Bumblebees improve 'Hass' avocado pollination and increase yield

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Introduction

- ‘Hass’ avocado yield is usually low.
- One of the reasons for this is the poor pollination.
- To overcome this problem we added BB hives to the orchards in addition to the HB hives.

Objective

- Improve ‘Hass’ pollination by adding bumblebees to increase fruit-set and yield.

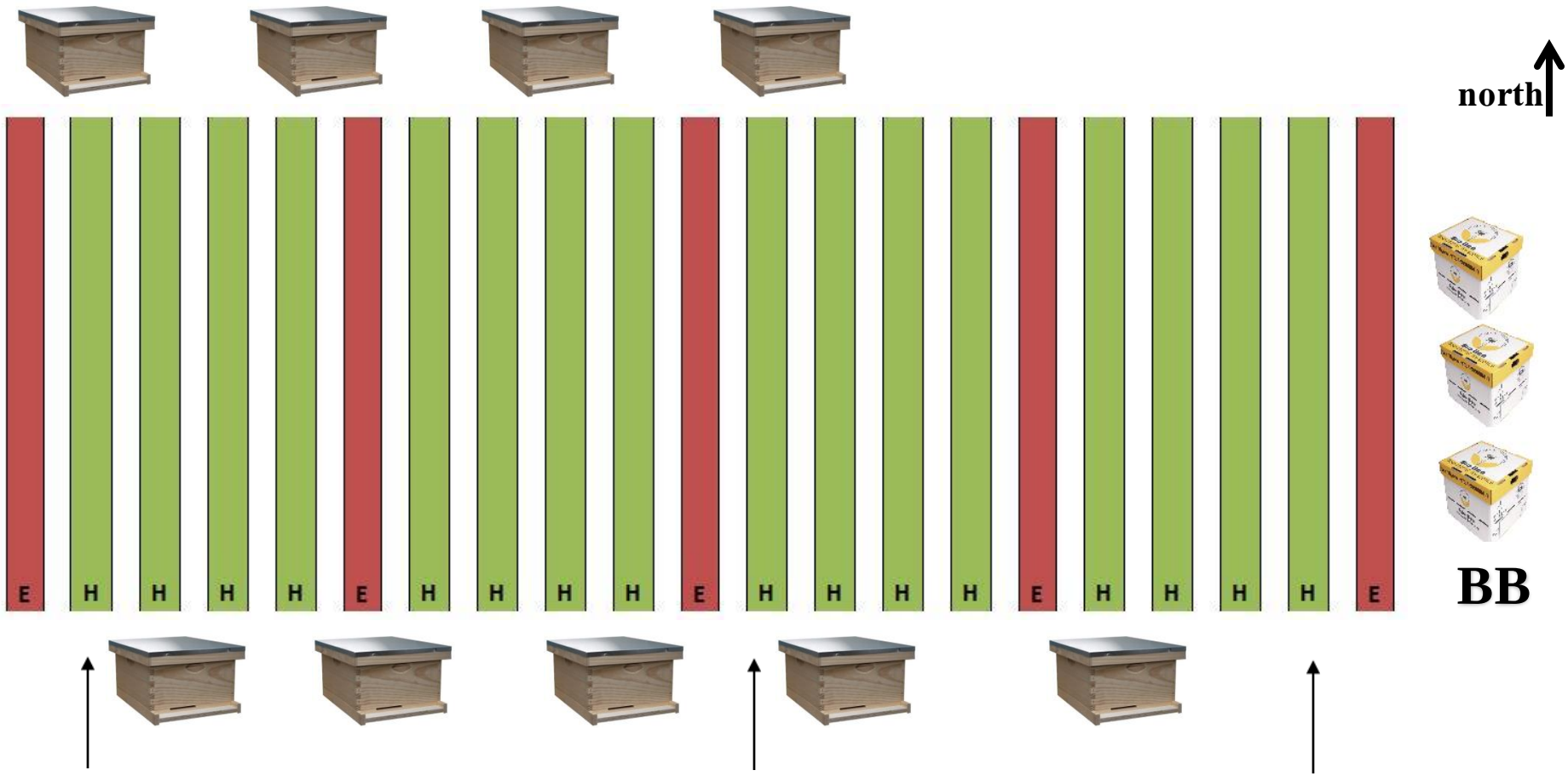
Why bumblebees?
What can they do to help?

The advantages of bumblebees (BBs)

- Active at lower temperatures than the honey bees (HBs).
- Operate very quickly (4 times the HBs).
- Larger than HB (2 fold).
- Do not transfer information to each other.

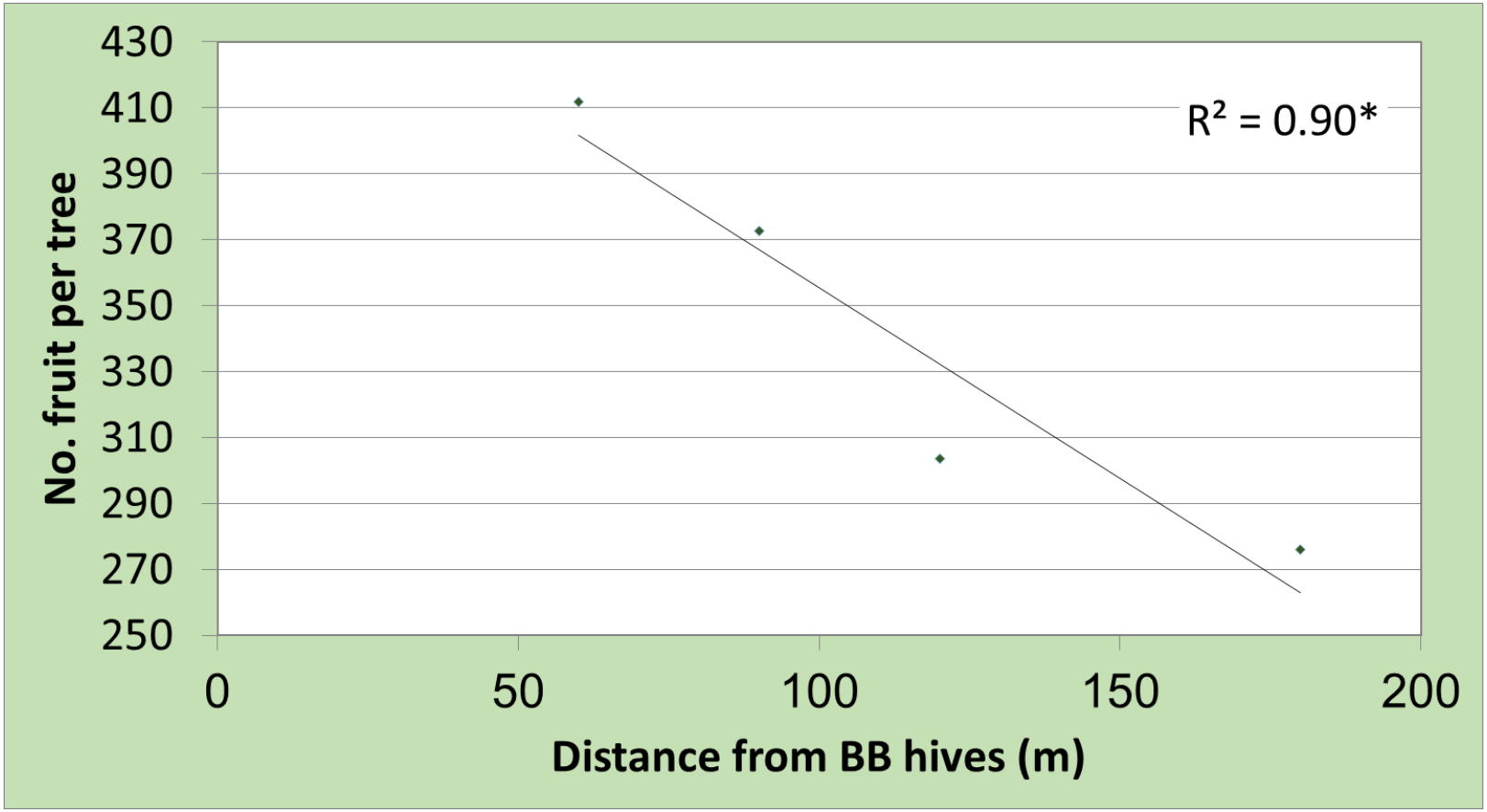
First year: Kfar Giladi 2017

Schematic map



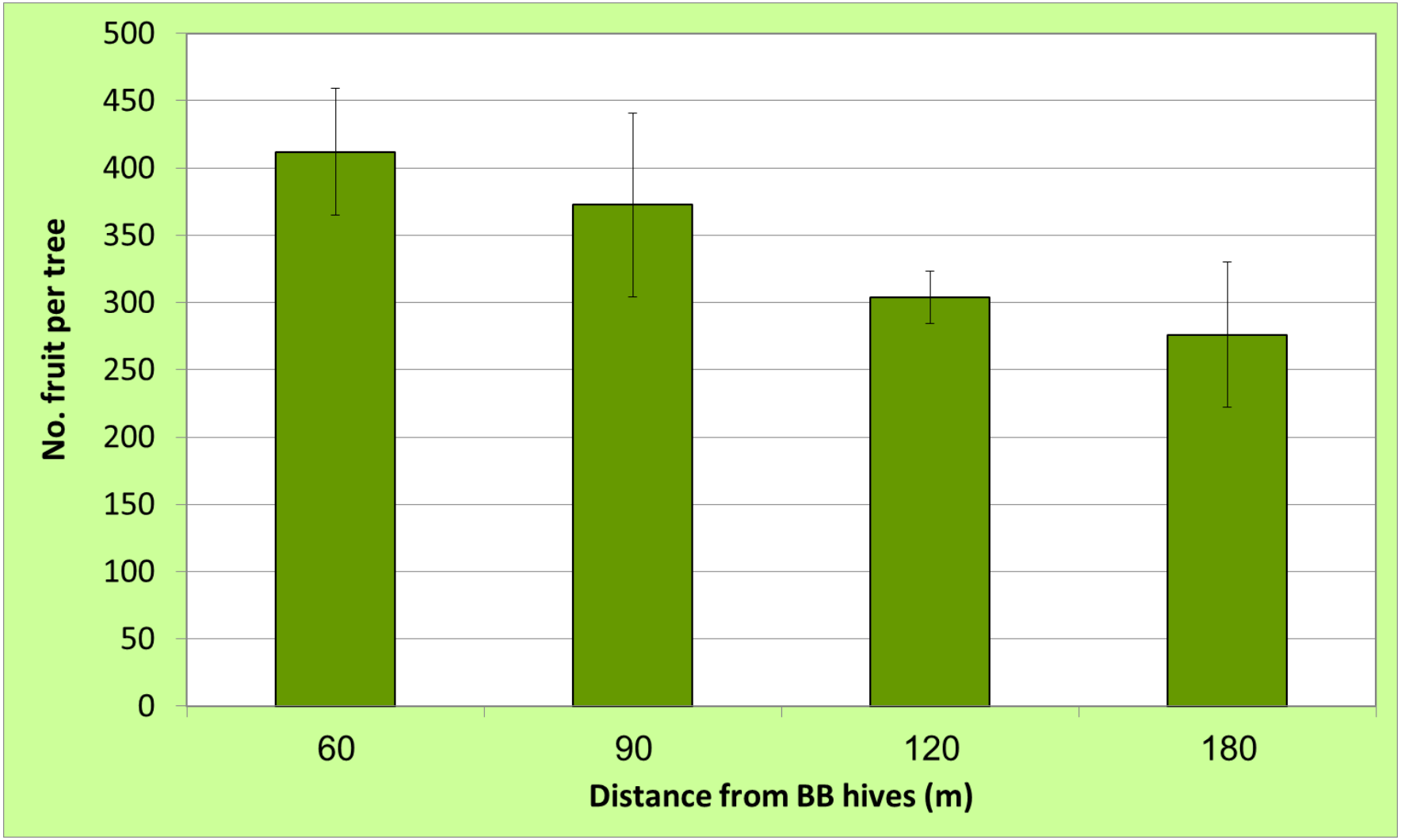
First year: Kfar Giladi 2017

Relationship between row distance from bumblebee (BB) hives and the number of fruit per 'Hass' tree

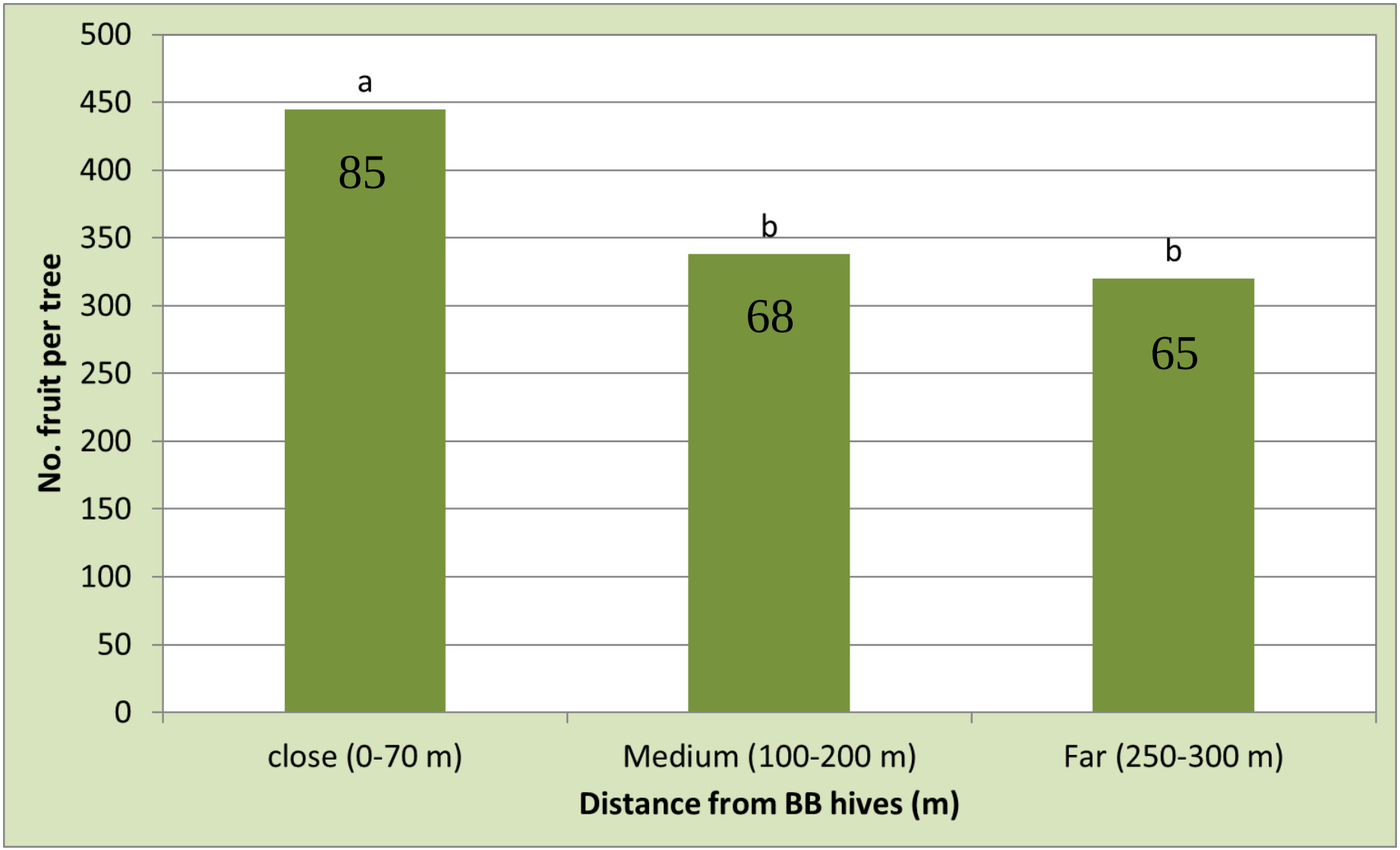


Results of the 2nd year 2018

The total number of fruits per tree, 'Hass' Kfar Giladi 2018

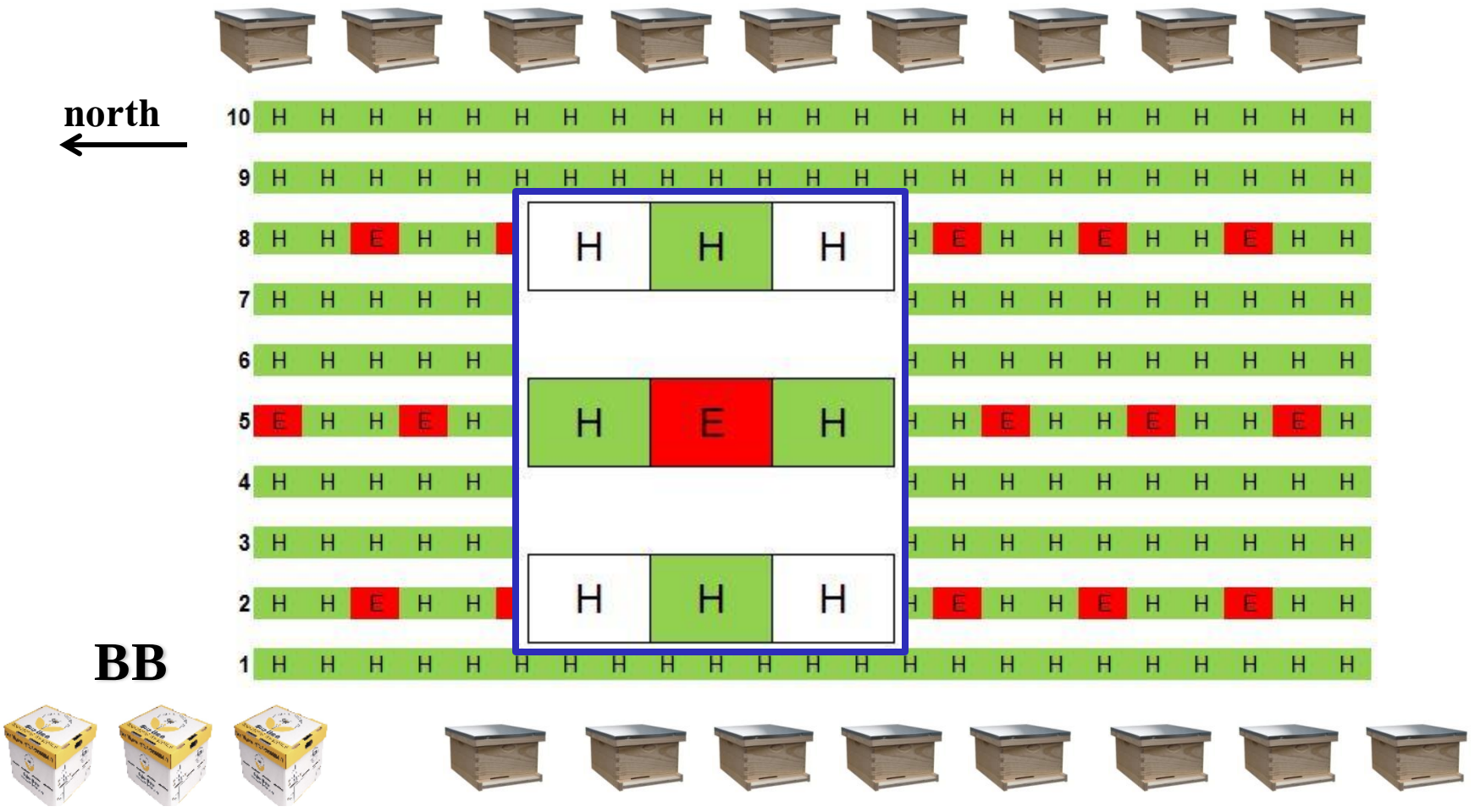


The total number of fruits (and the yield in kg) per tree, 'Hass' Regba 2018

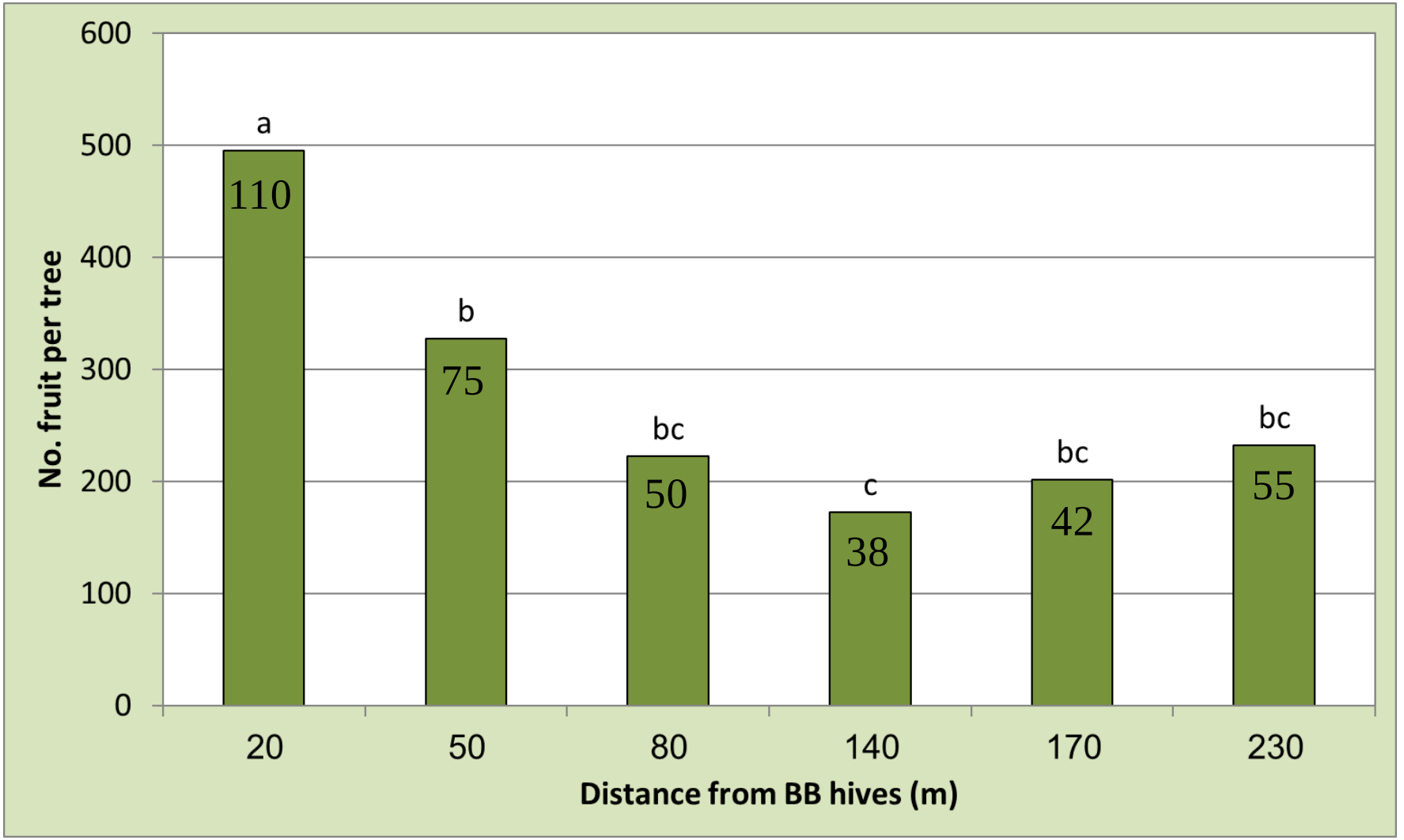


Kfar Hanassi 2018

Schematic map



The total number of fruits (and the yield in kg) per tree, 'Hass' Kfar Hanassi 2018



3rd year 2019

Main objectives

- Expanding the trails
- Monitoring BB + HB activity on the trees to find the correlation between it and the yield.
- Examining the **pollination rates** of ‘Hass’ flowers at all distances from BB hives.

Bees activity

No. of HB and BB on tree per min.

a. Deference between cvs. ('Hass' *vs.* 'Ettinger')

pollinator	No. of bees per min.	
	Ettinger	Hass
HB	28.6	6.9
BB	0.1	0.02

Conclusion: 'Hass' is a less attractive cv. for bees

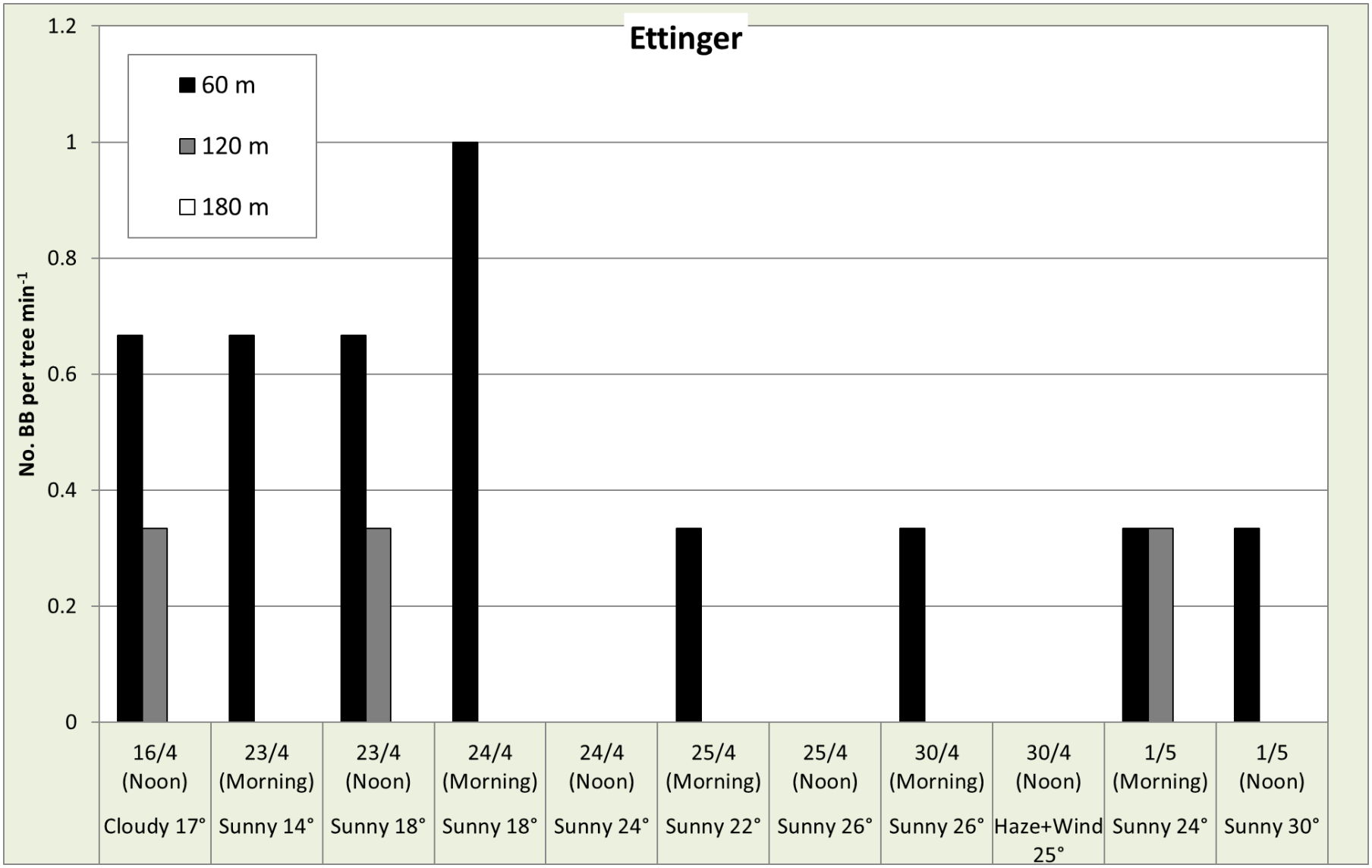
Bees activity

No. of HB and BB on tree per min.

b. Deference between distances (close, medium and far from BB hives)

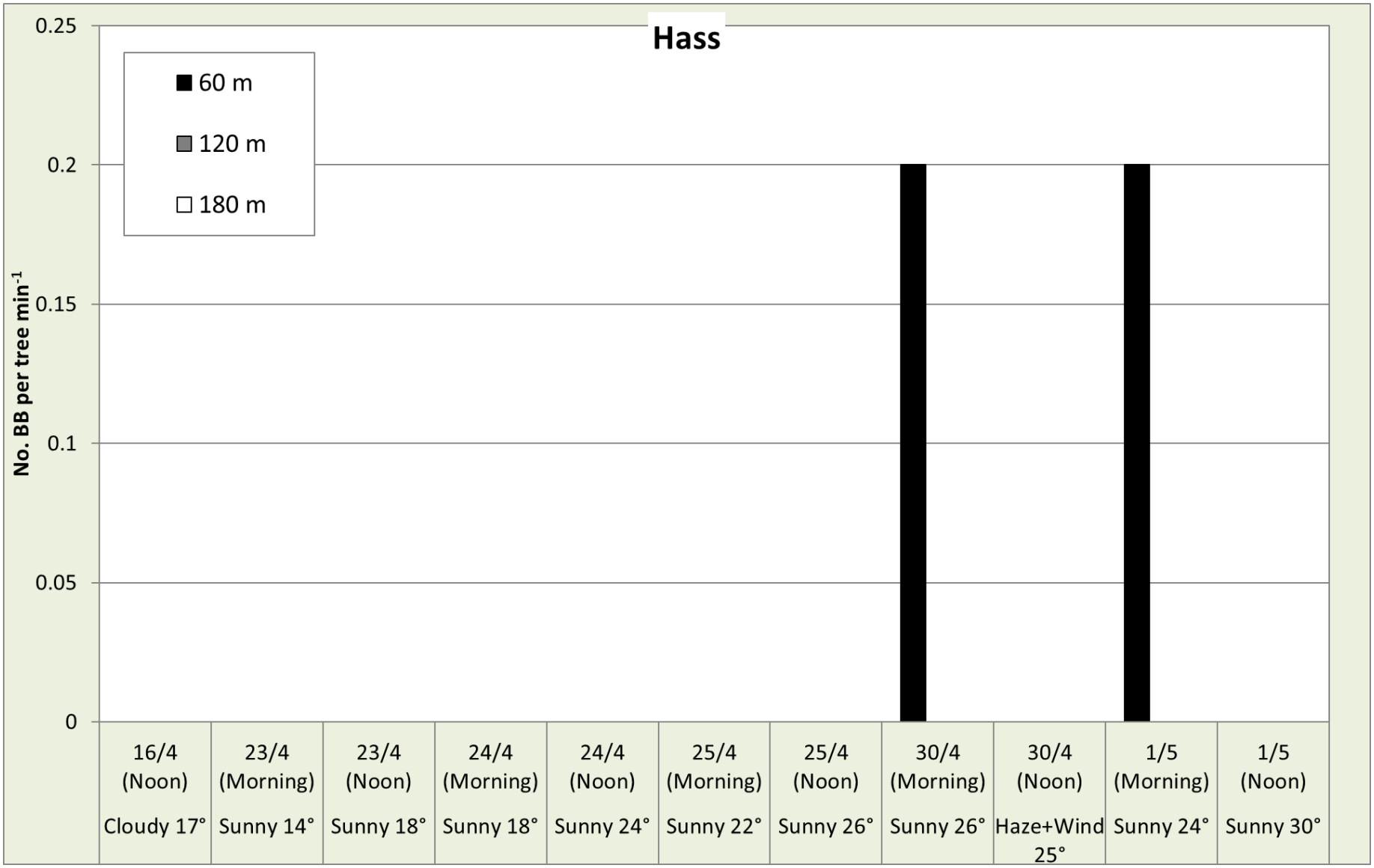
- HB – No deference between distances
- BB – Different scattering at different distances

BB activity on ‘Ettinger’



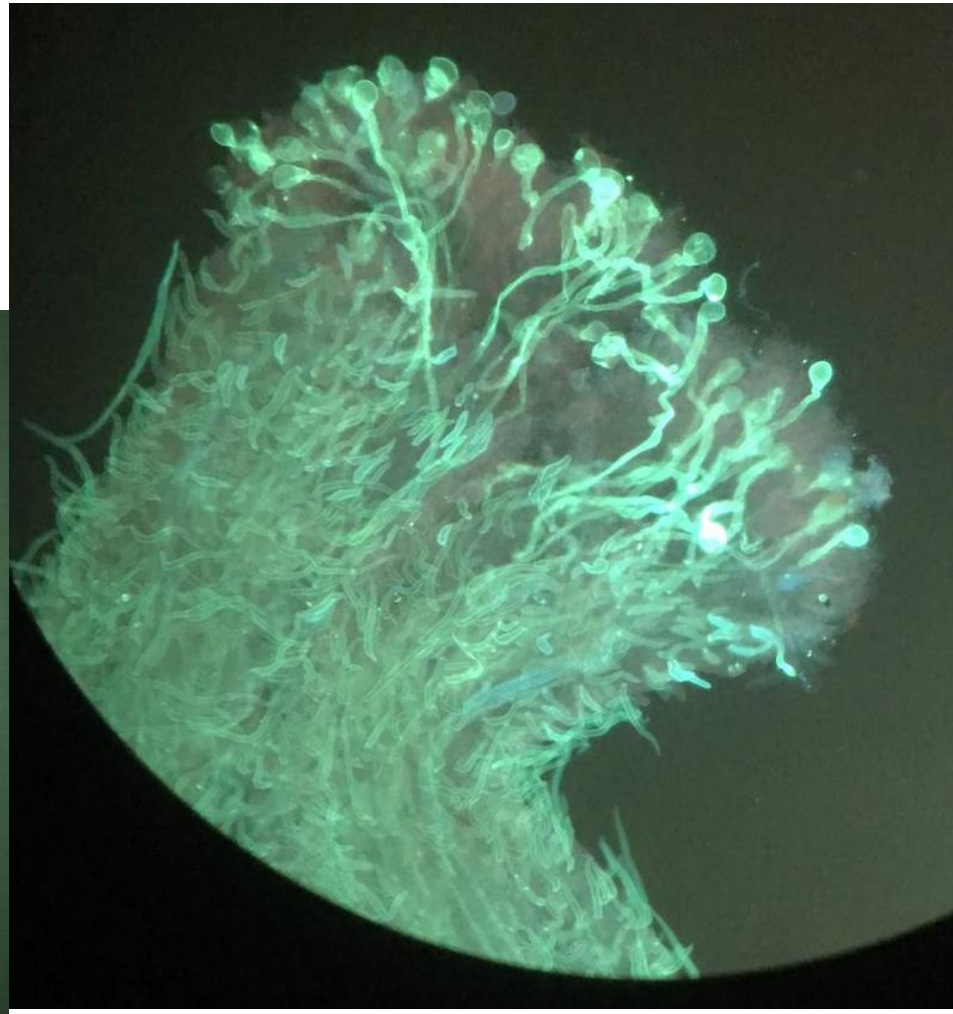
Conclusion: BB activity only in the close and medium distances

BB activity on ‘Hass’



Conclusion: BB activity only in the close distance

Pollination rate

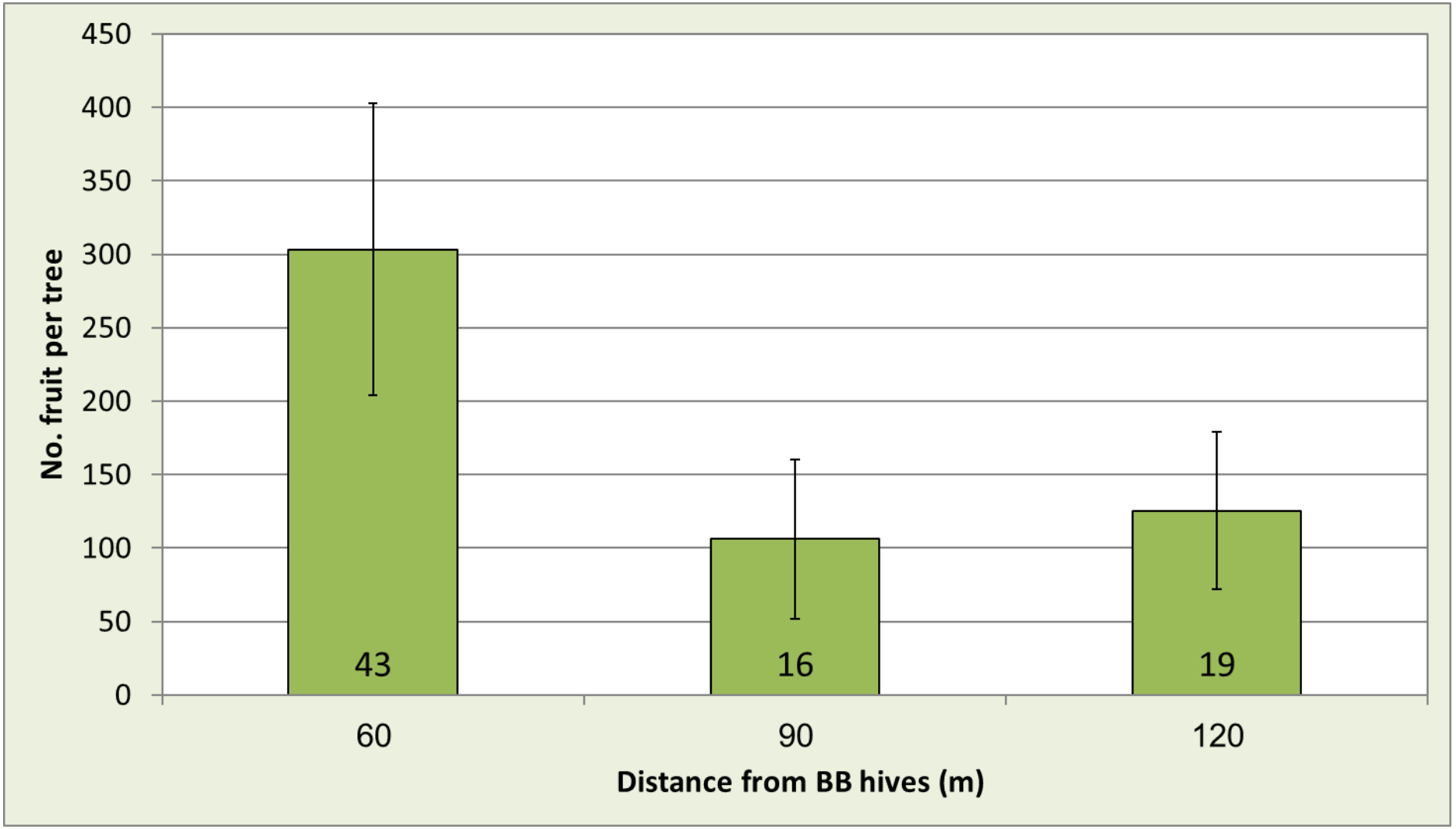


Pollination rate and no. of grains per stigma of ‘Hass’ flowers at three different distances from the BB hives

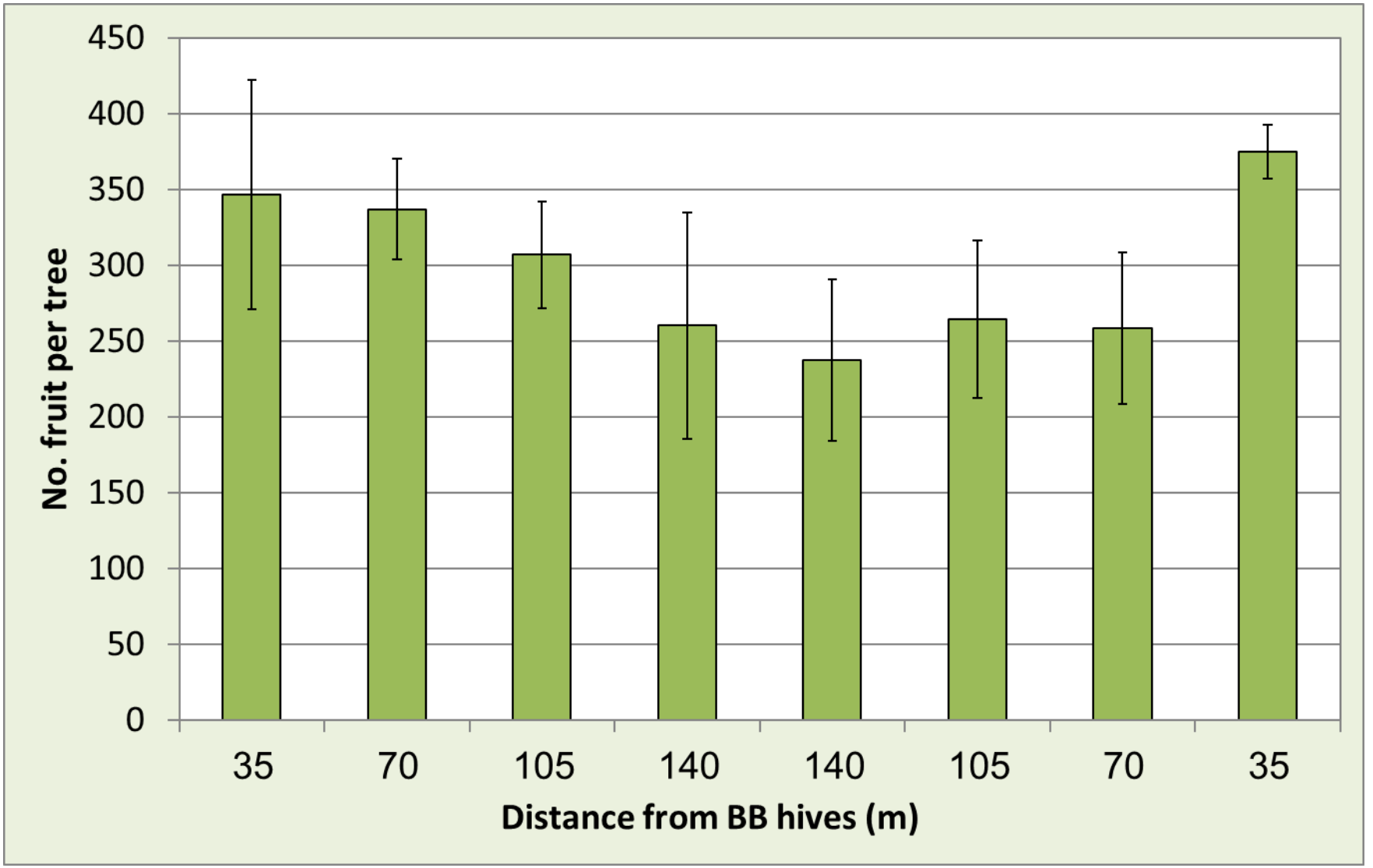
Distance from bumblebee hives (m)	Pollination rate (%)	Grains per stigma (no.)
60	94	4.5
120	76	2.5
180	67	2.1
Significance	NS	*

Yield

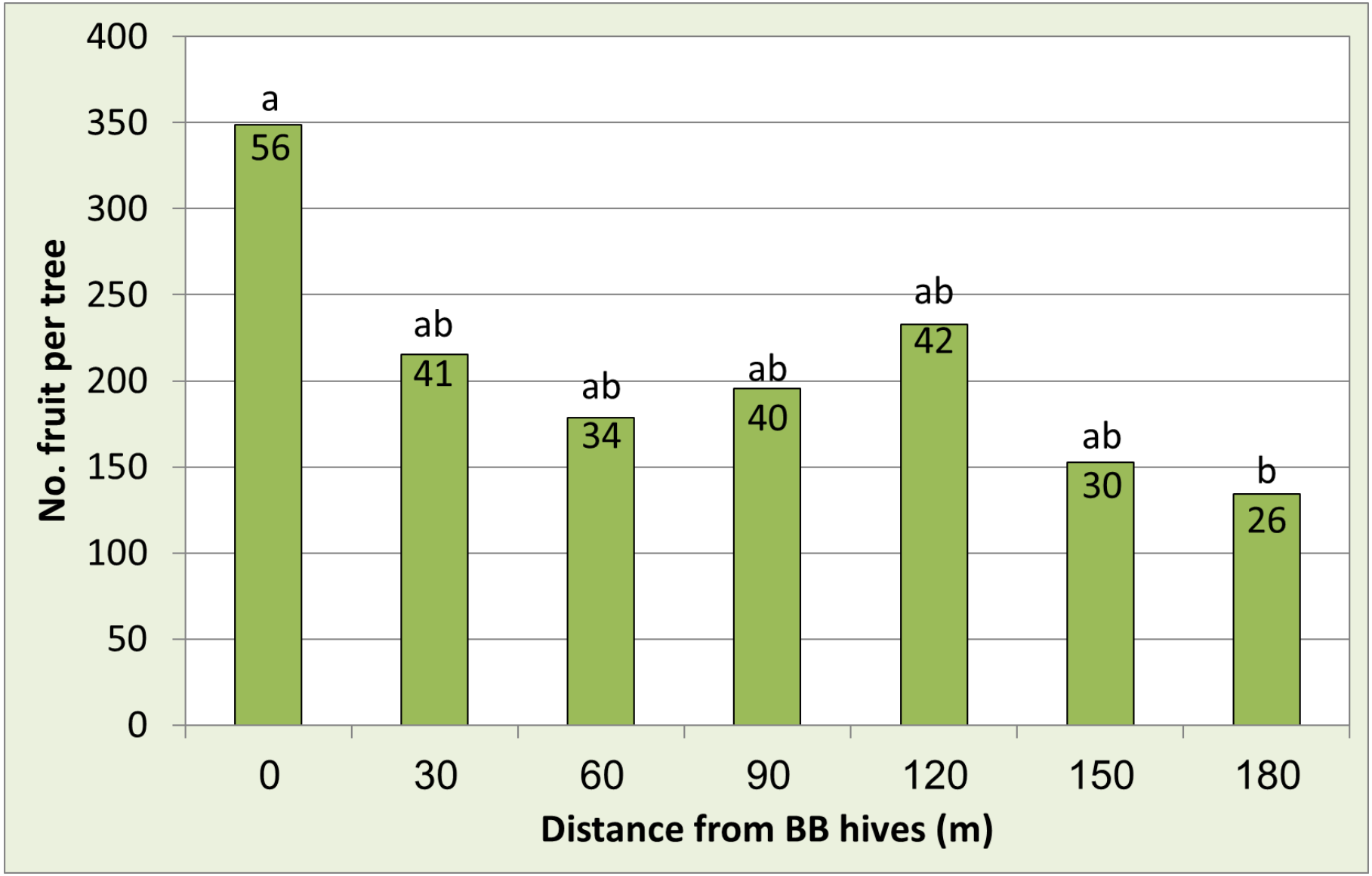
The total number of fruits (and the yield in kg) per tree, 'Hass' Kfar Giladi 2019



The total number of fruits per tree, 'Hass' Regba 2019



The total number of fruits (and the yield in kg) per tree, 'Hass' Eyal 2019

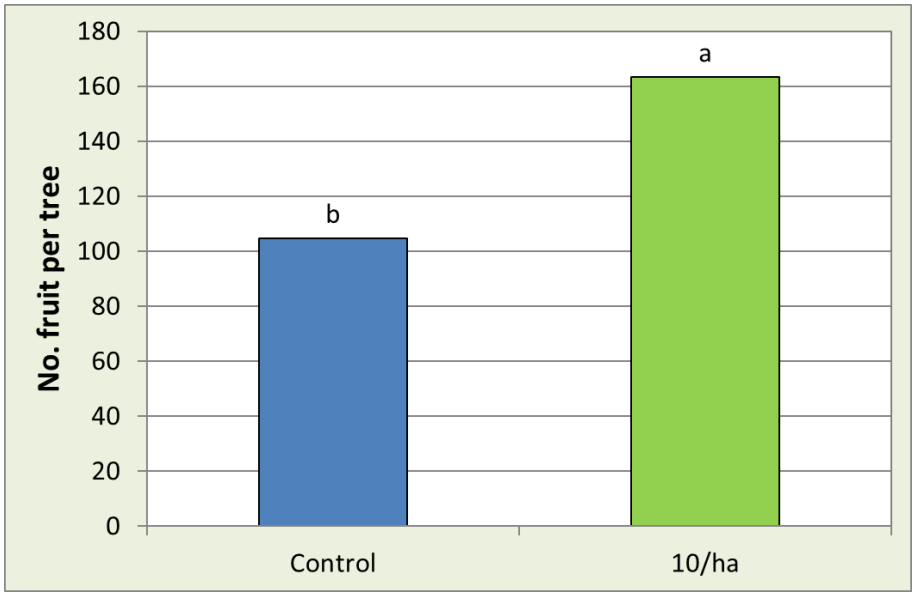


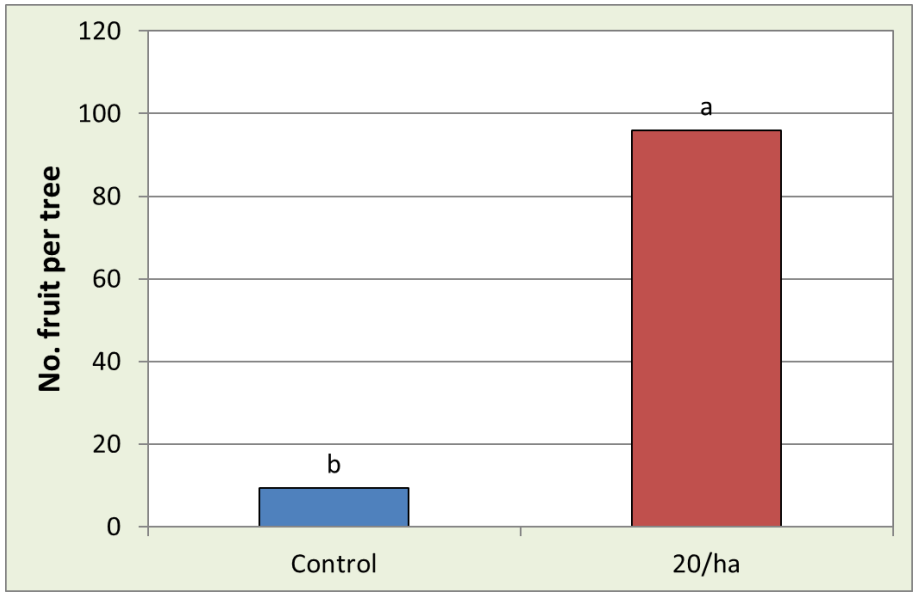
4th year 2020

Objective

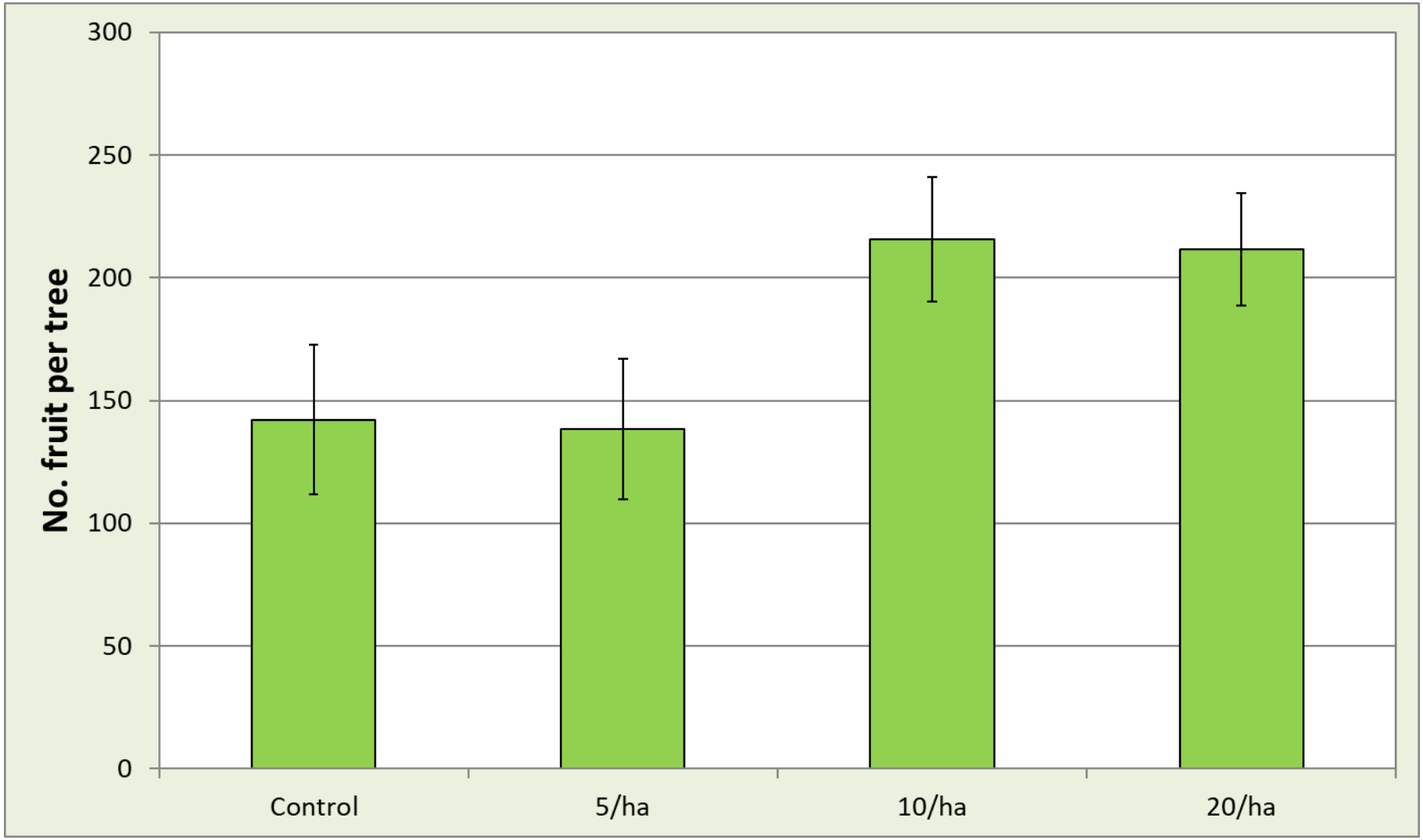
- Examine the optimum **density** of BB hive per ha.

The total number of fruits per tree, ‘Hass’ Eyal 2020

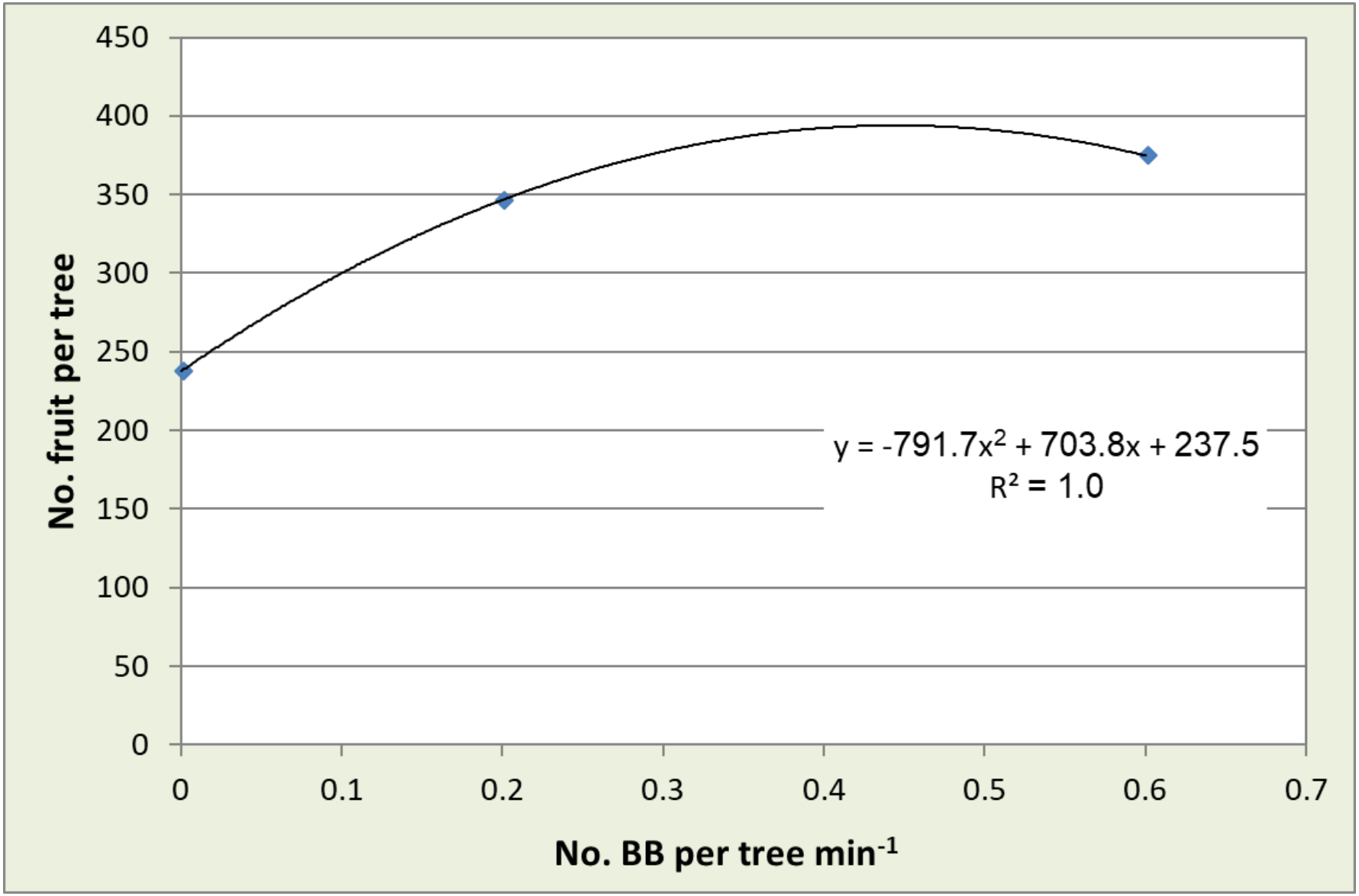




The total number of fruits per tree, 'Hass' Negba 2020



Correlation between no. BB/tree/min. and yield



Conclusions

- Low pollination is the main reason for poor yield of 'Hass' avocado.
- Adding BBs to the orchards (10 hives per ha.) improves pollination rate and no. of pollen grains on the stigma, which increases fertilization, fruit-set and yield.
- The optimal radius of BB activity from the BB hives is 50 to 70 m.
- Stern et al., 2021. Bumblebees (*Bombus terrestris*) improve 'Hass' avocado (*Persea americana*) pollination. Plants 2021, 10, 1372. https://doi.org/10.3390/plants10071372.

Thank you

BB

HB

HB