Relative Tomato Spotted Wilt Incidence and Field Performance among Peanut Cultivars as Influenced by Different Input Production Practices in Georgia.

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ABSTRACT

During 2017-19, 30 replicated yield trials were conducted to determine relative tomato spotted wilt (TSW) incidence and general field performance among 19 runner and virginia market type peanut (*Arachis hypogaea* L.) cultivars. Four different input production practices were compared across three Georgia locations (Tifton, Plains, and Midville). Two early-planted (April) field tests were conducted at Tifton and Plains each year. One early-planted trial involved maximum-input practices of recommended pesticides with irrigation, and the other early-planted field trial did not receive any fungicides, insecticides, or irrigation. Early-planted maximum-input production practices with irrigation resulted in the highest percentage of mid-season TSW and late-season total disease incidences while also producing the highest pod yields and dollar values. Two other optimum-planted (May) maximum-input field tests were conducted at Tifton, Plains, and Midville, GA as part of the official statewide variety trials (OVT). These OVT utilized maximum-input production practices of pesticides both with and without irrigation. In the OVT, midseason TSW incidence showed no difference between irrigated and non-irrigated; however, the end-of-season total disease percentages which were predominantly TSW did show significantly higher disease percentage, produced the highest pod yields and dollar values within the irrigated field tests compared to the non-irrigated tests. In the overall four tests comparison, disease results showed significantly lower TSW incidence in the early-planted tests without fungicides and insecticides input production practices and no-irrigation; whereas, both optimum planted OVT(s) had the lowest total disease incidence. Overall average field performance for pod yields and dollar values were significantly highest in the optimum-planted tests with maximum-inputs including irrigation. Significant differences were also found among the 19 peanut cultivars. 'Georgia-06G', 'Georgia-12Y', and 'Georgia-18RU' had the lowest relative TSW incidence compared to the other runner-type cultivars. 'Georgia-19HP' had the lowest TSW incidence and total disease incidence among the virginia-type cultivars. Among the runner cultivars, Georgia-12Y had the lowest total disease incidence at the end of the season. The highest pod yields were found with Georgia-06G and 'Georgia-16HO'; whereas, Georgia-18RU and Georgia-06G had the highest dollar values among the runner-type peanut cultivars. Georgia-19HP had the highest pod yield and dollar value among the virginia-type cultivars.

Key Words: *Arachis hypogaea* L., groundnut, runner-types, virginia-types, irrigation, pesticides, planting dates.

Georgia is the top peanut (*Arachis hypogaea* L.) producing state in the U.S. accounting for roughly half of all peanuts produced each year (Archer, 2016). Within the state, approximately 40 to 60% peanut hectarage is irrigated in any given growing season depending upon increase or decrease in overall peanut supply and demand factors.

Each year, insect and disease problems can also affect overall peanut production. However, current insecticides and fungicides are very effective but can be costly. Unfortunately since the mid-1980s, tomato spotted wilt (TSW) disease caused by *Tomato spotted wilt virus* (TSWV) has persisted in the southeastern U.S. growing region (Branch and Culbreath, 2015). Cultivar resistance has been the primary control strategy for TSWV and is used in combination with other management practices like planting dates (Brown *et al.*, 2005).

General or horizontal field resistance to TSWV should not be confused with specific or vertical resistance (Fehr, 1987; Vanderplank, 1984). Immunity to TSWV has not lasted very long in other crops, since it is normally controlled by single gene, which puts pressure on the virus to mutate (Moury *et al.*, 1997; Roggero *et al.*, 2002). In contrast, moderate to high general resistance is usually controlled by multiple genes, each acting in an

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additive manner which allows for both the virus and host plants to co-exist and reduces viral survival pressure. General field resistance to TSWV in peanut has been shown to be stable and long-lasting for >20 years (Branch and Culbreath, 2018). However under certain conditions, even the most resistant available cultivars may require an integrated management program to prevent yield loss due to TSWV.

The objective of this study was to assess the relative TSW incidence and general field performance among several commercially available peanut cultivars. Different testing environments were used to determine the effect of varying production practices on TSW incidence and field performance of current peanut cultivars over years and locations in Georgia.

MATERIALS AND METHODS

During three years (2017-19), 30 total field trials were conducted to determine TSW incidence and general field performance of 19 peanut cultivars. Four different production practices were compared across three Georgia locations (Tifton, Plains, and Midville).

Two-pairs of four field production practice trials were planted early in April each year at Tifton and Plains, GA. At each location, one field trial involved maximum-input production practices of recommended pesticides for weed, disease, and insect control with irrigation. The other early-planted field trial did not receive any foliar fungicides or insecticides and no irrigation.

Another set of paired production practice field trials had an optimum-planting date in May each year as recommended for better TSW control; whereas, April-plantings usually have higher TSW incidence. These statewide Official Variety Trials (OVT) utilized maximum-input production practices of pesticides both with and without irrigation at three Georgia locations (Tifton, Plains, and Midville).

A randomized complete block field design with six replications was used for each location. These four varying production practice field trials were conducted on a Tifton loamy sand soil type (fine-loamy, siliceous, thermic Plinthic Kandiudult) at Tifton, GA; a Greenville sandy clay loam (fine, kaolinitic, thermic Rhodic Kandiudult) at Plains, GA; and a Dothan sandy loam (fine-loamy, kaolinitic, thermic Plinthic Kandiudult) at Midville. All plots in each test consisted of two-rows, 6.1 m long x 1.8 m wide.

TSW disease occurrence included classical chlorotic ring spot symptoms on leaves of both stunted as well as normal size plants. TSW incidence (0-100%) was first assessed at approximately midseason (70 days after planting), when TSW is typically the only disease occurring during that part of the growing season. Additionally, percentages of total disease incidence were scored prior to digging, which included primarily TSW but also soilborne diseases. A disease "hit" equaled one or more diseased plants in a 30.5-cm section of row.

Each entry was individually dug near optimum maturity based upon the hull-scrape method from adjacent border plots (Williams and Drexler, 1981). After harvest, peanut pods from each plot were dried with forced warm-air to approximately 6% moisture. Pod samples were then cleaned before weighing for yield determinations. Grade samples were presized and shelled on federal state inspection service equipment accordingly for runner and virginia-type peanuts, respectively. Gross dollar values, were calculated from yield and grade based upon peanut loan schedules for each year.

Data from these tests were combined and statistically analyzed by analysis of variance (ANOVA) using general linear model. Waller-Duncan's T-test (k-ratio = 100) were used for mean separation involving three or more means, and T-tests were used for only two mean comparisons in SAS (SAS Institute, Inc., Cary, NC).

RESULTS AND DISCUSSION

Field performance trials were conducted for three-years (2017-19) at Tifton and Plains, GA to compare two different early-planted tests involving maximum-input production practices with irrigation versus no-fungicides, no-insecticides, and without irrigation (Table 1). The maximum-input production practices with irrigation resulted in significantly ($P \leq 0.05$) higher percentage of TSW and total disease incidence, but as expected had the higher pod yields and dollar values. The highest TSW and total disease percentages in the maximum-input production practices with irrigation confirms an earlier report (Branch *et al.*, 2003), which included different runner and virginia-type cultivars compared to this current study.

During 2017-19, field performance trials were likewise conducted at Tifton, Plains, and Midville locations to compare two optimum-planted tests for maximum-input production practices with and without irrigation (Table 2). The mid-season TSW incidence showed no significant differences between

Table 1. Three-Year Relative Tomato Spotted Wilt Incidence and Field Performance Averaged over Six Early-Planted Tests of 19 Peanut Cultivars for Maximum-Input with Irrigation versus No-Fungicide and No-Insecticide without Irrigation, 2017-19.

Production Inputs	TSW	Total Disease	Pod Yield	Dollar Value
	(%)	(%)	(kg/ha)	($/ha)
Maximum	6.0 a[1]	26.0 a	5588 a	2272 a
None	4.4 b	18.7 b	4728 b	1913 b

[1]Means within columns followed by the same letter are not significantly different at P≤0.05 according to T-test paired comparisons.

irrigated and non-irrigated trials. However, the end-of-season total disease percentages, predominantly consisting of TSW, did show significantly higher percentage in the irrigated tests compared to the non-irrigated tests involving both maximum-input production practices. Similar to the early-planted tests, the average pod yields and dollar values were significantly higher in the irrigated tests compared to the non-irrigated tests. These results agree with a previous report involving the Georgia peanut OVT irrigated test having a significantly higher pod yields and dollar values compared to the non-irrigated test at these same locations (Isleib *et al.*, 2014).

In the overall four tests comparison between each of the two early-planted tests and each of the two optimum-planted tests, disease results showed significantly lower TSW incidence in the early-planted tests without fungicide, insecticide, or irrigation compared to the other three test conditions (Table 3). As recommended for planting dates by the Georgia Cooperative Extension Service, average field performance for pod yields and dollar values were significantly highest in the optimum-planted tests with maximum-input production practices including irrigation in comparison to the other three testing environments. These findings show that the highest average field performance for

Table 2. Three-Year Relative Tomato Spotted Wilt Incidence and Field Performance Averaged over Nine Optimum-Planted Tests of 19 Peanut Cultivars for Maximum-Inputs with Irrigation versus Non-Irrigation, 2017-19.

Production Inputs	TSW	Total Disease	Pod Yield	Dollar Value
	(%)	(%)	(kg/ha)	($/ha)
Irrigated	6.8 a[1]	12.8 a	6339 a	2563 a
Non-Irrigated	6.6 a	11.4 b	4743 b	1866 b

[1]Means within columns followed by the same letter are not significantly different at P≤0.05 according to T-test paired comparisons.

Table 3. Three-Year Relative Tomato Spotted Wilt Incidence and Field Performance Averaged over Early-Planted Tests with Maximum-Inputs and No-Inputs versus Optimum-Planted Tests with Maximum-Inputs with Irrigation and Maximum-Inputs without Irrigation, 2017-19.

Production Inputs	TSW	Total Disease	Pod Yield	Dollar Value
	(%)	(%)	(kg/ha)	($/ha)
Optimum-Planted with Maximum-Inputs and Irrigation	6.6 a[1]	12.4 c	6389 a	2586 a
Early-Planted with Maximum-Inputs and Irrigation	6.0 a	26.0 a	5588 b	2272 b
Early-Planted without Inputs and No-Irrigation	4.4 b	18.7 b	4728 c	1913 c
Optimum-Planted with Maximum Inputs and w/o Irrigation	6.4 a	11.2 c	4782 c	1884 c

[1]Means within columns followed by the same letter are not significantly different at P≤0.05 according to Waller-Duncan's T-test for multiple range comparisons.

pod yield and dollar value also had among the lowest total disease incidence and among the highest TSW incidence which does not agree with an earlier report (Brown *et al.*, 2005). Additional reports have also noted earlier April planting dates had more TSW compared to optimum-planting dates in May (Culbreath *et al.*, 2010; Nuti *et al.*, 2014; Tillman *et al.*, 2007). It should be pointed out that in this study, the TSW percentages at mid-season are relatively low at <10%. In addition, another probable explanation is that the current peanut cultivars have much higher TSWV general field resistance than past cultivars.

Table 4 shows the three-year relative TSW incidence and field performance of 14 current runner and five virginia market type peanut cultivars averaged over these 30 tests. Significant differences were found among these 19 peanut cultivars for TSW and total disease incidence as well as pod yields and dollar values. 'Georgia-06G' (Branch, 2007), 'Georgia-12Y' (Branch, 2013), and 'Georgia-18RU' (Branch, 2019) had the lowest TSW incidence at midseason compared to other runner cultivars; whereas, 'Georgia-19HP' (Branch and Brenneman, 2020) had the lowest TSW and total disease incidence among the virginia-type cultivars. Among the runner-type cultivars, Georgia-12Y had the lowest total disease incidence which included predominantly TSW but also any soilborne diseases (i.e. white mold or stem rot) observed at the time of rating. Since Georgia-12Y has good resistance to *Sclerotium rolfsi*, Sacc., it is

Table 4. Three-Year (30 Tests) Relative Tomato Spotted Wilt Incidence and Field Performance of 14 Runner and Five Virginia Type Peanut Cultivars Averaged over Four Test Environments and Three Georgia Locations, 2017-19.

Cultivar	TSW	Total Disease	Pod Yield	Dollar Value
Runner-Type:	(%)	(%)	(kg/ha)	($/ha)
Georgia-18RU	4.1 jk[1]	14.4 hij	5831 abc	2425 a
Georgia-06G	3.4 k	11.6 k	5961 a	2398 a
Georgia-16HO	5.1 hi	13.8 hij	5903 a	2376 ab
TUFRunner ‘297’	6.9 de	19.0 cd	5858 ab	2363 abc
FloRun ‘331’	8.4 b	20.8 c	5885 ab	2336 abc
Georgia-12Y	3.5 k	8.9 l	5894 a	2320 abc
Georgia-09B	4.7 ij	16.5 efg	5626 bcd	2274 bcd
Georgia Greener	5.2 ghi	13.7 hij	5590 cde	2266 cde
Georgia-07W	5.0 i	14.0 hij	5374 def	2159 efg
AU-NPL 17	7.2 bcd	15.7 fgh	5483 de	2135 fg
TifNV-High O/L	6.7 def	15.2 ghi	5344 efg	2112 fg
Georgia-14N	4.7 ij	13.6 ijk	5085 g	2092 g
TUFRunner ‘511’	11.2 a	27.5 a	5180 fg	2088 g
Tifguard	6.1 efg	15.4 ghi	5151 fg	2053 g
Virginia-Type:				
Georgia-19HP	4.6 ij	12.5 jk	5521 de	2343 abc
Georgia-11J	8.2 b	18.3 de	5353 ef	2202 def
Bailey	6.0 efg	17.4 def	4569 h	1805 h
Wynne	8.0 bc	25.0 b	4418 hi	1692 i
Sullivan	6.0 fgh	18.3 de	4277 i	1692 i

[1]Means within columns followed by the same letter are not significantly different at $P \leq 0.05$ according to Waller-Duncan’s T-test for multiple range comparisons.

not surprising to see these results at the end of the growing season.

The highest pod yield was found with Georgia-06G, ‘Georgia-16HO’ (Branch, 2017), and Georgia-12Y, but these three cultivars were not significantly different in yield from Georgia-18RU, FloRun ‘331’ (Tillman, 2021), and TUFRunner ‘297’ (Tillman, 2018). Likewise, Georgia-18RU and Georgia-06G had the highest dollar values, but these two runner-type peanut cultivars were not significantly different from Georgia-16HO, TUFRunner ‘297’, FloRun ‘331’, and Georgia-12Y. The new virginia-type peanut cultivar Georgia-19HP, which also had the highest pod yield and dollar value among the virginia-types, was not significantly different from ‘Georgia-11J’ (Branch, 2012) in pod yield.

It is interesting to note that among these six runner cultivars and two virginia cultivars with the highest field performance for pod yield and dollar values, the Georgia cultivars had the lowest TSW and total disease incidence. The highest disease percentages were found with the more susceptible TUFRunner ‘511’; cultivar (Tillman and Gorbet, 2017) which had 11.2% TSW and 27.5% total disease incidence at the end of the growing season, respectively.

TSW persists as an important disease in southeastern U.S. peanut production areas, however, general TSWV field resistance among several of these cultivars appears to be significantly better than many of the more susceptible cultivars. The TSWV resistance of Georgia-06G has previously been shown to be very stable across many years (Branch and Culbreath, 2018), and now shows stable TSWV resistance across different input production practices. Because TSW incidence can be somewhat sporadic in any given test, location, and year, evaluations should include pooled data across as many different environments as possible for an accurate comparison of relative general TSWV resistance in peanut.

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