

THE USE OF A NATURAL PRODUCT FOR THE CONTROL
OF ANNUAL WEEDS IN TURF

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The last few years have brought increased public interest in environmental issues concerning the use of pesticides. This has been particularly true in the turf industry where the general public may be involved in the applications of pesticides to their own lawns or where they may see the application of these materials on golf courses or by lawn care companies. With this concern, has come an increased interest in natural products that are perceived as being safer than traditional synthetic pesticides.

In 1986, a research project involving food-grade corn meal as a growth media for a microorganism produced some observations that led to the patenting of a natural organic product for the preemergence control of annual weeds. The objective of this work was to establish a *Pythium* fungi in the soil of a new golf course green that had been constructed at the Iowa State University turfgrass research area. The effects of this pathogen were then to be observed on creeping bentgrass (*Agrostis palustris*) that was to be seeded on the infested soil.

The *Pythium* was cultured in the laboratory for several weeks on the corn meal and then taken the field area where it was placed on the surface and tilled into a 3 to 4 inch depth of the soil (Figure 1). Along with the inoculated corn meal plots, plots of the same size were treated with fresh corn meal that had not been

treated with *Pythium*. The same total amount of corn meal was used in the two separate treatments. A third 'control' plot to which no corn meal applied was also established. Three cultivars of Creeping bentgrass were then seeded in strips over the top of the plots.

The attempt to establish *Pythium* in the treated plots was a failure and normal germination occurred in those areas. Normal germination also was observed in the control plots. But in the plots that had received the fresh corn meal, establishment was greatly reduced.

The reason for this inhibition was uncertain. One possible explanation was that there was some type of organic compound contained in the fresh corn meal that was destroyed by the activity of the fungal organism. To test this idea, several samples of processed corn grain were obtained for further testing. These included the starch, corn germ, corn fiber, and corn gluten meal (the protein fraction of the grain). These materials and the fresh corn meal used in the field trial were applied to pots of soil in the green house at increasing rates (Figure 2). Creeping bentgrass was then seeded over the top of the treated plots and germination was observed. The results of the greenhouse trials showed that the inhibitory substance was clearly in the protein fraction, the corn gluten meal (Figure 3).

Close observations of the grass plants in the greenhouse showed that the shoot (the above ground portion of the plant) formed normally in all pots. The effect of the corn gluten meal was to stop root formation. In pots treated with an effective rate of corn gluten meal, no rooting occurred and all plants died when water was withheld and the surface of the pots was allowed to dry.

The corn gluten meal is a 60 % corn protein material that is approximately 10 % nitrogen (N) by weight. It is a byproduct of the wet-milling process and is sold as a feed material for cattle, poultry, and several other species of livestock. It has been used in fish food for commercial fish production. It is also a primary constituent of some dog food products. Corn gluten meal is produced as a fine, yellow powder, but can be easily pelletized for easier application to the soil.

The next step in the research was to screen the effects of corn gluten meal on a series of other species. It was found that there were some differences in sensitivity, but that the material is effective in stopping or inhibiting root formation at the time of germination in a wide variety of both monocotyledonous (grasses) and dicotyledonous (broadleaf) species, including crabgrass (*Digitaria spp.*).

Corn gluten meal was then screened on mature Kentucky bluegrass (*Poa pratensis*) to determine if it had any detrimental effects on grasses once they were fully established. It was found that not

only did the material not damage the mature grass, but that it made an excellent natural-organic fertilizer. Later work conducted over a series of years in the field has repeatedly shown that corn gluten meal compares to the best commercially-available natural fertilizers. (Data comparing corn gluten meal to other fertilizer materials has appeared in the annual Iowa Turfgrass Research Reports since 1989. It appears in these reports under the coded name 'ISU EXPERIMENTAL'.)

The observations that corn gluten meal can inhibit the establishment of germinating weeds and at the same time serve as a fertilizer for mature grasses led to the idea that the material could be used as a natural 'weed and feed' product for lawns and other turf areas, as well as for garden and other crop production systems where weeds are a problem. Field trials demonstrated that this was possible and a patent was applied for on the concept in 1989. Patent 5,030,268, titled Preemergence Weed Control Using Corn Gluten Meal, was issued in 1991.

Continuing field work has shown that rates of corn gluten meal in the range of 20 lbs/1000 sq. ft. will reduce crabgrass infestation in Kentucky bluegrass turf by from 50 to 60 % in the first year. As rates are increased, almost total control can be achieved. Timing is important because microbial activity is known to destroy the activity of the active component and it is recommended that the application be made close to the time of weed germination. Moisture is necessary to activate the material, but extended wet

periods can reduce its effectiveness, as is the case with synthetic preemergence herbicides.

Current recommendations are that corn gluten meal be applied at 20 lbs product/1000 sq. ft. At 10 % N by weight, this is an N application rate of 2 lbs. N/1000 sq. ft. This will significantly reduce germinating weeds in the first year and should with time bring this type of weed problem under control. Figures and show the first and second year's data respectively from a field trial on the control of crabgrass in Kentucky bluegrass turf. The repeat applications in 1992 were made to the same plots. The high rates of application in this study was far beyond what would be used in the turf industry. They were included to look for any possible detrimental effects to the Kentucky bluegrass turf from over applications. No damage was observed in either year. Of greatest interest is the 2 lb. N/1000 sq. ft. rate (20 lbs product/1000 sq. ft.). Crabgrass was reduced by 60 % in 1991 and by 85 % in the 1992 at that rate of application.

It should be pointed out that there is no postemergence control of weeds. Any weed that has germinated and formed a root will not be controlled by corn gluten meal. As is the case with any weed and feed material, the weeds that do germinate will benefit from the nitrogen in the corn gluten meal.

The mechanism of weed control centers on the growth regulating, inhibition of root formation at the time of germination. It has

been observed in both the greenhouse and in the field that if the soil surface remains wet during the germination period, affected plants may recover and resume rooting. A short drying period is needed for the death of weed seedlings during the critical time when no root system has formed. As is the case with other natural substitutes for synthetic pesticides that have reached the market, corn gluten meal will not provide as complete control as synthetics and is likely to cost more. But, it does provide a natural substitute for those who choose not to use synthetic herbicides for preemergence weed control.

In 1989, another major project was initiated to find the chemical structure of the active component responsible for the inhibition of root systems. Ph.D. candidate Dianna Liu has been working for 3 years on the project and in early 1992 identified 5 chemical structures associated with the root inhibiting response.

Synthetic samples of these materials were obtained and the same root inhibiting response as observed with the naturally occurring materials has been demonstrated with the synthetic materials.

These active components will open the door to many other areas of research. Possibly the corn gluten meal could be fortified to increase its effectiveness at lower rates of application. Less material would be required to achieve complete weed control.

A second Ph.D. student, Bryan Unruh, is presently conducting studies to determine the mode of action of these materials at the

cellular level. This work could potentially lead to the discovery or development of similar compounds of use for weed control.

The active component may be useful in its pure form for weed control in cropping systems for which the corn gluten meal is not practical because of its cost. Research at Iowa State University by Dr. Jack Dekker of the Agronomy Department has shown that the corn gluten meal is active against many important agronomic weeds of significance in corn production. He has also shown that some corn hybrids are susceptible to its effects whereas others are tolerant. When the active component is available in larger amounts, there should be corn hybrids identified on which it can be safely tested.

Strawberry's, along with other fruit and vegetable crops, present a more immediate opportunity for the use of corn gluten meal in its natural form. These crops have a much higher value and could provide a practical market for meal when proper timing and application methods have been established for the many cropping systems involved. Two years of work on strawberries have been conducted in the greenhouse and field work of this and other crops are planned for the 1993 season.

The interest in the idea of using corn gluten meal as a natural weed control has met with a great deal of interest in the United States and in other countries. There is presently much interest among environmental groups in the restriction pesticide use,

particularly in the urban environment where large quantities of these materials are used on lawns and gardens. A ready market should be there when the material is becomes available for sale. The present goal is to have corn gluten meal ready for the turf market in the early months of 1994.