PROJECT NAME: Improved Management of Tomato Spotted Wilt Virus in the VA/NC Peanut Area: Evaluation of the Thrips Vectors, Their Seasonal Abundance, and Sensitivity to Insecticides

TERM OF PROJECT: 1 Year

FUNDS REQUESTED: $10,103

PROJECT LEADERS (CO-INVESTIGATORS): Drs. D. Ames Herbert, Jr. (Virginia Tech), and Rick Brandenburg (NC State University)

LOCATIONS: The Virginia Tech, Tidewater Agricultural Research and Extension Center, Suffolk, VA, and the NC State University, Peanut Belt Research Station, Lewiston, NC

OBJECTIVES:
1. To document the species of thrips that feed on peanut
   a. to collect adult thrips from peanut field experiments throughout the season and identify collections to species.
2. To document the presence and abundance of thrips populations throughout the season.
   a. to assess thrips population dynamics by weekly sampling of adult and larval populations in peanut field experiments.
3. To evaluate insecticide thrips control strategies and products for impact on thrips populations and species.
   a. to compare various in-furrow applied insecticides for impact on thrips populations and species.
   b. to evaluate the impact of repeated mid- and late-season foliar insecticide sprays on thrips populations and species.

RESEARCH PLAN:
All field experiments were conducted at both the Virginia Tech Tidewater AREC in Suffolk, VA and at the NC State University Peanut Belt Research Station in Lewiston, NC. Peanut plantings were in single rows at four seed per foot of row. Plots were established using three insecticides used by most VA/NC peanut growers (Temik 15G, Orthene 97, and Thimet 20G) applied in-furrow at planting. An additional set of plots were established using a series of additional mid- and late-season foliar band applications of Orthene 97. Treatments consisted of Orthene 97 being applied one, two, three or four times at bi-weekly intervals beginning two weeks after plant cracking. All plots were four rows by 40 feet and established using a randomized complete block, four replicate experimental design. The experiments were managed for weeds and diseases using standard recommended practices according to the respective states involved.

Thrips Population Sampling: At both locations, thrips populations were collected from each plot weekly, from plant emergence to the end of August, by cutting 10 main stem terminals
from each plot, placing them into alcohol, and separating the thrips using screen/washing techniques. All adults and immatures were separated and counted. Adults were identified to species (note: only adult thrips can be effectively identified to species). Species identifications, seasonal abundance, and number of generations information were determined using standard statistical techniques.

**TSWV Incidence Determinations:** Incidence of TSWV was assessed at least three times during the season by walking all plots and counting the number of diseased plants in the two center rows of each plot (number per 80 row feet). After digging, 10 randomly selected taproots from each plot were collected and assessed for presence of virus. Taproots were collected, washed, crushed and subjected to Agdia Inc. ELISA TSWV determination test kit procedures (which indicate presence of virus).

**Other Data Collected:** Thrips injury to plants was determined using a standard 1-10 plant injury rating scale, weekly for the first five weeks after plant emergence. Plant stands were taken in each experiment/location. Yields were determined by harvesting the center two rows of each plot using standard peanut harvesting equipment modified for small plot use. Plot yields were adjusted to 7 percent moisture.

**RESULTS:**

Complete data tables for the research projects for both states are attached as an appendix to this report (pages 7-12, Tidewater AREC, Suffolk, VA; pages 13-18, Peanut Belt Res. Sta., Lewiston, NC). Following is a brief discussion, with six visual aids, that helps summarize the results.

TSWV levels appeared to be much lower in 2003 compared with 2002. At both locations, percent of plants showing disease symptoms was relatively low throughout the several weeks that visual ratings were taken. At Tidewater, if you review all three experiments (Figures 1, 3 and 5) you will see that there was a significant difference in number of diseased plants among the insecticide treatments in only one (Figure 3). In that experiment, Thimet 20G applied in-furrow at planting resulted in less TSWV compared with several other treatments. The same was true in the Lewiston experiment on July 29 (Appendix, Table 9). These results agree with last year’s findings, and with observations in other states (e.g., Georgia, Alabama). Unlike results in 2002, additional in-season foliar applications of Orthene 97 did not result in less virus compared with in-furrow applications, alone (Figures 3 & 5; Appendix, Tables 9 & 10). That is, additional insecticide treatments, although improving thrips control, did not have an impact on the level of TSWV.

Taproot evaluations were added to the 2003 experiments, where taproots randomly selected from plots were tested for TSWV (see Research Plan, above). Results were surprising in that very high levels of disease were detected in taproots at both locations. Whereas numbers of plants with visual symptoms were low (never more than 20%), taproot samples ranged from 47.5 to 72.5 percent registering positive for TSWV. In most of the experiments, as was seen with the percentage of plants showing above ground disease symptoms, Thimet 20G resulted in less virus in taproots, and was significantly lower compared to several other treatments in one test (Figure 5). This high level of TSWV in taproots raises several questions. Why were taproot levels high when above ground symptoms were low? Was the virus at higher levels in above ground plant tissues but not expressed because plants were not under as much stress as in the 2002 growing season? Will the virus re-express in future seasons, especially if plants suffer stress from other sources, such as drought? Our conclusion is that, based on taproot findings,
TSWV is still in the environment at relatively higher levels and will recur given the right set of conditions. Only time and further research will reveal more information to help explain TSWV and its relationship to peanut.

There were no significant differences in peanut yields among treatments in either the Lewiston experiment (Appendix, Table 12) or in one of the Tidewater AREC experiments (Figure 2). There were significant differences in two of the Tidewater AREC experiments (Figures 4 & 6). However, these differences appear to have been due to differences in levels of thrips control, as opposed to differences in levels of TSWV control. In Figure 4, in most cases, the additional foliar application of Orthene 97 improved yields. Also, Temik 15G and Thimet 20G resulted in better yields compared with Admire 2F. The highest yield was achieved with Temik 15G followed by a single foliar application of Orthene 97. In Figure 6, Temik and Thimet applied alone had comparable yields, and yields with both were increased with application of an additional Orthene 97 treatment. As was seen in 2002, a single application of Orthene provided the same level of yield increase as two, three or four applications.

These results were published by the respective investigators in their annual reports, discussed in 2004 county and multi-county peanut production meetings, and used to further refine the risk index brochure prototype developed in 2002.
Figure 1. Percent of peanut plants with visual symptoms of TSWV, Tidewater AREC, 2003.

Figure 2. Yield of peanut treated with selected insecticide, Tidewater AREC, 2003.
Figure 3. Percent of peanut plants with visual symptoms of TSWV, Tidewater AREC, 2003.

Figure 4. Yield of peanut treated with selected insecticide, Tidewater AREC, 2003.
Figure 5. Percent of peanut plants with visual symptoms of TSWV, Tidewater AREC, 2003.

<table>
<thead>
<tr>
<th>Material</th>
<th>Rate/A</th>
<th>Yield (lb/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temik 15G</td>
<td>7 lb</td>
<td>3042 c</td>
</tr>
<tr>
<td>Temik 15G + Orthene 97 (x1)</td>
<td>7 lb + 6 oz</td>
<td>3958 ab</td>
</tr>
<tr>
<td>Temik 15G + Orthene 97 (x2)</td>
<td>7 lb + 6 oz</td>
<td>3735 a-c</td>
</tr>
<tr>
<td>Temik 15G + Orthene 97 (x3)</td>
<td>7 lb + 6 oz</td>
<td>3870 ab</td>
</tr>
<tr>
<td>Temik 15G + Orthene 97 (x4)</td>
<td>7 lb + 6 oz</td>
<td>3651 a-c</td>
</tr>
<tr>
<td>Thimet 20G</td>
<td>5 lb</td>
<td>3289 bc</td>
</tr>
<tr>
<td>Thimet 20G + Orthene 97 (x1)</td>
<td>5 lb + 6 oz</td>
<td>3773 a-c</td>
</tr>
<tr>
<td>Thimet 20G + Orthene 97 (x2)</td>
<td>5 lb + 6 oz</td>
<td>3890 ab</td>
</tr>
<tr>
<td>Thimet 20G + Orthene 97 (x3)</td>
<td>5 lb + 6 oz</td>
<td>3790 ab</td>
</tr>
<tr>
<td>Thimet 20G + Orthene 97 (x4)</td>
<td>5 lb + 6 oz</td>
<td>4212 a</td>
</tr>
<tr>
<td>LSD</td>
<td></td>
<td>742</td>
</tr>
</tbody>
</table>

Figure 6. Yield of peanut treated with selected insecticide, Tidewater AREC, 2003.
Appendix

Tidewater AREC (Suffolk, VA) data--Tables 1-6
and
Peanut Belt Research Station (Lewiston, NC) data--Tables 7-12
Table 1. Counts of plants with TSWV symptoms, PT-TSWV1. Tidewater Agricultural Research and Extension Center, Suffolk, Virginia, 2003.

<table>
<thead>
<tr>
<th>Material</th>
<th>Rate/A &amp; application method</th>
<th>July 13</th>
<th></th>
<th>July 29</th>
<th></th>
<th>August 29</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean no./80 row ft</td>
<td>Percent of total plants</td>
<td>Mean no./80 row ft</td>
<td>Percent of total plants</td>
<td>Mean no./80 row ft</td>
<td>Percent of total plants</td>
</tr>
<tr>
<td>1. Temik 15G</td>
<td>7.0 lb/A (IF)</td>
<td>4.25 a</td>
<td>1.98 a²</td>
<td>13.75 ab</td>
<td>6.48 ab²</td>
<td>18.25 a</td>
<td>8.61 a²</td>
</tr>
<tr>
<td>2. Orthene 97</td>
<td>16.5 oz/A (IF)</td>
<td>4.25 a</td>
<td>1.83 a</td>
<td>11.50 b</td>
<td>4.96 b</td>
<td>18.25 a</td>
<td>7.87 a</td>
</tr>
<tr>
<td>3. Thimet 20G</td>
<td>5.0 lb/A (IF)</td>
<td>4.00 a</td>
<td>1.87 a</td>
<td>9.25 b</td>
<td>4.35 b</td>
<td>16.00 a</td>
<td>7.48 a</td>
</tr>
<tr>
<td>4. Temik 15G + Thimet 20G</td>
<td>3.5 lb/A (IF)</td>
<td>5.25 a</td>
<td>2.51 a</td>
<td>17.75 a</td>
<td>8.53 a</td>
<td>20.00 a</td>
<td>9.68 a</td>
</tr>
<tr>
<td>5. Untreated</td>
<td>---</td>
<td>3.50 a</td>
<td>1.61 a</td>
<td>13.75 ab</td>
<td>6.27 ab</td>
<td>20.75 a</td>
<td>9.55 a</td>
</tr>
</tbody>
</table>

LSD

<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>3.05</td>
<td>0.01²</td>
<td>5.85</td>
<td>0.03²</td>
<td>8.95</td>
<td>0.04²</td>
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</tr>
<tr>
<td>(P=0.38)</td>
<td>(P=0.40)</td>
<td>(P&lt;0.01)</td>
<td>(P&lt;0.01)</td>
<td>(P=0.20)</td>
<td>(P=0.16)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Means within a column followed by the same letter(s) are not significantly different.

1 Based on stand counts taken May 28.

2 Based on arcsin transformation.
Table 2. Percent of taproots testing positive for TSWV, PT-TSWV1. Tidewater Agricultural Research and Extension Center, Suffolk, Virginia, 2003.

<table>
<thead>
<tr>
<th>Material</th>
<th>Rate/A &amp; application method&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Oct 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Temik 15G</td>
<td>7.0 lb/A (IF)</td>
<td>57.5 a</td>
</tr>
<tr>
<td>2. Orthene 97</td>
<td>16.5 oz/A (IF)</td>
<td>47.5 a</td>
</tr>
<tr>
<td>3. Thimet 20G</td>
<td>5.0 lb/A (IF)</td>
<td>52.5 a</td>
</tr>
<tr>
<td>4. Temik 15G +</td>
<td>3.5 lb/A (IF)</td>
<td>65.0 a</td>
</tr>
<tr>
<td>Thimet 20G +</td>
<td>+ 3.5 lb/A (IF)</td>
<td></td>
</tr>
<tr>
<td>5. Untreated</td>
<td>---</td>
<td>57.5 a</td>
</tr>
</tbody>
</table>

LSD: 20.5 (P=0.01)

<sup>1</sup> Means within a column followed by the same letter(s) are not significantly different.

<sup>2</sup> Based on ten randomly selected root samples per plot subjected to an Agdia TSWV test kit.

<sup>3</sup> IF treatments were applied on May 7.

<table>
<thead>
<tr>
<th>Material</th>
<th>Rate/A &amp; application method</th>
<th>Jul 13</th>
<th>Jul 29</th>
<th>Aug 31</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean no./80 row ft</td>
<td>Percent of total plants</td>
<td>Mean no./80 row ft</td>
</tr>
<tr>
<td>1. Temik 15G</td>
<td>7.0 lb/A (IF)</td>
<td>6.75 a-c</td>
<td>3.16 ab²</td>
<td>16.00 a</td>
</tr>
<tr>
<td>2. Temik 15G + Orthene 97</td>
<td>7.0 lb/A (IF)</td>
<td>5.00 a-c</td>
<td>2.20 ab</td>
<td>16.00 a</td>
</tr>
<tr>
<td>+ Thimet 20G</td>
<td>6 oz/A (BC at late GC)</td>
<td>3.00 c</td>
<td>1.40 b</td>
<td>12.00 a</td>
</tr>
<tr>
<td>4. Thimet 20G + Orthene 97</td>
<td>5.0 lb/A (IF)</td>
<td>4.00 bc</td>
<td>1.91 ab</td>
<td>13.75 a</td>
</tr>
<tr>
<td>+ Thimet 20G</td>
<td>6 oz/A (BC at late GC)</td>
<td>8.50 a</td>
<td>3.76 a</td>
<td>23.50 a</td>
</tr>
<tr>
<td>5. Admire 2F</td>
<td>19 oz/A (IF)</td>
<td>7.50 ab</td>
<td>3.39 a</td>
<td>22.00 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC)</td>
<td>8.50 a</td>
<td>3.76 a</td>
<td>23.50 a</td>
</tr>
<tr>
<td>7. Untreated</td>
<td>--</td>
<td>6.25 a-c</td>
<td>2.71 ab</td>
<td>24.50 a</td>
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</tbody>
</table>

LSD

<table>
<thead>
<tr>
<th></th>
<th>Jul 13</th>
<th>Jul 29</th>
<th>Aug 31</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.23</td>
<td>0.02²</td>
<td>12.70</td>
</tr>
<tr>
<td></td>
<td>(P=0.09)</td>
<td>(P=0.08)</td>
<td>(P=0.19)</td>
</tr>
<tr>
<td>Means within a column followed by the same letter(s) are not significantly different.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Based on stand counts taken May 29.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Based on arcsin transformation.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4. Percent of taproots testing positive for TSWV, PT-TSWV2. Tidewater Agricultural Research and Extension Center, Suffolk, Virginia, 2003.

<table>
<thead>
<tr>
<th>Material</th>
<th>Rate/A &amp; application method&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Oct 6-7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Temik 15G</td>
<td>7.0 lb/A (IF)</td>
<td>65.0 a</td>
</tr>
<tr>
<td>2. Temik 15G + Orthene 97</td>
<td>7.0 lb/A (IF) 6 oz/A (BC at late GC)</td>
<td>57.5 a</td>
</tr>
<tr>
<td>3. Thimet 20G</td>
<td>5.0 lb/A (IF)</td>
<td>50.0 a</td>
</tr>
<tr>
<td>4. Thimet 20G + Orthene 97</td>
<td>5.0 lb/A (IF) 6 oz/A (BC at late GC)</td>
<td>55.0 a</td>
</tr>
<tr>
<td>5. Admire 2F</td>
<td>10 oz/A (IF)</td>
<td>60.0 a</td>
</tr>
<tr>
<td>6. Admire 2F + Orthene 97</td>
<td>19 oz/A (IF) 6 oz/A (BC at late GC)</td>
<td>52.5 a</td>
</tr>
<tr>
<td>7. Untreated</td>
<td></td>
<td>55.0 a</td>
</tr>
</tbody>
</table>

LSD 24.1 (P=0.13)

Means within a column followed by the same letter(s) are not significantly different.

1 Based on ten randomly selected root samples per plot subjected to an Agdia TSWV test kit.

2 IF treatments were applied on May 7; BC at late GC treatments were applied on May 28.

<table>
<thead>
<tr>
<th>Material</th>
<th>Rate/A &amp; application method</th>
<th>Jul 13</th>
<th>Jul 29</th>
<th>Aug 31</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean no./80 row ft</td>
<td>Percent of total plants</td>
<td>Mean no./80 row ft</td>
</tr>
<tr>
<td>1. Temik 15G</td>
<td>7.0 lb/A (IF)</td>
<td>4.00 a</td>
<td>1.63 a&quot;</td>
<td>15.25 a</td>
</tr>
<tr>
<td></td>
<td>6 oz/A (BC at late GC)</td>
<td>5.25 a</td>
<td>2.31 a</td>
<td>13.25 a</td>
</tr>
<tr>
<td>2. Temik 15G</td>
<td>7.0 lb/A (IF)</td>
<td>4.75 a</td>
<td>2.25 a</td>
<td>13.25 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC)</td>
<td>4.75 a</td>
<td>2.15 a</td>
<td>13.25 a</td>
</tr>
<tr>
<td>3. Temik 15G</td>
<td>7.0 lb/A (IF)</td>
<td>4.50 a</td>
<td>2.05 a</td>
<td>9.50 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC)</td>
<td>5.00 a</td>
<td>2.21 a</td>
<td>15.00 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC + 2 wk)</td>
<td>3.00 a</td>
<td>1.42 a</td>
<td>11.00 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC + 2 wk)</td>
<td>2.75 a</td>
<td>1.30 a</td>
<td>9.25 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC + 4 wk)</td>
<td>4.00 a</td>
<td>1.89 a</td>
<td>11.25 a</td>
</tr>
<tr>
<td>4. Temik 15G</td>
<td>7.0 lb/A (IF)</td>
<td>5.00 a</td>
<td>2.21 a</td>
<td>15.00 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC)</td>
<td>3.00 a</td>
<td>1.42 a</td>
<td>11.00 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC + 2 wk)</td>
<td>2.75 a</td>
<td>1.30 a</td>
<td>9.25 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC + 2 wk)</td>
<td>4.00 a</td>
<td>1.89 a</td>
<td>11.25 a</td>
</tr>
<tr>
<td>5. Temik 15G</td>
<td>7.0 lb/A (IF)</td>
<td>5.00 a</td>
<td>2.21 a</td>
<td>15.00 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC)</td>
<td>3.00 a</td>
<td>1.42 a</td>
<td>11.00 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC + 2 wk)</td>
<td>2.75 a</td>
<td>1.30 a</td>
<td>9.25 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC + 2 wk)</td>
<td>4.00 a</td>
<td>1.89 a</td>
<td>11.25 a</td>
</tr>
<tr>
<td>6. Thimet 20G</td>
<td>5.0 lb/A (IF)</td>
<td>3.50 a</td>
<td>1.54 a</td>
<td>14.25 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC)</td>
<td>5.00 a</td>
<td>2.21 a</td>
<td>15.00 a</td>
</tr>
<tr>
<td>7. Thimet 20G</td>
<td>5.0 lb/A (IF)</td>
<td>4.50 a</td>
<td>2.05 a</td>
<td>9.50 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC)</td>
<td>3.00 a</td>
<td>1.42 a</td>
<td>11.00 a</td>
</tr>
<tr>
<td>8. Thimet 20G</td>
<td>5.0 lb/A (IF)</td>
<td>4.50 a</td>
<td>2.05 a</td>
<td>9.50 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC)</td>
<td>3.00 a</td>
<td>1.42 a</td>
<td>11.00 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC + 2 wk)</td>
<td>2.75 a</td>
<td>1.30 a</td>
<td>9.25 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC + 2 wk)</td>
<td>4.00 a</td>
<td>1.89 a</td>
<td>11.25 a</td>
</tr>
<tr>
<td>9. Thimet 20G</td>
<td>5.0 lb/A (IF)</td>
<td>5.00 a</td>
<td>2.21 a</td>
<td>15.00 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC)</td>
<td>3.00 a</td>
<td>1.42 a</td>
<td>11.00 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC + 2 wk)</td>
<td>2.75 a</td>
<td>1.30 a</td>
<td>9.25 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC + 2 wk)</td>
<td>4.00 a</td>
<td>1.89 a</td>
<td>11.25 a</td>
</tr>
<tr>
<td>10. Thimet 20G</td>
<td>5.0 lb/A (IF)</td>
<td>4.00 a</td>
<td>1.89 a</td>
<td>11.25 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC)</td>
<td>5.00 a</td>
<td>2.21 a</td>
<td>15.00 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC + 2 wk)</td>
<td>3.00 a</td>
<td>1.42 a</td>
<td>11.00 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC + 2 wk)</td>
<td>2.75 a</td>
<td>1.30 a</td>
<td>9.25 a</td>
</tr>
<tr>
<td>+ Orthene 97</td>
<td>6 oz/A (BC at late GC + 2 wk)</td>
<td>4.00 a</td>
<td>1.89 a</td>
<td>11.25 a</td>
</tr>
<tr>
<td>LSD</td>
<td></td>
<td>2.59</td>
<td>0.01²</td>
<td>6.79</td>
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</tbody>
</table>

Means within a column followed by the same letter(s) are not significantly different.  
Based on stand counts taken May 29.  
Based on arcsin transformation.

<table>
<thead>
<tr>
<th>Material</th>
<th>Rate/A &amp; application method</th>
<th>Mean percent of taproots positive for TSWV&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Oct 2-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Temik 15G</td>
<td>7.0 lb/A (IF)</td>
<td></td>
<td>55.0 b-d</td>
</tr>
<tr>
<td>2. Temik 15G + Orthene 97</td>
<td>6 oz/A (BC at late GC)</td>
<td></td>
<td>50.0 cd</td>
</tr>
<tr>
<td>3. Temik 15G + Orthene 97</td>
<td>6 oz/A (BC at late GC)</td>
<td></td>
<td>55.0 b-d</td>
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<td>4. Temik 15G + Orthene 97</td>
<td>6 oz/A (BC at late GC + 2 wk)</td>
<td></td>
<td>62.5 a-d</td>
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<tr>
<td>5. Temik 15G + Orthene 97</td>
<td>6 oz/A (BC at late GC + 4 wk)</td>
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<td>77.5 a</td>
</tr>
<tr>
<td>6. Thimet 20G</td>
<td>5.0 lb/A (IF)</td>
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<td>67.5 a-d</td>
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<tr>
<td>7. Thimet 20G + Orthene 97</td>
<td>6 oz/A (BC at late GC)</td>
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<td>55.0 b-d</td>
</tr>
<tr>
<td>8. Thimet 20G + Orthene 97</td>
<td>6 oz/A (BC at late GC + 2 wk)</td>
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<td>6 oz/A (BC at late GC + 6 wk)</td>
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<td>70.0 a-c</td>
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</tbody>
</table>

**LSD**

22.4

(P=0.04)

<sup>1</sup> Means within a column followed by the same letter(s) are not significantly different.

<sup>2</sup> Based on ten randomly selected root samples per plot subjected to an Agdia TSWV test kit.

<sup>3</sup> IF treatments were applied on May 7; BC at late GC treatments were applied on May 28.
<table>
<thead>
<tr>
<th>Treatments</th>
<th>Rate (lb. a.i./Acre)</th>
<th>Application Method</th>
<th>Number of TSWV Symptomatic Plants</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>1. Temik 15G</td>
<td>1.0</td>
<td>IF</td>
<td>3.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2. Orthene 97</td>
<td>1.0</td>
<td>IF</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>3. Thimet 20G</td>
<td>1.0</td>
<td>IF</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>4. Temik 15G + Thimet 20G</td>
<td>3.5</td>
<td>IF</td>
<td>1.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>IF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Temik 15G + Orthene 97</td>
<td>1.0</td>
<td>IF</td>
<td>2.00</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>0.36 (6 oz product/A)</td>
<td>FB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Thimet 20G + Orthene 97</td>
<td>1.0</td>
<td>IF</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>0.36 (6 oz product/A)</td>
<td>FB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Admire 2F</td>
<td>0.3 (19 oz product/A)*</td>
<td>IF</td>
<td>3.00</td>
<td>0.00</td>
</tr>
<tr>
<td>8. Admire 2F + Orthene 97 (as needed)</td>
<td>0.3</td>
<td>IF</td>
<td>0.00</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>0.36</td>
<td>IF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Temik 15G + Orthene 97 (x1)</td>
<td>1.0</td>
<td>IF</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>0.36 (6 oz product/A)</td>
<td>FB (x1)</td>
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</tr>
<tr>
<td>10. Temik 15G + Orthene 97 (x2)</td>
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<td>0.00</td>
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<tr>
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<td>0.36 (6 oz product/A)</td>
<td>FB (x2)</td>
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<td>11. Temik 15G + Orthene 97 (x3)</td>
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<td>1.00</td>
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<tr>
<td></td>
<td>0.36 (6 oz product/A)</td>
<td>FB (x3)</td>
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<td></td>
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<tr>
<td>12. Temik 15G + Orthene 97 (x4)</td>
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<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.36 (6 oz product/A)</td>
<td>FB (x4)</td>
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<td></td>
</tr>
<tr>
<td>13. Thimet 20G + Orthene 97 (x1)</td>
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<td>1.00</td>
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<tr>
<td></td>
<td>0.36 (6 oz product/A)</td>
<td>FB (x1)</td>
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<tr>
<td>14. Thimet 20G + Orthene 97 (x2)</td>
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<td>IF</td>
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<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.36 (6 oz product/A)</td>
<td>FB (x2)</td>
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<td></td>
</tr>
<tr>
<td>15. Thimet 20G + Orthene 97 (x3)</td>
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<td>IF</td>
<td>1.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.36 (6 oz product/A)</td>
<td>FB (x3)</td>
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</tr>
<tr>
<td>16. Thimet 20G + Orthene 97 (x4)</td>
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<td>IF</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.36 (6 oz product/A)</td>
<td>FB (x4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Untreated</td>
<td>--</td>
<td>--</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

*Means followed by the same letter are not significantly different (LSD, P=0.05).
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<tr>
<th>Treatments</th>
<th>Rate (lb. a.i./Acre)</th>
<th>Application Method</th>
<th>Number of TSWV Symptomatic Plants</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>1. Temik 15G</td>
<td>1.0</td>
<td>IF</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>2. Orthene 97</td>
<td>1.0</td>
<td>IF</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>3. Thimet 20G</td>
<td>1.0</td>
<td>IF</td>
<td>0.00</td>
<td>4.00</td>
</tr>
<tr>
<td>4. Temik 15G + Thimet 20G</td>
<td>3.5</td>
<td>IF</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>IF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Temik 15G + Orthene 97</td>
<td>1.0 + 0.36 (6 oz product/A)</td>
<td>IF FB</td>
<td>4.00</td>
<td>6.00</td>
</tr>
<tr>
<td>6. Thimet 20G + Orthene 97</td>
<td>1.0 + 0.36</td>
<td>IF FB</td>
<td>2.00</td>
<td>4.00</td>
</tr>
<tr>
<td>7. Admire 2F</td>
<td>0.3 (19 oz product/A)*</td>
<td>IF</td>
<td>3.00</td>
<td>2.00</td>
</tr>
<tr>
<td>8. Admire 2F + Orthene 97 (as needed)</td>
<td>0.3 + 0.36</td>
<td>IF FB</td>
<td>4.00</td>
<td>8.00</td>
</tr>
<tr>
<td>9. Temik 15G + Orthene 97 (x1)</td>
<td>1.0 + 0.36 (6 oz product/A)</td>
<td>IF FB (x1)</td>
<td>7.00</td>
<td>1.00</td>
</tr>
<tr>
<td>10. Temik 15G + Orthene 97 (x2)</td>
<td>1.0 + 0.36 (6 oz product/A)</td>
<td>IF FB (x2)</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>11. Temik 15G + Orthene 97 (x3)</td>
<td>1.0 + 0.36 (6 oz product/A)</td>
<td>IF FB (x3)</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td>12. Temik 15G + Orthene 97 (x4)</td>
<td>1.0 + 0.36 (6 oz product/A)</td>
<td>IF FB (x4)</td>
<td>3.00</td>
<td>2.00</td>
</tr>
<tr>
<td>13. Thimet 20G + Orthene 97 (x1)</td>
<td>0.4 + 0.36 (6 oz product/A)</td>
<td>IF FB (x1)</td>
<td>0.00</td>
<td>5.00</td>
</tr>
<tr>
<td>14. Thimet 20G + Orthene 97 (x2)</td>
<td>0.4 + 0.36 (6 oz product/A)</td>
<td>IF FB (x2)</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>15. Thimet 20G + Orthene 97 (x3)</td>
<td>0.4 + 0.36 (6 oz product/A)</td>
<td>IF FB (x3)</td>
<td>4.00</td>
<td>1.00</td>
</tr>
<tr>
<td>16. Thimet 20G + Orthene 97 (x4)</td>
<td>0.4 + 0.36 (6 oz product/A)</td>
<td>IF FB (x4)</td>
<td>4.00</td>
<td>1.00</td>
</tr>
<tr>
<td>17. Untreated</td>
<td>--</td>
<td>--</td>
<td>2.00</td>
<td>2.00</td>
</tr>
</tbody>
</table>

¹Means followed by the same letter are not significantly different (LSD, P=0.05).

<table>
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<tr>
<th>Treatments</th>
<th>Rate (lb. a.i./Acre)</th>
<th>Application Method</th>
<th>Number of TSWV Symptomatic Plants</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Temik 15G</td>
<td>1.0</td>
<td>IF</td>
<td>I 9.00  II 2.00  III 2.00  IV 4.00</td>
<td>4.25 abcd1</td>
</tr>
<tr>
<td>2. Orthene 97</td>
<td>1.0</td>
<td>IF</td>
<td>I 1.00  II 4.00  III 18.00  IV 11.00</td>
<td>8.50 d</td>
</tr>
<tr>
<td>3. Thimet 20G</td>
<td>1.0</td>
<td>IF</td>
<td>I 1.00  II 5.00  III 3.00  IV 1.00</td>
<td>2.50 ab</td>
</tr>
<tr>
<td>4. Temik 15G + Thimet 20G</td>
<td>3.5 3.5</td>
<td>IF  IF</td>
<td>I 5.00  II 1.00  III 4.00  IV 11.00</td>
<td>5.25 abcd</td>
</tr>
<tr>
<td>5. Temik 15G + Orthene 97</td>
<td>1.0 0.36 (6 oz product/A)</td>
<td>IF  FB</td>
<td>I 2.00  II 7.00  III 5.00  IV 9.00</td>
<td>5.75 bcd</td>
</tr>
<tr>
<td>6. Thimet 20G + Orthene 97</td>
<td>1.0 0.36</td>
<td>IF  FB</td>
<td>I 2.00  II 4.00  III 7.00  IV 6.00</td>
<td>4.75 abcd</td>
</tr>
<tr>
<td>7. Admire 2F</td>
<td>0.3 (19 oz product/A)*</td>
<td>IF</td>
<td>I 4.00  II 9.00  III 5.00  IV 2.00</td>
<td>5.00 abcd</td>
</tr>
<tr>
<td>8. Admire 2F + Orthene 97 (as needed)</td>
<td>0.3 0.36</td>
<td>IF  FB</td>
<td>I 4.00  II 8.00  III 7.00  IV 9.00</td>
<td>7.00 cd</td>
</tr>
<tr>
<td>9. Temik 15G + Orthene 97 (x1)</td>
<td>1.0 0.36 (6 oz product/A)</td>
<td>IF  FB (x1)</td>
<td>I 6.00  II 5.00  III 1.00  IV 2.00</td>
<td>3.50 abcd</td>
</tr>
<tr>
<td>10. Temik 15G + Orthene 97 (x2)</td>
<td>1.0 0.36 (6 oz product/A)</td>
<td>IF  FB (x2)</td>
<td>I 2.00  II 5.00  III 1.00  IV 3.00</td>
<td>2.75 abc</td>
</tr>
<tr>
<td>11. Temik 15G + Orthene 97 (x3)</td>
<td>1.0 0.36 (6 oz product/A)</td>
<td>IF  FB (x3)</td>
<td>I 7.00  II 4.00  III 5.00  IV 3.00</td>
<td>4.75 abcd</td>
</tr>
<tr>
<td>12. Temik 15G + Orthene 97 (x4)</td>
<td>1.0 0.36 (6 oz product/A)</td>
<td>IF  FB (x4)</td>
<td>I 4.00  II 3.00  III 5.00  IV 2.00</td>
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<td>13. Thimet 20G + Orthene 97 (x1)</td>
<td>0.4 0.36 (6 oz product/A)</td>
<td>IF  FB (x1)</td>
<td>I 1.00  II 3.00  III 1.00  IV 6.00</td>
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<td>14. Thimet 20G + Orthene 97 (x2)</td>
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<td>I 2.00  II 1.00  III 0.00  IV 3.00</td>
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<tr>
<td>15. Thimet 20G + Orthene 97 (x3)</td>
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<td>IF  FB (x3)</td>
<td>I 7.00  II 1.00  III 1.00  IV 2.00</td>
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</tr>
<tr>
<td>16. Thimet 20G + Orthene 97 (x4)</td>
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<td>IF  FB (x4)</td>
<td>I 1.00  II 1.00  III 10.00  IV 3.00</td>
<td>3.75 abcd</td>
</tr>
<tr>
<td>17. Untreated</td>
<td>--</td>
<td>--</td>
<td>I 4.00  II 2.00  III 2.00  IV 13.00</td>
<td>5.25 abcd</td>
</tr>
</tbody>
</table>

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<tr>
<td></td>
<td></td>
<td></td>
<td>I</td>
<td>II</td>
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<tr>
<td>1. Temik 15G</td>
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<td>IF</td>
<td>2.00</td>
<td>2.00</td>
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<tr>
<td>2. Orthene 97</td>
<td>1.0</td>
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<tr>
<td>3. Thimet 20G</td>
<td>1.0</td>
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<td>4.00</td>
</tr>
<tr>
<td>4. Temik 15G + Thimet 20G</td>
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<td>3.00</td>
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<tr>
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<td>IF FB (x1)</td>
<td>4.00</td>
<td>3.00</td>
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<tr>
<td>6. Thimet 20G + Orthene 97</td>
<td>0.36 (6 oz product/A)</td>
<td>IF FB (x2)</td>
<td>2.00</td>
<td>5.00</td>
</tr>
<tr>
<td>7. Admire 2F</td>
<td>0.3 (19 oz product/A)*</td>
<td>IF</td>
<td>3.00</td>
<td>4.00</td>
</tr>
<tr>
<td>8. Admire 2F + Orthene 97 (as needed)</td>
<td>0.3</td>
<td>IF FB (x3)</td>
<td>4.00</td>
<td>6.00</td>
</tr>
<tr>
<td>9. Temik 15G + Orthene 97 (x1)</td>
<td>0.36 (6 oz product/A)</td>
<td>IF FB (x1)</td>
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<td>2.00</td>
</tr>
<tr>
<td>10. Temik 15G + Orthene 97 (x2)</td>
<td>0.36 (6 oz product/A)</td>
<td>IF FB (x2)</td>
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<td>2.00</td>
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<tr>
<td>12. Temik 15G + Orthene 97 (x4)</td>
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<td>IF FB (x3)</td>
<td>3.00</td>
<td>2.00</td>
</tr>
<tr>
<td>16. Thimet 20G + Orthene 97 (x4)</td>
<td>0.36 (6 oz product/A)</td>
<td>IF FB (x4)</td>
<td>5.00</td>
<td>0.00</td>
</tr>
<tr>
<td>17. Untreated</td>
<td>--</td>
<td>--</td>
<td>5.00</td>
<td>2.00</td>
</tr>
</tbody>
</table>

*Means followed by the same letter are not significantly different (LSD, P=0.05).
Table 11. Taproot sampling for TSWV (samples taken on 10/2/03). Lewiston, NC, 2003.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Rate (lb. a.i./Acre)</th>
<th>Application Method</th>
<th>Number of Positive Taproots (Total of 10 Taproots Per Replication)</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>1. Temik 15G</td>
<td>1.0</td>
<td>IF</td>
<td>6.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2. Orthene 97</td>
<td>1.0</td>
<td>IF</td>
<td>6.00</td>
<td>5.00</td>
</tr>
<tr>
<td>3. Thimet 20G</td>
<td>1.0</td>
<td>IF</td>
<td>5.00</td>
<td>6.00</td>
</tr>
<tr>
<td>4. Temik 15G + Thimet 20G</td>
<td></td>
<td>IF</td>
<td>7.00</td>
<td>7.00</td>
</tr>
<tr>
<td>5. Temik 15G + Orthene 97</td>
<td>1.0 (0.36 oz product/A)</td>
<td>IF</td>
<td>9.00</td>
<td>8.00</td>
</tr>
<tr>
<td>6. Thimet 20G + Orthene 97</td>
<td>1.0 (0.36 oz product/A)</td>
<td>IF</td>
<td>3.00</td>
<td>4.00</td>
</tr>
<tr>
<td>7. Admire 2F</td>
<td>0.3 (19 oz product/A)*</td>
<td>IF</td>
<td>6.00</td>
<td>4.00</td>
</tr>
<tr>
<td>8. Admire 2F + Orthene 97 (as needed)</td>
<td></td>
<td>IF</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td>9. Temik 15G + Orthene 97 (x1)</td>
<td>0.36 (6 oz product/A)</td>
<td>IF</td>
<td>2.00</td>
<td>5.00</td>
</tr>
<tr>
<td>10. Temik 15G + Orthene 97 (x2)</td>
<td>0.36 (6 oz product/A)</td>
<td>IF</td>
<td>1.00</td>
<td>0.00</td>
</tr>
<tr>
<td>11. Temik 15G + Orthene 97 (x3)</td>
<td>0.36 (6 oz product/A)</td>
<td>IF</td>
<td>6.00</td>
<td>9.00</td>
</tr>
<tr>
<td>12. Temik 15G + Orthene 97 (x4)</td>
<td>0.36 (6 oz product/A)</td>
<td>IF</td>
<td>5.00</td>
<td>6.00</td>
</tr>
<tr>
<td>13. Thimet 20G + Orthene 97 (x1)</td>
<td>0.36 (6 oz product/A)</td>
<td>IF</td>
<td>2.00</td>
<td>4.00</td>
</tr>
<tr>
<td>14. Thimet 20G + Orthene 97 (x2)</td>
<td>0.36 (6 oz product/A)</td>
<td>IF</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td>15. Thimet 20G + Orthene 97 (x3)</td>
<td>0.36 (6 oz product/A)</td>
<td>IF</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td>16. Thimet 20G + Orthene 97 (x4)</td>
<td>0.36 (6 oz product/A)</td>
<td>IF</td>
<td>8.00</td>
<td>6.00</td>
</tr>
<tr>
<td>17. Untreated</td>
<td>--</td>
<td>--</td>
<td>7.00</td>
<td>3.00</td>
</tr>
</tbody>
</table>

^1Means followed by the same letter are not significantly different (LSD, P=0.05).

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Rate (lb. a.i./Acre)</th>
<th>Application Method</th>
<th>Peanut Yield lb/acre</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Temik 15G</td>
<td>1.0</td>
<td>IF</td>
<td>5534.00</td>
<td>5869.00</td>
</tr>
<tr>
<td>2. Orthene 97</td>
<td>1.0</td>
<td>IF</td>
<td>5411.00</td>
<td>4986.00</td>
</tr>
<tr>
<td>3. Thimet 20G</td>
<td>1.0</td>
<td>IF</td>
<td>5679.00</td>
<td>4852.00</td>
</tr>
<tr>
<td>4. Temik 15G + Thimet 20G</td>
<td>3.5</td>
<td>IF</td>
<td>4807.00</td>
<td>4539.00</td>
</tr>
<tr>
<td>5. Temik 15G + Orthene 97</td>
<td>1.0</td>
<td>IF</td>
<td>5478.00</td>
<td>5087.00</td>
</tr>
<tr>
<td>6. Thimet 20G + Orthene 97</td>
<td>1.0</td>
<td>IF</td>
<td>4304.00</td>
<td>4740.00</td>
</tr>
<tr>
<td>7. Admire 2F</td>
<td>0.3 (19 oz/A)*</td>
<td>IF</td>
<td>4584.00</td>
<td>4751.00</td>
</tr>
<tr>
<td>8. Admire 2F + Orthene 97 (as needed)</td>
<td>0.3</td>
<td>IF</td>
<td>4550.00</td>
<td>4975.00</td>
</tr>
<tr>
<td>9. Temik 15G + Orthene 97 (x1)</td>
<td>1.0</td>
<td>IF</td>
<td>4729.00</td>
<td>4874.00</td>
</tr>
<tr>
<td>10. Temik 15G + Orthene 97 (x2)</td>
<td>0.36 (6 oz/A)</td>
<td>IF</td>
<td>4572.00</td>
<td>4438.00</td>
</tr>
<tr>
<td>11. Temik 15G + Orthene 97 (x3)</td>
<td>1.0</td>
<td>IF</td>
<td>4852.00</td>
<td>5288.00</td>
</tr>
<tr>
<td>12. Temik 15G + Orthene 97 (x4)</td>
<td>0.36 (6 oz product/A)</td>
<td>IF</td>
<td>4908.00</td>
<td>4543.00</td>
</tr>
<tr>
<td>13. Thimet 20G + Orthene 97 (x1)</td>
<td>0.4</td>
<td>IF</td>
<td>5165.00</td>
<td>5031.00</td>
</tr>
<tr>
<td>14. Thimet 20G + Orthene 97 (x2)</td>
<td>0.36 (6 oz/A)</td>
<td>IF</td>
<td>4852.00</td>
<td>4751.00</td>
</tr>
<tr>
<td>15. Thimet 20G + Orthene 97 (x3)</td>
<td>0.4</td>
<td>IF</td>
<td>5400.00</td>
<td>4662.00</td>
</tr>
<tr>
<td>16. Thimet 20G + Orthene 97 (x4)</td>
<td>0.36 (6 oz/A)</td>
<td>IF</td>
<td>5221.00</td>
<td>4628.00</td>
</tr>
<tr>
<td>17. Untreated</td>
<td>--</td>
<td>--</td>
<td>5243.00</td>
<td>4170.00</td>
</tr>
</tbody>
</table>

†Means followed by the same letter are not significantly different (Duncan’s MRT, P=0.05).