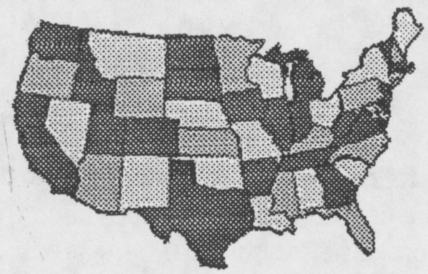
TurfComms

V. 13, I.4 June 23, 2001



PURPOSE: To pass on what we learn willingly and happily to others in the profession so as to improve turf conditions around the country.

USGA OPEN: I could not believe what I heard while listening to the Open on Saturday. I would have sworn I heard that the U.S.G.A. was slowing down one of the greens because it had too much slope in it. Is that correct? The U.S.G.A. is running an Open with deliberately different speeds on the greens?

Well got some confirmation on this. The 9th and 18th greens had been slowed down slightly by not double mowing. These greens have such severe slopes that at U.S. Open Stimpmeter speeds they had difficulty coming up with pin position that met other objectives. But, why not slow down the other greens so they will all have a uniform speed? I thought that was the purpose of the Stimpmeter – **uniformity.**

VANDALISM: It is US Open time as a write this and a couple of articles got my dander up. Two of these were in the June issue of Golf Course Management and the third was in the June issue of Golfdom. Superintendents will probably always have to deal with vandalism. At some locations it is so bad they take in all the flags every night and everything else on the course is chained down or cemented in.

Fire your employees and they may come back to haunt you. When 30 of a 38 man crew quit, are

---

TURFCOMMS is published at unpredictable intervals by the editor and publisher:

Douglas T. Hawes, Ph.D.
Certified Professional Agronomist
Specializing in Golf Course
Maintenance Consulting

3517 Deep Valley Trail
Plano, Texas 75023
(972) 867-0176
Fax (972) 519-9263

web site <http://www.geocities.com/turfcomms/index.html>
e-mail: dhawes@dallas.net

Subscription cost is $15. Send checks to Doug Hawes at the above address.

fired, or are run off in the first six months of a new superintendent's regime I think vandalism should be expected. In my years of watching superintendents in action such a loss in experienced workers has got to make it awfully difficult to manage a first class golf course. It would also really make me wonder about the character/personality of the superintendent. This one I have never met. According to two of these articles the above crew departure and vandalism occurred two years before a US Open. I'll bet that had the boys at Far Hills sitting on the edge of their chairs.

LUNCH WITH MILT: I have only personally known three people well who I felt were of genius level intelligence. One was a fellow student in grade school. He got thrown out of school because as a very bored young man he caused the teacher too much trouble. A second was the husband to my sister-in-law. He divorced her almost 20 years ago and I have not seen much of him since but, he made it big in the food processing industry. The third is Milt Engelke who I have now known for close to tweny years and as most of you know, is a turf breeder here at TX A&M at Dallas. I had lunch with him at the end of May, I mention the genius level intelligence to indicate that I'm always a great deal in awe when I spend one on one time with this man. On this day we first went over his current research projects and then went out to lunch.

Dr. Engelke is known for producing new bentgrasses, zoysias, and buffalograsses. The bulk of our conversation and all of the plot work shown that day centered around those three grasses with emphasis on **zoysias**. I was most impressed with the management study he was doing which included both zoysias and bermudagrasses at various heights of cut, fertility and water regimes. In this study **'Cavalier'** zoysia mowed twice a week at ½ inch with a reel mower and with fairway groomers (conditioning reels are what Milt prefers to call them) produced a turf that would be a super fairway or tee turf.

Don't try twice a week groomer reels on 419 bermudagrass; you'll wear it out. Even once a week, Dr. Engelke pointed out, might well be too much for 419. Although the twice a week mowing with groomers produced an excellent playing surface Cavalier it was not a nice dark and uniform green. But, putting color aside it was as good if not better than any fairway playing surface I've seen and that includes a few US Opens.

Two dates to consider putting on your calendar: Texas Field Day is **Sept. 19th** at Dallas. Milt also mentioned an International Symposium on Urban Environment to be held a few miles south of the Dallas TX A&M site **May 20-22, 2002**.

TREE FERTILIZATION: Dr. Dan Herms, Ohio State U. at Wooster, gave a talk on this at the National Arborist Assoc.'s TCI Expo 2000 in NC that has the tree care industry buzzing. I'm looking at two articles one by Dr. Herms himself on the subject and a article by Michael Oswald on the talk. The first is in the May issue of the <u>Tree Care Industry</u> magazine, the second in <u>Arbor Age</u>, June issue. He showed data that strongly indicates that as you increase the nitrogen level in trees you increase insect feeding on those trees. As he writes, "a recently published review of a large number of scientific studies found that in virtually every case, fertilization decreased tree resistance to insects." He goes on to write that his research supports these findings.

Those of us in turf should not find this too hard to believe, we all have seen the leaf eaters attack the "well" fertilized turf. Does it mean we should avoid fertilizing trees? No, but do it judiciously and be aware of what may happen if growth is excessively stimulated by your fertilizations.

MAGNETS: I ended the Dec. 29, 2000, issue of TurfComms (V.13,I.2) with a review of Dr. Dennis Martin's talk on this subject. His conclusion was that there was no evidnce that any of these devices improved turf quality. Well at the end of March I got an email from Dr. John Hall III of VPI, Blacksburg, VA saying: "Got to the end and read what you wrote about magnets. Want to share a little story with you. A guy I barely know got (I thought) suckered into becoming a distributor for these magnets and a "PI water system." He called me at the office and said he wanted to talk to me about it. So I patiently listened and finally said "I tell you what…I'll do a little test on tall fescue germination in petri plates using your water and magnets and we will analyze the data to see if anything happens."

All the effects I will mention are statistically significant at the 5% level.

1) Six days after planting the Pi water + magnet treatment had 3 times more radicles merging than tap water alone and 2 times more than the pi water alone.
2) Nine days after planting the Pi water + magnet treatment had 2.5 times more shoots emerging than the tap water alone.
3) 23 days after planting the Pi water + magnet treatment and the pi water alone treatment both had individual seedling weights 25% higher than tap water, suggesting that the effect was primarily from the Pi water at this stage.

I am quite amazed, but too busy to do anything with the observation. Need to retire to have time to mess around with these off the wall ideas like this.

GEOTEXTILES AS AN INTERMEDIATE LAYER IN USGA TYPE GREENS: I have shortened the title some of a new Bulletin on this subject put out by Dr. Lloyd Callahan, et al from the Univ. of Tenn. It has a February 2001 date on it. It is called Bulletin 699, and is released by the Orn. Hort. And Landscape Design Dept. The 64 page bulletin reviews work done at U. of Tenn. One study was an evaluation of the reliability, durability, and performance of ten geotextiles as intermediate layer drainage separators."

The bulletin emphasizes the very real problem of migration of the smaller soil particles into the choker and pea gravel layer below. First, I think this can be largely prevented if the correct choker sand layer is installed over the proper size gravel. I would agree that this is not easy to do and is seldom accomplished. Therefore why not use a manufactured geofabric that can be precisely produced to do what choker sand layers often fail to do. This Bulletin notes that none of the approaches tried as alternatives to choker layers and choker layers themselves "were able to prevent particle migration." However, Terrabond fabrics constructed for such use performed more satisfactorily than any other approach.

The Terrabonds studied were soft, thick, spunbond, non-woven, needle-punched, continuous filament polypropylene-polyester geotextile fabrics from 86 to 321 g/m^2 wt, and from 1.5 to 4.5 mm thickness. However, the lightest of these did not work satisfactorily. At least 100g/m^2 wt was needed for satisfactory performance. Terrabonds are manufactured by Hoechst Celanese Corp.

PGA TOUR: Read two items in today's paper (5/30/01) that got an emotional reaction from me. First, I am very unhappy that the Supreme Court of the USA has decided that the Americans with Disabilities Act should determine how professional golf is played.

Secondly, there was a column by Bill Nichols noting that Lanny Wadkins was telling it like it is in the CBS booth and will get another chance at the lead analyst's spot this weekend at the Memorial. I don't often watch PGA golf on TV but I just might this weekend to hear Lanny tell the truth about what is going on out on the course.

ENTOMOPATHOGENIC NEMATODES (ENs) AND THEIR USE IN CONTROLLING INSECT PESTS

An alternative nontoxic approach for the control of insect pests of turf.

**Robin Bedding, Chief Research Scientist, CSIRO Entomology, Box 1700, Canberra, ACT 2601.*
robinb@ento.csiro.au *David Nickson, Reseach &Development, Ecogrow Australia.*
NNicksons@aol.com.au

Introduction

Nematodes are primitive, unsegmented roundworms. The largest nematode *Placentanema gigantissima* from the placenta of sperm whales is 8 m long and 2 cm thick and the smallest, *Greeffiella minutum* is only 0.08 mm long and lives free in the sea (Poinar 1983). Apart from insects, nematodes are the next most common animals on earth with nearly a million different species likely. They are found almost everywhere from the tops of the highest mountains to the depths of the deepest seas. Most nematodes are completely harmless but the roundworms that affect our domestic animals and the eelworms that cause billions of dollars damage to crops and turf worldwide are all nematodes. Three of the 10 most common diseases of man are caused by nematodes and other nematodes cause elephantiasis and African river blindness.

The nematodes that we use to control insects are about as different from most of these harmful nematodes as human beings are from goldfish.

The first nematode to be used successfully in the control of an insect pest was in Australia nearly 30 years ago when CSIRO introduced *Beddingia* (then called *Deladenus*) *siricidicola.* This nematode sterilises the sirex wasp which is the main pest of our one million hectares of pine forest (Bedding, 1993). Without control it is estimated that the Sirex wasp could cause from one to four billion dollars worth of tree death in every 35 year-rotation of these forests. The nematode, which is the main means of controlling it, has prevented this. *B. siricidicola* is used as a classical biological control agent; once introduced into a forest it can more less be left to look after itself because sirex females transmit it throughout the population.

However, the nematodes that are used to control **most** insect pests are of very different than this. They seek out and kill various insect pests and are used rather like insecticides (biopesticides), killing insects only near to where they are applied. We call these nematodes ENs (entomopathogenic nematodes). CSIRO was also first in the world to use ENs commercially. This was against black vine weevil in ornamentals from 1981 and against currant borer moth in black currants from 1983. Now various ENs are used around the world against a variety of pests though usually in niche markets (e.g. fungus gnats in plant nurseries, hydroponics, and mushroom houses; weevils on ornamentals, strawberries, cranberries, citrus and bananas; scarabs of amenity turf, ornamentals and blueberries; cutworms, webworms, billbugs and mole crickets on amenity turf; termites in houses and trees; peach borer moth in apples in China; carpenter worm in shade trees in China and fig trees in the USA). Recently at 13% of sales of bio insecticides in industrialised countries ENs were already second only to *Bacillus thuriengensis(**BT**)* at 80%.

Considerable progress has also been made during the last 20 years or so on the taxonomy, biology, genetics, ecology, host range, production, application technologies, laboratory trials, field trials and commercialisation of ENs and their symbiotic bacteria resulting in over 2000 publications during this time.

In order to understand how ENs might be used to control pests it is helpful to be aware of what they are, where they are found, how they work and how best to manipulate them.

ENs

Most ENs belong to one of two genera, *Steinernema* of which there are some 18 species described or *Heterorhabditis* with eight species. The infective juvenile EN is more or less microscopic, anything from 0.5 mm to 1.5 mm long depending on species. It has a closed mouth and anus and cannot feed until it finds an insect. Usually it is found in soil and is activated by insect movement and then follows a gradient of carbon dioxide to find the insect. Now it needs to get into the insect's blood cavity in order to kill it. ENs enter through the insect's natural body openings, the mouth, anus or respiratory inlets (spiracles) and then penetrate into the blood cavity from the gut or breeding tubes; *Heterorhabditis* species can also penetrate through chinks in the insect's armour (the interskeletal membranes) by scratching away at these with a special tooth.

Once in the insect's blood the EN infective juvenile releases a highly specialised symbiotic bacterium found only in ENs (*Xenorhabdus* spp. in *Steinernema*, *Photorhabdus* spp. in *Heterorhabditis*). These symbiotic bacteria multiply and rapidly kill the insect within a day or so. The bacteria then convert the insect into suitable food for the nematodes and produce a range of antibiotics and anti-feedants that preserve the dead insect while the nematodes feed and breed up within it. After about 10 days a medium-sized scarab cadaver may produce up to 100,000 or more infective juvenile ENs that are released into the soil and seek out new insect pest hosts. Unfortunately there are many fungi and other organisms that can attack the infective juveniles before they are able to enter an insect pest.

Occurrence and discovery

ENs have been found in soils throughout the world using the wax moth baiting technique. Using this technique we and others have found as many as one in three soil samples taken in this way from various countries and habitats contain ENs. Doubtless most readers will have at least one species of EN on their property. Unfortunately the most common strains are usually poorly infective strains, poorly distributed and in such low numbers that they have little affect on pest insect populations.

To use ENs in insect control we select the best species and the best strain of that species, produce it in vast numbers and then apply it evenly so that many ENs can reach each insect pest provided there is a water film between the pest and ENs.

Safety

Various tests against mice, rabbits and monkeys have shown that the ENs tested are harmless when fed, injected or inhaled. They are also harmless to earth worms and other non-insect organisms including plants and they are of course nonpolluting. They have now been used on a large scale in various countries for over ten years and large numbers of production workers have been exposed to thousands of billions of them without any adverse effects being recorded. The EPA in the USA and many other countries including Australia have exempted ENs from registration. However as with a variety of materials from pollen and flour to various insects and plants there is always the possibility of some individuals developing allergies to ENs so that it is wise to prevent the possible inhalation of EN sprays and skin contamination with them.

Production

It is far too expensive to rear ENs inside insects at least in industrialised countries. CSIRO pioneered the use of the ENs own symbiotic bacteria to convert various crude media into ideal food for culturing ENs aseptically on three-dimensional carriers. Essentially we use crumbed waste upholstery foam to provide a large surface area on which a thin layer of medium is distributed. We have patented culture chambers that are self-aerating while maintaining uncontaminated nematode/bacterial growth throughout the culture period and have used these to produce many hundreds of billions of ENs for trials and commercial use.

Formulation and storage

It takes about 2000 million ENs to treat one hectare**(800 million/A or 20 million/1000 sq. ft.)** where the insect pest is reasonably susceptible. It is impractical to supply them to end users in a water suspension that would have to be kept continually aerated and would even then only last for a few days. We have patented a number of ways of formulating ENs. The latest formulation is comprised of about 50% micro-cellulose and 50% nematodes that can be readily mixed in spray tanks, sprayed without blocking nozzles and can survive several months at constant temperature. This long shelf life has been achieved by manipulating the nematodes' physiology. One problem is that by this time fungal contamination develops and it has been very difficult to find a suitable preservative that does not harm the nematodes but keeps fungus at bay for several months. Another problem is that the nematodes must be kept at a precise water content for maximum shelf life but it is difficult to provide them with oxygen while preventing water loss.

However many of these problems are now almost solved and we do have products that are currently being marketed satisfactorily for the control the number of insect pests including turf pests both in Australia and overseas by our licensee, Ecogrow Australia Pty Ltd.

Examples of EN use in CSIRO projects

In the original paper there is information on:*Currant borer moth, Black vine weevil in ornamentals, Fungus gnats on seedlings, hydroponically grown flowers and mushrooms, Banana weevils, Apple borer moth in China,* and *Carpenter worm in shade trees.*

Pests of turf
The main insect pests of turf in Australia are:

Common name	*Scientific name*
African black beetle	*Heteronychus arator*
Black headed cockchafer	*Aphodius tasmaniae*
Red headed cockchafer	*Adoryphorus couloni*
Lawn or pruinose scarab	*Sericesthis geminata*
Argentine scarab	*Cyclocephala signaticollis*
Billbugs	*Sphenophorus brunipennis*
Argentine stem weevil	*Listronotus bonariensis*
Lawn armyworms	*Spodoptera mauritia*
Webworms	*Herpetogramma licarsisali*
Cutworms	*Agrotis* species
Underground grass grubs	*Oncopera* species
Changa mole crickets	*Scapteriscus didactylus*

Of these, the Argentine stem weevil and then the African black beetle are probably of most general importance but many of the others including billbug and cutworms can cause severe problems in some areas. **Currently most success has been achieved in Australia in using a new strain of the EN *Heterorhabditis zealandica* against black beetle and Argentine stem weevil where good control has been achieved in over 150 amenity turf sites** and against bill bugs, and Argentine scarab although fewer treatments were made on these (Ecogrow Ltd., *pers comm.*). Another, EN, *Steinernema carpocapsae* has been successful in early trials against cutworm.

Using ENs

For all the pests mentioned, treatment with ENs will involve certain basic principles. Unfortunately ENs cannot be applied quite as simply as insecticides. Being living organisms they are subject to damage from UV light and from desiccation. They will also **settle out** in spray tanks if not agitated properly. And, they need a water film to move through to reach their targets. Thus when applying to soil to treat various pests, the soil must be moist though not too wet, and even the extreme surface needs to be moist so that the area to be treated needs to be carefully watered just before. Because ENs are susceptible to UV light they should never be applied during sunlight and preferably at dusk. Even though the ENs can move to seek out insect pests they cannot go very far (just a few cm) and the nearer you can get them to the insect the more likely they are to be able to infect that insect. Essentially every sq cm of soil surface should receive its quota of nematodes with the exception of drip systems where the nematodes can be delivered precisely to the plants root system where scarab damage may occur, as in grape vines. After spraying ENs onto the soil surface it is advisable to irrigate that surface again. This helps to wash the nematodes down through the vegetation and even partly into the soil. Another problem affecting nematodes is temperature extremes. Essentially ENs cannot infect at temperatures below about 15 degrees**(59°F)** and many kinds of them are stressed at temperatures over 30 degrees C **(86°F)**. They can however survive without being able to infect in some cases at temperatures below freezing.

On a small-scale, for instance on backyard lawns, ENs can be applied using venturi sprayers such those used for "Weed and Feed" but on a larger scale boom sprayers are very effective and if properly adapted irrigation systems can be used. It is important then to remove filters while spraying ENs and to ensure that nozzle sizes are adequate.

Conclusion

The use of ENs is really still in its infancy and there is considerable potential yet to be fulfilled. New species and strains of ENs are constantly being found and can now be stored in liquid nitrogen indefinitely to preserve genetic diversity. Most of our domestic animals and plants have been modified by artificial selection and this is undoubtedly possible with entomopathogenic nematodes (particularly because their short life cycle) and has indeed been already attempted with some success. As better and better strains become available more kinds of insect pests can be targeted and fewer ENs will be required for treatments that will therefore become less expensive. There is also much research being conducted on methods for applying ENs that should help to further reduce treatment costs.

The great advantages of using these biopesticides are in operator and end-user safety, absence of withholding periods, the advantage of minimising the treated area by monitoring insect populations, minimal harm to natural enemies and lack of environmental pollution.

***Edited by D. Hawes for TurfComms readers. The original with two pages of references and other materials can be accessed at the editor's website <u>http://www.geocities.com/turfcomms/index.html</u>**

PLEASE NOTE: Although this and the last issue have been 8 pages we hopefully will return to the normal four page format with the next issue. Also, with the next issue we will pick up an East Coast editor, I think.