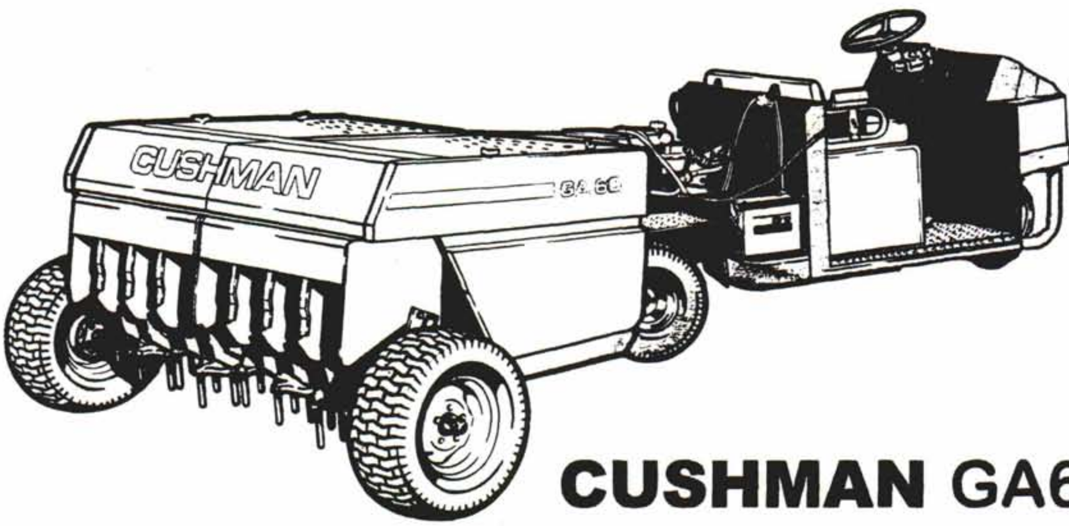
The whole course aerator ...



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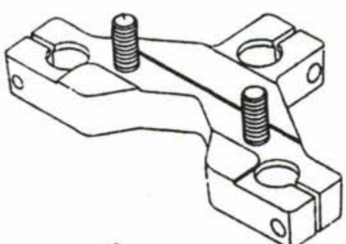
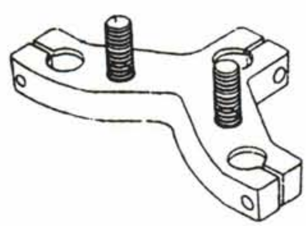


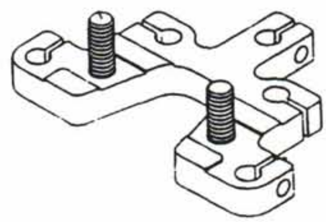
tines:
3/4" open*
5/8" solid

GREENS AND TEES



tines:
5/8" coring tine*
1/2" core
3/8" core
1/2" solid

QUAD TINES



tines:
1/4" solid*
1/4" hollow

*denotes standard tine set

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(continued from page 10)

maintenance equipment and the equipment drives away with the ball, another ball may be substituted with no penalty.

In all instances, if the ball in play is embedded by a piece of maintenance equipment, the golfer is permitted to lift, clean and place the ball without penalty —Rule 20-3(b) (Lie of Ball Altered); and if the ball is deemed to be damaged by a mower or any other piece of maintenance equipment, another ball may be substituted—Rule 5-3 (Ball Unfit for Play).

Rule 25 is the rule dealing with Abnormal Ground Conditions (casual water, ground under repair, certain damage to the course), and there are a number of interesting decisions based on Rule 25 relating to golf course maintenance. Decision 25/14 defines a "hole made by a greenkeeper" as ground temporarily dug up in connection with course maintenance, such as a hole made in removing turf or a tree stump, laying pipelines, etc.

Decision 25/15 states than an aeration hole is not a hole made by a greenkeeper; therefore, relief is not granted. However, a local rule (33-8/32) is suggested which may be adopted by your club that does allow a player to take relief from aeration holes. Naturally, where there are aeration holes, there are aeration plugs. The ruling pertaining to aeration plugs can be found in Decision 23/12. It states that although loose soil is not a loose impediment through the green, aeration plugs are considered to be "compacted soil," so they are considered to be loose impediments which may be moved away from the ball before making a shot. Just don't move the ball when you move the plugs or you'll be

Is there relief from a tree stump under the rules? Decision 25/8 says that unless the stump is marked as ground under repair, or is in the process of being removed, there is no relief. A tree stump is nothing more than a short tree, according to the USGA.

assessed a one-stroke penalty under Rule 18-2(c) (Ball Moved After Touching Loose Impediment).

How should ruts made by tractors be treated under the rules? Decision 25/16 explains that a rut made by a tractor is not a hole made by a greenkeeper. Deep ruts should be declared as ground under repair by the committee; however, shallow indentation made by greenkeeping equipment is not ground under repair. A ball in a shallow indentation would have to be played as it lies.

Is there relief from a tree stump under the rules? Decision 25/8 says that unless the stump is marked as ground under repair, or is in the process of being removed, there is no relief. A tree stump is nothing more than a short tree, according to the USGA.

(continued on page 22)

Tank Mixing Fungicides for Better Control

Paul Sartoretto, Ph.D.
Technical Director
W.A. Cleary Chemical Corporation

My article, "Compatibility in the Spray Tank," was first published in February of 1977. In that article, I described four simple rules, which when followed would permit one to successfully tank mix pesticides without incurring phytotoxicity. This present article deals with one specific aspect of tank mixing, namely fungicides, to obtain a broader spectrum of disease control for the turfgrass professional.

A Question of Solubility

As the world of fungicide products shrinks due to slower new product introductions and faster old product retirements, I get an increasing number of phone calls asking about the compatibility of pesticides in the spray tank. I welcome the calls, but if one were to truly understand a universal principle of tank mixing and its relationship to phytotoxicity, one could pigeonhole any new product by knowing if it is soluble or insoluble. The manufacturer will use key letters after the name of the product that can indicate whether it is soluble or insoluble. Examples of such letterings are as follows:

Solubles
- S: Solution
- SP: Soluble Powder
- E: Emulsion
- EC: Emulsifiable Concentrate

Insolubles
- WP: Wettable Powder
- F: Flowable
- WDG: Water Dispersible Granule

For quick and easy reference, I have categorized in table form the commonly known pesticides currently used for turf disease control. Should a new pesticide appear on the market, just determine whether it is water soluble or whether it is insoluble, then proceed using the following information. A large number of pesticides are insoluble, and before they can be used, they must be milled down to submicron size so that they will disperse in water; whereas, solubles dissolve in water and when in solution are molecular in size. Submicron-size particles are thousands of times larger than molecules. Therein lies the difference. A solution, when sprayed on a grass blade, will move in and out of the blade at ease by the process of osmosis. In other words, molecules of water and molecules of soluble pesticide will easily move in and out of the grass blade through the stomates. Too high of a concentration of soluble pesticide or soluble beneficial fertilizer will burn the grass. The insoluble submicron particles of pesticide or organic fertilizer are too large to pass through the stomates. If they can't enter the grass blade they won't burn the grass.

Understanding this universal principle, one can conclude insolubles are not phytotoxic when tank mixed together up to the labeled rates for each product. However, solubles could be phytotoxic at or below labeled rates in the tank mix. Label rates of soluble pesticides must be respected and carefully followed. If you were to mix full rates of soluble pesticides, you would undoubtedly exceed the safety factor and encounter phytotoxicity. That is why it is necessary to back off and use half rates or even third of the rates when mixing soluble pesticides. A classic example is a premixed herbicide product which contains a combination of three soluble herbicides: 2,4-D, MCPP, and Dicamba. These products generally contain 1/3 lb. of 2,4-D, 1/2 lb. MCPP, and 1/9 lb. of Dicamba per acre, which are actually one-third rates of each if you were to use them separately. Many other examples of this concept exist both in pesticides and fertilizers.

Also discussed in my previous article is the treatment of emulsifiable concentrates (ECs). Some manufacturers will take water insoluble pesticides and dissolve them in hydrocarbons, then add emulsifiers. Most ECs are insecticides. Treat them like solubles because the hydrocarbons can penetrate the grass blade through the stomates. Since the pesticide is now soluble in the hydrocarbon, it is no longer submicron size but is molecular in size and can also penetrate the grass blade.

Tank Mixing

Tank mixing fungicides is not new. There must have been someone advocating tank mixing before me, but I started with the classic tank mix of PMAS – Thiram forty-five years ago. That popular tank mix was used for almost thirty-five years. PMAS was a powerful soluble contact fungicide with both preventive and curative properties, but its solubility was its shortcoming. It was sprayed at 500 ppm, and within two or three days, the normal irrigation practices would wash it off the grass blades; whereas, Thiram was an insoluble contact sprayed at 10,000 ppm, and it took at least four to five days to wash off the last traces of it. Had PMAS

(continued on page 16)

(continued from page 14)

been sprayed twice a week, there would have been no need to add Thiram to it because the grass blade would have been protected at all times. Therefore, insolubles were added so that the superintendent would only have to spray once every seven- to ten-day intervals.

To appreciate the value and importance of insoluble contact fungicides, one has to understand how they work. First, understand that they are truly not insoluble, but for all practical purposes they are referred to as insolubles with solubilities in water in the range of 10 to 100 ppm, low enough to be regarded as non-phytotoxic when sprayed at heavy rates. Their action is preventive, not curative. They act very similar to preemerge crabgrass killers as opposed to postemerge crabgrass killers. One puts down a heavy rate of preemerge crabgrass control which has only a few parts per million solubility, sufficient to kill the tender crabgrass seedlings which have germinated. But if crabgrass has germinated when the seedling has rooted and slightly matured, that few parts per million solubility is insufficient to kill the plant.

Insoluble contact fungicides act in a similar manner. They are applied at heavy rates, and as long as there are a few parts per million of insoluble fungicide left on the grass blade, it is sufficient to kill the spore when it sends out its tender shoot; but the insoluble contact doesn't have sufficient solubility to kill the more mature mycelia. That's the job of the soluble contact.

It was this philosophy that set a trend in the fifties, and other manufacturers followed shortly thereafter. Each had excellent soluble contacts with good curative power which never had to be used above the rate of one oz. per 1000 sq. ft., as phytotoxicity could be encountered above that rate. This group of products was efficient and economical and was mostly used in conjunction with insoluble contacts. Mallinekrodt had Calo-clor and Cadminate and also mixtures with Thiram. Upjohn had the excellent Actidione, and sold it straight or mixed with PCNB or Thiram. Cleary also added soluble Caddy to its line. Believe it or not, DuPont also had a soluble organomercury in its line. Tersan OM was a combination of mercury and Thiram. If you were a superintendent in the fifties and sixties, I'm sure you would have been tank mixing or using tank mixed products. The mixtures were always a soluble with an insoluble contact.

In the 1970s, three great systemics were introduced: DuPont's 1991, Cleary's 3336, and Rhone-Poulenc's 26019. They were awesome when first used commercially.

However, the seventies ushered in a new era: the advent of the systemics and the phasing out of those great soluble contacts. In the 1970s, three great systemics were introduced: DuPont's 1991, Cleary's 3336, and Rhone-Poulenc's 26019. They were awesome when first used commercially. One or two oz. per 1000 sq. ft. gave excellent broad spectrum control for six or seven weeks! It appeared there was no further need for soluble or insoluble contacts.

Then strange things began to happen. The rates had to be upped, and the intervals were shortened; still disease was coming through. The grass plant which was supposed to be rendered immune was succumbing to resistant strains of the diseases, just as we had experienced resistance in the past with insects and insecticides. In medicine, antibiotic drugs were performing similarly. Repeated use of the same antibiotic developed resistant strains of the infectious organism. Obviously, the answer was simple: switch to different systemic or a different antibiotic which would control the dominant resistant strain. It worked, but for how long? Until another resistant strain developed?

Fortunately, several good systemics were developed during the late seventies and eighties, and the practice of alternating systemic pesticides has reduced the resistance problem somewhat, but not completely. A few years' experience with the new systemics made us realize that the contact fungicides, far from becoming obsolete, had to fill in the gaps of disease control created by the deficiencies of the systemics. Therefore, it was logical to add 3336 to the near perfect mixture of PMAS+Thiram. The residual control of PMAS+Thiram was tailing off at the ten-day interval; adding 3336 did extend the control. Ultimately, in the late eighties, all soluble contacts came under scrutiny by EPA; and as a result they were all canceled: PMAS, CADMINATE, CADDY, ACTIDIONE, AND CALO-CLOR.

They were all so powerful and economical products to use. They have been sorely missed and have made the job of replacing them expensive and complicated. Personally, if I had to choose between systemics or soluble contacts, I would prefer the latter.

(continued on page 18)

Tank Mixing Fungicides
(continued from page 16)

Fungicides Are Different

Although there appears to be a fairly large number of systemic fungicides, these fungicides are limited to a small number of chemical families. Competitive factors have lead to the development of new materials; however, these products are the result of structural changes to the molecules within a similar chemical group. Research has shown that the fungicidal activities of these groups are similar, normally disrupting one distinct function within the fungal organism. When tank mixing, it would not be wise to mix two systemics within the same group. No synergism or broader spectrum of activity is achieved by doing so. This is so beautifully explained by Professor Patricia Sanders, Penn State plant pathologist, in her article: "USE SENSE and Be Skeptical." The article is a classic and should be read, studied, and thoroughly understood by anyone who wishes to begin tank mixing. She explains there are three groups of broad spectrum systemic fungicides:

BENZIMIDAZOLES: Cleary's 3336, Fungo-50, Tersan 1991 (discontinued)

DICARBOXIMIDES: Chipco 26019, Vorlan

STEROL INHIBITORS: Bayleton, Banner, Rubigan

Ms. Sander's research has shown that any fungus that is resistant to one member in a group will become resistant to all the members in that group. Therefore, it is futile to mix systemics within the group. "Broad spectrum systemics must be mixed between but not within groups." Example: Don't mix 3336 with 1991, but you can mix 3336 with Bayleton or 26019. She also points out that there are three *Pythium* systemics: Subdue, Banol, and Aliette. They each have different modes of actions; they can be mixed as either two-component or three-component systems, using half rates, or in the later case, using one-third rates to avoid resistant strains. Ms. Sanders has found that reduced rates of fungicides in the mixtures are not only economical and environmentally sound but produce a broader spectrum of control and have been found to have a synergistic effect. I have also found the same results in all my tank mixing.

Contact fungicides fail when they are not present on the grass blade but succeed when they are. To spread the interval of application beyond ten days is not a good idea for contact fungicides.

Fungicide Mixtures

Since most all systemics have been found to be somewhat deficient in the control of some diseases, it is necessary to add contact fungicides to the mixture to make up for this deficiency. A good example is brown patch. I have found by adding Daconil 2787 and a Mancozeb product, such as PROTECT T/O or PCNB or Thiram, to the systemic mixture, brown patch does not occur; but without them, it will eventually persist.

In other research, Dr. Bruce Clarke at Rutgers University has done some remarkable work in controlling summer patch with 4 oz. per 1000 sq. ft. rates of the sterol inhibitors such as Banner, Bayleton, etc., and also 8 oz. per 1000 sq. ft. rates of benzimidazoles such as 3336 or Fungo 50 at monthly intervals.

The results are phenomenal and when combined with proper soil chemistry management indicate that the turf manager may finally get the upper hand on this disease. Best results occur when they are watered in. They have long residuals in the soil, and these heavy rates give one full month protection before the next application.

Unfortunately, some superintendents are using this application solely for disease control on greens and could be in danger of getting resistance or also the occurrence of other diseases such as brown patch for which systemic control is weak. I reason that it would be just as sensible to supply the grass plant with incremental amounts of systemic through weekly or ten-day interval applications; and in these incremental applications, contact fungicides are added to the mixture so that they can do their job. Contact fungicides fail when they are not present on the grass blade but succeed when they are. To spread the interval of application beyond ten days is not a good idea for contact fungicides. Also, watering in the mixture is bad because the contact must stay on the grass blade as long as possible. Your irrigating practice will suffice in getting the systemic into the soil. It has a long residual. I have had excellent control by spraying a mixture of 1/2 oz. Bayleton, 1 oz. 3336, 1 oz. Daconil, and 1 oz. Thiram at weekly or ten-day intervals; and when stressful disease weather approaches, I increase the contact fungicides to 2 oz. each yet keeping the systemics at the low rate. Other substitutions can be made, such as substituting 26019 or Banner in the mixture; but always making sure that one is not using two systemics within the same

(continued on page 24)

Must We Always Demand Perfection?

Denis Griffiths
President
American Society of Golf Course Architects

Years ago, when the links courses of Scotland and England were laid out in and around the natural dunes and landforms, man moved minimal earth to provide contiguous golf holes. Everything on the links was adapted to fit existing conditions. You might say that Mother Nature was actually the builder, and the course designer was merely the one who discovered the routing.

This use of nature often provided courses that were testing and frequently offered imperfect lies, blind shots and unmanicured turf. Part of the enjoyment of these courses, however, resided in having to respond to these challenging circumstances, often through creative shotmaking.

But somewhere along the line, the American perception of the game strayed from its European roots. That perception, which has been a major influence on course design around the world, applauds wonderfully maintained, impeccable golf courses. It also encourages complete fairness in design and is skeptical of "unusual" design measures such as the occasional blind shot.

Television, golf magazines and the PGA tour have all had a hand in furthering this perception, particularly in setting expectations that are often mistaken for standards. Announcers banter on about how players are penalized for anything less than a perfect lie, and touring professionals complain about course conditions. Meanwhile, we nod in empathy.

But must a good tee shot always be rewarded with a perfect lie? Must every shot be hit to a clearly visible target? Must it always be possible to advance a ball from a sand bunker? Must every green hold approaches? Must the play area contain 100 percent turf coverage throughout the season, no matter what weather conditions exist?

It is my belief that the quality of a game of golf should be judged more on the integrity of the course's design than on its condition. The goal of the golf course architect is to create variety, demanding that players use every club in their bag. Less-than-perfect turf conditions provide an additional variable that should not necessarily be considered a negative.

I am the first to agree that these conditions can contribute to the game's overall enjoyment level, but I also feel this "Americanization" may eliminate many shots that are required on the traditional Scottish and English courses—shots that add to the overall challenge and finesse of the game.

In discussions with other members of the American Society of Golf Course Architects, I find that most strive to meet these Americanized expectations. As a result, today's golf course architecture may best be described as a study on how to best modify terrain to create the desired golfing experience.

With sites containing more and more limitations—whether they be related to size, terrain or environment—designing to this American-style of golf often involves extensive earthwork to reform the ground, especially to prevent blind shots and provide level play areas. It also requires green construction methods, irrigation system design and grass selection that have reached a level of sophistication almost beyond comprehension. All in the name of perfect playing conditions.

While meeting golfers' expectations, these designs have and will continue to drive course construction costs higher. The dramatic upswing in maintenance costs is likely to continue as well. (It is not uncommon today for the average annual maintenance cost of a 25-year-old facility to exceed the original cost of construction for the same course!) All of which has lead to an overall rise in green fees.

(continued on page 28)