by Dr. James B. Beard

TURFGRASS RESEARCH REVIEW

Affects of antitranspirants on plant growth

Antitranspirants—uses and affects on plant life.
D.C. Davenport, R.M. Hagan, and P.E. Martin. 1969. California Turfgrass Culture. 19(4):25-27. (from the University of California at Davis, Davis, Calif. 95616).

This paper is a preliminary report of research conducted by the authors concerning the affects of antitranspirants on water conservation and plant growth. The studies were conducted on creeping red fescue (*Festuca rubra*). Phenyl mercuric acetate (PMA) was sprayed on the foliage at concentrations ranging from 10^{-4}M to 10^{-3} M.

Results showed that the quantity of water transpired was reduced by 18 per cent when a moderate PMA concentration of $10^{-3 \cdot 5}$M was used. There was no significant reduction in shoot growth at this concentration. A high PMA concentration of $10^{-3 \cdot 3}$M resulted in a 30 per cent reduction in the amount of water lost by transpiration and also caused a 35 per cent reduction in the amount of shoot growth. Toxicity was evident at the higher rate of application. The authors indicate that tolerance to rates of PMA application will vary with the particular turfgrass species involved. This factor should be recognized and proper adjustments made to avoid potential phytotoxicity. The authors stress that this is a progress report and that further studies are needed on optimum concentrations, application methods and potential detrimental affects to the turfgrass plant.

Comments: An antitranspirant is a compound which is utilized to reduce the transpiration rate of plant foliage. Approximately 80 per cent of the water loss from transpiration occurs through the stomata, which are small pores or openings in the surface of turfgrass leaves. Phenyl mercuric acetate (PMA) is an antitranspirant which stimulates the closing of stomata. Stomata closure caused by PMA has been observed in a wide range of plant species including grasses, as has been reported in the above study. A 15 to 20 per cent reduction in the rate of water loss from creeping red fescue leaves is certainly significant, particularly when the water stress potential is high. Data such as is reported in the above paper suggests that the onset of turfgrass wilting can be delayed or even prevented by an application of PMA at the proper rate and time.

The stomata, through which water is lost by transpiration, are also the main pathways for carbon dioxide diffusion into the leaf where it is used as one of the essential raw materials in the vital photosynthetic process. If the stomatal-closing antitranspirant was completely effective in restricting carbon dioxide movement into the leaves, it could also reduce the photosynthetic process below minimal levels. However, data from this paper indicate that concentrations of PMA can be used which will significantly reduce the rate of transpirational water loss but will not close a sufficient

(Continued on page 22)

(Continued from page 19)

number of stomata to seriously restrict the photosynthetic process.

A significant reduction in shoot growth was evident at the higher PMA concentration used in the study. The authors indicate that this is a direct phytotoxicity to the leaf tissue rather than the indirect affect of growth reduction caused by a restriction in the photosynthetic process. A small reduction in photosynthesis caused by a restriction in carbon dioxide movement into the leaf would not be critical in high quality turfs as long as sufficient carbohydrates are being synthesized to maintain the existing tissues and to provide an adequate recuperative potential. Thus, a certain amount of shoot growth reduction is not objectionable since it will reduce the mowing requirement and frequency of irrigation.

A potentially more serious problem associated with the use of a stomatalclosing antitranspirant is the possible loss of the vital cooling process of the leaf which will result from a reduction in transpiration. The transpirational process is a vital cooling mechanism in turfgrass leaves during periods of heat stress. If PMA should close sufficient stomata to seriously impair the leaf cooling process associated with transpiration, leaf temperatures can increase to potentially injurious levels quite rapidly. Studies concerning this potential disadvantage associated with the use of stomatal-closing antitranspirants are lacking. Thus just how important such a factor is is not known at this time. It is likely that a sufficiently low concentration of PMA could be used which would provide a significant reduction in the rate of water loss and yet not seriously restrict the transpirational cooling mechanism. However, the specific rates of PMA application at which is achieved cannot be determined by the available data.

The duration of effectiveness of an antitranspirant and the resultant

(Continued on page 24)

BEARD

(Continued from page 22)

frequency of application is determined by the (a) frequency of mowing, (b) amount of shoot growth produced, (c) environmental conditions and (d) efficiency of the chemical used. Further study is also needed in this area. The effectiveness of antitranspirants could vary from as little as a few days to several weeks, depending on the specific conditions.

In summary, the use of stomatal-closing antitranspirants is a promising new idea for modifying certain detrimental physiological processes in the turfgrass plant. However, before it can be utilized with maximum effectiveness further research must be conducted on a number of aspects related to its use, rate of application, method of application and frequency of application, particularly as related to potentially detrimental affects. Possibly, the use of antitranspirants on turfgrasses will become another valuable cultural practice available for use in maintaining high quality turfgrasses.

Growth and carbohydrate storage of three* Poa pratensis *L. strains as influenced by temperature.

V. B. Youngner and F. J. Nudge. 1968. Crop Science. 8:455-457. (from the Department of Agronomy, University of California at Riverside, Riverside, Calif.)

The objective of this study was to investigate the effect of temperature on the shoot density and total available carbohydrate content of shoot bases of three varieties of Kentucky bluegrass: (a) Merion, (b) 0217 Fylking and (c) Newport. The data was collected after growing eight weeks at a given temperature regime and maintained at a cutting height of 1.6 inches.

Distinct differences were evident among the three Kentucky bluegrass varieties in terms of temperature effects. Merion and

(Continued on page 26)

BEARD

(Continued from page 24)

0217 had significantly higher shoot densities than Newport at high temperatures. Newport produced a higher shoot density at lower temperatures. At any one temperature treatment, the 0217 had a significantly higher shoot density than Merion or Newport.

The total available carbohydrate content found in the base of turfgrass shoots was significantly lower for Newport at any given temperature than for either Merion or 0217. This investigation also showed that the lowest level of total available carbohydrates occurred at the temperature which resulted in the greatest amount of shoot growth.

Comments: The results of this study indicate that Newport is better adapted to cooler temperatures, whereas Merion and 0217 Fylking are better adapted to warmer conditions as measured by the shoot density and level of reserve carbohydrates. The results of this paper suggest one factor which may contribute to the better adaptation of Merion to warmer climates in comparison to other Kentucky bluegrass varieties. It also suggests that 0217 Fylking may produce a similar response.

The measurement of total available carbohydrates in turfgrass tissues is an important indicator of the overall vigor, rooting depth and recuperative potential of the plant. Turfmen should attempt to develop cultural practices which will maintain a medium to high level of carbohydrate reserves at all times. In this paper the lowest carbohydrate level occurred at the highest rate of shoot growth. Other factors which tend to deplete the carbohydrate reserve are (a) an excessively high nitrogen fertility level or (b) severe defoliation of the shoots, due to either an excessively close cutting height or an excessively long interval between mowings.

More studies of this type are badly needed in order to obtain a more detailed understanding of the proper adaptation and use of the turfgrass varieties currently available. In the past most studies have been devoted to comparisons between species such as bentgrass and bluegrass. With the increased number of researchers working in the turfgrass area more effort will go into the responses of varieties within a species. □

Other papers of interest:

1. *Measuring rooting of sodded turfs.* J.W. King and J.B. Beard. 1969. Agronomy Journal. 61(4): 497-498. (from the Department of Crop and Soil Sciences Michigan State University, East Lansing, Mich. 48823.)