Fusarium Blight

continued

may result in poor water penetration and predispose the turf to stress conditions. Irrigation practices based on weather requirements or a time clock may be a factor in creating less than optimum growing conditions. Nutrient levels used to maintain turf at a specific aesthetic quality may be providing nutrients favorable for pathogen buildup. In some cases, one may question major shifts in climate or community design that favor the buildup of disease-causing organisms.

Improved turfgrass varieties may be a better host for the pathogen or provide better microclimate conditions for the fungus to grow. A greater need for instant grass has resulted in more sod being grown on soils that may be contaminated with *Fusarium,* or there may be selectivity for *Fusarium* associated with the use of fungicides or related pesticides. The changing air pollution load in some areas may be associated with stress. Sod handling practices by subcontractors leave much to be desired at times when sod stress is the issue. The degree of *Fusarium* blight indicates that the complexity of the problem is more than realized initially. To determine whether this is strictly associated with the pathogen or whether changing cultural practices also influence the level of stress will require further research to identify the situation as it currently exists.

Effects of Cultural Practices On Fusarium Blight Incidence In Kentucky Bluegrass

by A. J. Turgeon

Diseases of turf result from the combination of a susceptible host and environmental conditions conducive to the pathogenic activity of specific disease-causing organisms. For example, leaf spot *(Helminthosporium vagans)* disease typically occurs in susceptible varieties of Kentucky bluegrass under the cool, moist conditions occurring in midspring, while brown patch *(Rhizoctonia solani)* develops on closely clipped turfs during the hot, humid weather of midsummer. However, the extent of turfgrass deterioration from pathogenic organisms is frequently associated with additional factors as well. The cultural program of fertilizing, mowing, and irrigating may substantially affect the severity of disease incidence in a turf during certain periods in the growing season.

Field research and practical experience in managing turfs have resulted in the evolution of certain principles of turfgrass culture that are based, in part, on the association of mowing height and frequency, fertilization rate and timing, and other such factors with the incidence and severity of diseases. Most of these observations have been on Kenblue-type (common) or Merion Kentucky bluegrasses and traditionally have used cultivars of other turfgrass species. Today, increasing numbers of superior cultivars are being planted for many different uses and cultural intensities. Questions arise regarding the application of established principles of culture to the newer varieties. Apparent differences in turfgrass density, vigor, disease susceptibility, and other parameters suggest that the principles of culture may change somewhat from cultivar to cultivar.

A study was initiated at the University of Illinois in which five Kentucky bluegrass cultivars (Nugget, Merion, Fylking, Pennstar, and Kenblue) were maintained under two mowing heights 0.75 and 1.5 inches) and four fertilization regimes (2, 4, 6, and 8 pounds of nitrogen per 1,000 square feet annually) beginning April, 1973. By early August, with half of the fertilizer applications made, differential development of *Fusarium* blight disease was observed in plots (Turgeon and Meyers, 1974). Generally higher spring fertilization rates were associated with substantially higher incidence of the disease in summer. This was evident in all cultivars except Kenblue, which was severely affected regardless of fertility level. Pennstar was essentially unaffected at the lowest (2 pounds) level of nitrogen fertilization, while slight to moderate blighting occurred in plots receiving the 4-pound level of nitrogen. The 6- and 8-pound nitrogen levels were associated with a severe incidence of *Fusarium* blight. Fylking was slightly to moderately blighted at the 2- and 4-pound nitrogen lev-

Table 1. Effects of Mowing Height and Fertilization on the Incidence of Fusarium Blight Disease in Seven Kentucky Bluegrass Varieties in 1975[a]

Mowing height (in.)	Fert.[b] (lb. N/ 1,000 sq. ft./yr.)	Variety						
		Windsor	A-20	Nugget	Merion	Fylking	Pennstar	Kenblue
.75	2	1.0	1.0	1.0	1.3	1.3	1.3	5.7
1.50	2	1.0	1.0	1.0	1.3	1.0	1.3	6.0
.75	4	1.0	1.0	1.0	1.3	1.7	2.0	5.7
1.50	4	1.0	1.0	1.0	1.3	1.7	1.3	4.7
.75	6	1.0	1.0	1.0	2.0	4.0	4.7	6.0
1.50	6	1.0	1.0	1.0	2.0	2.7	4.3	5.7
.75	8	1.0	1.0	1.7	4.3	6.0	6.3	7.0
1.50	8	1.0	1.0	1.3	4.3	5.0	6.0	7.0

[a] *Visual ratings of disease were made using a scale of 1 through 9 with 1 representing no disease and 9 representing complete necrosis of the turf.*

[b] *Fertilization was performed using a 10-6-4 ($N:P_2O_5:K_2O$) analysis water-soluble fertilizer applied in equal amounts in April, May, August, and September for two years on Windsor and A-20 and for three years on Nugget, Merion, Fylking, Pennstar, and Kenblue.*

Table 2. Relative Susceptibility of Kentucky Bluegrass Varieties to Fusarium *Blight in Illinois*

Disease susceptibility levels						
High	**Moderate**		**Low**		**No symptoms**	
Delft	**Ba 61-91**	**Kenblue**	**A-34**	**Merion**	**A-20**	**Monopoly**
EVB-305	**Brunswick**	**IL-3817**	**Ba 62-55**	**Cheri**	**Adelphi**	**P-59**
K1-138	**EVB-307**	**Nugget**	**Baron**	**Parade**	**Campina**	**P-140**
	Fylking	**PSU-197**	**Bonnieblue**	**Plush**	**Edmundi**	**PSU-150**
	Geronimo	**Park**	**EVB-391**	**PSU-169**	**Glade**	**Sodco**
	K1-157	**Pennstar**	**Galaxy**	**PSU-190**	**K1-132**	**Touchdown**
	K1-187	**RAM No. 2**	**K1-131**	**RAM No. 1**	**K1-143**	**Victa**
			K1-133	**Sydsport**	**Majestic**	**Windsor**
			K1-155	**Vantage**		
			K1-158			

els and severely diseased at higher levels. Merion responded in much the same manner as Pennstar, and Nugget was largely unaffected except at the highest nitrogen level. The incidence of *Fusarium* blight in Nugget, Merion, and Fylking was slightly higher in plots maintained at the 1.5-inch mowing height. No such difference was apparent in the Pennstar and Kenblue plots.

Continuation and expansion of this study with the inclusion of Windsor and A-20 Kentucky bluegrasses provided similar results during the next two growing seasons. No *Fusarium* blight symptoms were observed in Windsor or A-20, while Nugget, Merion, Fylking, and Pennstar characteristically showed more disease with increasing spring fertilization rates (Table 1). As in 1973 the severity of *Fusarium* blight disease was uniformly high in the Kenblue plots. Random probing of the plots revealed very severe soil compaction in the section of the field where the Kenblue plots were located, suggesting that compacted soil conditions may so weaken the turf that its susceptibility to *Fusarium* blight disease is much greater. Data from the Kentucky bluegrass variety plots, established in April, 1972, do not show Kenblue to be inherently more susceptible to *Fusarium* blight than Fylking, Pennstar, or Nugget under a moderate intensity of culture (4 pounds of nitrogen per 1,000 square feet a year, 1.5 inches mowing height) and fairly uniform soil physical conditions (Table 2).

Based on these observations, the varieties Deltt, EVB-305, and K1-138 should not be planted on sites where *Fusarium* blight is a concern; other varieties, including A-20, Adelphi, Glade, Majestic, Sodco, Touchdown, and Victa, appear promising because of the apparent lack of *Fusarium* blight symptoms during the period of observation.

Another factor believed to be of importance in the development of *Fusarium* blight disease is thatch. Many turfgrass scientists feel that the susceptibility of a turf to *Fusarium* blight may be greatly increased where substantial levels of thatch have been allowed to develop. While this may be true, there was no clear correlation between the thatching tendency of Kentucky bluegrass varieties (Table 3) and their relative susceptibility to *Fusarium* blight. For example, Touchdown Kentucky bluegrass was the most thatch-prone variety — its thatch layer averaged over 1.9 centimeters thick — while Park was the least thatch-prone variety, with only 0.71 centimeters of thatch. Yet, Park was found to be moderately susceptible to *Fusarium* blight while Touchdown showed no symptoms of the disease. Since recent results from tests at Rutgers showed that *Fusarium* blight incidence in Kentucky bluegrass varieties was dramatically increased where thatch-inducing calcium arsenate was applied to the plots (Funk, 1975), it is likely that thatch development is associated with more severe incidence of this disease in susceptible varieties. However, this relationship apparently does not exist when comparing the differenctial thatching tendency and *Fusarium* blightsusceptibility of different Kentucky bluegrass varieties.

An additional factor frequently associated with the severity of turfgrass diseases is whether or not clippings are removed as part of the mowing operations. Results from a study initiated in early 1974 showed that, at high nitrogen fertilization rates, the severity of *Fusarium*

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Table 3. Relative Thatching Tendency of Kentucky Bluegrass Varieties During the Fourth Season After Planting

Thatch depth, cm[a]	Varieties
More than 1.50	**Brunswick, EVB-305, Glade, Cheri, Nugget, P-140, RAM No. 1, Touchdown**
1.50 - 1.25	**A-20, Ba62-55, Baron, EVB-391, Fylking, K1-131, K1-132, K1-143, K1-187,Majestic, P-59, Plush, PSU-190, RAM No. 2, Sodco, Victa**
1.25 - 1.00	**A-34, Adelphi, Ba 61-91, Bonnieblue, Campina, Delft, Edmundi, EVB-307, Galaxy, Geronimo, K1-133, K1-138, K1-155, K1-157, K1-158, IL-3817, Merion, Monopoly, Parade, Pennstar, PSU-150, PSU-169, Sydsport, Vantage, Windsor**
Less than 1.00	**Kenblue, Park, PSU-197**

[a]*Thatching depth was determined by measuring the thickness of the thatch at four places on two plugs 2 inches in diameter taken from each of the three replicate plots of each variety.*

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blight was reduced by clipping removal (Table 4). The basis for this relationship is not clearly understood; however, it does appear that clipping removal with mowing should be considered on highly fertilized sites where *Fusarium* blight has been a recurring problem.

Table 4. Effects of Clipping Removal and Fertilization on Fusarium *Blight Incidence in Kenblue Kentucky Bluegrass Turf*

Fertilization[a] (lb. N/1,000 sq. ft./yr.)	*Fusarium* blight rating[b]	
	Clippings removed	Clippings returned
2	1.3	1.2
5	1.5	1.7
8	1.5	3.7

[a] *A 10-6-4 ($N:P_2O_5:K_2O$) analysis water-soluble fertilizer was applied in equal amounts in April, May, August, and September for two years.*
[b] *Visual ratings of disease were made using a scale of 1 through 9 with 1 representing no disease and 9 representing no disease and 9 representing complete necrosis of the turf.*

A final cultural factor of importance in controlling *Fusarium* blight is irrigation. This is most evident during midsummer stress or drouthy periods when light watering has been instrumental in reducing disease symptoms and promoting turfgrass survival. A turf with a deteriorated root system cannot survive prolonged stress periods unless supplemental irrigation is frequent enough to prevent dessication of the plants. Although this practice is inconsistent with traditional principles of turfgrass culture, it may be necessary for the survival of a severely diseases turf.

In conclusion, there are two fundamental approaches
to controlling *Fusarium* blight in Kentucky bluegrass. The "environmental-oriented" approach is to adjust the cultural program by avoiding excessive nitrogen fertilization during spring, providing adequate moisture for turfgrass survival during stress periods through irrigation, performing appropriate cultivation practices to control thatch and alleviate soil compaction and applying effective fungicides properly. The "plant-oriented" approach involves the introduction of superior Kentucky bluegrass varieties that, under local conditions, do not appear to be adversely affected by the *Fusarium organism.*

LITERATURE CITED

Funk, C. R. 1975. Personal communication.
Turgeon, A. J., and W. R. Meyer. 1974. Effects of mowing height and fertilization level on disease incidence in five Kentucky bluegrasses, *Plant Dis. Reporter* 58:514-516.

The Role of Nematodes in the Development of Fusarium Blight

by J. M. Vargas, Jr.

Extensive surveys were made to determine if factors other than *Fusarium roseum* and *Fusarium tricinctum* were involved in the development of *Fusarium* blight. The surveys revealed that high populations of nematodes, especially the nematodes *Tylen-chorhynchus dubius* and *Creconemoides* spp., occured in *Fusarium*-blighted turfs.

A greenhouse study was conducted to determine what role, if any, the stunt (*T. dubius*) nematode played in the development of *Fusarium* blight. In this study, only *T. dubius* was able to produce most severely stunted top growth and root system, the two characteristic symptoms normally associated with *Fusarium* blight-infected turfgrass plants. The *F. roseum*-treated plants had reduced root and top growth, but the reduction was not significant when compared to the untreated controls. It appeared that the nematode was the dominant pathogen in the *F. roseum/T. dubius* interaction, which is responsible for *Fusarium* blight in Michigan. It must be remembered that Michigan is really borderline for *Fusarium* blight development. Michigan does not have the long periods of hot, humid weather normally associated with *Fusarium* blight development in more southern areas. In fact, our *Fusarium* blight outbreaks usually occur during periods of drought stress, whether it is hot and dry or cool and dry. Our worst outbreaks have been in late September and early October when the daily temperature did not go above the high 70's. So while the nematodes may be important in Michigan and other northern edges of the *Fusarium* blight region, they may not be as important in the more southern regions.

Before we had determined that nematodes were involved in the disease interaction, we had obtained control of the disease with the systemic fungicide Tersan 1991, but only where we drenched the material into the root zone. We originally thought this was related to the upward translocation in the plant of the systemic fungicide. These results were puzzling in light of the involvement of the nematodes in the development of the disease. Upon further investigation, Tersan 1991 was shown to be a nematicide in addition to a systemic fungicide. We now believe if it is drenched into the root zone and grass plants roots will pick it up and prevent nematodes from feeding. Tersan 1991, of course, can also protect the plant from infection by the *F. roseum* fungus. If *Fusarium* blight is an interaction between a nematode and a fungus, with the nematode being the dominant pathogen, then one should be able to control the disease with nematicides Dasanit and Oxymal. However, it appears that they must be applied early in the season, before the *Fusarium* blight symptoms begin to appear.

Drought stress appears to be the main factor in symptom development after infection has taken place. This is logical, since you have a weakened grass plant with a poorly developed root system; as soon as drought stress is applied, it will begin to wilt and eventually die. Light, frequently watering of *Fusarium*-blighted turfs during periods of drought stress can prevent *Fusarium* blight symptom development. During hot, dry weather, syringing lightly about midday may also be necessary, and symptom development of the disease can be prevented by following such a watering program. Not enough information is known to make recommendations concerning varieties that are resistant to *Fusarium* blight. However, there is enough evidence to show that Merion, Fylking, and Pennstar are three very