

GROWTH OF BIOFUEL CROPS ON RECLAIMED MINED LAND IN WEST VIRGINIA

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Corn - Ethanol

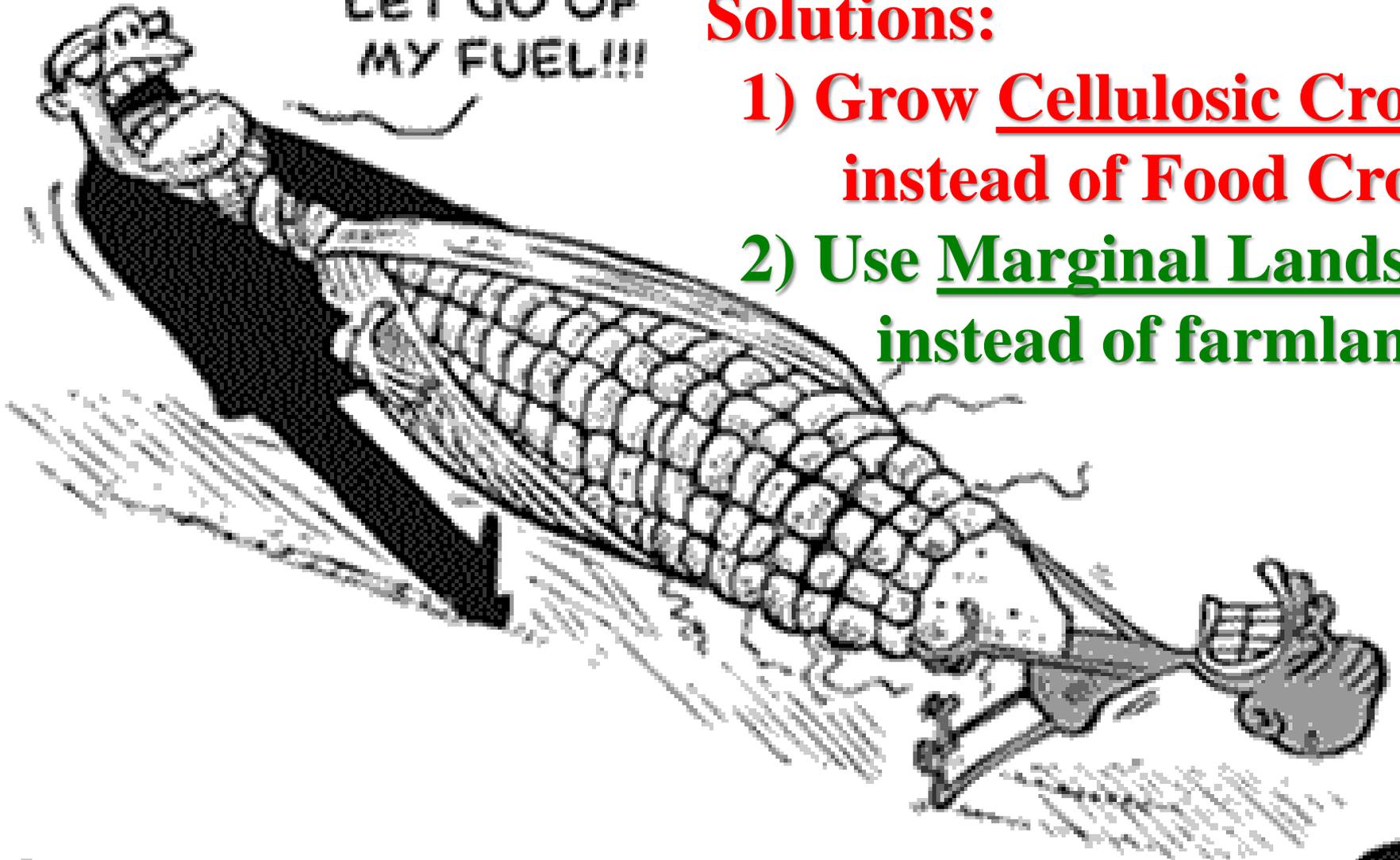


Food vs. Fuel Debate

LET GO OF
MY FUEL!!!

Solutions:

- 1) Grow Cellulosic Crops instead of Food Crops
- 2) Use Marginal Lands instead of farmland.



Cellulose – It's Everywhere!



Biomass Feedstocks

Starch/Sugar Feedstocks

- Corn
- Sugarcane



Cellulosic Feedstocks

Ag Plant Wastes:

- Corn/Grain Stover
- Forest Residues
- Sawdust
- Paper Pulp

Energy Crops

- Switchgrass
- Miscanthus

Coal Mining disturbs landscapes and forests



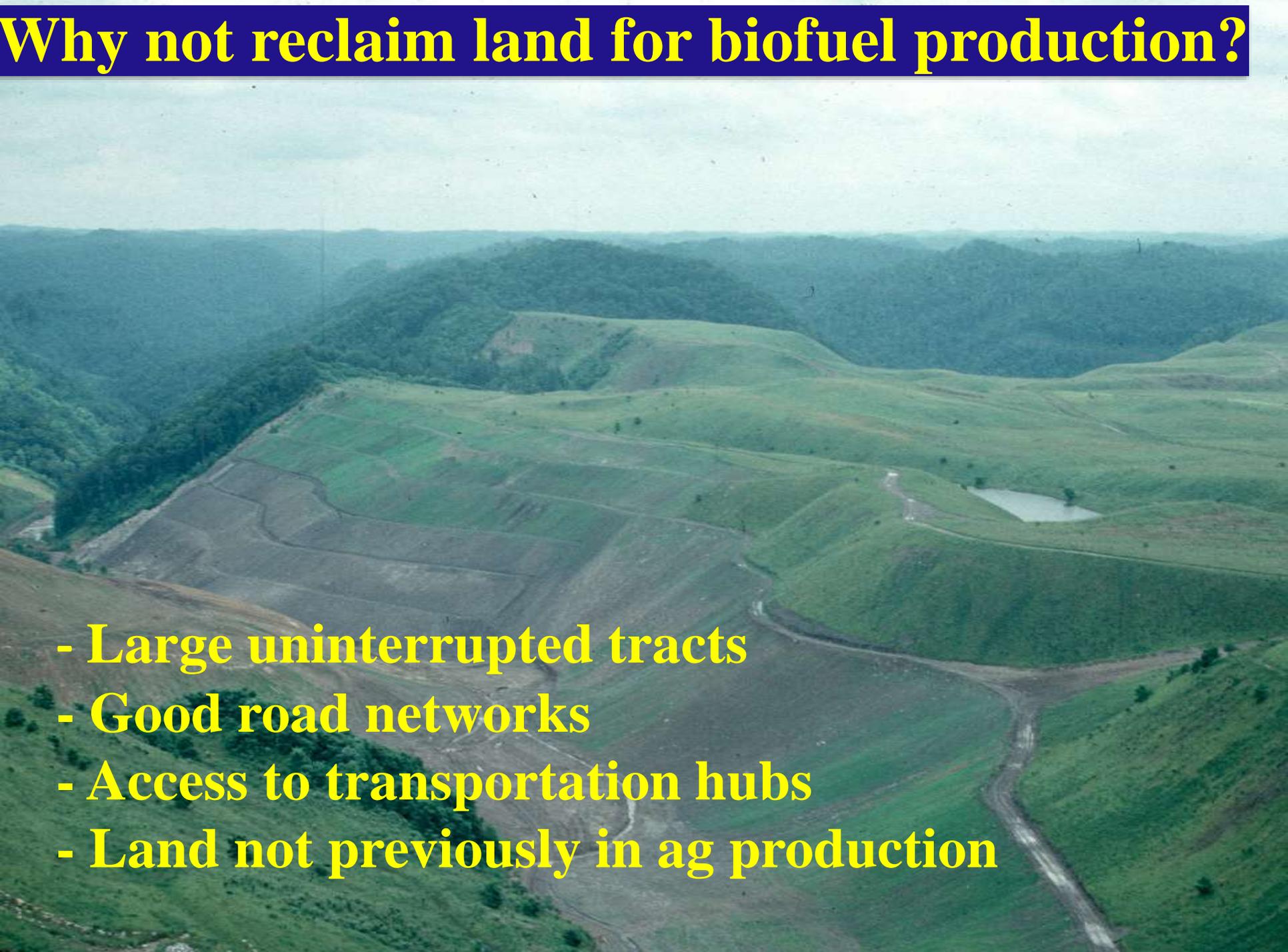
07/23/2015

These lands can be reclaimed to productive uses



07/23/2015

Why not reclaim land for biofuel production?

- 
- Large uninterrupted tracts
 - Good road networks
 - Access to transportation hubs
 - Land not previously in ag production

BioEnergy Crops - 2nd Yr –

Switchgrass on Reclaimed Mine



06/17/2010

Switchgrass, Miscanthus Pellets, Biomass, Ethanol



2008 6 4

2008

Switchgrass Yields

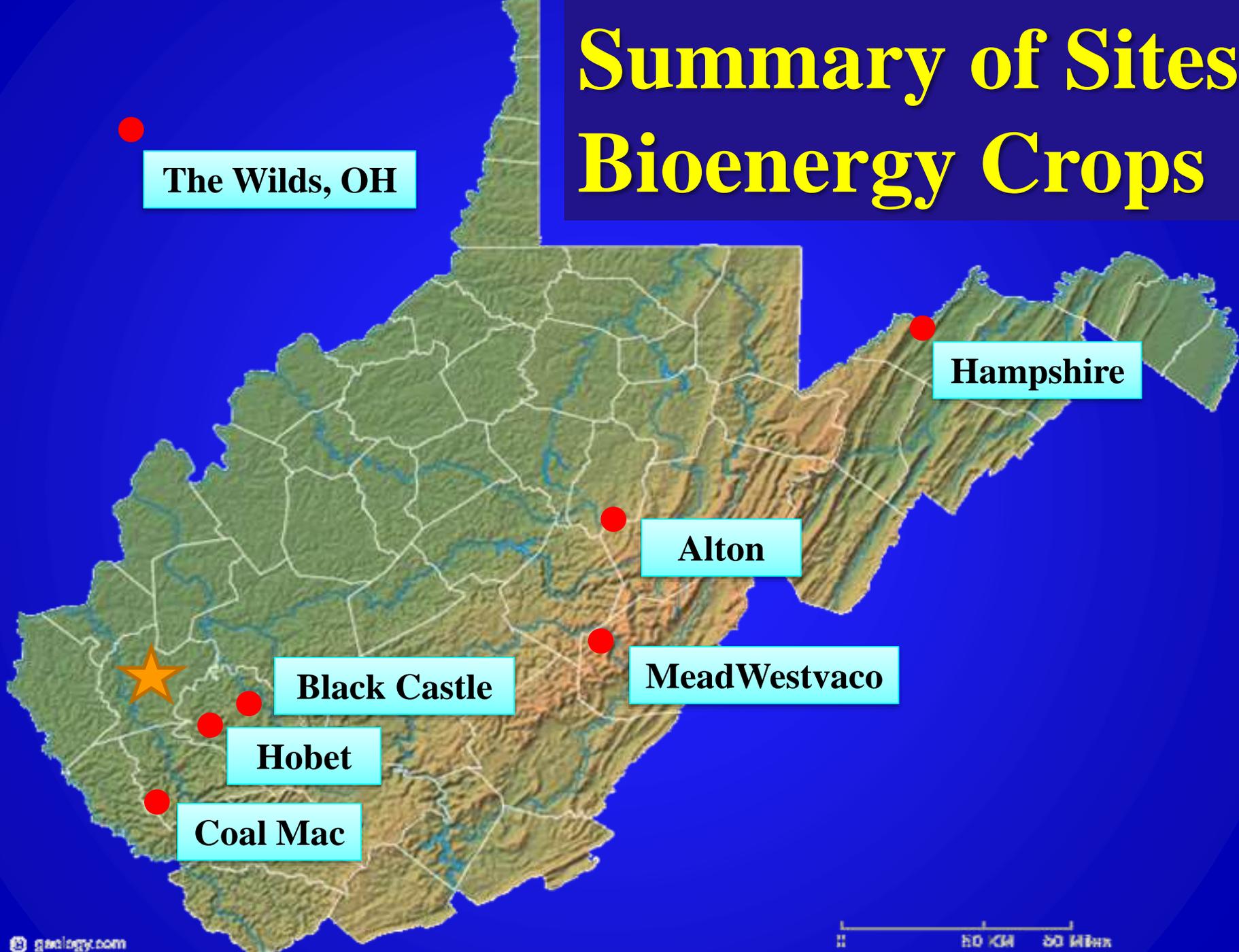
Study	Yield Mt ha ⁻¹	Description
Fike et al. (2006a)	14	4 cultivars, 8 sites, 5 states (including WV)
Vogel & Masters (1998)	15	3 states in Midwestern US
Fike et al. (2006b)	14	Years 6 - 9 of production
McLaughlin (2005)	11 – 19	Cave-in-Rock; 10-year study in 13 states
Schmer et al. (2008)	5 – 11	Marginal cropland 
Mulkey et al. (2006)	< 7.5	CRP land in South Dakota

Goal would be 5.0 Mt ha⁻¹

**Can switchgrass
grow on land even
poorer quality than
marginal cropland?
... like reclaimed
mine lands...??**



Summary of Sites Bioenergy Crops



The Wilds, OH

Hampshire

Alton

MeadWestvaco

Black Castle

Hobet

Coal Mac

First 2 Sites – planted 2008



Hobet

Hampshire

Varieties

- **Three varieties of switchgrass**
 - Carthage
 - Cave-in-Rock
 - Shawnee

Hand seeding at Hobet



RESULTS

Soil Properties

Hampshire (Good Site)

- 74% Fines
- pH = 7.4
- EC = 421 $\mu\text{s}/\text{cm}$
- P = 8.0 mg kg^{-1} soil
- Ca = 50 $\text{cmol}_c \text{ kg}^{-1}$

Hobet (Poor Site)

- 55% Fines
- pH = 8.0
- EC = 109 $\mu\text{s}/\text{cm}$
- P = 50 mg kg^{-1} soil
- Ca = 2.0 $\text{cmol}_c \text{ kg}^{-1}$

Results - Yield

8th Yr

Variety

Hampshire

Hobet

----- Mt ha⁻¹ -----

Cave in Rock

15.1

1.1

Carthage

6.0

1.3

Shawnee

13.2

1.4

Hampshire – 8th Year – 15 Mt ha⁻¹



10.16.2015

Hobet – 8th Year – 1.5 Mt ha⁻¹



09.11.2014

Where do our numbers stand?

Agricultural Land: 15 - 20 Mt ha⁻¹
Cave-in-Rock at Hampshire: 15 Mt ha⁻¹
Shawnee at Hobet: 1.5 Mt ha⁻¹

Goal of 5.0 Mt ha⁻¹

What about other crops?



Switchgrass

Kanlow and BoMaster

Miscanthus

Illinois and MBX-002



Each 0.4 ha or 1 acre

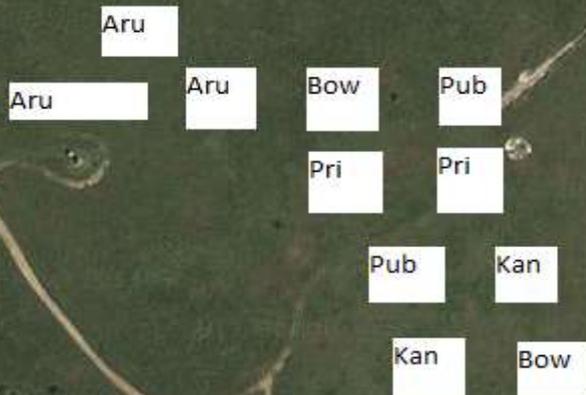
5 plots Kanlow

5 plots BoMaster

5 plots Miscanthus – private

5 plots Miscanthus – public

3 plots Arundo



200 ft
100 m

Must Herbicide!



06/14/2013

Switchgrass drilled into killed sod



Miscanthus sprigs planting at Alton



Planted sprigs like tree seedlings



Alton Soils

70% Fines

pH = 7.5

EC = 368 $\mu\text{s}/\text{cm}$

P = 40 mg kg^{-1} soil

K = 0.2 $\text{cmol}_c \text{ kg}^{-1}$

Ca = 3.2 $\text{cmol}_c \text{ kg}^{-1}$

10/26/2012

Variety

3rd Yr

6th Yr

----- Mt ha⁻¹ -----

Switchgrass

Kanlow

4.9

7.9

BoMaster

4.0

8.0

Goal of 5.0 Mt ha⁻¹

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Switchgrass – Alton – 3rd Yr

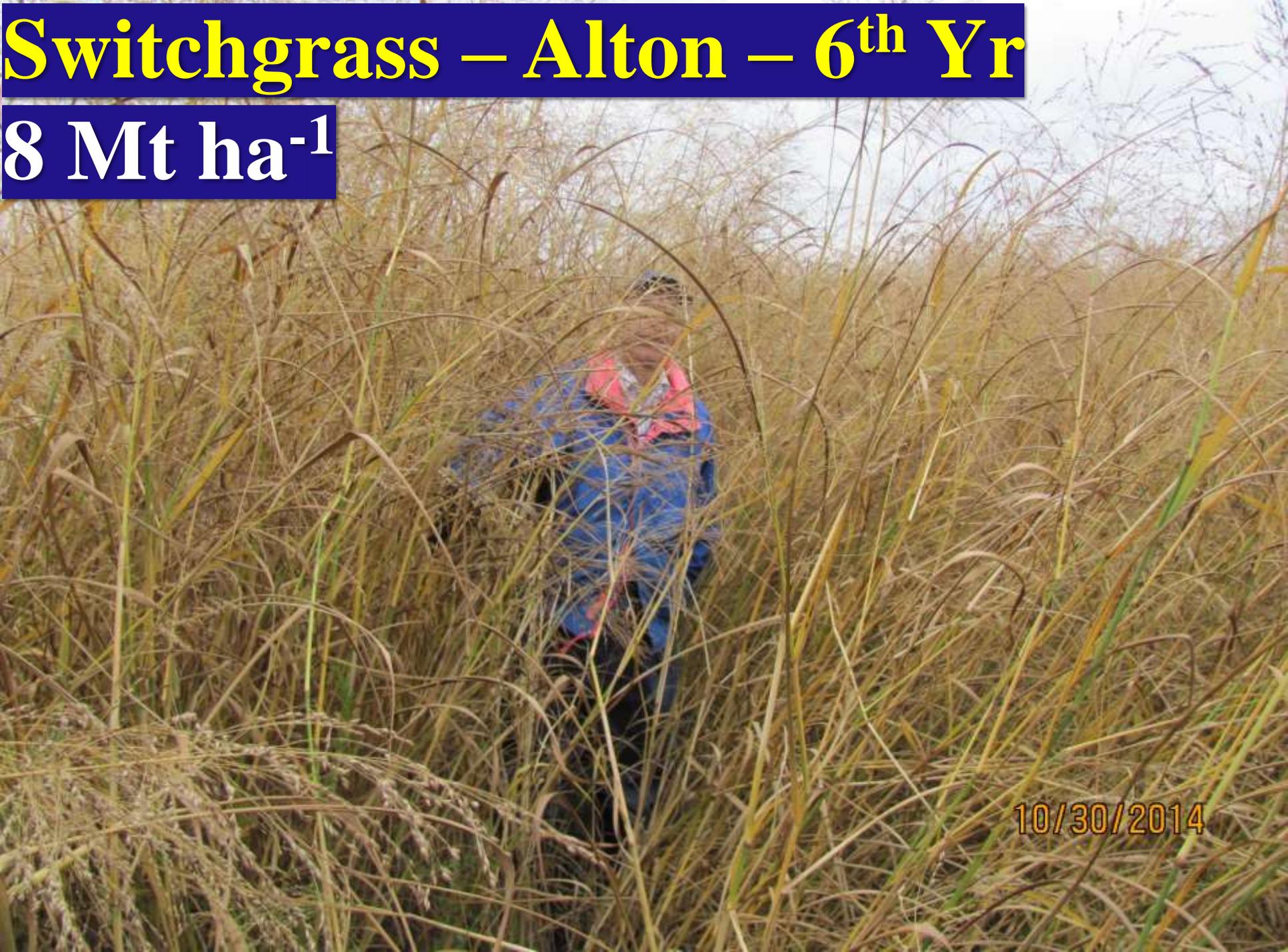
5 Mt ha⁻¹



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Switchgrass – Alton – 6th Yr

8 Mt ha⁻¹



10/30/2014

<u>Variety</u>	<u>3rd Yr</u>	<u>6th Yr</u>
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----- Mt ha⁻¹ -----

Miscanthus

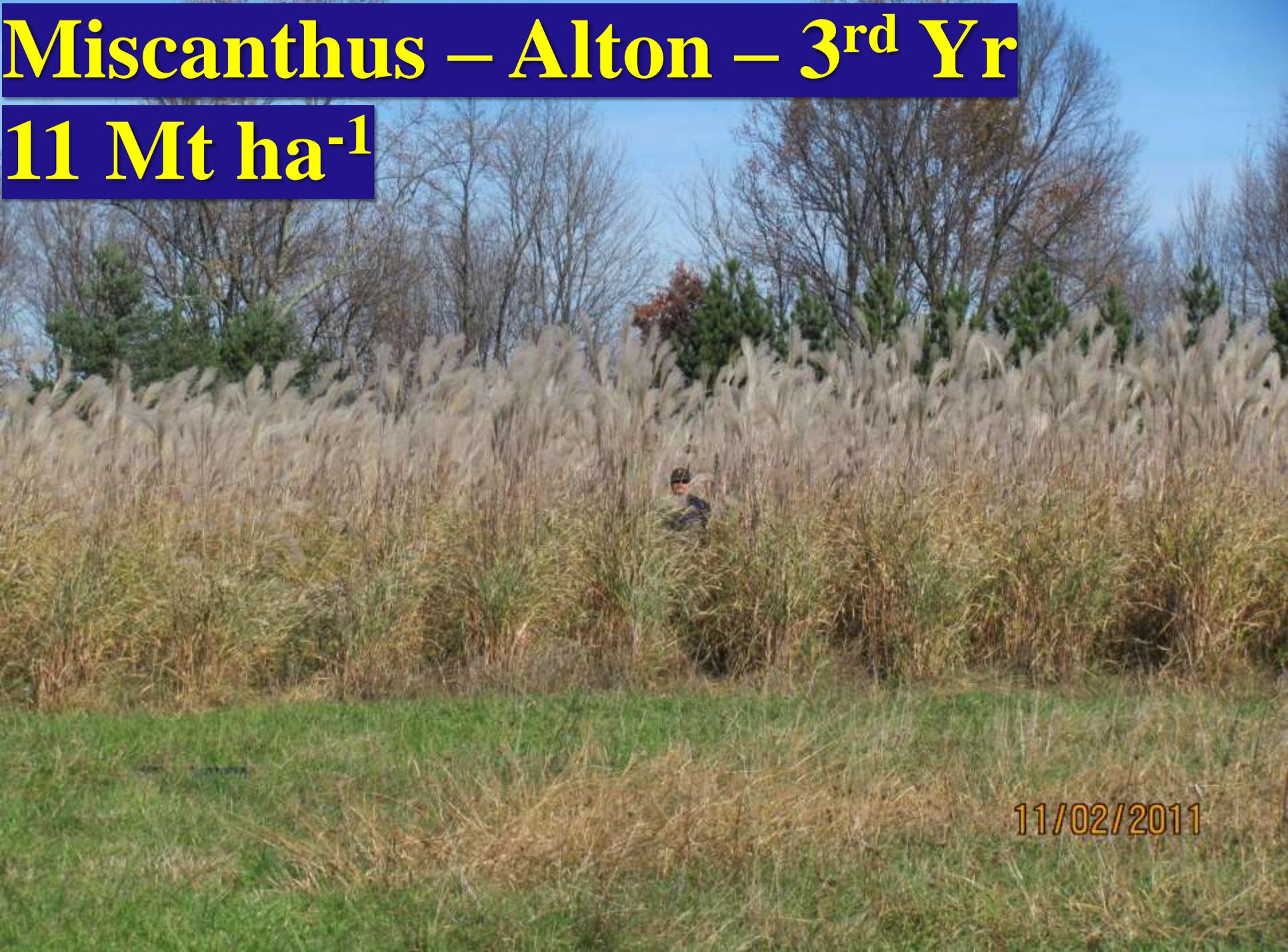
Illinois	4.9	11.4
MBX-002	11.7	13.7

Goal is 7.5 Mt ha⁻¹

10/30/2014

Miscanthus – Alton – 3rd Yr

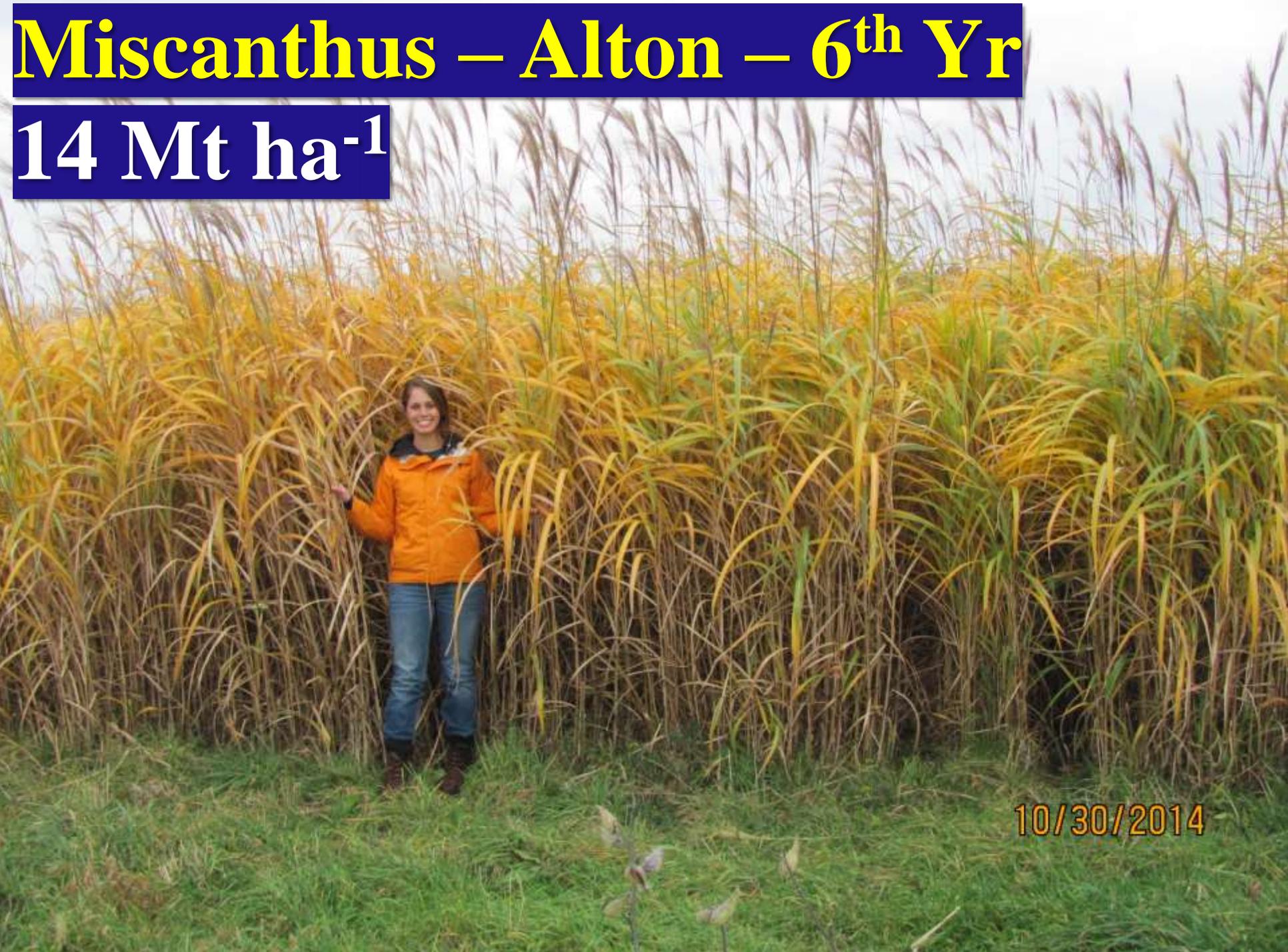
11 Mt ha⁻¹



11/02/2011

Miscanthus – Alton – 6th Yr

14 Mt ha⁻¹

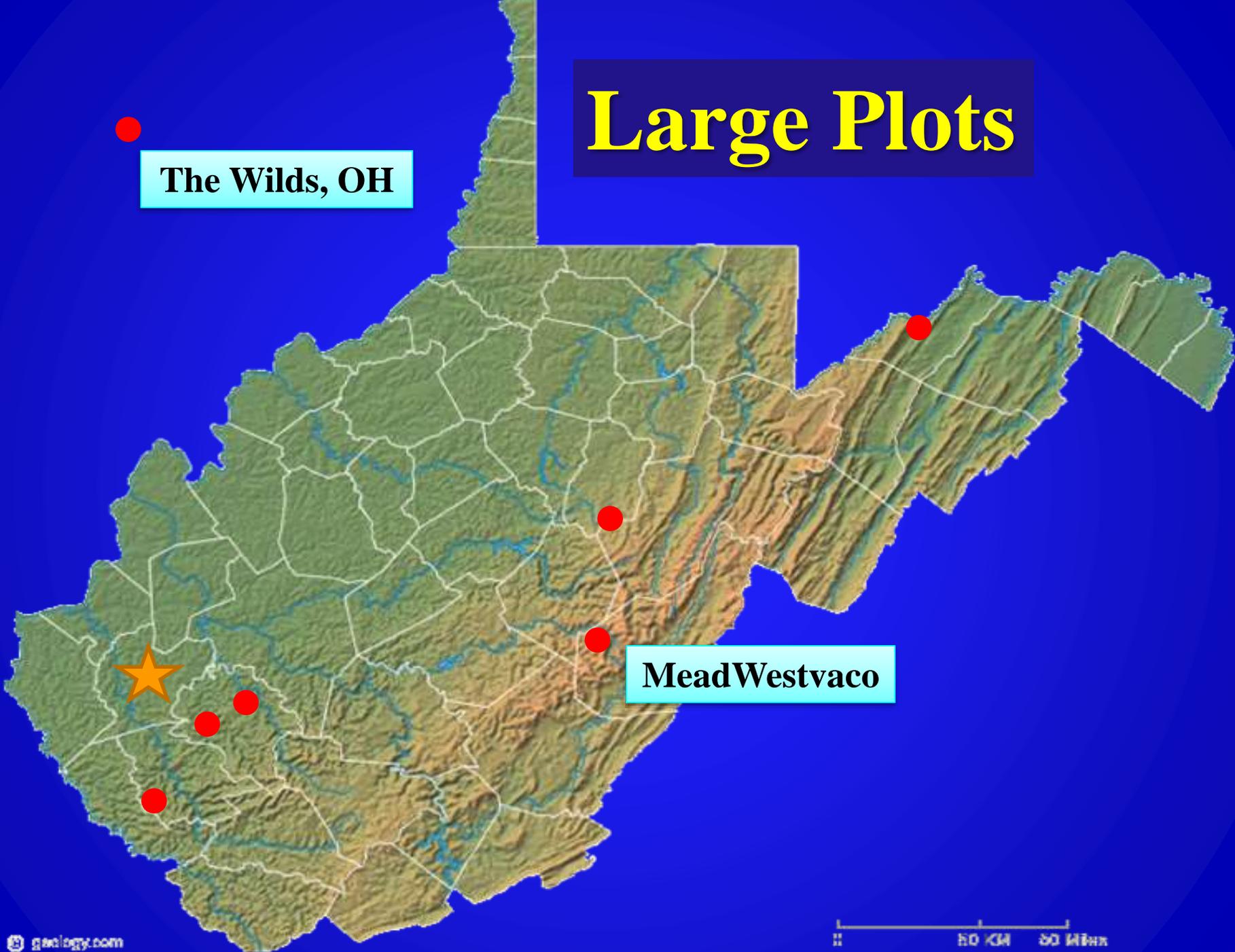


10/30/2014

Large Plots

The Wilds, OH

MeadWestvaco



Switchgrass – MeadWestvaco – 1st Yr



09/04/2013

Switchgrass – MeadWestvaco – 2nd Yr

3 Mt ha⁻¹



The Wilds – Drilling into herbicided area



Switchgrass – The Wilds – 1st Yr



08/13/2013

Switchgrass – The Wilds – 2nd Yr

5 Mt ha⁻¹



10.07.2014

Harvest at The Wilds - 2017



Conventional Haying Equipment



Conclusions

After 3rd year on reclaimed land

Switchgrass: $> 5.0 \text{ Mt ha}^{-1}$

Miscanthus: 10 to 15 Mt ha^{-1}

Increasing to the 8th year

09/10/2012

Questions?

