

# BREEDING GEORGIA-ADAPTED COTTON GERMPLASM AND CULTIVARS WITH EMPHASIS ON ROOT-KNOT NEMATODE (RKN) RESISTANCE

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## Introduction

Poor profit potential of cotton production from yield stagnation and high pest management costs impels creation of cultivars with inherent genetic resistance to enhance economic returns for Georgia cotton producers. Insect, nematode, and weed pest management costs are among the highest expenditures growers face in cotton production (National Cotton Council, 2001), thus their reduction would enhance profitability of cotton production.

Surveys of the densities of root-knot nematodes (*Meloidogyne incognita*, RKN) reveal that the major cotton-producing counties in Georgia have damaging levels of root-knot nematodes (National Cotton Council, 1998). It is estimated that Georgia producers lose about 77,000 bales of cotton annually from RKN damage (Blasingame and Petal, 2001). Crop rotation, while a recommended cultural practice to lessen soil populations of RKN, is not an option for most Georgia growers because of the lack of suitable non-host crops with which to rotate their cotton acreages. Therefore, inherent genetic resistance provides an attractive alternative to pesticides and crop rotation.

Despite the widespread occurrence of RKN in most cotton production areas in the Southeast and that genetic resistance to RKN has existed since 1974 (Shepherd, 1974), private cultivar developers have exhibited little interest in fulfilling this need. Commonly cited reasons for the slow progress in developing RKN resistant cultivars is that the current screening process is costly, tedious, time consuming and destructive for identifying resistance genotypes. Further, most breeding stations neither have the facilities nor personnel with expertise in nematology to carry out the screening process to identify resistant material. Of those RKN-resistant (CPCSD Acala NemX) or tolerant cultivars (ST LA887 or PM H1560) that have been distributed by commercial cotton seed companies, none are adapted to the Southeast. Cotton cultivars adapted for the unique aspects of the Georgian environment, such as rainfall patterns, soils types and depth, and *presence of root-knot nematodes* must be developed to give the best available genetics to the GA producer.

Public breeders have historically been the pre-breeders; doing the challenging work of developing new acceptable parents that can then be directly used to make improved cultivars. Because the recent shift to patenting cultivars will slow the industry's overall development of enhanced cultivars, the seed companies will place a higher priority on the ongoing renewal of their gene pools as well as trying to locate other sources of adapted germplasm. In this seller's market, publicly released germplasm lines should have the leverage to ensure that the better adapted material developed by a state gets to that state's cotton farmer.

Taken as a whole, a UGA cotton breeding program with continuity provides the foundation to ensure that traits needed by the Georgia cotton growers such as

increased yield and enhanced fiber quality in cultivars that are adapted to Georgia production conditions would not be overlooked. Specifically, the objective to develop Georgia-adapted cotton germplasm with RKN resistance will benefit the state's producers by providing increased yield and decreased production costs whereas the increased availability of RKN-resistant germplasm will benefit the cotton industry across the belt.

### **Materials and Methods**

Drs. Chee, May, and Davis developed advanced RKN resistant parents from a backcross breeding population using M120RNR and M155RNR RKN resistant donor parent with the elite breeding line PD94042 (May, 1999).

### **Results and Discussion**

RKN resistant BC3F3 lines have been further selected during the first quarter of 2006 in a 10 plant sub-sample that was inoculated twice with a very high rate of nematodes and evaluated for galling. About 1 out of 6 plants had near immunity just like M-120. Further field testing in 2006 rigorously selected 25 out of 176 entries which are being verified with additional testing in the greenhouse. Unfortunately, the growth of the RKN cotton population in the greenhouse was delayed due to some equipment problems that ended up keeping the greenhouse slightly cooler than desired. This led to a holdup in planting the 176 entry test in Dr. Davis' RKN infested field which, in turn, affected the nicking of the planned crossing in July to GA breeding lines. However, this missed crossing opportunity had an unexpected benefit since additional information from the 2006 yield tests indicated better parental selections than what we would have used in the summer. To ensure that the better yielding, value-added GA lines nicked with the RKN resistant parents, these parents were planted after harvest in the greenhouse.

We are planning to use the most up-to-date molecular markers from a companion project (Shen et al., 2006) in a three-cycle backcrossing program to insert the RKN resistance gene during 2007. We believe this approach should provide a more reliable insertion of the RKN resistance gene and, thereby, a more trustworthy release of the germplasm/cultivars. The chromosomal region bearing the RKN resistance that is indicated by these molecular markers has also been already verified independently (Ynturi et al., 2006), although our work appears to have markers that are, at present, closer to the RKN resistance gene. Our lab has also already found in some preliminary fingerprinting that the markers appear polymorphic between the Georgia lines and both parents of the RKN resistance donors. We plan to complete the backcrossing by the end of autumn 2007 so we can send the BC<sub>2</sub> population to the winter nursery in Mexico to obtain seed for the 2008 growing season. In the summer of 2008, we intend to plant an unreplicated modified augmented design yield test (with every 5th row in the trial assigned to a conventional check cultivar) in either Tifton or Plains to select for yield and to verify the homozygosity of the RKN resistance marker(s). The trial will be machine harvested and the seed-cotton yield of each F4 progeny row compared with seed-cotton yield of the nearest check row.

We will harvest boll samples for lint %, fiber quality, and for seed in a parallel increase field for the rows that significantly out-yield the nearest check plot. The preliminary trial (PT), which is the next step, will be conducted near Tifton or Plains, GA, depending upon land availability. Advanced generation germplasm lines promoted from the PT shall be tested in an Advanced yield trial (AT) in Plains and Tifton. Elite germplasm lines from a successful performance in the ATs will be tested in locations throughout the state in both dryland and irrigated fields in the University of Georgia Official Variety Trials. This approach should quickly provide a solid performing release of RKN resistant germplasm/cultivars.

## References

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