

Precision breeding for multiple disease resistance

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Tomato spotted wilt virus (TSWV) is a significant issue in Georgia peanut production, causing yield and economic losses each season. Genetic resistance is essential to maintain yield and quality of the crop. Breeding programs have obtained resistance to TSWV through PI 203396 with great success for many years. A second source of resistance was identified via PI 576638 (SSD6) and its highly resistant offspring, NC94022. A major quantitative trait locus (QTL) was identified on chromosome A01 in a SunOleic 97R (TSWV susceptible) x NC94022 population. To further understand this resistance, a single recombinant inbred line (RIL_F155) produced from Tifrunner x SSD6 (resistant parent of NC94022) was crossed with eight unique breeding lines and progeny were screened with molecular markers to identify presence or absence of the QTL region on A01. These progenies have been evaluated over three field seasons (2022-2024) under varying environmental conditions for their resistance to TSWV and agronomic traits, including yield. From 2022 to 2024, progenies with the highest TSWV field resistance and favorable agronomic traits were advanced for further development. In 2024, 31 lines at the F₅ generation were planted in replicated 10-foot, two-row plots at Gibbs Farm in Tifton, GA on April 9th. A seeding rate of four seed per foot and early planting date were used to enhance TSWV pressure. Georgia-06G, TifNV-HG and TifGP-2 were used as check lines. TSWV ratings were taken as a percent of the plot canopy showing typical TSWV symptoms represented as a one to ten score. Final TSWV ratings were taken at 122 days, and all plots were harvested at 132 days post planting.

As in previous years, lines containing the QTL region on A01 showed significantly greater TSWV resistance as compared to lines lacking this region, including Georgia-06G and other check lines. Lines with improved TSWV resistance lacked the significant yellowing and ringspot symptoms of TSWV infected plants and maintained acceptable yields. There was no significant difference in yield between RIL_F155 derived lines and check lines, though there was a numerical difference between lines (Figure 1). Only one line yielded greater than Georgia-06G in 2024. All lines yielded higher in 2024 than in 2023 due to improved field conditions in 2024.

Molecular screening of lines with markers for other traits of interest was repeated, including late leaf spot and root-knot nematode resistance and high oleic acid content. Twenty-one of 80 lines showed the favorable allele for one additional trait and 14 for a combination of two additional traits.

Results obtained in 2024 indicate that the QTL for TSWV resistance is still of importance for further study and the populations studied here show both improved resistance and maintained agronomic traits through multiple field trials. Five lines have been selected for crossing within the breeding program and remaining lines will be further explored in the field and lab.

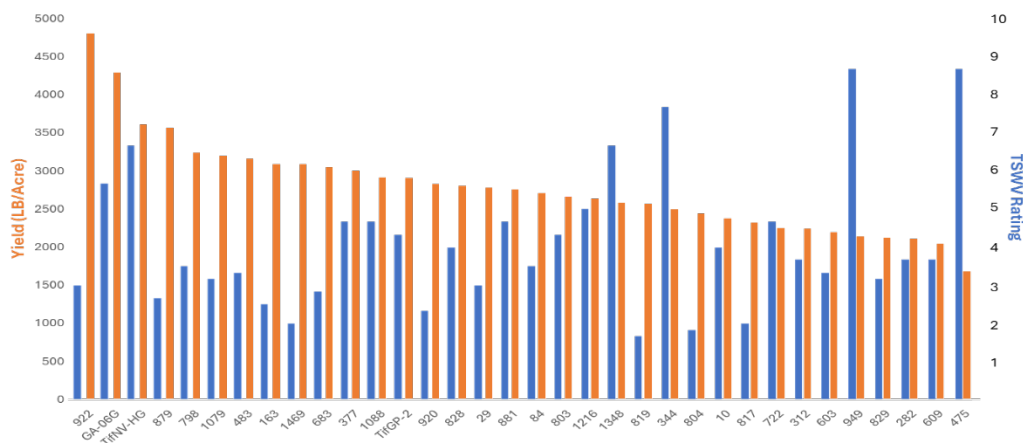


Figure 1. Distribution of yield and TSWV ratings for lines screened in 2024. No significant difference between yield ($p=0.17$) but a numerical difference is observed. Significant difference between TSWV ratings ($p<0.001$). Negative correlation between TSWV rating and yield, not significant in 2024 but significant in previous years of study.