TURFGRASS NUTRITION & ENVIRONMENTAL STRESS

By Charles G. Wilson

Everyone attending this conference knows what turfgrasses are. Nutrition to some means simply the application of fertilizer, and to others the grasses ability to manufacture food in the presence of light, chlorophyll, favorable temperature, and moisture when the necessary elements are available to support growth.

The definition of environment in the sense we use it today would be hardly recognizable in a dictionary of only a few year's ago. Possibly the easiest way for us to consider environment is "all of the surrounding conditions and influences that affect the development of aliving thing"(1).

Stress is thought to be a shortening of the word distress and is "the overpowering pressure of some adverse force or influence" (2). Normally, as we use the word in turfgrass culture, it relates to the influence of something too cold, too hot, too wet or too dry that changes an expected growth reaction. As an example, 2, 4-D applied to a dandelion suffering from drouth seldom results in a satisfactory kill of the weed.

> "Not that it is so, but so
> it seems to me, to be,
> as I now see the things
> I think I see." (3)

Love, Wisconsin is responsible for the quotation. It should guide all of us who attempt to detect turfgrass ills. I feel quite safe in saying our field diagnosis of problems will become increasingly more difficult with the passage of time. With automatic irrigation we don't get the stress from drought. With the use of spinner spreaders we don't have the missed streaks and double rate overlaps which showed so vividly the result of treatment. It will behoove all growers not only to keep records of what they apply, but also to keep them for a period of years. Some adverse affects of treatment are not seen for months or even years following the application. In any case, there is seldom good reason to credit the last thing done with either success or failure.

Mr. G. A. Farley wrote a book over 40 year's ago on Soils, Fertilization and Growth. I quote directly from it. "A deep study of conditions revealed by ten years experience in the general maintenance of golf turf discloses one outstanding fact; nitrogen is a two-edged sword, cutting one way for the greenkeeper, and the other way against him. Just enough is good enough, and too much is just too bad".

Farley was from Cleveland, but the south reports the same. Dr. Granville Horn of the University of Florida has had ten years of extensive fertility tests on bermudagrass and other warm-season grasses. His results show nutrition to be closely associated with insect and nematode

stress. One year mole crickets were only active on the ammonium sulfate plots. Yet another time, chinch bug injury was devastating on all nitrogen source plots except those fertilized with activated sewage.

Nematode injury has been considerably less on the natural organic plots when compared with ureaform and other water soluble nitrogen carriers in Florida. Similar tests farther north at Tifton, Georgia indicate the same thing. Both Rutgers and Iowa State Universities have reported nitrogen source differences in relation to disease incidence, and Dr. Beard at Michigan State has shown the importance of timing of application as well as nitrogen source in relation to snowmold diseases.

Beard has further shown relationships between nitrogen and shade tolerance and the importance of balancing potassium with nitrogen to impart greater winter hardiness. "Heat hardiness is reduced at excessive nitrogen levels, and turfgrasses grown on wet soils or under irrigated conditions are less heat hardy than when grown under water stress", according to Beard in his just released book, Turfgrass: Science and Culture. "Heat hardiness is also reduced by short mowing and acid soil conditions" (4).

"A number of herbicides injure grass root systems. With high levels of irrigation and fertilization this may be of no concern, but may cause severe injury on unirrigated turf during a drought" (5). Madison from California also points out that "plant poisons affect all plants to some degree. Cereals treated with herbicides greatly outyielded untreated plots, but yields were less than in plots kept clean by hand weeding."

Madison and Beard among others are in agreement that when nitrogen is deficient a modest amount will increase growth of both tips and roots. But when nitrogen is adequate to bring individual plants into competition, increased nitrogen results in decreased rooting"(6).

I have been credited with the statement: "A shallow root system is the mark of a successful superintendent". As we strive and succeed in getting ever greater density, shallow rooting will result because of the competition for space, air, moisture, etc. Palychenko has reported hundredfold increases in rooting of isolated space plantings compared to drilling cereal plants in close spaced rows. Dr. Bill Daniel reports on the "Pat System for Sports Fields" at this conference. One of the greatest benefits from suction pumping removal of water may be the removal of noxious gasses and the re-aeration of the soil. It will be interesting indeed to see what affect this pumping action has on depth of rooting.

I believe Al Radko of the U. S. G. A. Green Section was the first and, if not, among the first to preach against excessive nitrogen applications. We, too, have warned that some nitrogen recommendations for established turf are far too high. Conversely, we feel levels suggested for turf establishment are far too low. Madison believes that even under California's long growing season 1,000 pounds of actual nitrogen per acre tends to be excessive, and that high nitrogen to please the eye may obscure some apparent problems during times of stress.

What else can one add but AMEN - So be it.

We have tried to show a few occurrences in the nutrition - grass - stress - environment syndrome. In many instances there isn't good documentation as to WHY they happen. We are not sure of all the why's and that is the best reason of all why turfgrass research must continue to be supported. It deserves the same amount of dollars from each of our purses that we give to worthy charities and the church.

One of the why it happens, in my opinion, is called physiological drought. "When applied in excessive amounts or when the soil is very dry, certain salts burn or cause plants to wilt more than others. Burning is measured by the salt index and is due to the effect the salt has in increasing the osmotic pressure of the soil solution"(7). Almost everything (fertilizer, fungicide, insecticide, herbicide, water) that we apply to turf is a salt or contains salt and thus has a salt index. In essence, when the concentration is greater on the outside of the leaf, crown, stem or root than on the inside, moisture will be lost from the grass. We notice this in extreme cases as a fertilizer or other compound burn. But, even in less severe stress, the salt still takes its toll and is noticed as wilt.

The most important phenomenon, in my opinion, is that the effect can continue for many days, and in some instances months or year's, following the initial application. As mentioned earlier, it is not as noticeable under frequent irrigation, but that doesn't mean that the influence is absent. In fact, it may be present and a contributing factor to winter and summer injury, disease and insect depredations.

Rader, White and Whittacker worked out the salt index on a pound for pound basis of several fertilizer materials. Some of their findings follow.

Material	Salt Index
Muriate of Potash	116
Ammonium Nitrate	109
Urea	75
Potassium Nitrate	74
Ammonium Sulfate	69
Calcium Nitrate	53
Sulfate of Potash	46
20% Superphosphate	8
Gypsum	8
Organic Ammoniates	3.5

The higher the number, the greater the tendency of the material to burn. The organic ammoniates figure is an average. Organic ammoniates include seed meals, leather tankages, manure, sewage sludge, etc. There are vast differences within this broad grouping. Processing of some materials has changed since 1943 when the work was done. Leather comes in increasing quantity as does manure from feed lots where salt is copiously

fed as a "Tenderizer . The range found in sewages is even greater and is too involved for discussion here. Needless to say, we feel that our product's salt safety is of significance in it's use and response on turf.

We should also state that turf fertilizers are applied on a pound of nitrogen basis rather than a pound of material basis. In practice ammonium sulfate would be used at better than double the rate used for urea, thus it would cause wilt or burn first when the two materials are compared. Ureaformaldehyde fertilizers were not available when the work was done. They would still have a salt index and one can only guess the actual amount. We might expect an index of 25 for the cold water soluble nitrogen alone, and something more would have to be added for the hot water and insoluble nitrogen.

Many superintendents have switched to sulfate of potash in recent years, the reason being high salt index of muriate of potash. When compared directly, muriate has twice the tendency to cause wilt or burn.

To paraphrase Mr. Farley, not only the nitrogen but also potassium, phosphorus, molybdenum, or for that matter any fertilizer, fungicide, insecticide or herbicide, is a two-edged sword, cutting one way for and one way against the grass grower. "Just enough is good enough, and too much is just too bad".

References

(1) Thorndike-Barnhart Comprehensive Desk Dictionary. (1962)
(2) Oxford Universal Dictionary. (1955)
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(6) _____ Principles of Turfgrass Culture. (1970)
(7) Rader, White, Whittaker Soil Science Proceedings 55: 201-18.(1943)