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Drainage *from page 18*

possible after a downpour, a drainage system providing runoff that keeps up with rainfall may be justified. In areas of high intensity rainfall, design drainage rates as high as 1/3-in. per hour or 8 in. in 24 hours (160 gpm per acre) are used.

In the example shown, a football field 160 by 360 ft., 10 lines 300 ft. long, spaced 16 feet apart are used. Each line would handle the flow from 16 by 360 ft., or 5,760 sq. ft. (or 0.13 acres). Water flow requirement is 21 gpm per line. For a slope of 0.04, 3-in. tubing is adequate. For a slope of 0.100 4-in. tubing is required.

While drainage is certainly a major factor in successful landscaping, its cost, in proportion to the overall construction budget, is small. Depending upon locality and conditions encountered, drainage cost represents only about 8% to 10% of a total golf course construction budget and only about 5% of a landscaping budget. **WTT**

Four-inch golf course drain in shallow trench and covered with gravel for rapid intake.

PROFESSIONAL APPLICATOR MUST KNOW MIXING BASICS

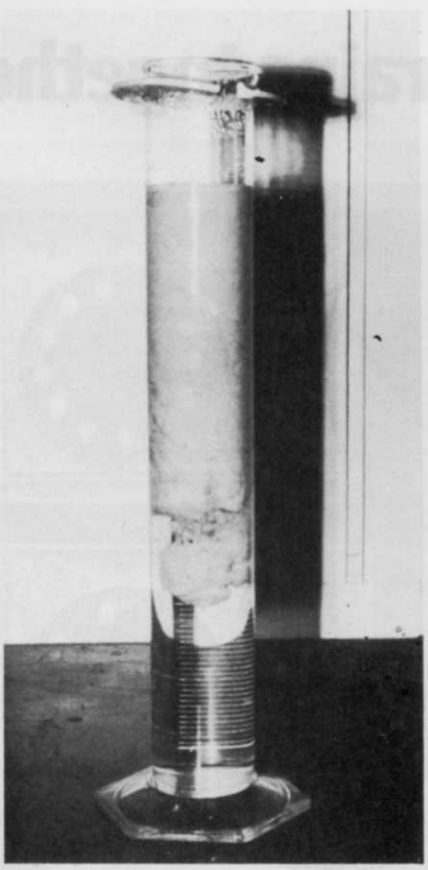
by Paul A. Sartoretto, Ph.D.

Can a pesticide applicator get by without a knowledge of chemistry and still determine what pesticides are compatible in the spray tank? A knowledge of chemistry is helpful, but not essential if one masters a few basic rules.

A professional must know that the pesticides he mixes in water will retain their own identity and not react with each other. The following four rules and exceptions are helpful in determining tank mixes. However, if there is any doubt, simple tests using a glass jar can be used to check compatibility.

Green Industry applicators are concerned primarily with water mixes. Therefore, the need is to determine how each chemical reacts with water and how each chemical reacts with other chemicals in a water system.

Dr. Sartoretto is a member of the board of W. A. Cleary Corp., Somerset, NJ. He is also director of research and development for the company. Sartoretto has a Ph.D. in chemistry from Notre Dame.



This test shows the material mixes well with water, evidenced by the uniform dispersal as the material falls with gravity.

All chemicals can be classed into three groups; cationic (positively charged), anionic (negatively charged), and nonionic (no charge). Positively charged chemicals (cations) attract negatively charged chemicals (anions). Nonions have no attraction to other chemicals, but their ability to mingle (solubility) with other nonions of similar structure must be recognized. In a water system, nonions that are soluble are termed hydrophyllic, and nonions that are insoluble are termed hydrophobic.

When cations and anions are mixed together they form salts. When large heavy cations and heavy anions come in contact, they form heavy salts which are insoluble and precipitate out of the mix. (Precipitate means to separate out of the solution or suspension, usually a visible solid dropping to the bottom of the container). Smaller cations and anions form smaller salts which can co-exist in solution without precipitating. The specific cations and anions that might cause problems are listed in the "Exception to the Rules" section of this article.

The basic principle of chemical compatibility is the classification of all chemicals, whether they be herbicides, fungicides, insecticides or fertilizers, into two groups: **solubles** and **insolubles,** because it's the physical properties not the chemical properties that determine compatibility 99% of the time.

Having then classified all chemicals into solubles and insolubles, I have devised a set of rules which when followed carefully permits the applicator to tank mix at will without incurring phytotoxicity. E.P.A. has devised key signal letters which alert applicators and inform them whether or not the product they are using is soluble or insoluble. These signal letters are as follows:

S	indicates	solution
SP	"	soluble powder
EC	"	emulsifiable concentrate
WP	"	wettable powder
F	"	flowable

The S, SP, and EC are classified as solubles; whereas, the WP and F are insolubles.

The amount of water sprayed per 1000 sq. ft. is another variable that requires some explanation that will affect the pesticides that should or should not be mixed in the spray tank. For example, an applicator will use 3 to 5 gallons per 1000 sq. ft. on greens and tees, and only ½ to 1 gallon per 1000 sq. ft. on fairways, depending upon whether he is using a mist blower or a spray boom.

By far, the largest group of chemicals are the insolubles. Most technical chemicals are, for all practical purposes, insoluble in water. The

Continues on page 26

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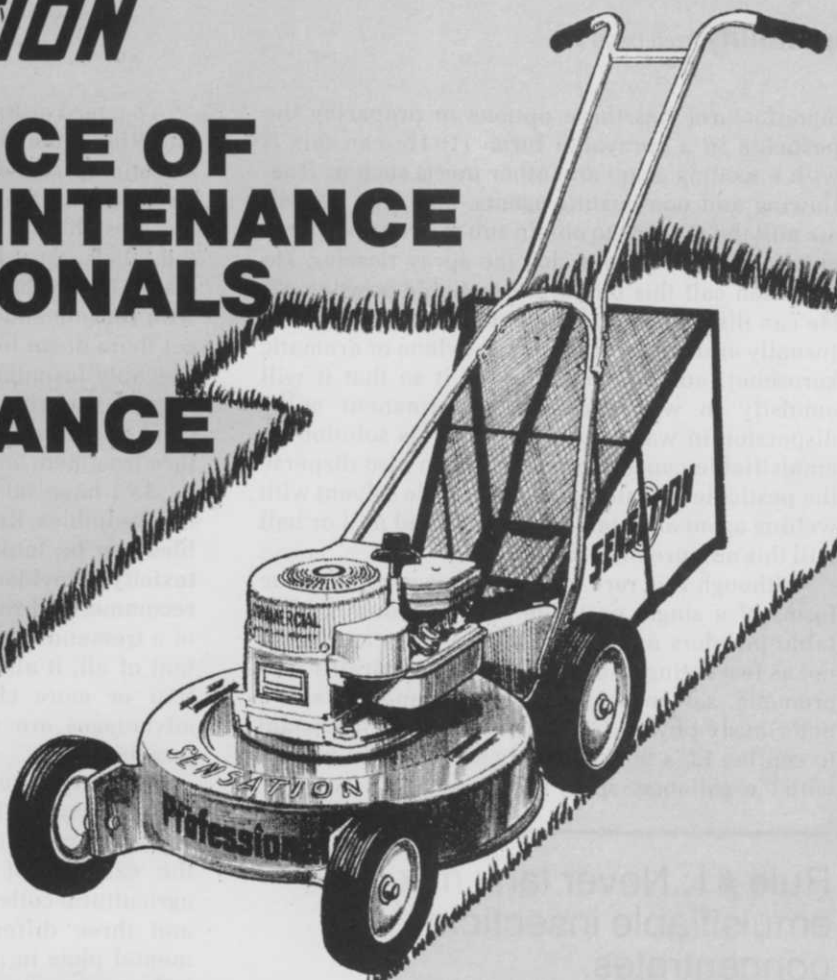

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Compatibility *from page 24*

manufacturer has three options in preparing the pesticide in a sprayable form. (1) He can mix it with a wetting agent and other inerts such as free-flowing and non-dusting agents, and then he will air-mill the mixture to obtain sub-micron size particles so that it will not clog the spray nozzles. He will then call this mixture a wettable powder. (2) He can dissolve the pesticide in an organic solvent (usually aromatic spirits such as xylene or aromatic kerosene), add an emulsifier to it so that it will emulsify in water to give a permanent milky dispersion in water, and will call this solution an emulsifiable concentrate. (3) He can also disperse the pesticide in water or water soluble solvent with wetting agent and stabilizers then sand mill or ball mill this mixture into a flowable.

Although it is rare, one can encounter all three forms of a single pesticide: EC, WP, and F. Wettable powders and flowables are safer to use but not as fast acting as emulsifiable concentrates. The aromatic solvents used in preparing EC's are notoriously phytotoxic. This is why it is important to confine EC's but are rarely used. The EC's used with low gallonage spray invite phytotoxicity.

Rule #1: Never tank mix emulsifiable insecticide concentrates.

Rule #2: All insolubles can be tank mixed without incurring phytotoxicity provided the products are sprayed at recommended rates.

Rule #3: Only one soluble chemical can be tank mixed with any number of insolubles. If two soluble chemicals are tank mixed with or without insolubles, the rate of each soluble should be cut in half to avoid phytotoxicity.

Rule #4: Soluble fertilizers and trace elements can be added individually or mixed, provided the amount will not exceed one ounce solid per gallon tank spray mix.

To guard against such an occurrence we formulate **Rule Number 1. Never tank mix emulsifiable insecticide concentrates.** Not only will you incur phytotoxicity from the aromatic solvent sitting on the grass blade, but the insecticides, according to the labels, must be sprayed with large volumes of water (10 to 30 gallons), sometimes followed up with recommendations to water them in heavily to get them down to grubs. The wettable powder and flowable formulations will not burn but must still require watering for grub proofing. However, they can be used with a limited amount of water for surface treatment and can be treated as insolubles.

As I have said before, the largest category are the insolubles. **Rule Number 2 states that all insolubles can be tank mixed without incurring phytotoxicity provided the products are sprayed at recommended rates.** This permits the tank mixing of a tremendous variety of chemicals. Most important of all, it allows the applicator to spray three, four or more chemicals at the same time. The advantages are unbelievable if he explores the possibilities.

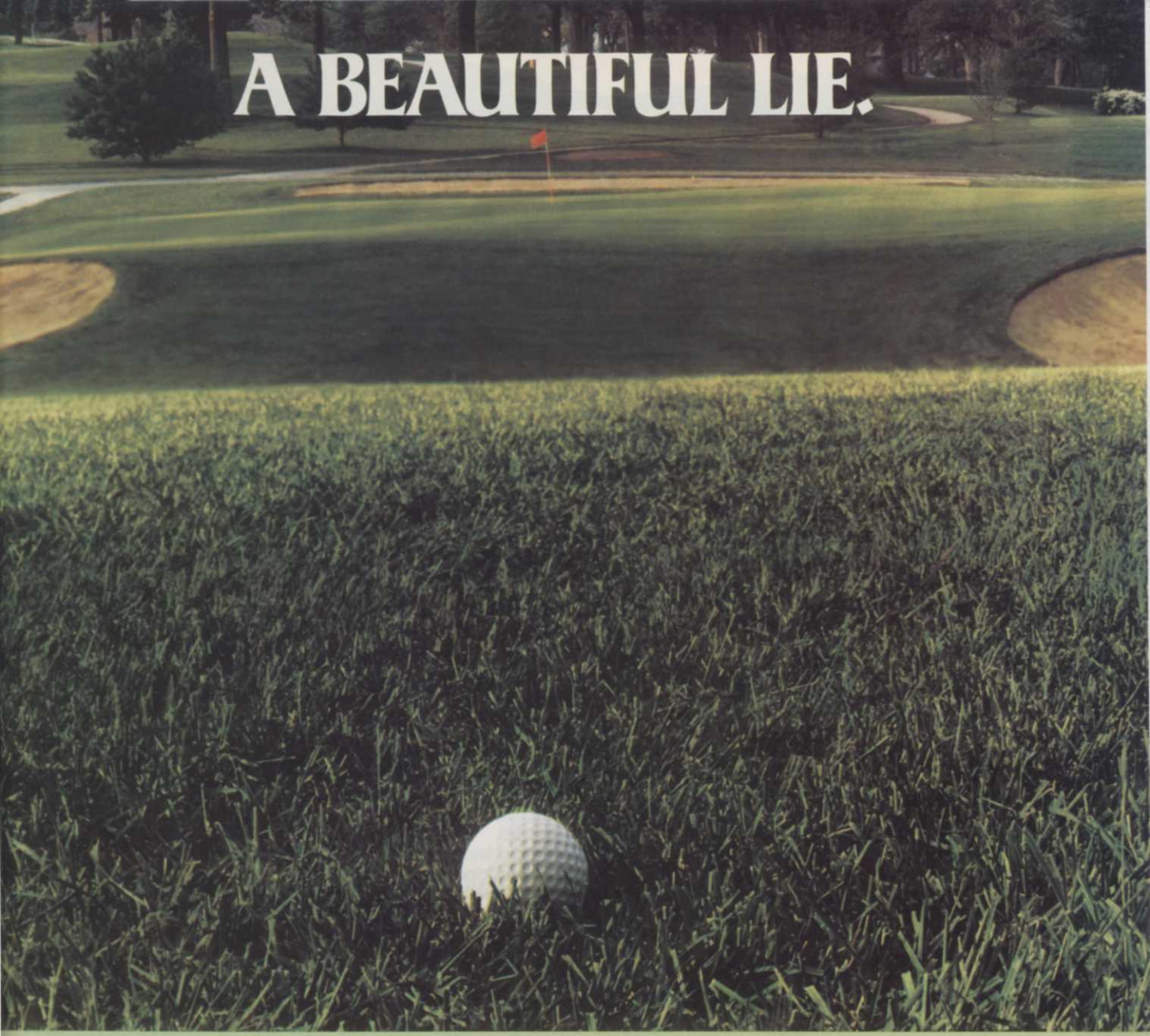
Broad spectrum control, where money is no object, is a must. The applicator should not rely on a single chemical to control a target disease. Follow the example of the pathologists at the various agricultural colleges. Note how they are mixing two and three different fungicides in their experimental plots in an attempt to achieve better control.

The trend that I have tried to pioneer over the last 20 years is precisely in this direction and many competitive manufacturers have joined in. More recently, with the advent of systemic fungicides the broad spectrum mixture has assumed brighter and newer horizons because of the longer residual control attainable with the addition of a systemic along with one or two contact fungicides in the spray tank.

Prior to the systemics, it was an accepted fact that contact fungicides did their job on the grass blade and in the thatch and were dissipated within two to three days. A good contact fungicide will kill germinating spores at a few parts per million. It is usually sprayed on the grass blade at about 5,000 parts per million. With the present-day irrigation and mowing practices, it doesn't take more than two to three days to get down to a dilution below the effective five parts per million.

In hot, humid weather accompanied by sporadic showers, an applicator had to spray twice a week, otherwise his grass would go unprotected the latter part of the week. This is not the case since the advent of systemics. They hydrolyze in the soil to knock down the fungus population, not only in the soil but also within the grass blade by diffusion through the root system, thereby giving extended protection.

Continues on page 31



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