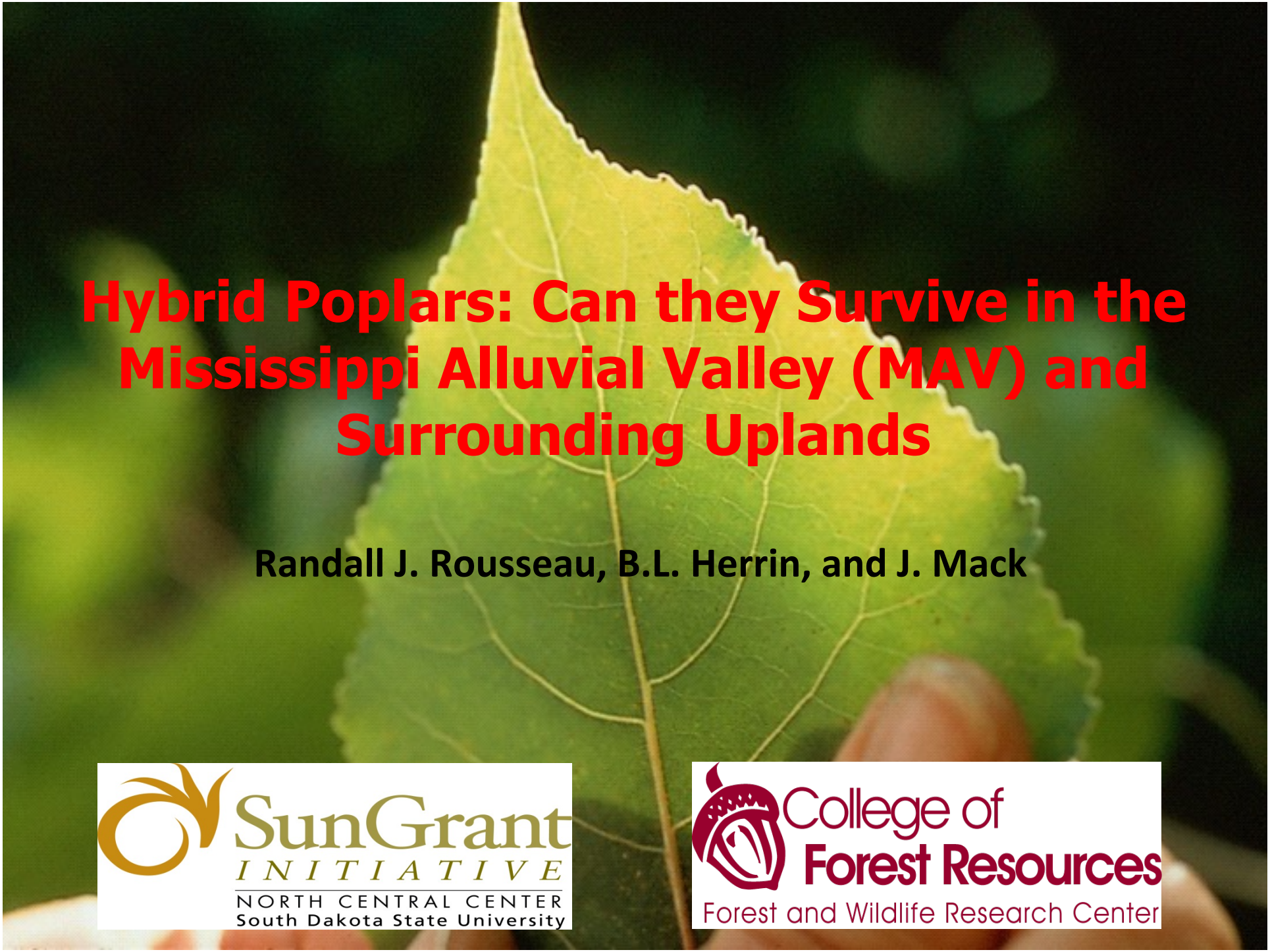

Hybrid Poplars: Can they Survive in the Mississippi Alluvial Valley (MAV) and Surrounding Uplands

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Hybrid Poplar Survival and Growth in the MAV

A Southern Perspective:

There is no doubt that hybrid poplars have been extremely useful in the US, but very limited work in this area, especially in the MAV

a. Rapid growth rates which allowed a short rotation captured the imagination of the pulp and paper industry

b. Non-industrial private landowners also sought these hybrids for both timber revenue as well as horticultural aspects

Hybrid Poplar Survival and Growth in the MAV

Background Information:

a. Northern hybrid poplars performance on sites in southern Illinois showed – Poor growth rates and disease

b. In 1987, TD hybrids were included in a clonal refinement study –

These were 5 TD hybrids from Univ. of Washington which were placed on alluvial sites

Hybrid Poplar Survival and Growth in the MAV

Background Information: (Cont'd)

c. Additional testing of TD and TDD hybrids on alluvial sites were done from in 1988 and 1989

- This testing was primarily done to determine if clones could be found that enhanced rooting – thus resulting in greater survival
- Poor adaptability and disease susceptibility plagued these hybrid poplars

Hybrid Poplar Survival and Growth in the MAV

Background Information: (Cont'd)

On alluvial sites in the MAV it became apparent that the hybrids (more specifically the TD and TDD taxa):

1. Early growth and survival was superior to eastern cottonwood (from bud break to well into the first growing season)
2. Extremely susceptible to diseases in the MAV, resulting in a high rate of mortality
3. None of the clones examined survived longer than 5 years on batture land

Hybrid Poplar Survival and Growth in the MAV

Background Information: (Cont'd)

During the mid-1990s, hybrid poplar trials and plantations were included on upland sites in KY, TN, WV, and VA:

1. Trials included a much wider array of hybrid taxa, such as TD, TDD, TM, TMM, and TN
2. In addition, operational plantings of DN, TD, and NM taxa were established
3. Growth rates were recorded but many taxa including TD, TDD, and DM fell prey to Septoria on all sites except for VA


Upland Site in Western Kentucky

Survival of five *Populus* taxa at 2 and 9 years on upland sites in western Kentucky

	Survival (%)	
Taxa	**Age 2**	**Age 9**
TD	97.7a	53.9a
TDD	88.8b	20.6b
TM	95.8ab	20.6b
TMM	90.0ab	21.5b
TN	91.3ab	8.8c
Test Avg.	92.4	23.9

Mean Disease Rating Levels for the 5 *Populus* Taxa at Nine Years

Taxa	-----Age 9---- Mean	Range
TD	3.02	1 – 4
TDD	2.71	1 – 4
TM	3.84	3 – 4
TMM	4.00	4
TN	3.97	3 – 4

Disease Ratings
1 – No disease
2 – Limb only
3 – Limb & Stem
4 – Dead or dieback to the ground

Mean DBH, Height and Volume Index of the Top Performing Clones in the 1999 *Populus* Taxa Study

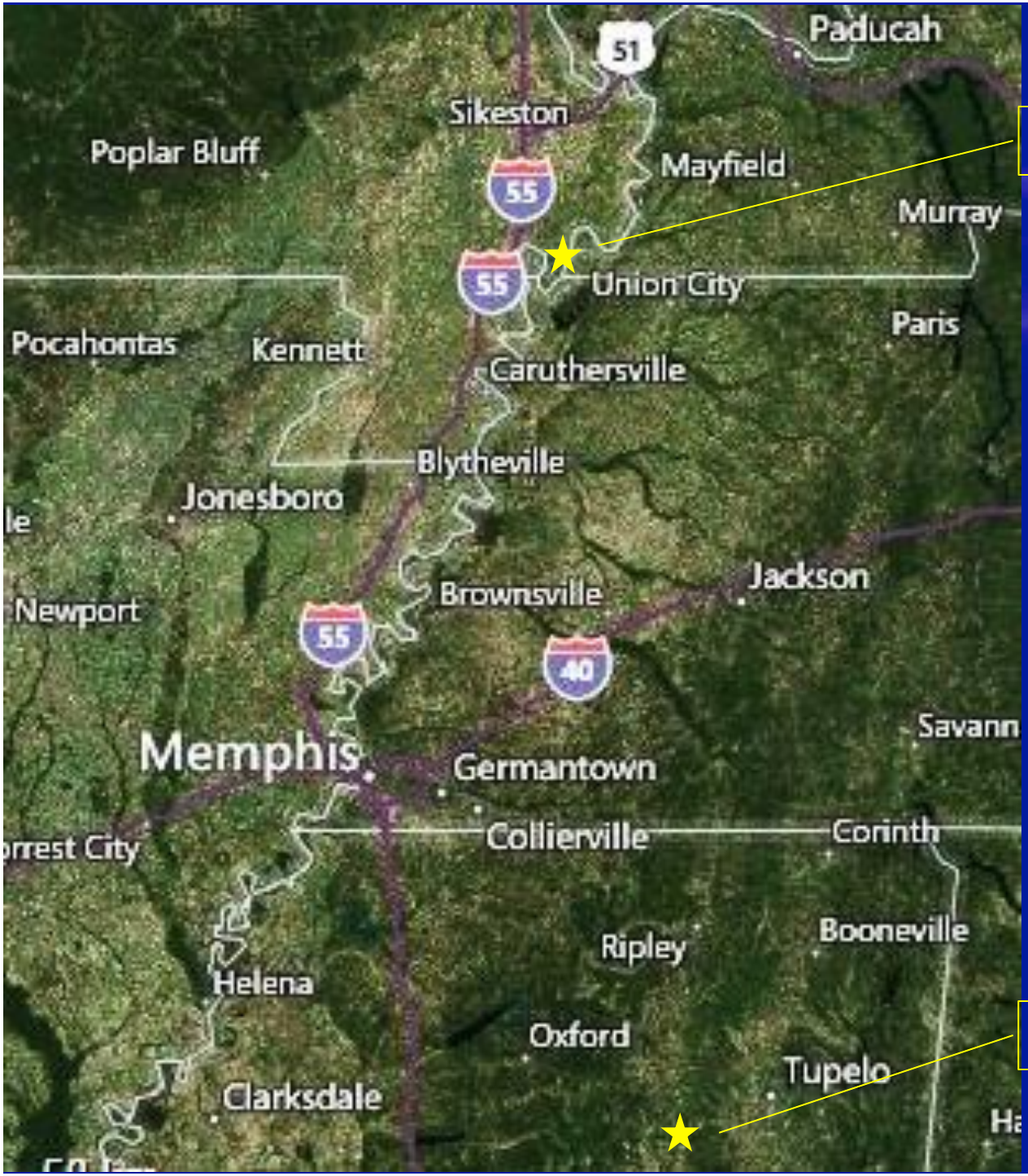
	Age 9				
Clone	Sur. (%)	DBH (in)	HT (ft)	V-INDEX	D-INDEX
TD					
24	94	7.2	37.4	2133	2.3
25	94	6.0	35.6	1395	2.7
TDD					
16	69	4.9	24.0	623	3.6

Hybrid Poplar Survival and Growth in the MAV

Sun Grant – *Populus* Feedstock Program

The focus of this program was to develop germplasm that could be used in the renewable energy sector

- Breeding efforts – with the South more focused on pure eastern cottonwood mating
- Consolidated Feedstock Testing
  Evaluating various taxa across a number of sites in 2010 and 2011



Alluvial – New Madrid, MO

2010 & 2011 Consolidated Populus Trials

Upland – Pontotoc, MS

Table 1. Age-four percent stem canker and the number of resistant clones in the 2010 Populus Consolidated Trial located on the alluvial site in **southeast Missouri** and the upland site in **northeast Mississippi**

		Stem Infection		No. of Resistant Clones	
Taxa	Number of Clones	Alluvial (%)	Upland (%)	Alluvial	Upland
DD	36	0	0	36	36
TD	8	75 - 100	17 - 100	0	0
DT	3	0 - 50	0 - 100	1	1
DM	6	100	67 - 100	0	0
DN	25	0 - 100	0 - 83	10	5

Table 2. Height, volume, percent canker, and survival of the top 10 clones at age four in the 2010 Populus Consolidated Trial located on the alluvial site in **southeast Missouri**

		Age 4					
Clone	Taxa	Survival (%)	DBH (in)	Height (ft)	Volume (ft^3)	Volume (Rank)	Canker (%)
AG443	DD	50	6.0	40.6	3.38	1	0.0
AG413	DD	50				2	0.0
AG414	DD	83				3	0.0
AG462	DD	33				4	0.0
25-2	DD	67				5	0.0
011-32S	DD	33				6	0.0
AG435	DD	33				7	0.0
ST66	DD	83				8	0.0
AG412	DD	83				9	0.0
AG427	DD	67	5.0	37.4	2.33	10	0.0
Mean		**58**	**5.6**	**39.7**	**2.88**		**0.0**

Table 3. Age-four survival height, dbh, volume, volume rank and stem canker for the overall best performing clones of the 2010 Populus Consolidated Trial located in **southeast Missouri**

		Age 4					
Clone	Taxa	Survival (%)	DBH (in)	Height (ft)	Volume (ft^3)	Volume (Rank)	Canker (%)
AG414	DD	83	5.9	40.2	3.35	2	0.0
ST66	DD	83			2.53	8	0.0
AG412	DD	83			2.43	9	0.0
ST259	DD	100			2.17	12	0.0
110804	DD	83			2.10	13	0.0
3-1	DD	100			2.09	14	0.0
110412	DD	100			1.97	16	0.0
111234	DD	100			1.89	18	0.0
111733	DD	83			1.65	23	0.0
111014	DD	100	4.3	36.9	1.62	26	0.0
Mean		91.7	4.8	39.3	1.97		0.00

Table 4. Age-four survival, volume, and volume rank of the most resistant hybrid poplar clones in the 2010 Populus Consolidated Trial located on the alluvial site in **southeast Missouri**

		Age 4			
Clone ID	Taxa	Survival (%)	Volume (ft^3)	Volume (Rank)	Canker (%)
13780	DN	100	1.16	34	0.0
13788	DN	100	0.85	41	0.0
99008098	DN	50	0.76	45	0.0
99037051	DN	67	0.69	51	0.0
22033013	DN	100	0.58	53	0.0
4491	DT	100	0.50	57	0.0
99007116	DN	67	0.45	61	0.0
99007115	DN	100	0.42	64	0.0
99008002	DN	67	0.40	66	0.0
12805	DT	83	1.84	19	25
Mean		83.4	0.77		

Table 5. Age-four survival, volume, and percent canker of the top 10 clones in the 2010 Populus Consolidated Trial located on the upland site in **northeast Mississippi**

		Age 4			
Clone	Taxa	Survival (%)	Volume (ft^3)	Volume (Rank)	Canker (%)
8019	DM	100	1.05	1	67
AG 443	DD	100	0.78	2	0
147-1	DD	83	0.79	3	0
110412	DD	100	0.73	4	0
AG 412	DD	83	0.71	5	0
24-128	TD	100	0.70	6	100
3-1	DD	83	0.66	7	0
6323	DM	100	0.65	8	100
105-1	DD	100	0.62	9	0
80-5	DD	50	0.59	10	0
Mean		90	0.73		

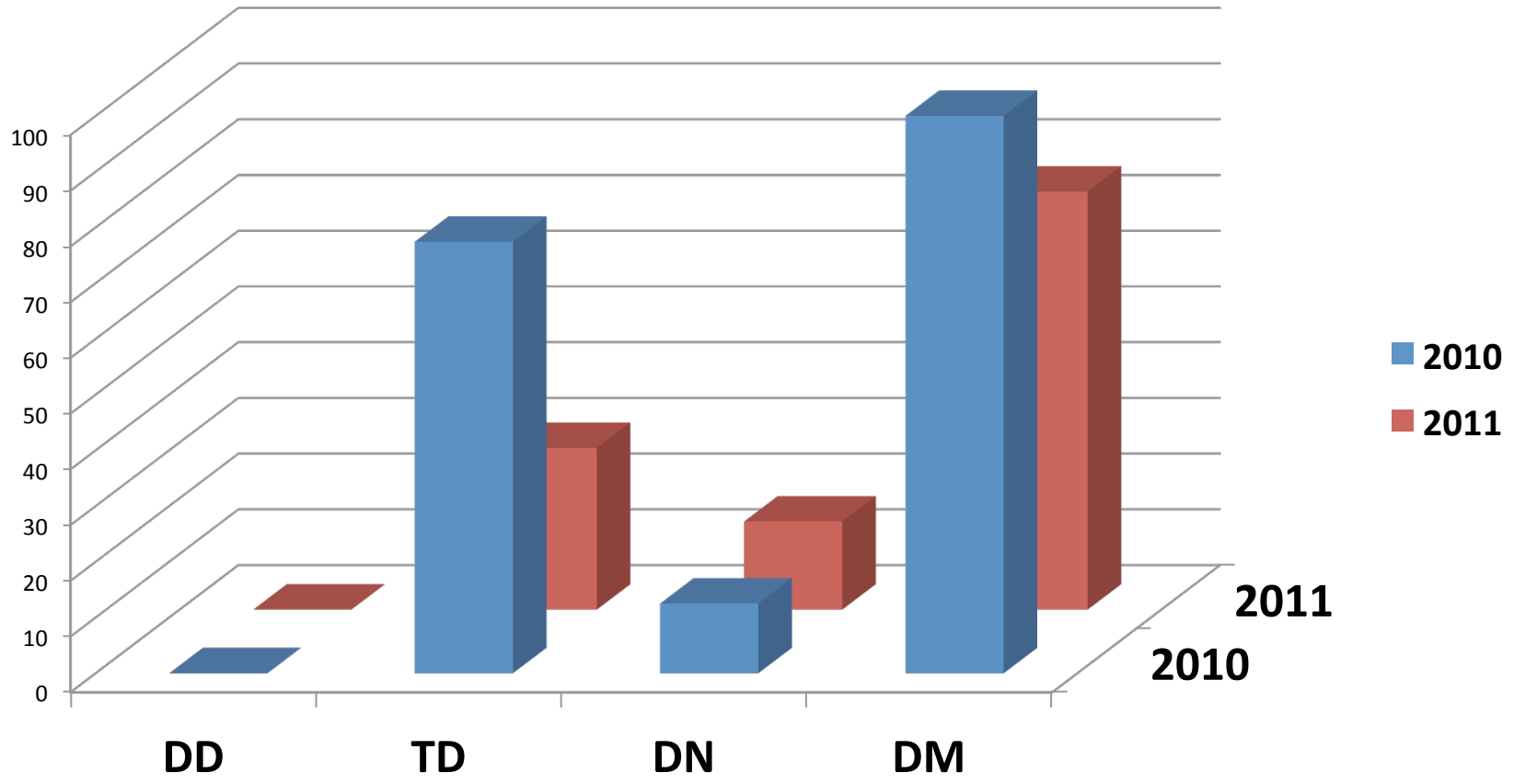


Figure 2. Age-3 percent stem infection by taxa of the common clones in the 2010-2011 Populus Consolidated Feedstock Test located in northeast Mississippi

CLONE	TAXA	2010 AGE 3 Common Clones (Upland Site – NE MS) Survival (%)	DBH (in)	Height (ft)	Volume (ft^3)	Canker (%)	2011 AGE 3 Common Clones (Upland Site – NE MS) Survival (%)	DBH (in)	Height (ft)	Volume (ft^3)	Canker (%)
110412	**DD**	**100.0**			**0.40**	**0**	**50**			**0.23**	**0**
110804	**DD**	**83.0**			**0.19**	**0**	**100**			**0.14**	**0**
ST66	**DD**	**83.0**			**0.20**	**0**	**83**			**0.18**	**0**
ST244	**DD**	**83.0**			**0.24**	**0**	**100**			**0.18**	**0**
ST259	**DD**	**100.0**			**0.14**	**0**	**83**			**0.28**	**0**
AG435	**DD**	**50.0**			**0.13**	**0**	**67**			**0.26**	**0**
AG437	**DD**	**50.0**			**0.11**	**0**	**100**			**0.25**	**0**
AG414	**DD**	**100.0**	**2.1**	**20.0**	**0.29**	**0**	**100**	**2.2**	**19.5**	**0.30**	**0**
AG187	TD	100.0			0.24	100.0	83			0.18	60.0
AG188	TD	83.0			0.19	100.0	100			0.18	67.0
AG229	**TD**	**100.0**	**2.0**	**16.9**	**0.24**	**100.0**	**100**	**1.9**	**18.1**	**0.25**	**50.0**
12804	TD	67.0			0.14	75.0	33			0.09	100.0
1428	TD	100.0			0.14	17.0	100			0.13	0
6018	TD	67.0			0.18	75.0	100			0.15	0
6198	DT	100.0			0.22	100.0	67			0.27	0
9732-31	**DN**	**100.0**	**1.2**	**14.5**	**0.14**	**0**	**100**	**0.9**	**10.2**	**0.11**	**0**
22021048	**DN**	**100.0**			**0.11**	**33.0**	**67**			**0.12**	**25.0**
99007115	**DN**	**100.0**			**0.10**	**17.0**	**50**			**0.09**	**0**
DN5	**DN**	**83.0**			**0.11**	**0**	**100**			**0.09**	**33.0**
6320	DM	100.0			0.31	100.0	100			0.18	100.0
6329	**DM**	**100.0**	**2.2**	**22.0**	**0.32**	**100.0**	**100**	**2.2**	**18.3**	**0.28**	**50.0**
NM6	NM	67.0			0.09	0	83			0.09	0

Summary:

1. The alluvial location of the Consolidated Populus Trial showed a greater amount of stem cankers resulting in higher mortality rates of hybrid poplar
2. The upland location of the 2010 and 2011 Consolidated Poplar Trials developed stem canker slower but the disease is present and beginning to cause mortality
3. Eastern cottonwood superior in the MAV but limited number of hybrid poplar clones show some promise as sites move away from the MAV
4. DM taxa appears to be the most susceptible however the limited number of clones may need expansion to determine if resistance can be found


Questions

Table 6. Age-three survival, dbh, height, volume, and stem cankers of the **common clones** between the 2010 and 2011 **Populus Consolidated Upland Trials Mississippi**

2010 Populus Trial		AGE 3				
TAXA	Number of Clones	Survival (%)	DBH (in)	Height (ft)	Volume (ft^3)	Canker (%)
DD	8	81.3	1.6	17.3	0.2131	0.0
TD	6	86.1	1.6	16.4	0.1872	77.4
DN	4	95.8	1.0	12.4	0.1169	12.5
DM	2	100	2.2	21.8	0.3202	100

2011 Populus Trial		AGE 3				
TAXA	Number of Clones	Survival (%)	DBH (in)	Height (ft)	Volume (ft^3)	Canker (%)
DD	8	85.4	1.8	16.3	0.2070	00.0
TD	6	86.1	1.3	13.4	0.1402	29.0
DN	4	79.1	0.8	9.6	0.1306	15.8
DM	2	100.0	1.9	16.5	0.2220	75.0


Questions


Questions

Mean Height and Range of the 5 *Populus* Taxa at Ages 2 and 9 Years

Taxa	-----Age 2----- Mean (ft)	Range (ft)	-----Age 9----- Mean (ft)	Range (ft)
TD	9.5a	4.5 – 14.0	29.8a	10.0 – 37.8
TDD	8.5c	4.0 – 14.0	22.1b	9.3 – 24.0
TM	9.5a	3.0 – 15.0	20.5bc	8.6 – 36.0
TMM	8.9b	1.0 – 13.0	13.9d	3.0 – 25.5
TN	8.5c	5.5 – 14.5	19.2c	11.6 – 30.3
Test Avg.	9.0	1.0 – 15.0	23.6	3.0 – 49.6

Populus Taxa Study

Field Design:

a. Nested Design

- Eight blocks, 5 Taxa (i.e. TD, TDD, TM, TMM, and TN) with 10 clones/Taxon
- Each clone planted in 2-tree row plots at a spacing of 10 x 10 ft.
- Study disked twice in the first year and fertilized with 150 lbs of N and 75 lbs of P
- Measurements taken at ages 2 and 9

Table 1. Height and volume performance through time for the top 10 clones at age four for the 2010 Populus Consolidated Trial located on the upland site in northeast Mississippi

		Age 1		Age 2				
Clone ID	Taxa	Height (ft)	Height (Rank)[1]	Height (ft)	Height (Rank)[1]	Growth (ft)	Volume (ft^3)	Volume (Rank)[1]
8019	DM	8.2	6	18.9	1	10.7	0.208	1
AG 443	DD	5.3	52	12.9	21	7.5	0.133	17
147-1	DD	7.2	16	15.5	8	8.2	0.189	3
105-1	DD	6.3	31	12.2	27	5.9	0.155	12
80-5	DD	6.3	33	12.5	23	6.2	0.173	8
3-1	DD	5.7	48	12.4	26	6.6	0.145	16
110412	DD	6.6	25	14.6	11	8.0	0.152	13
24-128	TD	7.3	14	14.8	10	7.5	0.156	10
AG 412	DD	5.0	61	11.8	35	6.8	0.121	27
6323	DM	8.6	3	17.6	2	9.0	0.194	2

[1] – Height and volume ranking at that specific age

Table 1. Height and volume performance through time for the top 10 clones at age four for the 2010 Populus Consolidated Trial located on the upland site in northeast Mississippi (Cont'd)

		Age 3					Age 4				
Clone ID	Taxa	Height (ft)	Height (Rank)[1]	Growth (ft)	Volume (ft^3)	Volume (Rank)[1]	Height (ft)	Height (Rank)[1]	Growth (ft)	Volume (ft^3)	Volume (Rank)[1]
8019	DM	28.1	1	9.3	0.636	1	31.7	1	3.6	1.141	1
AG 443	DD	22.5	6	9.7	0.500	2	27.9	3	5.4	0.940	2
147-1	DD	23.0	2	7.6	0.486	3	27.2	4	4.2	0.848	3
105-1	DD	19.3	24	7.1	0.416	8	25.3	14	6.0	0.824	4
80-5	DD	19.8	22	7.4	0.484	4	23.7	24	3.8	0.815	5
3-1	DD	22.4	7	10.0	0.410	10	26.6	7	4.2	0.778	6
110412	DD	22.7	4	8.0	0.427	7	26.7	5	4.0	0.771	7
24-128	TD	22.0	11	7.2	0.434	6	25.4	13	3.4	0.767	8
AG 412	DD	20.9	17	9.1	0.380	11	25.5	12	4.6	0.736	9
6323	DM	22.4	8	4.7	0.414	9	26.3	9	3.9	0.725	10

[1] – Height and volume ranking at that specific age

Populus Taxa Study

Previous Site Uses:

1. Natural stand of mixed hardwoods
2. Loblolly pine plantation

Site Preparation:

1. Harvest, shearing, raking, piling and burning
2. Disk, and sub-soiled in both directions at a spacing of 10 x 10 ft.

Populus Taxa Study

Test Site:

Location – Livingston Co., KY

- Karst topography
- Primary loess deposition above limestone
- Test located on a broad ridge with a combination of Loring and Zanesville soils
- Depth of soil to a fragipan is approximately 24 inches

Mean DBH and Range and Volume Index of the 5 *Populus* Taxa at Nine Years

---------Age 9---------

Taxa	----DBH---- Mean (in)	Range (in)	Volume Index Mean
TD	5.22a	1.5 – 8.8	1090a
TDD	3.78b	2.3 – 6.0	367b
TM	4.02b	1.3 – 7.0	447b
TMM	2.69c	1.6 – 4.8	153c
TN	4.18b	2.3 – 6.2	372b
Test Avg.	4.36	1.3 – 8.8	642

Populus Taxa Study

Genetic Material:

5 *Populus* Taxa

1. *P. trichocarpa* x *P. nigra*
2. *P. trichocarpa* x *P. deltoides*
3. *P. trichocarpa* x *P. maximowiczii*
4. *TxD* x *P. deltoides*
5. *TxM* x *P. maximowiczii*

Populus Taxa Study

Measurements:

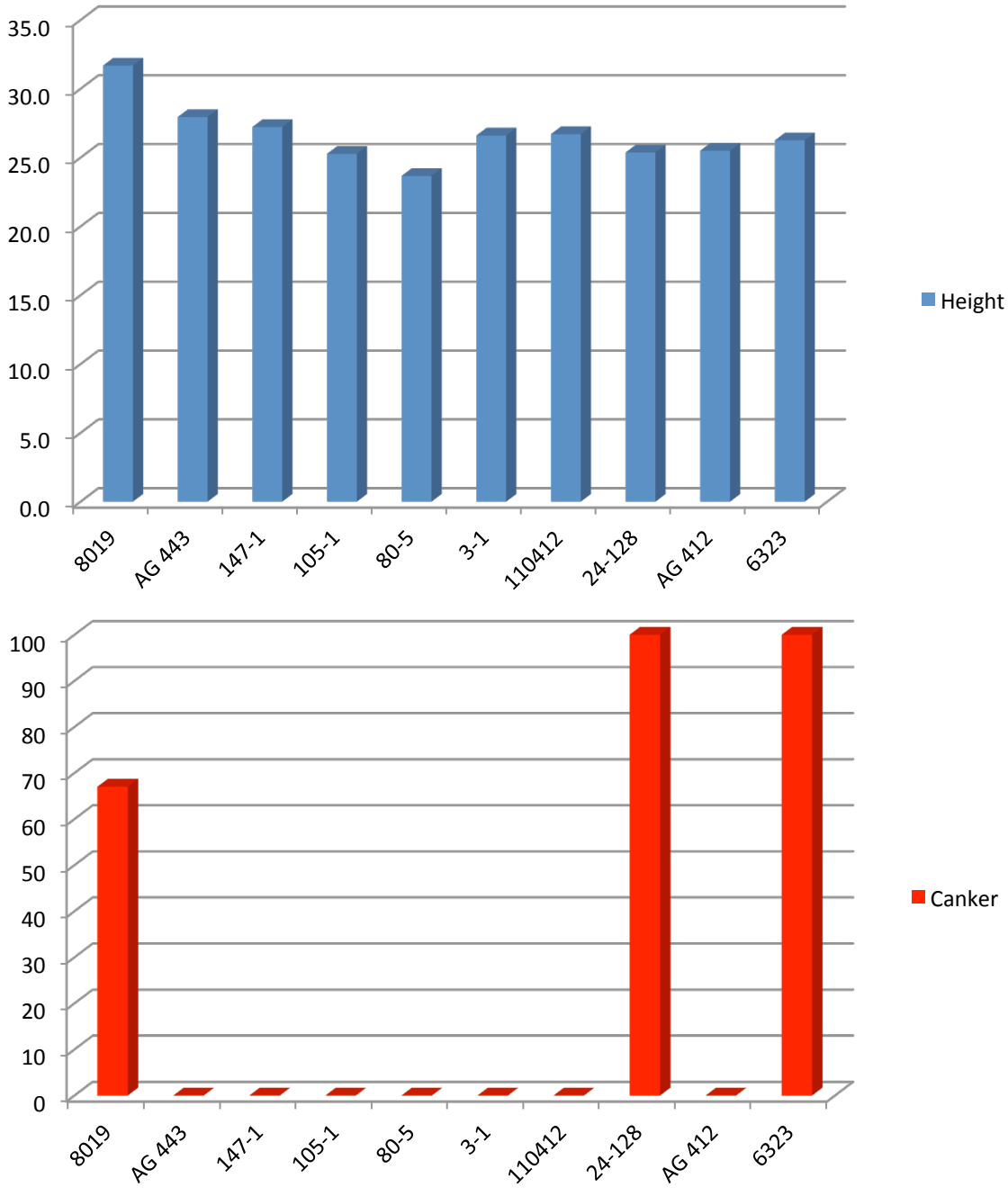
1. Total height, survival and crown scores at age 2

   Crown scores (leaf color and retention)

   1= Full crown and green leaf color
   2= 25% of crown gone and pale green leaf color
   3= 75% of crown and yellowish leaf color
   4= GT 75% of crown gone and yellow to brown leaf color

2. Total height, dbh and disease levels at age 9

   Disease Rating: 1= None, 2= Limbs only, 3= Limb and stem, 4= Reprout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105-1
80-5
3-1
110412
24-128
AG 412
6323
Canker

Table 2. Height, volume, percent canker, and survival of the top 10 clones at age four in the 2010 Populus Consolidated Trial located on the alluvial site in southeast Missouri

		Age 4					
Clone	Taxa	Survival (%)	DBH (in)	Height (ft)	Volume (ft^3)	Volume (Rank)	Canker (%)
AG443	DD	50	6.0	40.6	3.38	1	0.0
AG413	DD	50	6.1	39.5	3.35	2	0.0
AG414	DD	83	5.9	40.2	3.35	3	0.0
AG462	DD	33	5.7	42.0	3.11	4	0.0
25-2	DD	67	5.7	38.2	3.00	5	0.0
011-32S	DD	33	5.5	40.0	2.71	6	0.0
AG435	DD	33	5.4	39.8	2.63	7	0.0
ST66	DD	83	5.2	40.4	2.53	8	0.0
AG412	DD	83	5.1	39.2	2.43	9	0.0
AG427	DD	67	5.0	37.4	2.33	10	0.0
Mean		58	5.6	39.7	2.88		0.0