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Premature Senescence Syndrome

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Premature senescence syndrome has occurred over the past several years in the eastern and southern cotton production regions. This condition is generally thought to be caused by insufficient potassium in plant leaf tissue which predisposes the foliage to secondary pathogen infection. This was very widespread across both regions in 2002, 2003 and was also observed to a limited extent in 2005. The scenario that appears to favor the onset of premature senescence is very dry conditions during the boll filling period followed by extended periods of wet, cloudy weather post-cutout, and plants with decent boll load (relatively speaking). Symptoms are seen in the upper third of the canopy and are characterized initially as yellowing between the leaf veins followed by a rapid change in leaf tissue to a red/orange/bronze coloration (Figure I). The affected leaves continue to deteriorate, eventually showing brown, necrotic lesions and leaf margins. Generally, secondary foliar pathogens such as *Alternaria, Cercospora* and *Stemphyllium* can be isolated from affected leaf tissue (Figure II). These are not considered primary pathogens, but they attack these debilitated plants and contribute to premature senescence and defoliation (Figure III).

The boll is the major sink for potassium (60% of total plant potassium is in the bolls). Adequate potassium is necessary for fiber and seed development. Also, potassium is important for enzyme activation, pH balance, stomatal control and translocation of photosynthates. Both the extended dry period and the onset of late season rains (waterlogged soils) contribute to reduced root function. The relatively non-functioning root system can't uptake enough potassium (and perhaps other nutrients) to meet boll demand, hence the deficiency. Barren plants and those with very little boll load will generally appear unaffected because their demand for potassium and other nutrients is much less (Figure IV).

In addition, the plant hormone cytokinin is important in regulating senescence and roots are a major site of cytokinin production. As root function decreases, so does the production of cytokinin, which leads to senescence.

For nutrients to be absorbed by plant roots, they must come in contact with the root surface. There are generally three ways that this occurs: root interception (very small amounts), movement of ions by mass flow with the soil solution, and diffusion of ions through the soil solution. Most of the potassium moves to roots by diffusion. Diffusion occurs when an ion moves from an area of high concentration to one of low concentration. As plant roots absorb nutrients from the surrounding soil solution, a diffusion gradient is established. Under low soil moisture conditions, water films around soil particles become deleted and discontinuous, slowing the movement of potassium to the roots, thereby reducing uptake. Under these conditions, plants cannot absorb enough of the nutrient to meet boll demand.

Research has indicated that this condition can occur even in fields that contain ample soil potassium. In 2002 and 2003, we collected soil samples from about 20 fields showing signs of premature senescence. Results indicated that soil test potassium levels in 18 of these fields were in the moderate to high category, and presumably sufficient for optimum plant growth.

However, it is important to test the soil annually to determine seasonal crop needs. In addition, annual soil testing will provide a good history for tracking nutrient levels over time. Moderate soil potassium levels in fields with a history of premature senescence may signal the need for supplemental fertilizer. Soil applications of potassium fertilizer may be justified in some situations. In-season foliar potassium applications have been evaluated, but generally have proven effective only about 20% of the time.

Figure I. Symptomology first appears on younger leaves in upper-third of canopy indicating K requirements exceed plant uptake

Figure II. Alternaria,Stemphyllium,Cercospora

Figure III. Premature Defoliation

Figure IV.

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