Garden & Landscape
Plant Selection:
Heirloom, Native,
or Hybrid

Schoolyard Gardens Conference 2015
Everyone in the Garden
Minnesota Landscape Arboretum
February 27, 2015

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A Neolithic Beginning

- Neolithic Revolution
  - Agricultural Revolution
  - ~12,000 years ago (10,200 BC)
  - Fertile Crescent of SW Asia
  - First domestication of plants and animals; protection of native species was the first evidence of domestication
A Neolithic Beginning

- Nomadic Hunter/Gatherers
  - Reliance on Native Plants/Wild Types

- Sedentary Agrarian-Based Societies
  - Domesticated/Cultivated Varieties
A Neolithic Beginning

- Human-mediated plant selection (unintentional and intentional) and ultimately selective breeding for desired phenotypes (domesticated strains); mutants selected and cultivated if they had desirable traits.

- Pioneer Crops (Founder/Neolithic Crops) – 8
  - Cereals – Emmer & Einkorn Wheat and Barley (*Triticum* and *Hordeum*)
  - Pulses (Legumes) – Lentils, Peas, Chickpeas, and Bitter Vetch (*Lens, Pisum, Cicer, and Vicia*)
  - Other – Flax (*Linum*)
A Neolithic Beginning

- **Wheat** (*Triticum*) – wild-type dispersed its seed (shattered); mutation occurred that resulted in a non-shattering type; collected more because easier; became primary seed source for future crops = selection for this desirable trait; relies on farmers for reproduction and dissemination; mutation may have died-out without human intervention.

- **Tomato** (*Solanum lycopersicum*) – species was primarily self-incompatible; pollinated by native bees that did not move with plant; trait of self-fertility/compatibility became desirable and has been selected for to maximize self-compatibility.
A Neolithic Beginning

- China (8,000 years ago) – Foxtail & Broomcorn Millet, and Rice
- China (5,000 years ago) – Soybean
- China (4,500 years ago) – Orange and Peach
- Africa – Coffee, Sorghum, Pearl Millet, Kola Nut, Yam, and Oil Palm
- Central America – Corn (Teosinte, very different from corn of today), Beans, and Squash
- South America – Potato, Manioc, and Tomato
- Papua New Guinea – Bananas, Taro, and Sugarcane
A Neolithic Beginning

- Specialized crop production methods – irrigation, deforestation, irrigation, fertilization (manure)
- Surplus production allowed for societal evolution
- Greater society increasingly disconnected from food production
**Human-Mediated Plant Selection**

- *Brassica oleracea var. oleracea* – the wild, undomesticated form is called wild cabbage; native on limestone cliffs in coastal regions of southern and western Europe; biennial; produces a loose rosette of fleshy leaves the first year and a tall flowering stalk with yellow flowers the second year; leaves fleshier than other species.

- Highly nutritious and health benefits; cultivar groups developed through human breeding/selection – Acephala Group (collard greens, kale), Alboglabra Group (Chinese broccoli), Botrytis Group (broccoflower, cauliflower), Capitata Group (green and purple/red cabbage), Italica Group (broccoli), Gemmifera Group (Brussels sprouts), Gongylodes Group (kohlrabi), and the Savoy Cabbage Group (Savoy cabbage).
Brassica oleracea
Brassica oleracea
Definition of Agriculture

Agriculture – the art, science, technology, and business of producing domesticated animals, plants, and other life forms for food, fiber, energy, pharmaceutical, and other uses to sustain and enhance the lives of human beings.

Includes Animal Science/Husbandry, Agronomy, Silviculture, and Horticulture
Branches of Agriculture

- **Animal Science/Husbandry** – the art, science, technology, and business of producing livestock and other animals for food, fiber, and other uses.

- **Aquaculture** – the art, science, technology, and business of producing aquatic organisms including fish, mollusks, crustaceans and aquatic plants for food and other uses.
Branches of Agriculture

- **Agronomy** – the art, science, technology, and business of producing extensively-cultivated agricultural crops for food, fiber, energy, and other uses.
  - Agricultural commodities planted on large acreages that have a relatively low per unit value

- **Silviculture** – the art, science, technology, and business of growing forest crops (Forestry)
Branches of Agriculture

- **Horticulture** – the art, science, technology, and business of producing intensively-cultivated agricultural crops and other plants for food, fiber, and other uses.

- Agricultural commodities planted on small acreages that have a high per unit value.
Branches of Horticulture

- **Olericulture** – vegetables (including some botanical fruits; e.g., tomatoes, cucurbitis)
- **Pomology** – fruits (ripened ovaries and associated tissues; excludes grapes and fruits used as vegetables)
- **Viticulture** – grapes
- **Oenology** – wine and wine-making
- **Floriculture** – floral crops
- **Turf Management** – turf
Branches of Horticulture

- **Landscape Horticulture** – landscape plants and the design, installation, and maintenance of landscapes.

- **Arboriculture** – planting and care of woody perennials in landscape settings.

- **Postharvest Physiology** – physiology of living plants and tissues following harvest and its relationship to postharvest handling and storage with the goal of maintaining the quality of horticultural commodities.
Plant Taxonomy

Classifying and Naming Plants

- **Domain** - Eukarya
  - **Kingdom** - Plantae
    - **Phylum** (Division) - 
      - **Class** -
        - **Order** -
          - **Family** -
            - **Genus** -
              - **Species** -

Human manipulations of plants typically involve manipulations at the species level, but may involve the genus and family level and occasionally plants and other organisms that are not closely related or at all related.
Plant Taxonomy & Nomenclature

- **Genus** (plural = genera) – the taxonomic ranking between family and species consisting of one or more structurally or phylogenetically related species; sometimes descriptive or may be a cultural name; the first part of the binomial species name for each of the species within the genus.

- **Species** (plural = species) – the taxonomic rank below genus; the second part of the binomial species name and typically descriptive.

  - A species is typically defined as the largest group of organisms capable of interbreeding and producing fertile offspring.
Botanical/Scientific Names – a binomial (or trinomial) name consisting of the genus (or generic) name and the specific epithet (species name), and sometimes a subspecies or variety name, plus a cultivar name if applicable; an authority - the name(s) of the person or persons involved in naming the plant - may also be included.

- The genus name is capitalized italicized or underlined
- The specific epithet is in lower case and italicized or underlined
- Subspecies and variety names are lower case and italicized or underlined and preceded by subsp. or var., respectively
Plant Nomenclature

Botanical/Scientific Names – Examples:

- Solanum lycopersicum L. / Lycopersicon esculentum Mill. – Tomato
- Solanum tuberosum L. – Potato
- Zea mays L. – Maize, Corn
- Amelanchier spp. Medik. – Juneberries
- Aronia melanocarpa (Michx.) Elliot. – Black Chokeberry
- Picea pungens Engelm. – Colorado Spruce
- Picea pungens var. glauca Reg.) Beissn. – Colorado Blue Spruce
- Picea glauca (Moench) Voss. – White Spruce
- Pices glauca var. densata – Black Hills White Spruce

Note that, like species names, variety and subspecies names are typically descriptive
Plant Hybrids

- **Hybrid Definition** – crossing of two genetically distinct individuals (hybridization).

- **Intraspecific Hybrids** – natural or human-mediated crosses between two genetically distinct individuals within the same species.

- **Interspecific Hybrids** – natural or human-mediated crosses between two different species within the same genus.
  - Naturally-occurring examples include *Quercus* (oak), *Carya* (hickory), and *Salix* (willow); can make identification difficult
  - *Magnolia × soulangeana* – *Magnolia denudata × Magnolia liliiflora*
  - *Pelargonium × hortorum* – *P. inquinans × P. zonale*
Plant Hybrids

**Intergeneric Hybrids** – human-mediated crosses between species from different genera; typically sterile.

- ×*Crategosorbus* – *Crataegus* sp. × *Sorbus* sp. (Rosaceae)
- ×*Heucherella* – *Heuchera* × *Tiarella* (Saxifragaceae)
- ×*Ferobergia* – *Ferocactus* sp. × *Leuchtembergia* sp. (Cactaceae)
- ×*Sorboaronia* – *Sorbus* sp. × *Aronia* sp. (Rosaceae)

Hybrids between domesticated and wild species may be problematic; wild populations have evolved naturally through natural selection in response to the environment resulting in populations that are better adapted and more likely to survive while domesticated species have been selected through selective breeding for desirable characteristics from a human perspective that may have little to do with survival in the wild; genetic pollution.
Plant Hybrids

- **F1 Hybrids** – human-mediated crosses between two inbred, homozygous (90% or more) lines with desirable characteristics (requires multiple generations); once a cross with desirable traits is identified, repeating the cross yields exactly the same result.

- Advantages – homogeneity and predictability are the primary advantages of F1 hybrids (uniformity); improved fitness and performance compared to uncontrolled crosses including **hybrid vigor**.
Plant Hybrids

Drawbacks – the seed from F1 hybrids cannot be used for subsequent crops as the offspring (F2 hybrids) will exhibit considerable variability or a lack of hybrid vigor; for annuals, F1 hybrid seed must be produced annually; expensive (usually offset by the desirable traits of the progeny - uniformity, better quality, improved yield, etc.); mature at the same time which is a commercial advantage, but may be a disadvantage for smaller producers and home gardeners who often benefit from crops that mature over a longer period.
Plant Hybrids

- **Backcrossed Hybrids** – crossing a hybrid (including F1 hybrids) with one of its parents to produce offspring having a genetic identity closer to the backcrossed parent (BC1 hybrids).
Cultivar

- A cultivar is a plant or grouping of plants that has been selected for one or more special characteristics that can be maintained through propagation; most cultivars have originated in cultivated environments, but a few are selections directly from wild populations; possess a distinct level of uniformity and are propagated as clones or hybrids; typically given a cultivar name that becomes part of the botanical/scientific name.
Most landscape plants – trees, shrubs, herbaceous perennials, and annuals – including things like shade trees, roses, hydrangeas, daylilies, irises, plantain lilies (hostas), irises, peonies, and daffodils are cultivars produced through careful breeding and selection efforts for a variety of characteristics like flower color, form, fall color, thornlessness (thorns have benefit in the wild), and even sterility (‘Spring Snow’ flowering crabapple; invasive species connection; parthenocarpy); similarly, the world's agricultural food crops (woody and herbaceous) are almost exclusively cultivars that have been selected for characteristics like yield, flavor, and resistance to disease; often thousands of cultivars.
Examples of Cultivars and Cultivar Names:

- *Malus domestica* ‘Honeycrisp’
- *Vitis vinifera* ‘Muscat de Frontignan’
- *Amelanchier alnifolia* ‘Regent’
- *Fragaria vesca* ‘Mesabi’
- *Vaccinium* ‘MNPink1’
  - Pink Popcorn™ Blueberry (trademarked; common law)
- *Hydrangea paniculata* ‘Renhy’
  - Strawberry Parfait® Panicle Hydrangea (registered trademark)

Fermentation: yeast; wine, beer, bread; health benefits
Provenance

- Related to natural selection; adaptability to local environmental conditions (temperature, soils, etc.)

- Provenance is defined as the geographic location of the female parent (male often unknown) or parents of a particular plant (seeds, cuttings, graft components (scions and rootstocks), etc.

- Gives us a hint about the potential tolerances of the resulting seedlings or asexually propagated plants.
Plant Origins & Effects

- **Native / Indigenous** – a plant that is naturally indigenous to an area (variously defined)

- **Non-Native / Introduced / Exotic** – a species living outside its native range that was deliberately or accidentally introduced by human activity

- **Naturalized** – non-native species that have escaped cultivation and become established in native ecosystems; they never become natives
Plant Origins & Effects

- **Invasive** – non-native species that have become naturalized with negative consequences on native ecosystems.

- Can native species be invasive?

**Aggressive Natives**

*Rhus typhina* – Staghorn Sumac
Heirloom Species Definition – plant varieties (cultivars) that have been nurtured, selected, and handed down from generation to generation; seed-produced varieties are open-pollinated; like most popular vegetables, heirloom varieties are valued for specific traits and are the result of human intervention (carefully selected and preserved for many years); often associated with a particular geographic region; connections with the past and some have unique and fascinating histories; also called heritage species.
Heirloom Species

- Heirloom varieties exist for many vegetables, including tomatoes, squash, peppers, and beans, flowers, and herbs.
- Woody “heirloom” species also exist; maintained through vegetative means (cuttings and grafts) – e.g., apples, grapes.

*Phaseolus vulgaris ‘Anasazi’* & *Cucurbita maxima ‘Rouge Vif d'Etampes’* (French Red)
Heirloom Tomatoes

- Like other heirloom species grown from seed, heirloom tomatoes are open pollinated (rarely occurs), but are stable and breed true to type unlike hybrid varieties; can save seed from year to year (unlike hybrids).

- Popular with home gardeners and organic producers; offer a wide variety of colors, shapes, sizes, and flavor profiles; while they tend to be more interesting and flavorful, these traits are often at the expense of shelf life, disease resistance, and productivity.
Heirloom Tomatoes

Compared to heirloom varieties, commercial hybrids tend to be more uniform produce bigger yields; early and cold tolerant selections tolerate cool temperatures and fruit better when nights are cool, which usually discourages fruit set; plant breeders have also developed varieties that store better and have enhanced nutritional value including higher levels of β-carotenes and vitamin A.
‘Valencia’
‘San Marzano’
‘Garden Peach’
‘Cherokee Purple’
‘Brandy Yellow’
‘Green Zebra’
‘Red Zebra’
‘Costoluto Genovese’
Plant Origins & Effects

- Are native species inherently better than non-native species?  Yes & No

- If a named cultivar was selected from a native population, is it still native? Yes
  
  *Symphyotrichum novae-angliae* (L.) G.L. Nesom. (formerly *Aster novae-angliae* L.) ‘Purple Dome’

- Are heirloom species inherently better than commercial hybrids?  Yes & No
Native vs. Non-Native
Genetically Modified Plants

- Also called transgenic plants; plants that have been genetically modified through genetic engineering (recombinant DNA techniques) to impart one or more desired trait or traits.
  - Pest resistance, improved nutrition, increased yields, improved flavor, improved storage characteristics, drought resistance, salt tolerance, and many others
- Transformation methods include:
  - *Agrobacterium tumefaciens* (bacterium; naturally able to transfer DNA)
  - Gene Gun
  - Others
Genetically Modified Plants

- ‘Flavr Savr’ Tomato (*Solanum lycopersicum*) (approved, but abandoned)
- Arctic® Golden & Arctic® Granny Apple (*Malus domestica*) (just approved)
- Bt Corn (*Zea mays*) (around a long time)
- Glyphosate Resistant Soybeans (*Glycine max*) (around a long time)
- ‘Golden Rice 2’ (*Oryza sativa*; not yet approved)

β-carotene >>>> Vitamin A
Humans & Domesticated Plants

- Humans have been selecting plants for desirable characteristics from a human perspective for thousands of years.

- The selection process continues today – plant breeders, amateur and expert (private and public), are working hard to develop new and improved plants for the purposes of food production and other reasons (increased yields, better nutritional value, pest resistance, and tolerance of a variety of plant environmental stressors like temperature, drought, and soil salinity; MN Landscape Arboretum.)
Humans & Domesticated Plants

- Do we believe the intentions of these folks are malicious; do they want their creations to harm the people or the environment?

- We often forget that there are also efforts and programs designed to gather and preserve the earth’s native diversity and protect it from extinction that might be caused by a variety of known and unforeseen forces; the value of this genetic diversity is recognized and valued.
Native, Non-Native, Heirloom, Cultivar, F1 Hybrid, Grafted, GM – ???

- When selecting plants for garden and landscape use . . .
- Understand what the terms mean and the potential advantages of the different options
- As should always be the case, plant selection choices should ultimately depend on the conditions of the site and your gardening objectives
Native, Non-Native, Heirloom, Cultivar, F1 Hybrid, Grafted, GM – ???

- There are some bright lines:
- Standard plant breeding and selection techniques and their products have benefited society for hundreds of years
- Native plants are important components of native ecosystems and have many benefits, but they may not always be the best choice for a given landscape
Native, Non-Native, Heirloom, Cultivar, F1 Hybrid, Grafted, GM – ???

- Introduced, non-native species that have the capacity to escape cultivation can cause significant damage to native ecosystems; should be carefully assessed

- A not so bright line – genetically modified plants that have genomes that would never be produced in nature should be very carefully reviewed to avoid unforeseen consequences; caution and common sense
Reconnect With Our Food

- Hunter/Gatherer > Agrarian > Commercial Production
- Have lost our connection with food – where it comes from and how it is produced
- Not just plants – animals too
- Improving?
Reconnect With Our Food

Chickens (*Gallus gallus* var. *domesticus*) and schoolyard gardens also have the potential to work well together and further the people/where-does-our-food-come-from connection; as does the European Honey Bee (*Apis mellifera*)
Questions

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