmart has filed a patent for robot bees that will help pollinate in the same way as living bees.

Image: REUTERS/Jamal Saidi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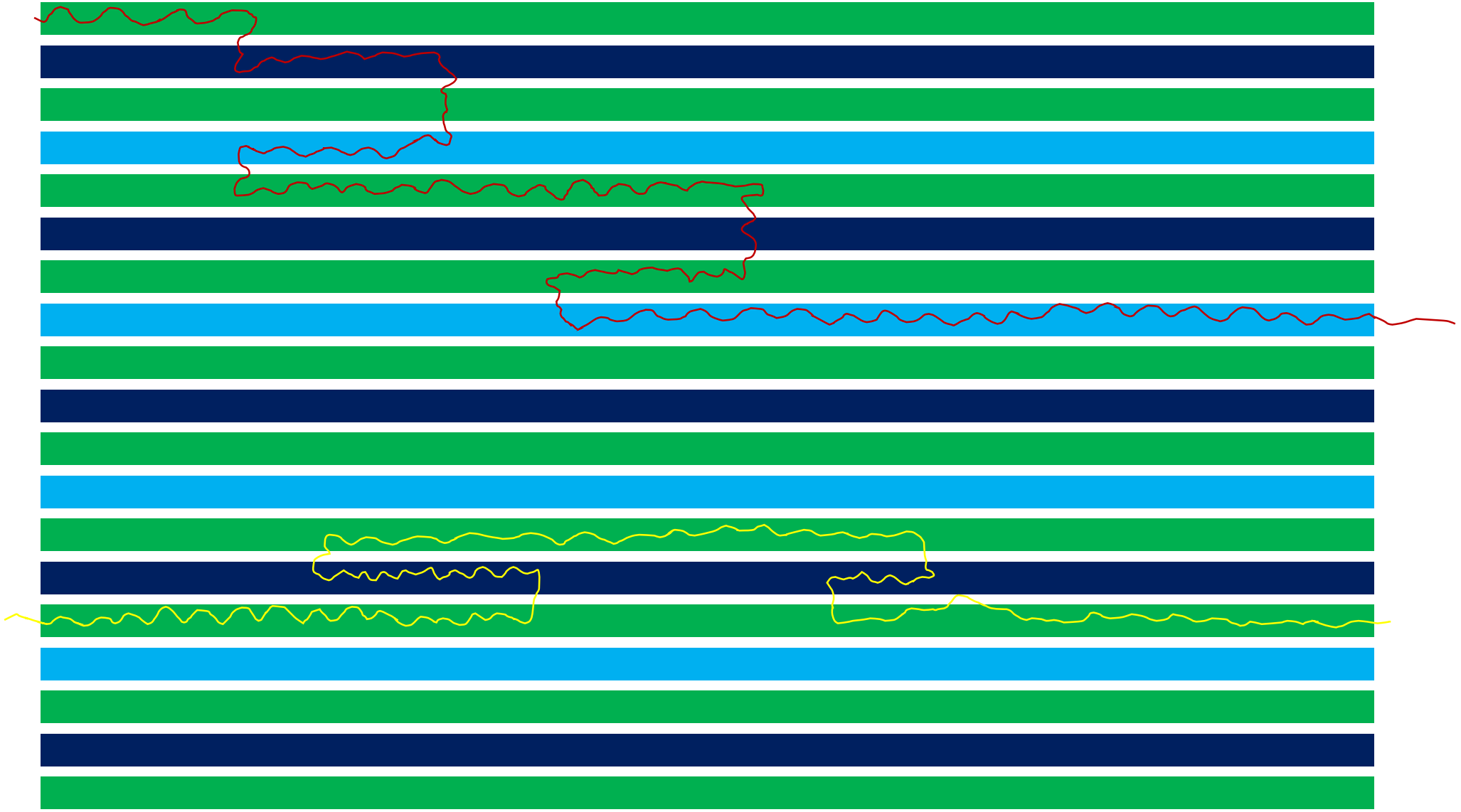
Breeding for self compatible varieties?



Self-fertile crops are nothing new

- Self compatibility reduces reliance on bees, but does not necessarily *eliminate* the role
- Self-compatible almonds have been around for decades (they just don’t taste as good!)
- Changing varieties is expensive, risky and takes time
- Breeders will only focus on eliminating need for pollinators if pollination becomes a top priority challenge for that crop

Summary

- Underpollination is common – even when positive cost/benefit
- Great potential for beekeepers to play a larger role in agriculture
- Requires better negotiation of the insecticide problem
- Technology can remove the need for bees in theory
- In practice, will depend on the price comparison: bees vs. technology
- Breeding for self fertilizing crops happens, but other traits are more economically important
- To be part of the future of agriculture, beekeepers need to find common ground with growers

Thanks John Evans, Mick Neave, Joel Armstrong, Danny Le Feuvre, Alice Fournier, Sarina Macfadyen

Australian National University

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Department of Agriculture and Water Resources

Horticulture Innovation Australia

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