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MICHIGAN

A PATCH of GREEN

Official Publication of the
Michigan & Border Cities Golf Course Superintendents Association

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PROFESSIONAL APPLICATOR MUST KNOW MIXING BASICS

by: Paul A. Sartoretto, PH.D.

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

Can a pesticide applicator get by without a knowledge of chemistry and still determine what pesticides are compatible in the spray tank? A knowledge edge 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.

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, noniums 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). Small 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 compatability 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

Continued on Page 6

Mixing Basics, Cont.

product they are using is soluble or insoluble. These signal letters are as follows:

S indicates solution.
SP indicates emulsifiable concentrate
EC indicates emulsifiable concentrate
WP indicates wettable powder
F indicates 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 trees, and only½ to 1 gallon per 1000 sq. ft. on fairways, depending on 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 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 submicron 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.

To guard against such an occurence 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 impor-

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tant 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 reply on a single 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 lat 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.

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.

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 or 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.

There are soluble fungicides as well. When applying soluble chemicals including fungicides, keep in mind Rule Number 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. Although they are not numerous, the superintendent is familiar with and has had experience in applying the soluble fungicides such as PMAS, Caddy, Cadminate and Actidione. The latter two are soluble in the spray tank. Coincidentally, three large manufacturers have mixtures of solubles with insolubles presently being marketed.

There is no question that the soluble fungicides have the clout necessary to stop an advanced fungus infection. One can only hypothesize why this is so, and the question resolves itself with the explanation to the difference between fungicidal and fungistatic activity. Fungicides kill whereas fungistats inhibit. But this explanation is too simple. When a spore germinates and sends out a tiny, tender shoot, it is easily killed. Since this is only visible microscopically, the net result determined by sight is that the chemical has prevented spore germination-fungistatic effect. If the spore germinates and the shoot gets a foothold within the grass blade, it takes a more powerful chemical to kill it - fungicidal effect. Some insoluble fungicides possess this advanced stage killing ability to varying degrees; but all of the solubles are immediately fungicidal.

The author has maintained for sev-

Continued on Next Page

eral years that the ideal tank mix of fungicides is a three-way combination of soluble contact / insoluble contact / insoluble systemic mixture; and, for years has even recommended mixing two soluble contacts, each at half rate to get a broader spectrum than the single soluble at full rate.

Applying rules 2 and 3 in an attempt to get a broader spectrum of control, all of the insolubles can be tank mixed. They can also be tank mixed with one of the solubles or one of the soluble-insoluble combination. If the solubles and soluble-insoluble combinations are tank mixed, the dosage should be cut in proportion to the number of chemicals added. Because of the soluble portion of the group of soluble-insolubles, they should be treated as if they were solubles. It should be emphasized again that the dosages of two solubles should be cut in half if tank mixed. If three solubles are tank mixed, the dosages should be cut to on-third of the recommended rate of each soluble component.

A prime example is the successful combination of MCPP, 2,4-3 and dicamba. The recommended rate of MCPP is between 1 and 1-1/2 pounds per acre and the rate of 2,4-D is 1 pound per acre and the rate of dicamba is 1/4-1/3 pound per acre. However, a successful combination of the three is in the neighborhood of 1/2 pound MCPP, plus 1/4 pound 2,4-D, plus 1/8 pound dicamba. These come premixed in approximately that ratio under the trade names of Trimec and Trex-San.

There are some MCPP / 2,4-D combinations in which the rate of MCPP is 1 pound and the rate of 2,4-D is 1/2 pound. Another example of the synergistic effect of two postemergent chemicals is the combination of DSMA and 2,4-D. In Texas, where 2,4-D is not prevalently used because of its injury to cotton, DSMA anhydrous is recommended for the control of dallisgrass at the rate of 7-10 pounds per acre on bermudagrass. In nearby Lousiana equally good control has been achieved by the use of 4-5 pounds DSMA plus 1/2 pound of 2,4-D. This practice has been going on for more than 10 years and, coincidentally, it conforms with rule number 2, which dictates that if two solubles are used together it is a wise practice to cut the dosage of each in half.

Every pesticide applicator knows that fertilizers are usually combinations of insoluble components, and because of the soluble fractions the fertilizers must be watered to prevent burning. It is not an uncommon practice to add soluble fertilizers to the spray tank in small quantities to attain an immediate greening effect on specific occasions. A more common practice is to add chelated iron for the same reason. But there have been instances of burning because an applicator had a heavy hand in applying these products.

The phenomenon known as salt index comes into play in determining how much of the soluble fertilizer components can be added to the spray tank without incurring phytotoxicity.

CONCLUDED IN NEXT ISSUE –
COMPLETE WITH SOLUBILITY
AND FORMULATION TABLE –

LD_{50} - What is it?

The common use of the term LD50 can be confusing. As it is usually used, it means the number of milligrams of active ingredient (technical 100% pesticide) per kilogram of a test annimal (commonly the rat) that are required to kill 50% of the test population of animals. The confusing part is that LD50 given is usually for the pure technical chemical, not for any of the several formulations that may be on the market. The materials that you buy may contain anywhere from 1% to 80% of the technical material and therefore they would be less dangerous to handle than the technical. This explains why a 15% granular formulation of a phosphate insecticide may have a skull and crossbones label and you must have a permit to purchase it, while a 1% formulation of the same insecticide may be legally sold in the garden mart to an amateur without a license.

The LD50 is given as oral (by mouth) or dermal (on the skin); few pesticides are as dangerous on the skin as by mouth. Whether the formulation you choose is a wettable powder, a dust, granular or a liquid, the formulation affects the degree of hazard. Therefore the warning given on the label should be studied before a pesticide is used, and the precautions specified should be followed. Lists of LD50's are informative, but since they are seldom given for the formulations that the grower uses, the labels are more important than the technical LD50.

The lower the LD50 of a pesticide, the greater the danger to man or animals. Class 1 Highly toxic - must carry the word Danger, a skull and crossbones and Poison in red. These have an acute oral LD50 of from 0-50 mg/kg. A single dose of a few drops of the technical, 100% material taken orally may be fatal to a 150 lb. person. Class 2 Moderately toxic - must carry the word WARNING. These have an LD50 of from 50 to 500 mg/kg. A single dose of the technical 100% material of one teaspoon to one ounce taken orally may be fatal. Class 3 Slightly toxic - these have the word CAUTION and an oral LD50 of from 500 to 5000 mg/kg. A single dose of the technical 100% material of from 1 ounce to 1 pint may be fatal. Class 4 - pesticides with an acute oral LD50 over 5000 are considered relatively nontoxic.

A respirator and protective clothing should always be used when working with Class 1 or 2 materials; gloves are especially important when handling those with a low dermal LD50. All exposed skin should be washed immediately after using all pesticides. Carelessness in working with every pesticide endangers not only the health and lives of those involved, but also the continued availability of pesticides. Read the labels.

A few persons may also develop an allergic reaction to some pesticides. They will have to work out their own precautions.

(Article taken from Geiger News Vol. 16, No. 1, Feb., 1980).

Frank Laemmlen, Botany & Plant Pathology

MEMORANDUM

To: Turfgrass Supporters

From: P.E. Rieke, J.M. Vargas Jr. and J.E. Kaufmann

Subject: Use of monies raised by M & BC GCSAA for the Michigan Turfgrass Foundation

Monies raised by the Michigan and Border Cities Golf Course Superintendents Association of America provide the backbone of support for the turfgrass research program at Michigan State University. It provides the basic monies to maintain the turfgrass research plots at the crops farm and soil farm at M.S.U. in East Lansing and at the Traverse City Country Club in Traverse City. In addition to the basic support of the turfgrass research field labs, the monies are being used for specific research projects to benefit you including the following:

1) Dorman N applications on Poa annua and other turfs;

2) N carrier responses;

3) Nitrogen analysis of turf clipping from field plot studies as a possible method of predicting nitrogen requirements.

4) Developing cultural systems for maintaining Poa annua;

5) Developing prediction models for dollar spot, anthracnose, and leaf spot to reduce fungicide usage;

6) Nitrogen fertility timing effects on Fusarium blight development;

7) Physiological effect of systemic fungicides on turfgrass;

8) Chemical growth retardants to save on mowing costs on low maintenance areas;

9) The potential of perennial ryegrass for golf course fairway use in Michigan;

10) Effect of coring on possible compaction problems;

11) In-state travel expenses to conduct research and to visit turfgrass managers having problems in Michigan.

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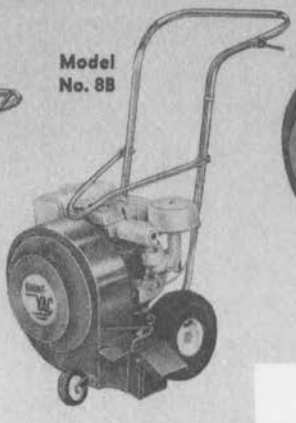

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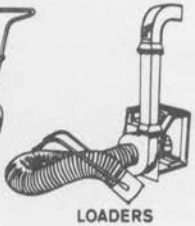

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