

2010 Season Report: Cornell Onion Breeding Program
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1. Determine whether there are differential responses of *B. squamosa* isolates from around NYS to Botrytis leaf blight (BLB) resistant or BLB tolerant onions. (in coop. J. Lorbeer)

When disease resistance is transferred into a crop, there is always a question of whether any pathogen isolates can overcome the resistance. With the transfer of BLB resistance to onion, it is important to test for variability in pathogenesis among *B. squamosa* isolates. Five *B. squamosa* isolates were used in spring 2010 BLB mist chamber tests for differences in pathogenicity. One isolate was MD16, the isolate used by the Cornell breeding program in breeding for BLB resistance. MD16 has been in culture for many years. The other 4 isolates tested were newly collected from different NYS onion growing regions in 2009.

The results clearly show that similar results were obtained when each isolate was used to inoculate the different onions genotype (Table 1). In each case, Candy showed the worst disease symptoms, followed by the susceptible female parent GAL-cms, the GAL-cms x BLB-R line 07-801 F1 hybrid, with the least symptoms on the BLB-R line 07-07-801. A similar pattern is seen when data are combined across isolates. Overall, the tests to date do not indicate differential pathogenicity among isolates, and the MD16 isolate used by the breeding program is no less pathogenic than the isolates newly collected in 2009. This is encouraging for the potential use and sustainability of BLB resistant cultivars for control of BLB

Table 1. BLB Resistance Against Differing Isolates: Chamber Assay

Isolate	Pedigree	Lesion per sq cm
ELMT2	Candy	25.4 a
	GAL-cms	17.7 ab
	GAL-cms x 07-801	10.1 b
	07-801	9.7 b
MD16	Candy	27.6 a
	GAL-cms	18.3 ab
	GAL-cms x 07-801	11.9 bc
	07-801	7.9 c
OSMT4	Candy	23.3 a
	GAL-cms	16.6 ab
	GAL-cms x 07-801	11.0 b
	07-801	8.9 b
WCSS5	Candy	26.3 a
	GAL-cms	16.6 b
	GAL-cms x 07-801	10.5 b
	07-801	4.5 c
OCMT1	Candy	18.7 a
	GAL-cms	17.1 a
	GAL-cms x 07-801	6.2 b
	07-801	5.2 b
All isolates combined	Candy	24.3 a
	GAL-cms	17.2 b
	GAL-cms x 07-801	9.9 c
	07-801	7.3 c

Means not followed by the same letter are significantly different at 0.05 level, by Tukey-Kramer

2. Determine the effect of heterozygous vs. homozygous BLB resistance or BLB tolerance on BLB control across locations and production systems (in coop with J. Lorbeer, C. Hoeping, M. Ulrich, JJ Schell.)

For Botrytis leaf blight (BLB) resistance to be used in commercial onion hybrids, information is needed regarding the degree of disease control provided by heterozygous vs. homozygous BLB resistance (one parent BLB resistant vs. both parents BLB resistant). To determine this, a set of resistant and susceptible parents, their F1, and controls were evaluated in miniplots in NYS. Nine miniplot trials were transplanted in

2010, in Elba, Oswego, Orange County and Ithaca, NY, with each trial designed using randomized complete block with 4 replications.

Results from the 5 successful trials showed moderate levels of disease in the susceptible control Festival (Table 2). The gallanthum male sterile parent used in the hybrid production was also susceptible, but had less symptoms than Festival, perhaps due to its smaller size. The least disease was observed in the homozygous BLB resistant lines, which had disease levels that were significantly lower than that of the susceptible control. Two of the three fixed lines also had significantly lower disease than their heterozygous BLB resistant F1 hybrids (Table 3).

The BLB tolerant line Kasmer Red-BLB showed a significantly lower level of symptoms compared to the susceptible controls, indicating that under the moderate disease pressure present this year, the BLB tolerance had positive value (Table 3). Prior years showed that this tolerance is recessive and does not function in hybrids, however, direct use of this OP red onion could be considered for organic production.

3. Bulb size of entries in the BLB regional trials

Bulbs for all of the trials were pulled in late August through early September, and harvested ca. 2 weeks after pulling. The bulbs were held in stacked crates in Ithaca, to cure during the last weeks of September, and were graded during October. Of the three lines homozygous for BLB resistance, 08-516 had the larger bulbs (Table 4). This was also reflected in the hybrids made with these lines. The BLB heterozygous hybrid created using 08-516 as the male parent also produced the largest bulbs, which were similar in size to bulbs of the hybrid control Festival. The larger average bulb weights were associated with higher % jumbo bulbs, and higher % large plus jumbo bulbs.

Of the two lines homozygous for BLB tolerance, KR BLB Tol. had the larger bulbs, but the difference was not significant (Table 5). This was also reflected in the hybrids made with these lines. The BLB heterozygous hybrid created using KR BLB Tol. as the male

Table 2. 2010 Combined Data Four Locations BLB Regional Miniplot Trials for controls and entries with *A. roylei* derived BLB resistance

Entry	Type of entry	Mean Lesion Count + Size
Festival	Susceptible control	1.95 A
08-516 X C male	Heterozygous hybrid	1.64 AB
Gal. Female	Susceptible female	1.61 AB
08-3001 (Gal.) X 08-905	Heterozygous hybrid	1.36 BC
08-514	BLB R male	1.07 CD
08-516	(BLB R male	0.90 D
08-905	BLB R male	0.75 D

Table 3. 2010 Combined Data Four Locations BLB Regional Miniplot Trials

Entry	Type of Entry	Mean Lesion Count + Size
Festival	Susceptible control	1.95 A
(Gal X RIX U) X KR BLB tolerant	Heterozygous hybrid	1.25 B
KR BLB Tolerant	BLB Tolerant Male	1.19 B
(Gal X RIX U) X KR BLB Tol (M1S1)	Heterozygous hybrid	1.08 BC
Kasmer Red BLB Tol (M1S1)	BLB Tolerant Male	0.75 C

Means not followed by the same letter are significantly different at 0.05 level, Tukey-Kramer HS

parent also produced the larger bulbs, however, again the difference was not significant.

4. PERFORMANCE OF MILD HYBRIDS WITH A DOUBLED HAPLOID MALE PARENTS. (IN COOP L. EARLE)

The Cornell onion breeding program has been attempting to develop milder onion lines with higher BRIX plus storability, and adaptation to NYS. This effort has resulted in 3 lines, one of which is red. As these lines were being developed, the germplasm was also used in doubled haploid line development, through a cooperative project with Dr. Lisa Earle, resulting in 6 milder DH lines. The ultimate test of any onion inbred is whether it can produce a high quality hybrid. The 2009 season VBI report included trials showing the advance in bulb size and uniformity of experimental pungent onion hybrids for which DH lines were male parents. This year, similar trials were performed for milder onion experimental hybrids, some of which have DH lines as the male parents. The same female sterile onion was used to create a series of experimental mild hybrids. Two replicated mild trials were performed in 2010, one in muck soil in Oswego NY and one in mineral soil in the Cornell East Ithaca farm. Onion plants were grown under greenhouse conditions, hardened off in a cold frame and transplanted to the field. The trials are designed using randomized complete block, with 6 reps per location.

The plants grew well through the season. At the end of the season, bulbs were pulled, harvested, and cured during September to prepare for analysis. The bulbs were graded to determine yield and bulb size. Samples of the bulbs were used in laboratory assays to determine BRIX and also pungency using the pyruvate assay. The rest of the onions were stored and regarded in December to determine storability.

The results of the two trials were combined for analysis of bulb size and storability (Table 6). The average bulb weights of all of the hybrids were significantly larger than that of female parent, as was expected. Bulb weights of three DH hybrids are significantly greater than that of commercial hybrid with same female parent (Derby). The

Table 5. Bulb traits for controls and entries related to Kasmer Red derived BLB tolerance.

Entry	Bulb wt (g)	% jumbo bulbs
Candy	224.0 A	26.6 A
Festival	196.9 A B	22.1 A B
(Gal X RIX U) X KR BLB Tol.	150.8 B C	2.7 C
KR BLB Tol.	141.7 B C	9.7 B C
Galanthum	140.7 B C	6.8 C
(Gal X RIX U) X Kasmer Red BLB Tol (M1S1)	124.8 A B C	0.0 B C
Kasmer Red BLB Tol (M1S1)	105.7 C	0.7 C

Means not followed by the same letter are significantly different at 0.05 level, Tukey-Kramer HSD

Table 6 Analysis of bulb size and storability, combining both trials

Level	ave bulb weight (gm)	% jumbo bulbs	% weight stored
AmSp A line	154.7 *	13.0	91.8 *
Derby	207.8	27.6	67.5
L1856 X CDH0666602	246.0	54.3 *	100 *
L1856 X CDH0666605	246.0	61.6 *	100 *
L1856 X CDH0666607	251.5	59.7*	99.4 *
L1856 X CDH 06- 707,727,737	256.0 *	54.5 *	99.2 *
L1856 X CDH0666606	262.0 *	61.8 *	97.8 *
L1856 X CDH0666600	266.1 *	69.0 *	98.3 *

Means followed by * are significantly different at Alpha 0.05 from the means of the control: the sibling commercial hybrid Derby, respectively using the Dunnett test of planned comparisons.

larger average bulb weights were associated with higher % jumbo bulbs. The % jumbo bulbs of all 6 DH experimental hybrids were larger than that of Derby. Derby also has relatively poor bulb storability (67% of bulbs), commonly seen of mild onions. However, all of the DH experimental hybrids had far better bulb storability than Derby, ranging from 97 to 100%.

The results of the two trials were analyzed separately for bulb pungency (measured by the pyruvate assay) and BRIX levels (Tables 7 and 8). For the Trial grown on muck soil in Oswego, none of the DH experimental hybrids have higher mM Pyruvate than the control hybrid Derby. Therefore all of the hybrids are at least as mild as the commercial hybrid with same female parent (Derby). All five of the DH experimental hybrids have significantly higher Brix than that of the control hybrid Derby.

For the Trial grown on mineral soil at the East Ithaca Trial, none of the experimental hybrids were significantly different than the control hybrid Derby in mM Pyruvate. Four experimental DH hybrids have significantly higher Brix than the control hybrid Derby.

The results of both trials indicate that some of the experimental DH hybrids are as mild as Derby, but have significantly higher Brix than this sibling control. Low pungency and high BRIX is a unique combination that could lend itself to different culinary uses.

Table 7 Analysis of Brix and Pungency of hybrid entries in Oswego Mild onion trial, 2010

Hybrid Entry	mM Pyruvate	Brix
L1856 X CDH0666606	6.8	7.4 *
Candy	6.8	6.3
AmSp A line	6.8	5.7
Derby	6.6	5.5
L1856 X CDH0666605	6.5	7.2 *
L1856 X CDH0666607	6.1	7.3 *
L1856 X CDH0666600	6.1	7.0 *
L1856 X CDH0666602	6.1	6.7*

Table 8 Analysis of Brix and Pungency of hybrid entries only in East Ithaca Mild onion trial, 2010

Hybrid Entry	mM Pyruvate	Brix
AmSp A line	5.1	7.2
Candy	5.9	7.3
Derby	5.3	7.04
L1856 X CDH0666600	5.2	7.9
L1856 X CDH0666602	4.9	8.2*
L1856 X CDH0666605	4.7	8.4*
L1856 X CDH0666606	5.7	8.7*
L1856 X CDH0666607	5.1	8.6*

Means followed by * are significantly different at Alpha 0.05 from the means of the control: the sibling commercial hybrid Derby, respectively using the Dunnett test of planned comparisons.