Physiological Leaf Roll of Tomato

A Fact Sheet prepared by *The Pacific Northwest Vegetable Extension Group*
http://mtvernon.wsu.edu/path_team/vegpath_team.htm

The PNW VEG includes specialists from the University of Idaho, Oregon State University, Washington State University and USDA-ARS who contribute expertise in plant pathology, horticulture and entomology to help identify and offer solutions to vegetable problems in Idaho, Oregon and Washington.

Many areas in the PNW experienced unusually hot and dry conditions during the 2009 growing season, including record dry and warm conditions west of the Cascade Mountains. PNW VEG members in Idaho, Oregon, and Washington have received many reports of moderate to severe leaf rolling on tomato plants in home gardens and commercial fields this season (see photos). Although the leaf roll symptoms are similar to those caused by certain viruses (curly top and tomato yellow leaf curl, for example), the symptoms noted in the PNW in 2009 were likely the result of a disorder on tomatoes called 'physiological leaf roll.'

Physiological leaf roll starts with upward cupping at the leaf margins followed by inward rolling of the leaves (Fig. 1). Lower leaves are affected first, and can sometimes recover if environmental conditions and cultural factors are adjusted to reduce stress. If the conditions favoring leaf roll are prolonged, affected leaves may not recover. In severe cases, whole plants can be affected. If environmental conditions and cultural factors are adjusted after prolonged leaf rolling, new growth that develops may not exhibit leaf roll symptoms (Fig. 1B).

Many university extension publications (listed below) provide information about this physiological condition. Several causes are reported. The severity of leaf roll appears to be cultivar dependent. High production-potential cultivars tend to be most susceptible. Staking cultivars of tomato are reported to be more sensitive to this disorder than bushy cultivars. In some cases, the condition is believed to occur most commonly when plants are staked and pruned during dry soil conditions. In other cases, causes listed include growing high-producing cultivars under high nitrogen fertility programs, phosphate deficiency, or extended dry periods. Also, the disorder has been attributed in some areas to excess soil moisture coupled with prolonged high temperatures.

In a study in Florida, removal of young vegetative shoots and fruit hands caused rapid and severe rolling of the lower leaves of 'Floradel' tomato plants, and symptoms progressed to the upper leaves. Sugar and starch accumulation in the lower leaves was positively correlated with the degree of leaf rolling, and overhead shading decreased the severity of leaf roll. A report from Kansas indicated that when spring weather is mild at planting, top growth may be more vigorous than root growth. If drier summer weather follows, the foliage may transpire water faster than the root system absorbs water from the soil, and the plant compensates by rolling the leaves to

reduce transpiration surface area of the foliage. This situation may reflect PNW tomato growing conditions in 2009.

Regardless of the cause of physiological leaf roll, the symptoms are generally the same in that the margins of the leaves roll up and in (Fig. 1). Leaf roll symptoms first appear on the older (lower) leaves, and may be temporary, disappearing after a few days. Not all leaves on a plant may exhibit rolling, but eventually the rolling can involve most leaves on a plant and persist through the season. The margins of adjacent leaflets may touch or overlap. Rolled leaves become rough and leathery but are otherwise normal in size and appearance. There is no discoloration of leaf veins associated with this condition. Plant growth, fruit yield, and fruit quality are not believed to be affected (Fig. 1C).

Some management strategies recommended for physiological leaf roll include: (i) planting bushy type cultivars, (ii) planting in well-drained soils and maintaining uniform, adequate soil moisture (~1 inch per week during the growing season depending on the area of production), (iii) being careful not to over-fertilize especially with nitrogen fertilizers (iv) providing adequate phosphorus fertilizer, (v) avoiding severe pruning, and (vi) maintaining temperatures below 95^{o}F by using shading or evaporative cooling. Follow closely the fertilizer programs recommended for specific regions of production and specific tomato cultivars, e.g., http://hort-devel-nwrec.hort.oregonstate.edu/tomato.html#fertilize.

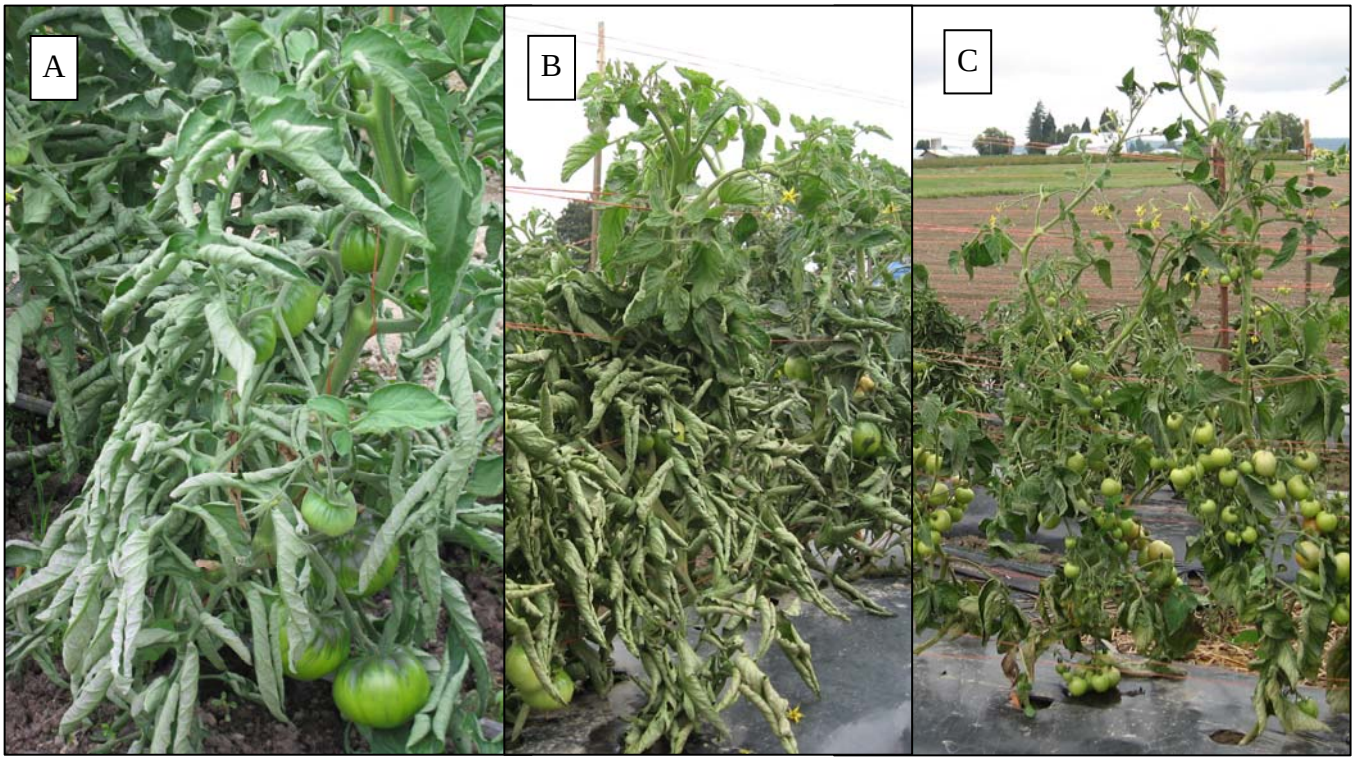

Fig. 1. A) Severe physiological leaf roll symptoms on a tomato plant. **B)** Tomato plants with physiological leaf roll on the older (lower) leaves with normal new (top) growth that developed after air temperatures cooled. **C)** Some tomato cultivars are less susceptible to physiological leaf roll than others.

Accurate plant diagnosis is essential before management practices are initiated. Some tomato pathogens can cause symptoms very similar to physiological leaf roll, so it is important not to confuse a non-infectious problem like physiological leaf roll with infectious diseases of tomato. For example, *curly top virus* causes upward leaf rolling but leaves are typically also yellow, thickened and crisp. *Tomato mosaic virus* can cause prominent leaf roll but mostly during early growth stages and accompanied by mosaic symptoms. *Tomato yellow leaf curl virus* causes leaves to cup down or up depending on the plant growth stage at the time of infection. Aster yellows phytoplasma can cause leaf roll on upper leaves. Informative photos on tomato diseases are on several university websites. The *Compendium of Tomato Diseases* published by APS Press (http://www.shopapspress.org/) has valuable information and photos on tomato problems.

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