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Nematode Management Using Sorghum and Its Relatives[1]

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Introduction

Sorghum (*Sorghum bicolor* (L.) Moench) and sorghum-sudangrass (*S. bicolor* x *S. sudanense* (Piper) Stapf) are often used in crop rotation systems in Florida. Not only do they produce a source of forage or silage for animal feed, but many cultivars are effective in reducing population levels of root-knot nematodes, which are key nematode pests in Florida as well as many other parts of the world. Sorghum-sudangrass (*S. bicolor* x *S. sudanense*), also known as sorghum x sudangrass, sudax, or sudex, is a hybrid between sorghum (*S. bicolor*) and sudangrass (*S. sudanense*). Specific cultivars of either sorghum, sudangrass, or sudex provide a potential for nematode management, with the hybrid having more advantages over either one of its parents.

Sorghum

Sorghum, currently classified as *S. bicolor*, was formerly known as *S. vulgare* Pers. Although sorghum is often used as a forage source, sorghum grain is used as food in many countries. This grass can also be used as a source of sugar, syrup (produced from sweet sorghum types), fiber, and grain.

In the U.S., grain sorghum is of more commercial importance than forage sorghum. Grain sorghum (Figure 1) (less than 6 feet tall) is usually shorter than forage sorghum (Figure 2) (6-15 feet), and may be planted for food grain or silage, whereas forage sorghum is planted for silage only. Forage sorghum matures later in the year than grain sorghum, and it is usually only harvested once. Forage sorghum can produce more biomass than sudangrass (Anonymous, 2002).

Figure 1. Grain sorghum, *Sorghum bicolor*. Credits: R. McSorley, University of Florida

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Figure 2. Forage sorghum, *Sorghum bicolor*. Credits: K.-H. Wang, University of Florida

Sudangrass

Sudangrass (*Sorghum sudanense*, formerly classified as *S. vulgare* var. *sudanense*) has high palatability and does not produce toxic compounds that threaten livestock and horses (Mojtahedi et al., 1993). Some varieties, most notably Trudan 8, also have nematicidal properties. Therefore, sudangrass can be planted for forage and nematode management. Sudangrass usually grows 3-8 feet high. It will regrow following each harvest until cool temperature or lack of moisture (Anonymous, 2002).

Sorghum-Sudangrass

Sorghum-sudangrass (Figure 3), also commonly called sudax, sudex, or sorghum x sudangrass (Sudax® is registered by DeKalb Genetics Corporation, De Kalb, IL) is advantageous over either parent in that it produces larger quantities of biomass. It resembles sudangrass but is taller and has larger stems and leaves. Like sudangrass, the hybrid will regrow after each harvest unless restricted by environmental conditions (Anonymous, 2002). Sorghum-sudangrass roots deeply, and may even help to aerate compacted subsoils (Valenzuela and Smith, 2002). This hybrid is able to grow in soil with a pH range of 5.5-8.3 and is sometimes used to reclaim alkaline soil (Valenzuela and Smith, 2002). It is very drought tolerant, has high seedling vigor, and some varieties have reduced lignin content (such as the brown midrib sorghum x sudangrass crosses) to increase digestibility for animals and decomposition rate. However, some sorghum-sudangrass varieties can be toxic to livestock and horses (Mojtahedi et al., 1993).

Figure 3. Sorghum-sudangrass (*S. bicolor* x *S. sudanense*). Credits: R. McSorley, University of Florida

Advantages as a Cover Crop

Cover crops are crops grown between cash crop cycles to provide ground cover, reduce erosion, increase organic matter, or reduce pests. Due to its rapid biomass production, sorghum-sudangrass is recommended as a cover crop to build up organic matter content in soil. Dry matter production can be as much as 8,000-10,000 lbs/acre/year. Also, it generally does not support populations of some key nematode pests, such as root-knot nematodes (*Meloidogyne* spp.). In addition, sorghum-sudangrass is found to have other pest management properties listed below.

Disease and Insect Management

Certain sorghum-sudangrass varieties are not only poor hosts for root-knot nematodes, but may also be resistant to some diseases and insect pests. According to Monsanto (2003), four of their varieties are resistant to downy mildew (*Sclerospora sorghi*), one to anthracnose (*Collectotrichum* sp.), two to maize dwarf mosaic virus, one to head smut (*Sphacelotheca reiliana*), and nine to greenbug (an aphid, *Schizaphis graminum*).

Weed Management

Sorghum or some other crops, including barley (*Hordeum vulgare*), rye (*Secale cereale*), buckwheat (*Fagopyrum esculentum*), sudangrass, sweet clover (*Melilotus* sp.), and sunflower (*Helianthus* spp.), can be planted to suppress weed growth (Rice, 1984). These crops have traditionally been called “smother crops” because of their ability to suppress weed growth. The weed-suppressive properties of sorghum are attributed to competition and its vigorous growth habit. However, some believe that toxic substances produced by sorghum might also play a role for this weed-smothering effect (Overland, 1966).

Nematode Management

It is important to select specific cultivars of sorghum, sudangrass, or sorghum-sudangrass for nematode management. In Florida, 'SX-17' sorghum-sudangrass did not support reproduction of the root-knot nematodes *Meloidogyne incognita* (races 1 and 3), *M. arenaria* (race 1), or *M. javanica* (McSorley et al., 1994a; McSorley and Gallaher, 1991). No egg masses were found on 'SX-17' in any of the tests. Another study by McSorley et al. (1994b) suggests that sorghum-sudangrass (here, 'SX-17') could be a beneficial crop for use in a rotation for the control of nematodes (*Meloidogyne* spp.) and yield improvement of subsequent vegetable crops.

In the north, a cultivar of sudangrass (Trudan 8) suppressed the northern root-knot nematode, *M. hapla*, in vegetables (Widmer and Abawi, 2002; Rehiayani and Hafez, 1998). In an Oregon potato trial in which sudangrass and sorghum-sudangrass residues were incorporated into the soil, the sudangrass cultivar Trudan 8 and sorghum-sudangrass hybrids Sordan 79, SS-222, and Bravo II reduced populations of *Meloidogyne chitwoodi* (Mojtahedi et al., 1993).

It has been noted, however, that sudangrass can harbor large populations of a lesion nematode (*Pratylenchus penetrans*) (Marks and Townshend, 1973). In Florida, sorghum 'FS25E' and sorghum-sudangrass 'SX-17' did not reduce populations of other plant-parasitic nematodes such as *Paratrichodorus minor* (stubby root nematode), *Pratylenchus scribneri* (lesion nematode), or *Mesocriconema* spp. (ring nematodes) (McSorley and Gallaher, 1991). A more recent study conducted by Thies et al. (1995) found that although forage sorghum, sudangrass, and sorghum-sudangrass are all hosts for *P. penetrans*, these crops are less suitable hosts than are other forage crop species such as white clover (*Trifolium repens*), oat (*Avena sativa*), and rye. Sting nematode (*Belonolaimus longicaudatus*) populations were found to be high enough to reduce yields in cool-season vegetables when planted after sorghum-sudangrass (Rhoades, 1980), and populations of *Meloidogyne arenaria* (root-knot nematode) juveniles in a sorghum-soybean (*Glycine max*) rotation were elevated above numbers found in either a soybean monoculture or a corn (*Zea mays*)-soybean rotation (Rodriguez-Kabana et al., 1991). Also, stubby-root nematode populations built up when sorghum- sudangrass was used in a rotation (McSorley et al., 1994b). The nematode species will persist in the site, and so nematode susceptibility of the subsequent crop(s) should be evaluated before deciding on a sorghum or sorghum-sudangrass rotation.

Host status of cultivars of sorghum and sorghum-sudangrass for several key plant-parasitic nematodes in Florida are summarized in Table 1.

Planting Tips

Although sorghum-sudangrass is a warm season crop, the Sustainable Agriculture Network (2003) believes that it can be planted year-round in south and central Florida. However, it may still be a good practice to plant sorghum-sudangrass in late spring or early summer. The best planting time is when soils are warm and moist. Although sorghum-sudangrass tolerates high pH (and moderate acidity) and low fertility, it will become better established with good fertility (with special attention paid to nitrogen) and near-neutral pH (Sarrantonio, 1994). Sorghum-sudangrass biomass will increase with the rate of nitrogen applied. For the best biomass accumulation, the Sustainable Agriculture Network (2003) suggests applying 75 to 100 lbs of nitrogen per acre. The Sustainable Agriculture Network also recommends broadcasting 40 to 50 lbs of seed per acre, or drilling 35 to 40 lbs of seed to a depth of 2 inches. These rates should provide a thick cover for smothering weed competition.

Sorghum-sudangrass may be interplanted (broadcast together) with buckwheat or with legumes such as sesbania (*Sesbania exaltata*), forage soybean (*Glycine max*), or cowpea (*Vigna unguiculata*). Buckwheat germinates very quickly and may help suppress early weeds (Sustainable Agriculture Network, 2003). However, root-knot nematodes may not be suppressed in mixed plantings with sorghum-sudangrass, and could be increased if the interplanted crops are good nematode hosts.

In warmer regions where fall crops are grown, a better option may be to mow the sorghum-sudangrass and incorporate into the soil. If incorporating sorghum-sudangrass residue into the soil, it is important to break the plants into smaller pieces so decomposition will be hastened. Disking, flail chopping, or sicklebar mowing before tillage will decrease the likelihood of residue nitrogen being tied up and thus unavailable to the subsequent crop. Sudangrass has a very high C:N ratio, meaning that large amounts of biomass will take a relatively long time to be fully decomposed by soil microorganisms (Sattell et al., 1998). If residues are to be left on the soil surface (as in a no-till operation), flail chopping after the frost or using an herbicide to kill the sorghum-sudangrass is recommended by the Sustainable Agriculture Network (2003). If sudangrass or sorghum-sudangrass residues are to be used for suppression of nematodes or soilborne diseases, best results are obtained if the material is incorporated while still green (Orfonedes, 1995; Widner and Abawi, 2002). However, best suppression of root-knot nematodes in Florida has occurred when sorghum or sorghum-sudangrass are used as rotation crops. Benefits of using the crop residues for nematode suppression in Florida are unknown and untested.

Problems and Warnings of Growing Sorghum-Sudangrass

Sorghum-sudangrass contains levels of hydrocyanide and hordenine (an alkaloid). Prussic acid (hydrocyanide) is bound to sugars within the plant, and is released during frosts, decomposition, drought stress, and mechanical damage. If using sorghum-sudangrass as forage for cattle, Chambliss (2002) recommends not allowing grazing until the plants are at least 24 inches tall since prussic acid content may be higher in younger plants. Horses should never be allowed to graze on or eat hay made from sorghum-sudangrass as it may cause inflammation of the urinary tract (cystitis syndrome) (Chambliss, 2002; Sattell et al., 1998).

In terms of nematode suppression, there is some variability in the influence of sudangrass on growth of lettuce (*Lactuca sativa*) in the greenhouse. Phytotoxicity can occur if the green manure is not decomposed properly. Viaene and Abawi (1998) planted lettuce 1 month after incorporation of sudangrass. However, 1- or 2-month-old tissues were more effective than 3-month-old tissue of sudangrass for nematode suppression (Viaene and Abawi, 1998). Therefore, proper management of the sudangrass as a cover crop is important for the best results of nematode suppression and yield improvement.

Cover cropping with sorghum in southeastern Florida aggrevates problems with wireworms. Early harvest of sorghum before wireworms (Coleoptera: Elateridae) oviposit can alleviate this problem (Weingartner, et al., 1993).

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Table 1. Host status of cultivars of sorghum and sorghum-sudangrass to important plant-parasitic nematodes in Florida.

Plant/Nematode	Cultivar		Reference
	Poor/Non-host	Good host	
Sorghum			
Meloidogyne incognita race 1	'DeKalb FS25E', 'DeKalb BR64'	'Asgrow Chaparral'	Gallaher et al., 1991; McSorley and Gallaher, 1991; 1993
M. arenaria		+[a]	Rodriguez-Kabana et al., 1991
Pratylenchus scribneri		'DeKalb BR64'	McSorley and Gallaher, 1991
Paratrichodorus minor		+	McSorley and Gallaher, 1991
Mesocriconema sphaerocephala		'DeKalb FS25E', 'DeKalb BR64', 'Asgrow Chaparral'	Gallaher et al., 1991; McSorley and Gallaher, 1991; 1993
Sorghum-sudangrass			
Meloidogyne incognita race 1 and race 3	'SX-17'		McSorley et al., 1994a
M. javanica	'SX-17', 'ST6E'		McSorley et al., 1994a
M. arenaria	'SX-17'		McSorley et al., 1994a, c
Heterodera glycines	+		Rodriguez-Kabana et al., 1991
Paratrichodorus minor		'SX-17'	McSorley et al., 1994b, McSorley and Dickson, 1995
Belonolaimus spp.		+, 'SX-17'	Rhoades, 1980; McSorley and Dickson, 1995
Pratylenchus spp.		'SX-17'	McSorley and Dickson, 1995
Mesocriconema spp.		'SX-17'	McSorley and Dickson, 1995

[a] + indicates results of the study cited was poor host or good host, but cultivar was not specified in the study.