National Watermelon Association Research Proposal 2010

Title: Evaluation of resistant rootstocks for managing root-knot nematodes in grafted watermelon

Principal investigators

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Significance of Proposed Work to U.S. Watermelon Production

The southern root-knot nematode (*Meloidogyne incognita*) causes extensive damage to watermelon (*Citrullus lanatus* var. *lanatus*) in the southern U.S. (Davis, 2007; Sumner and Johnson, 1973; Thies, 1996). Root-knot nematodes also increase the severity of soil borne diseases such as Fusarium wilt in watermelon (Sumner and Johnson, 1973). The primary control method for root-knot nematodes in watermelon has been soil fumigation with methyl bromide. In Georgia, RKN significantly reduced fruit yield of 'Cooperstown' seedless watermelon grown in non-treated soil beds compared to that grown in methyl bromide treated soil beds (Davis, 2007). However, methyl bromide is being excluded from use in the United States (US Environmental Protection Agency, 2000). Furthermore, restrictions on the use of other soil fumigants and nematicides also are becoming more stringent. Consequently, managing root-knot nematodes in high value crops such as watermelon is becoming more difficult. The predicted annual yield loss for watermelon grown in fields without methyl bromide fumigation is 17% (Lynch and Carpenter, 1999).

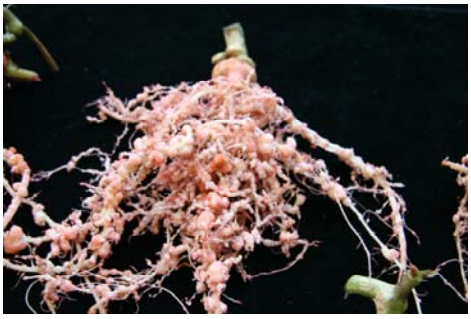

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Fig. 1a

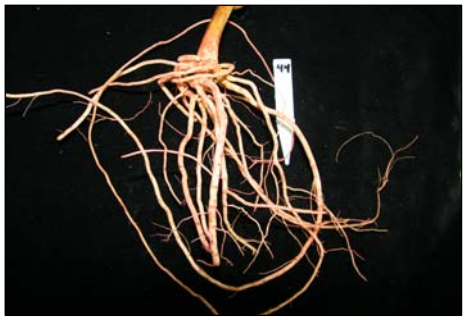

Fig. 1b

Fig. 1a and 1b. 'Strong Tosa' hybrid squash with heavy galling (Fig.1a) and RKVL 302 wild watermelon rootstock (Fig. 1b) with healthy roots grown in a root-knot nematode infested field, Charleston, SC.

Grafting scions of watermelon cultivars onto resistant cucurbit rootstocks is gaining acceptance as an alternative to pre-plant soil fumigation with methyl bromide for managing soil-borne diseases (Core, 2005; Edelstein and Ben-Hur, 2006). Bottle gourd (*Lagenaria siceraria*) and hybrid squash (*Cucurbita moschata x C. maxima*) are currently used as rootstocks for watermelon in Europe, Asia, and the Middle East, primarily because of their resistances to Fusarium wilt. However, we have demonstrated in field tests in Charleston, SC that hybrid squash (Fig. 1a) and bottle gourd are highly susceptible to RKN (Thies et al., 2008). Thus, hybrid squash and bottle gourd would not be preferred rootstocks for use in many areas of the southern U.S., where RKN are a serious pest of watermelon. In greenhouse tests, we identified several wild watermelons (*Citrullus lanatus* var. citroides) in the USDA Watermelon Plant Introduction Collection that are moderately resistant to RKN (Thies and Levi, 2003; Thies and Levi, 2007). We have developed breeding lines derived from these wild watermelon Plant Introductions that may be useful as

rootstocks for grafted watermelon. In 2009, we evaluated five of the best wild watermelon breeding lines in a field test at the U.S. Vegetable Laboratory, Charleston, SC. All five of these wild watermelon rootstocks (Fig. 1b) exhibited minimal root galling and had good fibrous root systems, indicating that these rootstocks are resistant to southern root-knot nematode (Thies et al., 2010). Furthermore, the wild watermelon rootstock RKVL 318 produced the most fruit and highest yield of any of the rootstock entries in the test.

In 2010, we propose to test the two best performing wild watermelon lines (selected from the 2009 test) as rootstocks for the scion 'Tri-X 313' in a RKN-infested field with and without methyl bromide soil fumigation treatments.

Research to be Conducted

Seven rootstock/seedless watermelon scion combinations will be evaluated in a field infested with the southern root-knot nematode, *Meloidogyne incognita*, in Charleston, S.C. Rootstocks will be grafted to the scion triploid watermelon 'Tri-X 313' and planted on raised white plastic mulch beds at 8' x 3' plant density. One-half of the plots will be fumigated with methyl bromide/chloropicrin (67/33) at 350 lbs/A when beds are prepared. **Rootstock genotypes:** The two best performing wild watermelon (*Citrullus lanatus* var. *citroides*, RKVL 301 and RKVL 318) germplasm lines selected from the 2009 Charleston RKN Study (Thies et al., 2010), one bottle gourd (*Lagenaria siceraria* 'Emphasis') cultivar, one squash (*Cucurbita moschata* x *C. maxima* 'Strong Tosa') hybrid, and one commercial watermelon rootstock (*C. lanatus* var. *citroides* 'Ojakkyo') will be evaluated as rootstocks. Non-grafted and self-grafted 'Tri-X 313' will be included as check entries in the study. **Experimental design:** The experimental design will be a split-plot design where whole plots will be methyl bromide treatments [non-treated control and methyl bromide (67%)/chloropicrin (33%) at 350 lbs/A] and sub-plots will be the 7 rootstock/scion combinations. The rootstock genotypes will be arranged in a randomized complete block within the methyl bromide whole plot treatments. The experiment will have six replicates of five plants per replicate. **Data collection:** The pollenizer 'SP-4' will be interplanted between every third and fourth grafted seedless watermelon. Watermelon fruit will be harvested and yield data collected. Fruit weight, fruit size (length x diameter), and fruit quality traits including total soluble solids (brix), incidence of hollow heart, and presence of hard seeds will be recorded. At the end of the harvest season, roots of all plants will be dug and evaluated for percent of root system galled by southern RKN. Nematode eggs will be extracted from the roots using 1% NaOCl (Hussey and Barker, 1973) and eggs will be counted using a stereomicroscope. Root galling percentages will be arcsine transformed and eggs per gram fresh root will be $\log^{10}(x + 1)$ transformed for analysis of variance to normalize data. Analysis of variance will be conducted using the GLM procedure of SAS v.9.1 for Windows (SAS Institute Inc., Cary, NC) and means will be separated using Fisher's Protected Least Significant Difference (LSD).

Timeframe: The research will be conducted from March 15, 2010 through September 30, 2010.

Literature cited

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Funding Requested

03/15/2010 – 10/31/2010

A. Salaries and wages for temporary labor	$13,390
B. Fringe Benefits (8%)	1,071
C. Total Salaries, Wages and Benefits	$14,461
D. Equipment	$ -0-
E. Materials and supplies:	$ 1,500
Plastic mulch, drip tape and irrigation supplies, artificial potting medium, plastic trays, labels, fertilizer, pesticides	
Total direct costs	$ 15,961
Indirect (overhead) costs to USDA	1,773
Total direct and indirect costs	$17,734

Personnel

A. Two temporary student laborers from Clemson University or another local college will be hired to assist in conducting the evaluation under the direction of a GS-8 technician assigned to the Nematology Project, U.S. Vegetable Laboratory, Charleston, SC.

B. The personnel will work at the U.S. Vegetable Laboratory, Charleston, SC under the supervision of J. A. Thies, Research Plant Pathologist. Dr. Thies will devote 10% time to directing the project, rating the roots for resistance (percent root galling), recording yield data, analyzing data, and preparing and presenting reports. Dr. R. Hassell will provide grafted watermelon transplants.