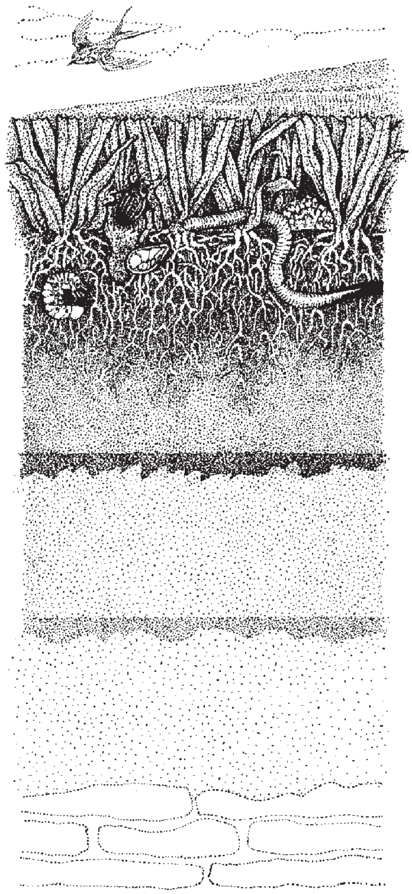
CORNELL UNIVERSITY TURFGRASS TIMES

CUTT

Spring 1992 • Volume Three • Number One • *A Publication of Cornell Cooperative Extension*



Turfgrass Pesticide Leaching Studies

Research recently conducted at the Cornell University Turfgrass Field Research Laboratory using the AREST facility (see CUTT V.2#4 for a description of AREST) investigated the potential of some commonly used turfgrass pesticides to leach from a two year old medium-maintenance Kentucky bluegrass turf. The results showed that the risk of pesticide leaching is generally small but that the risk is influenced by the combination of soil, pesticide and leaching event. The differences found indicated that decisions a turfgrass manager makes may affect whether or not pesticide leaching occurs. ■

This article is a summary of the work conducted by Nina Roth Borromeo under the guidance of Professor Marty Petrovic. The research partially fulfilled the requirements for Ms. Borromeo's Master of Science degree. Money for this research was provided partially by the New York State Turfgrass Association from their matching funds program.

Experimental Procedure

The three factors under investigation in this experiment were soil type, pesticide type and leaching event. The choices for each variable were made in order to reflect a range in the potential for leaching. All combinations of soil and leaching regimes were tested for all of the pesticides in the study.

A soil's leaching potential was expected to be reflected partially by soil texture and partially by the soil organic matter content. Finer textured soils and soils containing more organic matter were expected to have lower leaching potentials. The three soils used in the experiment were a fine textured Hudson silt loam, a medium textured Arkport sandy loam and a coarse textured medium sized sand (which met the USGA sand size specifications for putting green construction). The Hudson soil contained the most organic matter, 5.0 %, while the sand contained the least organic matter, 0.06 %. The Arkport soil contained 3.9 % organic matter.

The chemicals tested were carbaryl, chlorothalonil, and the diethylamine salts of 2,4-D and dicamba. Two factors which may influence the leaching potential of a specific pesticide are the solubility of the pesticide and the adsorption of the pesticide to soil particles. High solubilities and low adsorption ratings should indicate a greater risk for leaching. Table 1 lists some of the characteristics of the four pesticides tested. Therefore it would appear that dicamba and 2,4-D would be the most susceptible to leaching while chlorothalonil would be the least susceptible. The chemicals were applied to the plots at the recommended rates, so

continued on page 4

This Times

1. Turfgrass Pesticide Leaching Studies
David B. Davidson, Dept. of Floriculture and Ornamental Horticulture

2. Status of Turfgrass Nematodes in New York
Peter Mullin, Dept. of Plant Pathology

3. Scanning the Journals

8. Pest Watch

Status of Turfgrass Nematodes in New York State

Turf damage associated with infestations of stunt, ring, and spiral nematodes was only observed in samples from which relatively high populations of these nematodes were recovered.

Relatively small recoverable populations of root knot nematodes seemed to be capable of damaging turf.

At the beginning of 1991, the Cornell Nematode Diagnostic Laboratory was established as a separate branch facility of the Insect and Plant Disease Diagnostic Service. In the period from 2/8/91 to 12/5/91 a total of 62 samples suspected to contain nematodes were received for diagnosis from growers, county cooperative extension agents, and independent consultants. Most samples were received from areas in which plants were observed to be adversely affected in some way, although in several cases diagnoses were requested to confirm absence of significant populations of plant parasitic nematodes. Reports containing information on generic populations of nematodes and, where applicable, the damage potential of observed nematode genera were returned to the requestor upon completion of the diagnosis.

Recommendations for control procedures were referred to county cooperative extension agents. Samples came from several counties in New York State, as well as from California, Connecticut, Massachusetts, New Jersey, and Vermont. See Table 1 for the by-state distribution of samples. New York State samples were distributed by county as shown in Table 2.

Table 1: State origin of nematode samples received in 1991

State	Number of Samples Total	Turf
New York	47	18
New Jersey	6	5
Vermont	4	4
Connecticut	3	3
California	1	0
Massachusetts	1	1

Table 2: Samples received from New York State counties

County	Number of Samples Total	Turf
Nassau	8	7
Orange	7	0
Wayne	5	0
Sullivan	4	4
Bronx	3	0
Monroe	3	1
Ulster	3	0
Westchester	3	3
Suffolk	2	1
Albany	1	1
Cattaraugus	1	0
Chemung	1	0
Erie	1	0
Genesee	1	0
Oswego	1	1
Queens	1	0
St. Lawrence	1	0
Seneca	1	0

Samples were received from many different types of host plants. Table 3 summarizes host plant distribution for 1991 samples.

Table 3: Host plants from which samples were submitted, 1991

Host	Total Samples	NYS Samples
Turf*	31	18
Apple (total)	9	9
Ida Red	2	2
Macintosh	1	1
Rome	1	1
Other	5	5
Lettuce	4	4
Black bamboo	3	3
Onion	3	3
Boxwood	2	2
Raspberry	2	2
Clematis	1	1
Fava bean	1	1
Grapevine	1	0
Maize	1	1
Rose (cv. 'Bridal Pink')	1	1
Serviceberry	1	1
Sour cherry	1	1
Unknown (terrarium)	1	0

** In most cases, turf samples consisted of mixtures of bentgrass and annual bluegrass. Specific identification of plants was often not included with the samples, however.*

Nematodes were extracted from samples primarily by a modification of the sucrose flotation extraction procedure (Zuckerman et al., 1990). Samples which were deemed likely by initial inspection to contain endoparasitic nematodes (such as *Pratylenchus*, *Meloidogyne*, and *Heterodera* spp.) were also subjected to a pie pan extraction procedure (modified Baermann tray extraction) as

continued on page 6

CUTT, "Cornell University Turfgrass Times" is published four times per year by Cornell Cooperative Extension and the Turfgrass Science Program at Cornell University, Ithaca, New York 14853. Address correspondence to: *Cornell University Turfgrass Times*, 20 Plant Science Building, Cornell University, Ithaca, NY 14853; telephone: (607) 255-1629
Editor-in-Chief: Norman W. Hummel, Jr.
Acting Editor: Joann Gruttadaurio
Masthead Illustration: Benn Nadelman
Illustrations: Patti Witten and Timothy Tryon
Design & Production: Ghostwriters, inc., Ithaca, NY

Managing Dollar Spot In Tall Fescue

Tall fescue is one of the numerous turfgrass species attacked by dollar spot. In an experiment examining the effect of management practices on the susceptibility of two cultivars of tall fescue ('Mustang' and 'Kentucky-31') to dollar spot, an investigator at Oklahoma State University, in Stillwater, varied seeding rate, cutting height, and N-fertilization rate in a two-year field study. Other workers had demonstrated suppression of dollar spot at higher N-fertilization rates in creeping bentgrass, and lower seeding rates in Kentucky bluegrass, but the effect of these variables on tall fescue was unknown.

Two cuttings heights (19 & 57mm), three seeding densities (5, 29, & 78g seed/m^2) and 2 fertilization rates (4.9 & 24.4g N/m^2 per year) were replicated nine times for each fescue cultivar. A natural infestation of dollar spot provided the disease challenge. Only the fertilization trials produced a non-significant result, but this cannot be assumed to hold for other soil conditions. Dollar spot was more severe at the higher cutting height and higher seeding rate. The researcher surmised that the unexpected mowing effect may be due to the more effective removal of infected leaf tips, and the seeding rate effect may be due to the stress of overcrowding. Finally, 'Mustang' was more susceptible than 'Kentucky 31', perhaps because of the former's higher shoot density.

(From: A.D. Brede, 1991. Interaction of Management Factors on Dollar Spot Disease Severity in Tall Fescue Turf. HortScience 26(11):1391-1392).

Foliar Absorption of Nitrogen Sources

In a study comparing the uptake of three nitrogen sources applied as foliar sprays, researchers at the University of Nevada, Reno, applied urea, ammonium sulfate, and potassium nitrate to the leaves of perennial ryegrass in a controlled environment chamber. Foliar applications of urea nitrogen are commonly used on turfgrass and fruit trees due to urea's high solubility, low expense, and low risk of injury, but little is known about the suitability of the alternative nitrogen sources tested in this study.

Through measurements of radioactively labeled nitrogen, washing procedures, and Kjeldahl tissue analysis, no difference was found between the three sources in the amount of nitrogen absorbed. In all cases after 48 hours about 1/3 of the nitrogen absorbed was found in the upper half of the leaves, 1/2 in the lower half of leaves and crowns, and the remainder in the roots.

The researchers conclude that perennial ryegrass absorbs foliar applied N from the three sources studied with equal facility, even though there are subsequent differences in the metabolism of the nitrate and ammonia ions. Uptake is most rapid during the first twelve hours, and after 48 hours about 40% of the applied total is absorbed. Ammonium sulfate and potassium nitrate, however, burn foliage more readily than urea and cannot be used at the same concentration. After 48 hours, more than 1/3 of the total applied N remained on or in the upper leaves, all of which is lost if clippings are discarded. If clippings must be removed, the researchers recommend watering treated turf before mowing, thus washing residual nitrogen from the leaves into the soil.

(From: D.C. Bowman and J.L. Paul. 1992. Foliar Absorption of Urea, Ammonium, and Nitrate by Perennial Ryegrass Turf. J. Amer. Soc. Hort. Sci. 117(1):75-79.)

Biological Control of Dollar Spot

It has been estimated that more money is spent in the U.S. to manage dollar spot than any other disease on the golf course. Although effective fungicidal remedies are available, and management practices such as high nitrogen applications and adequate watering can suppress the disease, they are all expensive. In an effort to reduce costs and the potential for pollution, two Canadian researchers investigated biological control measures against dollar spot using a sand-cornmeal or chopped grain topdressing containing bacteria and fungi antagonistic to the dollar spot pathogen.

Potential antagonists were obtained from turfgrass and culture collections, isolated in the laboratory and screened in the greenhouse for effectiveness. Promising isolates were then grown on cornmeal or chopped wheat and field tested on an established experimental green of Penncross creeping bentgrass. The most effective isolate, *Fusarium heterosporum*, reduced dollar spot intensity in the field by 93% in 1987 when applied weekly as a sand-cornmeal top-dressing, and by 86% in 1988 when applied at half the 1987 rate. Biweekly applications and applications of killed media were only slightly less effective. The killed media experiments suggest that the effect of the antagonist is achieved by the production of a toxin, rather than through competition or parasitism.

continued on page 5

Scanning the Journals

A review of current journal articles

Dollar spot was more severe at the higher cutting height and higher seeding rate.

Perennial ryegrass absorbs foliar applied N from the three sources studied with equal facility, even though there are differences in the metabolism of the nitrate and ammonia ions.

With an improved organic carrier allowing lower application rates, a sound theoretical basis for the biological control of dollar spot can be developed.

Turfgrass Pesticide Leaching Studies

continued from cover

The results of this initial study seem to indicate that turfgrass areas are at a relatively low risk for pesticide leaching.

the amount of each pesticide applied varied. Eighteen grams of chlorothalonil, 11.0 g of carbaryl, 1.5 g of 2,4-D, and 0.56 g of dicamba were applied to each plot.

Two leaching regimes were under investigation: once per week (1X) and three times per week (3X). In both cases irrigation continued until leachate began to drain from the lysimeters. The leaching experiment began on the day prior to the pesticide applications when the plots were irrigated to saturate the soil. Two days after the pesticide applications leaching was initiated on the 3X plots. Seven days elapsed before the first leaching occurred on the 1X plots. The effects of two separate applications of pesticide were measured. The first test began on October 11, 1989 and the second test was started on July 24, 1990.

A second trend was that the recovery of pesticide in the leachate was related to the solubility of the pesticide and to the adsorption ratings of the pesticides. So, as a percentage of the pesticide applied, more dicamba was found in the leachate compared to 2,4-D, carbaryl or chlorothalonil. Table 2 presents data from the 1990 test; unfortunately chlorothalonil data was available only for the 1989 fall test. Very little of the applied carbaryl was found at all in any plots with recoveries ranging from 0.1 % to zero. In 1989 the percentage of chlorothalonil leached was much lower than for the other pesticides. The most recovered from any plot was 0.276 mg (0.0004 % of total applied) of material, in the leachate from the Hudson soil leached three times per week.

A third trend in the data was related to the leaching treatment and the relationship between the leaching regime and soil type. More pesticide was recovered in the leachate from the 3X sand and the 3X Hudson soil compared to the 1X leaching regime. Further, much more pesticide was leached from the sand than from the Hudson soil. In contrast, approximately the same amount of pesticide was leached from the Arkport soil under the two leaching conditions. If the comparison is made between the Hudson and Arkport soils then more pesticide was leached from the Hudson under the 3X treatment but the reverse appeared to hold true for the 1X leaching regime.

Fourth, the type of soil and the type of pesticide appeared to affect the length of time it took for the maximum concentration of a pesticide to leach through the soil. Data from the summer test indicated that most of the pesticide leached from the Hudson soil 3X treatment was leached after the first irrigation, two days after the application of material. Very little material was recovered in the rest of the study from the Hudson plots. In contrast the greatest concentrations of 2,4-D and dicamba leached through the 3X sand 12 days and 9 days after application respectively. The peak concentration of carbaryl was also recorded 9 days after the application of the pesticide. Peak concentrations of pesticide from the 1X sand occurred 15 days after treatment for all three chemicals.

An unexpected result of the experiment was that the maximum amount of leaching from the 3X Hudson soil plots occurred after the first irriga-

Table 1. Solubility and adsorption characteristics for the pesticides used in the leaching studies.

Pesticide	Water Solubility	Soil Adsorption
Dicamba	high	very limited
2,4-D	high	very limited
Carbaryl	slight	moderate
Chlorothalonil	insignificant	substantial

Table 2. Fraction of applied pesticide recovered in the leachate. Summer 1990 test.

Soil Type	Leaching Regime	Total Pesticide Leached: Dicamba	Total Pesticide Leached: 2,4-D	Total Pesticide Leached: Carbaryl
	(per week)	(% of total applied)	(% of total applied)	(% of total applied)
Sand	1X	0.82	0.12	0.004
	3X	4.31	0.86	0.018
Arkport	1X	0.012	0.0014	0
	3X	0.004	0.0004	0
Hudson	1X	0.012	0.00015	0
	3X	0.04	0.005	0.0002

Results

One of the more striking trends from both tests was that the levels of pesticide leaching were generally small. The greatest amount of pesticide leached was 21 mg, which occurred twice, in both instances from the 3X sand plots. In the fall test 21 mg of 2,4-D was recovered in leachate (1.4 % of applied) and in the summer 21 mg of dicamba was recovered in leachate (4.3 % of applied). The greatest amount of pesticide leached from either the Hudson soil or the Arkport soil was 4 mg of carbaryl (0.04 % of applied) in the fall test from the Hudson 3X plot.

Scanning the Journals

continued from page 3

tion. It had been expected that the losses of pesticide in the leachate from the Hudson soil would have been small and slow to occur. One feature unique to the Hudson soil which may partially account for the rapid leaching was the presence of earthworms. Their burrows could provide channels for water carrying pesticides to leach rapidly from the soil. So, the potential for water to rapidly move to the drain lines combined with the short two day interval between the pesticide application and the first leaching event seemed to increase the risk for pesticide leaching. It is important to note that very little pesticide was found in the first leachate collected from the 1X plots. In this case the leaching event was seven days after the application of the pesticide. Apparently most of the pesticide became unavailable for leaching within seven days of being applied.

Summary

The results of this initial study seem to indicate that turfgrass areas are at a relatively low risk for pesticide leaching. Factors unique to the turfgrass system which may contribute to this lower risk are the high plant density and the presence of a thatch layer. Despite the general low risk though there are situations where leaching may be a potential problem, for example when soluble pesticides are applied to very sandy soils. By managing the selection of pesticide and the scheduling of irrigation the risk of leaching from turfgrass areas can be made even lower.

David B. Davidson
Dept. of Floriculture and Ornamental Horticulture

The workers conclude that with an improved organic carrier allowing lower application rates, and further research into the biology of the disease and the antagonist, a sound theoretical basis for the biological control of dollar spot can be developed.

(From: D.M. Goodman and L.L. Burpee, 1991. Biological Control of Dollar Spot Disease of Creeping Bentgrass. Phytopathology 81:1438-1446.)

Identity of Pythium Root Rot Pathogen

Pythium root and crown rot has become an increasingly severe problem in the northeastern U.S. Attacking nearly all species of cool-season turfgrass, the disease is favored by prolonged wet conditions at both high and low temperatures. Symptoms include root and crown decay, reduced stand density and vigor, leaf chlorosis, and in severe infestations, total loss of stand. Because the foliar symptoms of the disease are fairly nondescript, and because many *Pythium* species can be isolated from diseased (as well as healthy) turf, the identity of the causative agent of Pythium root and crown rot has remained something of a mystery.

Cornell researchers Eric Nelson and Cheryl Craft conducted laboratory, growth chamber and field studies of 121 *Pythium* isolates recovered from golf courses mostly within the upstate N.Y. area. The isolates were tested on creeping bentgrass and perennial ryegrass at high and low temperatures. Five species of *Pythium* were found to be pathogens of creeping bentgrass at cool temperatures, and three were also pathogenic at high temperatures. Three of the five species also attacked perennial ryegrass. *Pythium graminicola* was the pathogen most commonly isolated from diseased turf, and more isolates of this species expressed virulence toward both grass species at high and low temperatures than any other *Pythium* tested. The researchers conclude that *P. graminicola* is the most common cause of Pythium root and crown rot in N.Y. turfgrass.

(From: E.B. Nelson and C.M. Craft, 1991. Identification and Comparative Pathogenicity of Pythium sp. from Roots and Crowns of Turfgrasses Exhibiting Symptoms of Root Rot. Phytopathology 81:1529-1536.)

Though the identity of the causative agent of Pythium root and crown rot has remained something of a mystery, the researchers conclude that* P. graminicola *is the most common cause in N.Y. turfgrass.

Turfgrass Nematodes in New York State

continued from page 2

The information obtained from samples received in 1991 indicates the possibility that nematodes play an important role in turfgrass problems in general and that they may be especially damaging in the highly favorable environments found in golf course greens.

described in Zuckerman et al. (1990). Samples which yielded individuals from endoparasitic species after sucrose flotation were also processed by the pie pan method in order to gauge relative efficiencies of the two methods and to obtain more accurate estimates of nematode populations. When root samples were submitted without accompanying soil, a simplified shaker extraction procedure (Zuckerman et al., 1990) was employed to extract nematodes. Root tissues infected with root knot nematodes (*Meloidogyne* spp.) were further analyzed by *in situ* staining of a representative subsample with acid fuchsin, followed by dissection and/or crushing of the stained roots to estimate numbers of nematodes (Southey, 1986).

Identification of most nematodes was made to genus, due to lack of time and available resource materials. In some cases, root knot and cyst (*Heterodera* spp.) nematodes were identified to species by analysis of perineal patterns and vulval cone morphology, respectively. Table 4 summarizes information on the host distribution of plant parasitic nematodes recovered from 1991 samples. turfgrass nematode problems. The following tables summarize data concerning the nematode genera, mean numbers of individuals (expressed per 100 c.c. of soil), and ranges of individuals per samples observed. For convenience, several narrowly defined genera have been grouped together under more general classifications. These "form groups" include *Criconemoides* (comprising *Criconemella*, *Criconemoides*, and *Macroposthonia*; 'Ring' nematodes), *Trichodorus* (*Paratrichdorus* and *Trichodorus*; 'Stubby root' nematodes), and *Tylenchorhynchus (Merlinius*, *Quinisulcius*, and *Tylenchorhynchus;* 'Stunt' nematodes).

The types of nematodes observed in turfgrass samples from New York State agree fairly closely with reports from Illinois (Melton et al., 1986). Of the genera encountered in 1991 from turf samples, only four (*Tylenchorhynchus*, *Criconemoides*, *Helicotylenchus*, and *Meloidogyne*) can be directly linked to observed damage. Turf damage associated with infestations of stunt, ring, and spiral nematodes was only observed in samples from which relatively high populations of these

Table 4: Distribution of plant-parasitic nematodes by host plant (1991 data)

Nematode	Host												
	Apple	Bamboo	Boxwood	Clematis	Fava Bean	Grape-vine	Lettuce	Maize	Onion	Rasp-berry	Rose	Sour Cherry	Turf	Other
Aphelenchus	x		x			x				x		x		
Criconemoides	x									x			x	
Ditylenchus	x													
Gracilacus	x													
Helicotylenchus	x	x			x				x			x	x	
Heterodera	x												x	
H. avenae													x	
H. iri													x	
Heterodera sp.	x												x	
Hoplolaimus													x	
Longidorus													x	
Meloidogyne				x									x	
M. hapla				x								x		
M. javanica														x
Meloidogyne sp.													x	
Paratylenchus	x					x					x			
Pratylenchus	x	x			x			x		x	x	x	x	
Rotylenchus		x												
Tetylenchus	x													
Trichodorus			x						x					
Tylenchorhynchus	x						x		x				x	
Tylenchus	x		x		x		x			x		x	x	
Xiphinema	x	x				x			x	x		x		

More samples were received from golf course turf than from any other type of crop. More than a third (38.3%) of the total samples received from New York State came from golf course greens. Nematode parasitism of turfgrass is of great concern to course managers statewide, as evidenced by the number of samples submitted and telephone calls received by the Diagnostic Lab pertaining to nematodes were recovered. In such samples populations greater than 1,000 individuals per 100 c.c. of soil of these genera (either singly or in combination) seemed to be capable of causing noticeable damage, although in many cases damage was not evident unless the greens had been stressed. A sample received from the North Fork Country Club, in Cutchogue (Suffolk County) contained greater than 10,000 *Heliootylenchus* adults and juveniles per 100 c.c. of soil, in addition to a smaller (200 per 100 c.c.) population of *Criconemoides*, and was described by the course manager as being "severely damaged". A group of samples received from the Preakness Hills Country Club in Wayne, New Jersey contained very high numbers of ring nematodes (ranging from 2,890 to 8,270 individuals per 100 c.c.), and these samples were obviously damaged. Interestingly, no other plant parasitic nematodes were detected in these samples. Relatively small recoverable populations (on the order of 100 or greater individuals per 100 c.c.) of root knot nematodes seemed to be capable of damaging turf. Some samples from greens that showed signs of damage contained moderate levels of cyst nematodes, but further study is needed to clearly define what constitutes a "damaging populations" of *Heterodera*.

No definite linkage between populations of other nematodes and damage to turfgrass can be established from these data, although genera such as *Hoplolaimus*, *Pratylenchus*, and *Longidorus* have been shown to damage turf in other studies (Smiley, 1983). The common appearance of members of the genus *Tylenchus* (or possibly related genera) is interesting, although little is known about the damage-causing potential of these small nematodes. Representatives of the genera *Belonolaimus* ('sting'), *Paratylenchus* ('pin'), *Trichodorus* ('stubby root'), and *Xiphinema* ('dagger') were not observed in turfgrass samples from New York State in 1991. These genera have been reported to cause damage to turf in Illinois, however (Melton et al., 1986), samples received from golf courses in other states were similar in nematode genera observed, in population levels of nematodes associated with observable damage, and in relative frequency of the major genera of turfgrass nematodes.

The information obtained from samples received in 1991 indicates the possibility that nematodes play an important role in turfgrass problems in general and that they may be especially damaging in the highly favorable environments found in golf course greens. Samples received in 1992 (and in subsequent years) will hopefully serve to further define the ranges, damaging population levels, and occurrence of turfgrass nematodes in New York State.

PETER MULLIN, DEPT. OF PLANT PATHOLOGY

Table 5: Genera of plant parasitic nematodes extracted from all turfgrass samples, 1991

Genus (Common name)	Samples containing genus Number	Percent	Mean # per sample (with range of #'s)
Criconemoides (ring)	20	64.5	1380 (20-8270)
Tylenchorhynchus (stunt)	20	64.5%	240 (10-2345)
Helicotylenchus (spiral)	11	35.5	1115 (10-10000)
Hoplolaimus (lance)	11	35.5	50 (10-140)
Tylenchus	9	29.0	645 (15-5470)
Heterodera (cyst)	9	29.0	42 (5-175)
H. avenae	3	9.7	29 (6-45)]
H. iri	1	3.2	175 (175)]
Heterodera sp.	5	16.1	24 (5-45)]
Meloidogyne (root knot)	6	19.4	271 (1-960)
M. hapla	2	6.4	481 (1-960)]
Meloidogyne sp.	4	12.9	166 (25-385)]
Pratylenchus (lesion)	5	16.1	20 (10-25)
Longidorus (needle)	3	9.7	20 (10-35)

Table 6. Genera of plant parasitic nematodes extracted from New York State turfgrass samples, 1991

Genus (Common name)	Samples containing genus Number	Percent	Mean # per sample (with range of #'s)
Tylenchorhynchus (stunt)	15	83.3%	135 (10-600)
Criconemoides (ring)	9	50.0	170 (60-280)
Helicotylenchus (spiral)	8	44.4	1520 (10-10000)
Hoplolaimus (lance)	8	44.4	60 (15-140)
Meloidogyne (root knot)	6	33.3	271 (1-960)
M. hapla	2	11.1	481 (1-960)]
Meloidogyne sp.	4	22.2	166 (25-385)]
Tylenchus	6	33.3	40 (15-125)
Heterodera (cyst)	6	33.3	32 (6-45)
H. avenae	3	16.7	29 (6-45)]
Heterodera sp.	3	16.7	35 (20-45)]
Pratylenchus (lesion)	4	22.2	15 (10-25)
Longidorus (needle)	1	5.5	20 (20)

Table 7: Distribution by county of turfgrass nematodes in New York State, 1991

Criconemoides	Monroe, Nassau, Suffolk, Westchester
Helicotylenchus	Albany, Nassau, Suffolk, Westchester
Heterodera	Westchester
H. avenae	Westchester
Heterodera sp.	Westchester
Hoplolaimus	Monroe, Nassau
Longidorus	Nassau
Meloidogyne	Monroe, Oswego, Sullivan, Westchester
M. hapla	Monroe, Oswego
Meloidogyne sp.	Sullivan, Westchester
Pratylenchus	Oswego, Westchester
Tylenchorhynchus	Albany, Monroe, Nassau, Oswego, Sullivan, Westchester
Tylenchus	Albany, Oswego, Sullivan, Westchester

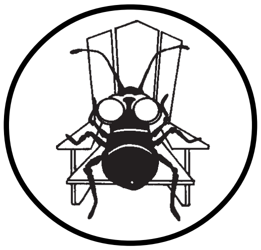
References

Melton, T.A., R.B. Malek, and M.C. Shurtleff. 1986. Nematode Parasites of Turfgrass. Illinois Cooperative Extension Service Report on Plant Diseases no. 1108. University of Illinois at Urbana-Champaign.

Smiley, R.W. 1983. Compendium of Turfgrass Diseases. The American Phytopathological Society, St. Paul, Minnesota. 102 pp.

Southey, J.F., ed. 1986. Laboratory Methods for Work with Plant and Soil Nematodes, 6th edition. Ministry of Agriculture, Fisheries and Food Reference Book 402. Her Majesty's Stationery Office, London. 202 pp.

Zuckerman, B.M., W.F. Mai, and L.R. Krusberg. 1990. Plant Nematology Laboratory Manual. Agricultural Experiment Station, University of Massachusetts, Amherst. 252 pp.



Pest Watch

Planning a weed management program where herbaceous ornamentals are present requires careful evaluation of all options before a herbicide is applied.

Spring Weed Control Calendar

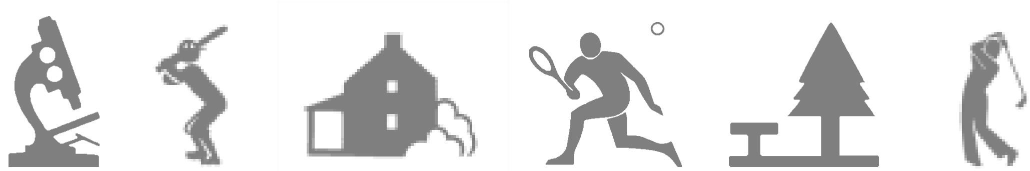
Mid- to Late March:	Replenish mulch in landscape beds. If a preemergent herbicide is needed, apply this before replenishing mulch. If herbaceous ornamentals are present or will be planted later in the season, **make your product selection carefully as many species may be injured by preemergent herbicides.**
Mid- to Late April:	Preemergent herbicide application for crabgrass control. See the Cornell Recommends and/or CUTT V.1(1) for the available options.
Mid-May:	Postemergent herbicide applications for broadleaf weed control (if you did not do so in the fall). See CUTT V.1(3) and the Cornell Recommends for the available options.
Early Summer:	Begin scouting for escaped crabgrass, emerging goosegrass, spurge, knotweed, oxalis, and nutsedge. For best results, make postemergent crabgrass control treatments when the weeds are young. Also, plan for nutsedge control treatments commencing in late June.

Weed Management in Herbaceous Ornamentals

Planning a weed management program where herbaceous ornamentals are present requires careful evaluation of all options before a herbicide is applied. Use mulches supplemented with manual removal. Where these measures have been inadequate, you may wish to select a herbicide. A new publication, *Weed Management Guide for Herbaceous Ornamentals*, by Andrew Senesac and Joseph Neal, is available to assist you in planning your weed management program in and around herbaceous ornamentals. This publication explains the options available, describes the registered herbicides, and contains tables of ornamental species registered as well as weeds controlled by each herbicide. If a herbicide is to be used, it is often desirable to plant only those ornamental species which are on the herbicide label. To this end, this publication should be consulted **before you plant.** Planning before you plant can help avoid weed management problems later in the season.

Weed Management Guide for Herbaceous Ornamentals sells for $1.25. To obtain a copy, write to Dr. Neal at the Dept. of Floriculture and Ornamental Horticulture, Cornell Univ., Ithaca NY 14853. All New York State Turfgrass Association members will be receiving a copy of this publication in the near future, compliments of NYSTA.

Joseph C. Neal
Dept. of Floriculture and Ornamental Horticulture



Cornell Cooperative Extension

Cornell University Turfgrass Times
20 Plant Science Building
Cornell University
Ithaca, NY 14853