College of Tropical Agriculture and Human Resources
University of Hawaii at Manoa

Shelter Belt Trees and Cacao pollinators

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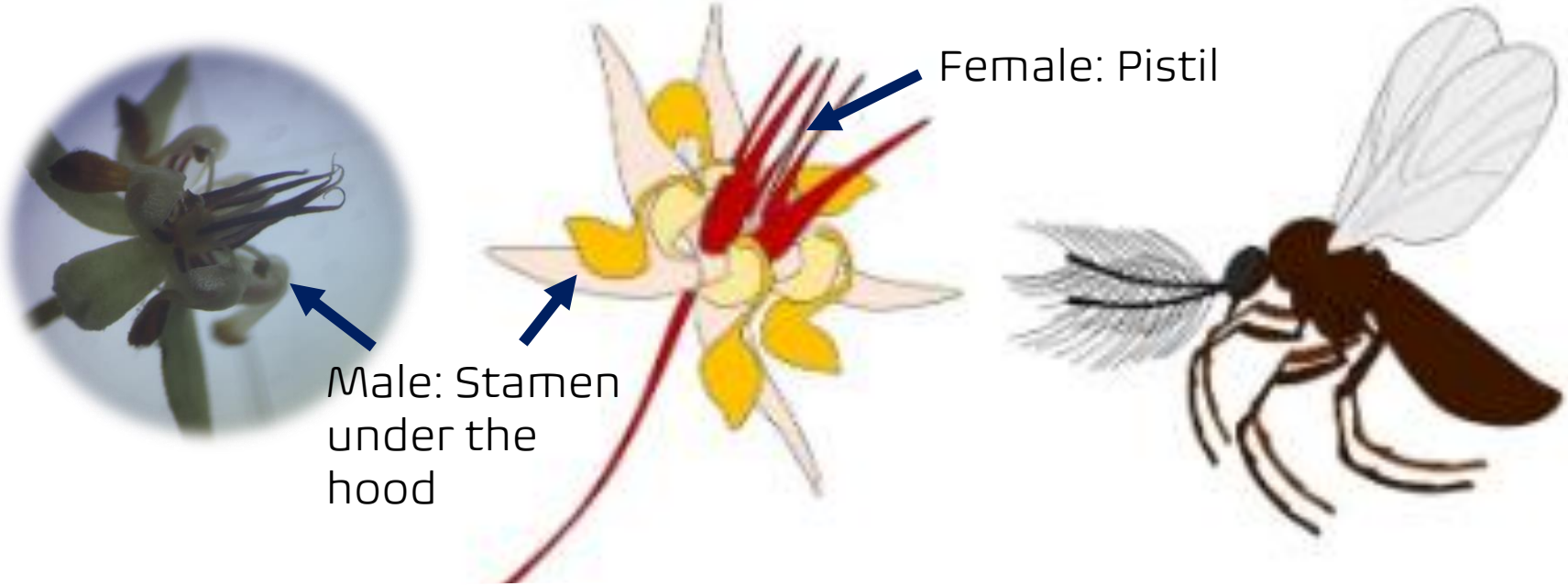
CTAHR PEPS

April 29, 2022

Poamoho Orchard Crop Field Day

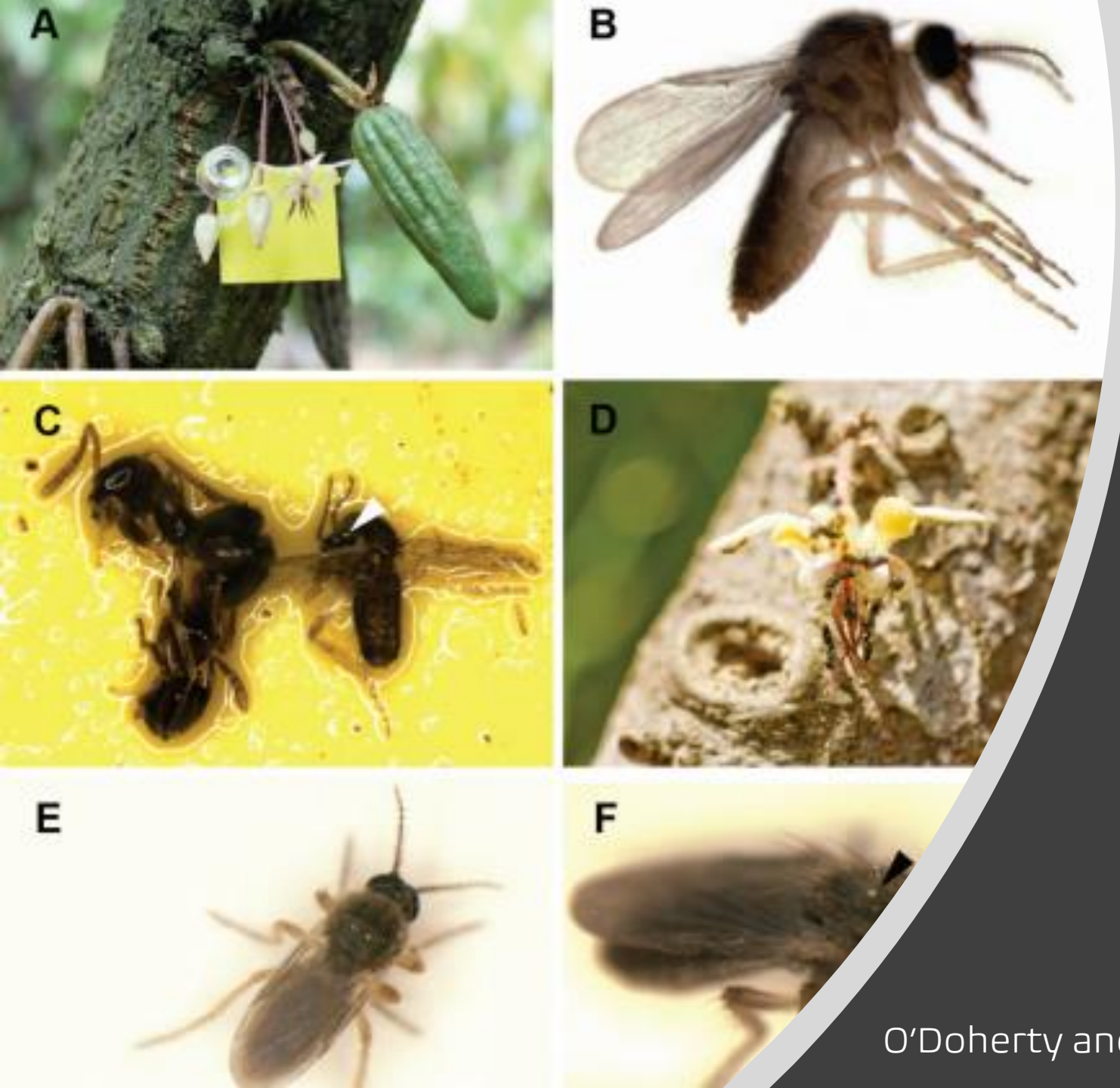
https://cacaopollination.com/cacao-pollinators/



- Cacao pollinators:
  - Biting midges (Ceratopogonidae: Forcipomyia)
  - Gall midges (Cecidomyiidae)
  - Unknown: Fungus gnats (Sciaridae), some parasitoid wastps, ants

Cacao pollinators

- In general, the rate of pollination is only 10% of the > 1000 flowers a cacao tree can produce each year.
- Cacao yield can be doubled when pollination is increased by manually pollinating flowers (Groeneveld et al., 2010).
- Only insects smaller than 2-3 mm can enter the small space inside the hoods and the staminode cage to access pollens.
- Cacao pollen is self-incompatible=need cross pollination



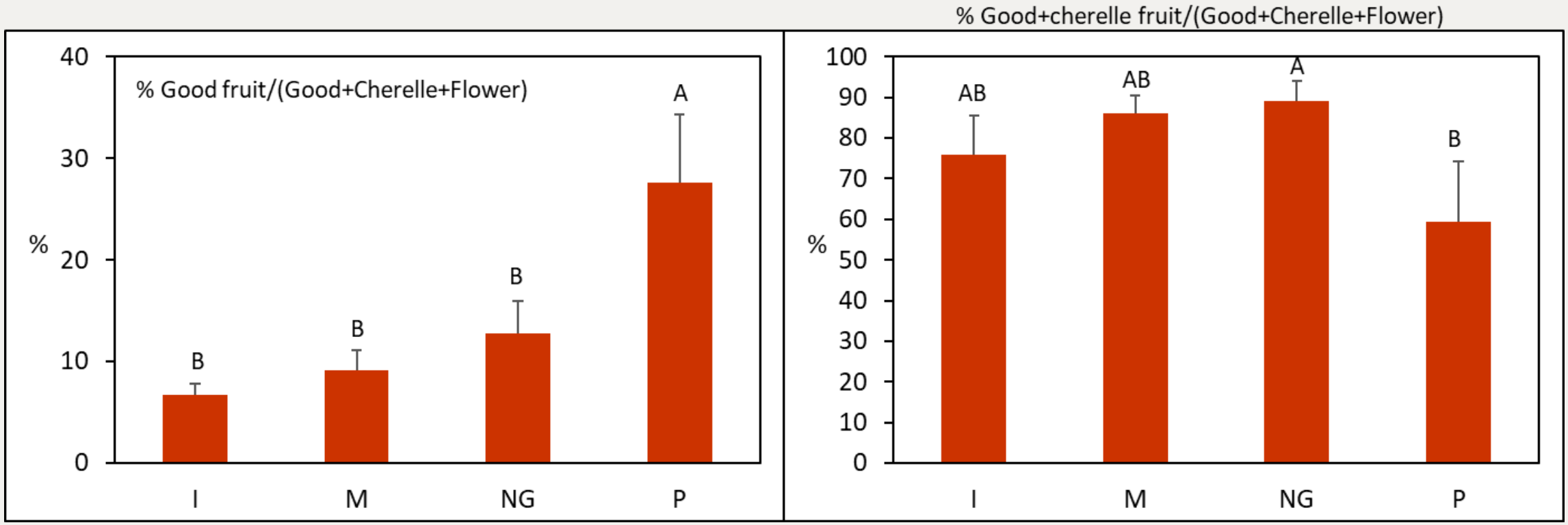
Forcipomyia hardyi (Diptera: Ceratopogonidae), a Potential Pollinator of Cacao *(Theobroma cacao)* Flowers in Hawaii

-an endemic biting midge found visiting cacao blossom in cacao orchards on Oahu.

O'Doherty and Zoll (2012)

Pollination of cacao in Hawaii

can be very good. March-April is the peak fruit harvesting season. Up to 27% good fruit set was documented recently if we ignore fruits suffering from Cherelle wilt.



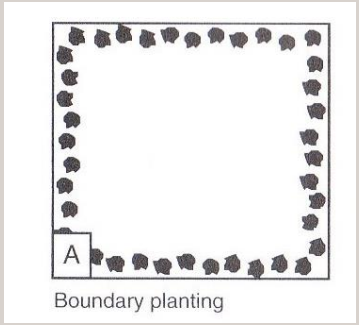
(Wang, 2022)

Cause of Cherelle wilt is unknown but a physiological disorder (Melnick et al., 2012).

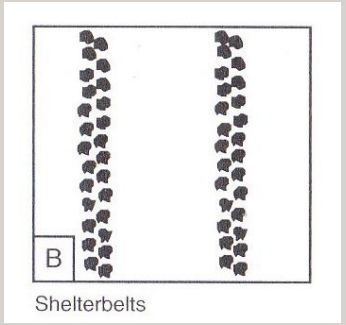
Where do cacao pollinators reproduce?

- The cacao pollinating midges are known to lay eggs in moist habitats e.g. rotting leaf litter, rotting banana pseudo-stems, rotting cacao pods and inside the water contained in bromeliad plants.

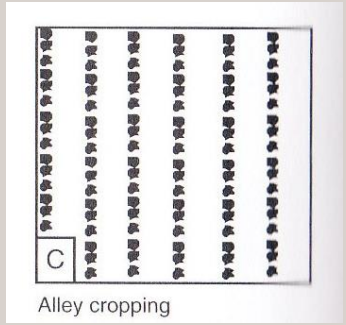
Shelter belt



Boundary planting



Shelterbelts



Alley cropping

- Benefits: 1) Young cacao trees need sun and wind protection; 2) Prevent the cacao trees from growing too tall for convenience of harvest and maintenance; 3) enhance habitats for pollinators.
- Common shade trees for cacao: banana, plantain, coconut, rubber. Cocoa seedlings should be planted 10–20 ft away from the shade trees.
- It is also a good practice to replant cacao seedlings next to a mother tree.

Survey on four sites with different boundary planting/shelterbelts in cacao fields

April 2022

Neem as boundary plants, Gliricidia as shelterbelts (NG)

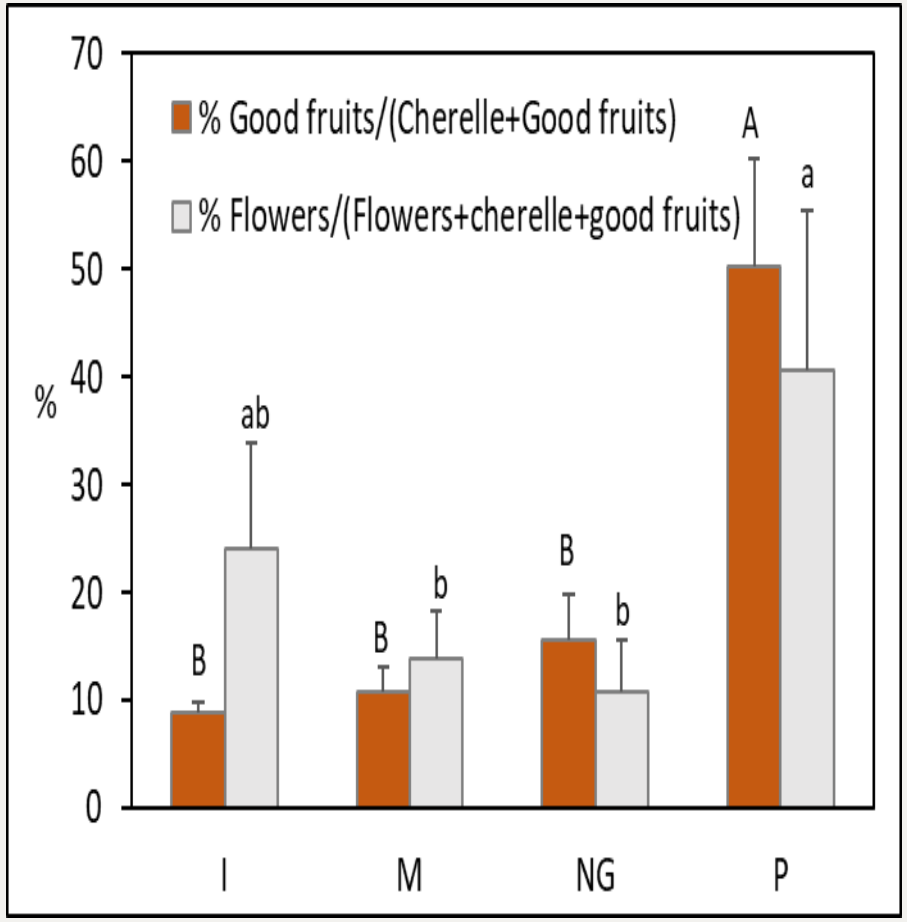
Mahagony+banana as boundary plants, Milo as shelterbelts (M)

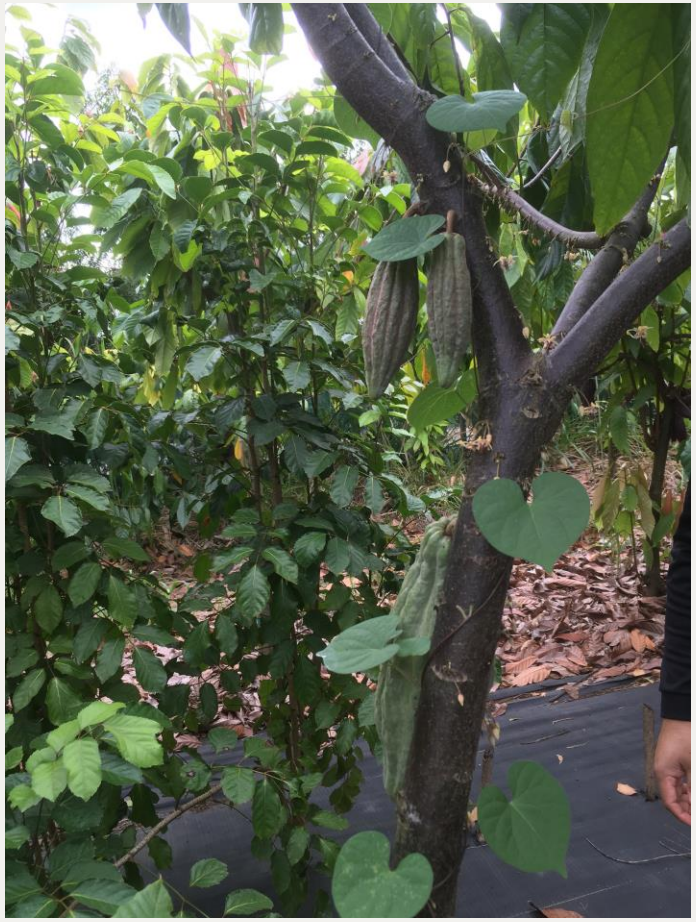
Ironwood as boundary plants (I)

Panex as shelterbelt plants (P)

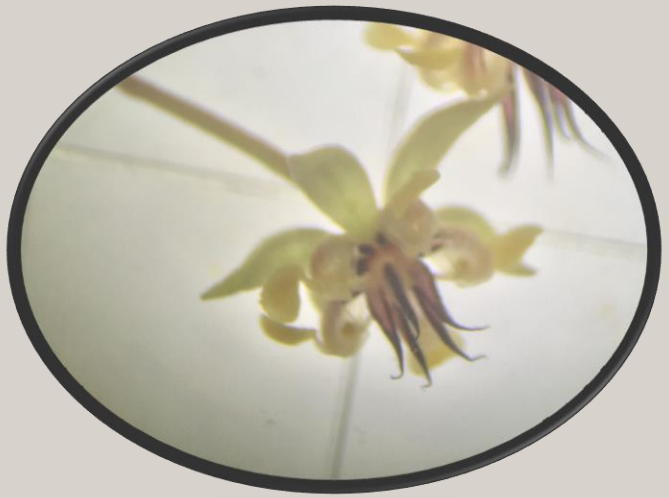
Which shade trees resulted in most successful fruit set?

- Panex as shelterbelts (with few neem trees at the border).
- However, Panex also resulted in most flowers not setting fruits.
- However, Panex resulted in least Cherelle wilt.



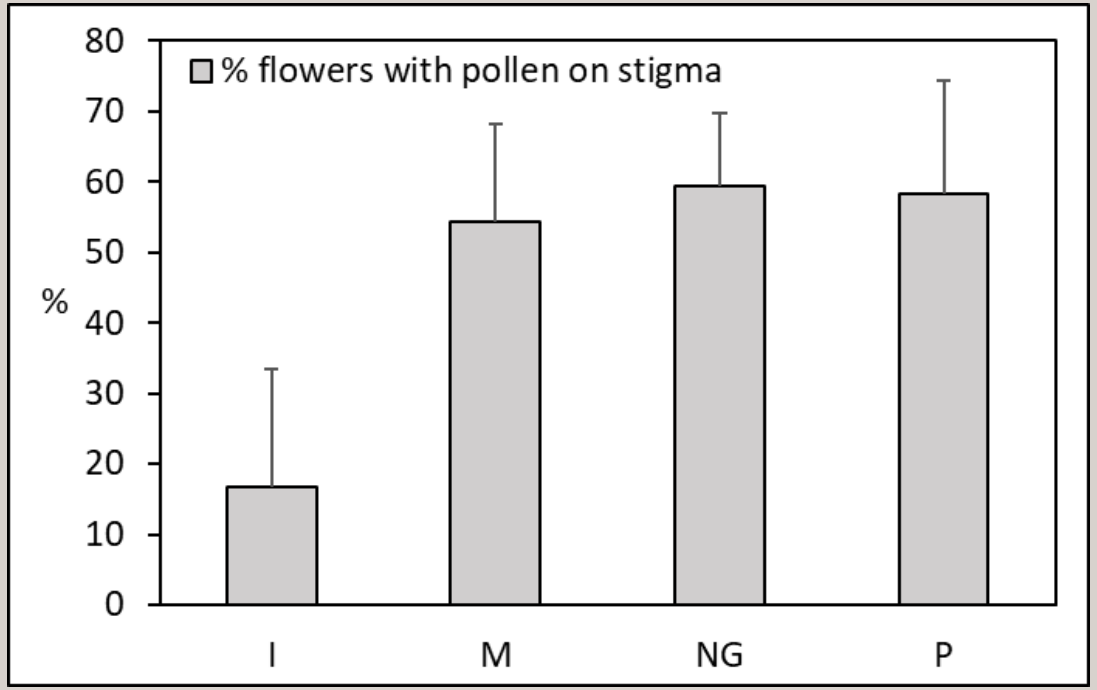


I = Ironwood M= Mahagony+milo+banana NG = Neem + Gliricidia P = Panex

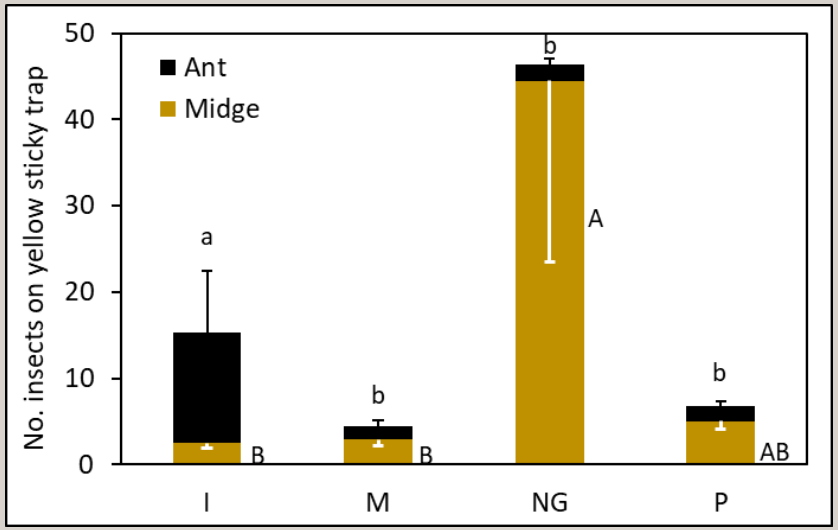


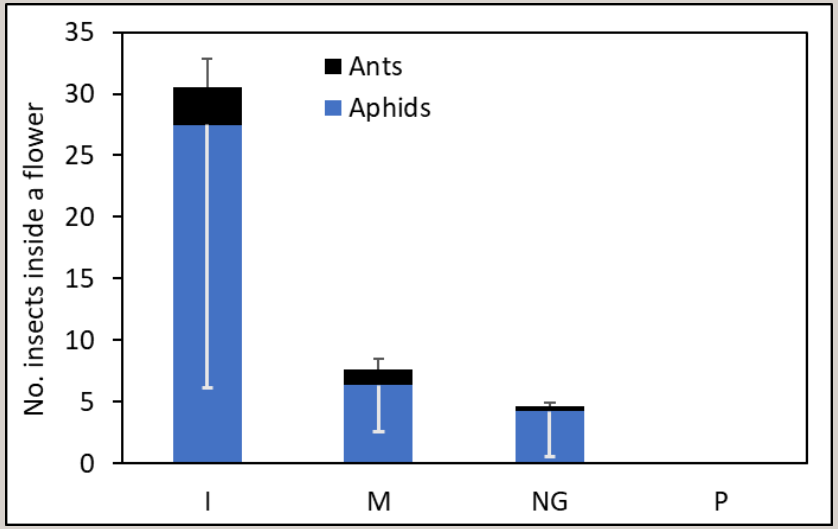
Observed pollens under the microscope

- Three flowers selected per plants from 4 plants at each site revealed lowest number of flowers with pollens found on stigma from cacao with “Ironwood” as the boundary.



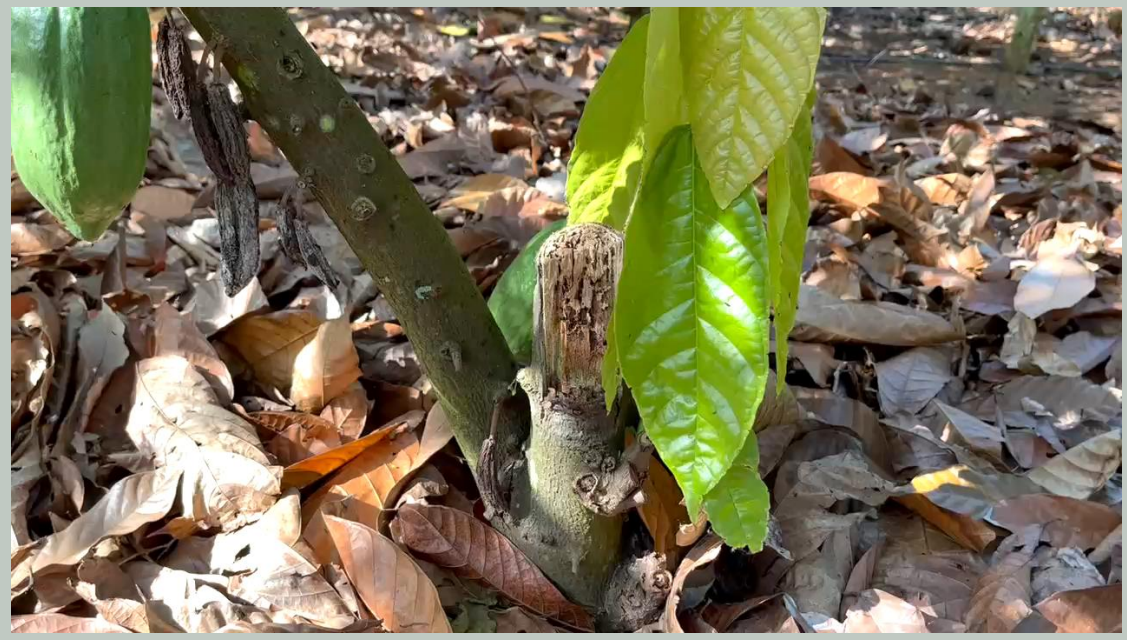
I = No shelterbelt inside this cacao plot, and not much leaf litters on the ground. .





Recovery of midges on yellow sticky traps installed on cacao tree trunk for 1 week were highest in neem and gliricidia (NG) plots probably due to the good shading and thick leaf litter mulch on the ground.

Summary



• Neem as boundary and gliricidia as shelterbelt along with thick cacao leaf litter (NG) provided the best habitat to sustain high population of biting midges.	• NG and Mahagony+milo+banana (M) were both effective in helping cacao to set fruits with minimal flowers unfertilized. - But NG and M tended to had more Cherelle wilt.
• Panex (P) though did not support high count of midges, when planted closely with cacao resulted in least Cherelle wilt, and highest cacao fruit set.	• Ironwood shelter might work better if surrounding all 4 borders, followed by intermittent planting of gliricidia or panex closer to the cacao rows.

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