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it's not about EMPTY PROMISES
Insecticidal soap, lemon dishwashing soap and the label rate of permethrin killed nematodes, but none of the treatments affected nematode infectivity. Only the insecticidal soap and label rate of permethrin flushed more infected mole crickets than the standard lemon dish soap in the field.

Thus, to determine the effectiveness of a nematode application, a dilute permethrin drench can flush mole crickets from the soil and provide accurate infection results.

**Compatibility with insecticides**

Combinations of insecticides and insect parasitic nematodes may have a synergistic effect on nematode infection rates against white grubs (Koppenhöffer and Kaya 1998, Koppenhöffer et al. 2000).

Grubs treated with imidacloprid became sluggish and could not move normally, which allowed cruiser nematodes to invade the grubs’ bodies. We wanted to determine if this could also occur for fast-moving mole crickets and an ambush nematode.

The half and full label rates of five insecticides used to control mole crickets were evaluated in the laboratory, including acephate (Orthene Turf, Tree and Ornamental Spray), bifenthrin (Talstar GC Flowable), deltamethrin (DeltaGard T&O), fipronil (Chipco Choice) and imidacloprid (Merit 75 WP). Submerging nematodes in these solutions for 24 hours did not harm nematode health or ability to infect mole crickets. More than 95 percent of the nematodes survived.

Mole crickets exposed to acephate, bifenthrin, deltamethrin or fipronil died within two days, and most of those exposed to imidacloprid died within 26 days. Nematodes infected nearly half or more of the treated crickets (range: 40 percent to 100 percent). Thus, tank-mixing nematodes and insecticides

---

**Impact of insecticides on nematode survival and subsequent infectivity of tawny mole crickets in laboratory assays.**

<table>
<thead>
<tr>
<th>Trade name</th>
<th>Rate</th>
<th>Percent survival of nematodes held in insecticide solutions for 24 hrs (n=5)</th>
<th>Avg. no. days until mole cricket death, after a 24-hr exposure to insecticide-treated nematodes (n=5)</th>
<th>Avg. no. days until mole cricket death after insecticide treatment, then 24-hr exposure to nematodes (n=5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthene TT&amp;O</td>
<td>1 kg Al/ha</td>
<td>96.3 a</td>
<td>1.4 b</td>
<td>1.0 b</td>
</tr>
<tr>
<td></td>
<td>2 kg Al/ha</td>
<td>97.5 a</td>
<td>1.4 b</td>
<td>1.0 b</td>
</tr>
<tr>
<td>Talstar GC Flowable</td>
<td>112 g Al/ha</td>
<td>95.9 a</td>
<td>2.8 b</td>
<td>1.0 b</td>
</tr>
<tr>
<td></td>
<td>224 g Al/ha</td>
<td>95.6 a</td>
<td>1.6 b</td>
<td>1.0 b</td>
</tr>
<tr>
<td>DeltaGard T&amp;O</td>
<td>73 g Al/ha</td>
<td>--</td>
<td>--</td>
<td>1.0 b</td>
</tr>
<tr>
<td></td>
<td>146 g Al/ha</td>
<td>--</td>
<td>--</td>
<td>1.0 b</td>
</tr>
<tr>
<td>Chipco Choice</td>
<td>140 g Al/ha</td>
<td>--</td>
<td>--</td>
<td>1.0 b</td>
</tr>
<tr>
<td></td>
<td>280 g Al/ha</td>
<td>--</td>
<td>--</td>
<td>1.4 b</td>
</tr>
<tr>
<td>Merit 75 WP</td>
<td>275 g Al/ha</td>
<td>100.0 a</td>
<td>23.2 a</td>
<td>25.6 a</td>
</tr>
<tr>
<td></td>
<td>451 g Al/ha</td>
<td>98.2 a</td>
<td>22.2 a</td>
<td>17.4 a</td>
</tr>
<tr>
<td>Untreated control</td>
<td>N/A</td>
<td>99.8 a</td>
<td>17.0 ab</td>
<td>39.6 a</td>
</tr>
</tbody>
</table>

Mean ± standard error of the mean (SEM), means within columns followed by different letters are significantly different at _ = 0.05 using Tukey’s honestly significant difference means separation test.

Editor’s note: g = gram, kg = kilogram, ha = hectare, Al = active ingredient.
Now you have the option of a granular product based on Primo® for regulating turf growth!

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The Only Granular Product based on Primo®

Governor™ provides the benefits of a turf growth regulator and convenience of a granular application.

Being Governor™ can be valuable in the following ways:
- Helps reduce mowing labor expense and equipment maintenance.
- Whenever a granular application is preferred over spray applications of a turf growth regulator product.
- When mowing operations conflict with frequent golf play, athletic events, or other outdoor events of extended duration.
- During times of undesirable heavy grass growth, such as Spring, when frequent rains also limit the opportunity for mowing.
- On steeply sloped or difficult to mow areas.
- In areas under air pollution restrictions which restrict mowing.
- Around mowing obstacles, such as fences, trees and shrubs, monuments and markers.
- When mowing crews and equipment are not readily available.

The active ingredient in Governor™ (trinexapac-ethyl) is time-tested by years of extensive use on golf courses and commercial lawns and landscapes.

Proper use of Governor™ offers you the following benefits:
- Reduces clippings by up to 50%.
- Allows for a longer interval between mowings.
- Redirects grass growth energy into roots and shoots, improving turf density, durability and color.
- Frequently reduces watering requirements.
- Will not harm neighboring plants.
- Seed germination is not affected. It doesn’t kill the grass or other plants like other chemical edger products can.
- Contains same active ingredient as Primo Maxx.

Mode of action:
- Foliar absorbed chemistry.
- Slows the production of gibberellic acid, a plant hormone that promotes elongation.
- Vertical shoot growth is slowed.
- Lateral and below ground growth is stimulated.

**Governor Growth Regulator & Fertilizer - SGN 75**
- 155% trinexapac-ethyl on 5-0-10 fertilizer & natural-base carrier.
- 50% of nitrogen is derived from Nutralene.
- Ideal for Greens and Fairways applications.

Efficacy on Perennial Ryegrass
**Dr. Mahady, Pebble Beach, CA**

- (3 weeks after treatment)
- Treatment (applied to wet turf)

Efficacy on Tifway Bermudagrass
**Dr. Bert McCarty, Clemson University**

- (3 weeks after treatment)
- Treatment (applied to wet turf)

Efficacy on Finelawn 88 Tall Fescue
**Dr. Jeff Kollenkark, Selma, CA**

- (3 weeks after treatment)
- Treatment (applied to wet turf)

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When every square inch counts™

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Continued from page 62
icides may be possible for a quick knockdown and long-term suppression.

Behavioral effects of infection
Finally, we wanted to see if nematode infection changed mole cricket tunneling, egg laying or avoidance behavior.

Tunnel distances and depths began decreasing after six days in mole crickets that were exposed to 500 or 10,000 S. scapterisci, but the total distance tunneled in 10 days and tunnel dimensions were consistent among healthy and infected mole crickets.

When placed into arenas with half of the sand treated with nematodes and the other half left untreated, mole crickets tunneled normally and equally in both halves, indicating that the nematodes were nonrepellent. When allowed to choose between nematodes or insecticides in lab assays, acephate, bifenthrin, imidacloprid and deltamethrin repelled mole crickets, but crickets seemed to prefer fipronil over S. scapterisci.

Egg chamber depth and the number of eggs laid was similar among healthy and nematode-infected female mole crickets. Thus, healthy females could become infected while laying eggs or infected females could still oviposit before dying, and offspring would escape immediate infection because nematodes cannot penetrate their bodies.

As a result, Nematac S may provide greater control when applied during the fall adult activity period because mole crickets are not laying eggs, and nematode populations could increase during the winter before mole cricket mating flights and egg-laying occur.

Eileen A. Buss is the landscape entomology extension specialist at the University of Florida. Her research and extension programs focus on the biology and integrated pest management of white grubs, billbugs, southern chinch bugs and mole crickets in Florida turfgrass.

REFERENCES
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Tifway bermudagrass (Cynodon dactylon x transvalensis Tifway) is a popular turfgrass utilized on golf course fairways and athletic fields. Aggressive summer growth habit, fine leaf texture and dark green color attribute to its popularity.

However, if mowed infrequently, excessive scalping and clipping production combine to decrease its appearance and aesthetic quality.

Plant growth regulators (PGRs) were introduced into the turf industry in the 1950s and since have been used on bermudagrass to reduce mowing requirements (Fagerness and Yelverton, 2000), enhance color (Waltz, 1997), reduce nitrogen allocation to foliage (Fagerness et al., 2004) and reduce sensitivity to shade (Bunnell, 2003). However, much of the improvements have been concentrated on hybrid bermudagrass putting green surfaces with only limited information for higher mowed turf such as fairways.

PGRs are classified as Type I or Type II based on their mode of action. Type I PGRs, maleic hydrazide (SloGro) or mefluidide (Embark), for example, inhibit cell division. Since being introduced in the 1950s, their use has become limited due to observed reductions in root quality and turf injury (Watschke et al., 1992). Type II PGRs were discovered by Japanese scientists working in rice (Oryza sativa L.). Type II mode of action involves inhibition of gibberellic acid (GA) biosynthesis, the hormone responsible for cell elongation.

Cutless 50WP (flurprimidol) is a Type II PGR that inhibits GA biosynthesis. Cutless interrupts this biosynthesis early in the GA biosynthetic pathway via the cytochrome p450 monooxygenase enzyme. Blocking this enzyme inhibits the formation of ent-kaurenoic acid, a precursor to active GAs. The result is shorter internode length and reduced vertical growth (SePRO, 2005).

Currently, much attention surrounds Cutless and Primo tank mix programs. Superintendents have raised questions such as: Is a Cutless and Primo tank mix more effective than applying each product alone? And is a Cutless and Primo tank mix more cost effective than either product alone? Benefits of Primo use include: increases in turf color, promotes lateral stem and root mass development and reduces vertical growth (SePRO, 2005).

By F.W. Totten, J.E. Toler and L.B. McCarty
6 oz product per acre combinations of Cutless plus Primo tank mix provided approximately 70 percent *Poa annua* control and 18 percent seed-head suppression in perennial ryegrass/Kentucky bluegrass fairways, which was comparable to Cutless used exclusively at 8 oz or 12 oz of product per acre (Bunnell, 2003).

Cooper (2003) reported that a 4 + 6 ounces product per acre Cutless + Primo tank mix produced less injury and greater turf color and density on Tifway bermudagrass throughout the season, compared to Primo alone at 12 oz product per acre and Cutless alone at 8 ounces product per acre. He also noted that an 8 plus 6 ounces product per acre Cutless plus Primo tank mix was comparable to Cutless alone at 24 ounces product per acre which provided greater than 90 percent control of *Poa annua* populations.

The use of a Cutless plus Primo tank mix provides the applicator with several potential benefits. This combination provides growth regulation in both early and late stages of gibberellic acid synthesis, and provides both foliar and root absorption of PGRs. From an economic standpoint, the applicator uses approximately half the rate of product of either PGR when used alone.

Combining Cutless and Primo could potentially provide longer residual growth regulation, thus reducing the number of applications required over a season. The objective of this research was to evaluate Tifway bermudagrass injury, regrowth and growth regulation in response to various rates of Cutless and Primo, alone and in combination.

### Materials and methods
The study was conducted during the summer of 2003 and ’04 at the registered Tifway bermudagrass research site at Clemson University. Experimental design was a randomized complete block with three replications and treatments were arranged as a 3-foot by 3-foot factorial design. Plot size was 36 square feet.

During both summers, turf was mowed six days a week at 0.56 inches (1.4 centimeters [cm]) and irrigated to maintain a well-watered status. Cutless and Primo were applied exclusively and in combination at the following rates:

**Cutless 50WP (flurprimidol)**
1. 0 oz product per acre
2. 2 oz product per acre (0.28 kg per ha)
3. 8 oz product per acre (0.56 kg per ha)

**Primo MAXX 1L (trinexapac-ethyl)**
1. 0 oz product per acre
2. 6 oz product per acre (0.42 kg per ha)
3. 12 oz product per acre (0.84 kg per ha)

Treatments were applied with a carbon dioxide (CO₂) backpack sprayer, calibrated at 20 gallons per acre (GPA) (187 liters [L] per ha). After the initial treatment, three sequential applications were made at three-week intervals.

During both years, turf injury was measured weekly on a scale of 0 to 100 percent with more than 30 percent being unacceptable. Percent lateral regrowth was measured using methods described by Bunnell (2003).

A 4-inch (10.4-cm) Tifway bermudagrass plug was removed at the initiation of the study from each replicate. The holes were backfilled with an 85 to 15 sand/peat mix. A wire mesh grid containing 230 uniform squares was constructed in equal dimension to the original hole. A green shoot present in one 0.062 square-inch square denoted one point.

Percent lateral regrowth was calculated by taking the number of squares green shoot points divided by total points (230), times 100.

Clippings were harvested from all treatments for all three replicates at four, eight and 12 weeks after the initial application and analyzed for dry weight. Data was analyzed using analysis of variation (ANOVA), and means were compared using least significant difference (LSD=0.05).

### Results and discussion
**2003 —** All injury observed during the 2003 season was acceptable, thus not exceeding the 30 percent threshold. No Primo x Cutless interaction was observed for bermudagrass injury one week after initial treatment (WAIT), indicating the two products were acting independently.

Greatest but still acceptable turfgrass injury was with Primo at 12 oz product per acre every three weeks (about 18 percent) and Cutless at 8 oz product per acre every three weeks (about 14 percent), as compared to the untreated. A Primo x Cutless interaction was observed two WAIT, indicating a synergistic response. Bermudagrass injury increased linearly as rate of Cutless increased. The greatest injury was with Cutless plus Primo tank mixed at 8 plus 12 oz product per acre every three weeks (about 25 percent), respectively, but again was deemed acceptable.

Continued on page 68
Continued from page 67

No Primo x Cutless interaction was observed for bermudagrass clipping reductions during the 2003 season. A linear reduction in clippings was observed as rate of Primo increased four WAIT. Clippings were reduced 43 percent by Primo 12 oz product per acre every three weeks (Table 1). Cutless alone did not produce a significant response in clipping yield.

A reduction in lateral regrowth occurred two WAIT as rate of Primo increased. Lateral regrowth was reduced 26 percent with Primo at 6 oz product per acre every three weeks and 41 percent with Primo at 12 oz product per acre every three weeks (Table 2). At four WAIT, a reduction in lateral regrowth was also observed as the rates of Primo and Cutless increased. Lat-

Continued on page 70

**TABLES 1-6**

Table 1. **Effect of Primo on Tifway bermudagrass clipping yield 4 WAIT during the summer of 2003.**

<table>
<thead>
<tr>
<th>Product</th>
<th>Rate (oz/acre/3 wk)</th>
<th>Clipping Yield (grams)</th>
<th>Clipping Reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primo</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Primo</td>
<td>6</td>
<td>4</td>
<td>22</td>
</tr>
<tr>
<td>Primo</td>
<td>12</td>
<td>3</td>
<td>43</td>
</tr>
<tr>
<td>LSD0.05</td>
<td>-</td>
<td>1.8</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 2. **Effect of Primo on Tifway bermudagrass lateral regrowth 2 WAIT during the summer of 2003.**

<table>
<thead>
<tr>
<th>Product</th>
<th>Rate (oz/acre/3 wk)</th>
<th>Lateral Regrowth (%)</th>
<th>Reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primo</td>
<td>0</td>
<td>59</td>
<td>0</td>
</tr>
<tr>
<td>Primo</td>
<td>6</td>
<td>44</td>
<td>26</td>
</tr>
<tr>
<td>Primo</td>
<td>12</td>
<td>35</td>
<td>41</td>
</tr>
<tr>
<td>LSD0.05</td>
<td>-</td>
<td>9.9</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 3. **Effects of Primo and Cutless on Tifway bermudagrass lateral regrowth 4 WAIT during the summer of 2003.**

<table>
<thead>
<tr>
<th>Product</th>
<th>Rate (oz/acre/3 wk)</th>
<th>Lateral Regrowth (%)</th>
<th>Reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primo</td>
<td>0</td>
<td>91</td>
<td>0</td>
</tr>
<tr>
<td>Primo</td>
<td>6</td>
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<td>Primo</td>
<td>12</td>
<td>71</td>
<td>22</td>
</tr>
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<td>Cutless</td>
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</tr>
<tr>
<td>Cutless</td>
<td>4</td>
<td>82</td>
<td>1</td>
</tr>
<tr>
<td>Cutless</td>
<td>8</td>
<td>74</td>
<td>11</td>
</tr>
<tr>
<td>LSD0.05</td>
<td>-</td>
<td>7.6</td>
<td>-</td>
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</tbody>
</table>

Table 4. **Effect of Primo on Tifway bermudagrass lateral regrowth 6 WAIT during the summer of 2003.**

<table>
<thead>
<tr>
<th>Product</th>
<th>Rate (oz/acre/3 wk)</th>
<th>Lateral Regrowth (%)</th>
<th>Reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primo</td>
<td>0</td>
<td>98</td>
<td>0</td>
</tr>
<tr>
<td>Primo</td>
<td>6</td>
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<td>4</td>
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<td>Primo</td>
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<td>90</td>
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</tr>
<tr>
<td>LSD0.05</td>
<td>-</td>
<td>2.6</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 5. **Effects of Primo and Cutless on Tifway bermudagrass clipping yield 8 WAIT during the summer of 2004.**

<table>
<thead>
<tr>
<th>Product</th>
<th>Rate (oz/acre/3 wk)</th>
<th>Clipping Yield (grams)</th>
<th>Clipping Reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primo</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Primo</td>
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<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Primo</td>
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</tr>
<tr>
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<td>0</td>
</tr>
<tr>
<td>Cutless</td>
<td>4</td>
<td>2</td>
<td>57</td>
</tr>
<tr>
<td>Cutless</td>
<td>8</td>
<td>2</td>
<td>59</td>
</tr>
<tr>
<td>LSD0.05</td>
<td>-</td>
<td>1.3</td>
<td>-</td>
</tr>
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</table>

Table 6. **Effect of Cutless on Tifway bermudagrass lateral regrowth 2 WAIT during the summer of 2004.**

<table>
<thead>
<tr>
<th>Product</th>
<th>Rate (oz/acre/3 wk)</th>
<th>Lateral Regrowth (%)</th>
<th>Reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutless</td>
<td>0</td>
<td>51</td>
<td>0</td>
</tr>
<tr>
<td>Cutless</td>
<td>4</td>
<td>44</td>
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<tr>
<td>Cutless</td>
<td>8</td>
<td>38</td>
<td>26</td>
</tr>
<tr>
<td>LSD0.05</td>
<td>-</td>
<td>12.2</td>
<td>-</td>
</tr>
</tbody>
</table>

Editor's note: WAIT is "Week After Initial Treatment"
Floratine – a different breed of dog. Turf is all that we do. And turf strength is our passion. It's reflected in our scientists' designs, our raw materials selection and our representatives' recommendations of exceptional products like Carbon Power, Astron and ProteSyn. Our singular focus is meeting the physiological requirements for grass to be stronger, longer.

Different? Sure, but we think your turf will appreciate the difference.
Continued from page 68
eral regrowth was reduced 16 percent with Primo at 6 oz product per acre every three weeks and 22 percent with Primo at 12 oz product per acre every three weeks (Table 3). With Cutless, lateral regrowth was reduced 11 percent at 8 oz product per acre every three weeks (Table 3).

At six WAIT, again, as rate of Primo increased, a decrease in regrowth occurred. Lateral regrowth was reduced 4 percent with Primo at 6 oz product per acre every three weeks and 8 percent with Primo at 12 oz product per acre every three weeks (Table 4).

2004. A Primo x Cutless interaction was not observed for any parameter measured, suggesting the two products acted independently. Therefore, the 2004 data indicated a Primo plus Cutless tank mix did not offer superior growth regulation compared to either individual product.

At one WAIT, an increase in bermudagrass injury was observed as rates of Primo and Cutless increased. The greatest injury was with Primo at 12 oz product per acre every three weeks (about 8 percent) and Cutless at 8 oz product per acre every three weeks (about 7.5 percent), as compared to the untreated. Bermudagrass injury increased as rate of Primo increased two WAIT.

The greatest injury was with Primo at 12 oz product per acre every three weeks (about 3 percent).

A reduction in clippings was observed eight WAIT as rates of Primo and Cutless increased. Clippings were reduced 49 percent by Primo 12 oz product per acre every three weeks (Table 5). With Cutless, clippings were reduced 57 percent by Cutless at 4 oz product per acre every three weeks and 59 percent by Cutless at 8 oz product per acre every three weeks (Table 5).

Cutless reduced lateral regrowth at two WAIT. This was reduced 26 percent at 8 oz product per acre every three weeks (Table 6).

In conclusion, during the 2003, season-long Primo plus Cutless tank mixed at 12 plus 8 oz product per acre every three weeks produced the greatest Tifway bermudagrass injury, while in 2004, Primo at 12 oz product per acre every three weeks and Cutless at 8 oz product per acre every three weeks had the greatest injury. All injury, however, was deemed minor and acceptable.

Clippings were reduced up to 43 percent four WAIT by Primo at 12 oz product per acre every three weeks in year one.

During year two, clippings were reduced up to 49 percent and 59 percent eight WAIT by Primo at 12 oz product per acre every three weeks and Cutless at 8 oz product per acre every three weeks, respectively.

In 2003, Primo at 12 oz product per acre every three weeks reduced lateral regrowth 41 percent, 22 percent and 8 percent at two, four and six WAIT, respectively. Therefore, these data indicate that a Primo plus Cutless tank mix does not offer superior growth regulation compared to individual product use.

Primo at 12 oz product per acre every three weeks and Cutless at 8 oz product per acre every three weeks produced the greatest reduction in clippings and percent lateral regrowth, while causing acceptable injury to Tifway bermudagrass.

Wesley Totten has a bachelor of science degree in agronomy and soils (concentration in turfgrass management) and a master's of science degree in horticulture, both from Auburn University. He is currently pursuing a doctorate at Clemson University in plant and environmental sciences.

Bert McCarty is professor of turfgrass/weed science at Clemson University.

Joe Toler is a professor of applied economics and statistics at Clemson University.

REFERENCES


