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Response of Nematode Communities to Sudangrass and Sorghum-Sudangrass Hybrids Grown as Green Manure Crops[1]

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Abstract: Two cultivars of sudangrass (Piper and Trudan 8) and three of sorghum-sudangrass (Sordan 79, P855F, and P877F) were grown as green manure crops in 1993 and 1994 and compared with sweet corn for their impact on nematode population dynamics. Nematodes were identified to trophic group, order, and to lower taxa when possible. Population densities were determined after 7 weeks of crop growth and 3 weeks after incorporation of green crop residue. Plant-parasitic nematode genera included *Pratylenchus, Longidorus, Xiphinema,* and *Paratrichodorus.* The plant-feeder trophic group increased or was maintained on all crops after 7 weeks, at which time population densities were lowest on corn in 1993 and equivalent among crops in 1994. The total number of nematodes in the plant-feeder trophic group did not differ before and after incorporation in 1993 and increased for Piper sudangrass, Sordan 79 and P855F sorghum-sudangrass, and sweet corn in 1994. After incorporation, numbers of bacterial-feeding nematodes increased for all crops in 1994 and for Piper sudangrass in 1993. There were no consistent crop treatment effects on the fungal-feeding, omnivore, and predator trophic groups after incorporation.
Key words: control, green manure, nematode, organic amendment, potato, *Sorghum bicolor,* sudangrass, sorghum-sudangrass hybrid.

Sudangrass (*Sorghum vulgare* var. *sudanense*) and sorghum-sudangrass (*S. bicolor* X *S. vulgare* var. *sudanense*) grown as cover crops (8) and as green manure crops (13) reduced population densities of some *Meloidogyne* spp. There is considerable interest in using these crops to control root-knot and other nematode populations in vegetable production systems. Presumably, *Meloidogyne* spp. are inhibited because these crops are poor hosts for nematode reproduction and, in the case of green manures, because the leaves contain chemicals that hydrolyze to form nematicidal compounds.

In laboratory and microplot studies with methyl bromide-treated soil, Mojtahedi et al. (13) found that leaves of sudangrass and sorghum-sudangrass hybrids chopped and incorporated as green manure suppressed *M. chitwoodi* compared with fallow or wheat green manures. Buried leaves of Trudan 8 sudangrass inhibited migration of *M. chitwoodi* second-stage juveniles. These results indicate that decomposing sudangrass leaves have nematicidal properties.

Davis et al. (3) reported that sudangrass grown as a green manure in field plots reduced the incidence of disease caused by *Verticillium dahliae* in a subsequent potato crop, but not more than sweet corn (*Zea mays*) chopped and incorporated into the soil. Total soil microbial activity was higher in plots treated with green manure compared with fallow, and there was a significant negative correlation between microbial activity and disease incidence. Data from this study suggest that biological, rather than chemical, activity might be involved in the suppressive effect of sudangrass on soil-borne organisms.

Pratylenchus spp. is the most significant nematode pest in some potato production regions, particulary when *V. dahliae* is also present. Sudangrass and sorghum-sudangrass suppressed population densities of *Pratylenchus* spp. in greenhouse experiments (4,5,9), indicating that these crops may have broad applicability in potato rotations. Sudangrass and sorghum-sudangrass support reproduction of other plant-parasitic nematodes that might damage crops grown in rotation with potato (7,12,14); however, sudangrass may still

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have potential as a rotation crop if incorporated residues are nematicidal.

Little is known about the nematicidal activity of decomposing sudangrass residues under field conditions. An important economic issue is whether nematode control achieved by planting sudangrass as a cover crop and green manure is equivalent to that obtained by incorporating green residue of a marketed crop after harvest. The first objective of our study was to determine the effect of sudangrass and sorghum-sudangrass on population densities of plant parasitic and nontarget nematodes during the period of crop growth and after incorporation of green crop residue into soil. The second objective was to determine whether the impact of these crops on nematode population densities was different from that of sweet corn.

Materials and Methods

Field trials were conducted at the Hancock Research Station, Hancock, Wisconsin, in 1993 and 1994 on two adjacent sites with the same soil type (Plainfield loamy sand; 92% sand, 5% silt, 3% clay; <1% organic matter) but different recent cropping histories. Potato was grown in the 1993 site and alfalfa in the 1994 site for 5 years prior to the study. From 1977 to 1989 both sites were planted with potato for 10 years and sweet corn for 2 years.

Six crops were evaluated for their impact on nematode populations, including: Piper sudangrass; Trudan 8 sudangrass hybrid; Sordan 79, P855F, and P877F sorghum-sudangrass hybrids; and GH1685 (Northrup King) sweet corn. The sudangrass and sorghum-sudangrass hybrids were planted in rows 15 cm apart at a seeding rate of 45 kg/hectare. Corn was planted in rows spaced 30 cm apart with 4.5 cm between plants. Each treatment was replicated six times in plots measuring 1.23 × 6.15 m arranged in randomized complete blocks. Plots were planted on 7 July 1993 and 14 June 1994 and irrigated at a rate of 1.25 cm water per week. At 63 days after planting (DAP), the crops were incorporated with Dynadrive tillage equipment (HCC, Inc., Mendota, IL). Immediately before incorporation, a subsample of shoots was collected from 2.4 m^2 of each plot, dried, and weighed to estimate the shoot biomass added.

Soil samples were collected immediately after planting, 52 (1993) or 54 (1994) DAP and before incorporation, and 21 days after incorporation (84 DAP). On each sampling date, six 2.5-cm-d soil cores were collected 20 cm deep in the row from each plot and combined. In 1993, a 200-cm^3 subsample of soil was processed by centrifugal flotation (6) with nested 250- and 38-μm-pore sieves. Roots retained on the 250-μm-pore sieve were collected and incubated in Baermann funnels for 48 hours. Nematodes collected from the soil and roots were combined into a single sample for each plot. In 1994, the extraction procedures were changed to minimize the number of dead and unrecognizable nematodes recovered. The 200-cm^3 soil subsample and the roots contained therein were divided into two portions and placed on two Baermann funnels for 48 hours. Nematodes collected from the two funnels were combined into a single sample. For both years, the samples were poured onto a scored counting dish and examined at ×160 magnification. Nematodes were counted to estimate total abundance, and at least 100 nematodes were identified to trophic level and order and to lower taxa when possible. The proportion of nematodes within each taxon was calculated by dividing each count by the total number identified. The proportional values were multiplied by the counts for the entire sample to calculate the total number of nematodes within each taxon. Counts were not adjusted for efficiency of the extraction procedures because this value was determined only for *Pratylenchus* spp. Preliminary experiments demonstrated that the extraction efficiency for *Pratylenchus* spp. was ca. 30% for both procedures.

Data were transformed by $\log_{10}(x + 1)$

values and analyzed with the General Linear Models analysis of variance procedure of SAS (SAS Institute, Cary, NC). Counts of nematodes collected on the third sampling date after incorporation of the crops were subjected to analysis of covariance with shoot biomass as the covariate. Crop treatment effects were compared for each sampling date by single-degree-of-freedom comparisons if the overall F statistic was significant at $P < 0.05$ and the F statistic for treatment was significant at $P < 0.10$. Changes in nematode population densities within each taxon were determined by an analysis of variance of data collected on three sampling dates. Population densities were compared among the first and second sampling dates and among the second and third sampling dates by single-degree-of-freedom comparisons if the overall F statistic was significant at $P = 0.05$ and the F statistic for sampling date was significant at $P = 0.03$.

Results

Eight orders (11) of nematodes were represented in soil samples taken from the plots. Plant-parasitic nematodes included *Pratylenchus scribneri* and *P. penetrans* in the order Tylenchida, and *Longidorus* spp. (primarily *L. breviannulatus*), *Paratrichodorus* spp., and *Xiphinema* spp. in the order Dorylaimida. Fungal feeders were represented by the genera *Aphelenchus* and *Aphelenchoides* in the order Aphelenchida and by the family Tylenchidae in the order Tylenchida. Bacterial feeders were identified from the orders Araeolaimida (mostly from the family Plectidae and genus *Wilsonema*), Chromadorida, Monhysterida primarily *Prismatolaimus*), and Rhabditida (genera *Acrobeles, Diploscapter,* families Cephalobidae and Rhabditidae, among others). Nematodes categorized as omnivores were all members of the order Dorylaimida. Predatory nematodes were from the orders Mononchida and Diplogasterida. There was no difference in initial population densities among the plots, except for *Paratrichodorus* spp. in 1993 when none were recovered from some plots.

The plant-feeder trophic group increased or was maintained on all crops at 52 (54) DAP (Table 1). In 1993, sudangrass and sorghum-sudangrass supported higher numbers of plant-feeding nematodes than corn ($P = 0.01$) (Table 2). Trends in the data suggest that all plant-parasitic genera were less abundant on corn in 1993, but the counts were too variable to distinguish the crops statistically for all but *Paratrichodorus* spp. In 1994, plant-feeders reproduced on corn and Trudan 8 sudangrass (Table 1), but the population densities achieved at 54 DAP did not differ among crops (Table 3). Suppressive effects of the cover crops were observed only for *Longidorus* spp. on P877F sorghum-sudangrass in 1993 (Table 1).

Incorporation of crop green manures did not impact plant-parasitic nematodes negatively (Table 1). The total number of nematodes in the plant-feeder trophic group did not differ before and after incorporation in 1993 and increased for three of the *Sorghum* spp. and corn in 1994. The only individual genus to show a significant increase was *Pratylenchus* spp. on corn. Population densities of *Pratylenchus* spp. were highest for corn and comparable for sudangrass and sorghum-sudangrass plots in 1994 (Table 3).

Counts of the total nematode community remained unchanged during crop growth in 1993 and declined in 1994 (Table 1). The decline in overall nematode numbers in 1994 was not due to decreased abundance of plant-parasitic, omnivorous, or predatory nematodes. There was no difference among crops for total nematode counts at 52 DAP in 1993 (Table 2) or 54 DAP in 1994 (Table 3).

After incorporation, numbers of bacterial-feeding nematodes, particularly members of the Rhabditida, increased for all crops in 1994 and for Piper sudangrass in 1993 (Table 1). In 1993, there were fewer Rhabditida in corn plots ($P = 0.08$) (Table 2). In 1994, corn residue supported the

TABLE 1. Increase (+) or decrease (−) in numbers of nematodes per 200 cm^3 soil from plots of sudangrass (S), sorghum-sudangrass (SS), or sweet corn from 0 to 52 (54) days after planting or from 52 (54) to 84 days after planting when the crops were incorporated as green manures.

	Plant feeders					Bacterial feeders					Fungal feeders			Omnivores	Predators			
Crop[a]	Xph[b]	Lng	Ptc	Prat	Total	Ara	Chr	Mnh	Rhab	Total	Aph	Tyl	Total	Dor	Mon	Dpl	Total	Total[c]
									1993									
S1	·	·	+	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·
S2	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
SS1	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	+	·
SS2	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
SS3	·	−	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Corn	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
									1994									
S1	·	·	·	·	·	x[d]	x	x	x	x	x	x	x	+	·	·	·	−
S2	·	·	·	·	+	x	x	x	x	x	x	x	x	+	·	·	·	−
SS1	·	·	·	·	·	x	x	x	x	x	x	x	x	·	·	·	·	−
SS2	·	·	·	·	·	x	x	x	x	x	x	x	x	+	·	·	·	−
SS3	·	·	·	·	·	x	x	x	x	x	x	x	x	·	·	·	·	−
Corn	·	·	·	·	+	x	x	x	x	x	x	x	x	·	·	·	·	−
									1993									
S1	·	·	·	·	·	·	·	·	+	+	·	·	·	·	·	·	·	·
S2	·	·	·	·	·	·	·	·	·	·	+	·	+	·	·	·	·	+
SS1	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·
SS2	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
SS3	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·
Corn	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
									1994									
S1	·	·	·	·	+	+	+	·	+	+	+	·	·	·	·	·	·	+
S2	·	·	·	·	·	·	+	·	+	+	·	·	·	+	·	·	·	+
SS1	·	·	·	·	+	+	+	·	+	+	·	·	·	·	·	·	·	+
SS2	·	·	·	·	+	·	·	·	+	+	·	·	·	+	·	·	·	+
SS3	·	·	·	·	·	·	+	·	+	+	·	·	·	·	·	+	·	+
Corn	·	·	·	+	+	·	+	·	+	+	·	+	·	·	·	·	·	+

The change in nematode population densities was significant at $P < 0.05$.

[a] Crops included Piper sudangrass (S1), Trudan 8 sudangrass hybrid (S2), Sordan 79 sorghum-sudangrass (SS1), P855F sorghum-sudangrass (SS2), P877F sorghum-sudangrass (SS3), or GH1685 sweet corn.

[b] Nematode taxa included *Xiphinema* spp. (Xph), *Longidorus* spp. (Lng), *Paratrichodorus* spp. (PTC), *Pratylenchus* spp. (Prat), and the orders Araeolaimida (Ara), Chromadorida (Chr), Monhysterida (Mnh), Rhabditida (Rhab), Aphelenchida (Aph), Tylenchida (Tyl), Dorylaimida (Dor), Diplogasterida (Dpl), and Mononchida (Mon).

[c] Total number of all nematodes present.

[d] Nematodes in the bacterial- and fungal-feeder trophic groups were not identified on the first sampling date in 1994.

TABLE 2. Nematode population densities per 200 cm³ soil from plots of sudangrass (S), sorghum-sudangrass (SS), or sweet corn in 1993.

	Plant feeders					Bacterial feeders					Fungal feeders			Omnivores	Predators			
Crop[a]	Xph[b]	Lng	Ptc	Prat	Total	Ara	Chr	Mnh	Rhab	Total	Aph	Tyl	Total	Dor	Mon	Dpl	Total	Total[c]
									At planting									
S1	0	7	0	0	7	22	70	0	380	472	20	44	64	32	7	0	7	825
S2	0	10	35	120	165	75	15	0	825	915	85	35	120	90	35	0	35	1,705
SS1	0	10	27	7	44	3	80	0	547	630	33	40	73	67	37	0	37	1,170
SS2	0	0	30	20	50	20	50	0	940	1010	60	0	60	50	40	0	40	1,370
SS3	0	7	0	20	27	0	7	0	280	287	47	0	47	94	33	0	33	700
Corn	0	0	0	15	15	65	15	0	510	590	55	60	115	90	40	0	40	1,115
P	ns	ns	.01	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
									52 Days after planting (DAP)									
S1	57	0	84	90	231	13	2	0	420	435	48	4	52	66	65	0	65	952
S2	25	0	71	31	127	15	2	0	479	496	49	22	71	105	57	0	68	944
SS1	19	0	100	27	146	13	0	2	457	472	44	3	47	126	58	2	60	970
SS2	39	0	20	69	128	41	0	0	582	623	82	14	96	228	46	0	58	1,290
SS3	32	0	173	33	238	42	6	3	459	510	62	11	73	147	90	3	90	1,144
Corn	5	0	9	28	42	15	3	0	550	568	42	12	54	108	39	0	39	902
P	ns	ns	.09	ns	.01	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
S vs Corn			.04		.01													
SS vs Corn			.07		.01													
S vs SS			.54		.98													
									3 Weeks after planting (84 DAP)									
S1	3	2	64	97	166	92	13	14	1,144	1,263	409	14	423	83	44	8	52	2,308
S2	1	0	67	46	114	171	4	15	779	969	327	51	378	135	58	0	58	1,882
SS1	3	0	76	36	115	49	41	5	911	1,006	289	48	337	123	68	3	71	1,856
SS2	3	0	41	33	77	131	31	6	940	1,108	294	47	341	184	105	22	127	2,076
SS3	2	0	51	31	84	69	17	16	707	809	194	15	209	117	53	16	69	1,493
Corn	0	0	0	36	36	52	22	16	613	703	123	47	170	97	57	10	67	1,239
P	ns	ns	ns	ns	ns	ns	ns	ns	.08	.07	ns	ns	ns	ns	ns	ns	ns	.05
S vs Corn									.02	.01								.01
SS vs Corn									.03	.02								.01
S vs SS									.81	.73								.76

Overall F tests for the analysis of variance were significant at $P < 0.05$. Significance levels for the F statistic for treatment differences and treatment contrasts are indicated.

[a] Crops included Piper sudangrass (S1), Trudan 8 sudangrass hybrid (S2), Sordan 79 sorghum-sudangrass (SS1), P855F sorghum-sudangrass (SS2), P877F sorghum-sudangrass (SS3), or GH1685 sweet corn.

[b] Nematode taxa included *Xiphinema* spp. (Xph), *Longidorus* spp. (Lng), *Paratrichodorus* spp. (Ptc), *Pratylenchus* spp. (Prat), and the orders Araeolaimida (Ara), Chromadorida (Chr), Monhysterida (Mnh), Rhabditida (Rhab), Aphelenchida (Aph), Tylenchida (Tyl), Dorylaimide (Dor), Diplogasterida (Dpl), and Mononchida (Mon).

[c] Total number of all nematodes present.

TABLE 3. Nematode population densities per 200 cm^3 soil from plots planted with sudangrass (S), sorghum-sudangrass (SS), or sweet corn in 1994.

	Plant feeders					Bacterial feeders					Fungal feeders			Omni-vores	Predators			
Crop[a]	Xph[b]	Lng	Ptc	Prat	Total	Ara	Chr	Mnh	Rhab	Total	Aph	Tyl	Total	Dor	Mon	Dpl	Total	Total[c]
									At planting									
S1	0	1	1	0	2	—[d]	—	—	6*[d]	—	1*	—	—	16	30	0	30	830
S2	0	0	0	0	0	—	—	—	2*	—	3*	—	—	17	9	9	18	933
SS1	0	1	0	1	2	—	—	—	2*	—	1*	—	—	18	23	1	24	661
SS2	0	0	0	0	0	—	—	—	4*	—	3*	—	—	9	11	4	15	667
SS3	0	1	0	0	1	—	—	—	3*	—	2*	—	—	13	19	1	20	751
Corn	0	1	0	1	2	—	—	—	5*	—	1*	—	—	10	14	0	14	884
P	ns	ns	ns	ns	ns				ns		ns			ns	ns	ns	ns	ns
								54 Days after planting (DAP)										
S1	0	0	5	1	6	16	14	21	146	197	32	16	48	36	12	12	24	319
S2	0	4	6	2	12	15	15	16	140	186	31	10	41	21	7	11	18	279
SS1	0	1	1	4	6	18	14	13	199	244	47	17	64	35	8	21	29	384
SS2	0	1	1	1	3	15	6	38	147	206	44	16	60	29	5	3	8	305
SS3	0	1	4	1	6	14	8	13	174	209	36	13	49	30	6	3	9	320
Corn	1	0	2	9	12	28	25	7	193	253	43	12	55	43	16	5	21	384
P	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
								3 Weeks after incorporation (84 DAP)										
S1	0	0	25	2	27	100	320	167	643	1,230	78	58	136	75	10	30	40	1,508
S2	2	0	17	8	27	92	322	108	417	939	62	45	107	48	23	7	30	1,150
SS1	0	0	13	15	28	145	296	131	683	1,255	113	63	176	51	27	30	57	1,569
SS2	0	0	16	2	18	98	262	114	415	889	102	51	153	48	25	10	35	1,160
SS3	0	0	24	0	24	93	266	145	523	1,027	97	38	135	31	17	36	53	1,271
Corn	0	0	10	147	157	147	432	77	825	1,481	108	55	163	58	15	12	27	1,888
P	ns	ns	ns	.01	ns	ns	ns	ns	.01	ns	ns	ns	ns	ns	ns	ns	ns	ns
S vs Corn				.01					.01									
SS vs Corn				.01					.01									
S vs SS				.76					.74									

Overall F tests for the analysis of variance were significant at $P < 0.05$. Significance levels for the F statistic for treatment differences and treatment contrasts are indicated.

[a] Crops included Piper sudangrass (S1), Trudan 8 sudangrass hybrid (S2), Sordan 79 sorghum-sudangrass (SS1), P855F sorghum-sudangrass (SS2), P877F sorghum-sudangrass (SS3), or GH1685 sweet corn.

[b] Nematode taxa included: *Xiphinema* spp. (Xph), *Longidorus* spp. (Lng), *Paratrichodorus* spp. (Ptc), *Pratylenchus* spp. (Prat), and the orders Araeolaimida (Ara), Chromadorida (Chr), Monhysterida (Mnh), Rhabditida (Rhab), Aphelenchida (Aph), Tylenchida (Tyl), Dorylaimida (Dor), Diplogasterida (Dpl), and Mononchida (Mon).

[c] Total number of all nematodes present.

[d] Nematodes in the bacterial- and fungal-feeder trophic groups were not identified at planting in 1994.

greatest number of Rhabditida ($P = 0.01$) (Table 3). There were no consistent crop treatment effects for the fungal-feeding, omnivore, and predator trophic groups after incorporation.

In 1993 and 1994, the amount of shoot biomass estimated just before incorporation did not differ among the sudangrass and sorghum-sudangrass treatments, but dry-shoot weight of all *Sorghum spp.* was greater than that of corn (data not presented).

Discussion

Sudangrass and sorghum-sudangrass did not impact the population dynamics of *Pratylenchus* spp. negatively after nearly 8 weeks of growth. The lack of suppression of *Pratylenchus* spp. by sudangrass was surprising because this crop had a detrimental impact on root-lesion population densities in three previous experiments (4,5,9). Our study may not be directly comparable to previous work, however, because we used a field (vs. greenhouse) environment, indigenous (vs. inoculated) nematodes, and soil volume (vs. root weight) as the unit describing nematode population density.

Field studies in other regions of the United States have shown that sorghum-sudangrass is a good to excellent host for many ectoparasites (7,12,14). Population densities of the ectoparasitic genera *Xiphinema* and *Paratrichodorus* tended to increase on both sorghum-sudangrass and sudangrass, but the data were not statistically significant except for one crop and date. This trend was not evident for *Longidorus* spp., and significant suppression was observed for one sorghum-sudangrass cultivar in 1 year.

The lack of suppressive effects by the green manures on plant-parasitic nematodes was unexpected, because the cultivars were the same as those which suppressed *M. chitwoodi* in a microplot study (13). Data from that study indicated that the green manures were nematicidal. The chemical responsible for the inhibition was presumed to be hydrogen cyanide, which is produced when a chemical constituent of leaves (dhurrin) is hydrolyzed by glucosidase once leaf tissue is disrupted (1). Hydrogen cyanide produced by decomposing sudangrass shoots is toxic to a wide range of organisms; thus, no group of nematodes should be immune to the toxic effects of sudangrass green manures. We found no evidence that the green manures had a detrimental impact on any nematode taxon or trophic group. Population densities of several nematode groups, including plant-feeders in some cases, increased after incorporation. If there was nematicidal activity of the residue it was either very short-lived, delayed longer than 3 weeks, or ineffective in reaching nematodes in all soil and root microhabitats.

Soil amendment with green manures increased population densities of bacterial-feeding and fungal-feeding nematodes involved in the decomposition food web. Abundance of microbivorous nematodes may indicate an abundant population of bacteria (2). Enhanced microbial activity, detected by Davis et al. (3) after sudangrass shoots were incorporated into soil infected with *Verticillium dahliae*, was credited with suppressing disease caused by this fungus. Identifying the contribution of hydrogen cyanide to the impact of sudangrass green manures on soil organisms will be difficult in field studies because of the unavoidable stimulation of soil microbial communities.

There was an advantage for nematode control in planting sudangrass or sorghum-sudangrass versus corn in 1994, but not in 1993. In no case were populations of plant-parasitic nematodes high, but the numbers of *Pratylenchus* spp. in sudangrass and sorghum-sudangrass plots at the end of the 1993 experiment were sufficient to cause yield loss to a subsequent potato crop if *V. dahliae* was also present (10). Sudangrass and sorghum-sudangrass may be useful for preventing high rates of increase of *Pratylenchus* spp. in potato rotations, but appear to have limited potential for reducing nematode population densities.

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