Ethnobotany. Lecture 20

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March 8, 2013

Outline

Plants make caffeine for bee pollinators!

Science 8 March 2013:
Vol. 339 no. 6124 pp. 1202-1204
DOI: 10.1126/science.1228806

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REPORT

Caffeine in Floral Nectar Enhances a Pollinator's Memory of Reward

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ABSTRACT | EDITOR'S SUMMARY

Plant defense compounds occur in floral nectar, but their ecological role is not well understood. We provide evidence that plant compounds pharmacologically alter pollinator behavior by enhancing their memory of reward. Honeybees rewarded with caffeine, which occurs naturally in nectar of *Coffea* and *Citrus* species, were three times as likely to remember a learned floral scent as were honeybees rewarded with sucrose alone. Caffeine potentiated responses of mushroom body neurons involved in olfactory learning and memory by acting as an adenosine receptor antagonist. Caffeine concentrations in nectar did not exceed the bees' bitter taste threshold, implying that pollinators impose selection for nectar that is pharmacologically active but not repellent. By using a drug to enhance memories of reward, plants secure pollinator fidelity and improve reproductive success.

Fruits, nuts and vegetables

Most important tropical and subtropical fruits

Durian, *Durio* spp.

- Several cultivated species, representatives of Malvaceae family
- Large size, unique odor and thorned fruit surface
- “King of the fruits”
- Odor is unusual, it is the reason why durian is banned, e.g., in public transportation. “Smell evokes reactions from deep appreciation to intense disgust, and has been described variously as almonds, rotten onions, turpentine and gym socks”...

Durian

Durian tree

Durian features

- Large tropical trees, fruits may be dangerous because they heavy, thorned and located very high
- Fruit content is rich of carbohydrates and fats
- Originated in Indonesia and became popular in Europe only in XX century

Eating durian, I

Eating durian, II

Carambola, starfruit, bilimbi *Averrhoa carambola*

- Tree native to Philippines
- Belongs to Oxalidaceae family
- Tree of tropical wet forests

Starfruit

Carambola features

- Harvested year round
- Fruits are rich of water, vitamin C and oxalic acid (family character)
- Contains antioxidants

Guava, *Psidium* spp.

- Representative of Myrtaceae, the family rich of useful species with medicine and other values
- All parts of plant contain essential oils
- More than 100 species, all are edible, some are cultivated (like *Psidium guajava*)

Guava flowers

Guava fruits

Guava features

- Originated in Central America
- Fruits contain up to 12% of sugars, diverse minerals (e.g., iron), many pectins
- In India, often consumed with salt

Tamarind, *Tamarindus indica*

- The rare fruit legume (Leguminosae)
- One of traditional national Indian fruits
- Edible part of fruit is a pulp, endocarp filling all spaces between seeds

Tamarind

Tamarind candy (India)

Tamarind features

- Plant of multiple uses, legumes used also as starch source (for flour), leaves as vegetables, all parts as medicine
- Normally, do not cultivated in plantations, it is a typical “street tree”
- Well adapted for monsoon climate
- Originated in Africa and was introduced to India in prehistoric times

Acerola, barbados cherry, *Malpighia glabra*

- Caribbean tree from Malpighiaceae family
- Fruits are typically sour, known as a richest source of vitamin C (2% of dry mass)
- Also have antioxidant value

Acerola

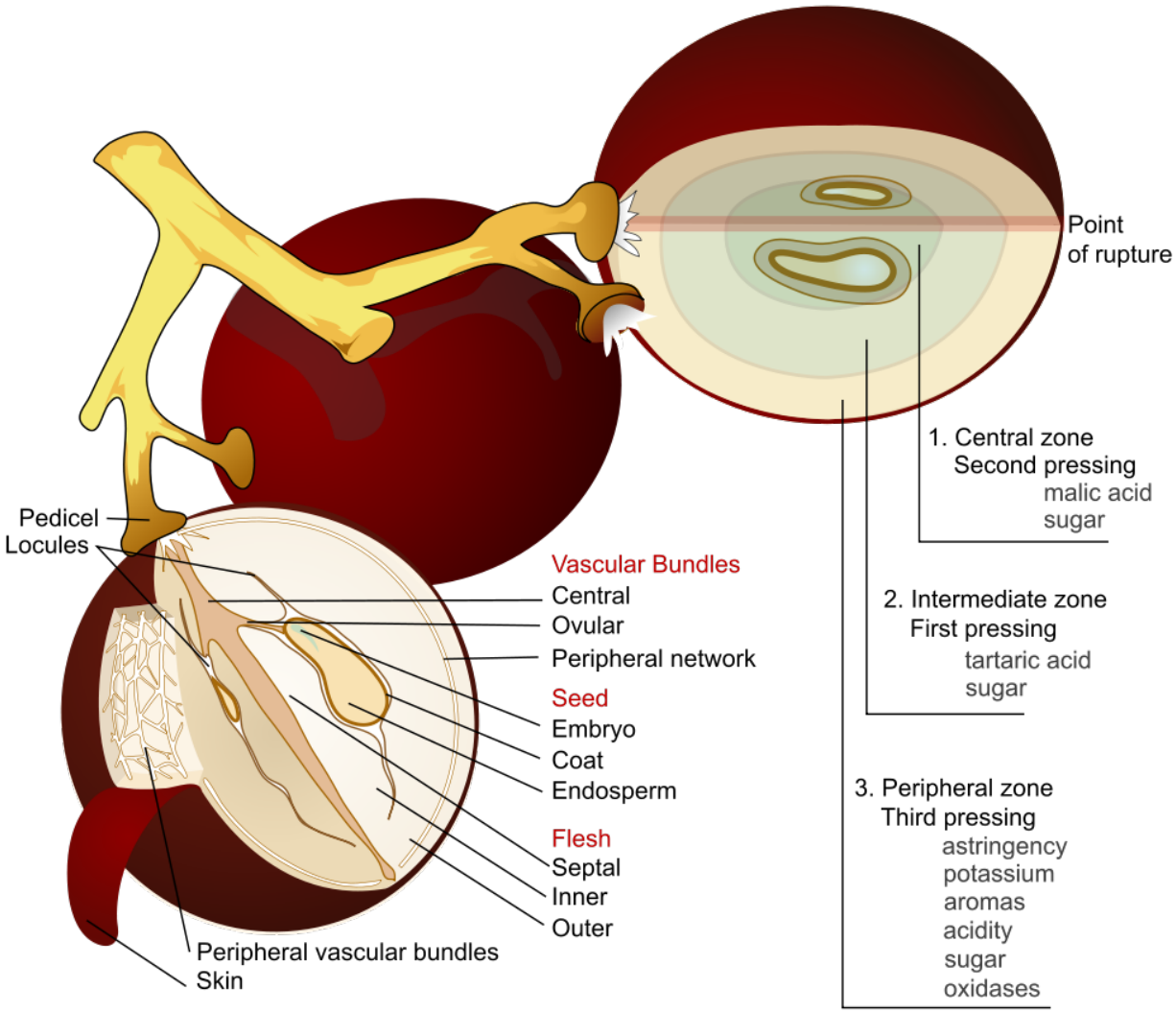
Grape, *Vitis vinifera*

- Belongs to grape family, Vitaceae
- Genus has 70 species, only several are cultivated

Grape biology and agriculture

- Woody vine with tendrils (modified shoots) and palmately lobed leaves
- Agriculture always depend on local climatic conditions
- Forming and cutting are two extremely important techniques

Grape


Point
of rupture
1. Central zone
Second pressing
malic acid
sugar
2. Intermediate zone
First pressing
tartaric acid
sugar
3. Peripheral zone
Third pressing
astringency
potassium
aromas
acidity
sugar
oxidases
Pedicel
Locules
Vascular Bundles
Central
Ovular
Peripheral network
Seed
Embryo
Coat
Endosperm
Flesh
Septal
Inner
Outer
Peripheral vascular bundles
Skin

Grape history

- Central Asian center of origin, cultivated from 4,000 BC
- In Europe, culture flourished in XVII–XVIII centuries
- Used for wine, glucose sugar (raisins) and oil

Persimmon, *Diospiros kaki*

- Belongs to mostly tropical blackwood family, Ebenaceae
- Large genus (200) but only one deciduous species cultivated

Persimmons

Persimmon features and history

- Originates in China
- Fruits are rich of microelements and carotens
- Used also as dry fruit and in eastern medicine; wood is widely used for furniture

Persimmon tree in Japan

Pomegranate, *Punica granatum*

- Belongs to Lythraceae family, genus has only 2 species
- Semi-evergreen shrub

Pomegranate features and history

- The edible parts of fruit are seed arils (similar to litchi)
- Old Mediterranean culture
- Trees are flowering from 2nd year
- One of the most reach of biologically active compounds fruit: contain ellagitannins, punicalagins, polyphenolic catechins, gallocatechins and anthocyanins. They reduce heart disease risks, oxidation, stimulate digestion and immune system.

Pomegranate flower

Date palm, *Phoenix dactylifera*

- Belongs to palm family, Palmae; genus with several species which are cultivated mostly as ornamental palms
- Plant of multiple use: everything, from roots to dry stems, are used

Date palm

Date palm biology and agriculture

- Extremely tolerant to heat, may grow with temperatures above 50°C
- Does not tolerate precipitation; water is normally taken only from deeper soil layers
- Propagated with subsidiary shoots (grow faster than seeds)

Date palm history

- One of the oldest cultivated plants
- Dry fruits are the main food source in North Africa; ≈300 kcal per 100 g (highest among all fruits)
- Dates are rich of minerals, especially potassium, sodium and calcium

Fig tree, *Ficus carica*

- Belongs to mulberry family, Moraceae, and to one of the largest flowering plant genus, *Ficus* ($\approx$1,000 species)
- One of the rare deciduous *Ficus*

Fig inflorescence

Fig tree biology and agriculture

- Edible part of fruit is the axis of inflorescence (not unlike pineapple)
- Have extremely complicated pollination system, including plants with sterile figs (caprifigs), fertile figs and fig wasps

Fig pollination

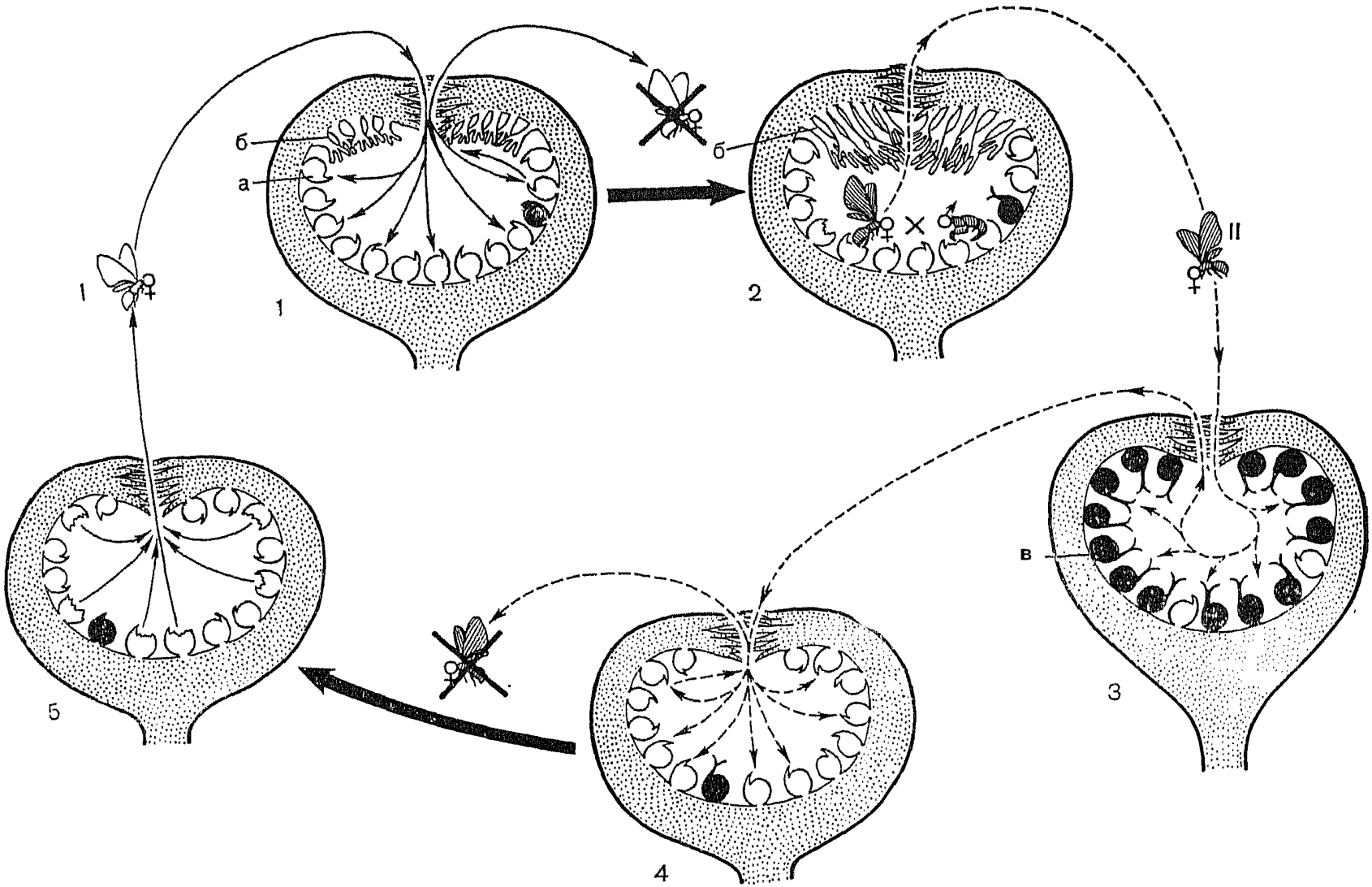
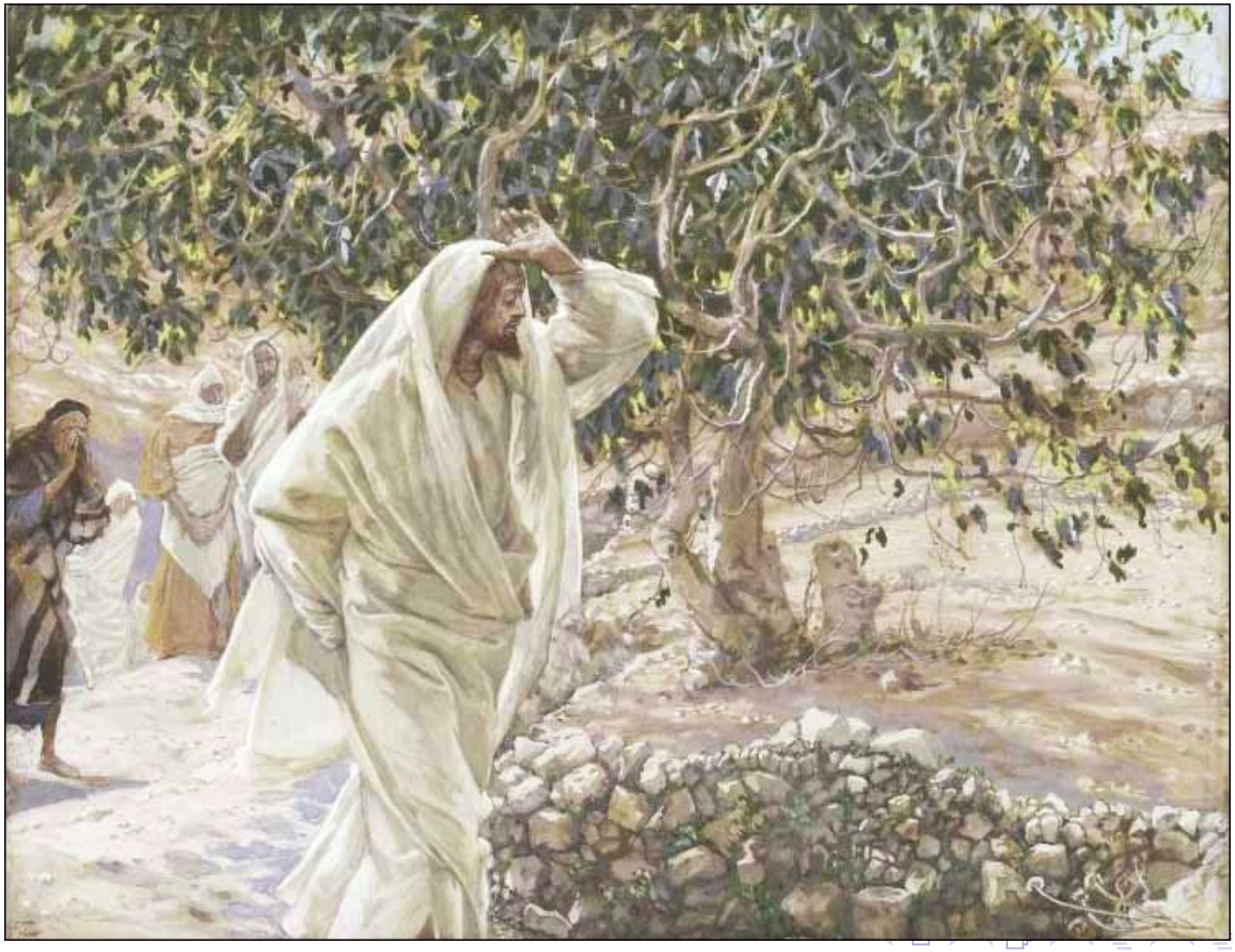


Fig wasps movie

Fig tree history

- Cultivated from Old Testament times in West Asian center
- “carica” is from “Caria”, the region in contemporary Turkey

Accursed fig tree (Tissot, illustrations for New Testament)



Mulberry, *Morus* spp.

- Same mulberry family, Moraceae
- Several species are cultivated: black (*Morus nigra*), white (*M. alba*) and red (*M. rubra*)
- Occurs both in Eurasia and North America

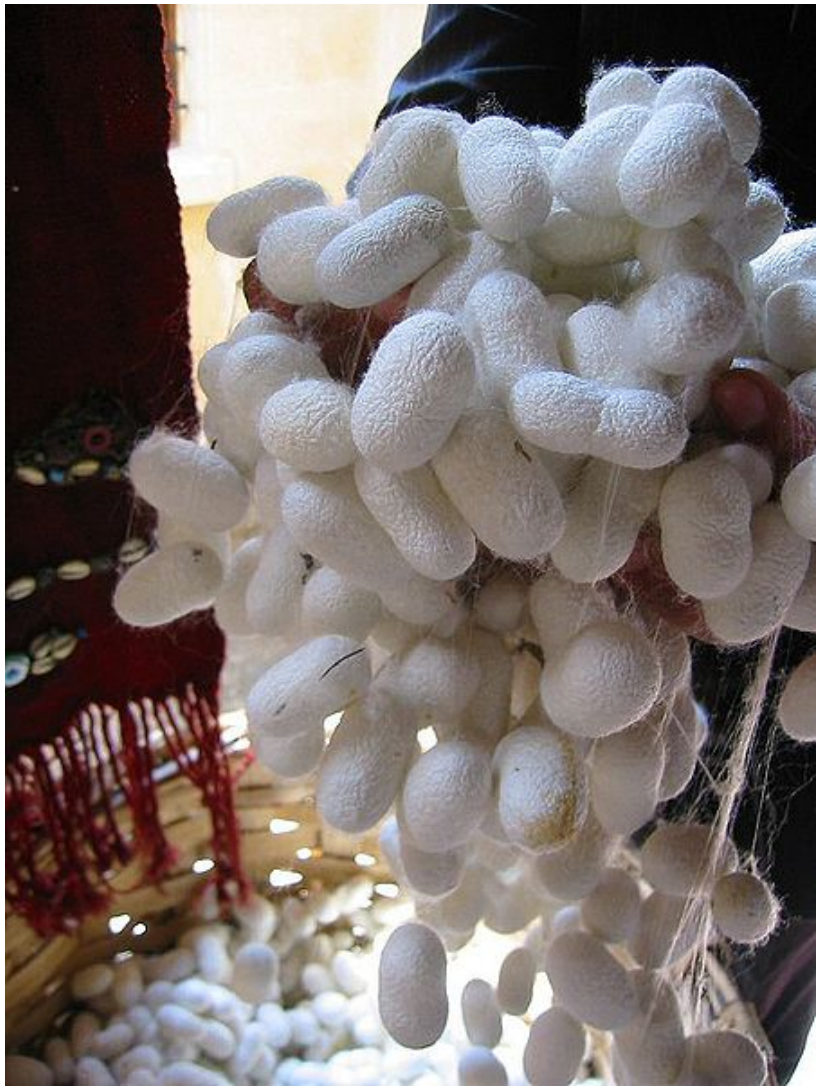
Mulberry

Mulberry features and history

- Deciduous trees, with compact raspberry-like inflorescences
- Infructescences are rich of sugars (≈22%), used raw, for wine, syrups etc.
- White mulberry is the feeding plant of silkworm, *Bombyx mori*

Silkworms on mulberry leaves

Cocoons



Kiwifruit, *Actinidia chinensis*

- Belong to Actinidiaceae family, genus contains ≈40 species
- Woody wines, cultivated mostly as ornamentals

Kiwifruit flowers

Kiwifruit biology and agriculture

- Dioecious, fast-growing plant
- Biggest problem is a pollination (needs saturation pollination)
- Fruits rich of sugars, pectins, organic acid and enzyme actinidin (analog of papain and bromelain)

Kiwifruit history

- In China, was cultivated as ornamental
- After 30 years of intensive selection (started in 1904), New Zealand invented the kiwi fruit

Summary

- Multiple tropical and subtropical fruits are mostly sources of vitamin C
- Many traditional Asian fruit cultures also have medicine value

For Further Reading

A. Shipunov.
Ethnobotany [Electronic resource].
2011—onwards.
Mode of access:
http://ashipunov.info/shipunov/school/biol_310