# COTTON RESPONSE TO ACID SOIL AMENDMENTS AND IRON ENRICHMENTS ON CALCAREOUS SOILS

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## Abstract

Two of the major crops grown in alkaline-calcareous soils of southern and south central Texas are cotton (*Gossypium hirsutum* L.) and grain sorghum [*Sorghum bicolor* (L) Moench]. Although these soils are not deficient in total Fe, both crops grown on these soils have exhibited Fe deficiency chlorosis symptoms due to a combination of high soil pH, $CaCO_3$ and $HCO_3^-$, in the root rhizosphere and Fe immobility within the plant leaf. Studies were conducted to correct this lime-induced problem by manipulating the soil rhizosphere pH and levels of plant available Fe. Field observations relating cotton plant mortality from disease in site specific areas supporting Fe deficient grain sorghum in previous seasons gave impetus to studies of a possible trace element-cotton disease relationship.

The objective of these experiments were to evaluate soil acidification amendments, animal waste and chelated Fe sources on changes in soil pH, soil Fe, dry matter and plant mortalities from Phymatotrichum root rot (PRR) on cotton. The studies were conducted on a Clareville sandy clay loam with histories of producing Fe deficient grain sorghum and PRR on cotton. Some of the Fe sources used were Fe treated Amaranthus, Iron Sul - Copper Mine Byproducts (High S, $H_2SO_4$ Fe product), and Florida-Mine Organic Fe Material. Several greenhouse and field experiments have evaluated improved plant nutrition, organic and chemical control treatments as well as acid amendments to the soil on cotton growth and disease suppression. Improved host-plant nutrition (IHPN) has been shown to be an important part of developing economically feasible methods for suppressing PRR on cotton in South Texas. Early research on the influence of sources of N fertilizer on PRR produced impressive results. Plant mortality data indicated that ammoniacal N such as that present in ammonium sulfate (AS) or urea caused a reduction in PRR especially in the early season. Increasing the rate of AS from 40 to 80 lb N/Ac (slightly above soil test recommended rate) reduced plant mortalities from 39 to 14 percent at the mid-summer counts. Progression of PRR continued rapidly after June 27 and approached 100 percent mortality for the calcium nitrate source. Other field studies at the same location showed deep moldboard tillage alone and preplant use of high rates of anhydrous ammonia showed only minimal effects on reducing PRR. Additional research with certain trace elements applied as stem drenches produced drastic reductions in plant mortalities. Those data show marked effects from Fe-chelate, and LiCl on disease suppression. Reduction in PRR only in the early season was measured with use of $FeS0_4$ or copperas as a source of Fe.

In summary, improving nutrition of the host plant (cotton) delayed plant mortality from PRR. Ammoniacal nitrogen fertilizer reduced severity of PRR while nitrate forms increased plant losses. Application of acid soil amendments increased the growth of cotton and reduced plant mortality from root rot. Additional studies show that soil amendments such as sulfuric acid, elemental S, high acid base fertilizers or addition of certain synthetic Fe chelates and plant-complexed Fe materials can be effective in improving the plant-available Fe levels of alkaline-calcareous soils. Placement of nickel and iron chelate (Fe-chel.-138) with planted seed suppressed early invasion of PRR and reduced plant mortalities to 27% of those in the control plots. The level of response to these amendments can be affected by the soil's chemistry and plant root activities. Results of these studies show practices which improve the available soil Fe status of calcareous soils may also increase cotton plant growth and suppress the incidence of cotton root rot disease.

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