

The Development of a Perennial Sunflower: Current Research and Challenges

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“By increasing the use of mixtures of grain-bearing perennials, we can better protect the soil and substantially reduce greenhouse gases, fossil-fuel use and toxic pollution.”

Wes Jackson and Wendell Berry

The New York Times January 5, 2009

Why Perennial?

- No need for fall tillage reducing input costs and soil erosion
- Provide living ground cover for longer periods
- Cover cropping within rows could reduce the need for summer tillage and herbicides

Methods for Creating Perennial Grains

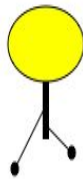
1. Direct domestication of wild relatives of grain crops
2. Wide hybridization of cereal grains with wild relatives

Objective

Annual (*H.annuus*) x Perennial (*H.tuberosus*)



Final Product (*Perennial H. annuus*)



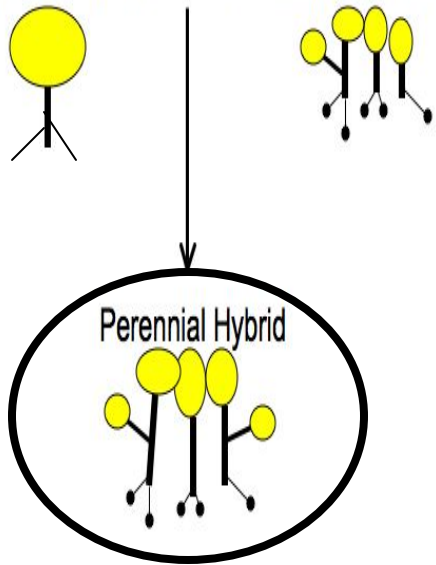
Helianthus tuberosus



Helianthus annuus

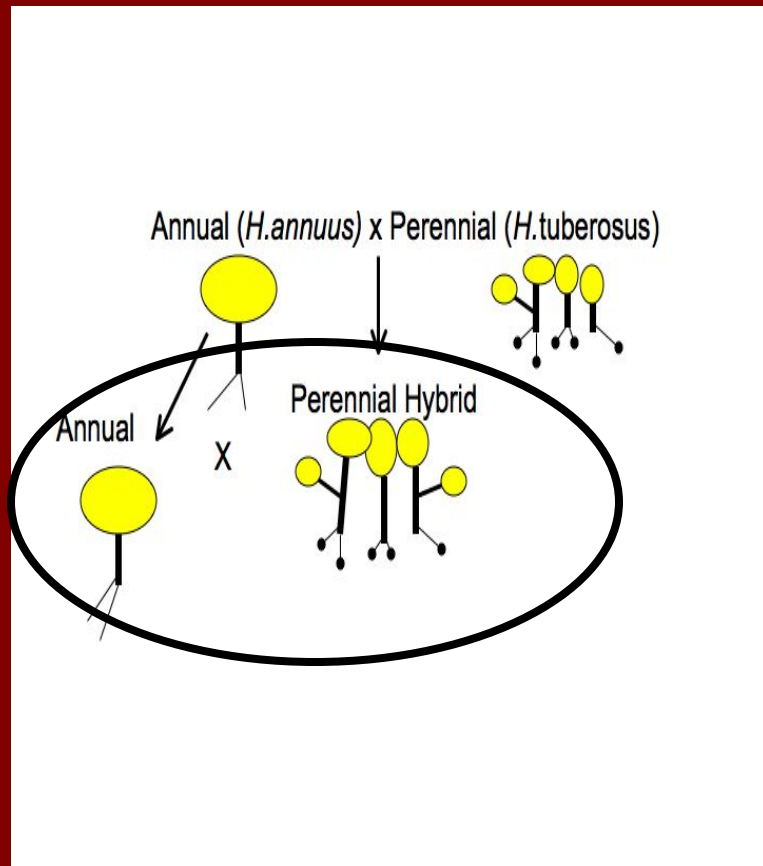
The Population

Annual (*H. annuus*) x Perennial (*H. tuberosus*)



F₁ hybrids in greenhouse

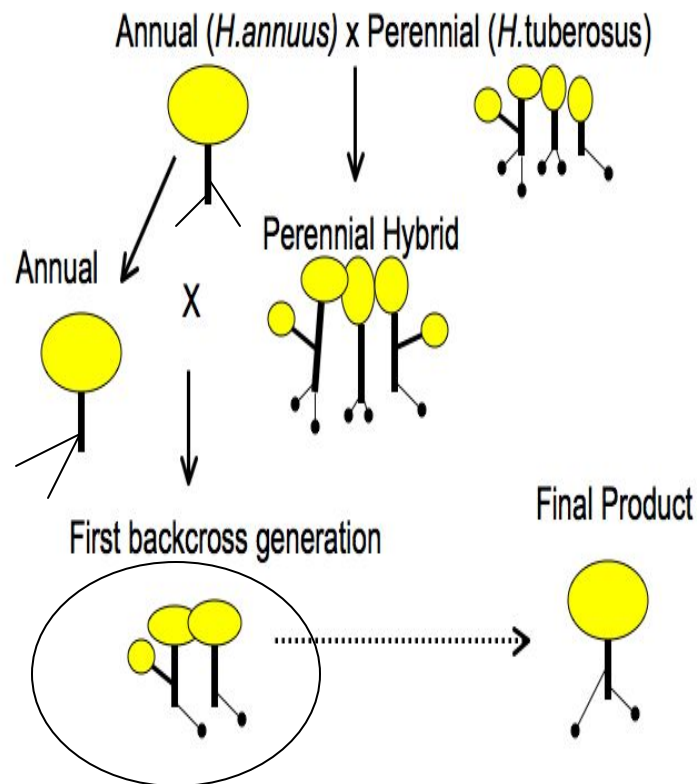
The Population



BC₁F₁ plants in St. Paul

The Population

Crossing Scheme



BC₁F₁ (right) next to the tetraploid annual (left)

Material in the Field

- 252 F_1 hybrids were planted with three replications in St. Paul
- In 2009 they will be scored for perennial traits
 - rhizome number, tuber number, tuber size, tuber yield, tuber germination



Rhizome from a BC_1F_1



Jerusalem Artichoke tuber

Next Step

- Note perennial habit in backcross plants by scoring perennial traits in hybrids
- Develop molecular markers to use in a perennial breeding program
- Select for perennial progeny to transfer into the field

Perennial Habit Model

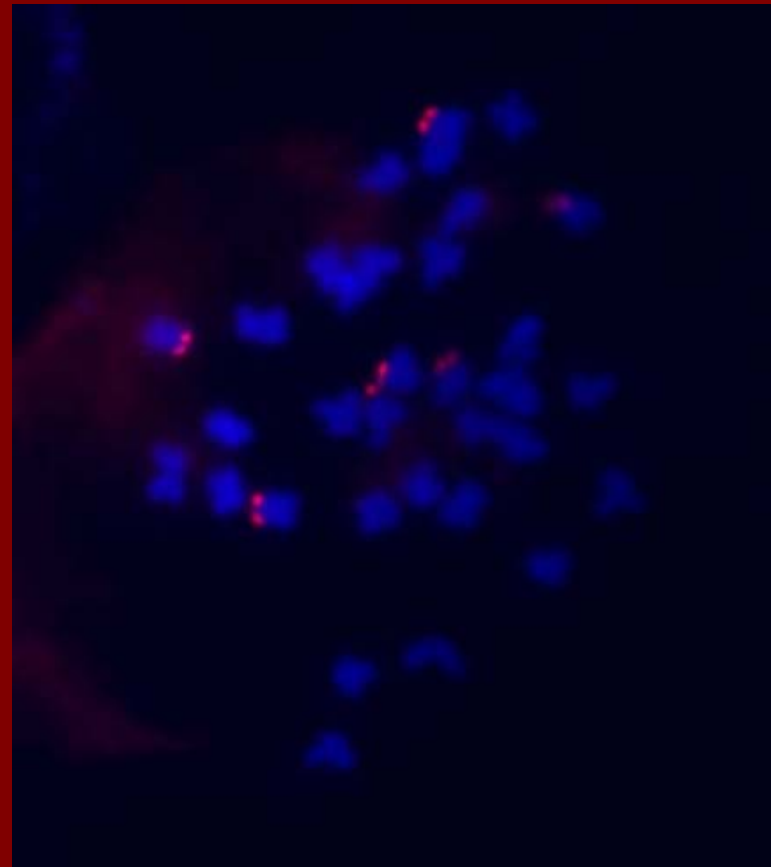
- Perennial habit is often viewed as a qualitative trait
- A robust perennial hybrid would have a better suite of genes than a minimal perennial hybrid

Goals

- Identify correlations between hybrid perennial traits versus perennial habit in the back cross plants
- Map genes for perennial habit traits in the hybrid population
- Identify genes that may be useful for breeding

Genome Diversity

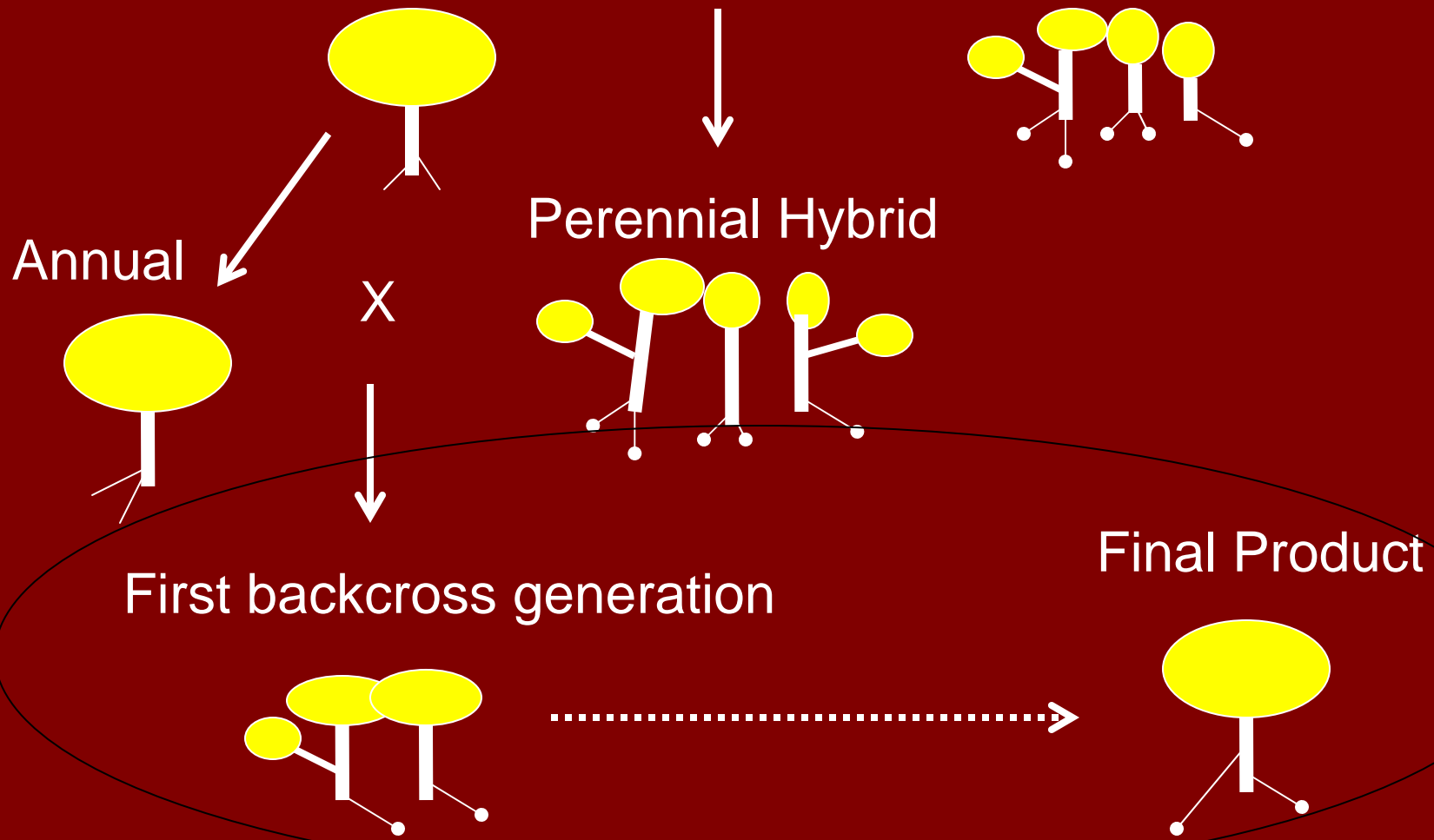
- Observe the rates of *H. annuus* chromosome retention in *H. annuus* x *H. tuberosus* backcross populations that exhibit perenniality



Picture of *H. annuus* genome courtesy of Dr. Robert Stupar

Crossing Scheme

Annual (*H.annuus*) x Perennial (*H.tuberosus*)



Questions?