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Clippings Disposal and Fertilization Influence Disease in Perennial Ryegrass Turf

J.H. Dunn[1], D.D. Minner[2], B.F. Fresenburg, and S.S. Bughrara[3]
Department of Horticulture, University of Missouri, Columbia, MO 65211

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Abstract. **We evaluated the effect of fertilization treatments in combination with clippings disposal on perennial ryegrass (*Lolium perenne* L.) in two adjacent locations. Clippings left on turf during mowing decreased dollar spot (*Sclerotinia homoeocarpa* F.T. Bennett) in both locations during three summers compared with clippings removed in mower baskets. However, brown patch (*Rhizoctonia solani* Kuhn) increased during July and Aug. 1995 when clippings were left on turf. Dollar spot was more severe with N (kg·ha^{-1}·year^{-1}) at 120 compared to 240; brown patch was more severe at 240. While clippings disposal had significant effects on disease incidence, implementation may not be practical because of the contrary responses of the observed diseases to this management approach.**

Use of perennial ryegrass on golf course fairways in the Midwest Transition Area is limited compared with other areas of the United States. Management of perennial ryegrass in summer in the Midwest Transition Area is difficult because high temperature and humidity create an ideal environment for dollar spot, pythium (*Pythium* sp.), brown patch, and other warm weather diseases. Researchers have made little improvement in perennial ryegrass disease resistance through traditional breeding methods (Vargas, 1994). Midwest turfgrass managers who choose to grow perennial ryegrass must still rely heavily on timely management practices to reduce disease.

Nutrition often influences disease incidence. For example, brown patch in turfgrass is often associated with high levels of applied N (Bloom and Couch, 1958; Britton, 1969; Schumann, 1992). Dollar spot occurs more often when turfgrass is deficient in N (Cook and Engel, 1964; Markland et al., 1969; Schumann, 1992). There is little evidence that potassium by itself may reduce disease incidence (Watschke et al., 1995). In fact, increased disease has sometimes been observed in response to increasing K (Waddington et al., 1978). However, an adequate K level is needed for healthy turfgrass and increasing K levels may allow turfgrass managers to use lower amounts of N while maintaining quality turfgrass (Christians et al., 1979). Likewise, iron in combination with lower N rates may be used to enhance greenness (Yust et al., 1984).

Clippings provide a source of N and other nutrients for the turfgrass plant (Vargas, 1994). Generally, turfgrass specialists recommend leaving clippings on higher mowed turf if they are not excessive, and removing clippings from closely mowed sports turf where they interfere with play (Turgeon, 1996). While researchers have demonstrated relationships between N and certain diseases, the effect of clippings removal on disease has not been established. Colbaugh and Knoop (1989) reported that *Drechslera* and *Bipolaris* sp. conidial populations were highest in warm-season bermudagrass (*Cynodon* sp.) when clippings were left on turf. However, disease symptoms were not apparent in their study. There is little evidence showing that clippings left on turf will encourage disease in cool season grasses (Vargas, 1994). The objective of our study was to determine the effect of N rate and clippings disposal on disease incidence and quality of perennial ryegrass.

Materials and Methods

We established the experiment in 1991 on a Mexico silt loam soil (fine, montmorillonitic, mesic Mollic Endoaqualfs) in two adjacent locations, henceforth referred to as L and J. Location L soil contained 4.4% organic matter (OM), P at (kg·ha^{-1}) 105, K at 580, and had a pH of 6.8; the values for location J soil were 4.2% OM, 99 P, 525 K, and pH 6.5. We seeded both locations with a blend of equal amounts of 'Achiever', 'Edge', 'Cutter', and 'Morningstar' perennial ryegrasses at 244 kg·ha^{-1} on 4 Sept. Turf was watered as needed during establishment and thereafter to prevent drought stress, and was mowed with a 3-reel (triplex) unit at 16 mm three times weekly. Clippings remained on plots during the first year of the study, 1992. We applied *N*-(1-ethylpropyl)-3,4 dimethyl-2,6 dinitrobenzenamine (pendimethalin) at 1.68 kg·ha^{-1} in April and May each year of the study to prevent annual grass germination. Broadleaf infestations were controlled, as needed, with applications of dimethylamine salts of 2,4-dichlorophenoxyacetic acid (2,4-D) at 1.36 kg·ha^{-1} + (±)-2-(4-chloro-2 methylphenoxy) propanoic acid (mecoprop) at 0.6 kg·ha^{-1} + 3,6-dichloro-o-anisic acid (dicamba) at 0.11 kg·ha^{-1}.

We initiated fertilization treatments in spring 1992. Nitrogen source was 50% urea (46N–0P–0K) and 50% isobutylidene diurea (31N–0P–0K), with the exception of March and November when only urea was applied. Six treatments of N at 120 kg·ha^{-1}·year^{-1} and six at 240 kg·ha^{-1}·year^{-1} were combined with several K (0 or 96 kg·ha^{-1}·year^{-1}) and Fe (0 or 48 kg·ha^{-1}·year^{-1}) treatments to give a total of 12 fertilizer treatments. However, K and Fe had no significant effect on disease or turfgrass quality. Therefore, treatments with the same N rates were pooled to determine the effect of N at 120 kg·ha^{-1} compared with 240 on turfgrass disease and quality.

Beginning 1 July 1993, we collected clippings in triplex mower baskets from one-half of each fertilization plot. Clippings were not collected from the remaining half of each plot. The design was a split plot with three replications, fertilization treatments as whole plots and clippings disposal as subplots.

We estimated severity of diseases as they occurred, using a scale of 1 (no disease) to 9 (100% of turf affected). Disease scores were transformed using $\sqrt{\text{score} + 0.5}$ because there was a linear relationship between mean score and the residual for Error B. Mean separation was done on this scale using one degree of freedom F tests. Score means are reported. Brown patch and dollar spot diseases were not difficult to visually separate because of the distinct differences in appearance. Dollar spot lesions were typically 5 to 7 cm in diameter and affected turf was straw colored. Brown patch was ≈12 to 24 cm in diameter and affected turf was brown to rust colored. Also, both diseases rarely occurred in the same plot. Our report of disease extent is based on ratings after we began collecting clippings in July 1993. We evaluated turf once per month for quality, beginning in June 1993 using a rating scale of 1 to 9 (best quality).

Results and Discussion

Higher N levels in location L and clippings left on turf in both locations gave small but significant reductions in dollar spot infestations in Aug. 1993 (Table 1). In Summer 1994 and 1995, higher N and clippings left on plots suppressed dollar spot more effectively than in 1993. We identified brown patch in the turf in late July and early Aug. 1995. Infestations were particularly severe where the high N rates were applied and where clippings were left on the turf. This effect on brown patch was contrary to the positive effect of higher N and clippings left on turf in suppressing dollar spot.

Significant N × clippings disposal interactions on disease occurred only in location J,

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[1]To whom reprint requests should be addressed.

[2]Current address: Dept. of Horticulture, Iowa State Univ., Ames, Iowa 50011.

[3]Current address: Dept. of Agronomy, Univ. of Missouri, Columbia, MO 65211.

July and Aug. 1995. In July, a combination of N at 240 kg•ha^{-1}•year^{-1} + clippings left suppressed dollar spot (disease rating 1.1) in contrast to the most disease (disease rating 4.7) with N at 120 + clippings removed. However, in Aug., N at 240 + clippings left enhanced brown patch (disease rating 3.1) compared with N at 120 + clippings removed (disease rating 1.5), an observation that was contrary to the July effect of N and clippings on dollar spot.

The reasons for effects of clippings disposal on disease occurrence are unclear. However, N is recycled to turf when clippings remain on the turf and a source of N is lost when clippings are removed. Earlier research suggests that higher N levels tend to suppress dollar spot but may enhance brown patch (Bloom and Couch, 1958; Cook et al., 1964). Therefore, clippings disposition and N treatments may have had an additive effect on these diseases. Also, clippings may contain a source of disease inoculum that is either left or removed from the turf, according to clippings disposal.

Turfgrass quality in July and August was consistent with the extent of dollar spot and brown patch infestations as influenced by fertilization and clippings disposition. In July and Aug. 1994, quality of turf receiving annual N treatments totaling 240 kg•ha^{-1}•year^{-1} and turf with clippings left was higher than for turf receiving N at 120 and turf with clippings removed, as dollar spot became most evident during July in the low N turf and in turf with clippings removed (Table 2). Turf quality was higher in location J with clippings left compared with clippings removed during June 1994, but this was not associated with disease.

In July 1995, quality of turf receiving annual N applications totaling 240 kg•ha^{-1}•year^{-1} and turf with clippings left was once again higher than for turf given the lower N at 120 and with clippings removed, as dollar spot infested these turfs (Table 2). In Aug. 1995, all turf showed poor quality as dollar spot activity continued in the low N turf and in turf with clippings removed, and brown patch affected turf receiving high N and turf with clippings left (we did not notice any brown patch in turf in 1994). Quality of turf infested with brown patch was slightly lower in Aug. 1995 compared with dollar spot-infested turf.

In summary, N at 240 kg•ha^{-1}•year^{-1} was associated with less dollar spot but worse infestations of brown patch in perennial ryegrass. These observations are similar to earlier reports of N effects on brown patch and dollar spot in other turfgrass species (Schumann, 1992). Clippings left on turf suppressed dollar spot but enhanced brown patch. Our findings contribute new knowledge regarding the influence of clippings disposal on perennial ryegrass, a subject on which information was previously lacking (Vargas, 1994). However, if short-term clippings disposition influences disease, practical implementation to suppress dollar spot must be coordinated with a procedure for closely monitoring weather conditions. This would be necessary to predict occurrence of brown patch and other diseases that might be enhanced by leaving clippings on turf. In the Midwest Transition Area, this might be difficult to accomplish because of rapidly fluctuating temperatures and humidity. Also, the influence of clippings disposition on disease may be a cumulative process over many weeks, and short-term disposition may have less influence on disease.

Table 1. Disease rating (1 = least, 9 = most) for perennial ryegrass turf at two locations in response to nitrogen and clippings disposal.

		Disease rating				
		Dollar spot			Brown patch	
Location	Treatment	Aug. 1993	July 1994	July 1995	July 1995	Aug. 1995
		N (kg•ha^{-1}•year^{-1})				
L	240	3.1	2.2	1.8	1.9	2.6
	120	4.1	3.6	3.1	1.3	1.6
		*	**	NS^z	NS^z	**
J	240	3.1	2.1	1.9	2.5	2.3
	120	3.4	2.9	4.3	1.4	1.6
		NS	**	**	*	*
		Clippings				
L	Left	3.3	2.1	1.8	1.8	2.9
	Removed	3.9	3.7	3.1	1.4	1.3
		*	**	**	**	**
J	Left	3.1	1.9	2.8	2.4	2.8
	Removed	3.7	3.1	3.4	1.5	1.2
		**	**	**	**	**

^{z}Significant at $P < 0.07$.
$^{NS, *, **}$Nonsignificant or significant at $P < 0.05$ or 0.01.

Table 2. Perennial ryegrass turf quality (1 = least, 9 = most) at two locations in response to nitrogen and clippings disposal.

		Quality rating					
Location	Treatment	June 1994	June 1995	July 1994	July 1995	Aug. 1994	Aug. 1995
		N (kg•ha^{-1}•year^{-1})					
L	240	4.9	5.4	5.2	5.9	5.4	3.5
	120	4.9	5.2	4.5	5.3	4.9	3.9
		NS	NS	NS^z	NS^z	**	*
J	240	5.1	5.3	5.3	6.0	5.4	3.6
	120	4.9	5.2	4.3	5.3	4.6	3.8
		NS	NS	*	**	**	NS
		Clippings					
L	Left	5.3	5.3	5.2	5.7	5.8	3.4
	Removed	4.6	5.3	4.5	5.5	4.5	3.9
		**	NS	**	**	**	**
J	Left	5.1	5.2	5.1	5.9	5.7	3.5
	Removed	5.0	5.3	4.4	5.4	4.3	3.9
		NS	NS	**	**	**	**

^{z}Significant at $P < 0.07$.
$^{NS, *, **}$Nonsignificant or significant at $P < 0.05$ or 0.01.

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