Development of peanut varieties with stem rot resistance and potentially more synchronous maturity using marker assisted selection

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Peanut stem rot (SR) / white mold is a destructive soil-borne disease that causes 5-10% yield loss in the southeastern USA. It is caused by a fungus *Athelia rolfsii* that survives in the soil and crop debris and germinates under favorable conditions leading to rapid mycelial growth and infection of plant tissues in contact with the soil. SR is the most critical peanut disease in Georgia, causing an annual ~$60-70 million loss including the cost to control. Though it can be controlled by fungicide application, developing disease resistant cultivars would bring economic and environmental benefits across the value chain. Buyer preference and economic factors such as yield, and market value are the deciding factors for selecting peanut cultivars by growers. Therefore, our breeding program has crossed multiple cultivars and accessions to generate varieties with new combinations of alleles for SR resistance, yield, and quality. One such cross with potential for SR resistance was made between two high-yielding runner type cultivars MARC I and Georgia 12Y (GA-12Y). MARC I is early maturing, SR susceptible while GA-12Y is late maturing and resistant to both stem rot and tomato spotted wilt virus (TSWV). A second cross was made between a highly resistant recombinant inbred line RIL703, from resistant parent NC 3033 and susceptible parent Tifrunner, a late maturing and TSWV resistant cultivar.

Molecular marker-assisted analysis indicated that two RIL703 × Tifrunner lines (C2997-03 and C2997-04) were segregating for two of our previously identified SR resistance QTLs. Ninety-six F3 seeds from these two lines and ten seeds each from twenty-two GA-12Y × Marc I F3 lines were screened for SR resistance. A sophisticated phenotyping protocol, developed at UGA, Tifton, was used for screening SR resistance. Briefly, five seedlings per row per plot were transplanted evenly among the direct-seeded GA-12Y seedlings one month after germination. A highly aggressive strain of *A. rolfsii* isolate (SR-18) was used for field inoculation. The disease symptoms were visible after about 2 weeks. The stem rot damage was rated after two, three, five weeks post-inoculation and during harvesting (eight weeks). Each hybrid plant was individually rated on a 0–5 scale for stem rot susceptibility. Seventy-one GA-12Y-derived lines and 33 RIL703-derived lines showed disease score 0 – 2 at the time of harvesting while susceptible controls and some hybrids died completely. (Fig. 1). Our preliminary analysis indicated that some of the hybrid lines showed higher seed weight in comparison to both parents. In addition to stem rot resistance, we also grew a portion of the F3 seeds from the GA-12Y population to identify genotypes that show a higher percentage of synchronous maturation. About sixty pods per line from two batches of seeds, harvested 10 days apart, were analyzed for seed maturity using a protocol standardized in our lab based on the color of the inner pericarp. The number of mature seeds in the GA-12Y-derived population slightly increased when plants were harvested at 154 days after planting instead of 143 days, indicating the late-maturing nature of these lines. Ten F4 seeds, collected from each of 24 RIL703 and 52 GA-12Y highly resistant lines, are being multiplied in our greenhouse to prepare for resistance confirmation in 2025. In summary, we have identified 76 highly SR resistant peanut lines by molecular marker and field screening. Some of these lines have shown higher seed weight than the parents. GA-12Y derived lines showed late maturity pattern though we could not screen the RIL703 derived lines due to limited numbers of seeds.

Figure 1: Selection of WM resistance lines

Leaf samples have been collected from all lines and will be genotyped by sequencing at Hudson Alpha. The genotypic and phenotypic data will be used to fine map the known QTLs in the RIL703 population and to identify new QTL(s) in the GA-12Y population and to understand the resistance mechanism. These lines will be screened in summer 2025 for both SR and TSWV resistance as well as seed maturity. Lines with high resistance and synchronous seed maturity will be selected for developing SR resistant lines.