Practices for Selecting & Breeding Regionally-Adapted Vegetable Seeds

By Erica Kempter

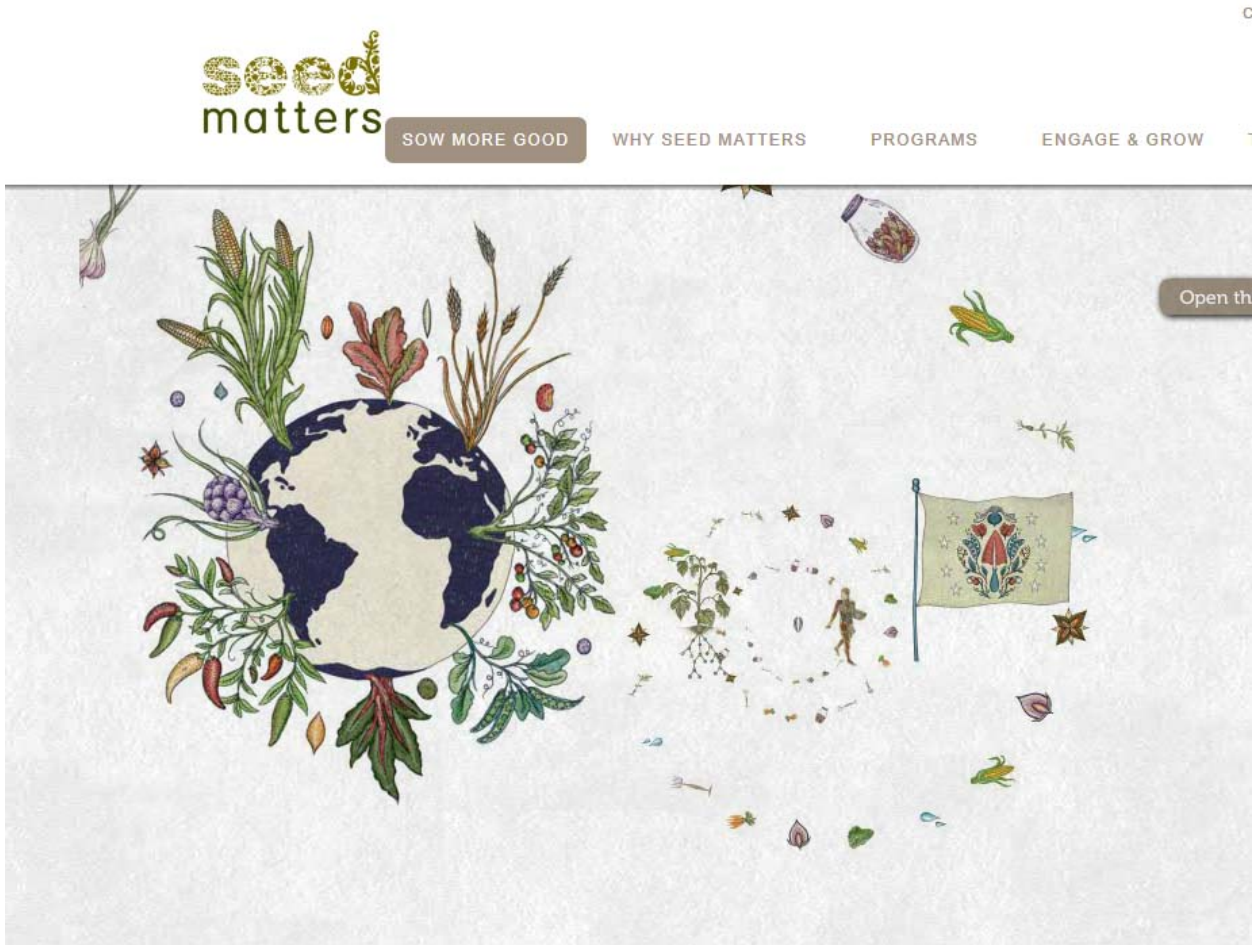
Nature & Nature Seeds

Where did our vegetable seeds come from?

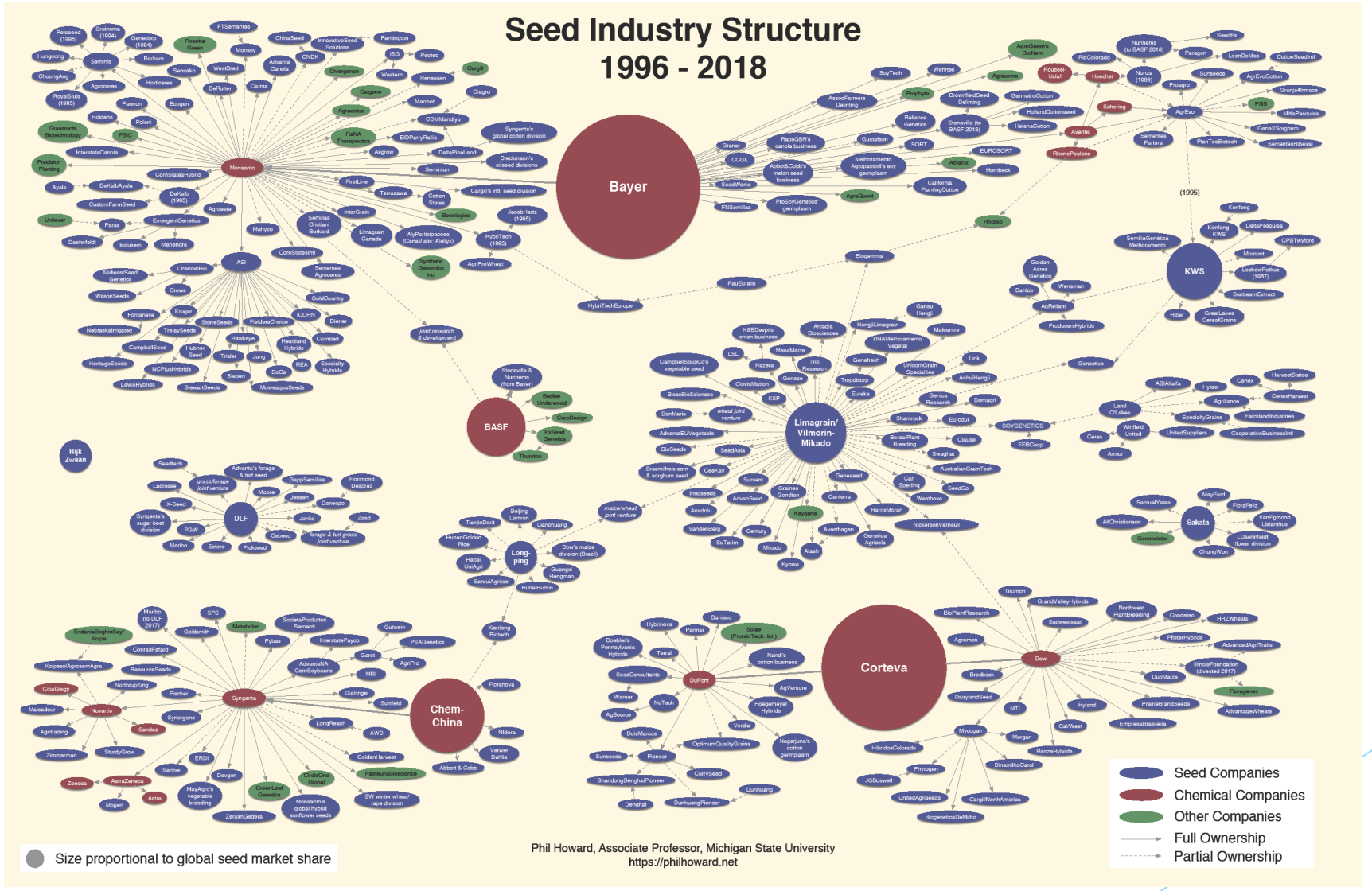
Adaptation

- Definition: The changes in structure and physiology of an organism to become more suited to an environment

Seed Biodiversity

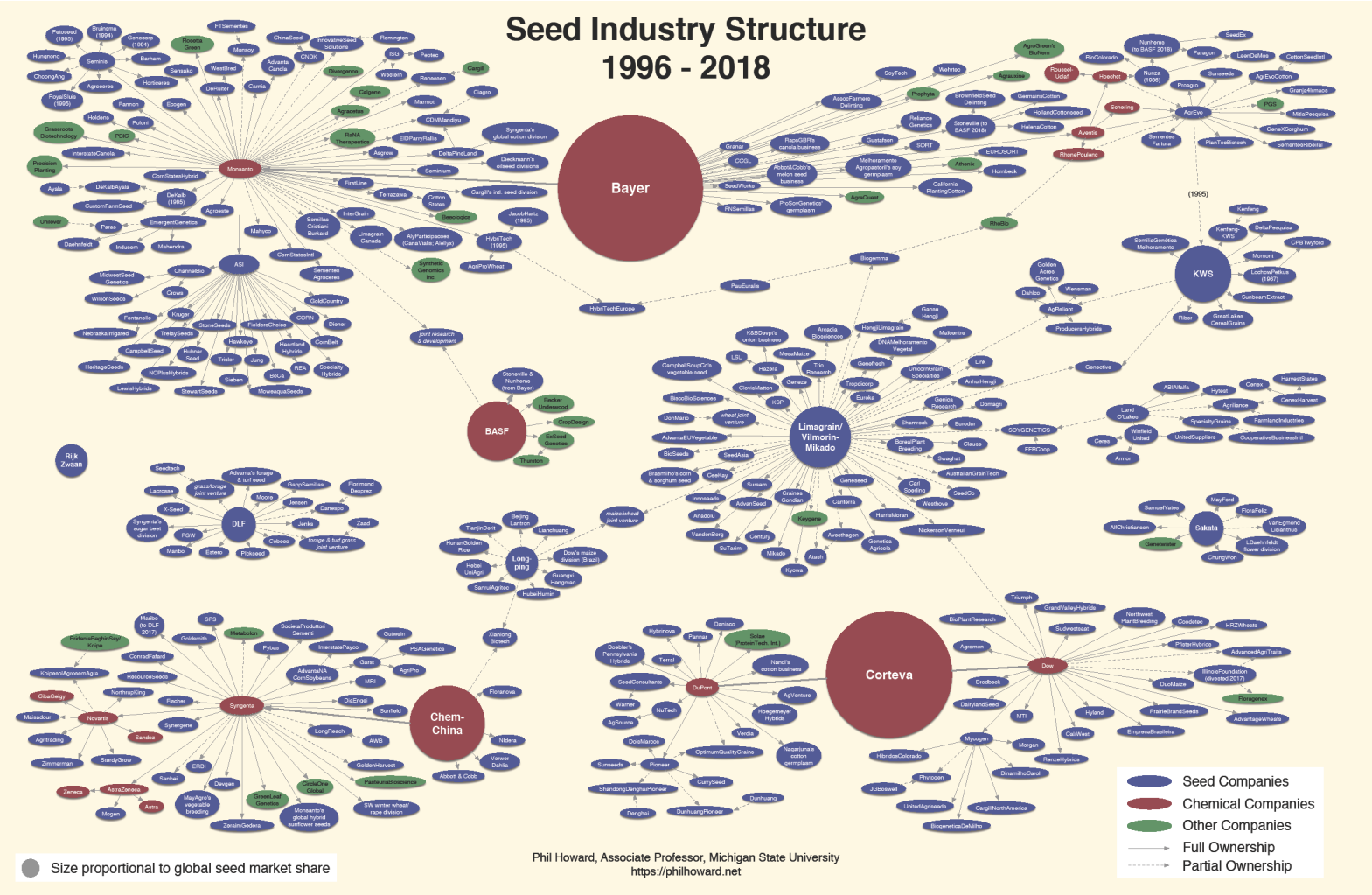


- 10,000 years created a world full of incredible food biodiversity.


Seed Industry Structure
1996 - 2018
Bayer
Monsanto
BASF
Limagrain/
Vilmorin-
Mikado
KWS
Corteva
DuPont
Dow
Syngenta
Chem-
China
Long-
ping
ASI
DLF
Sakata
Rijk
Zwaan
Seed Companies
Chemical Companies
Other Companies
Full Ownership
Partial Ownership
Size proportional to global seed market share
Phil Howard, Associate Professor, Michigan State University
https://philhoward.net

What Are Regionally-Adapted Seeds?

- Definition: Seeds that are genetically adapted to growing especially well in the climate of a particular place or region.
- They are Open-pollinated seed varieties (O.P.)
- Open-pollinated seeds can evolve and adapt to the place in which they are grown; hybrids by nature cannot



- By nature, seeds from this system are not regionally-adapted

Where do I find regionally-adapted seeds?

- Likely you won't find them by opening up any old seed catalog
- Where does seed from seed catalogs come from?
- Lack of transparency makes it challenging to find seeds that are regionally-adapted

How to find Regionally-Adapted Seeds Existing Variety Trials

- SKC – Seed to Kitchen Collaborative, UW Madison
  - Variety trials in the Midwest
  - https://seedtokitchen.horticulture.wisc.edu/trial-results.html
- NOVIC (Northern Organic Vegetable Improvement Collaborative)
  - Variety trials – some trials done in the Midwest, New York
  - https://varietytrials.eorganic.info/taxonomy/term/70
- Seed Linked
  - https://www.seedlinked.com/
- Organic Seed Alliance

How to find Regionally-Adapted Seeds Public Plant Breeders

- UW Madison
  - Irwin Goldman: beets, carrots, onions
  - Bill Tracy – sweet corn
  - Julie Dawson - tomatoes
- Cornell, NY
  - Michael Mazourek: squash, peppers, cucumbers,


Badger Flame Beet


Who Gets Kissed – sweet corn


Honeynut Squash

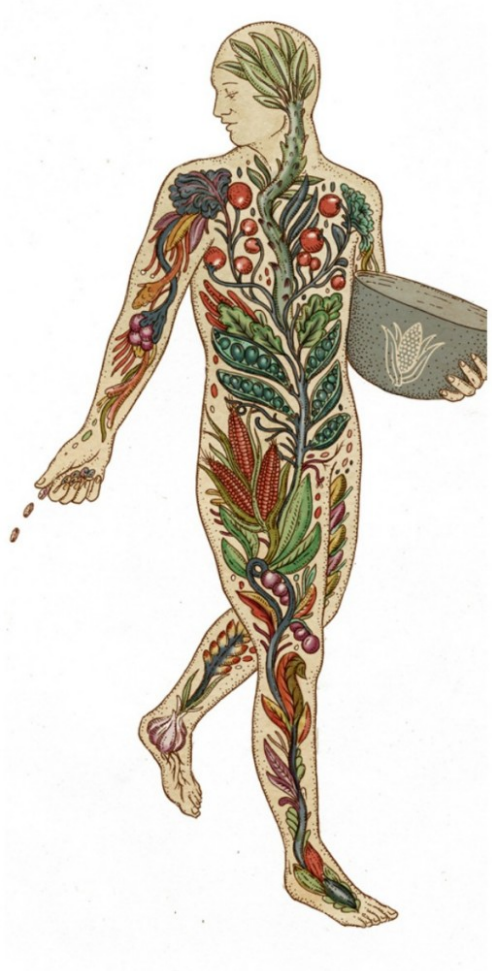
How to find Regionally-Adapted Seeds
Public Plant Breeders
Farmer/Breeders

- Podolls – Prairie Road Organic Seeds
  - Beets, beans, melons, onions, corn, squash, tomato, watermelon
- Frank Morton – Wild Garden Seeds, Oregon
- Adaptive Seeds - Oregon
- Evenstar Farm – Maryland
- Alan Kapular – Peace Seeds, Oregon

How to find Regionally-Adapted Seeds Tap into Existing Seed Biodiversity

- Seed Savers Exchange
- Open Source Seed Initiative
- Small, farm-based seed companies
  - Sandhill Preservation, Prairie Road Organic Seeds, Meadowlark Hearth Seeds,Ann Arbor Seed Company
  - Nature & Nurture Seeds
- Seed libraries & seed swaps
- USDA GRIN

seed matters™



How to find Regionally-Adapted Seeds
Do your own Variety Trials

- Lettuce - What to evaluate for?
  - Vigor, heat and bolt resistance, flavor
  - Eating quality, pest/disease resistance, days to maturity, storage, hardiness/frost resistance, nutrition
  -

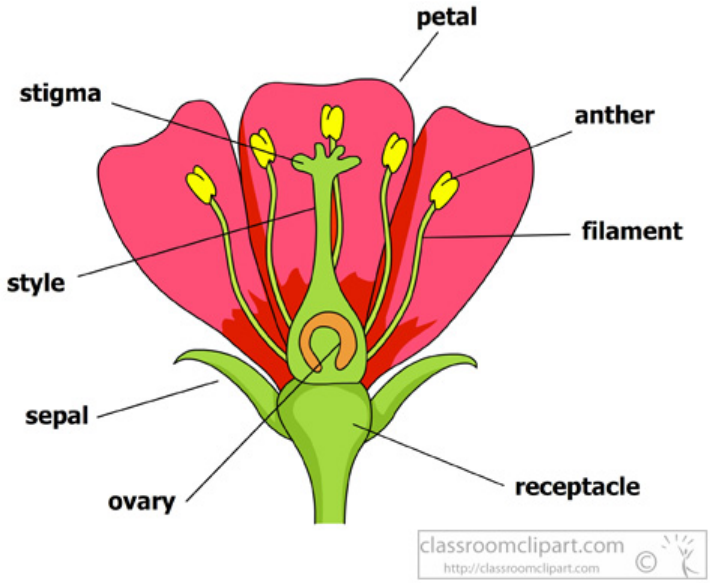
Grow and Save your Own Seeds to adapt them to your farm!

Adaptation to Soil Conditions

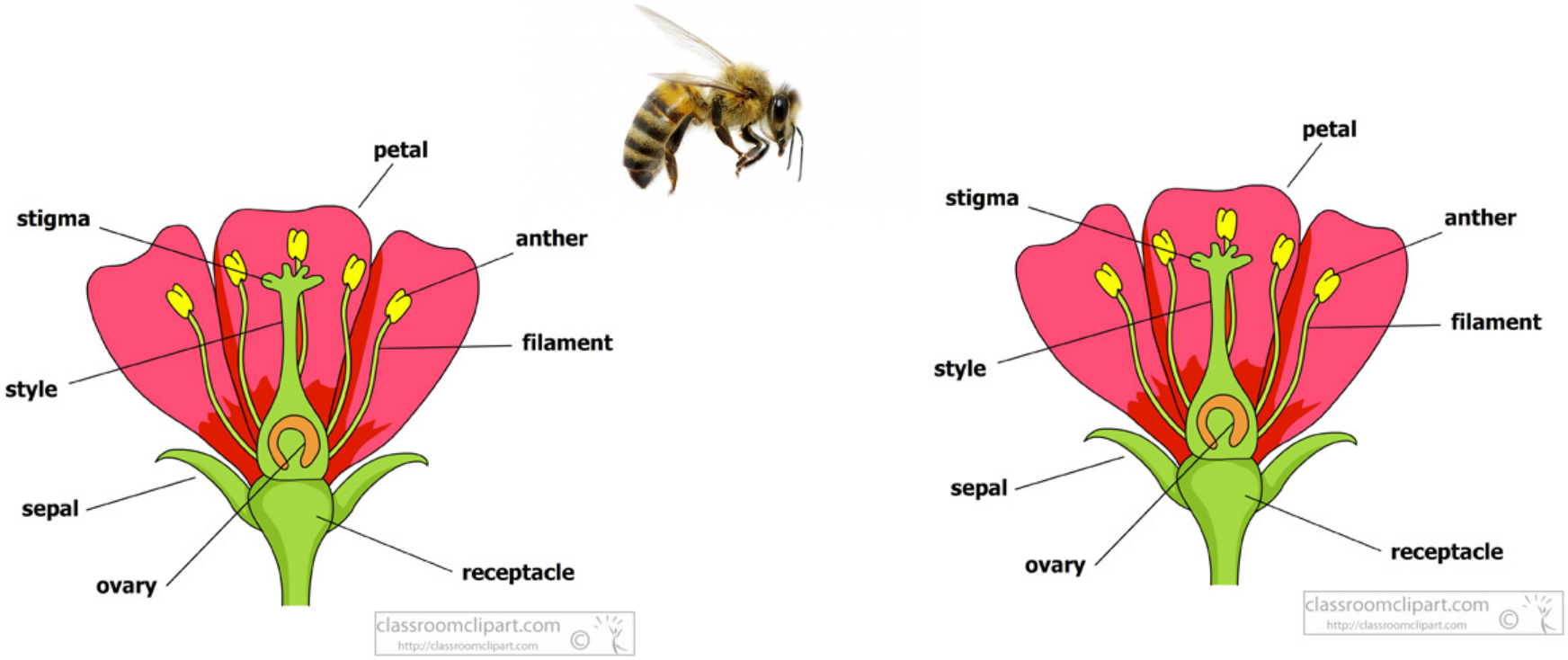
Adaptation to Climate

Regionally-Adapted Seeds
Grand Rapids Lettuce

How are seeds made?



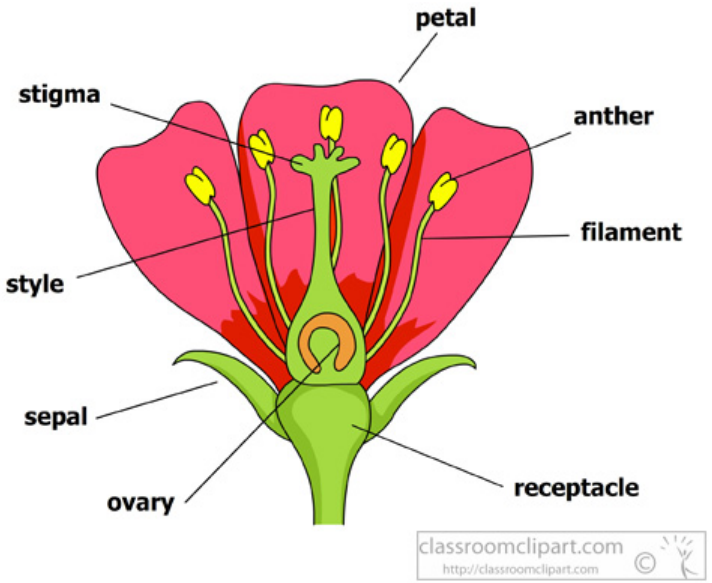
Cross Pollination



Pollen is transferred from one plant to another plant

So the parents are two separate plants.

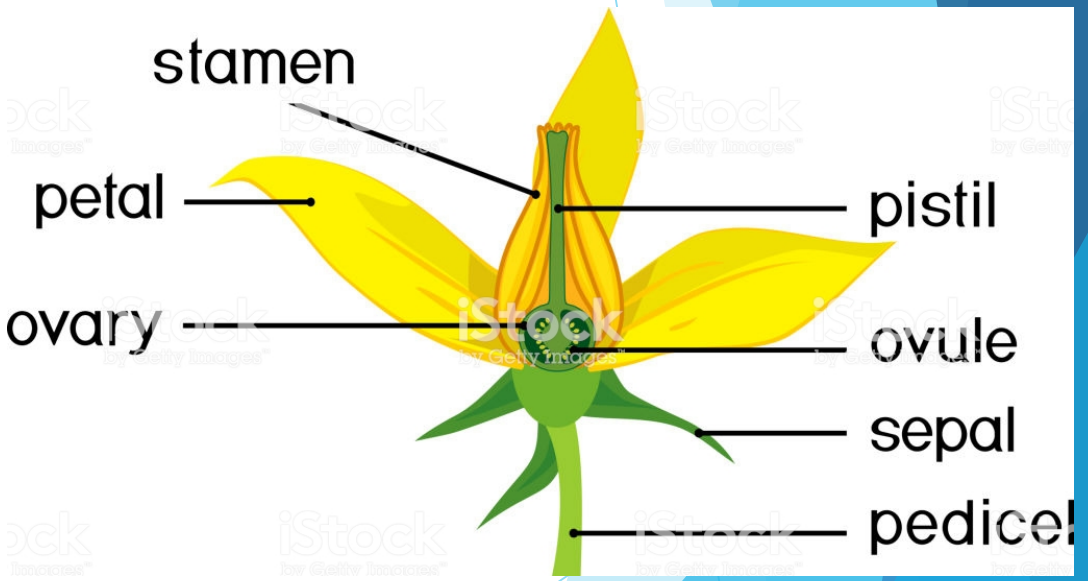
Self Pollination



- Pollen is transferred from the anther (male) to the stigma (female) of the same plant. This can either happen within the same flower or some plants have separate male and female flowers on the same plant.
- So the mom and the dad are the same plant.

Self-Pollinated Crops “selfers”

- Have closed flower structure that limits bee’s access to flower
- Do not suffer from “inbreeding depression” –loss of vigor due to inbreeding
- Tomatoes, Beans, Peas, Lettuce

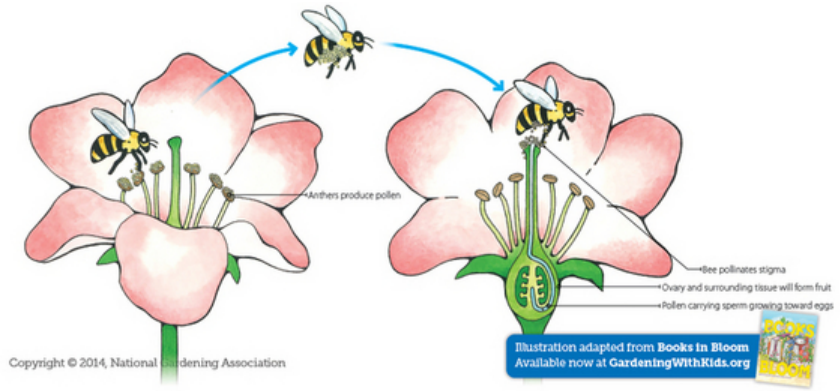


Self Pollinated Crops “promiscuous selfers”

- Peppers, Eggplant
- Can self pollinate or cross pollinate
- Do not suffer from “inbreeding depression” –loss of vigor due to inbreeding

“Out-Crossers” - Crops that tend to Cross Pollinate Example: Squash

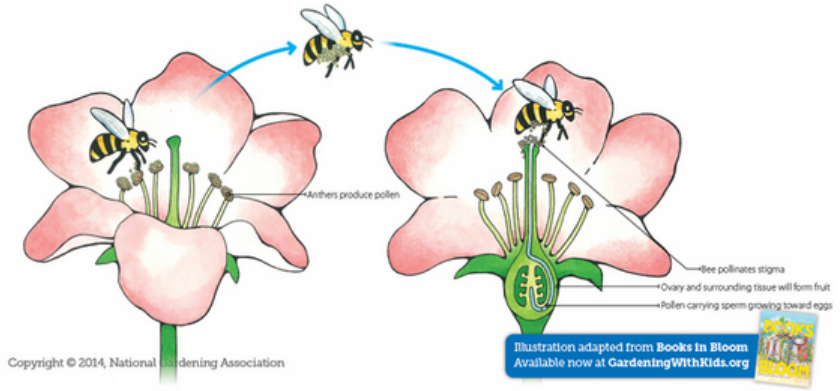
Delicata pollen (male) + Delicata stigma (female) => Delicata Squash Seeds



“Out-Crossers” - Crops that tend to Cross Pollinate

Example: Squash

- **Zucchini Pollen (male) + Delicata stigma (female) = crossed Squash Seeds**



How to Prevent/Minimize Cross Pollination?

Called “Isolation” or “Isolation Distance”

- controlling the pollen source by isolating plants by species
- Techniques
  - Isolation distance – separate each variety by a certain distance (in feet or miles)
  - Caging/row cover to prevent insects
  - Covering flowers and hand pollinating
- Isolation Technique is Determined by mode of pollination
  - Insect pollinated
  - Wind polliated

“Out-Crossers” - Crops that tend to Cross Pollinate (will cross with other varieties within the same species)

- Insect Pollinated – Isolate by ½ mile
  - Brassicas
    - Radish
    - Brassica oleracea (cabbage, kale, cauliflower, etc) - will cross with other Brassica oleracea)
    - Brassica rapa (turnips, chinese cabbage, mizuna etc)
    - Arugula
  - Onions
  - Carrots
  - Cucurbits (cucumber, squash, melons)

- Wind Pollinated – Isolate by
  - Chenopods – 1 mile
    - Spinach
    - Beets and Chard
  - Corn – 1-2 miles

Isolation Distance
Self-Pollinated Crops

"Selfers"

Isolation distance :10-50ft

- Lettuce
- Beans (not lima, runner, or fava), peas, soybeans
- Tomatoes

"Promiscious Selfers"

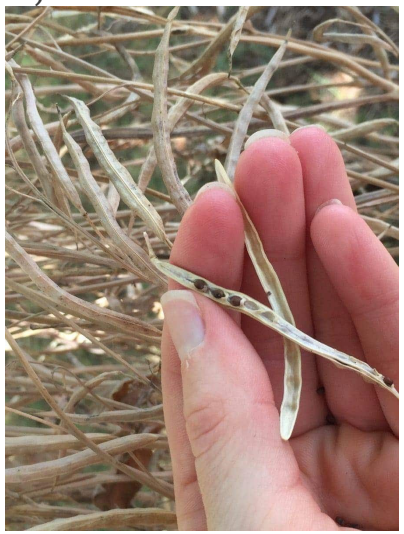
Isolation distance: 300ft or cover plants/flowers with row cover fabric

- Peppers
- Eggplant

Climate Considerations
Rain & Humidity

Dry-seeded crops:

- crops whose seeds need to be harvest when the seeds are dry
  - can be challenging to grow in our climate
  - Lettuce, brassicas, beans, peas, arugula, dill, cilantro, carrots, onions, roots, corn



Wet-seeded crops:

- crops whose seeds are harvested when encapsulated in a wet fruit
  - Tomato, pepper, eggplant, cucurbits, ground cherry, tomatillo
  - These are the easiest to grow in our climate

Climate Considerations
Temperature
for more info see “Seed to Seed” book

Warm Weather Seed Crops

- crops whose seeds prefer to develop when temps are warm (70-85F)
  - Tomato, pepper, eggplant, corn
  - Melons, watermelon
  - Eggplant & Basil – need a long hot summer

Cool Weather Seed Crops:

- crops whose seeds prefer to develop when temps are cool (60-75F)
  - Lettuce, brassicas, peas, arugula, mustard, beets/chard,
  - spinach & broccoli/cauliflower – can be challenging to grow seeds in hot humid summers

Annual vs Biennial Seed Crops

- Annual – make seed in one growing season
- Biennial – dig up plants in fall and store in cold storage; re-plant in spring (example beets)

Seed Growing Guidelines

- Use Open-Pollinated varieties
- Save seeds only from the strongest, healthiest plants
- Rogueing – remove bad plants (low vigor, early bolting, etc)
- Prevent/minimize cross pollination through isolation
- Consider minimum population size (how many plants do you need to grow to maintain enough genetic diversity in the seed crop in order to prevent inbreeding depression (ie loss of vigor) in future generations
  - "Selfers" – grow a minimum of 5-10 plants
  - "Out-Crossers"
    - Most "out-crosser" crops: 20-50 plants
    - Cucurbits: 5-10 plants
    - Corn: 50-100 plants

Seed Growing

- Different than vegetable production:
  - Spacing – much more space required
  - Time – much more time required
    - Seed crops use “real estate” much longer than veg crops

Best Seed Crops for the Midwest

Field Grown

- Tomatoes
- Peppers
  - Isolate varieties by covering with row cover fabric
- Cucumber
- Squash (choose early varieties)
- Amaranth, sunflowers
- Beans
- Peas

Need a Hoophouse

- Radish
- Spinach
- Arugula
- Mustard greens

Seed Growing & Harvesting:

Our crop planning revolves around seeds

Growing Peppers for Seed

Cleaning Pepper seeds

Growing Tomatoes for Seed

Decanting Tomato Seeds

Cucumbers

Squash

Growing Lettuce for Seed

Growing Lettuce for Seed

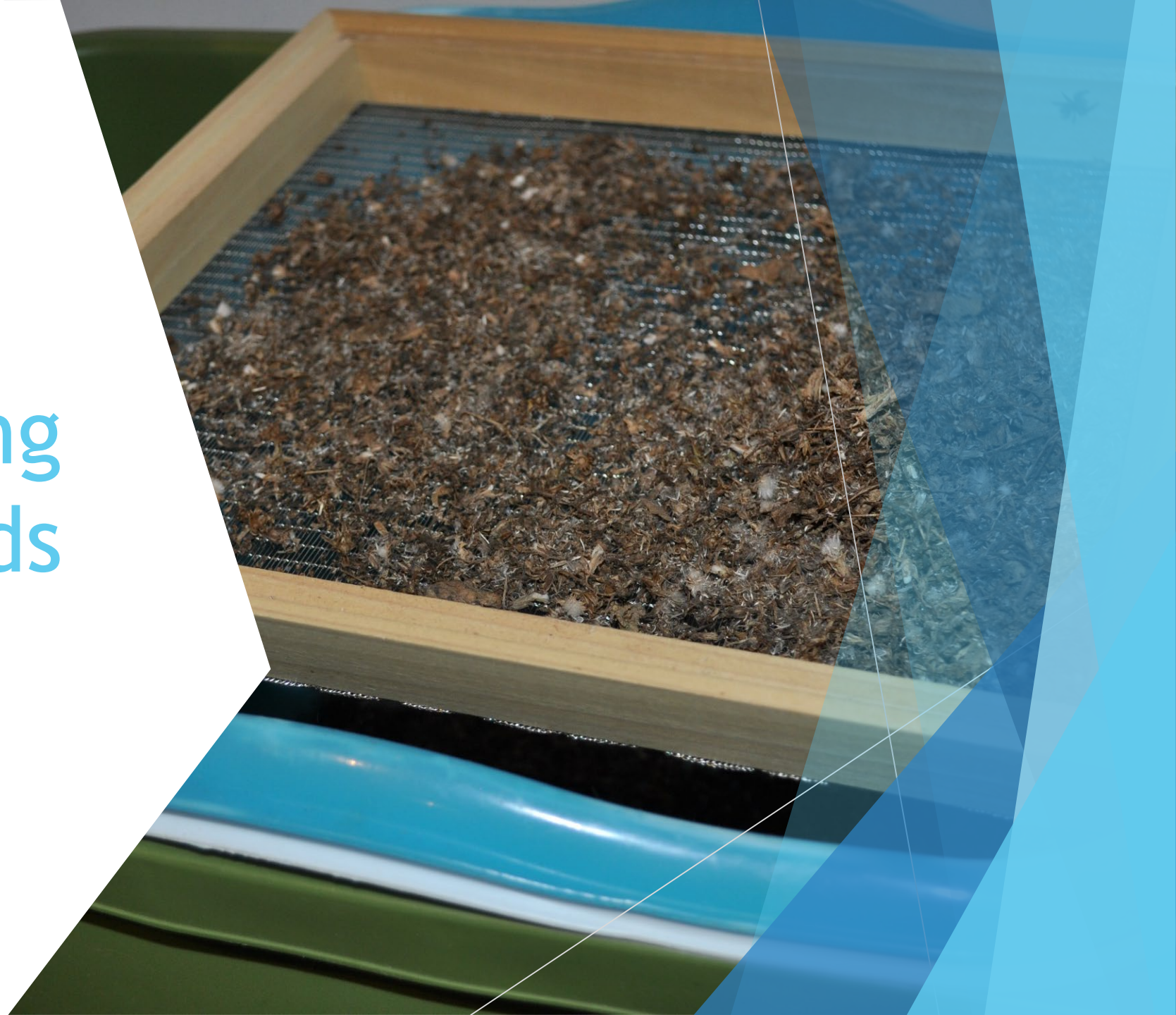

YEAR OF THE TIGER
TINY VIOLIN

Amaranth

Siberian kale (B. napus)


LEE KUAN YEW
GLOBAL BUSINESS PLAN COMPETITION

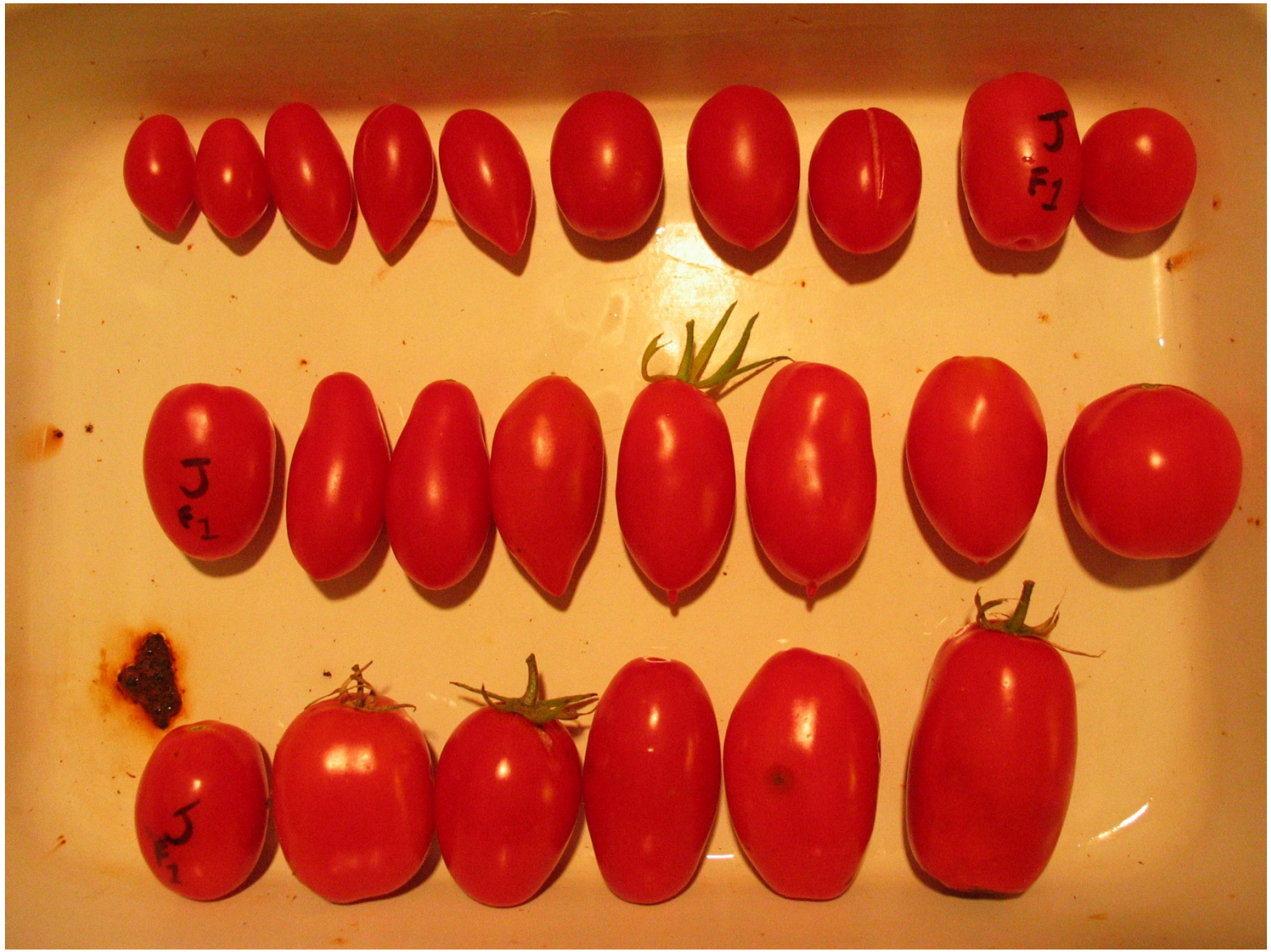
Dry Cleaning Seeds



Plant Breeding: goal: high yielding, marketable, great tasting tomatoes

Disease Resistance

Flavor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Stripes

Breeding Cold Hardy Greens

Breeding Cold Hardy Greens