

Importance of bee diversity for food systems

Marika Mänd

Estonian University of Life Sciences



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Animal pollination supports biodiversity

- Pollination is the process by which pollinators help plants to produce seeds and fruits by transporting pollen from one flower to another.
 - pollination is a key ecosystem service!
- The vast majority of plant species - almost 90%, - rely on pollinators
- High diversity of pollinator populations is a great indicator for overall health of an ecosystem
- The most common pollinators are insects, and among them, bees



Bees are the greatest pollinators

Honey bees



Bumble bees



Solitary bees



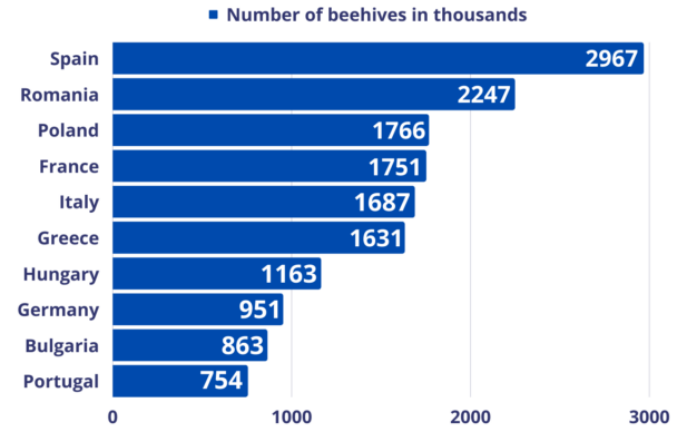
- Bees need huge amounts of nectar and pollen for living
- Bees might not forage exactly where the pollination service is needed
- Different bee species prefer to visit different flowers
- Plants often need repeated flower visits and different bee species to guarantee successful fruiting



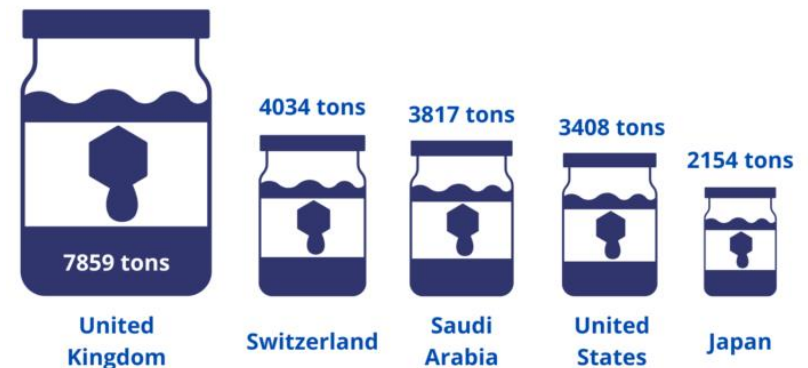
Honey bees contribute directly to food security

- One third of the world's food production depends on bees
- Additionally, honey bees provide high-quality food: honey, royal jelly, pollen
 - + other hive products to support human health: beeswax, propolis and honey bee venom
- Honey bees are the most widespread managed pollinators globally, and more than 80 million hives produce an estimated 1.6 million tons of honey annually.
- Beekeeping also provides an important source of income for many rural livelihoods.

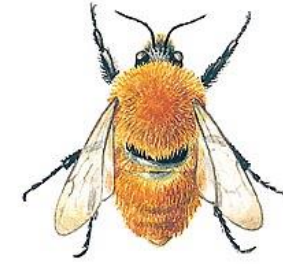
EU countries with the biggest number of beehives in 2020



Biggest honey importers from EU in 2020



Bumble bees as pollinators



- Bumble bees are very efficient pollinators and using them instead of honey bees represents a number of advantages:
 - They can carry more pollen
 - Due to their bigger size, bumble bees allow a better contact with stamens and pistils
 - They can work in precarious conditions, with cloudy sky, strong wind, rain or even at low temperatures between 5° and 10°
 - They can pollinate crops in greenhouses: tomato, pepper, eggplant, cucumber, strawberry



Domestication of bumble bees

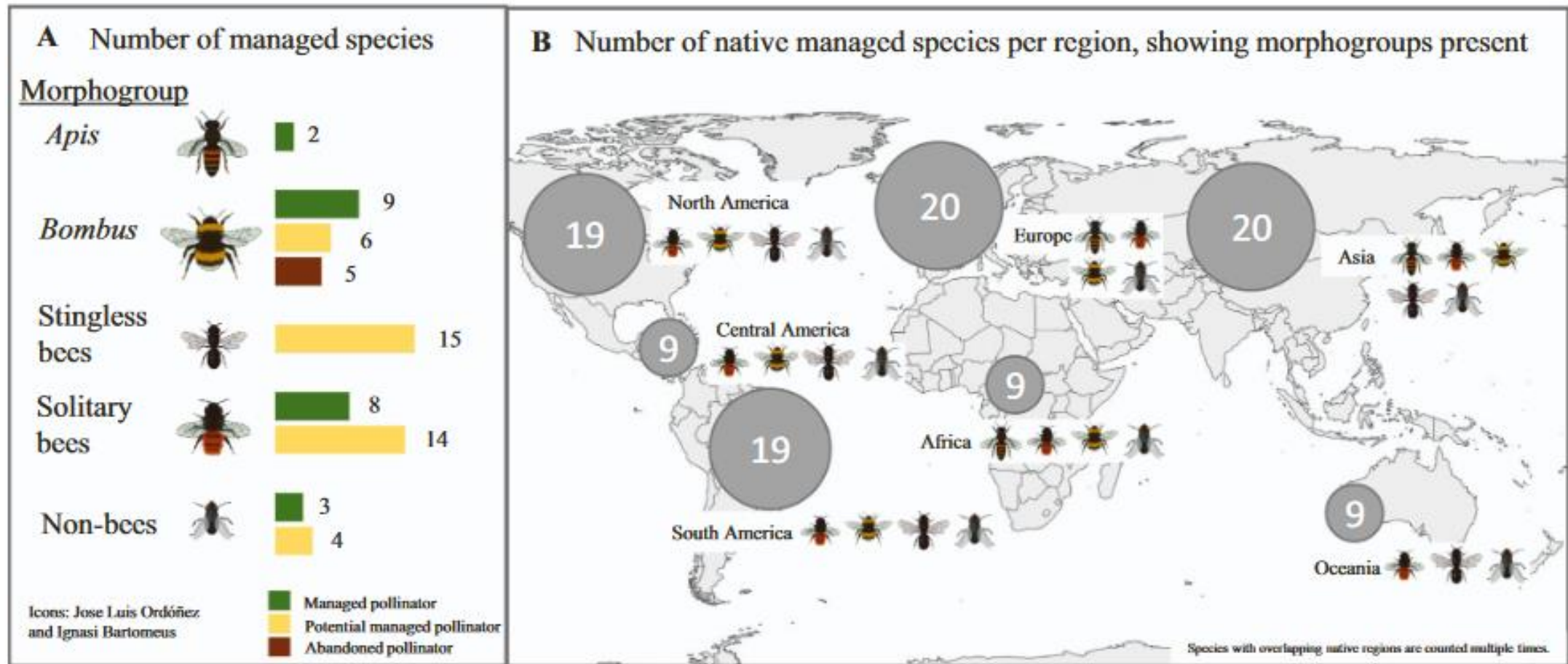
- Attempts to domesticate bumble bees started already in 1882
- Industrial rearing started in the Netherlands in 1980's with *B. terrestris*
- In North America *B. impatiens*



- Since then, non-*Apis* species, have become more widely used to pollinate fruits such as strawberries, raspberries, apples, pears, and vegetables



- There are 66 managed bee species used for crop pollination Osterman et al., 2021



Beevector technology: use of bees as vectors in precision biocontrol

- Technology, which combines the value of pollination with useful plant protection properties
- Insects can transport significant amounts of microbes attached to their body hairs
 - fungal and bacterial antagonists of plant diseases
 - insect pathogenic organisms (fungi, bacteria, viruses)
 - Most of the antagonist is transported into a flower visited by the insect, but some of it drops on leaves

Bee species used:

Honey bee, bumble bee *Bombus terrestris* and *B. impatiens*, and mason bees *Osmia bicornis* and *O. cornuta*



Photo: R. Karise

The strawberry

- Valuable and favoured berry crop worldwide
- Grey mould (*Botrytis* sp) – major problem in uncontrolled environment
 - Chemical treatment -RESIDUES
 - Microbial treatment -EXPENSIVE – wasting

The target site – **flower** (75% of infection occurs here!)



Photo: G Smagghe



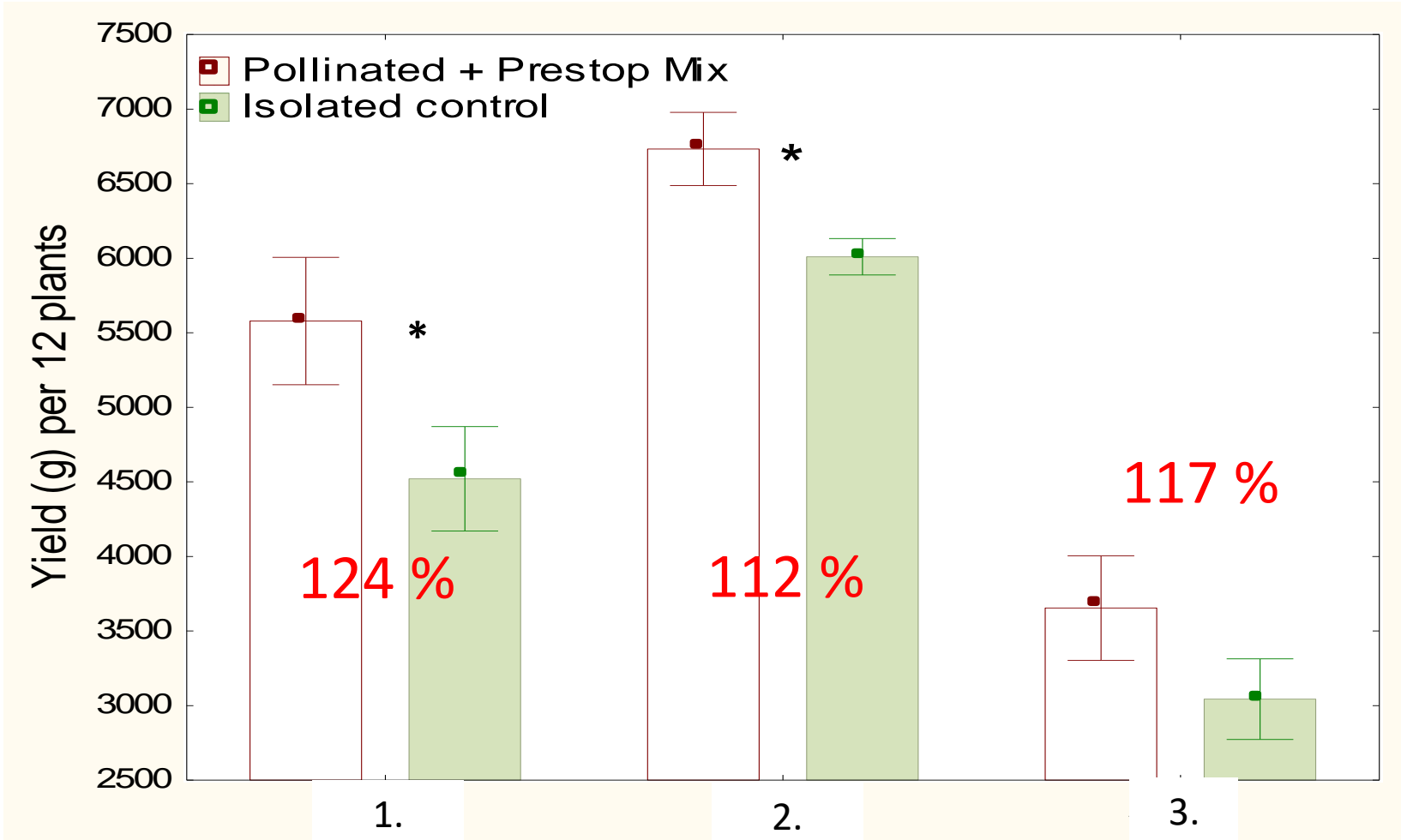
<http://www.vinetechequipment.com/Croplandsstrawberry.htm>

- Prestop Mix
- *Gliocladium catenulatum* – a fungus present in soils
 - Parasitizes on *Botrytis* and other plant pathogens
 - Competes for the space

Safe to non-target organisms, safe to environment
- Colonies of *Bombus terrestris* (BioPest) equipped with dispenser for biocontrol agent
- Bumble bees flying freely and carrying the BCA



The yield increases 10-25 % with bumble bees and Prestop-Mix



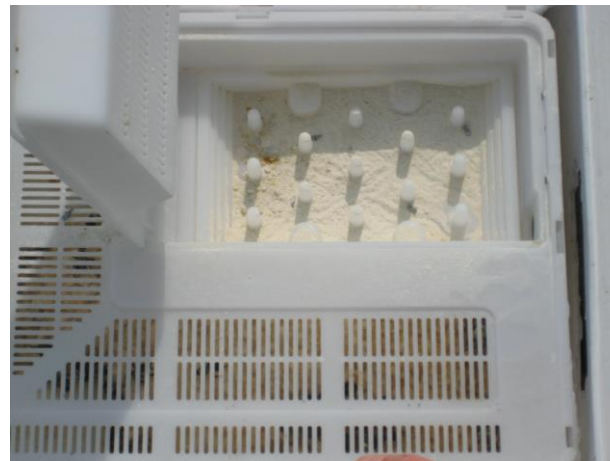


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Bee-Delivered Fungicide

BVT's tray holds the CR-7 for bees to walk on as they leave the hive.



Maccagnani et al. 2009 studied the efficiency of *Osmia cornuta* vectoring *Erwinia amylovora* to suppress fire blight in apples and pears

Many bumble bee and solitary bee species are used in modern pest control



Photos: B. Maccagnani

Pollination and pest control activities can be combined together

- Pollen collection and pollination
- Deliver antagonistic micro-organisms
 - For plant disease control (grey mould)
 - Preventive
 - Curative
 - For insect pest control (greenhouse whitefly, pollen beetle, coffee borer)



Trialeurodes vaporariorum



Botrytis cinerea

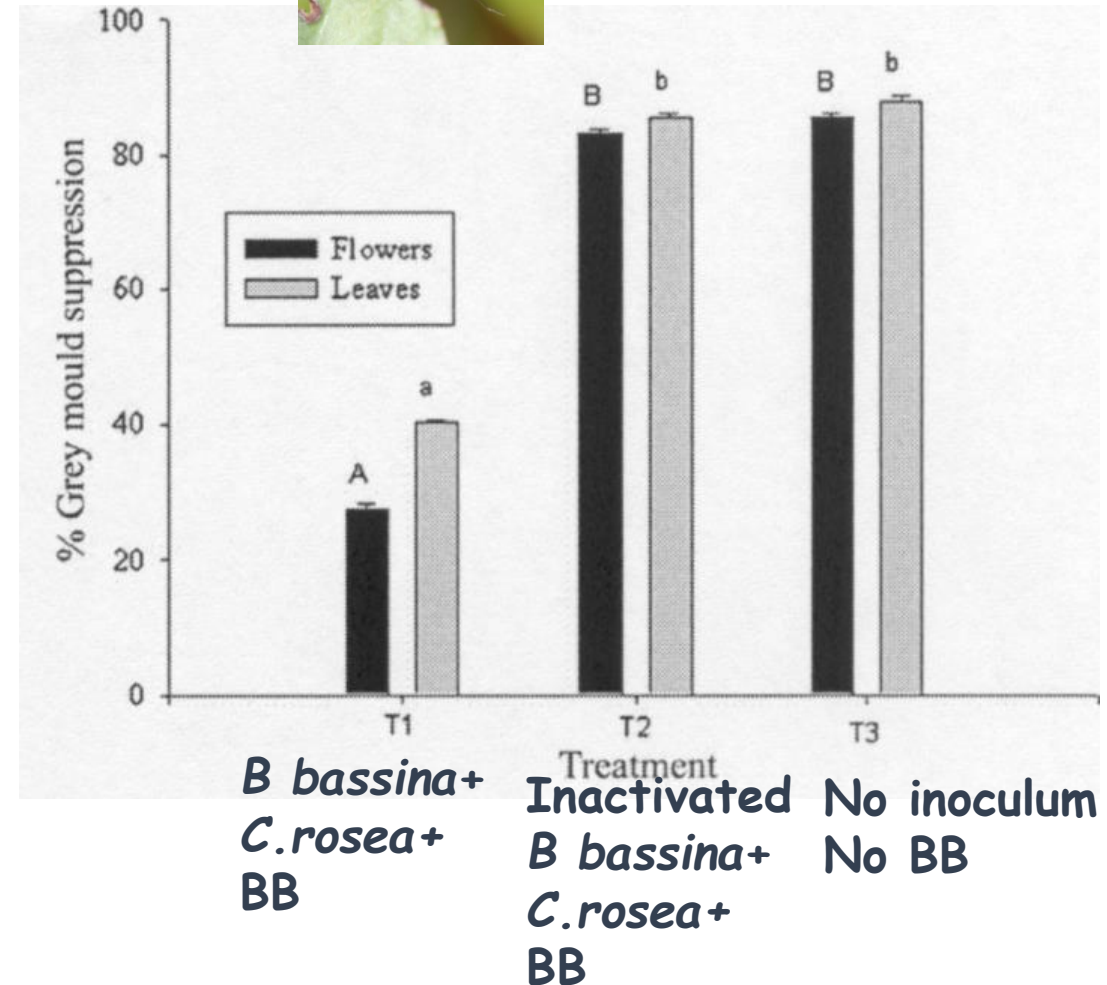
Bees can simultaneously deliver both bio-insecticide and -fungicide



Lygus lineolaris

Bee-vectoring in greenhouse tomato and sweet pepper

- *Beauveria bassina* caused substantial mortality of *Lygus*, whiteflies, thrips and aphids (**up to 80% mortality**)
- Biofungicide (*Clonostachys rosea*) for grey mould (**46-59% suppression**) control



The risk from these fungal agents to bumble bees appears to be minimal

CONCLUSIONS

The diverse pollinator communities play important role in environmental safety, culture, and aesthetics

- In agricultural ecosystems, pollinator diversity increases the quality and quantity of crop yield and ensures honey production
- Beevectoring as innovative system is successful in controlling pests in greenhouses and also open on fields

Thank You!

