

# The Potential Role of Sunflower Crop Wild Relatives for Adapting Sunflower to a Changing Climate

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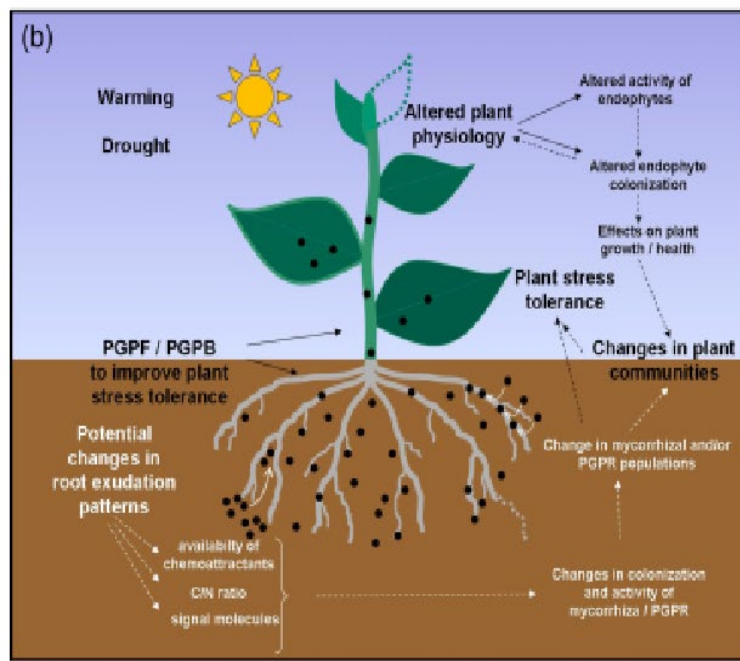
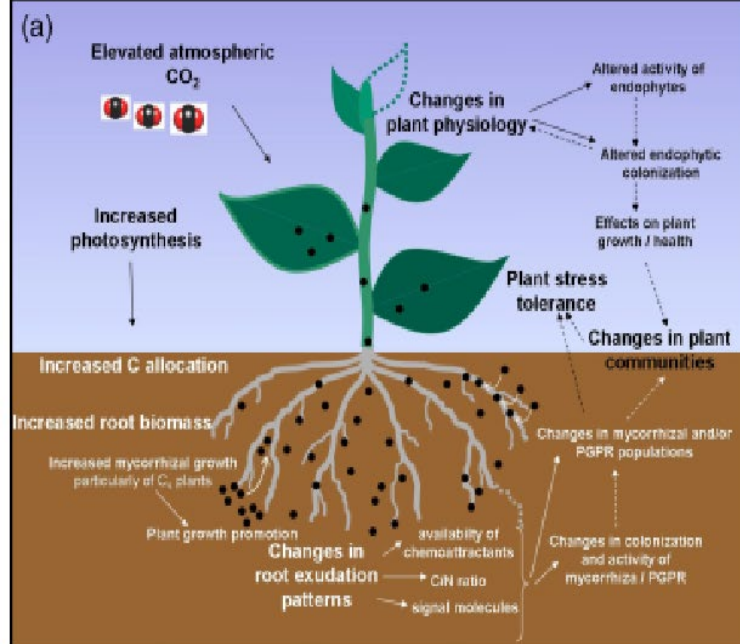
**Anomalous sunflower**

***H. anomalus*, Utah**



# Climate change challenges:

- Temperature rise
- Changing precipitation patterns and storm severity
- Changing soil salinity
- Existing and emerging pathogen challenges
- Increased levels of CO<sub>2</sub>
- **\*\*Complexity of trait interactions\*\***



A vertical strip on the left side of the slide shows a close-up of a sunflower head, with bright yellow petals and a dark brown center. The rest of the slide has a solid blue background.

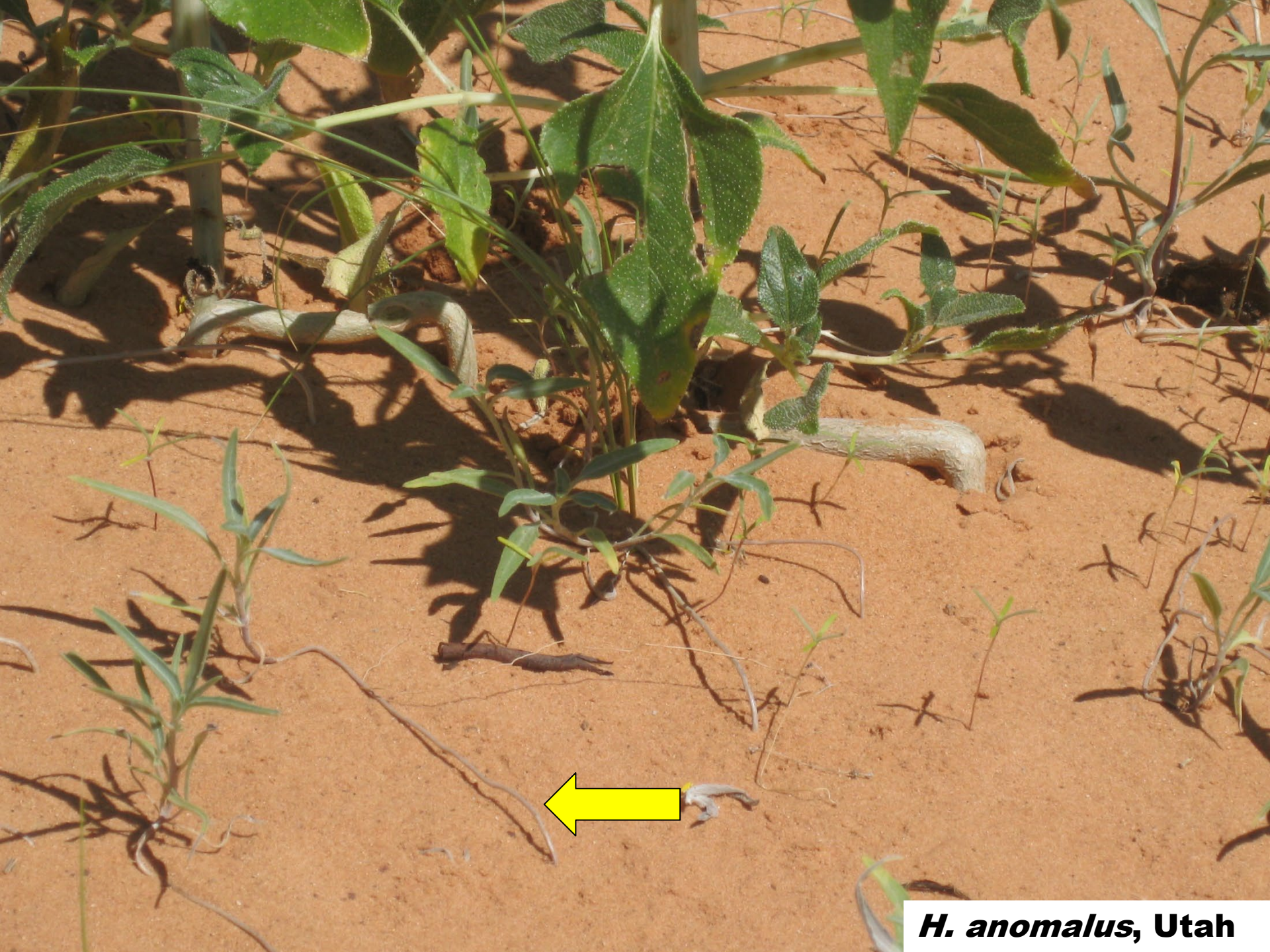
## ***H. anomalus* Traits**

- High oil content ~ 45%
- Largest seed of any wild species
- Lower WUE and higher nitrogen fixation
- More tolerant of nutrient stress and higher nutrient use efficiencies
- Lower plant conductance and transpiration rate.



**Anomalous sunflower**

***H. anomalus*, Utah**



***H. anomalus*, Utah**



***H. anomalus*, Utah**

A close-up photograph of a sunflower head, showing the bright yellow petals and the dark brown center. The image is positioned on the left side of the slide, partially overlapping the blue background.

## ***H. niveus ssp. tephrodes* Traits**

- High oil content > 40%
- Larger seed than many wild species
- Thick pubescent leaves reduce heat load and transpirational water loss under stress
- Higher instantaneous water use efficiency and photosynthetic rate on a leaf area basis
- Leaf pubescence may be promising for breeding for drought-prone, high radiation environments





Dune sunflower

*H. niveus* subsp. *tephrodes* –Algodones Dunes, California



***H. niveus* ssp. *tephrodes*– Algodones Dunes, California**



***H. niveus* subsp. *tephrodes* –Algodones Dunes, California**



***H. niveus* subsp. *tephrodes* –Algodones Dunes, California**



*H. niveus* subsp. *tephrodes* –Algodones Dunes, California

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## ***H. petiolaris* Traits**

- Under water deficits, osmotic potential retained full turgor and increased turgid to dry weight ratio
- Ability to osmotically adjust to water deficits
- Cell size may play a role in the osmotic adjustment and drought resistance
- Ability to readily regrow fine lateral roots in response to water and abort roots in drought
- Different leaf area distributions under water stress



**Prairie sunflower**

***H. petiolaris* ssp. *petiolaris*, North Dakota**



*H. petiolaris* ssp. *fallax*, New Mexico



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## ***H. exilis* Traits**

- Poor soils, very low organic matter
- Tolerates high concentrations of iron, chromium, nickel and cobalt
- High concentrations of magnesium and low concentration of calcium
- Shallow soil lacking many essential nutrients such as NPK
- White color due to asbestos



**Serpentine sunflower**

***H. exilis*, California**



## ***H. paradoxus* Traits**

- Up to 5 times more salt tolerant than parental species
- Tolerates salinity equal to sea water
- Accumulates salt crystals in intercellular space of plants
- Oilseed maintainer line HA 429 and HA 430 developed with single gene inheritance
- Salt tolerant candidate gene (CDPK3) mapped to salt tolerant QTL on LG4



**Pecos sunflower**

***H. paradoxus*, Texas**



***H. paradoxus*, New Mexico**

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## ***H. argophyllus* Traits**

- Higher water use efficiencies, better drought susceptibility index, and higher harvest index
- Low cell membrane injury, high epicuticular waxes and dense leaf hairs
- Lower leaf water potential and higher photosynthetic activity at a given leaf water potential
- Lower leaf water loss



**Silverleaf sunflower**

***H. argophyllus*, Daytona Beach, Florida**



***H. argophyllus*, Texas**





**Luka Cuk**

***H. argophyllus*, Texas**

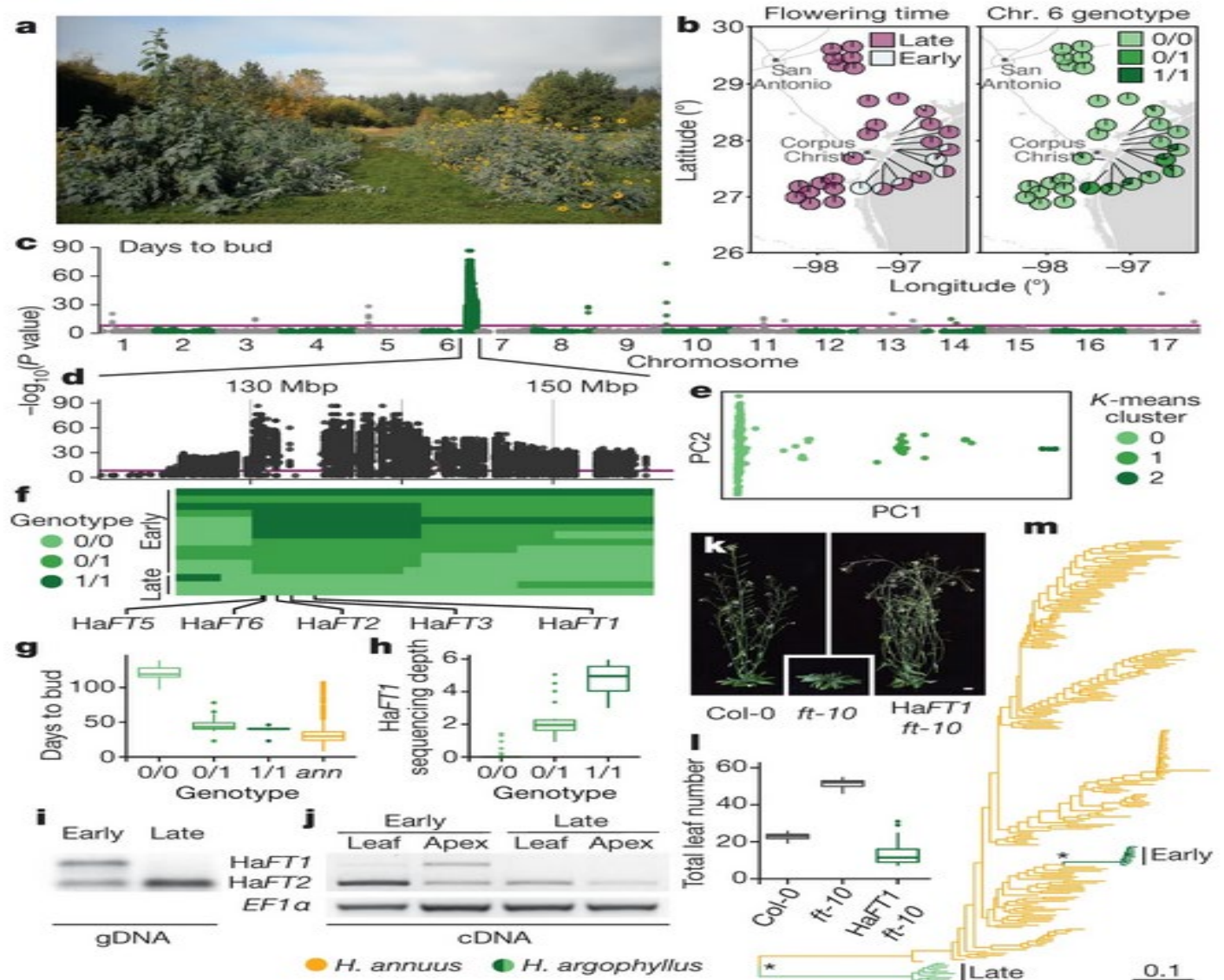
**What's Ahead???**

# **Challenges and Opportunities**



**Fig. 2: A large introgression from *H. annuus* containing a functional *HaFT1* gene causes early flowering in coastal *H. argophyllus*.**

From: Massive haplotypes underlie ecotypic differentiation in sunflowers





**Thank you  
Questions??**