Choosing LB, EB and SLS Resistant Tomato Varieties for 2014

What Tomato Growers Need to Know About Foliar Disease Resistance Issues?

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Selecting the best tomato (*Solanum lycopersicum*) cultivars (cvs.) to grow each season involves more than choosing the best color, shape and size, or even if they are determinant or indeterminant in growth habit. Purchasing cvs. with the most complete disease resistance package should now be a consideration for reducing losses to fungal and oomycete diseases, not to mention the added cost and time for any needed fungicide sprays that would normally be required. Perusal of most seed catalogs reveals that many cvs. offer the traditional disease identification codes, such as **VFN**, for Verticillium Wilt Fusarium wilt and Nematode resistance.

You will also see abbreviations for the following: Alternaria stem canker (*A. alternata* f. sp. *lycopersici*) (**A** or **AS**); Stemphylium Gray (Grey) Leaf Spot (caused by three species) (**St** or **L**), with resistance more common in globe cvs. and rare in cherry and grape cvs.; Fusarium crown and root rot (*F. oxysporum* f. sp. *radicis*, a rot inducing pathogen) (**FOR**); Tobacco (**TMV**) or Tomato Mosaic Virus (**TOMV**), both mechanically transmitted; and Tomato spotted wilt virus (**TSWV**) which is vectored by thrips. For the most part these are not an issue for production in the Northeast US.

During the past few years a few new cultivars with tolerance for Early blight (*Alternaria tomatophila* or A. *solani*) (**AB** or **EB**), and resistance for Late blight (*Phytophthora infestans*) (**LB**) and Septoria leaf spot (*S. lycopersici*) (**SLS**) have been introduced to the public. These three diseases are responsible for most tissue defoliation, and two (LB and EB) result in high fruit losses. The remainder of this report will examine 1) what genetic controls are possible for control of these three diseases, 2) a summary of what to expect with each genetic offering among commercially available cvs. (Table 1), and 3) how best to use these cultivars.

1. Forms of genetic control currently available

Early blight genetic control: The current genetic control available is tolerance! It is questionable how much protection is provided when the tolerance is only in the heterozygous condition. For example, when Mountain Merit (see Table 1), which is heterozygous for EB tolerance, was tested in research trials it showed less infection than a fully susceptible cultivar, but will still have considerable defoliation and may require some fungicide applications. The level of tolerance is definitely beneficial in plants homozygous for it, but this tolerance does not provide complete control. The stems are kept clean of all but small lesions, thus preventing early plant collapse. Leaves can still sustain substantial lesion and disease development under conditions that favor this disease. Fruit lesions are rarely a problem. It is good to supplement this available tolerance with core horticultural practices (rotation out of tomato/potato crops for at least 2 seasons, no solanaceous weeds in the field during this period, an adequate N_2 fertilization program). If minimal fungicides are required, then select those with low environmental impact quotient (EIQ) values like Quadris Top or the protectants chlorothalonil or mancozeb, and make the first application after fruit set occurs. For organic production choose from

among the 6 copper fungicides registered in NYS. Homeowners may choose from chlorothalonil and copper fungicides.

Late Blight genetic control: Three different genes have been described for late blight resistance in tomato.

Ph1: present in old cultivar New Yorker. *Ph1* is only known to control earlier genotypes of the late blight pathogen, but NOT to any of the current genotypes like US22 or US23. This gene is therefore not used in modern cultivars.

Ph2: was found in the old cultivar West Virginia 63. *Ph2* is effective against only some genotypes of the pathogen. *Ph2* slows, rather than providing complete control of the disease, and thus should be viewed as an inoculum provider. *Ph2* is not very effective as a stand-alone genetic control. *Ph2* is also found as solo homozygous resistance in the cultivar Legend, and should NOT be relied upon for LB control.

Ph3: *Ph3* was found in a wild cherry tomato, and transferred into a number of tomato lines. *Ph3* is almost dominant: mild disease can still be present on hybrids heterozygous for Ph3, but hybrids homozygous for this resistance have virtually complete resistance against almost all genotypes including US22 and US23 (Ex. Plum Regal, determinate Plum).

Ph2 + *Ph3* provides the best control of late blight occurs when the hybrid is homozygous for BOTH *Ph2* and *Ph3* (Ex. Iron Lady, triple resistant to EB, SLS and LB). To date, no genotype of late blight pathogen has been found to cause significant disease on such hybrids. If plants are heterozygous for BOTH *Ph2* and *Ph3* (Ex. Mountain Merit, Defiant PHR, Mountain Magic, Jasper) they provide fairly good protection against the current isolates of late blight, but some late season infection of fruit can be expected in long producing areas (ie. Long Island).

Septoria Leaf Spot: This appears to be a nearly dominant single gene resistance. We are still trying to determine if plants homozygous for SLS gene have stronger resistance than heterozygous plants. SLS resistant plants develop initial lesions that stay small, but SLS resistance strongly impedes pathogen reproduction, which suppresses epidemic development of this polycyclic disease. Best SLS control is obtained by minimizing initial sources of inoculums, so continue to use good core horticultural practices (mentioned under early blight) and grow upwind/separate from susceptible cultivars for strongest and longest control of disease. If seasonal rains occur during June, July and August and a 3 year rotation out of tomatoes was not adhered to, then expect that one or two fungicide sprays will be required. The spread of SLS can explode dramatically, especially with splashing water, either natural or via overhead irrigation is factored in. Fungicide programs are the same as described under early blight.

2. Current Cultivars

Development of resistant lines and hybrids using conventional breeding practices has been a goal of a number of breeding programs over the past decade. New hybrids have and are being released; Iron Lady has triple resistance as discussed, and is available for the 2013 season. The current cultivars combining resistance to 2 or 3 of these diseases are summarized in Table 1.

Table 1: Tomato cultivars combining genetic control for 2 or more foliar diseases

Tomato cultivars by type with other Resistance[1]	Control for the big 3 defoliating diseases				Seed Available from:
FM Round Oblate – Determinate	LB	EB	SLS	What to expect	-
Mountain Merit (F1) Fol 1, 2, 3; N; TSWV; V	Heteroz *Ph2*, *Ph3*	Heteroz EBT	Susceptible	Excellent control of LB; EB and SLS may require sprays	Bejo, Johnny's, Seedway
Defiant PHR (F1) Fol 1, 2; V	Heteroz *Ph2*, *Ph3*	Heteroz EBT	Susceptible	LB will be contained till end of season; EB and SLS require attention	Johnny's, Stokes
Iron Lady (F1) Fol 1, 2; V	Homoz *Ph2*, *Ph3*	Homoz EBT	Heterozygous SLS-R	Provides the highest level of control for all 3	High Mowing
Fresh Market Plum - Determinate					
Plum Regal (F1) Fol, 1, 2;V; TSWV	Homoz *Ph3*	Homoz EBT	Susceptible	Mild LB will occur; SLS will require attention	Johnny's, Seedway, Totally Tomatoes
Cherry - Indeterminate					
Jasper (F1) Fol 1, 2	Heteroz Ph2, Ph3	Heteroz EBT	Heterozy SLS-R	Provides a high level of res all 3	Johnny's, AAS
Campari - Indeterminate	-	-	-	-	-
Mountain Magic (F1) Fol 1, 2, 3; V	Heteroz *Ph2*, *Ph3*	Heteroz EBT	Susceptible	LB will be contained until end of season; EB and SLS require some attention	Johnny's, Totally Tomatoes, etc.

[1]Resistance key: **Fol** = Fusarium wilt races 1, 2, and 3, respectively, (***F***usarium ***oxysporum f. sp. lycopersici***); **V** = Verticillium wilt (**Vd-1** ***V****erticillium* ***d****ahliae* [also **Va**, ***V****erticillium* ***a****lbo-atrum*]); **N** = Root-knot nematode (3 = three species, ***M****eloidogyne* ***a****renaria* (Peanut RKN)*,* ***M****. incognita* (Southern RKN), and ***M****. javanica* (Javanese RKN) (***Mi-1* gene** covers most, but not for resistance to the Northern root-knot nematode = *M. hapla*, which is most common in the NE); **TSWV** = Tomato spotted wilt virus.

3. How best to use the cultivars currently available

Disease control recommendations are predicated on the need to follow certain core horticultural practices. Crop rotation out of tomato for 2-3 seasons is one of the most important in terms of reducing soilborne inoculum for either early blight (EB) or Septoria leaf spot (SLS). This is not possible in all grower's (or homeowners) situations, thus the influence of these two diseases needs to be considered. Also if you compost and have included tomato debris from the previous season, you may be introducing EB and SLS in this manner, even if rotation is followed. If you interplant these cvs., EBT (homozygous or heterozygous) or SLS-R (either homozygous or heterozygous) with fully susceptible tomato cvs., you can expect to have some inoculum spread into these Tolerant or Resistant cvs., with the amount of defoliation experienced determined by the amount of overwinter inoculum present at the beginning of the season, and how favorable the season will be for each disease. Here is a summary for each production group.

Commercial (conventional) agriculture. - In general, growers who follow the TOM-CAST predicting system will be able to increase the disease severity value index to 25 or higher DSV for their weekly calculations as to when sprays are necessary. If SLS is a threat on your farm, then a closer adherence to the spray schedule is necessary since SLS can explode during a summer with frequent showers. Still, a maximum of two sprays may be sufficient. In the case of EB, TOM-CAST can be followed using the same criterion and perhaps a single spray will be necessary. Make sure that no strobilurin fungicides are used alone because of widespread resistance for EB among all Group 11 fungicides. These fungicides can be used if mixed with another effective fungicide, (ie. Quadris Top, Quadris Opti, or other new chemistry that may be registered in the near future). In general, LB is not an issue if using the cvs. shown in Table 1 and due attention is paid.

Organic agriculture. – Here your options are more limited since only copper (at least 6 OMRI formulations are registered in NYS) is available. Our research over the past 3 seasons has shown that copper, when used preventatively, can be an effective control when teamed up with the resistance mentioned for either EB and SLS. We expect that under most situations the spray schedule can be reduced to a 10 day or longer interval. Again, LB should not be an issue, until very late in the season, depending on the cvs. grown.

Homeowners. – Backyard gardeners have the issue of not being able to rotate much around their annual tomato crop. Still if gardeners practice good sanitation by removing all debris at the end of the season and not composting any tomato debris, they should restrict any overwinter source of EB or SLS. Gardeners are in a better situation than organic growers, since if needed they could rely upon either copper or chlorothalonil for protection of the lower plant canopy. LB would be an issue for any susceptible cv. other than the resistant ones mentioned in Table 1.