



*In their research at Western Washington Experiment Station Drs. Goss and Gould report that Ophiobolus patch had no trouble establishing itself on this plot having "zero" soil potassium levels.*

## Turfgrass Diseases: The Relationship of Potassium

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Fertilizer naturally plays a most important role in the maintenance of good turf. Well-balanced nutritional programs can aid materially in helping to suppress weeds and diseases. Potassium, one of the three major plant food elements, plays an important role in turfgrass vigor, which in turn influences disease development.

Potassium serves many roles in the grass plant and, if it becomes deficient can cause:

1. Accumulation of carbohydrates that cannot be synthesized into proteins.
2. An excess of non-protein nitrogen.
3. Failure to produce new cells for lack of

amino acids essential for protoplasm formation.

4. Slower growth of meristematic tissue that permits replacement of diseased tissues.

5. Thinner cell walls and epidermal tissues.

According to George McNew, in the United States Department of Agriculture Yearbook, Plant Diseases, severe potassium deficiency could interfere with the activity of more than 25 different enzymes. He stated that more plant diseases have been retarded by the use of potash fertilizers than any other substance, perhaps because potassium is so essential for catalyzing cell activities. He further stated that the balance

of nutrient elements may be more important than concentration of total fertilizer when plants are exposed to attack by parasites. A deficiency or surplus of any one element often promotes diseases.

### EFFECT OF POTASSIUM

Dr. E. M. Evans and associates at Auburn University have reported a leaf spot disease on Coastal Bermudagrass that is related to soil potassium levels. This is one of the few papers in the literature that links a turfgrass pathologic problem with potassium deficiency. This disease is caused by two fungus species. Severe disease attacks were incited with zero levels of potassium and high nitrogen treatments. They concluded that severity was directly related to the degree of potassium deficiency.

### DOLLAR SPOT DISEASE

W. E. Pritchett and Granville C. Horn of Florida has reported less dollar spot disease caused by *Sclerotinia homeocarpa* where potassium was applied. J. Drew Smith in his book **Fungi and Turf Diseases** in 1955 stated that application of potash assisted slightly in recovery from infection of *Sclerotinia* dollar spot disease. Here are two indications, arrived at independently, that potassium does have some effect on dollar spot.

### BROWN PATCH

Pennsylvania State University has reported that brown patch disease, caused by *Rhizoctonia solani*, increased with increasing rates of nitrogen only when phosphorus and potassium were not concurrently increased. J. R. Bloom and Houston B. Couch in their investigations on the effect of nutrition, pH, and soil moisture on *Rhizoctonia* brown patch concluded that, as nitrogen is increased, there must be a concurrent increase in phosphorus and potassium to help lessen disease proneness and severity.

### RED THREAD DISEASE

Red Thread is a fungus disease caused by *Corticium fuciforme*.

In tests conducted at the Western Washington Research and Extension Center at Puyallup, Wash., we have found that nitrogen produced significant differences in the percent of diseased area or the number of stromata produced by the red thread fungus. Potassium was significant in bringing about a decrease in infection during one of these years. As potassium was increased

from the zero level to eight pounds concurrently with nitrogen from four to eight pounds per 1,000 sq. ft. per season, the percentage of area infected likewise decreased. The greatest infection from *Corticium* red thread occurs in the Pacific Northwest in late summer and during the fall. Tissue analyses show that potassium is lower in grass tissue during this period when infection is almost nil. Plots receiving a balanced high level of nutrition escape almost completely from red thread attacks during the growing season, but are infected somewhat during slower periods in fall and winter.

Most agronomists and pathologists agree that in the case of red thread, high nutritional levels increase the growth rate of the leaves, and the infected tissue is removed before becoming objectionable.

### FUSARIUM PATCH DISEASE

*Fusarium* patch disease is caused by the fungus *Fusarium nivale*. In our investigations in western Washington we have found this disease to decrease with increasing levels of potassium from zero to eight pounds per 1,000 sq. ft. per season on putting green turf. Increasing levels of potassium, however, did not prove to be significant in every year.

Increasing potassium levels tend to keep the disease incidence reduced somewhat in the six-pound and eight-pound per 1,000 sq. ft. per season nitrogen range but, when nitrogen was increased to 20 pounds per 1,000 sq. ft. per season, potassium had little effect on disease incidence. This seems to be positive proof that 20 pounds of nitrogen in relation to the four pounds of phosphorus and eight pounds of potassium per 1,000 sq. ft. per season are in balance and do not respond in a reasonable manner. Again, the greatest *Fusarium* patch infection occurs from early fall to early winter when the potassium level of tissue is approaching its lowest level.

### OPHILOBOLUS PATCH DISEASE

This disease, caused by the fungus *Ophiobolus graminis*, var. *avenae* has responded with practical significance to both phosphorus and potassium nutrition. We have reported in a previous paper, published in the *Agronomy Journal*, that potassium had a suppressing effect on the amount of disease in two years of investigations at Washington State University. Potassium was

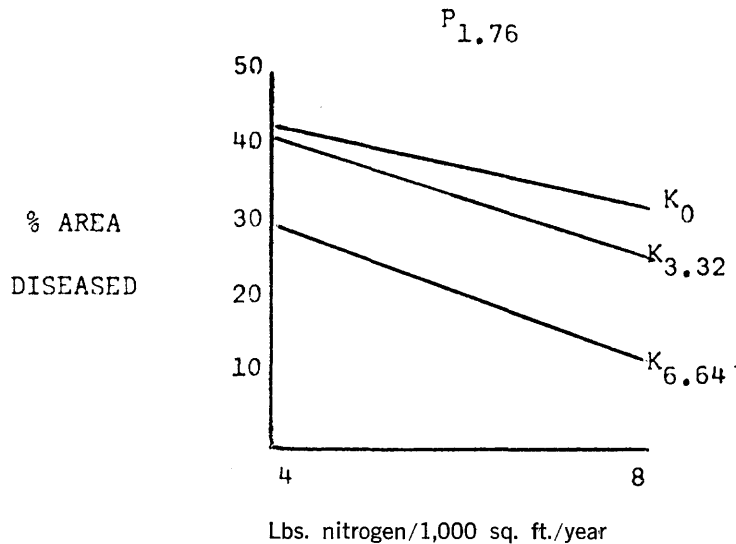


Figure 1.

Decrease in Red thread infection (*Corticium fuciforme*) with increasing rates of both nitrogen and potassium.

Note: Both P and K are expressed in elemental and not oxide.

found to reduce the amount of disease, regardless of nitrogen and phosphorus levels.

#### BALANCED NUTRITION IS A MUST

Here again, we cannot deny the value of the overall effects of a balanced nutritional program. Our results at Washington State University to date show that a balanced program made up of three parts of nitrogen, 1 part of phosphorus, and 2 parts potassium is giving best results in our turfgrass management programs. The intensity is quite another factor and, if not brought up to certain levels, means little, particularly in the case of *Ophiobolus* patch disease and red thread. Our results have shown on putting green turf that 12 pounds of nitrogen, four pounds of phosphorus ( $P_2O_5$ ) and eight pounds of potassium ( $K_2O$ ) per 1,000 sq. ft. per season have given us best results. Likewise, on less intensely managed areas, such as good quality lawns or fairways, we have found that six to eight pounds of nitrogen, two to three pounds of phosphorus ( $P_2O_5$ ) and four pounds of potassium ( $K_2O$ ) per 1,000 sq. ft. per season is a good program.

#### REMOVAL OF SOIL POTASSIUM

We have observed the decline in soil potassium in our same research plots over the past

eight years at the Puyallup Station. Soil potassium levels have declined constantly when nitrogen was applied at 12 and 20 pounds per 1,000 sq. ft. and potassium at four and eight pounds per 1,000 sq. ft. per season. These same potassium levels at the six-pound nitrogen rate are holding soil levels fairly constant. Where no potassium has been applied for eight years some plots, particularly in the high nitrogen range, show levels as low as 90 pounds per acre in 1967. These levels have dropped from a level over 500 pounds per acre initially when the experiment was initiated.

#### SUMMARY

It is difficult to select any one nutrient and establish a threshold value at which it determines certain degrees of disease susceptibility. We feel that, as nutrient levels approach a critical minimum, we may be able to assign primary roles to these certain elements.

It is obvious from these studies in observing the build-up and suppression of turfgrass diseases that nutritional programs alone are not the sole answer. Carefully planned and executed fungicidal programs must be accepted by the golf superintendent or other turfgrass manager if he is to maintain clean and healthy turf.

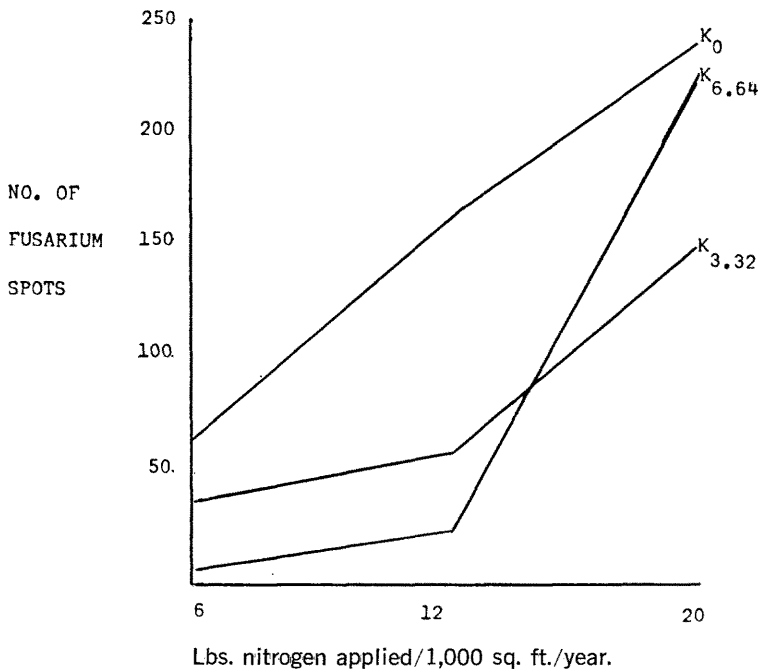


Figure 2.

Number of Fusarium patch spots (*Fusarium nivale*) are lowest with increasing rates of potassium but increase with increasing rates of nitrogen.

Note: Both P and K are expressed in elemental, not oxide.

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