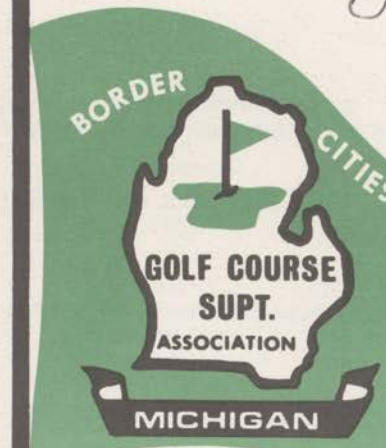
James B. Beard

JUNE 1984



A PATCH of GREEN

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Michigan & Border Cities Golf Course Superintendents Association

"A PATCH OF GREEN"

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EDITOR

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*Daconil 2787 is a registered trademark of Diamond Shamrock Corporation.

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Endophytic Fungi & Biological Control of Insects in Turfgrasses

BY Drs. Richard Hurley and C. Reed Funk

Plant breeders are continually developing new plant varieties in which desirable characteristics and plant performance are optimized. Plant performance is a reflection of the sum total of many factors, including yield or productivity, appearance, vigor, resistance to weed invasion, recovery from injury, persistence, and density, and can be enhanced by improving pest resistance and tolerance of herbicides, defoliation, heat and drought.

Resistance to insect predation is an important factor in a plant's performance. Consequently, plant breeders have sought to upgrade the insect resistance of important plant varieties. However, after a new variety providing insect resistance is developed, usually after years of painstaking breeding, insects may sooner or later evolve that are able to feed, without adverse effect, on the once insect-resistant plant. Thus, the ultimate grower of the new plant variety is faced with a number of alternatives. He can either await further development of a new variety of pest-resistance plant, or turn either to chemical pesticides or biological pest control.

Generally, chemical pesticides are unduly expensive and quite frequently they have an objectionable environmental impact.

An alternative to the use of chemical pesticides is biological pest control. Perhaps the best known use of biological pest control is the well-publicized case of the screwworm fly. There, the discovery that screwwork flies mated only once led to the method whereby large numbers of laboratory-bred male flies were sterilized by X-ray irradiation. By subsequently releasing these sterile males, the females with which they mated could lay only infertile eggs. Thus, by exploiting the known mating habits of a particular insect pest, its numbers were effectively curtailed. Another example of biological pest control includes the use of insect pathogens, such as certain lethal or debilitating insect viruses. Because these viruses are generally host-specific, the targeted insect pest can be readily controlled without harming beneficial species.

The advantages of biological control of insect pests are several. First, Biological controls are generally self-limiting; once numbers of the target species are reduced, so too are the biological controls. Second, biological pest controls are usually host-specific and do not attack desirable species. Finally, and perhaps most importantly, biological pest controls are normally environmentally compatible, unlike chemical pesticides which may persist in the environment and kill indiscriminately.

A "new" biological pest control has recently been recognized. Certain plants host symbiotic endophytic fungi which confer, among other things, an enhanced resistance to insect predation on the host plant. For example, in perennial rye-grasses, a positive association has been demonstrated between the presence of an endophytic fungus (literally,

CONTINUED NEXT PAGE

a fungus living within its plant host) and resistance of the plant to attack by some of the most prevalent insect infestations encountered in the field - i.e., the sod webowrm, the bluegrass billbug, the Argentine stem weevil, the Southern armyworm, and the chinch bug.

In particular, perennial ryegrasses hosting an endophytic fungus are highly resistant to feeding of the larval stages of sod webworms. Plants lacking the endophytic fungus can sustain substantial injury from feeding by sod webworm larvae. Resistance in ryegrasses hosting this fungus to feeding of the larval stages of the bluegrass billbug has also been observed. Also we have observed resistance to feeding by the chinch bug and others have observed resistance in ryegrasses hosting endophytic fungus to Argentine stem weevil. This endophyte enhanced insect resistance in ryegrasses to three different orders of very prevalent chewing insects provided us with a broad-based mechanism for developing new plants having enhanced performance including resistance to these insects.

The exact mechanism of this enhanced resistance to insect predation has not as yet been identified, although it is suspected that such resistance could involve the generation of chemicals toxic to insects feeding on plants containing the endophytic fungi. These chemicals might be produced by the endophytic fungus or by the host plants themselves in response to the invading fungus. The latter mechanism may mediate a generalized resistance to insects feeding on plant parts having the highest concentrations of endophytic fungi or their associated toxins.

In addition to the observed resistance to predation by insects, plants hosting the endophytic fungus have displayed a certain enhanced performance which includes improved ecological fitness, a more attractive appearance, increased vigor, reduced weed invasion, more rapid recovery from injury, improved persistance, increased density, and apparently greater stress tolerance. For example, in turf trials of tall fescue and perennial ryegrass varieties and single-plant progenies established during the late summer of 1976 at North Brunswick, New Jersey, those varieties containing a high level of endophytic fungus showed dramatically improved performance after seven years. Species tested tall fescue (**Festuca arundinacea**) and ryegrass (**Lolium perenne**). These plants were more persistent, showed reduced crabgrass invasion, produced a higher yield, had greater vigor, and displayed an improved appearance. Much of this improved performance of these fungal-endophyte-hosting plants appears to be associated with improved stress tolerance, such as tolerance of herbicides, heat, drought, and defoliation.

Similar enhanced performance, including resistance to the billbug and the chinch bug, has been observed for hard fescue and for chewings fescue.

The particular endophytic fungus involved in the above described insect resistance and enhanced performance in ryegrass has been provisionally designated the **Lolium** endophyte. A similar or identical endophyte fungus present within tall fescue has been identified as **Epichloe typhina** and was recently renamed **Acremonium coenophialum.**

The life cycles of endophytic fungi have been studied in detail. The fungus begins within the seed of the host plant, adjacent to the aleurone layer. When the seed germinates, the fungus spreads into the endosperm, from which the developing embryo derives nutrient, and subsequently into the embryo or developing seedling. Apparently, as the seedling develops strengthening tissue and air spaces, the fungus is able to grow between the plant's cells. In the mature plant, the fungus grows into the rhizomes, leaf seed tissue, flower stem, asnd seeds, but avoids penetration into the roots.

As a prelude to the invasion of the fungus into its host's developing seed, the fungus concentrates its mycelia in the flower stem. As the seed develops, the fungus grows into the seed adjacent to the aleurone layer, initially avoiding the embryo. Upon germination, invasion of the embryo begins, and the fungus life cycle continues as just described.

When seeds are harvested and then stored for later use, care must be taken to store them under cold, dry conditions. Long-term storage (18 months or more) of fungal endophyte

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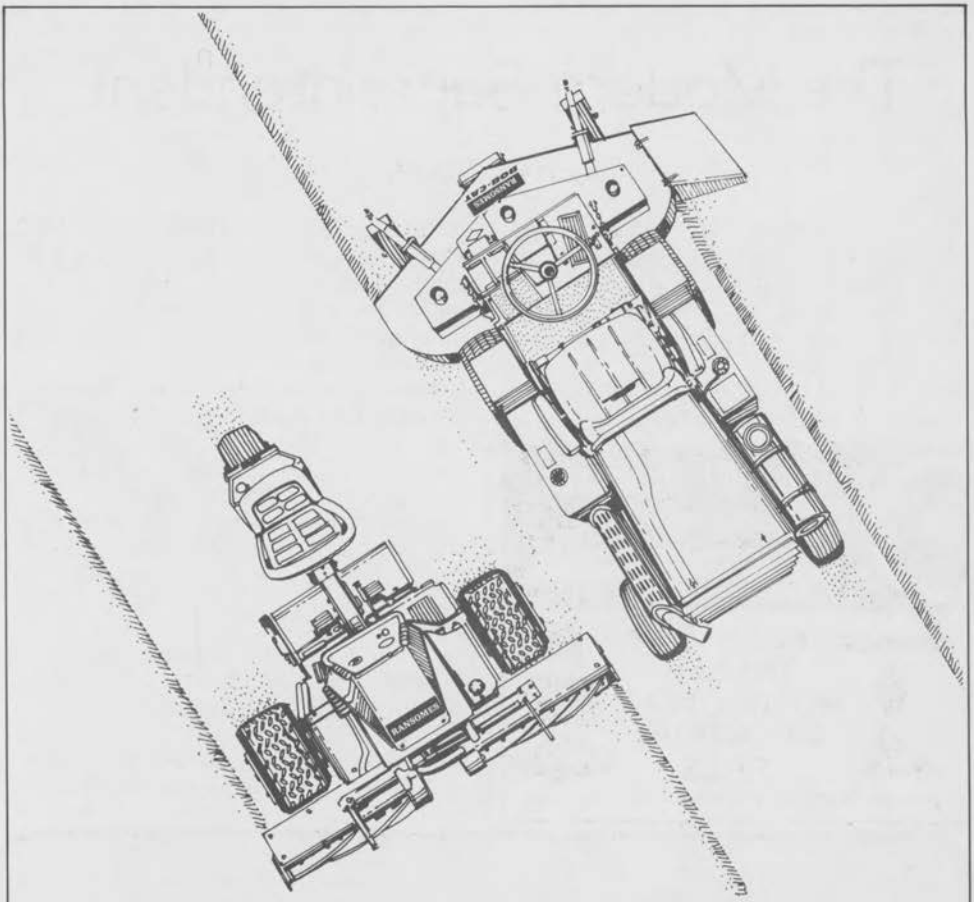

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BOB-CAT

The Modern Superintendent

By DAN JONES

Late on afternoon while sitting at my desk reflect-in on the events that had taken place that day on the golf course, the door to my office opened and in walked a man with a briefcase. This is what transpired.

Salesman - I am looking for Mr. Smith.

Smith - I am John Smith.

Salesman I am John Doe from the ABC Chemical Company. I have some products that can really help you (he hands me a lucite paperweight with 5 coins embedded in it and starts opening his briefcase).

Smith - I am not interested (I hand the paperweight back to the salesman).

Salesman - May I ask why?

Smith - Because your products are over priced for what you get.

Salesman - I am a new salesman with the company. The old salesman didn't treat you right. Let me prove that I can save you money. What products do you need?

Smith - I am just starting my weed program. How much is 2,4-D?

Salesman - What quantity?

Smith - 30 gallon drum.

Salesman - These prices are not for you. No sir. You get a real special price

CONTINUED PAGE 17

Budgeting & Purchasing Important Factors in the Business of Golf Course Management

I think we can assume that the majority of American Golf Course Superintendents today share equal levels of agronomic skills. It is apparent that the number of highly qualified turf managers in this country is increasing each year with better education and research. But if we are all good turf managers than what qualifies an individual to be an outstanding golf course superintendent? I believe the answer lies in the competence of managerial and business skills that the superintendent has developed. In every part of the United States, the most sought after jobs, the best maintained golf courses, and naturally the highest salaries are all going to the superintendent that has skills above and beyond Turfgrass Management. Those business skills include: (1) Personnel Mgmt.; (2) Basic Contract Law; (3) Public Relations; (4) Labor Relations; (5) Accounting; (6) Public Speaking, (7) Business Management; (8) Budgeting; (9) Purchasing.

Budgeting and purchasing are important

CONTINUED PAGE 14

ARE YOU INTERESTED IN JOINING THE *MICHIGAN AND BORDER CITIES GOLF COURSE SUPERINTENDENTS ASSOCIATION?*

FILL IN THE QUESTIONAIRE BELOW AND MAIL TO:

CLEM WOLFROM
DETROIT GOLF CLUB
530 Kendry
Bloomfield Hills, MI 48013
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DATE _____

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

OR YOU MAY CONTACT THE NEXT GOLF COURSE SUPPLIER WHO CALL ON YOU AND GIVE HIM THE INFORMATION NEEDED FOR APPLICATION.

infected seed stored under normal storage practices is known to give rise to plants free of endophyte; this is due to lost viability of the fungal endophyte. Endophyte levels in selected seed lots of ryegrass varieties:

High	Moderately High	Moderate	Low
Repell (GT-II)	Prelude	Palmer Pennfine	Gator Ranger
Pennant	Cowboy	Derby Delray	Manhattan Omega
Regal	All *Star	Dasher Linn	Elka Diplomat
	Premier		Citation Yorktown II

WHEN PURCHASING SEED TO CONTAIN HIGH ENDOPHYTE LEVELS LOOK FOR THE FOLLOWING TAG TO INSURE PRESENCE OF THE ENDOPHYTE

Test date _____

ENDOPHYTE ENHANCED PERFORMANCE™

When stored and used as directed seed of Repell Perennial Ryegrass will produce plants having endophyte enhanced performance.

An endophyte is a fungus that lives within, but is not necessarily parasitic on, another plant. The presence of an endophytic fungus produces no known adverse effects to the host plant but provides many advantages which enhance turfgrass performance.

In nature plants which contain the endophyte are able to survive insect attack. Resistance has been found to insects which typically feed on the lower stem and crown of plants as these areas normally have the highest concentration of the endophyte. Plants containing endophytic fungi have shown enhanced resistance to cutworms, sod webworms, armyworms, bill bug, Argentine stem weevil and chinch bugs.

Transmitted by seed, plants which contain an endophyte may also provide improved stress tolerance and persistance compared to non-infected plants. Additionally, enhanced performance may include a more attractive appearance, increased vigor and density and more rapid recovery from injury.

Repell Perennial Ryegrass was developed, produced and tested to insure that over 80% of the seed in this bag contained viable endophte at the date of testing. Endophyte viability will be significantly reduced by normal seed storage practices within 18 months. Cold storage (40) will prolong endophyte viability. To insure high endophyte viability seed should be stored under cool, dry conditions and used within nine months of the test date.

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elements in the business of golf course management. Each year the golf course superintendent either prepares or helps to prepare his budget for maintenance and improvement of the golf course. Four basic principles in budget preparation should be followed:

1. A budget should be based on a long range plan. Using the basis of long range planning we can look at the condition of the golf course and evaluate what we have, where we want to be, and what it will take to get there.

2. A budget should be based on a stated objective. A stated objectived may be written in the foreword of a budget. A stated objective should eliminate any grey areas and define the level of excellence a club desires. If you want a top conditioned golf course state that fact and prepare a budget accordingly. If you want an average golf course then state that fact and prepare a budget and maintenance program with moderation. It is important to realize that on a scale of 1 to 10 we cannot operate a golf course with a playing condition of 10 with a budget rating of 6. Inversely, if a club is spending money ckomparable to the better clubs in their area it should show in the high quality of playing conditions.

3. A budget should fit into the guidelines of the total club fiscal picture. In most cases the golf course is only one part of the total club budget. Be aware of total income and expenses of your entire club. All departments must work together to achieve the standards desired by the membership.

4. A budget should be consistant with other comparable clubs in your area. It is difficult to compare budgets but club members do it all of the time. Open the lines of communication among your peers and discuss your golf course as a business.

Once the needs of your golf course are established and converted into a financial forcast of dollars and cents, the next step in the budgeting process is the presentation. The presentation of the budget is usually done on both the Green Committee and the Board of Directors levels. The following items are helpful in the presentation:

1. Be prepared. Know your budget. If there are any questions be prepared to

CONTINUED PAGE 16

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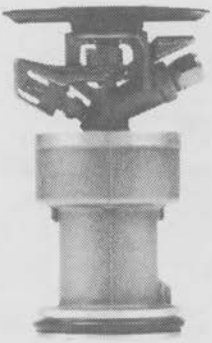

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answer them intelligently and confidently. A well prepared budget will speak for itself.

2. Neatness counts. Be sure that your budget is typewritten and easily understood by your members. I suggest that you mail a copy to the necessary members for their perusal prior to the date of a meeting. Use visual aids, if necessary, to explain items in the budget. This might include slides, charts, graphs, blueprints, etc.

3. Personal appearance. When you are presenting a budget show your members that you are a businessman in the way you dress.

Once your budget has been approved shoot for 98% accurancy. Although the golf course superintendent is dependent upon weather conditions to establish his annual expenditures, a good superintendent can stay within 2% over or under his forecasted figures. Labor continues to be our single largest expenditure in golf course maintenance. Other large accounts include the purchase of chemicals, materials, parts, and expendable supplies.

The purchasing of the aforementioned items is an area where we, as purchasing agents, can save our golf courses thousands of dollars each year. The best example is a recent set of price quotes on chemicals which showed a price variance of as much as 30% for specific items. With golf courses spending between $30,000 and $100,000 annually on chemicals and supplies it is our job to get the proper materials, to do the proper job, for the best price.

The following guidelines will help in purchasing:

1. Know the materials you will need. Using past records and current research results, develop a program for the upcoming year and forecast the types and amounts of material you will need.
2. Develop a purchasing strategy relative to the club's financial position. Be aware of early order discounts and early payment discounts. Be sure that your payments for purchases fit into the cash flow of the club comfortably.
3. Shop around and compare prices. Buy only reputable products from reputable distributors. Send out a list of materials you are purchasing and let the distributors that you deal with

quote you a price. If you are not currently doing this, the results will shock you! Prices for identical products may vary a great deal between different distributors.

For further help in budget preparation refer to **The Budget Process on a Golf Course** available from the Golf Course Superintendents Association of America. When purchasing items such as chemicals, fertilizers, paint, repair parts, etc. shop around and spend your clubs' money as if it were your own. Add to your foundation of agronomic skills and manage your golf course like a business - it is one.

Bruce R. Williams, Bob O'Link G.C.

Modern Superintendent, cont.

(he starts writing a lot of figures on a piece of paper). How does $6.48 a gallon sound.

Smith - Good, I am paying $7.15 a gallon from XYZ Company.

I am going to stop the conversation here to illustrate a point. Which company would you buy from? ABC? Sounds logical doesn't it. The cost per gallon is 10 less. That will really help you control your budget (the manager has been on your tail lately about costs) which is running considerably over. Should a superintendent place an order at this point? Let's listen to the rest of the conversation to find out.

Salesman - How many drums should I send out?

Smit - How many pounds of 2,4-D are in a gallon?

Salesman - Ah - Let's see - It will cover 10,000 square feet.

Smith - I don't care about your recommended rate. How many pounds of active ingredient per gallon?

Salesman - (Looking at sample label) 10,000 square feet sure is a lot for one gallon.

Smith - There it is at the bottom of the label: ¼ pound of 2,4-D per gallon. The product I am buying from XYZ Company has 4 pounds per gallon. That means your product costs 16 times more. (See figure 1.)

Salesman - How about liquid fertilizer. I can let you have it in 55 gallon lots for $6.50 a gallon.

Smith - I use liquid fertilizer on my golf course and I'm paying 50¢ a gallon for

Modern Superintendent, cont.

it. Now if you will excuse me I am very busy.

Salesman - But my product covers 25,000 square feet.

Smith - I said I am very busy. Good day.

Has this ever happened to you? Sure it has, we have all experienced this situation. How do you stand up to these salesmen? How can you be sure which salesman to buy from?

First, do not accept "free" gifts from salesmen. Do not deal with any company that will not give you a catalog. Do know how to read a label (both chemical and fertilizer) and insist on seeing the label before purchasing. Do not purchase if the concentration of active ingredient is not listed on the label. Compare prices of 2 or 3 compaines before purchasing.

Lastly, always consider service and reputation of the supplier. Deal with good reputable companies that belong to the South Florida Golf Course Superintendents Association. They support our organization financially, we should support them with our business.

During these troubled times, management is looking to the golf course superintendent to give him the best golf course for least dollar. Can we fill the role?

I would like to leave you with this one thought. Are you ashamed to have other superintendent look in your chemical room?

ANALYSIS OF CHEMICAL PRODUCTS 2,4-D

	Co. XYZ	Co. ABC
Pounds Material/Gallon	4.0	0.25
Cost Per Gallon	$7.15	$ 6.48
Cost/Pound Active Ing.	$1.79	$25.92
Cost/Acre (½ pound)	$ .89	$12.96
Difference Cost/Acre	-	1600%

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