List of Plant-Parasitic Nematodes Recorded in North Carolina

Weimin Ye

North Carolina's agricultural industry, including food, fiber, ornamentals and forestry, contributes $84 billion to the state's annual economy, accounts for more than 17 percent of the state's income, and employs 17 percent of the work force. North Carolina is one of the most diversified agricultural states in the nation. Approximately, 50,000 farmers grow over 80 different commodities in North Carolina utilizing 8.2 million of the state's 12.5 million hectares to furnish consumers a dependable and affordable supply of food and fiber. North Carolina produces more tobacco and sweet potatoes than any other state, ranks second in Christmas tree and third in tomato production. The state ranks nineth nationally in farm cash receipts of over $10.8 billion (NCDA&CS Agricultural Statistics, 2017).

Plant-parasitic nematodes are recognized as one of the greatest threat to crops throughout the world. Nematodes alone or in combination with other soil microorganisms have been found to attack almost every part of the plant including roots, stems, leaves, fruits and seeds. Crop damage caused worldwide by plant nematodes has been estimated at $US80 billion per year (Nicol et al., 2011). All crops are damaged by at least one species of nematode. Most plant-parasitic nematodes live in soil and damage plants by feeding in large numbers on roots, impairing the plant’s ability to take up water and nutrients. Severe root damage caused by nematodes typically results in aboveground symptoms that may include stunting, yellowing of leaves, incipient wilt, loss of plant vigor and/or an overall general decline in plant performance. Damage is often more pronounced when plants are under stress from lack of water or nutrients or when damaged by other diseases or insects. Although nematodes rarely kill plants, they can drastically limit plant growth and yields. Plant-parasitic nematodes are usually confined to localized areas in soil and spread very slowly by their own power. However, they may be dispersed more rapidly by movement of infested soil through cultivation, on soil clinging to farming tools and tillers, in water, wind or on roots of transplants.
In the state of North Carolina, nematodes are a major threat to most crops. About 94 plant-parasitic nematode species have been recorded. Among them, root knot, soybean cyst, reniform, sting, lesion, lance, stubby root, tobacco cyst, ring, and foliar nematodes are considered the most important. The list of plant-parasitic nematodes in Table 1 is based in part on the nematode section of the North Carolina Plant Disease Index by K. R. Barker (Grand, 1985) and includes all recent research findings (Ye et al., 2012, 2013, 2015a, b; Ye, 2017; Zeng et al., 2012b, 2015; Holguin et al, 2015a, 2016) and nematode assay services provided by the NCDA&CS. Nematode entries in this list do not necessarily indicate that all nematodes associated with a given plant species are pathogenic to that plant species. Although all of these nematodes are obligate parasites, some of them often cause little or no damage. Furthermore, nematodes are primarily soil inhabitants and may feed on associated weeds and grasses. In a few instances, the nematodes included under a given plant species probably were feeding primarily on these associated plants/weeds or had fed on previous crops.

Table 1. List of plant-parasitic nematodes recorded in North Carolina.

<table>
<thead>
<tr>
<th>No.</th>
<th>Nematode species</th>
<th>Crop or plant</th>
<th>References</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Anguina tritici</em></td>
<td>Rye, wheat</td>
<td>Grand, 1985</td>
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<td>2</td>
<td><em>Aorolaimus</em> spp.</td>
<td>Camellia</td>
<td>Grand, 1985</td>
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<td>3</td>
<td><em>Aphelenchoides fragariae</em></td>
<td>Ornamentals, strawberry</td>
<td>McCuiston et al., 2007; Kohl et al., 2010</td>
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<td>4</td>
<td><em>A. myceliophagus</em></td>
<td>Mushrooms, turfgrass</td>
<td>Zeng et al., 2012b</td>
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<td>5</td>
<td><em>A. parietinus</em></td>
<td>Cotton</td>
<td>Steiner, 1938; Society of Nematologists, 1984</td>
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<tr>
<td>6</td>
<td><em>A. ritzemabosi</em></td>
<td>Florist’s daisy</td>
<td>Strider, 1979; Grand, 1985</td>
</tr>
<tr>
<td>7</td>
<td><em>A. subtenuis</em></td>
<td>Unknown</td>
<td>Society of Nematologists, 1984</td>
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<td>8</td>
<td><em>Belonolaimus gracilis</em></td>
<td>Corn, cotton</td>
<td>Ruehle and Sasser, 1962</td>
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<tr>
<td>9</td>
<td><em>B. longicaudatus</em></td>
<td>Bermuda grass, common bean, corn, cotton, creeping grasses, peanut, soybean, tomato</td>
<td>Zeng et al., 2012b</td>
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<td>10</td>
<td><em>B. maritimus</em></td>
<td>American beachgrass</td>
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<td>12</td>
<td><em>Cactodera weissi</em></td>
<td>Bermuda grass, knotweed, tobacco</td>
<td>Grand, 1985; Ye, 2012</td>
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<td>13</td>
<td><em>C. sphagni</em></td>
<td>Trees</td>
<td>Ruehle, 1968</td>
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<td>15</td>
<td><em>Ditylenchus dipsaci</em></td>
<td>Alfalfa, ornamentals, white clover, wild onion</td>
<td>Barker and Sasser, 1959; Grand, 1985</td>
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<td>16</td>
<td><em>D. triformis</em></td>
<td>Iris</td>
<td>Hirschmann and Sasser, 1955</td>
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<td>17</td>
<td><em>Dolichodorus heterocephalus</em></td>
<td>Bermuda grass, camellia</td>
<td>Zeng et al., 2012b</td>
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<td>18</td>
<td><em>D. marylandicus</em></td>
<td>Pine</td>
<td>Lewis and Golden, 1981</td>
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<td>20</td>
<td><em>Globodera tabacum solanacearum</em></td>
<td>Carolina horsenettle, tobacco</td>
<td>Melton et al., 1991</td>
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<td>21</td>
<td><em>Helicotylenchus dihystera</em></td>
<td>Bermuda grass, common bean, corn, cotton, creeping grasses, loblolly pine, peach, peanut, slash pine, soybean</td>
<td>Aycock et al., 1976; Schmitt and Barker, 1988; Zeng et al., 2012b</td>
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<td>22</td>
<td><em>H. erythrae</em></td>
<td>Grass</td>
<td>Ruehle &amp; Sasser, 1962</td>
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<td>24</td>
<td><em>Hemicaloosia graminis</em></td>
<td>Turfgrass</td>
<td>Zeng et al., 2012a</td>
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<td></td>
<td>Species Name</td>
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<td>25</td>
<td><em>Hemicriconemoides chitwoodi</em></td>
<td>Camellia, turfgrass</td>
<td>Ye and Robbins, 2000; López et al., 2012a; Zeng et al., 2012b</td>
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<td>26</td>
<td><em>H. wessoni</em></td>
<td>Bermuda grass</td>
<td>Ye and Robbins, 2000; Zeng et al., 2012b</td>
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<td>27</td>
<td><em>Hemiclidiophora conida</em></td>
<td>Creeping bentgrass</td>
<td>Zeng et al., 2012b</td>
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<td>28</td>
<td><em>H. gigas</em></td>
<td>Forest soil</td>
<td>Thorne, 1955</td>
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<td>29</td>
<td><em>H. gracilis</em></td>
<td>Grass</td>
<td>Thorne, 1955</td>
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<td>30</td>
<td><em>H. mettleri</em></td>
<td>Trees</td>
<td>Brzeski, 1974</td>
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<td>31</td>
<td><em>H. parvana</em></td>
<td>Turfgrass</td>
<td>López et al., 2013; van den Berg et al., 2018</td>
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<td>32</td>
<td><em>H. robbinsi</em></td>
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<td>López et al., 2013; Subbotin et al., 2014; van den Berg et al., 2018</td>
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<td>33</td>
<td><em>H. sheri</em></td>
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<td>35</td>
<td><em>Heterodera cyperi</em></td>
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<td>Golden, et al., 1962</td>
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<td>36</td>
<td><em>H. glycines</em></td>
<td>Common bean, soybean</td>
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<td>37</td>
<td><em>H. lespedezae</em></td>
<td>Bush clover</td>
<td>Golden &amp; Cobb, 1963</td>
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<td><em>H. trifolii</em></td>
<td>Daylily, white clover</td>
<td>Grand, 1985; Ye, 2012</td>
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<td>39</td>
<td><em>Hoplolaimus columbus</em></td>
<td>Cotton, soybean</td>
<td>Sher, 1963; Schmitt and Barker, 1988; Holguin et al., 2015a, b, 2016</td>
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<td>41</td>
<td><em>H. galeatus</em></td>
<td>Bermuda grass, boxwood, Chinese holly, corn, cotton, creeping bentgrass, creeping grasses, slash pine, soybean, tall fescue, white clover</td>
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<td>42</td>
<td><em>H. stephanus</em></td>
<td>Soybean</td>
<td>Sher, 1963; Holguin et al., 2015a</td>
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<td>43</td>
<td><em>Longidorus breviannulatus</em></td>
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<td>49</td>
<td><em>Meloidogyne arenaria</em></td>
<td>Asparagus, azalea, carrot, daylily, peanut, corn, sweet potato, tobacco, soybean, tomato</td>
<td>Winstead &amp; Sasser, 1956</td>
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<td>50</td>
<td><em>M. carolinensis</em></td>
<td>Blueberry</td>
<td>Eisenback, 1982</td>
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<td>51</td>
<td><em>M. enterolobii</em></td>
<td>Cotton, horseweed, morning glory, sicklepod, soybean, sweet potato, tobacco</td>
<td>Ye et al., 2013</td>
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<td>52</td>
<td><em>M. graminis</em></td>
<td>Bermuda grass, blue oat grass, centipede grass, creeping bentgrass, creeping grasses, meadow fescue, St. Augustine grass</td>
<td>Ye et al., 2015b; Zeng et al., 2012b</td>
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<td>53</td>
<td><em>M. hapla</em></td>
<td>Boxwood, cabbage, cantaloupe, common bean, cotton, gingseng, Irish potato, pea, peanut, peony, sage, soybean, strawberry, sweet potato, tobacco, tomato, watermelon, wheat</td>
<td>Schmitt and Barker, 1988; Society of Nematologists, 1984</td>
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<tr>
<td>ID</td>
<td>Species</td>
<td>Hosts</td>
<td>Authors</td>
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<tr>
<td>54</td>
<td><em>M. incognita</em></td>
<td>Alfalfa, asparagus, azalea, bean, begonia, bentgrass, bermuda grass, boxwood, Buddleja, butterbean, cabbage, camellia, cantaloupe, carrot, collards, common bean, corn, cotton, creeping bentgrass, creeping grasses, cucumber, daylily, dogwood, eggplant, English oak, fig, forsythia, gardenia, green bean, holly, hyacinth bean, hydrangea, kiwifruit, Korean boxwood, lantana, liriopé, lime bean, mondo grass, milo, muskmelon, oak, okra, ornamentals, peach, pepper, peony, potato, pumpkin, sage, snap bean, soybean, spinach, squash, St. Augustine grass, strawberry, sweet potato, tobacco, tomato, tube rose, watermelon, white clover, zoysiagrass</td>
<td>Schmitt and Barker, 1988</td>
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<td>55</td>
<td><em>M. javanica</em></td>
<td>Boxwood, southern peas, soybean, sweet potato, tobacco, tomato</td>
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<td><em>M. marylandi</em></td>
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<td>Ye et al., 2015b</td>
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<td>57</td>
<td><em>M. megatyla</em></td>
<td>Loblolly pine</td>
<td>Baldwin and Sasser, 1979</td>
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<td>58</td>
<td><em>M. naasi</em></td>
<td>Bermuda grass, creeping bentgrass, creeping grasses</td>
<td>Zeng et al., 2012b; Ye et al., 2015b</td>
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<td>59</td>
<td><em>M. spatinae</em></td>
<td>Smooth cordgrass</td>
<td>Rau and Fassuliotis, 1965</td>
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<td>60</td>
<td><em>Mesoanguina</em></td>
<td>Bracted plantain</td>
<td>Vargas and Sasser, 1976</td>
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<td>61</td>
<td><em>Mesocriconema</em></td>
<td>Bermuda grass, creeping bentgrass, creeping grasses, soybean</td>
<td>Zeng et al., 2012b</td>
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<td>62</td>
<td><em>M. ornatum</em></td>
<td>Corn, blueberry, grasses, ornamentals, peanut</td>
<td>Ratanaworabhan and Smart, 1970; Barker et al., 1982; Schmitt and Barker, 1988; Powers et al., 2004; Jagdale et al., 2013</td>
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<td>63</td>
<td><em>M. sphaerocephalum</em></td>
<td>Corn, peanut</td>
<td>López et al., 2012; Zeng et al., 2012b</td>
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<td>64</td>
<td><em>M. xenoplax</em></td>
<td>Bermuda grass, Chinese holly, creeping bentgrass, ornamentals, peach</td>
<td>Aycock et al., 1976; Zeng et al., 2012b; Powers et al., 2004</td>
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<td>65</td>
<td><em>Nanidorus</em></td>
<td>American holly, azalea, bentgrass, bermuda grass, boxwood, camellia, centipedegrass, Chinese holly, corn, cotton, creeping bentgrass, holly, loblolly pine, longleaf pine, ornamentals, peach, peanut, slash pine, soybean, tall fescue, tobacco, white clover</td>
<td>Schmitt and Barker, 1988; Zeng et al., 2012b; Huang et al., 2018</td>
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<td>66</td>
<td><em>Ogma floridense</em></td>
<td>Bermuda grass</td>
<td>Zeng et al., 2012b</td>
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<td>67</td>
<td><em>Paratrichodorus</em></td>
<td>Creeping bentgrass</td>
<td>Zeng et al., 2012b</td>
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<td>68</td>
<td><em>P. porosus</em></td>
<td>Camellia, corn, sorghum, soybean</td>
<td>Huang et al., 2018</td>
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<td><em>Paratrichodorus</em></td>
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<td>70</td>
<td><em>Pratylenchus</em></td>
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<td>71</td>
<td><em>P. coffeae</em></td>
<td>Peach</td>
<td>Grand, 1985</td>
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<td>72</td>
<td><em>P. macrostylus</em></td>
<td>Fraser fir, red spruce</td>
<td>Hartman and Eisenback, 1991</td>
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<td>Species</td>
<td>Associated Plants</td>
<td>Refs</td>
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<td>74</td>
<td><em>P. penetrans</em></td>
<td>Bermuda grass, boxwood, peach, potato, soybean, tobacco</td>
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<td>75</td>
<td><em>P. pratensis</em></td>
<td>Cotton, ornamentals, potato, tobacco</td>
<td>Steiner, 1938; Grand, 1985</td>
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<td>76</td>
<td><em>P. scribneri</em></td>
<td>Common bean, peach, soybean, tobacco</td>
<td>Grand, 1985</td>
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<td>77</td>
<td><em>P. vulnus</em></td>
<td>Boxwood, Chinese holly, peach</td>
<td>Society of Nematologists, 1984; Grand, 1985</td>
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<td>78</td>
<td><em>P. zeae</em></td>
<td>Corn, peach, tall fescue</td>
<td>Grand, 1985; Schmitt and Barker, 1988</td>
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<td>79</td>
<td><em>Quinisulcius capitatus</em></td>
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<td><em>Rotylenchulus reniformis</em></td>
<td>Cotton, sweet potato</td>
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<td><em>Rotylenchus buxphilus</em></td>
<td>Azalea, boxwood</td>
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<td>82</td>
<td><em>R. pumilus</em></td>
<td>Trees</td>
<td>Ruehle, 1968</td>
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<td>83</td>
<td><em>Scutellonema brachyurus</em></td>
<td>Bermuda grass, corn, cotton, tobacco</td>
<td>Zeng et al., 2012b</td>
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<td><em>Trichodorus elefjohnsoni</em></td>
<td>Tulip poplar</td>
<td>Bernard, 1992</td>
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<td>85</td>
<td><em>T. obtusus</em></td>
<td>Bermuda grass, St. Augustine grass, zoysiagrass</td>
<td>Ye et al., 2015; Huang et al., 2018</td>
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<td>86</td>
<td><em>Trophurus spp.</em></td>
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<td>87</td>
<td><em>Tylenchorhynchus claytoni</em></td>
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<td>Steiner, 1937; Ruehle and Sasser, 1962; Aycock et al., 1976; Schmitt and Barker, 1988; Zeng et al., 2012b</td>
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<td>88</td>
<td><em>T. maximus</em></td>
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<td>90</td>
<td><em>Xenocriconemella macrodora</em></td>
<td>Boxelder maple</td>
<td>López et al., 2012</td>
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<td><em>Xiphinema americanum sensu lato</em></td>
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<td>Ruehle and Sasser, 1962; Zeng et al., 2012b</td>
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<td><em>Xiphinema bakeri</em></td>
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<td><em>Xiphinema chambersi</em></td>
<td>Azalea, bermuda grass, centipedegrass, ornamentals, rose, soybean</td>
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<td><em>Xiphinema krugi</em></td>
<td>Bermuda grass, boxwood, cotton, ornamentals, soybean, tomato</td>
<td>Ye and Robbins, 2010</td>
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References


Zeng, Y., Ye, W., Tredway, L., Martin, S. and Martin, M. (2012a). Description of *Hemicaloosia graminis* n.sp. (Nematoda: Caloosiidae) associated with turfgrasses in North and South Carolina, USA. Journal of Nematology 44 (2), 134-141.