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Hybrid Poplar as a Bioenergy Feedstock for the Pacific Northwest

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Advanced Hardwood Biofuels Northwest




- Funded by a $40 million AFRI CAP (coordinated agricultural project) from the USDA
- Led by the University of Washington and includes a broad consortium of universities and industry partners
- To develop a system to convert hybrid poplars into biofuel
- Goal: To generate liquid biofuels: gasoline, diesel and jet fuel that are fully compatible with existing infrastructure
- Target: To produce 400 million gallons of biofuel/yr. from 400,000 acres of hybrid poplar plantations around the PNW
- The biofuel production from this project will meet 75% of the region's target for the 2022 renewable fuel standard (RSF2)

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- The project is organized into five teams:
  1. **Conversion and distribution:** (ZeaChem Inc)
  2. **Feedstock:** (GreenWood Resources)
  3. **Sustainability:** (University of Washington & University of California, Davis)
  4. **Education:** (Oregon State University & Agriculture Center of Excellence – Walla Walla Community College)
  5. **Extension:** (Washington State University)
- Project timeline: 5 yrs.

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Feedstock Production (AHB-NW)




- To develop: Breeding, growing, and harvesting technology for poplar bioenergy plantations
- Use of regional demonstration plantations to determine:
  - Biomass yields
  - Economics
  - System impacts on the environment (wildlife, water quality and availability, land productivity)

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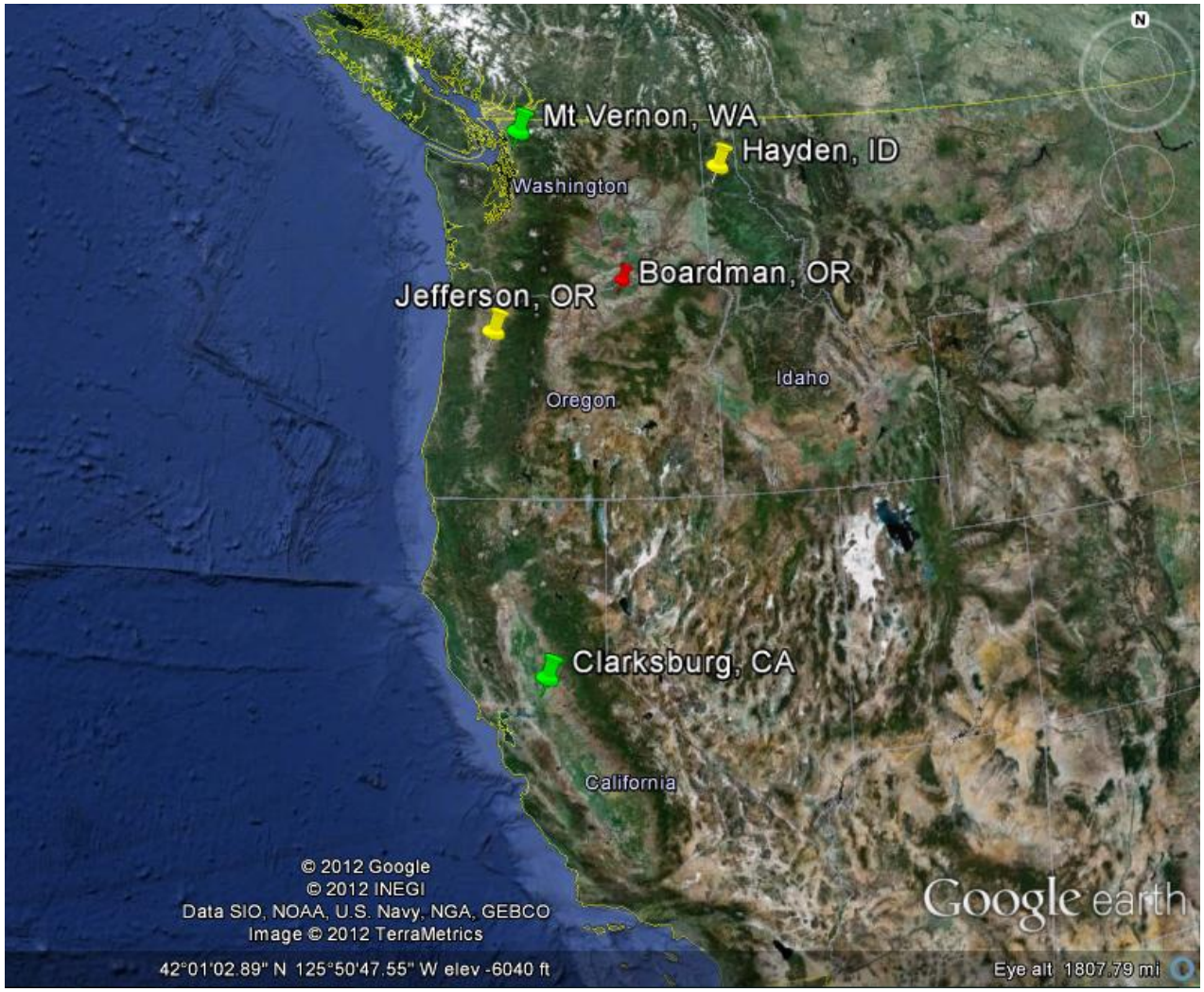
AFRI Demonstration Plantings (2012 - 2013)



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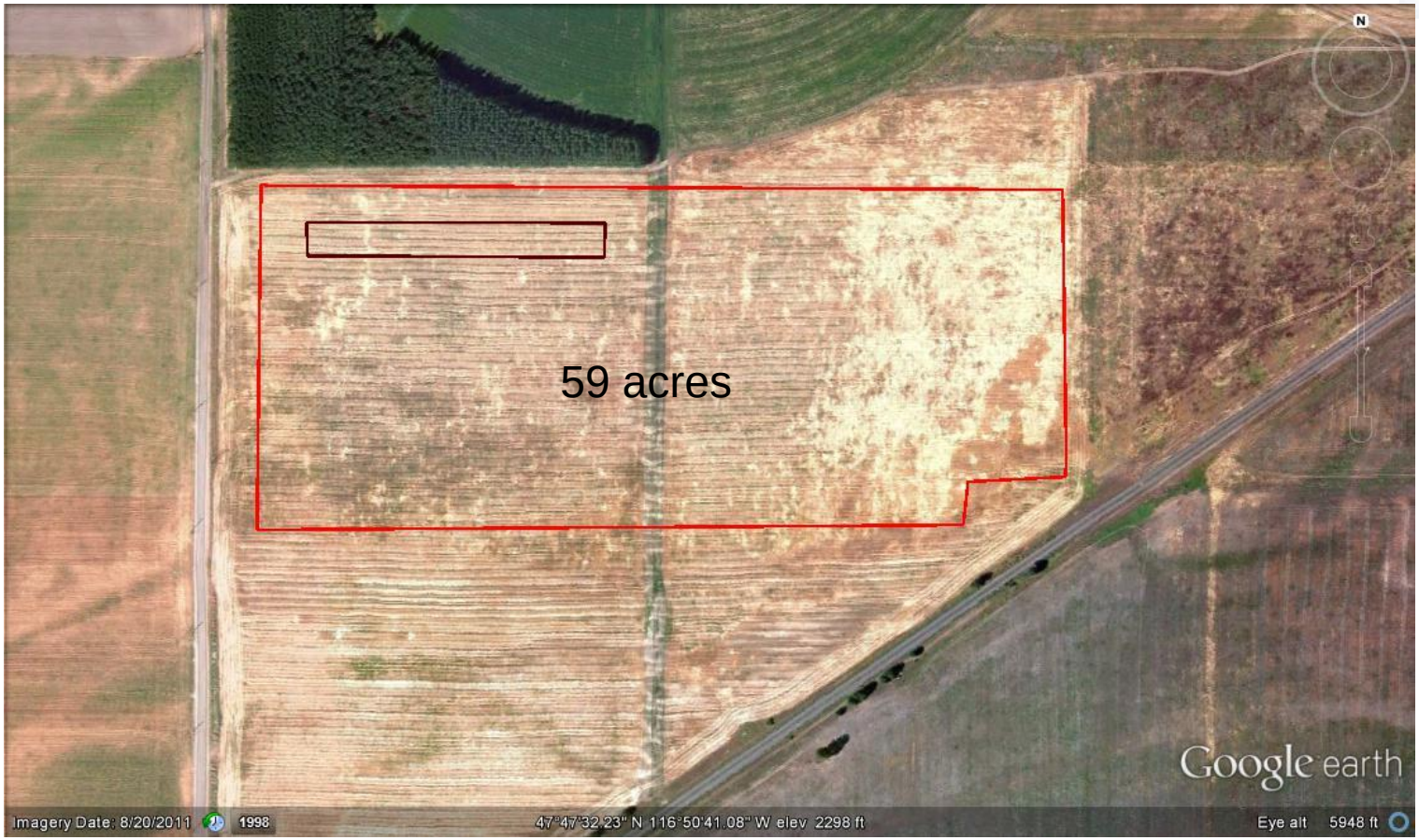
Hayden, ID (Xeric Site - 26” AVG ppt.)



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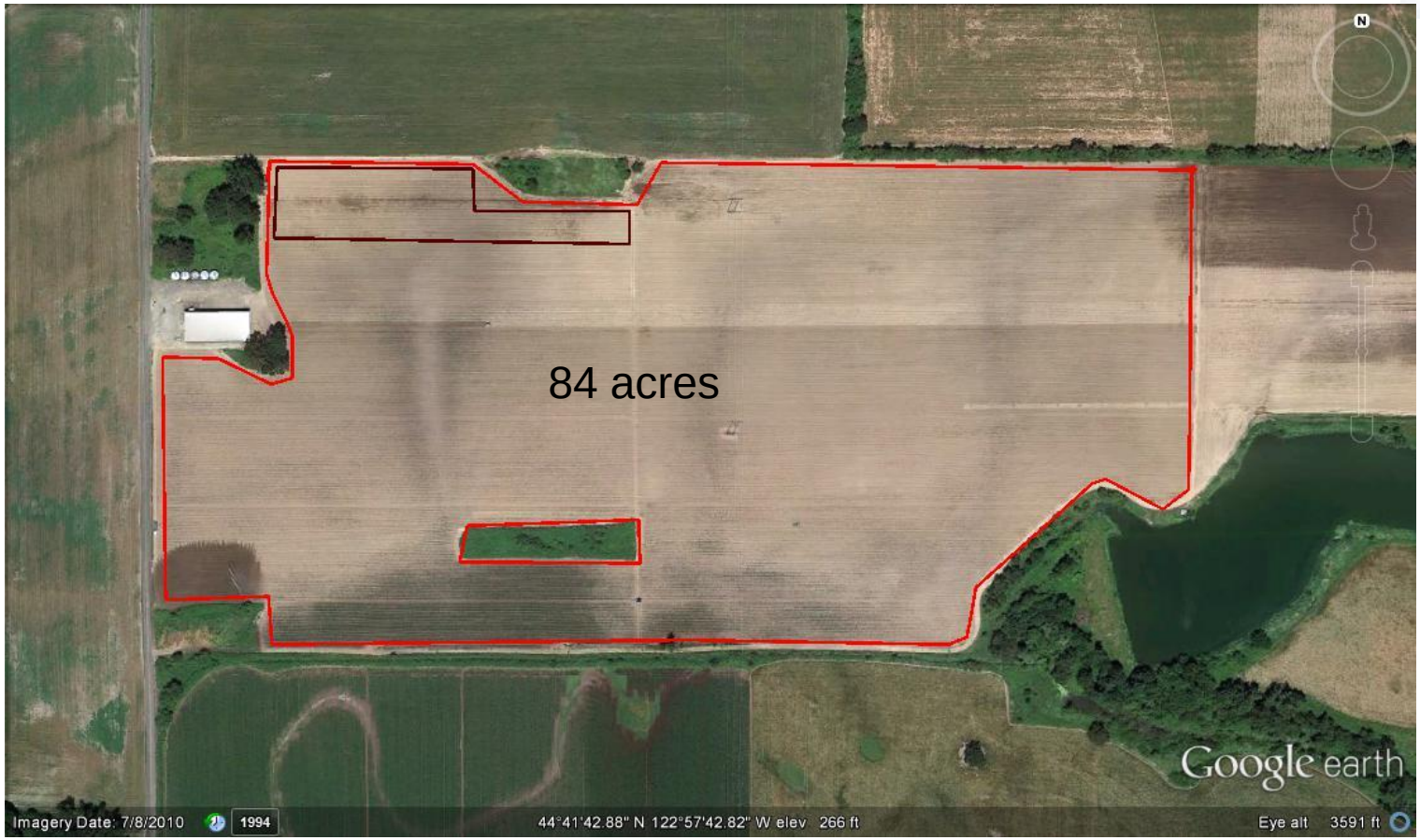
Jefferson, OR (Mesic Site - 53” AVG ppt.)



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Research Topics




- Poplar production as a bioenergy feedstock in the Pacific Northwest will entail regeneration management through coppice in short rotations.

- The implementation of this production system brings some challenges:
  - Selection of best genotypes
    - Adaptability
    - Pest and disease resistance
    - Resprouting vigor
    - Biomass yield and composition

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Research Topics (cont.)




- System design
  - Planting density
  - Rotation length
- Continuous production to meet conversion demands
- Sustainability

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Trials




1. Evaluation of hybrid poplar clones for bioenergy use

2. Hybrid poplar biomass productivity study

3. Preliminary evaluation of red alder inter-specific hybridization

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1. Evaluation of hybrid poplar clones for bioenergy




- To determine interactions for growth, adaptability, or coppicing across sites within the xeric and mesic physiographic deployment regions
- 75 clones within each physiographic region are being tested in single tree plots following a completely randomized design with 4 replications

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1. Evaluation of hybrid poplar clones for bioenergy




- Mesic sites (75 clones)
  - 27 clones from *P. ×generosa* (*P. deltoides ×P. trichocarpa*)
  - 28 clones from *P. ×generosa* (*P. trichocarpa ×P. deltoides*)
  - 19 clones from *P. deltoides × P. maximowiczii*
  - 1 clone from *P. trichocarpa × P. maximowiczii*

- Xeric sites (75 clones):
  - 69 clones from *P. ×canadensis* (*P. deltoides ×P. nigra*)
  - 6 clones from *P. ×generosa* (*P. deltoides ×P. trichocarpa*)

- Response variables: Survival, growth, resprouting vigor, Wood composition

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2. Hybrid poplar biomass productivity study




- To refine system design
- Split-plot RCBD (4 replications)
- 2 Harvest Seasons (Active: June-July, Dormant: Jan)
- 2 planting densities (1089 tpa: 10'x4'; 2178 tpa: 10'x2')
- 2 Alder intercropping (yes, no) (Heilman and Stettler, 1985)

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2. Hybrid poplar biomass productivity study




- Harvest (years 2 and 5)

- Response Variables:
  - Routine soil nutrient analysis and plant available N from surface horizon, at establishment, and at years 2 and 5.
  - Survival at years 1, 3, and 6.
  - Height and diameter at years 1, 2, and 5.
  - Biomass yield at years 2 and 5.
  - Coppicing ability at years 3 and 6 (Number of sprouts, vigor).

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3. Preliminary evaluation of red alder inter-specific hybridization




- To develop a germplasm base that complements the site adaptability of the poplar base

Alder hybrids:

- *Alnus rubra* open pollination (AR × op)
- *A. rubra* × *A. nepalensis* (AR × AN)
- *A. rubra* × *A. acuminata* (AR × AA)

Hierarchal design with five replications:

- Whole plots (Maternal genotypes)
- Subplots (Paternal genotypes: op, AN, AA)

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Acknowledgment




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