한잔지 : 5(1), 41~45, 1991

# 窒素質肥料의 形態와 窒酸化抑制劑가 세인트 어거스틴그래스의 브라운팻치 病發에 미치는 影響

金基善 · 黃煥朱*
서울大學校 農科大學 園藝學科

**Effects of the Form of Nitrogen Fertilizers and Nitrification Inhibitor on the Incidence of Brown Patch in St.Augustinegrass [*Stenotaphrum secundatum*(Walt.) Kuntze]**

**Kim, Ki-Sun, Hwan-Joo Hwang***
**Dept. of Horticulture, Seoul National University, Suwon 441-744**

## 摘 要

서양잔디중 난지형 잔디에 속하는 세인트 어거스틴그래스에서 암모늄태 질소와 질산태 질소질 비료의 시비가 브라운팻치 병 발생에 미치는 영향을 알아보고자 본 실험이 수행되었다.

포장에서 재배되고 있는 세인트 어거스틴그래스를 직경 10cm의 플러그를 굴취하여 플라스틱 포트에 이식한 후 뿌리의 활착을 위하여 온실내에서 한달간 재배하였고, 50kg N/ha의 성분비율에 맞추어서 균의 접종 1일전에 시비를 하였다. 잔디포장에서 분리한 *Rhizoctonia solani* 균을 agar 위에서 배양시킨 후 균이 배양되어 있는 agar block을 떼어서 태운 perennial ryegrass에 접종시켰다. 감염된 perennial ryegrass를 다시금 세인트 어거스틴그래스위에다 치상시켜서 잔디로의 접종을 꾀하였다.

그 결과 암모늄태 질소비료나 질산태 질소비료 그리고 무시비상태의 잔디에서의 병발생간에는 유의차가 인정되지 않았으나 질산화 억제제를 처리하여 암모늄상태의 질소성분이 질산태로 전환되는 것을 억제시킨 구에서는 타 처리구에 비하여 6~9배의 병발생율을 보였다. 따라서 잔디의 시비와 병발생을 연관시켜 볼 때 암모늄태 질소비료와 질산태 질소비료 공히 큰 차이는 없으나, 다만 질산태로 변한 후의 질소양분의 토양용탈로 인한 소모를 억제시키기 위하여 사용되는 질산화 억제제는 상당량의 암모늄태 질소성분을 상당기간동안 유지시키기 때문에 브라운팻치 병발생에 영향을 주므로 그 사용시기에 있어서 신중을 기하여야 하겠다.

## I. INTRODUCTION

Nitrogen has been intensively used and studied in relation to host nutrition and disease severity for many years because of its essential requirement for plant growth, its

*韓國放送通信大學 農學科(Dept. of Agronomy, Korea Air & Correspondence University, Seoul 110-510)

limited availability in soil, and its effects on cell size and wall thickness. However, it is known that high nitrogen content in plant tissue promote the incidence of disease (Beard, 1973, 1987; Bloom and Couch, 1960). It is reported that disease severity in plants was much greater at high nitrogen levels than at normal or low levels (Weinhold et al., 1969).

It is generally the form of nitrogen such as ammonium and nitrate available to the host or pathogen that affects disease severity or resistance (Huber and Watson, 1974). For example, ammonium form increased the activities of *Fusarium*, *Phytophthora*, *Helminthosporium*, and *Botrytis*, whereas, it decreased *Pythium*, *Ophiobolus*, *Puccinia*, and *Pseudomonas* diseases.

In the highly specialized field of turfgrass production and maintenance, the relationship between management practices and disease development is of prime importance. Therefore, observations concerning the relationship between fertility and disease occurrence is distinctive.

Rhizoctonia brown patch is one of the most serious disease during the growing season for major turfgrasses in Korea and the United States. Because the pathogen, *Rhizoctonia solani*, injures the stem, root, and leaf, but does not kill the underground rhizomes, the grasses can survive the next growing season. However, yellowish and terrible looking appearance results in major problem in lawns and golf courses.

Pathogens vary according to their preference to the form of nitrogen. *Rhizoctonia solani* prefers ammonium ($NH_4^+$) form to nitrate ($NO_3^-$), form as its nitrogen source (Weinhold et al., 1969; Weinhold et al., 1972), resulting in severe disease incidence in ammonium form fertilizer applied crops. However, it was not clarified in turfgrass species.

Nitrification inhibitor keeps ammonium from converting to nitrate. The use of nitrification inhibitor is a novel approach to the problem of reducing nitrate losses and increasing the efficiency with which fertilizers can be utilized by crops. However, since some pathogens perfers ammonium form of nitrogen as its nutrient source, the use of nitrification inhibitor can enbance the incidence of diseases.

This study was conducted to determine the effect of different types of nitrogen fertilizers on the incidence of brown patch disease in St. Augustinegrass which is widely used at homelawns and institutional lawns in southern part of the United States.

## II. MATERIALS AND METHODS

Diseased stem tissues from St. Augustinegrass plot in Texas A & M University (TAMU) Turfgrass Research Field Laboratory were transplanted to the water agar plate and then transferred onto petri-dishes filled with solid agar.

Perennial ryegrass seeds were burnt completely and autoclaved for two consecutive days. These ryegrass seeds were moistened with distilled and sterilized water. *Rhizoctonia solani* agar blocks were transplanted onto the ryegrass media and mixed with them with sterilized glass rod. Then, these infected

ryegrass seeds were kept at room temperature ranging from 24℃ to 27℃, which is favorable for the growth of *Rhizoctonia solani*.

Fifteen healthy 'Texas Common' St.Augustinegrass plugs with 10cm diameter from the TAMU Turfgrass Research Field Laboratory plot were transplanted on 10cm diameter plastic pots and grown for a month for root establishment and acclimation, and then introduced into the glasshouse with temperature 27℃ and high humidity condition to accelerate the growth of fungi (Allison et al., 1949).

Two types of nitrogen fertilizers were applied. Newly developed nitrification inhibitor 'DWELL' was used for the experiment (Loynachan, 1981). *Rhizoctonia solani* (approximately 1 spoonful of infected ryegrass seeds per pot) was inoculated to each pot 1 day after fertilization. The treatments were as follows:

1. No fertilizer + No inoculation
2. No fertilizer + Inoculation
3. Ammonium sulfate (50kg N/ha) + Inoculation
4. Ammonium sulfate (50kg N/ha) + Nitrification inhibitor + Inoculation
5. Ammonium nitrate (50kg N/ha) + Inoculation

Measurements were made everyday after inoculation by counting the diseased leaves and by visual turf quality ratings from 1 to 9 (9 = best).

The data were statistically analyzed by Duncan's multiple range test at 5% level.

## III. RESULTS AND DISCUSSION

The symptoms began to appear at 3 days after inoculation. The results at 5th and 7th day are shown in Tables 1 and 2.

Ammonium sulfate fertilizer associated with nitrification inhibitor treated pots showed the highest number of diseased yellowish leaves 6 to 9 times as much as in other pots, and the lowest turf quality. Although there is no statistically significant difference, ammonium sulfate treated pots showed slightly more diseased yellowish leaves and lower turf quality. There is no difference between the pots with no fertilizer plus inoculation and the pots treated with ammonium nitrate plus inoculation pots in terms of the number of

**Table 1.** The number of brown patch diseased leaves in St.Augustinegrass[1] as affected by nitrogen fertilizer forms and nitrification inhibitor.

| Days after inoculation | No fertilizer | No fertilizer + Inoculation | Ammonium sulfate + Inoculation | Amm.sulfate + DWELL[2] + Inoculation | Ammonium nitrate + Inoculation |
|---|---|---|---|---|---|
| 5 | 3.7 | 7.7 | 13.3 | 50.0 | 4.0 |
| 7 | 4.7[b3] | 9.3[b] | 13.3[b] | 57.0[a] | 6.3[b] |

[1] Pots were maintained in the glasshouse with temperature 27℃ and humid condition

[2] DWELL : Nitrification inhibitor

[3] Values with the same letter are not significantly different at 5% level by Duncan's multiple range test.

**Table 2.** Visual turf quality[1] of St.Augustinegrass[2] infected by brown patch as influenced by nitrogen fertilizer forms and nitrification inhibitor.

| Days after inoculation | No fertilizer | No fertilizer | Ammonium sulfate | Amm.sulfate + DWELL[3] | Ammonium nitrate |
|---|---|---|---|---|---|
| | | + Inoculation | | | |
| 5 | 8.3 | 8.0 | 7.7 | 4.3 | 8.7 |
| 7 | 8.3[a4] | 8.0[a] | 7.7[a] | 3.7[b] | 8.7[a] |

[1] Visual turf quality rating : 1−9, 9 = best

[2] Pots were maintained in the glasshouse with temperature 27℃ and humid condition

[3] DWELL : Nitrification inhibitor

[4] Values with the same letter are not significantly different at 5% level by Duncan's multiple range test.

diseased leaves and turf quality.

It is clearly demonstrated that ammonium form which was prevented from converting to nitrate form by nitrification inhibitor 'DWELL', resulted in the largest number of diseased yellowish leaves and the lowest turf quality. The reason why ammonium sulfate treated pots showed slightly more diseased yellowish leaves and lower turf quality is assumed that there still remained a little amount of $NH_4^+$ not converted to $NO_3^-$.

The incidence of brown patch in untreated pots assumed to be associated with the infection from the field before taking plugs or from adjacent inoculated pots.

Application of nitrogen fertilizer is a very routine and important practice to maintain the growth and the quality of turfgrasses. Considering the above results, it is suggested that either ammonium form or nitrate form of nitrogen fertilizer be used for the growth of St.Augustinegrass and possibly other turfgrasses. However, the use of nitrification inhibitor with ammonium form nitrogen fertilizer in order to reduce otherwise possible N leaching loss after conversion to nitrate form should be reconsidered in terms of the time of application. Brown patch prevailing period should be avoided for the application of nitrification inhibitor and ammonium form fertilizer. And also, all the environmental factors which interferes with the activites of nitrifying bacteria such as *Nitromonas* and *Nitrobacter* should be avoided, too. Therefore, with the cautious use of nitrification inhibitor, well-aerated soil, optimum soil pH, soil moisture supply, and temperature (Tisdale and Nelson, 1975) should be provided to minimize the brown patch disease in St. Augustinegrass or other turfgrass species.

## IV. SUMMARY

Effects of ammonium form nitrogen fertilizer, nitrate form fertilizer, and ammonium form fertilizer plus nitrification inhibitor (DWELL) on the incidence of Rhizoctonia brown patch and turf quality in 'Texas Common' St.Augustinegrass [*Stenotaphrum secundatum* (Walt.) Kuntze 'Texas Common'] which is one of warm-season turfgrasses

commonly used in southern part of the United States at homelawns and institutional lawns was determined.

Ten cm diameter of St.Augustinegrass plugs were transplanted onto plastic pots and grown for a month for the acclimation in the glasshouse. Turfs were fertilized 1 day before the inoculation at the rate of 50kg N/ha with ammonium sulfate, ammonium nitrate, and ammonium sulfate plus nitrification inhibitor. *Rhizoctonia solani* was isolated from the field and grown on agar media. Infected agar blocks were taken onto completely burnt perennial ryegrass seeds. Inoculation was practiced by putting these perennial ryegrass seeds on St.Augustinegrass.

There was no significant difference found among the pots treated with ammonium sulfate, ammonium nitrate, or no fertilizer. However, the pots treated with ammonium sulfate and nitrification inhibitor which prevented ammonium form from converting to nitrate form showed brown patch disease 6 to 9 times as much as those found in other pots.

Therefore, considering the relationship between the fertilization and the incidence of the disease, there was no difference between amonium form and nitrate form fertilization, however, the use of nitrification inhibitor with ammonium form fertilizer which keeps ammonium form from converting to nitrate form should be seriously reconsidered in terms of when to apply.

## V. REFERENCES


1. Beard, J.B. 1973. Turfgrass: Science and Culture. Prentice-Hall. Englewood-Cliffs, NJ.
2. Beard, J.B. 1987. Nitrogen: Apply less more often? Grounds Maintenance June: 26, 28, 30.
3. Bloom, J.R. and H.B. Couch. 1960. Influence of environment on disease of turfgrasses. I. Effects of nutrition, pH and soil moisture on Rhizoctonia brown patch. Phytopathology 50: 532-535.
4. Huber, D.M. and R.D. Watson. 1974. Nitrogen form and plant disease. Ann. Rev. Phytopathol. 12: 139-165.
5. Loynachan, T.E. 1981. Progress with nitrification inhibitor. Agrichemical Age 25(9): 16-17.
6. Weinhold, A.R., T. Bowman, and R.L. Dodman. 1969. Virulence of *Rhizoctonia solani* as affected by nutrition of the pathogen. Phytopathology 59: 1601-1605.
7. Weinhold, A.R., R.L. Dodman, and T. Bowman. 1972. Influence of exogenous nutrition on virulence of *Rhizoctonia solani*. Phytopathology 62: 278-281.