

I SEEQ, 2005



**The Mediterranean fruit fly (*Ceratitis capitata*)
harbors a dynamic and diverse gut bacterial
population of active diazotrophs**

Dept of Entomology & Dept of Microbiology
The Faculty of Agricultural, Food and Environmental Quality Sciences
The Hebrew University of Jerusalem
Rehovot, Israel

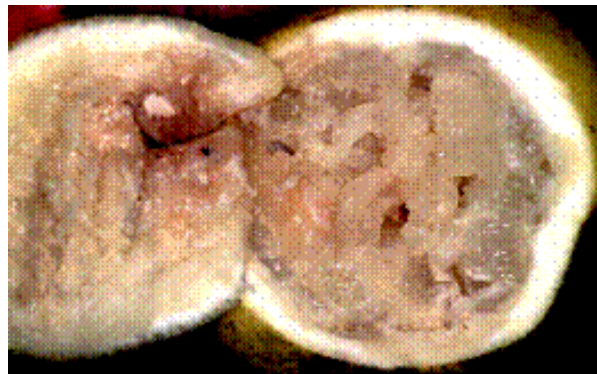
Microbial



Ecology

World Prokaryotic Population: $\sim 5.0 \times 10^{30}$

	Described species	Number of estimated species (in thousands)		Working figure	Accuracy of working figure
		High	Low		
Viruses	4	1000	50	400	Very poor
Bacteria	4	3000	50	1000	Very poor
Fungi	72	2700	200	1500	Moderate
'Protozoa'	40	200	60	200	Very poor
'Algae'	40	1000	150	400	Very poor
Plants	270	500	300	320	Good
Nematodes	25	1000	100	400	Poor
Arthropods					
Crustaceans	40	200	75	150	Moderate
Arachnids	75	1000	300	750	Moderate
Insects	950	100,000	2000	8000	Moderate
Molluscs	70	200	100	200	Moderate
Chordates	45	55	50	50	Good
Others	115	800	200	250	Moderate
Totals	1750	111,655	3635	13,620	Very poor

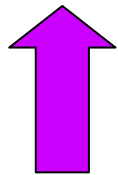
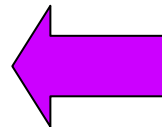
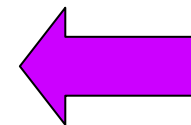
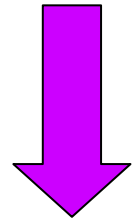
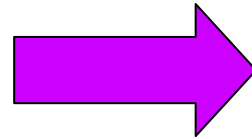


The medfly

- Important agricultural pest
- Female oviposits in fruits
- Needs nitrogen (also) at the adult stage



The medfly's life cycle

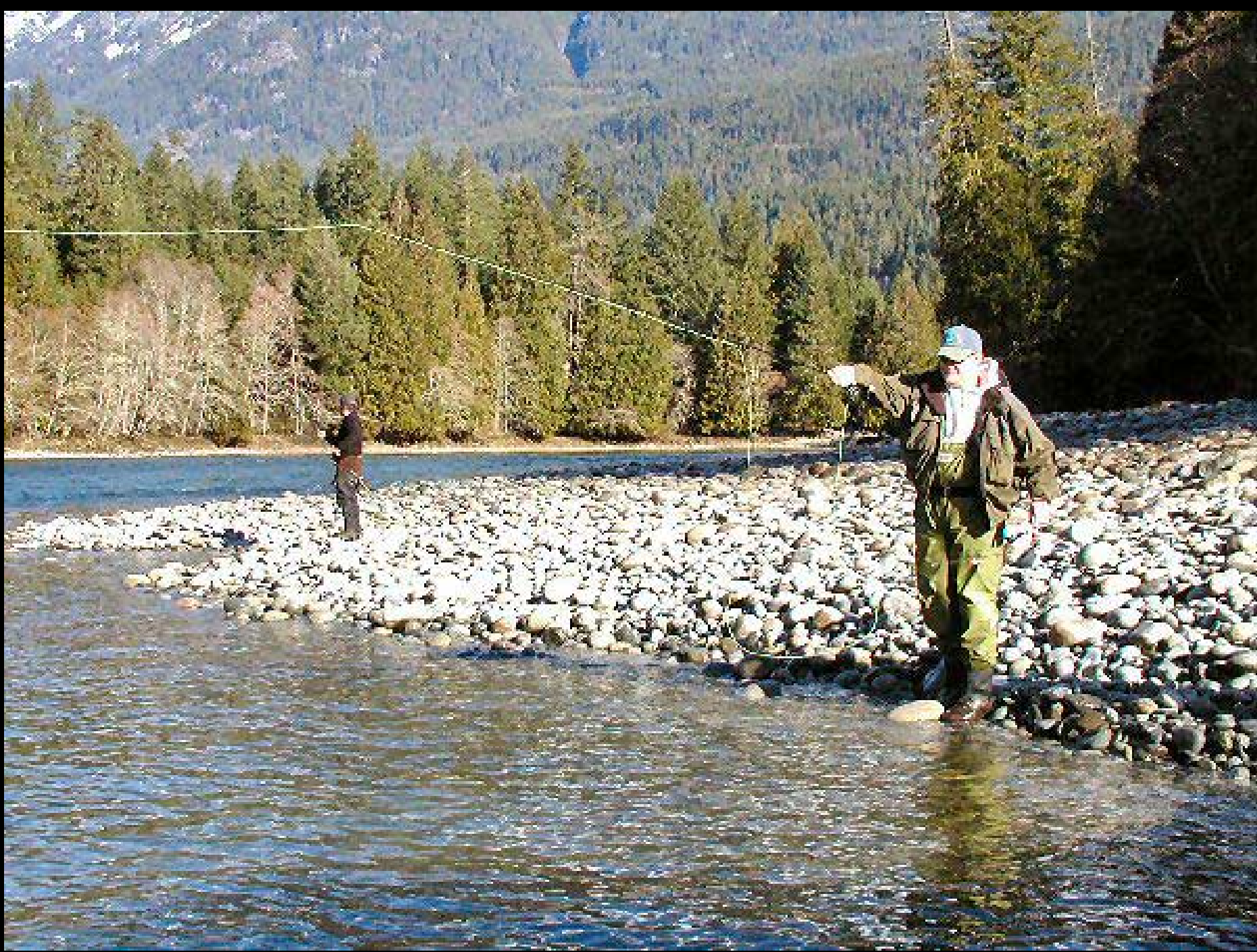


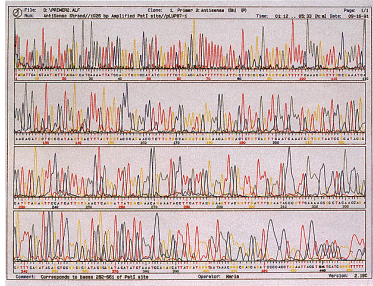
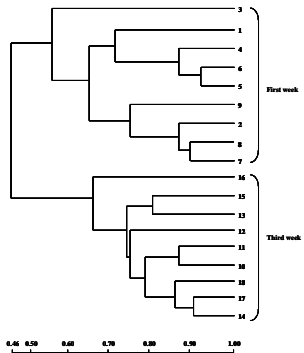
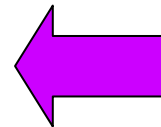
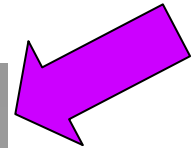
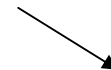
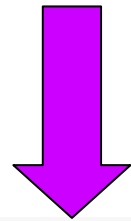
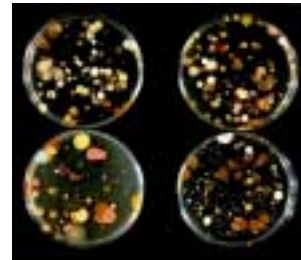
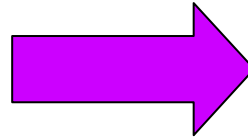
Host-borne microbial communities play essential roles related to nutrient acquisition, health, sex ratio, social behavior...

FITNESS

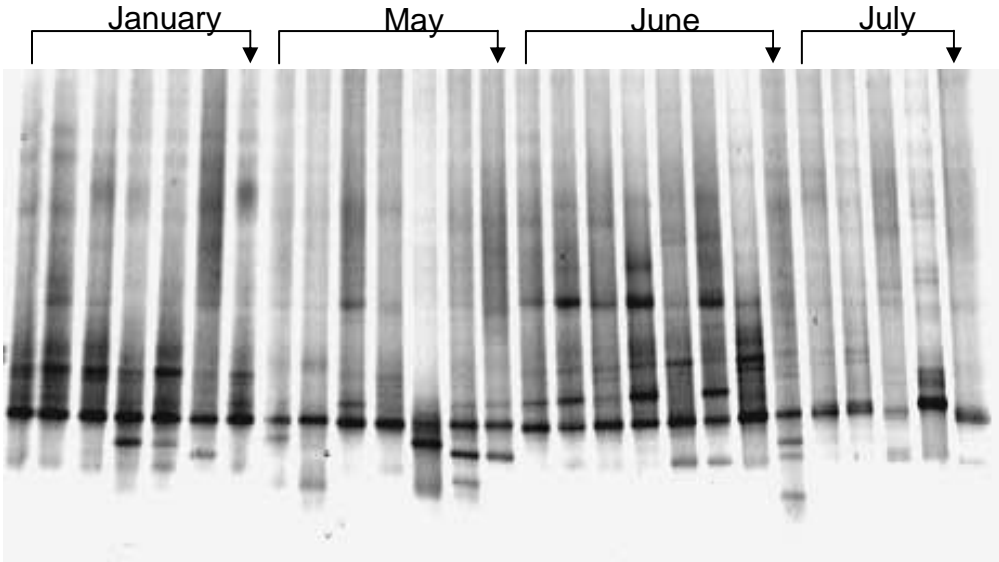
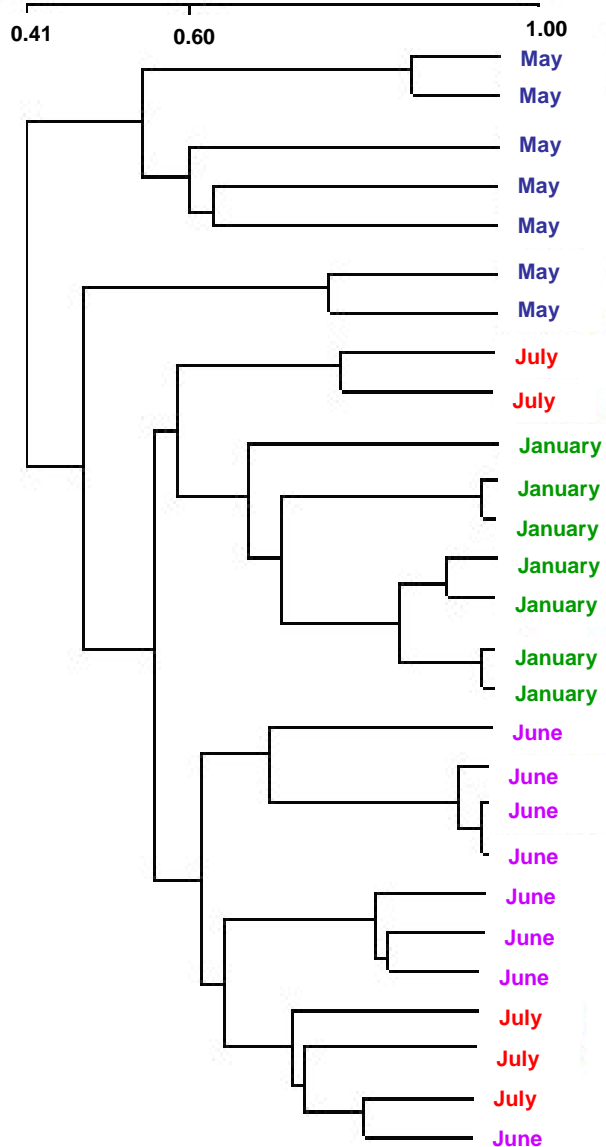
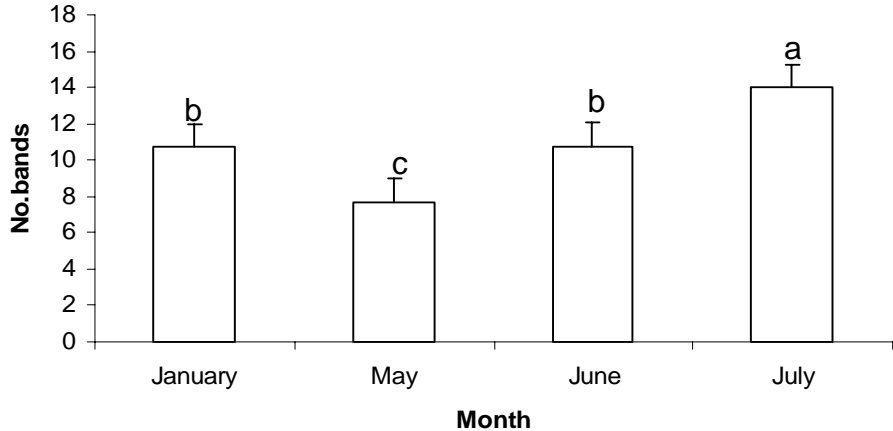
Objectives

- To identify the medfly's gut microbial community during its life cycle
- Discover and study functions performed by the populations forming this community

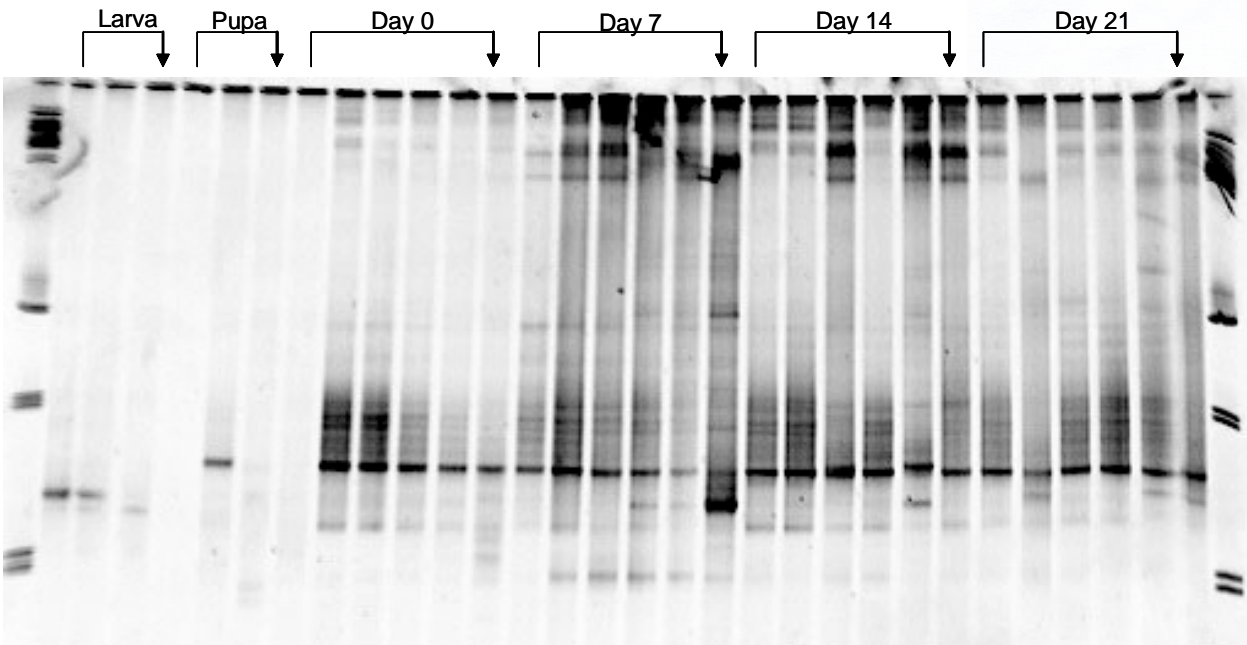
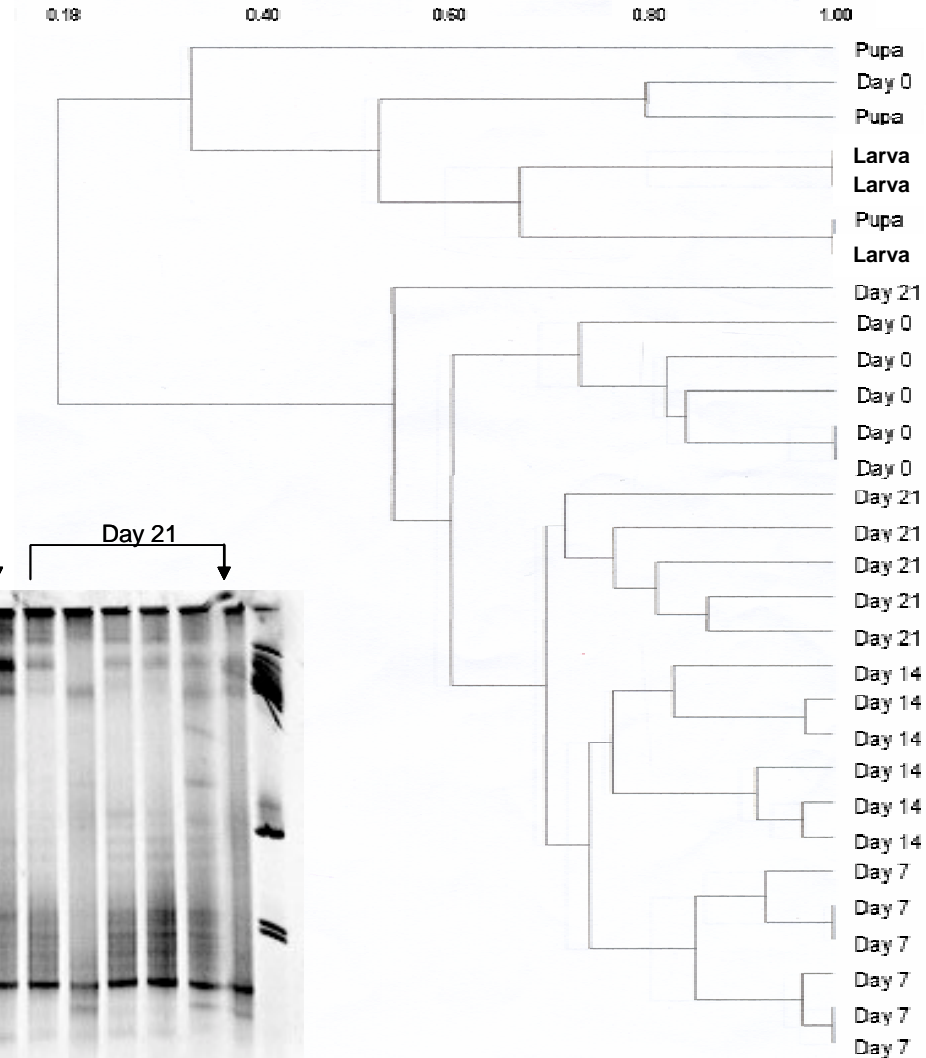
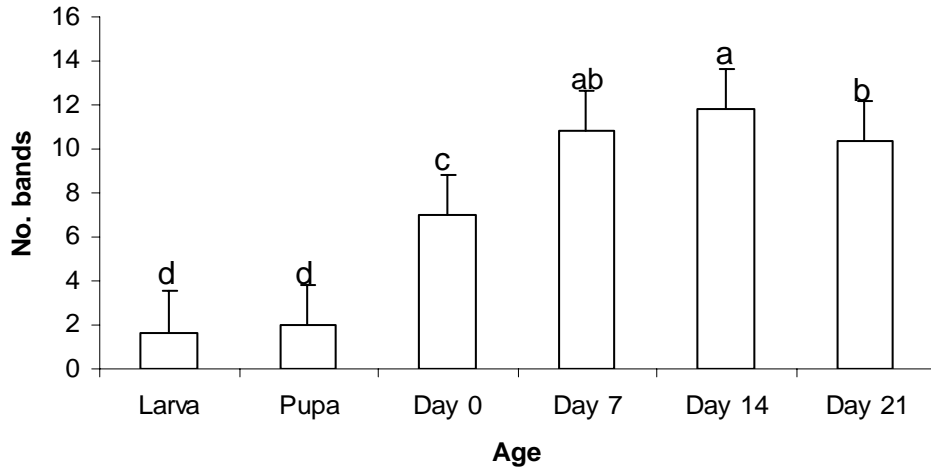




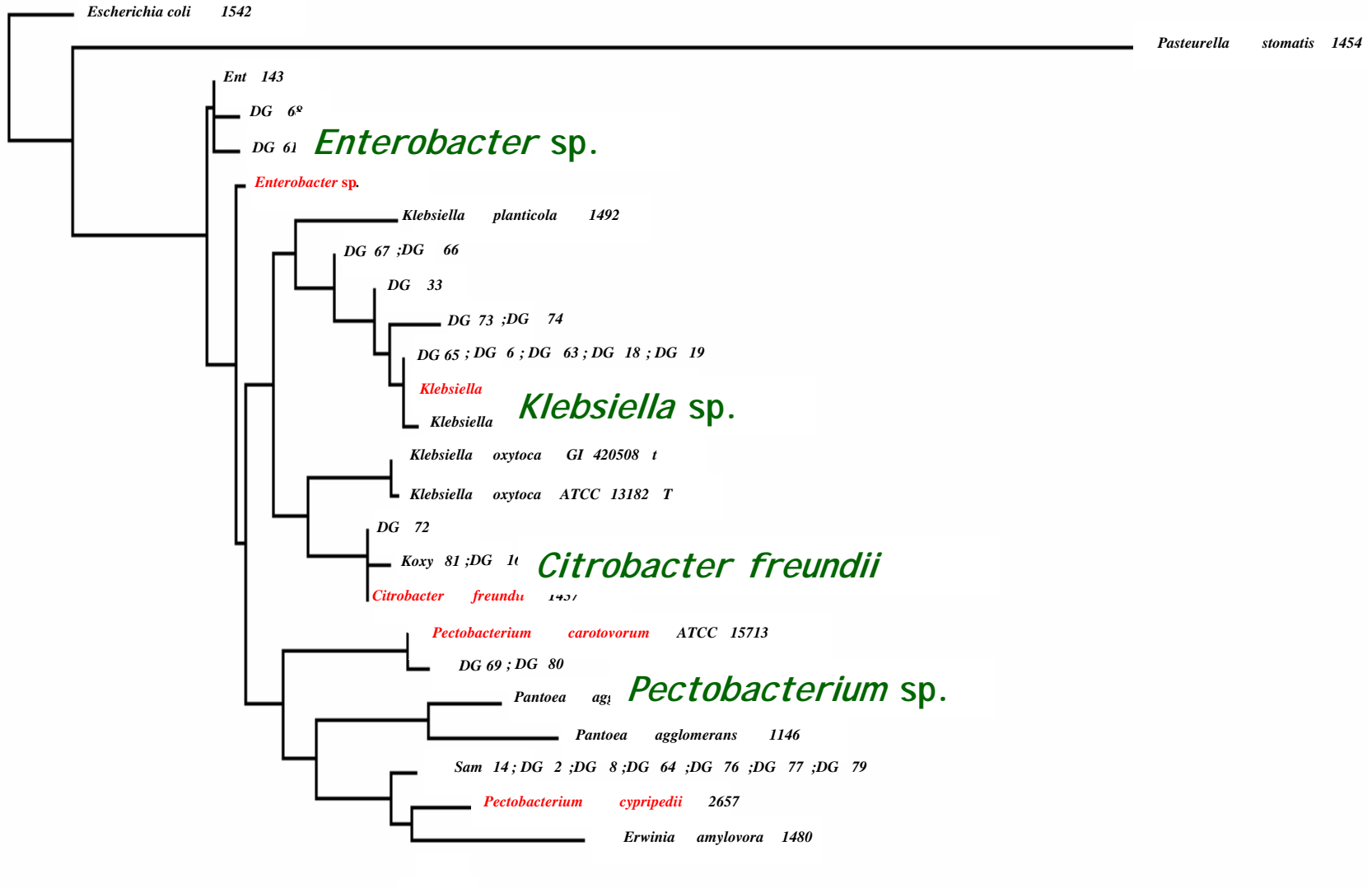
Gut bacterial community of adult flies - 2004



Gut bacterial community: larval, pupal and adult stages

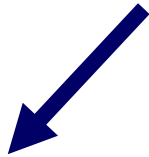


16S rRNA gene phylogeny



The medfly gut's community is essentially

Enterobacteriaceae



*Klebsiella, Citrobacter,
Enterobacter*

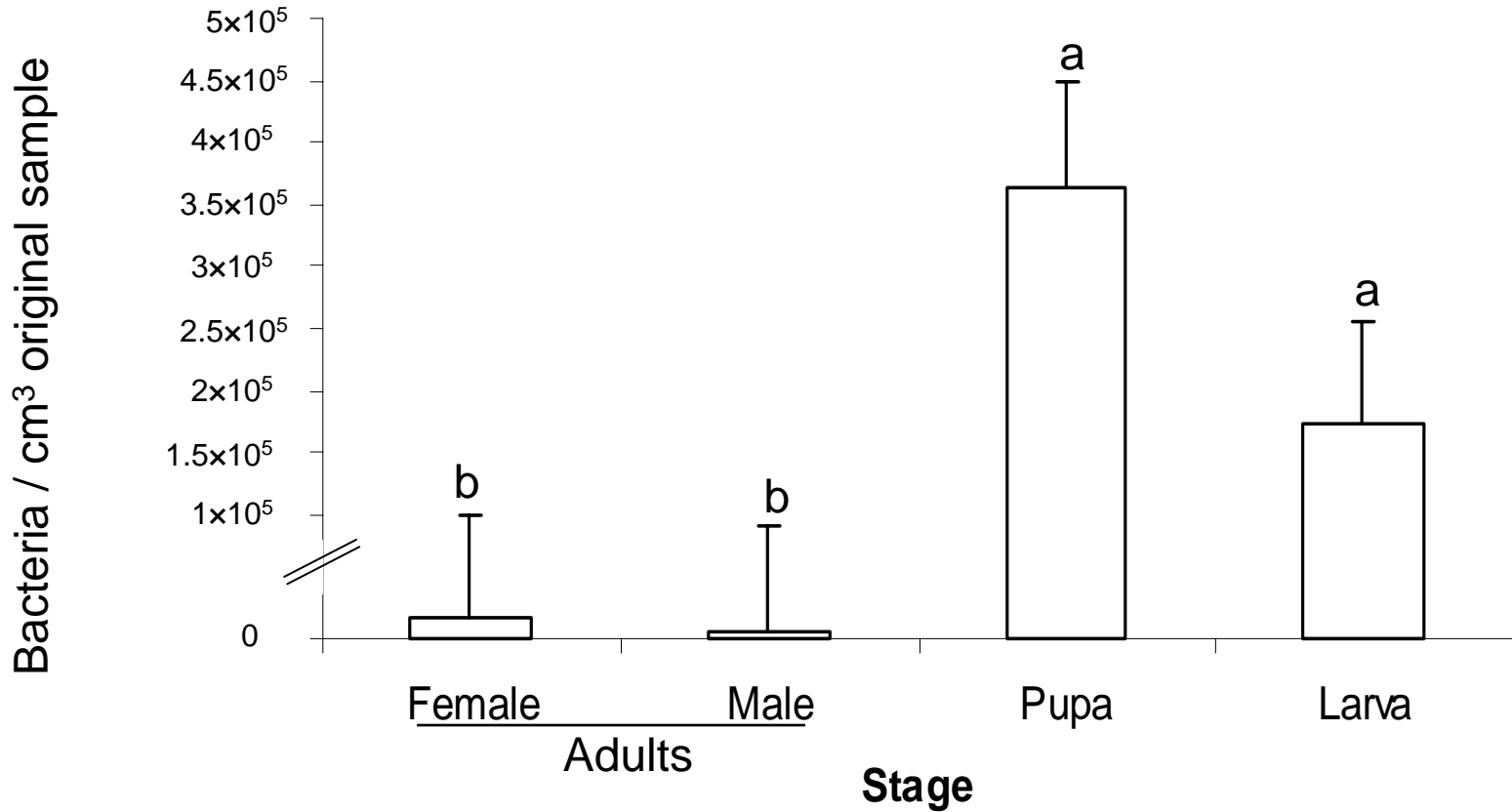
Diazotrophs



Pectobacterium

Pectin degradation

Pectinolytic bacteria in fly guts

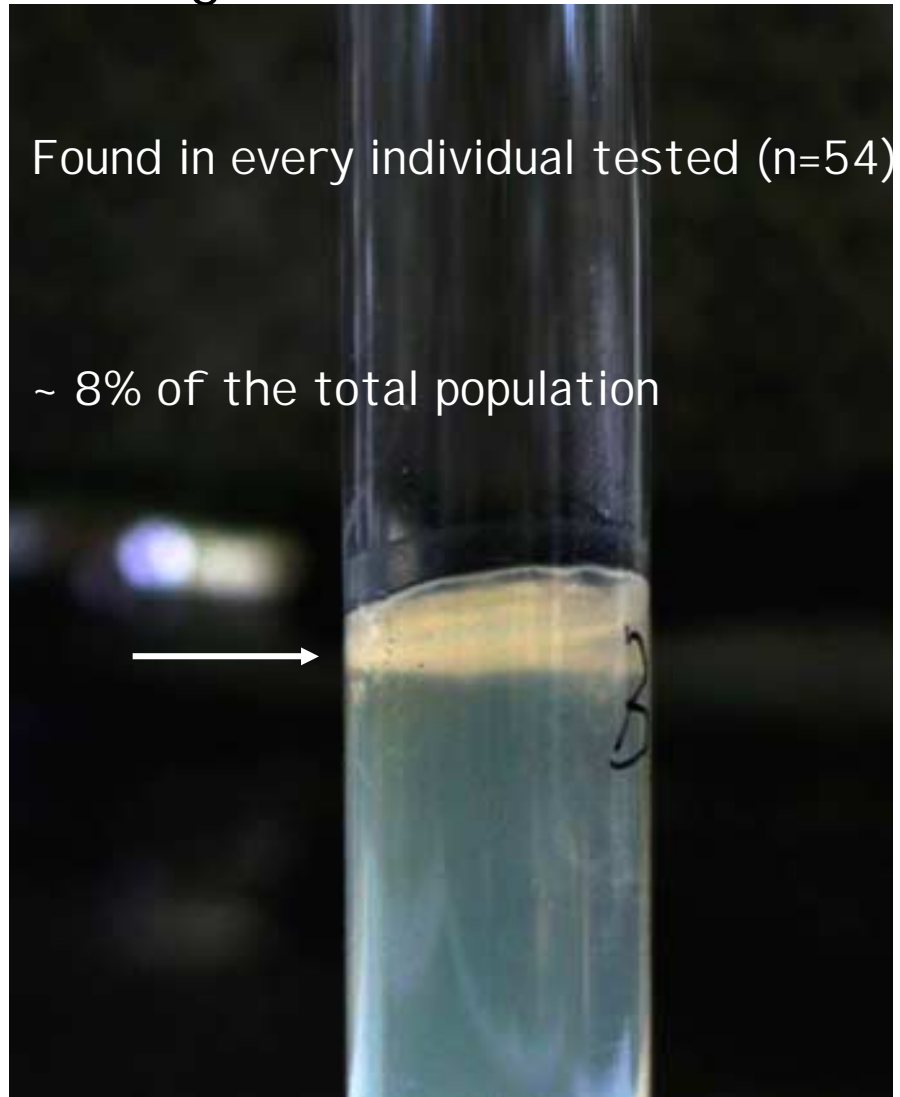


Does the larva benefit?

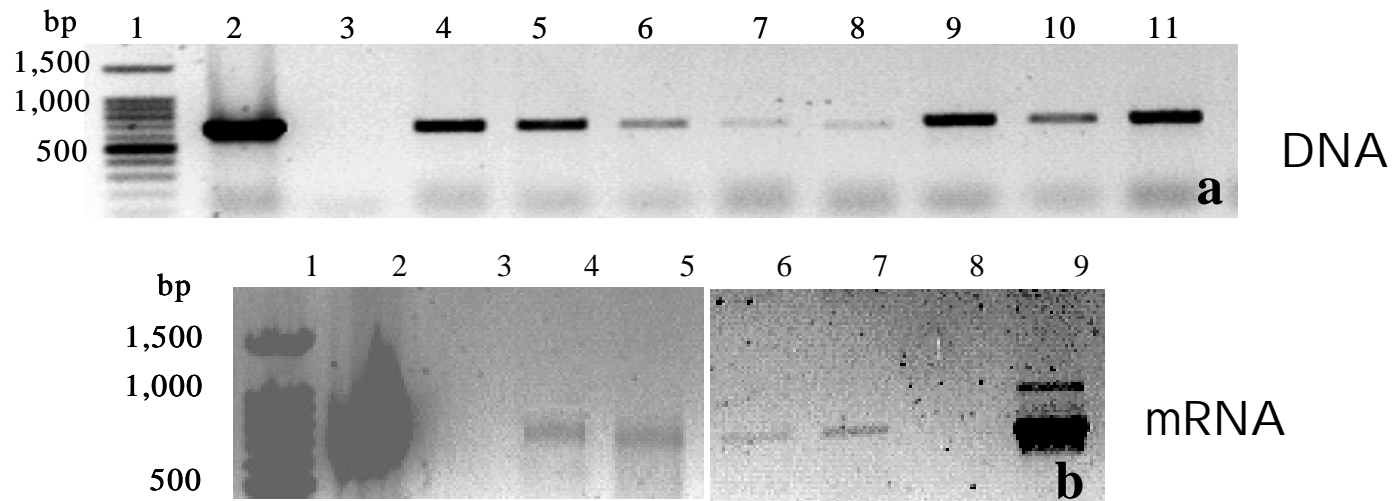
Nitrogen fixing bacteria in fly guts

Nitrogen fixation could be significant if:

- Diazotrophic bacteria are widely distributed within medfly populations
- Diazotrophic populations constitute a significant fraction of the gut bacterial community
- These bacteria deploy the molecular machinery for fixing atmospheric nitrogen
- Atmospheric nitrogen is fixed in vivo

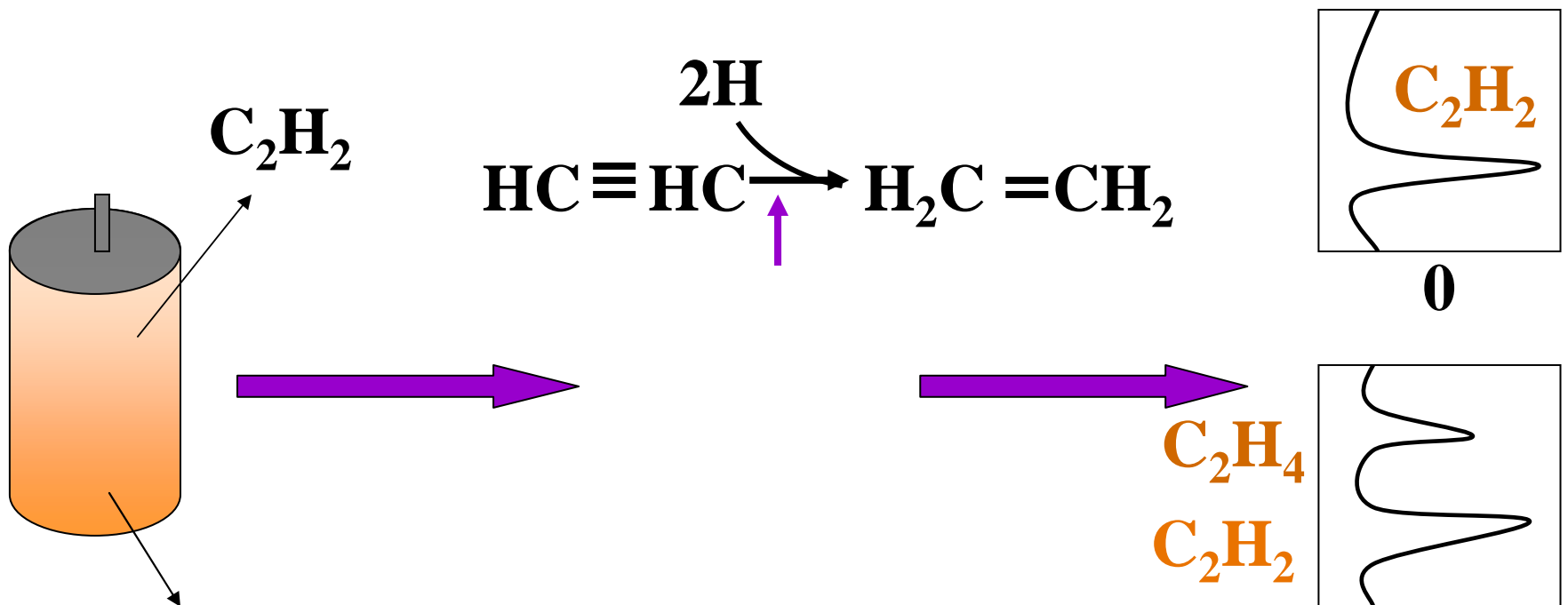
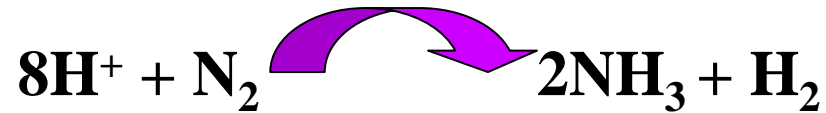


nif H analysis

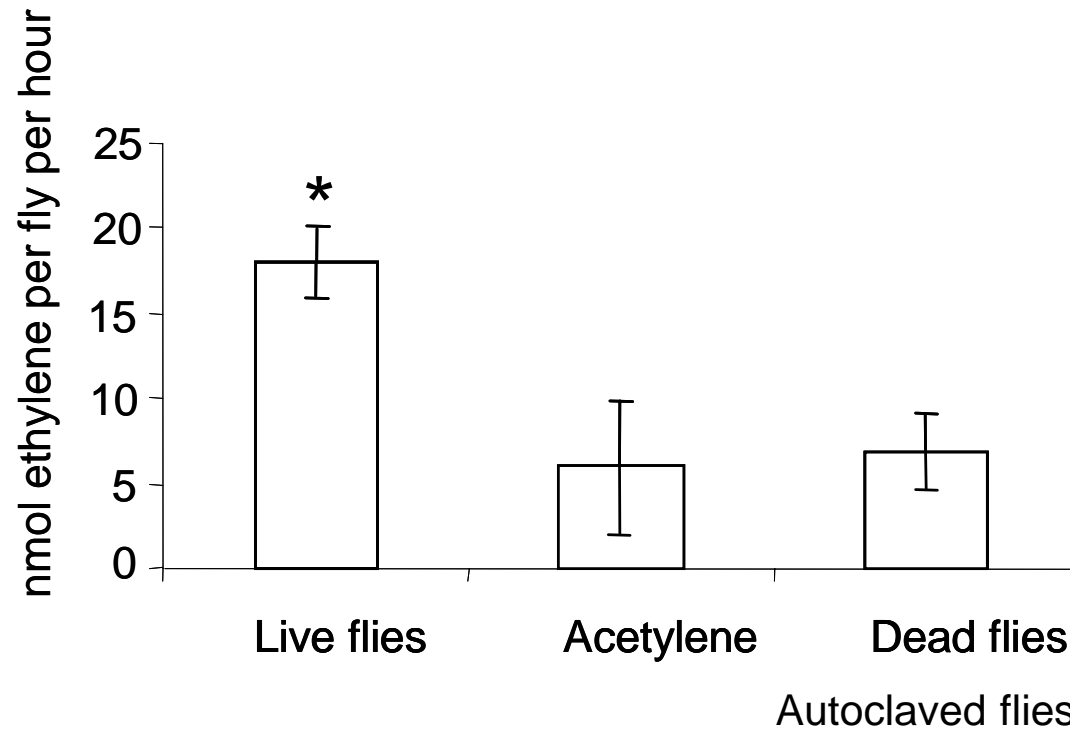


The molecular machinery for fixing atmospheric nitrogen is detected in the fly's gut

Acetylene Reduction Assay



In vivo nitrogen fixation



Atmospheric nitrogen is fixed in vivo

15-30% of the fly's daily protein intake

Summary

The medfly's gut bacterial community structure:

- Is correlated with the fly's developmental stage
- Changes during the active season

Two functions were identified:

- Pectinolysis
- Nitrogen fixation

????

- How is this association working? Does it contribute to the fly's fitness?

- Which role for the pectinolytic community?
Is nitrogen fixation common in fruit flies? In other insects? Influence on the nitrogen cycle?

- What is the relationship between the pectinolytic and diazotrophic activities?

- Is there a functional significance to the population diversity? (geographical? climatic?)

Faculty of Agriculture

Boaz Yuval

Batya Kamensky

Adi Behar

CSU, Hayward

Carol Lauzon

Binational Science Foundation

Chief Scientist-Min. Agriculture

