Effects of orchard design and pollenizer density on apple pollination services

PhD. Sara Straffon Díaz

PhD. Luca Carisio

Stefano Ponso

Tutor: Dott. Marco Porporato

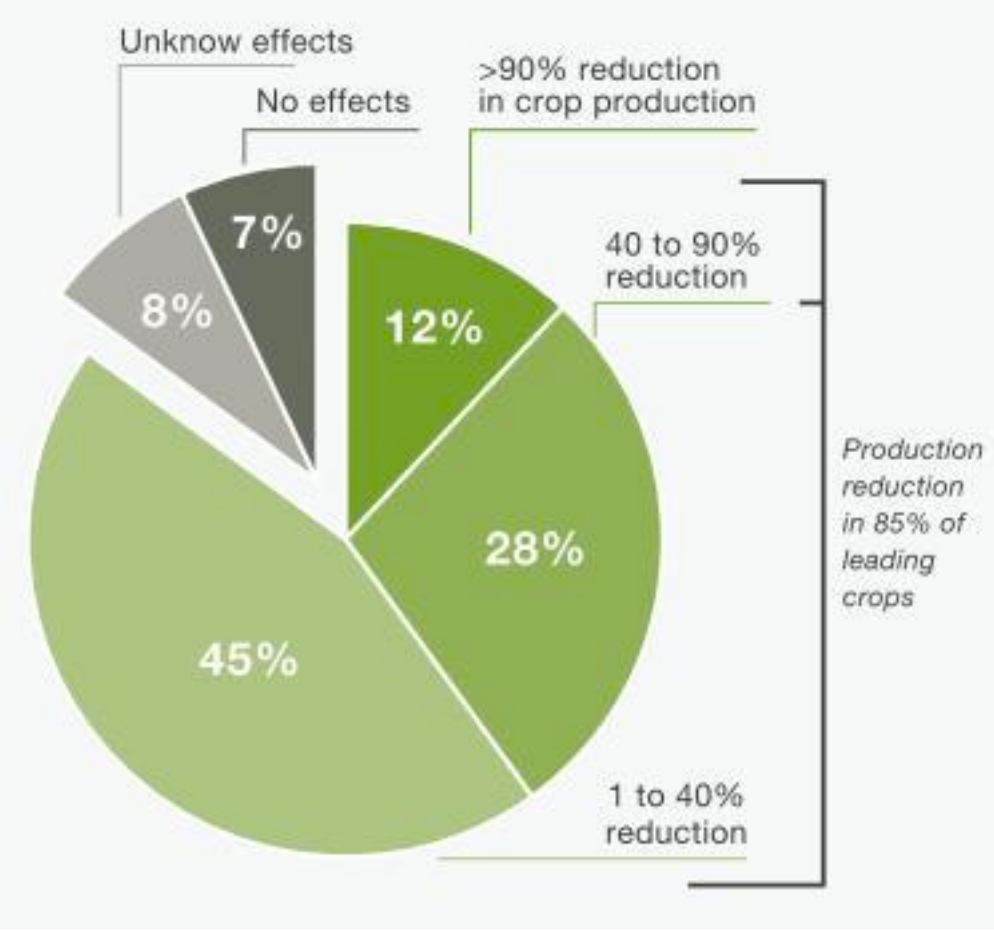
DISAFA

Gruppo di Ricerca in Apicoltura e Impollinazione

Università degli Studi di Torino

Background

Animal pollination dependent crops (91 of 107 leading crops)
= 85 % global crops



Klein *et. al*., 2007 In: IPBES, 2016.

Production volume

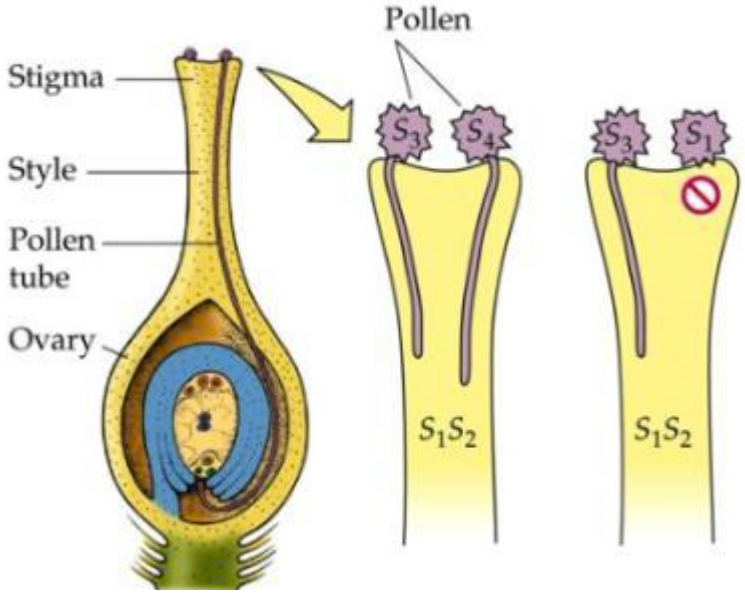
60 % of production comes from non-dependent crops

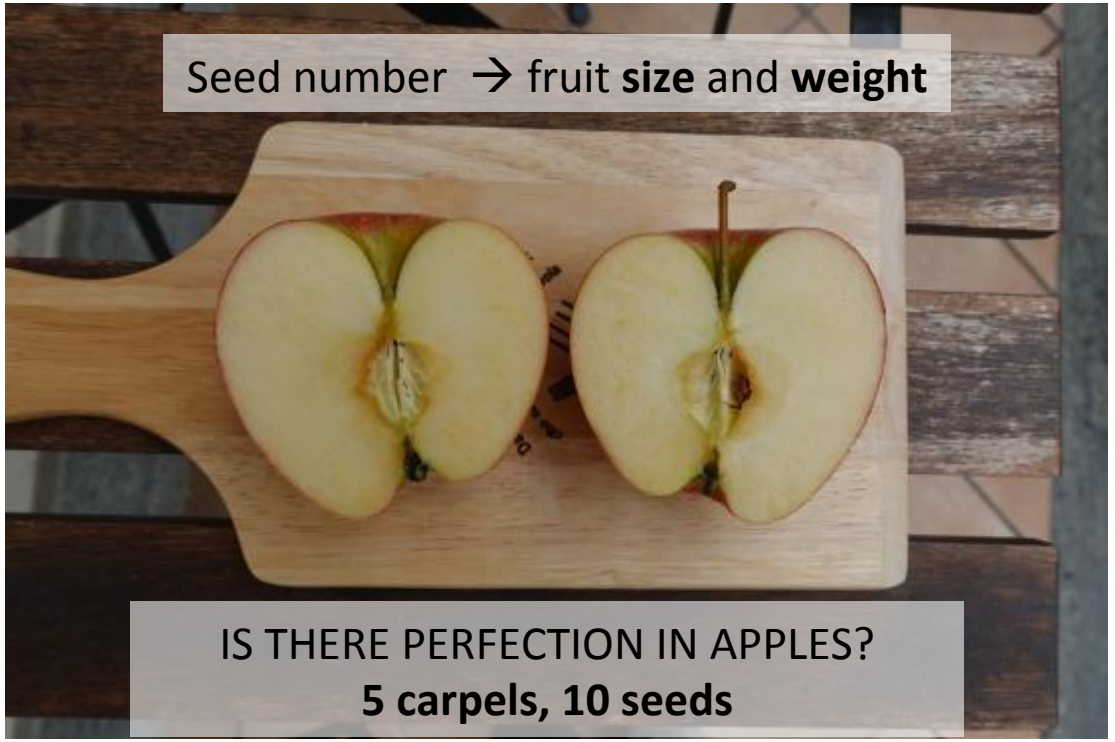
35 % animal-pollination dependent crops

5 % not been evaluated (established)

Bees: predominant group of pollinators
70% of world crops

Apple pollination facts





Self – Incompatibility:
apple needs cross-pollination between different varieties to sired seeds and set fruits

POLLINIZER = Pollinator plant that provides compatible pollen
CROSS POLLINATION

Pollination process: apple intensive crop

Phytosanitary and Thinning products

Phytosanitary and Thinning products

Phytosanitary and Thinning products

Hand Thinning

Blooming

- Orchard design
- Pollenizer density

Pollination

- Diversity and abondance of pollinators
- Foraging behavior
- Pollination deficit

Fruit Set

- Number of fruitlets

Seed Set

- Number of seeds
- Distribution of seeds

Lopsided apple

Final fruits

Number, Size, Shape, Weight

Work in progress

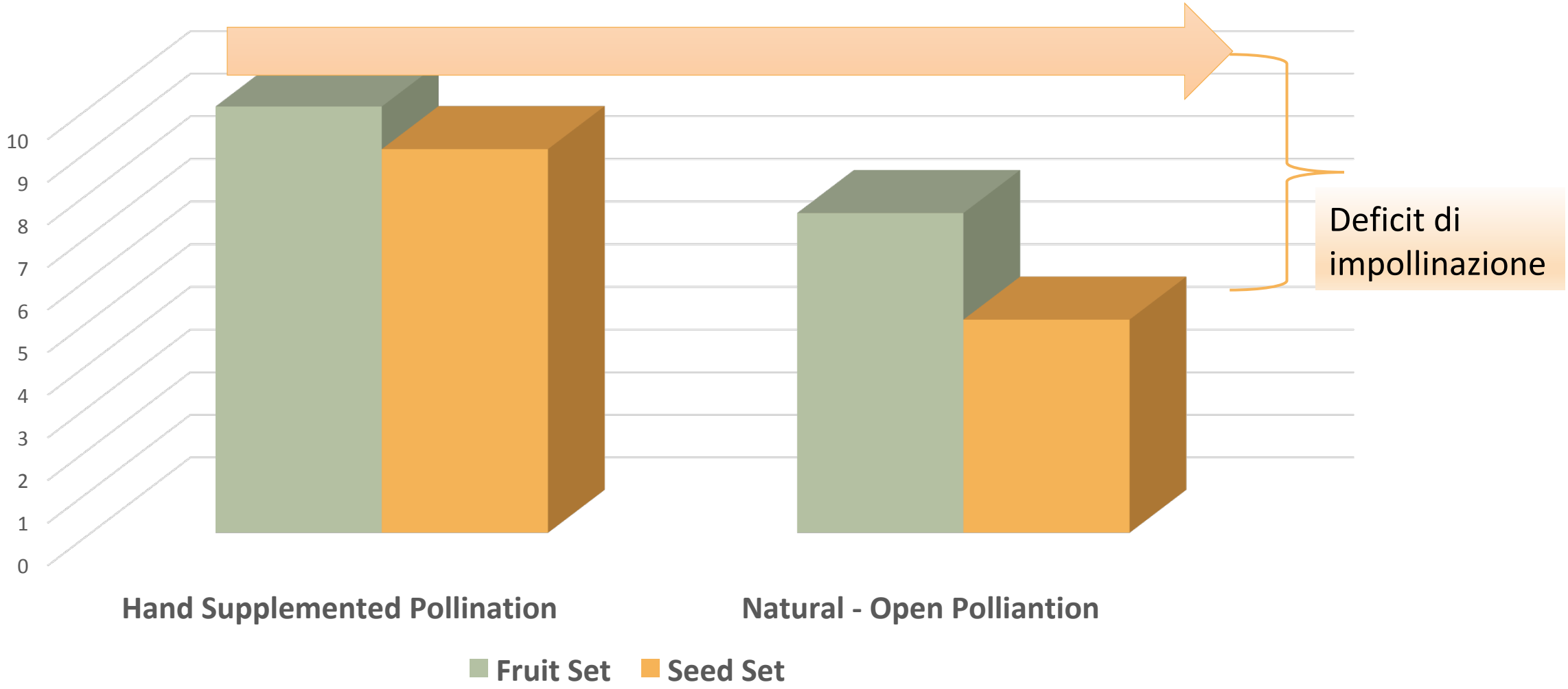
Aims

To assess the effects of two intensive agricultural conditions such as orchard design and pollenizer density on apple pollination service in **three intensive apple orchards: *cv.* Gala (main producing) and *cv.* Granny Smith (pollenizer)**

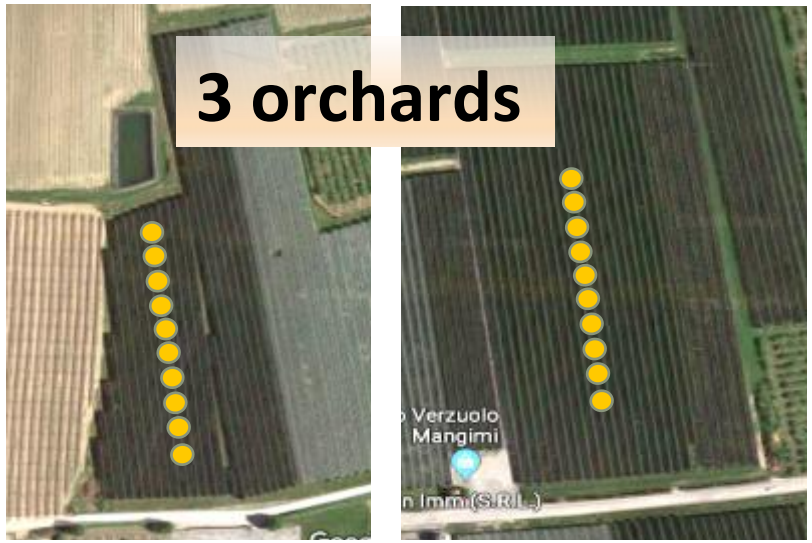
Agrion
Agricoltura ricerca innovazione

1. Is there optimal pollination in intensive apple orchards?

Pollination deficit



1. Pollination limitation experiment

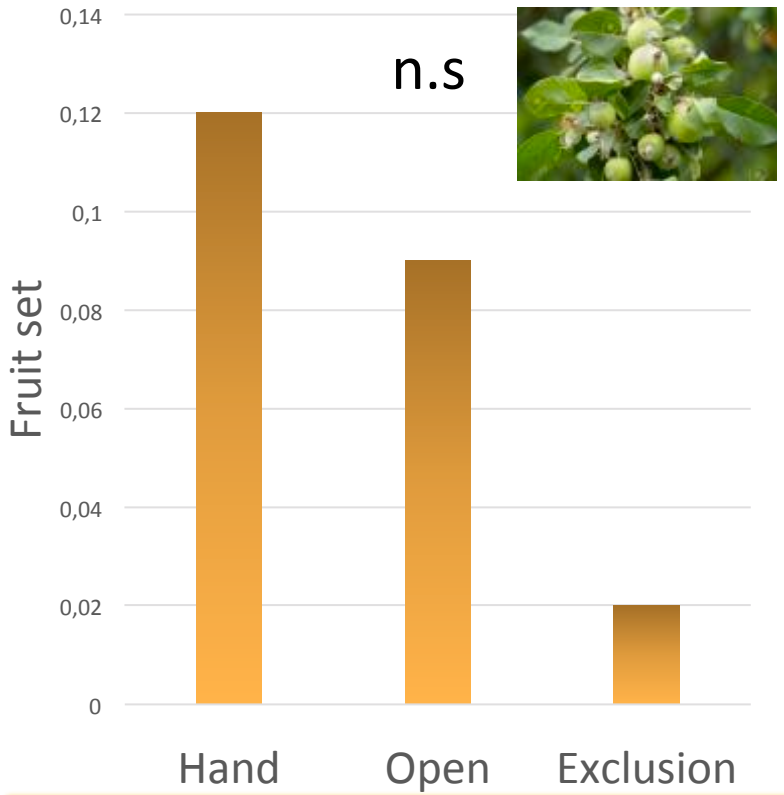


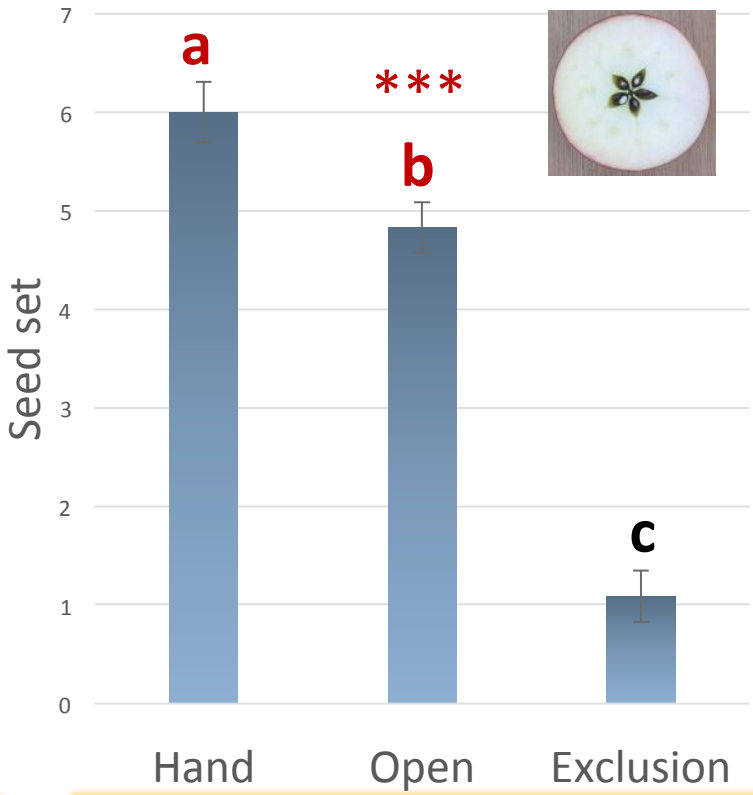
Hypothesis: Intensive managed agricultural area = negative impacts on wild pollinators and insufficient honey bee contribution ==**Limited pollination levels present**

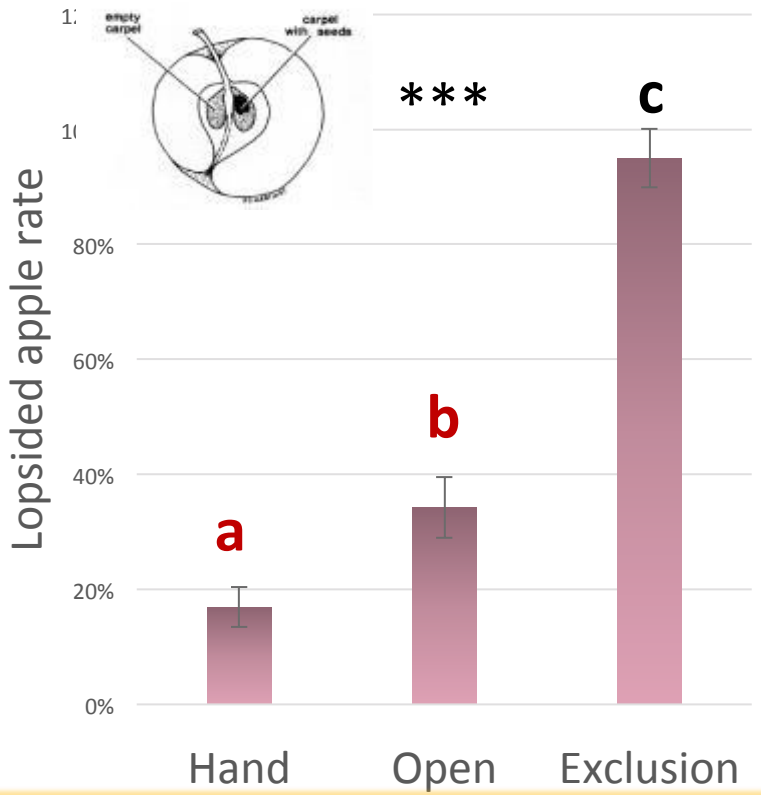
10 trees x orchard

3 treatments

Pollination limitation results







Although the visible differences, Fruit set was not affected by there was no effect

Seed set is strongly dependent on cross pollination, the deficit is small (1.2 seed/apple)

Lopsided apple is affected by pollination. 11% more of lopsided apples are produced on current conditions compared with hand supplemented.

Work in progress:

- Analyse If there are any effects on apple size and weight

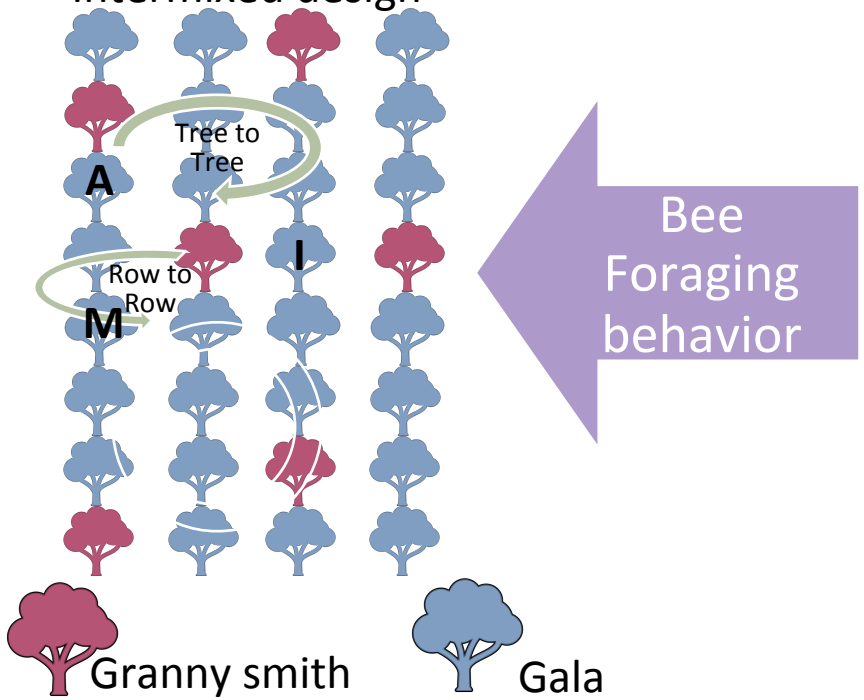
n.s : not significant
**: p<0,01
***: p<0,001

2. Does tree position inside orchard affect pollination service?

2.Orchard design effects

3 positions: Along, Medium, Interrow
12 trees/position
= 36 trees /orchards

Intermixed design



3 Possibilities:

- Bees move sequentially from Granny to the next Gala tree on the same row:

A>M>I

- Bees move from Granny to the closest Gala tree on the some row or/and to the Gala in the row in front of

A=I>M

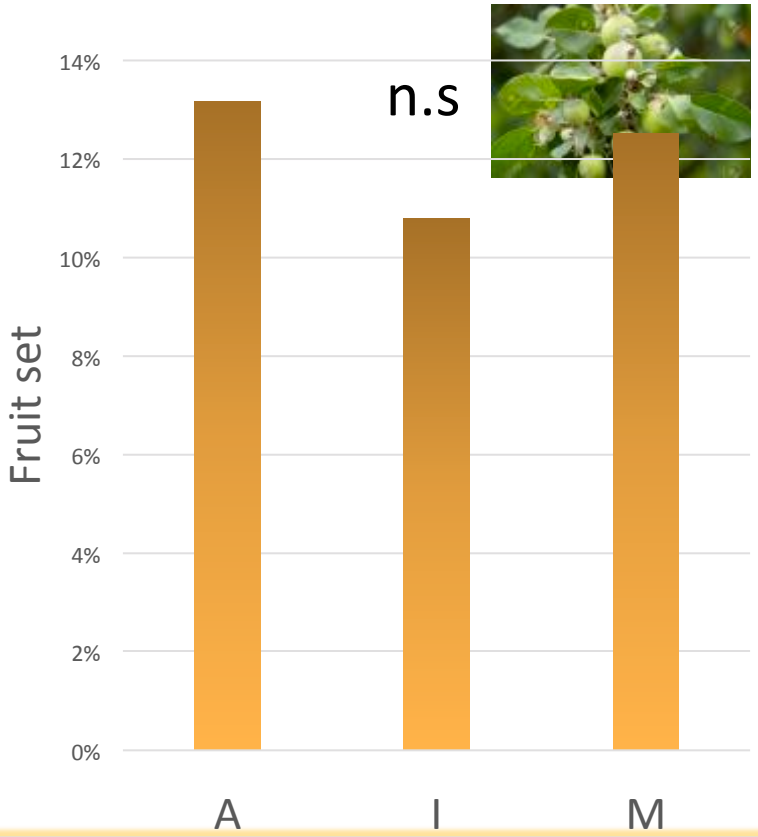
- Bees move from Granny tree to another tree following a random pattern

A=I=M

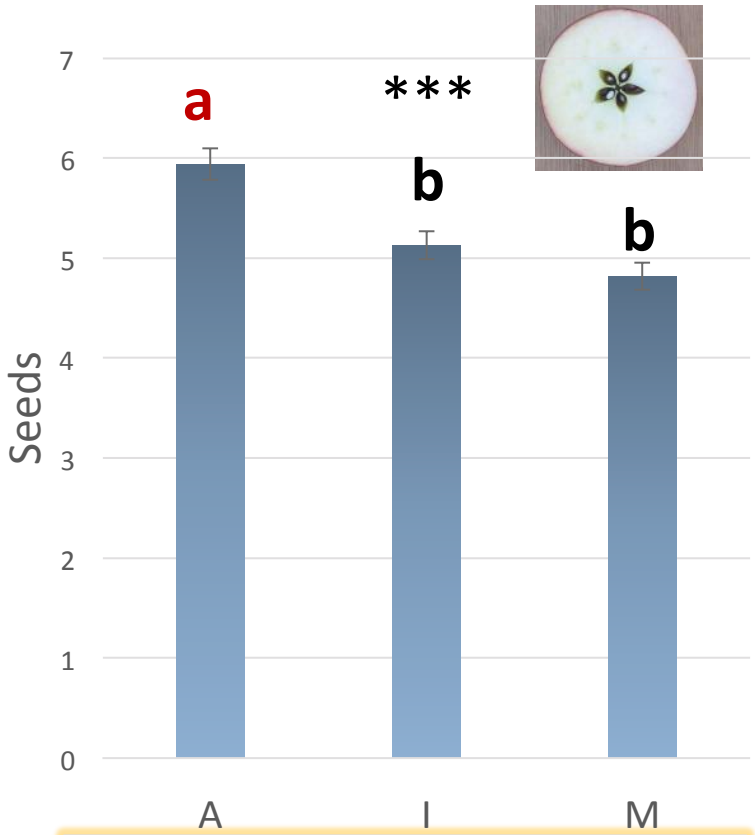
Hypothesis: shorter distance from pollenizer is translated in higher seed numbers and lesser lopsided apple.

A>M>I

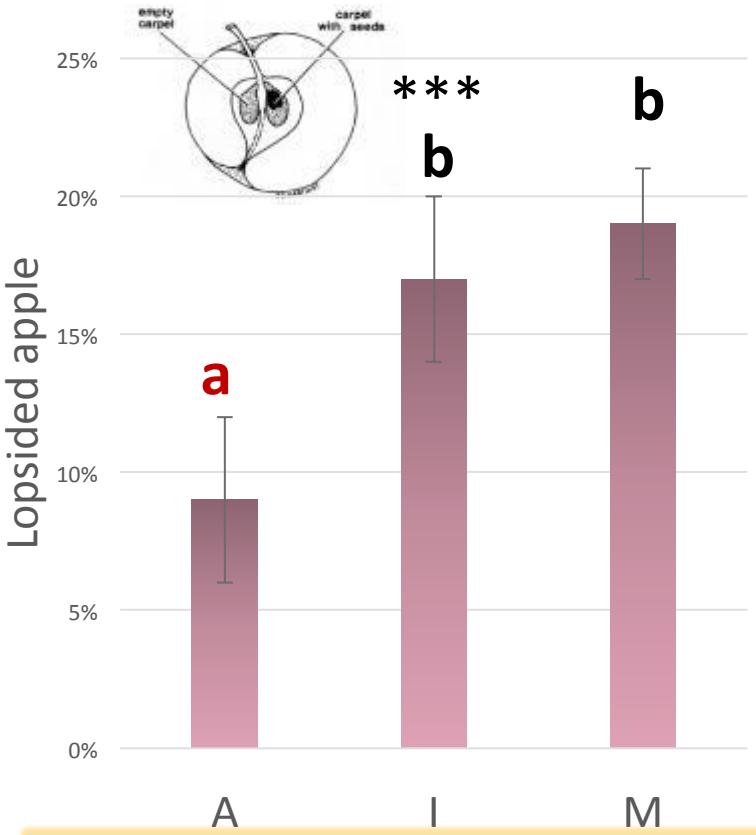
Orchard design results



No differences



Position from pollenizer influence pollination efficency. A position is more effectively pollinated

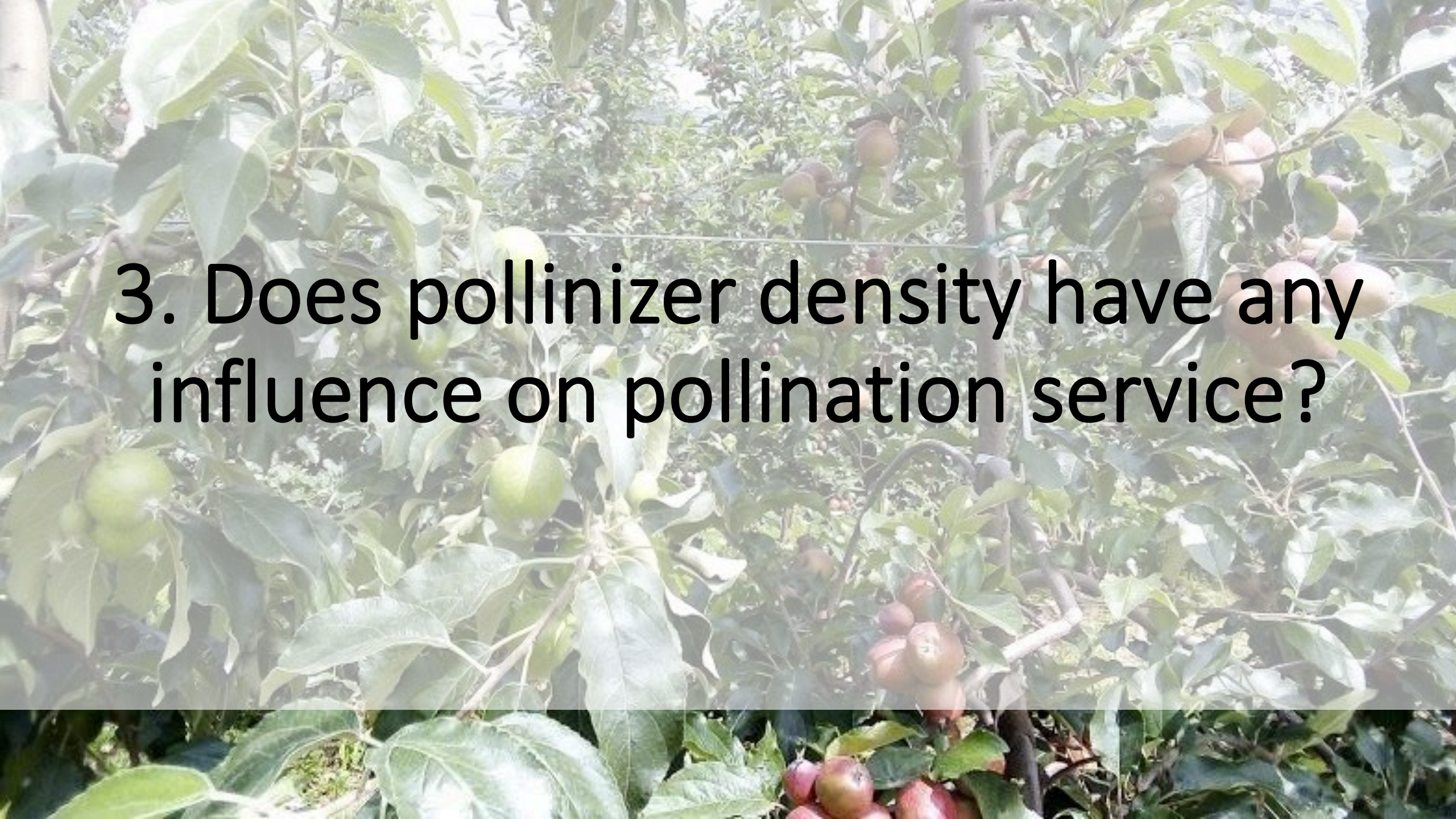


Lopsided apple is affected by position.
9% less assymetric apples on A position

Work in progress:

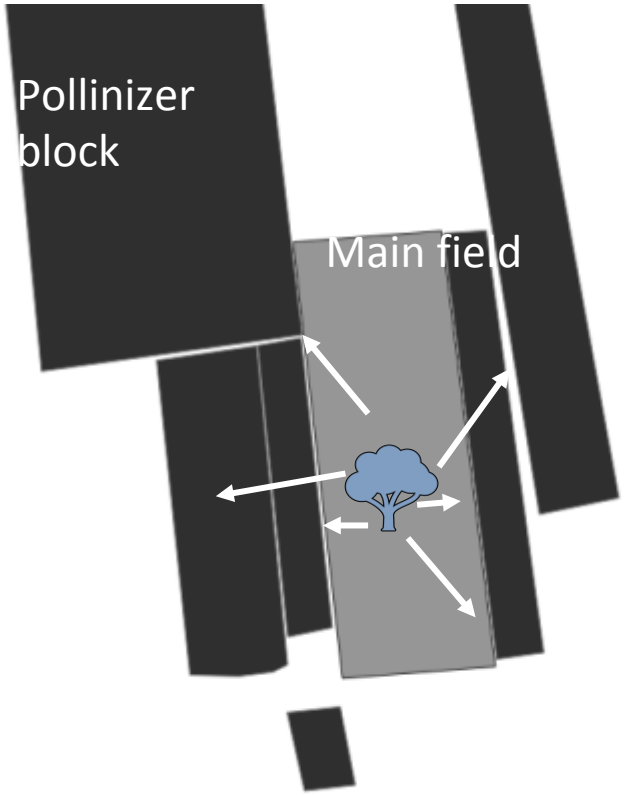
- Analyse if there are any effects on apple size and weight

n.s : not significant
**: p<0,01
***: p<0,001

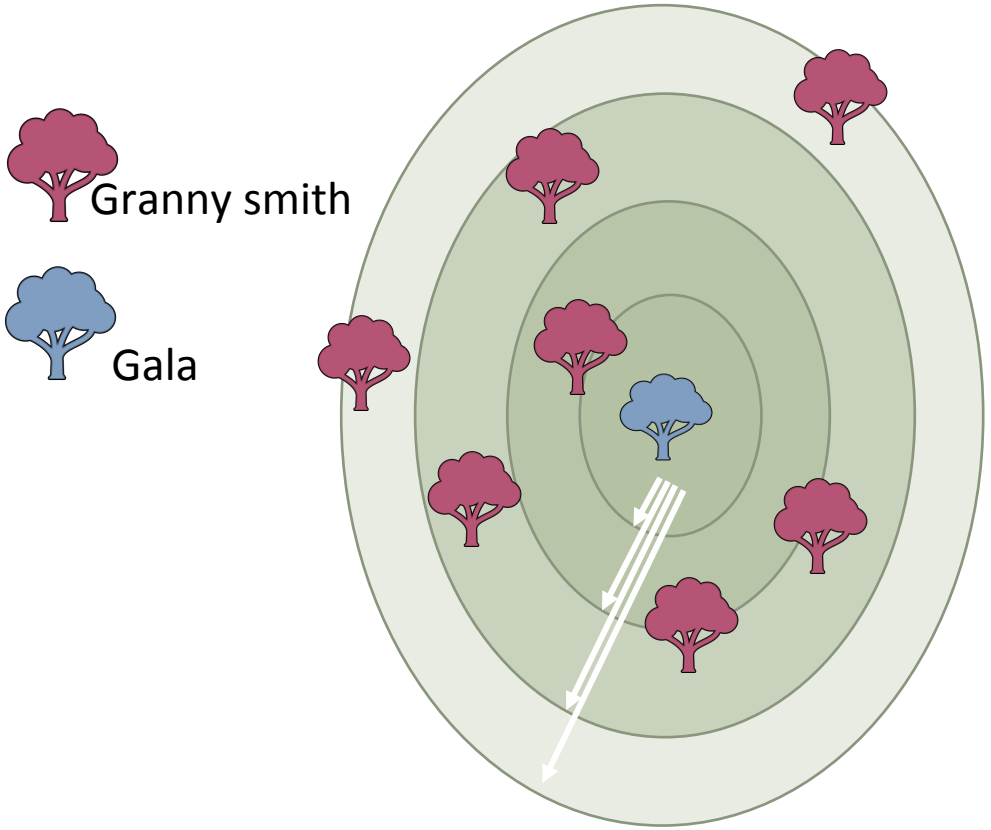


3. Does pollinizer density have any influence on pollination service?

Pollenizer density



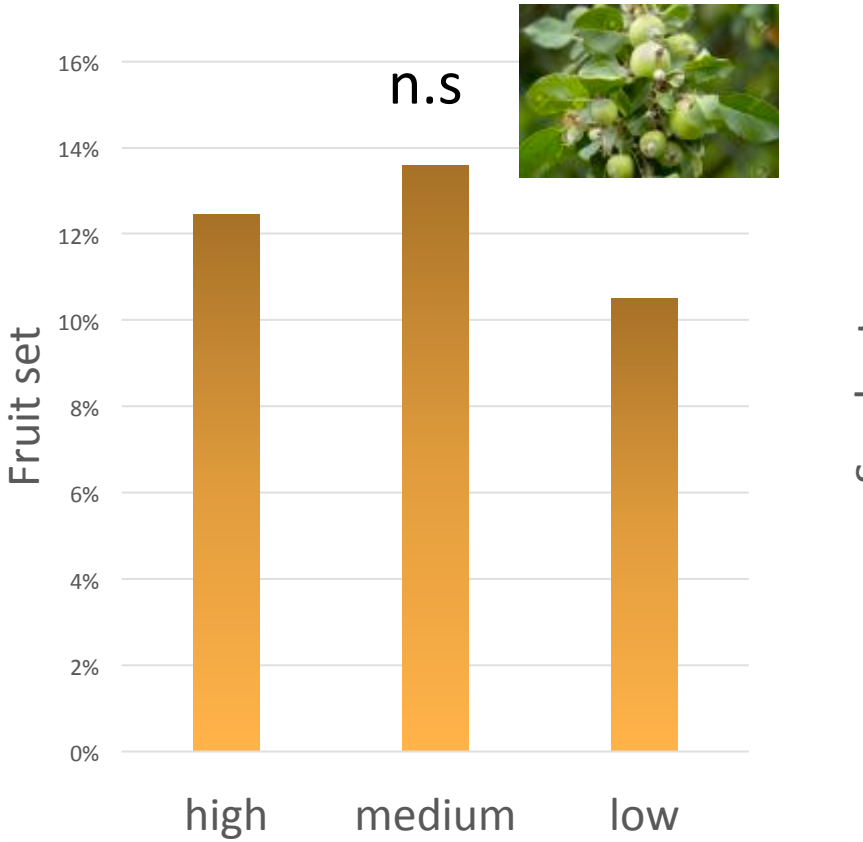
Distance is not suitable



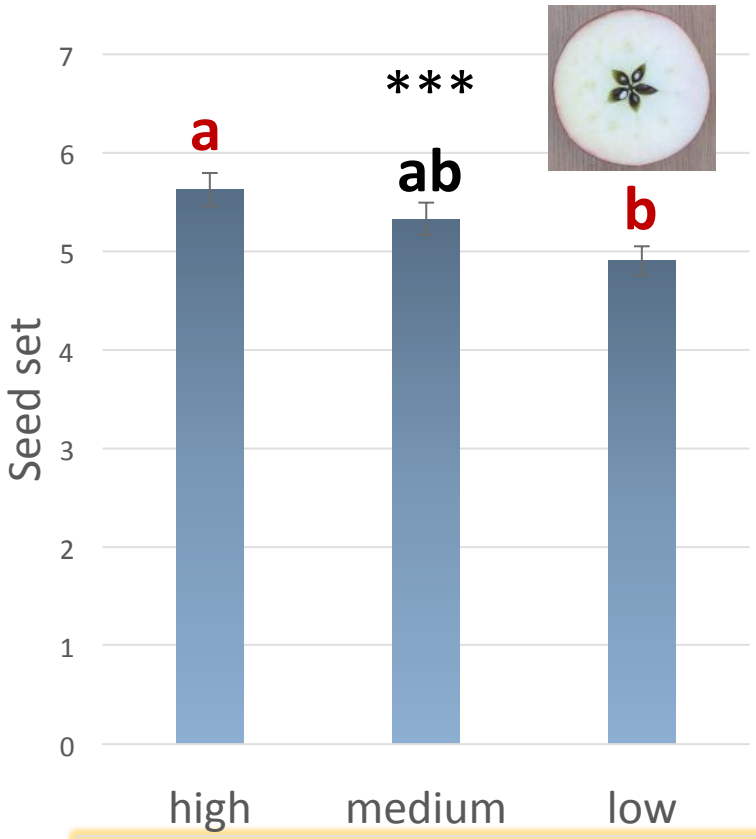
Pollinizer density as alternative

Density ranges	min	max
low	20	50
medium	95	125
high	170	200

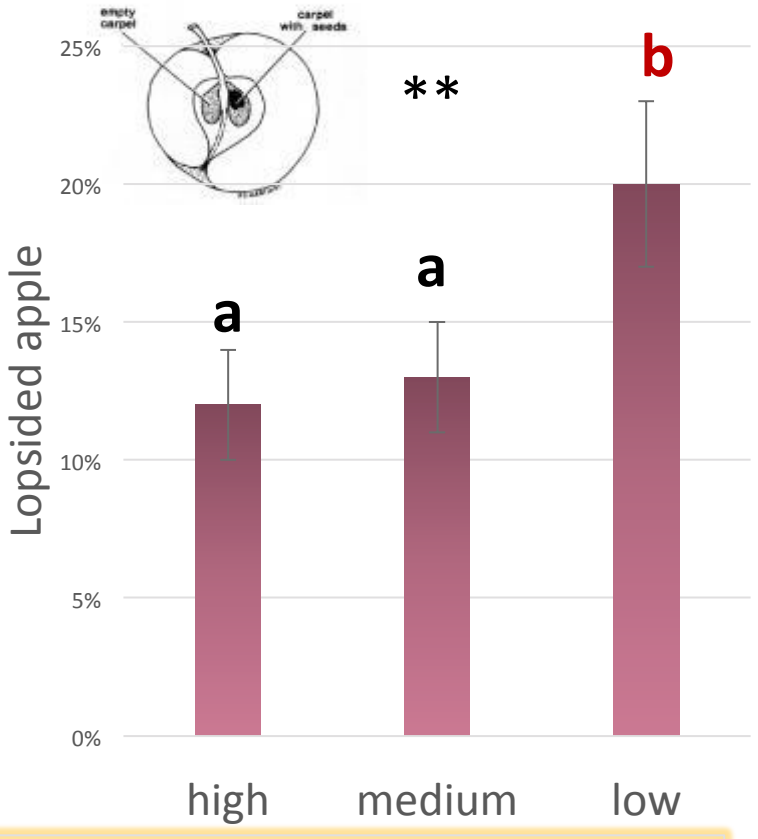
Pollenizer density



No differences



At high density correspond with greter amount of seeds



Lopsided apple has lower fraquency at higher density

Work in progress:

- Analyse if there are any effects on apple size and weight

n.s : not significant
**: p<0,01
***: p<0,001

Conclusions

- Pollination deficit present but small.
- Careful! 11% of lopsided apples are produced in the current conditions. Assessment of implications on economic level is needed.
- Intermixed design is determinant to give a uniform pollination level (maximum difference lopsided apples rate = 9 %). Pollenizer trees are fondamental, they should not be reduced.
- Low levels of Pollenizer density produce 8% di lopsided apples. To consider higher scales and surronding orchard is important to prevent higher proportions of lopsided apples.


Thanks for your attention