

Tomatoes for the Northeast Combining Early Blight and Late Blight Resistance

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ABSTRACT

Early blight and late blight have consistently been identified as the main tomato diseases in the northeast US. Growers have traditionally relied on calendar- or weather-driven fungicide sprays in order to control both diseases. Plant breeding efforts to identify and incorporate resistance for both diseases have progressed to the point that resistant lines with good horticultural characteristics are close to being released. This paper describes the progress made during 2005 in trials conducted in two regions of New York.

INTRODUCTION

Late blight (LB) (caused by *Phytophthora infestans*) is an increasingly significant problem in processing and fresh market tomato production. *P. infestans* is a pathogen with a variety of isolates. The original resistance genes, *Ph-1* and *Ph-2*, were both quite race specific, and so were not widely used in most breeding lines. Additional late blight resistance from *L. pimpinellifolium* L3708 was found by Black and Hanson and was transferred to elite breeding lines. A series of seven late blight-resistant lines was released that approach the type required of processing tomato. The late blight resistance in the lines involves the *Ph-3* gene plus added hypostatic genes that, together, allow the resistance to control more pathogen isolates. The first commercial processing tomato hybrids containing this resistance may be on the market for the 2006 growing season. Several breeding programs are transferring this resistance to fresh market tomato as well.

Resistance to early blight (EB) of tomato has previously been reported (2, 4). The pathogens causing EB exist as two different species, *Alternaria solani* which causes the traditional early blight of potato and *Alternaria tomatophila* which causes much of the disease on tomato (5). *A. tomatophila* has two phenotypes, appearing as light or dark in color in culture, with the light phenotype being significantly more pathogenic on tomato (1).

Tomato cultivars for the NE require earlier season and modified characteristics to adapt to the cooler late season and the diseases prevalent in the area. One aspect of our breeding program has been combining resistance to late blight and early blight in lines suited to the conditions of the NE. The expectation is that use of both resistances in a well designed IPM program should reduce fungicide use, risk of crop loss and costs of production. LB and EB resistance is being combined into fresh market lines developed at Cornell University. Dr. Randy Gardner of NCSU has been following a similar strategy to combine late blight and early blight resistance in fresh market tomato.

MATERIALS AND METHODS

Freeville conventional trial. Twenty two lines fixed for EB and LB resistance were established in plots consisting of 10 plants each with two replications. The standard

varieties Mountain Fresh and Supersonic along with line NC 96LB were used as checks. All plants were inoculated with the light phenotype of *A. tomatophila*. Plants were rated on three dates (19 Aug, 6 Sep, 19 Sep) for % defoliation using the Horsfall Barrett 0 to 11 rating scale (3), and for stem lesions using a 0 to 5 scale (0 = clean, 5 = stems cankered).

Kinderhook organic trial. This trial was conducted at the Roxbury Farm in Kinderhook, NY and consisted of a subset of 19 Cornell lines, three NC lines, and the standard varieties Sunchief and Mountain Fresh. The plots consisted of 8 plants with three reps. Plants were not inoculated in this trial.

RESULTS AND DISCUSSION

A three year cooperative project is focusing on testing the developing lines to determine their utility, any characteristics needed, and the proper use of dual resistant lines or hybrids. In this first year of the project, self progeny of the Cornell lines were screened in a severe early blight trial in Freeville NY during the summer of 2005. These lines and dual blight resistant lines developed by Dr. Randy Gardner were also included in a production trial in a commercial organic farm in Kinderhook, NY.

The results of the Early Blight trial confirmed that the Cornell lines were fixed for the early blight resistance (Table 1). The results of this early blight trial also demonstrated the difference in the degree of disease control the resistance provides on stems vs. on the foliage. The stem ratings on all of the resistant lines are uniformly very low (from 0.0 to 0.2), in contrast to the ratings of the susceptible controls (>4.0). However foliar symptoms, as measured by the % defoliation on the last reading date (19 Sep) or by area under the disease progress curve (AUDPC), were not as well controlled as the stem symptoms. There was also considerable variation among the resistant lines for foliar disease development. This could have been due to differences among these lines for maturity and fruit load/development, rather than any true difference for resistance.

Table 1. Early blight defoliation or stem ratings for inoculated trial, Freeville, NY

Entry	% Defoliation 9/19	AUDPC 8/19 to 9/19	Stem rating 9/19	Entry	% Defoliation 9/19	AUDPC 8/19 to 9/19	Stem rating 9/19
Supersonic	73.5	136.9	4.6	048143-03	70.3	87.4 *	0.0 *
Mountain Fresh	80.3	134.6	4.1 *	048143-05	73.9	84.6 *	0.0 *
NC 96LB	48.9	60.1 *	0.2 *	048143-07	76.9	106.0	0.0 *
048111-06	47.0 *	51.6 *	0.0 *	048144-01	70.7	102.2	0.0 *
048111-09	45.4 *	53.5 *	0.0 *	048144-04	68.8	103.7	0.0 *
048112-08	46.8	52.9 *	0.0 *	048144-07	63.7	106.0	0.0 *
048142-05	60.4	69.8 *	0.0 *	048144-09	78.3	95.9 *	0.1 *
048142-06	60.7	78.8 *	0.0 *	048117-02	68.7	78.8 *	0.0 *
048143-01	63.8	74.7 *	0.2 *	048117-04	67.6	82.3 *	0.0 *
048143-02	52.8	65.5 *	0.0 *	037104-08	77.4	93.8	0.0 *
				037104-08	86.7	98.2	0.2 *

Entries are significantly different from the Supersonic control by Dunnett's Test; Family error rate = 0.0500, Individual error rate = 0.00426

The late blight/early blight resistant lines being developed Cornell and similar lines being developed by Randy Gardner of NCSU were also included in production trial in a commercial organic farm in Kinderhook NY (Table 2) to evaluate horticultural characteristics of the resistant lines and hybrids. This trial was not inoculated, there was no appreciable early blight development and late blight did not occur.

The results of the trials in Kinderhook and Freeville allowed the selection of lines with the best horticultural characteristics in addition to disease resistance. The NC experimental hybrid NC0571 was close in % of #1 fruit to the control varieties Mt Fresh and Sunchief, but lower in total production. NC0576 had greater total production, but a slightly lower % of #1 fruit. The better inbreds in terms of production, fruit size, as well as fruit characters such as shape, smoothness, blossom end scar (data not shown) are included in Table 2. Production levels of these inbreds were high, through fruit size was smaller than that of the hybrids. In the coming year we will continue regional testing on the smaller set of selected dual resistant lines as well as hybrids created using the selected inbred lines. We will also test these lines and hybrids in disease trials with modest input of chemical controls, in addition to the resistance, to extend control of foliar symptoms of early blight.

Table 2. Production on controls and selected fresh market tomato lines fixed for early blight and late blight. Kinderhook, NY

Variety	Type	Total # marketable	Total wt marketable	#1 as % total fruit no.	#2 as % total fruit no.
Mt. Fresh	hybrid	461	303.6	86.8	13.2
Sunchief	hybrid	429	248.0	73.0	27.0
NC0571	hybrid	367	214.2	77.1	22.9
NC0576	hybrid	453	221.4	60.7	39.3
048143-07	inbred	537	246.0	59.8	40.2
NC 96LB	inbred	430	192.6	57.0	43.0
048111-06	inbred	386	169.6	53.6	46.4
048143-01	inbred	587	241.8	48.9	51.1
048142-06	inbred	591	223.2	48.1	51.9
048144-07	inbred	798	260.8	28.8	71.2

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