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DEVELOPMENT OF RESISTANCE TO PLANT-PARASITIC NEMATODES IN COTTON

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Abstract

Recent studies have documented that yield losses due to plant-parasitic nematodes are much greater than previously believed, such that in many regions of the cotton belt nematodes are now considered to be primary deterrents to achieving the genetic yield potential of any cotton cultivar. There are several options for management of nematodes that are technically feasible but none are widely acceptable based on the current economics of cotton production. This is especially true for the use of nematicides, which add significantly to production costs but only consistently increase yields in portions of fields with moderate to high nematode population densities. Host resistance is an effective approach to management of many plant pests and pathogens and is a management option that can be adopted without increasing production costs. Resistance typically has two major benefits, firstly it protects the cotton crop from damage caused by nematode parasitism, thus allowing the crop to achieve its genetic yield potential without the addition input of nematicides. Additionally, because most forms of resistance result in the inhibition of the nematode development, nematode reproduction is similarly inhibited. This leads to lower nematode population densities following a resistant crop than would occur following a susceptible crop, even if nematicides are used to protect the susceptible crop. Thus, any crop that is planted following a resistant cultivar will be exposed to fewer nematodes than if resistance had not been used. With long term use of resistance, nematodes populations may be reduced to the level where it is possible to grow even susceptible cotton cultivars without suffering a yield loss due to nematode parasitism. There are, unfortunately, some negative aspects to the use of host resistance. Resistance is a highly specific trait, thus resistance to root-knot nematodes will not provide protection against other nematode species. In some cases, resistance may be so specific so as to provide protection to only specific populations of a nematode species. Resistance may not be durable, in that with repeated use the nematode population may adapt to the resistance and develop the ability to parasitize that resistant cultivar. Finally, resistance is often found in undeveloped, poor yielding cotton genotypes such that considerable breeding effort may be needed to introgress resistance into cotton cultivars that have the yield potential, fiber quality, and other characteristics needed by the modern cotton industry. The root-knot nematode is the most widely distributed of the nematodes parasitizing cotton and causes the most substantial yield losses beltwide. Resistance to this nematode has been identified in numerous cotton genotypes and more that 25 years of breeding effort has resulted in several resistant cotton lines with yield potentials that are close to that of the best yielding susceptible cultivars, three of these lines have even been released as cultivars (Acala NemX, Paymaster 1560, and Stoneville LA 887). Most cotton cultivars grown today are products of the private sector and are susceptible to root-knot nematodes. Thus, for resistance to root-knot nematodes to be widely available breeders from private companies will need to make crosses with known nematode-resistant genotypes and then select for resistance as well as yield potential and other important traits. The reniform nematode has a much more limited distribution but is causing significant cotton yield losses in some states, especially Alabama, Louisiana, and Mississippi. Resistance to the reniform nematode is known only from *Gossypium* sp. other than *G. hirsutum* (upland cotton). These forms of resistance will requires several years of breeding effort before it will be feasible to introduce the resistance into cultivars with superior yield and other agronomic properties. No useful forms of resistance to the Columbia lance or sting nematodes are known to exist. In summary, resistance to root-knot nematodes in superior cotton genotypes can be achieved with in 3 to 4 years once a major effort by private breeders is initiated. Resistance to reniform is a more distant possibility, but with the modern tools of biology and an appropriate effort, the probability for success is high. The development and use of host resistance will make it possible for cotton producers to increase yields without additional production costs, by allowing the cotton crop to achieve its genetic yield potential regardless of the presence of nematodes.