

## Meadowview Notes 2008-2009

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Meadowview experienced drought conditions in 2008 and into the start of 2009. However, there was enough rain during the 2008 growing season to make most crops. This second year of drought may have impaired chestnut production somewhat, and impaired growth of new seedlings on some soils.

### **Inventory.**

Our current holdings are presented in Table 1, and changes from 2008 to 2009 are indicated in Table 2. We now have more than 57,000 trees and planted nuts, an increase of almost 10,00 over last year (Table 2). Most of the increase is due to the addition of B<sub>3</sub>-F<sub>2</sub> trees, which increased by 7,118. We also added 1,171 B<sub>3</sub>-F<sub>3</sub> trees. Our holdings of other types are relatively constant, with new plantings offset by removals, as we have made selections and rogued the rejects. Next year the total number of B<sub>3</sub>-F<sub>2</sub> trees should start to decline dramatically as we rogue reject trees and near the end of addition of new trees to our Clapper and Graves seed orchards. We did not rogue many trees this year because we were leaving them for histological studies, to be described below.

### **Harvest.**

This year, we continued our efforts to make backcross F<sub>2</sub>s for sources of blight resistance other than Clapper and Graves. The general lack of success in these efforts can be found in the relevant rows of Table 3. We also tried to make test crosses back to Chinese and American chestnut and backcross F<sub>2</sub>s for the Nanking source of resistance, and a few others. Some of these crosses were successful. We plan to assemble full sets with future crosses.

In 2008 we harvested more B<sub>3</sub>-F<sub>2</sub> nuts from trees with the Graves source of resistance than the Clapper source. This was because we have completed the planting of B<sub>3</sub>-F<sub>2</sub> nuts for many lines from the Clapper source and did not harvest from their parents in 2008, whereas most Graves lines were still incomplete in 2008. With the planting of these B<sub>3</sub>-F<sub>2</sub> Graves nuts in 2009, most lines from that source of resistance also are complete, with 1350 nuts planted per line.

We harvested 2433 Clapper B<sub>3</sub>-F<sub>3</sub> nuts in 2008, and additionally our first crop of Graves B<sub>3</sub>-F<sub>3</sub> nuts, numbering 1659. These enabled further planting in orchard and forest test sites, and more distribution of B<sub>3</sub>-F<sub>3</sub> nuts and seedlings to TACF members.

### **Blight resistance screening in B<sub>3</sub>-F<sub>3</sub> seedlings.**

In 2008, we tested the blight resistance of B<sub>3</sub>-F<sub>3</sub> seedlings planted in 2006, from our first B<sub>3</sub>-F<sub>3</sub> harvest in 2005. Since there were only about 100 B<sub>3</sub>-F<sub>3</sub> seed harvested in 2005, from five separate mother trees, these had not been planted in a formal test with controls. It was only in 2009 that we planted a formal test of B<sub>3</sub>-F<sub>3</sub> progeny, once a sufficient number of seeds and seedlings had been accumulated to merit a formal test. The results of the preliminary test performed in 2008 are shown in Table 4, as canker size statistics from October measurements after inoculation in June. Blight cankers on these trees were small, with no trees with very large cankers. For informal comparison, similar statistics from a 1993 test are shown in Table 5. These results are encouraging, suggesting that the parent B<sub>3</sub>-F<sub>2</sub> trees were reasonably homozygous for blight resistance, since the variation in canker sizes was small. A comparison of canker sizes between the B<sub>3</sub>-F<sub>3</sub> of Table 4 and the size of cankers on Chinese chestnut in Table 5 also suggest B<sub>3</sub>-F<sub>2</sub> blight resistance was comparable to Chinese chestnut. However, a formal statement of this conclusion will have to await the results of the formal test planted in 2008, which we expect in 2011. The tentativeness of this conclusion is also reinforced by the fact that most of the B<sub>3</sub>-F<sub>3</sub> sprouts died as a result of the inoculations (although many have resprouted).

This death was not unexpected and occurred also in the 1993 test of Table 5, including the Chinese chestnut seedlings, as well as in other tests.

### **Components of blight resistance.**

There are a number of ways that our B<sub>3</sub>-F<sub>3</sub>s might not end up with enough blight resistance or American characteristics to thrive in forested settings. Many of these will only be revealed when the trees are grown in the forest, but we might be able to determine before then whether or not our screen for blight resistance is failing to detect components of blight resistance. Of particular interest to us has been sclerification of the phelloderm layer of wound periderm.

Wound periderm is the tissue trees develop to isolate cankered from uncantered portions of bark. Sclerification of phelloderm rigidifies the wound periderm, enabling an increase in stem diameter to slough off the cankered bark as the underlying tissues grow and expand. Wound phelloderm sclerifies most of the time in Chinese but not American chestnut. Sclerification begins in September or October after wounding and inoculation in June, yet our screen for blight resistance depends strongly on the rate of canker expansion during the summer and early fall.

Evaluation of backcross progeny for this trait has suggested we indeed are not selecting for it. Further tests are in progress to characterize progeny for the trait more thoroughly. These should enable us to decide whether it will be necessary to select for this trait.

### **Acknowledgements.**

We would like to thank Lou Silveri, Dave Lazor, and Sam Fisher for helping with pollinations and inoculations. Special thanks to Dave Slack for volunteering one or two days a week all year round for the past four years! Also, we need to acknowledge the role of George Sykes, Danny Honaker, Darryl Caudell, Lori Hall, Louise Cottrell, Bobby Scarborough, Bob Wesche and many others in keeping the farms running from day to day. Thanks to all —this wouldn't get done without their help. If you are interested in helping to pollinate next year, plan on any time in June (call 276 944-4631). If you are interested in learning more about the Elder Hostel program, call 617 426-8055 or write 75 Federal St., Boston MA 02110.

*We would like to remind all TACF members that you are welcome to visit the farms at any time. We are in a white house on the northeast side of Virginia Route 80, one-third of a mile southeast of Exit 24 on Interstate 81, the Meadowview Exit. We generally are there during normal work hours, but it might be good to call ahead (276 944-4631).*

Table 1. Type and number of chestnut trees and planted nuts at TACF Meadowview Research Farms in May 2009, with the number of sources of blight resistance and the number of American chestnut lines in the breeding stock.

Type of Tree	Number of		
	Nuts or Trees	Sources of Resistance	American Lines
American	1943		220
Chinese	505	56	
Chinese x American: F <sub>1</sub>	453	20	82
American x (Chinese x American): B <sub>1</sub>	669	14	28
American x [American x (Chinese x American)]: B <sub>2</sub>	1921	12	67
American x {American x [American x (Chinese x American)]}: B <sub>3</sub>	1910	10	81
Am x (Am x {Am x [Am x (Ch x Am)]}):B <sub>4</sub>	509	3	6
(Ch x Am) x (Ch x Am): F <sub>2</sub>	320	5	10
[Ch x Am) x (Ch x Am)] x [Ch x Am) x (Ch x Am)]:F <sub>3</sub>	5	1	1
[Am x (Ch x Am)] x [Am x (Ch x Am)]: B <sub>1</sub> -F <sub>2</sub>	837	7	12
{Am x [Am x (Ch x Am)]} x {Am x [Am x (Ch x Am)]}:B <sub>2</sub> -F <sub>2</sub>	245	6	12
(Am x {Am x [Am x (Ch x Am)]}) x (Am x {Am x [Am x (Ch x Am)]}):B <sub>3</sub> -F <sub>2</sub>	38358	2	48
B <sub>3</sub> -F <sub>3</sub>	1267	1	10
Chinese x (Chinese x American): Chinese B <sub>1</sub>	183	4	4
Chinese x [American x (Chinese x American)]	126	3	8
Chinese x {American x [American x (Chinese x American)]}	294	5	16
Chinese x Chinese	2014	67	
Chinese x Japanese	109	2	
Chinese x European	140	1	
Chinese x Large, Surviving American	153	7	7
European	1	1	1
European x American F <sub>1</sub>	2	1	1
Japanese	8	3	3
Japanese x American F <sub>1</sub>	9	2	2
[(Japanese x American) x American] B <sub>1</sub>	10	2	2
{[(Japanese x American) x American] x American} B <sub>2</sub>	134	1	1
Japanese x European	157	1	1
Japanese x Large, Surviving American	27	5	5
<i>Castanea ozarkensis</i>	30	1	2
<i>Castanea pumila</i>	39	2	2
<i>Castanea seguinii</i>	48	3	3
Large Surviving American F <sub>1</sub>	1109	19	50
Large Surviving American B <sub>1</sub>	541	7	13
Large Surviving American B <sub>2</sub>	169	3	4
Large Surviving American I <sub>1</sub>	1893	31	32
Large Surviving American I <sub>2</sub>	338	7	8
Large Surviving American I <sub>3</sub>	88	1	1
Large Surviving American F <sub>2</sub>	143	7	11
Large Surviving American F <sub>3</sub>	320	1	1
Large Surviving American other	64	6	6
Other	61		
<b>Total</b>	<b>57152</b>		

\* The number of lines varied depending on the source of resistance. We will have to make additional crosses in some lines to achieve the desired number of progeny per generation within a line. In keeping with past practice, the

number of lines for each source of resistance are added separately; thus, progeny from two sources of resistance that share an American parent would be counted as two lines rather than one line (this only occurs rarely).

Table 2. Changes between 2008 and 2009 in the number of chestnut trees and planted nuts of different types at TACF Meadowview Research Farms, including changes in the number of sources of blight resistance and the number of American chestnut lines in the breeding stock.

Type of Tree	Increase or Decrease* in Number of		
	Nuts or Trees	Sources of Resistance	America Lines
American	-63		10
Chinese	-57		
Chinese x American: F <sub>1</sub>	-22	61	3
American x (Chinese x American): B <sub>1</sub>	147	14	-1
American x [American x (Chinese x American)]: B <sub>2</sub>	177	56	24
American x {American x [American x (Chinese x American)]}: B <sub>3</sub>	114	72	0
Am x (Am x {Am x [Am x (Ch x Am)]}):B <sub>4</sub>	69	3	1
(Ch x Am) x (Ch x Am): F <sub>2</sub>	3	5	3
[Ch x Am) x (Ch x Am)] x [Ch x Am) x (Ch x Am)]:F <sub>3</sub>	0	0	0
[Am x (Ch x Am)] x [Am x (Ch x Am)]: B <sub>1</sub> -F <sub>2</sub>	366	8	8
{Am x [Am x (Ch x Am)]} x {Am x [Am x (Ch x Am)]}:B <sub>2</sub> -F <sub>2</sub>	5	6	6
(Am x {Am x [Am x (Ch x Am)]}) x (Am x {Am x [Am x (Ch x Am)]}):B <sub>3</sub> -F <sub>2</sub>	7118	46	1
B <sub>3</sub> -F <sub>3</sub>	1171	9	8
Chinese x (Chinese x American): Chinese B <sub>1</sub>	-1	1	0
Chinese x [American x (Chinese x American)]	85	7	7
Chinese x {American x [American x (Chinese x American)]}	-141	11	0
Chinese x Chinese	-449	-3	
Chinese x Japanese	0	0	
Chinese x European	0	0	
Chinese x Large, Surviving American	-135	-3	-3
European	0	0	0
European x American F <sub>1</sub>	0	0	0
Japanese	-2	-1	-1
Japanese x American F <sub>1</sub>	0	0	0
[(Japanese x American) x American] B <sub>1</sub>	0	0	0
{[(Japanese x American) x American] x American} B <sub>2</sub>	0	-1	-1
Japanese x European	0		
Japanese x Large, Surviving American	0		0
<i>Castanea ozarkensis</i>	30	1	2
<i>Castanea pumila</i>	39	2	2
<i>Castanea sequinii</i>	0	0	0
Large Surviving American F <sub>1</sub>	324	31	3
Large Surviving American B <sub>1</sub>	95	5	-18
Large Surviving American B <sub>2</sub>	75	2	-2
Large Surviving American I <sub>1</sub>	385	11	9
Large Surviving American I <sub>2</sub>	-26	2	2
Large Surviving American I <sub>3</sub>	88	1	1
Large Surviving American F <sub>2</sub>	-7	5	1
Large Surviving American F <sub>3</sub>	320	1	1
Large Surviving American other	0	0	0
Other	30		
<b>Total</b>	<b>9738</b>		

\* The decreases in Chinese, F<sub>1</sub>, B<sub>3</sub>, and Large, Surviving American trees reflects roguing of trees with inadequate levels of blight resistance. The increases reflect further breeding and collecting.

Table 3. The American Chestnut Foundation Meadowview Farms 2008 nut harvest from controlled pollinations and selected open pollinations.

Nut Type*	Female Parent	Pollen Parent	Pollinated			Unpollinated Checks			Number Crosses
			nuts	bags	burs	nuts	bags	burs	
AxA	American	American	12	39	86	.	.	.	1
B <sub>1</sub>	American	opDunstan F <sub>1</sub>	193	89	249	0	17	18	6
B <sub>1</sub>	mollissima11 F <sub>1</sub>	American	4	26	29	0	4	5	3
B <sub>1</sub> -F <sub>2</sub>	72-211 B <sub>1</sub>	72-211 B <sub>1</sub>	57	56	116	0	70	7	4
B <sub>1</sub> -F <sub>2</sub>	Nanking B <sub>1</sub>	Nanking B <sub>1</sub>	289	305	757	0	35	43	3
B <sub>1</sub> -F <sub>3</sub>	B <sub>1</sub> -F <sub>2</sub> Clapper;Graves	open pollinated	17271		6128				9
B <sub>1</sub> xC	MusickChinese B <sub>1</sub>	MuChin1 Chinese	20	128	205	0	8	14	4
B <sub>1</sub> xC	Nanking B <sub>1</sub>	Nanking Chinese	67	97	217	0	10	18	4
B <sub>2</sub>	American	72-211 B <sub>1</sub>	435	184	399	2	18	22	14
B <sub>2</sub>	American	mollissima10 B <sub>1</sub>	39	74	103	0	9	6	3
B <sub>2</sub>	Nanking B <sub>1</sub>	American	137	134	229	0	22	16	4
B <sub>2</sub> -F <sub>2</sub>	Nanking B <sub>2</sub>	Nanking B <sub>2</sub>	20	101	205	0	10	13	3
B <sub>2</sub> -F <sub>2</sub>	R11T14 B <sub>2</sub>	R11T14 B <sub>2</sub>	5	122	342	0	8	29	1
B <sub>2</sub> -F <sub>3</sub>	B <sub>2</sub> -F <sub>2</sub> op Clapper	open pollinated	10764		4495				5
B <sub>2</sub> -F <sub>3</sub>	B <sub>2</sub> -F <sub>2</sub> Graves	open pollinated	1467		1149				3
B <sub>2</sub> xC	MusickChinese B <sub>2</sub>	MuChin1 Chinese	0	13	20	0	1	1	1
B <sub>3</sub>	American	MusickChinese B <sub>2</sub>	89	174	294	1	16	24	11
B <sub>3</sub>	American	Nanking B <sub>2</sub>	129	161	336	1	23	46	10
B <sub>3</sub>	Chapter		2446	2664	7595	8	290	741	57
B <sub>3</sub> -F <sub>2</sub>	Clapper B <sub>3</sub>	open pollinated	7859		4422				49
B <sub>3</sub> -F <sub>2</sub>	Graves B <sub>3</sub>	open pollinated	16926		10147				46
B <sub>3</sub> -F <sub>2</sub>	Graves B <sub>3</sub>	Graves B <sub>3</sub>	60	132	371	0	14	35	2
B <sub>3</sub> -F <sub>3</sub>	Clapper B <sub>3</sub> -F <sub>2</sub>	open pollinated	2433		1472				41
B <sub>3</sub> -F <sub>3</sub>	Graves B <sub>3</sub> -F <sub>2</sub>	open pollinated	1659		949				37
B <sub>4</sub>	American	Douglas B <sub>3</sub>	69	82	156	0	9	14	6
CxC	Meiling Chinese	Mahogany Chinese	11	40	.	0	3	2	
CxC	Nanking Chinese	Mahogany Chinese	27	28	47	0	3	3	
CxC	Nanking Chinese	Vanuxem Chinese	93	165	519	0	19	26	
F1	Kuling Chinese	American	18	89	.	4	5	9	1
F1	Meiling Chinese	American	192	209	100	1	17	25	2
LSA B <sub>1</sub>	American	NCChamp LSA F <sub>1</sub>	338	149	358	1	15	31	3
LSA B <sub>1</sub>	American	Ort;Ort LSA F <sub>2</sub>	30	102	186	0	13	24	7
LSA B <sub>1</sub>	Corrigan LSA F <sub>1</sub>	American	68	17	40	0	3	5	1
LSA B <sub>1</sub>	Ort;Ort LSA F <sub>2</sub>	American	244	98	229	3	20	8	2
LSA B <sub>2</sub>	American	Ort LSA B <sub>1</sub>	95	46	55	0	5	5	4
LSA B <sub>2</sub>	DaresBeach LSA B <sub>1</sub>	American	75	26	56	0	2	6	1
LSA B <sub>2</sub>	NCF179 LSA B <sub>1</sub>	American	5	5	18	0	1	4	1
LSA B <sub>2</sub>	Ort LSA B <sub>1</sub>	American	124	173	324	0	14	22	2
LSA F <sub>2</sub>	NCChamp LSA F <sub>1</sub>	NCChamp LSA F <sub>1</sub>	17	110	118	0	11	16	3
LSA F <sub>3</sub>	Ort;Ort LSA F <sub>2</sub>	Ort;Ort LSA F <sub>2</sub>	336	163	370	0	11	25	3
LSA I <sub>1</sub>	Amherst LSA F <sub>1</sub>	WayahBig LSA op	4	30	54	0	4	8	3
LSA I <sub>1</sub>	DaresBeach LSA B <sub>1</sub>	WayahBig LSA op	11	66	141	0	7	18	1
LSA I <sub>1</sub>	DaresBeach LSA F <sub>1</sub>	NCChamp LSA F <sub>1</sub>	13	38	108	0	4	9	1
LSA I <sub>1</sub>	NCChamp LSA F <sub>1</sub>	WayahBig LSA op	10	25	103	0	2	1	2
LSA I <sub>1</sub>	Ort LSA B <sub>1</sub>	Amherst LSA F <sub>1</sub>	93	47	173	0	8	16	2
LSA I <sub>1</sub>	Ort LSA B <sub>1</sub>	CareyMacon2 LSA op	8	30	44	0	3	4	1
LSA I <sub>1</sub>	Ort LSA B <sub>1</sub>	NCF179 LSA B <sub>1</sub>	89	32	68	0	3	10	1
LSA I <sub>1</sub>	Ort LSA B <sub>1</sub>	WayahBig LSA op	77	186	418	0	11	24	3
LSA I <sub>1</sub>	Ort LSA F <sub>1</sub>	CareyMacon2 LSA op	17	48	86	2	5	8	1
LSA I <sub>1</sub>	Ort;Ort LSA F <sub>2</sub>	CareyMacon2 LSA op	73	39	82	9	3	12	1

LSA I <sub>1</sub>	Ort;Ort LSA F <sub>2</sub>	NCF179 LSA B <sub>1</sub>	10	18	17	0	1	2	1
LSA I <sub>1</sub>	Ort;Ort LSA F <sub>2</sub>	WayahBig LSA op	1	10	8	0	2	3	1
LSA I <sub>1</sub>	ScientistsCliffs LSA B <sub>1</sub>	WayahBig LSA op	6	17	27	0	1	1	1
LSA I <sub>1</sub>	WayahBig LSA op	Weekly LSA op	85	61	144	0	6	10	1
LSA I <sub>1</sub>	DaresBeach LSA op	CareyMacon2 LSA op	0	21	10	0	.	.	2
LSA I <sub>1</sub>	Weekly LSA op	NCChamp LSA F <sub>1</sub>	72	48	69	0	6	9	1
LSA F <sub>1</sub>	American	opDaresBeach;Ort LSA I <sub>1</sub>	258	94	182	3	7	16	3
LSA F <sub>1</sub>	opDaresBeach;Ort LSA I <sub>1</sub>	American	37	26	47	1	4	9	1
LSA I <sub>2</sub>	opDaresBeach;Ort LSA I <sub>1</sub>	NCChamp LSA F <sub>1</sub>	265	95	261	6	21	7	1
<b>Total Controlled Pollinations, w/o Chapter</b>			<b>4427</b>	<b>4268</b>	<b>8576</b>	<b>34</b>	<b>514</b>	<b>689</b>	

\*LSA denotes Large, Surviving American, defined as an American chestnut over 13 inches in diameter at breast height (54 inches) that has blight but has survived it longer than approximately 10 years.

Table 4. Mean, standard deviation and distribution of chestnut blight canker size classes (mean length and width of cankers incited by two strains of the blight fungus) for Chinese-American B<sub>3</sub>-F<sub>3</sub> progeny from the Clapper source of blight resistance, in 2008

Mother	Mean	Standard Deviation	Canker Size Class (cm)				
			1.0-2.6	2.6-4.2	4.2-5.8	5.8-7.4	7.4-9.0
D5-17-111	4.1	0.7	1	10	7		
D5-17-121	4.4	1.6	1	2	3		1
D5-17-21	3.7	1.0		1	1		
D5-18-126	4.1	0.8	2	17	17	1	
D5-18-138	4.1	1.0		2	2		

Table 5. Mean, standard deviation and distribution of canker size classes (mean length and width of cankers incited by two strains of the blight fungus) for straight F<sub>2</sub>, B<sub>1</sub>-F<sub>2</sub> and B<sub>2</sub> American x Chinese chestnut progeny and controls, in 1993.

Cross Type	Mean	Standard Deviation	Canker Size Class (cm)						
			1.0-2.6	2.6-4.2	4.2-5.8	5.8-7.4	7.4-9.0	9.0-10.6	10.6-
Seedling American	9.6	1.1					3	5	2
F <sub>1</sub> 'Nanking'	8.4	1.0				2	4	3	
Seedling Chinese	5.2	1.0		2	7	3			
'Meiling' Chinese	5.5	1.1		1	2	2			
'Nanking' Chinese	2.9	1.4	3		2				
F <sub>2</sub> 'Mahogany'	7.7	1.9		5	23	48	48	29	15
B <sub>1</sub> -F <sub>2</sub> 'Clapper' x 'Graves'	6.9	1.9	4	25	84	116	112	54	4
B <sub>2</sub> 'Graves'	9.1	1.5			2	4	15	26	6

### A Quick Guide to Chestnut Breeding Terminology

Parents	=	Offspring
American x Chinese	=	F <sub>1</sub> , "F-one"
F <sub>1</sub> x F <sub>1</sub>	=	F <sub>2</sub> , F-two
F <sub>2</sub> x F <sub>2</sub>	=	F <sub>3</sub> , F-three
F <sub>1</sub> x American	=	B <sub>1</sub> , first backcross, or B-one
B <sub>1</sub> x American	=	B <sub>2</sub> , second backcross, or B-two
B <sub>2</sub> x American	=	B <sub>3</sub> , third backcross, or B-three
B <sub>3</sub> x American	=	B <sub>4</sub> , fourth backcross, or B-four
B <sub>1</sub> x B <sub>1</sub>	=	B <sub>1</sub> -F <sub>2</sub> , B-one F-two
B <sub>1</sub> -F <sub>2</sub> x B <sub>1</sub> -F <sub>2</sub>	=	B <sub>1</sub> -F <sub>3</sub> , B-one F-three
B <sub>2</sub> x B <sub>2</sub>	=	B <sub>2</sub> -F <sub>2</sub> , B-two F-two
B <sub>2</sub> -F <sub>2</sub> x B <sub>2</sub> -F <sub>2</sub>	=	B <sub>2</sub> -F <sub>3</sub> , B-two F-three
B <sub>3</sub> x B <sub>3</sub>	=	B <sub>3</sub> -F <sub>2</sub> , B-three F-two
B <sub>3</sub> -F <sub>2</sub> x B <sub>3</sub> -F <sub>2</sub>	=	B <sub>3</sub> -F <sub>3</sub> , B-three F-three