The Crop of the Day

Strawberry

Today’s Crop: Gift of Uto family

(c) Paul Gepts 2016
Today’s strawberries

Watsonville, CA

Sources

- California Giant Berry Farms: http://www.calgiant.com/our-company
- California Strawberry Commission: http://www.calstrawberry.com

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**Fragaria, the crop (I)**

- **Main production areas:**
  - temperate zones, some subtropical
  - China, USA, Mexico, Turkey, Spain
- **Yields:**
  - seasonal variety: 10-13 t/ha
  - ever-bearing varieties: 50-100 t/ha
- **Plants:**
  - Perennial, herbaceous
  - Rosette of leaves, inflorescences, runners or stolons (= vegetative propagation)

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**Where are strawberries grown in the U.S.?**

- 80% of US production in California:
  - Up until October, then Florida takes over
- Average yield: 47,500 lbs/acre (~kg/ha)
- Consumption: 6.1 lb/person; 80% fresh
Where are strawberries grown in CA?

California Strawberry Commission

- Fifth most valuable crop in CA (CDFA)
- 40,000 acres:
  - Coastal California: San Diego to Monterey
  - Rich sandy soil
  - Temperate climates
- Southern Area:
  - Fall & winter: Ventura Co.;
  - Late December – early January: Orange & San Diego counties
  - Staggered planting → harvests from March into late fall
- Northern Area:
  - Santa Cruz, Monterey, Santa Clara, San Benito counties: Watsonville, Salinas
  - Shipments start in April, peak in May or June, and continue through November

Fragaria, the crop (II)

- (False) Fruits:
  - Enlarged fleshy receptacle
  - Growth stimulated by true fruits = achenes
- Uses:
  - fresh
  - processed: canning, jams, freezing, flavoring, confectionary
- Nutrition:
  - Highest content of all the berries in vit. C: 1/2 cup = 70% RDA
  - 1/2 cup = more fiber than one slice of whole wheat bread
**Fragaria, the genus**

- **Rosaceae**
  - several 10s of species forming polyploid series: 2n=2x to 2n=8x (octoploids), with x = 7; autopolyploid
- **Distribution:**
  - Europe and Americas: temperate and subarctic
- **Reproduction:**
  - wild polyploid: dioecious; cultivated: hermaphroditic, but cross-pollination is preferred for full seed set.
  - vegetative: "runners"
- **Dispersal:** seeds, by birds

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**Several species of strawberries**

- **Upper right:**
  - Everbearers: varieties Seascape, Ogallala
- **Upper left:**
  - Musk strawberry: variety Profumata di Tortona
- **Lower:**
  - White & red alpine strawberries (*F. vesca*)

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**Fragaria vesca** - Wood strawberry, Fraise des Bois, Alpine strawberry

- Diploid, $2n=2x=14$
- Monoecious
- Distribution: most common wild diploid
  - meadows, forest margins
  - temperate Eurasia, North America
- Archaeology:
  - Seeds from Neolithic, Roman, Medieval
- Cultivation:
  - Probably by Romans
  - In Renaissance: food, ornament, medicine
    (see herbals) -> larger fruits
  - Selection: larger fruits, longer-bearing;
    white-fruited (birds!)
  - Still widely planted for home use

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**Fragaria moschata** - Musk or hautbois strawberry or bubbleberry

- Hexaploid, $2n=6x=42$
- Dioecious
- Distribution:
  - France, southern Europe, Russia, Siberia
- Incipient domestication:
  - Wallonia, Germany, France: 15th-17th century
  - Domestication arrested by introduction of the two following species from the Americas
  - Still grown for flavor and aroma; no increase in fruit size
Fragaria virginiana - Virginia or scarlet strawberry

- Octoploid, 2n=8x=56
- Woods and meadows of North America, from East coast to Rocky Mountains and from New Mexico to Alaska
- Famous quote: from Roger Williams (1643): "...this berry is the wonder of all fruits growing naturally in these parts. It is of itself excellent so that one of the chieuest doctors of England was wont to say, that God could have made, but never did make a better berry. In some parts where the Indians have planted, I have many times seen as many as would fill a good ship, within few miles compass...."
- 1620s: cultivation in Europe:
  - selection of hermaphroditic cultivars
  - A few varieties still grown: unique flavor

Fragaria chiloensis - the Chilean strawberry (Island of Chiloe)

- Octoploid, 2n=8x=56
- Origin:
  - probably on Pacific coast (sand dunes) of North America
  - dispersal by migratory birds to Hawaii, southern Chile, Argentina: wild populations in Chile
- Domestication:
  - by Araucanians in Chile
  - planting runners, selection for larger fruits, different colors (red, yellow, white)
- Dispersal:
  - by Spaniards: during 16th-17th centuries in cool highlands of Latin America
  - by French (naval officer Frezier) around 1715: to Paris, 5 female plants: white to pinkish, large fruits; domesticated by Mapuches
  - production in Brittany around 1750 by interplanting with F. moschata and F. virginiana (sources of pollen)

http://elefectorayleigh.wordpress.com/2013/08/15/el-curious-origen-de-las-frutillas/
**The voyages of F. chiloensis**

![Map of F. chiloensis origin and dispersal](image)

*Fig. 1: Origin and Dispersal of Fragaria chiloensis (Wilhelm and Saign, 1974)*

Finn et al. 2013

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**Fragaria ananassa - the garden strawberry or pineapple strawberry**

- Octoploid, $2n=2x=56$
- **Origin:**
  - cross *F. chiloensis* x *F. virginiana*
  - combines larger fruit size of *F.c.* and hermaphroditism of *F.v.*
  - recognized by Antoine Nicolas Duchesne (1766): repeated the cross and grew progeny, which matched *F. ananassa* in appearance. His theory was only accepted in 20th century. He was well-ahead of his time not only because of his finding but also because of his methodology.
- **History:**
  - became main strawberry
  - additional diversity from California races of *F. chiloense* $\rightarrow$ “everbearing” type, with greatly extended season
  - cross between *F. ananassa* and Rocky mountain race of *F. virginiana*: drought, low temperatures
- *F.v.* and *F.c.* both donors of additional disease resistances

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Relationships among New World strawberries (Hokanson et al. 2006)

- N = 111 accessions; 5 SSRs

Reconstructing the modern strawberry

Reconstructing *Fragaria × ananassa* utilizing wild *F. virginiana* and *F. chiloensis*: inheritance of winter injury, photoperiod sensitivity, fruit size, female fertility and disease resistance in hybrid progenies

James J. Luby · James F. Hanko · Adam Dale · Seda Serçe

- “...substantial breeding progress can be made by reconstructing *F. x ananassa* if care is taken to select elite, complementary genotypes of *F. virginiana* and *F. chiloensis.*”
- Large fruit, high fertility, disease resistance, winter hardiness, photoperiod sensitivity, spring bloom date
More recently, the search for a better tasting strawberry

- ‘Mara des Bois’ strawberry: out of this world flavor! (photo P. Gepts)
- Developed by Marionnet, French breeding company
- Article in NY Times (April 13, 2005)
- Ulrich & Olbricht 2013: “In strawberries, like in other fruits, the flavors appreciated by consumers are best represented in old cultivars and so-called land races or heirloom varieties (Alston, 1992). Breeding activities of the past decades on F. × ananassa cultivars for high-yielding and firm strawberries were accompanied with a dramatic loss of genetic diversity in modern cultivars.”

Some related sites of interest

- Strawberry as ground cover (from North Carolina State U.)
- California Strawberry Commission: http://www.californiastrawberries.com
- Oregon Strawberry Commission