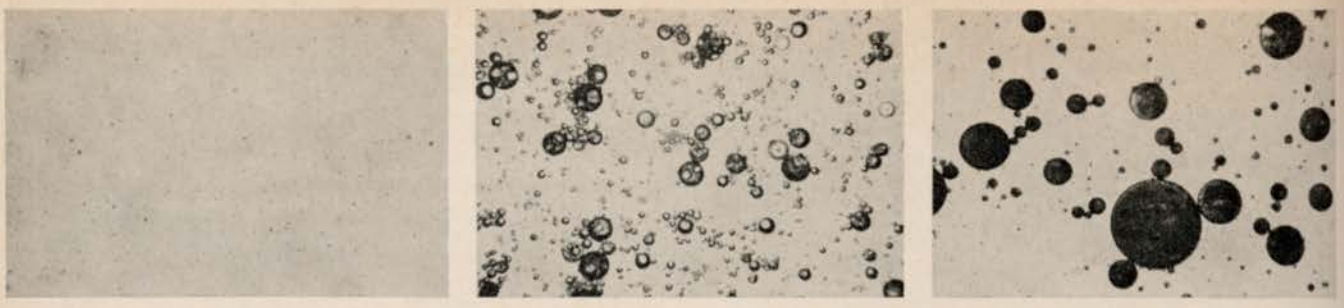

Photomicrographs of three emulsions made from emulsifiable concentrates bought on the open market show the tremendous variation in quality that exists among commercial pesticide formulations. Photo at extreme left is top quality preparation; middle shot is a borderline formulation; picture at far right is a very poor formulation. In general, author Wilson reveals, top quality materials were most expensive, poor quality cheapest. All these photographs were taken at the same magnification.

How Good Are the Formulations You Buy?

By FRANK L. WILSON
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TWENTY-FIVE per cent DDT is 25% DDT. How often have you heard this thought expressed in regard to buying pesticides? Chemically it is true, but active ingredient content is only part of the story of how a pesticide will perform. The physical characteristics of a formulation are just as important as its chemical content.

Our objective in lawn spraying is to bring a pesticide in contact with a pest in a manner that results in the control of the pest. For example, our major lawn pest in Florida is the chinch bug. We know that this insect is usually found in the stolon or runner portion of the St. Augustine grass mat. Therefore, to control this pest we must deposit our pesticide on this portion of the turf. We try to accomplish this by applying large quantities of spray to the grass leaves, so that runoff occurs and the spray travels downward to the stolon area.

Most of us have always believed that if the water portion of our spray reached a certain spot, insecticide was carried there also. Unfortunately, this is not always true. Poor quality "loose" emulsions deposit most of their pesticide content on impact or shortly thereafter. In lawn spraying these deposits are found on the grass leaves. These deposits are undesirable for several reasons. They are in a location where the fewest chinch bugs contact them, are subject to more rapid breakdown due to weathering, are removed by mowing, and increase the chances of human poisoning.

Variation in the quality of pesticide formulations is difficult to understand without some knowledge of surface active agents. "Surface active agent" is a broad term that includes emulsifiers, wetting agents, and spreaders.

These spray additives are necessary to overcome interfacial or surface tension. In liquids the tendency to pull together that exists between molecules keeps them close to one another. Beneath the surface each molecule is surrounded by other molecules and is subjected to pull in all directions. At the surface of a liquid the molecules are attracted inwards and to each side by adjoining molecules, but encounter little attraction from above. Above the liquid is air, in which the molecules are far apart and few in number. This gives very little outward pull to balance the inward pull, and every surface molecule, therefore, is subjected to a strong inward pull. This causes a contraction of the surface until it has become the smallest possible for a given volume. This phenomenon is the reason water forms round droplets when falling through space. This force is called surface tension when it is measured at the surface of a liquid or solid. It is called interfacial tension when it exists between two liquids, such as at the surface between water and oil.

It is common knowledge that oil will not dissolve in water. If two liquids, such as oil and water, which are almost entirely insoluble in each other, are agitated, one will momentarily become uniformly distributed through the other in the form of small globules. When agitation is terminated, the two liquids separate into distinct layers or phases. This separation is caused by interfacial tension.

Use of Emulsifiers

We can prepare fairly stable mixtures (emulsions) of such materials by adding surface ac-

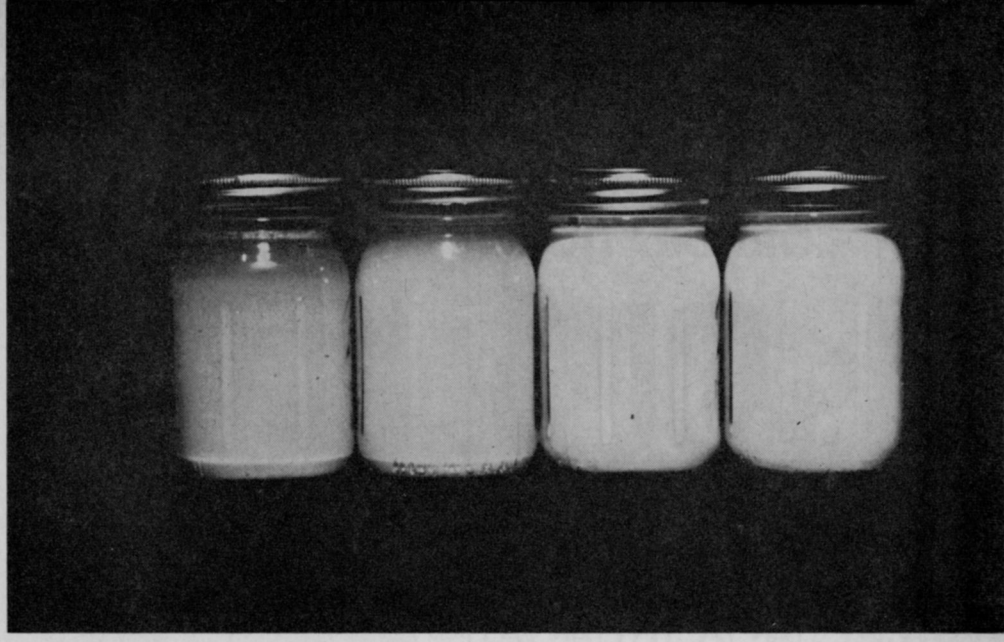
Why does a turf spray job go wrong? When it does happen, author Frank Wilson believes, it could be the result of an inferior chemical formulation. This article tells why faulty emulsions create headaches for contract applicators, and offers some quick and easy tests which determine how good a formulation really is. Entomologist Wilson, whose articles and speeches are ever popular with CAs, is well known in the spray industry.

tive agents, called emulsifiers. Emulsifiers consist of long chains of hydrocarbon molecules. One end of the chain is attracted to water, and the other end is attracted to oil. An emulsifier tends to lower interfacial tension by "coating" each of the globules that is formed with a colloidal or monomolecular layer. In other words, emulsifiers form a "shell" or "skin" around the oil globules. This "shell" acts as a "bridge" between the two liquids.

It is common knowledge that as materials are divided into smaller and smaller particles, the surface area increases. Because of this, more of a given emulsifier is required for a small globule-size, quality emulsion than is needed for a large globule-size formulation.

Pesticide globules within a spray droplet are deposited on a plant by one of two methods.

A spray consisting only of pesticide-oil-solvent and water will have the highest depositing ability, because the separation of oil and water, when it strikes the plant, would be unhindered by an emulsifier "shell" surrounding the oil globules. If an emulsifier is used in small quantities just sufficient to separate the pesticide-solvent into relatively large globules, the formulation is a quick-break or "loose" emulsion. In this type of formulation the emulsifier "shell" is weak and easily broken. When this type of formulation is sprayed on a plant, the emulsifier "shell" is usually broken by the spray droplet impact. This causes the pesticide to deposit at or close to the point of droplet impact.



Here's a simple comparison test applicators can use to see if formulations measure up to necessary standards of quality. The two products on the left are much poorer emulsions than the two products on the right. Details for using this test are spelled out in the article.

In the second type of deposition, the spray deposits its pesticide content when the water phase of the spray evaporates. This type of deposition is associated with strong emulsifier "shells" and small globule size, which is typical of the so-called "tight" emulsion. "Tight" emulsions are made by using large amounts of emulsifiers, so that the formulation will form small globules when it is mixed with water. In this type of emulsion the interfacial membrane is strong and will usually withstand spray droplet impact.

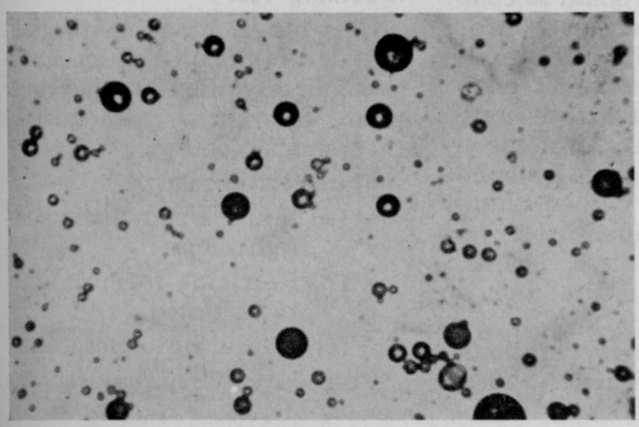
Emulsion-forming materials are the most widely used pesticide formulations in the horticultural spraying industry. These *emulsifiable concentrates* are clear pesticide-solvent-emulsifier solutions that, when added to water and agitated, are self-emulsifying. The globule size of the spray emulsion is dependent on the *kind and amount of emulsifiers* used.

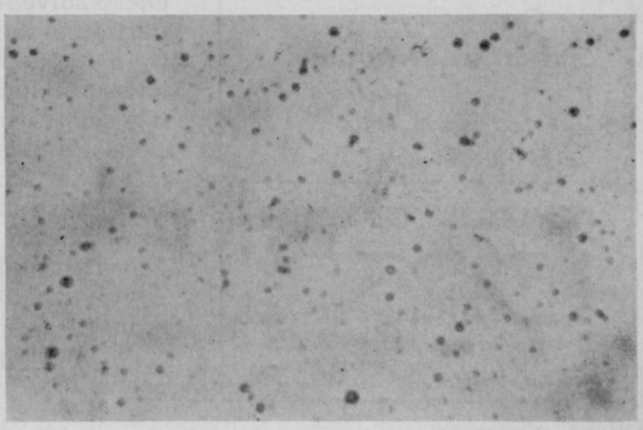
Concentrates Vary

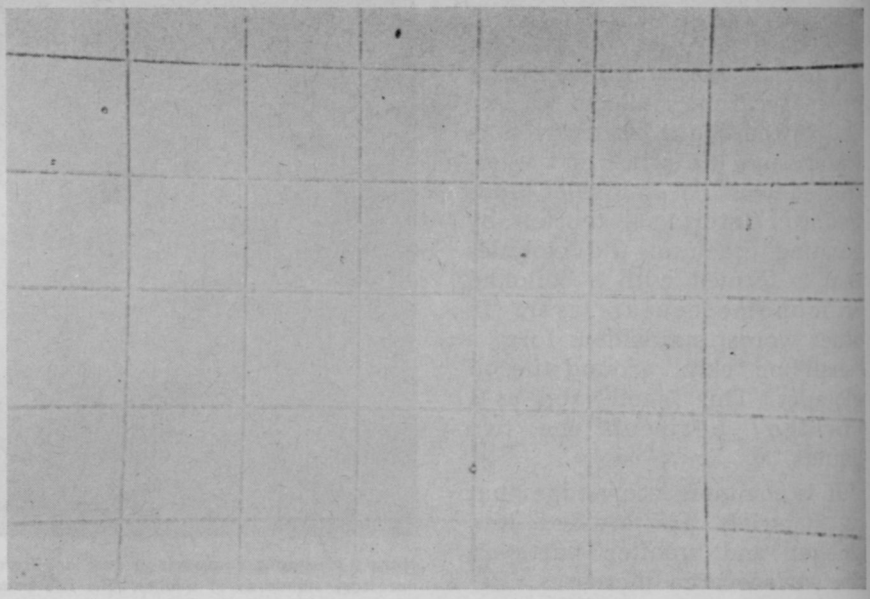
The quality of commercially available emulsifiable concentrates varies widely. Poor quality most frequently occurs in those products that are highly competitive. Some companies have refused to make cheap materials. Others have met this problem by manufacturing two formulations, one quality and one for the price market. A few companies have specialized in price products. The major contributing factor to poor quality pesticide formulations is *price buying.*

Pesticide manufacturers are in

What happens to prepared sprays after they're applied? Below left is a sample formulation before it was applied to a St. Augustine lawn. Note the large particles. Below right is a sampling of the same spray after it was applied to St. Augustine turf. The droplet was recovered from the stolon or runner area of the grass. Notice the absence of large particles which were apparently deposited on the upper layers of turf, another reason to demand good, small-particle-size formulations.







This ocular micrometer grid can be used to measure particle size of formulations as shown in the preceding photographs. Each square is equal to 1/125th of an inch.

business to make a profit, just as any other businessman. They supply what their customers want. We all know that it is difficult to buy a Cadillac for the price of a Chevrolet. With any product something must be cheapened if the price is to be reduced. In most states, some agency—usually the State Department of Agriculture—is responsible for testing pesticide formulations for active ingredient content as described on the product label. This testing is concerned with pesticide content only. Physical characteristics of a formulation are not checked. Therefore, the kind and amount of solvents and emulsifiers that are used in a formulation are decided by the integrity of the manufacturer and the market for which the product is intended. Solvents can play a major role in phytotoxicity or plant burn, but the savings that a manufacturer can make by using cheap solvents are small in comparison to those that can be made by cheapening emulsifiers. We have previously seen that quality, small globule-sized emulsions require more of a given emulsifier than a large globule-sized formulation. When emulsifier quality or quantity is reduced in order to sell cheaper, the quality of the formulation is reduced.

In lawn spraying operations, particularly for chinch bugs, nematodes, or grubs, the use of cheap pesticide formulations is usually false economy. Cheap formulations tend to deposit their pesticide content on spray droplet impact. This results in heavy pesticide deposits on the grass leaves, where chinch bugs, nematodes and grubs are seldom found.

Three Ways to Test Pesticide Quality

These tests are designed as comparison tests whereby you can compare one formulation with another. To be fair, restrict your comparisons to different formulations of the same pesticide. For example, compare company "A"'s 25% DDT emulsifiable concentrate vs. company "B"'s 25% DDT emulsifiable concentrate. Comparisons between different pesticides, such as Diazinon vs. chlordane, are usually misleading.

I. Settling Test

This test is based on the fact that large globules of an emulsion will separate from the water phase of a spray more quickly than small globules.

Materials needed:

(a) Pint jars with watertight caps.

(b) Pesticide formulations to be tested.

(c) Measuring tablespoon.

Procedure: Mix 2 tablespoons

Next month:

What Turfmen Should Know About Nematodes

of concentrate in 1 pint of water. Put the cap on the jar, and shake the jar 10 times. Place all test jars side by side for easy comparison. Observe for visible settling or layering at 5, 10, 15 and 30-minute and one-hour intervals. Any material which shows layering or settling within 5 minutes should be considered unsatisfactory. This layering may occur at either the top or bottom of the jar.

II. Comparison with Skim Milk

Milk consists of small globules of oil and fats suspended in a water phase. It is a "quality" emulsion that can be used as a standard for comparative purposes.

Materials needed:

(a) A piece of flat glass.

(b) Black background.

(c) Sunlight or a strong artificial light.

(d) Eye dropper.

(e) Skim milk.

Procedure: Place the glass plate on the black background. Mix the pesticides as described in the settling test. Place one drop of milk next to each drop of "spray mix." The more closely a formulation resembles milk, the better its quality. Materials which appear granular or gritty should be considered questionable.

III. Comparison of Globule Size (Optional)

(a) A few spraymen have *microscopes*. For these individuals it is easy to check globule size. Mix the pesticide in question as described in the settling test. Place a drop of the spray mix on a glass slide, cover with a cover slip, and observe with the microscope. One formulation can be compared to another very easily.

(b) *35 mm slide projectors* can also be used to compare globule size. Obtain a 2″ x 2″ glass slide binder for each formulation to be tested. Mix the pesticide as described in the settling test. Place one drop of "spray mix" on a 2 x 2 glass slide, then cover the drop with another 2 x 2 glass slide. Tape the two pieces of glass together.

Set up your slide projector so that the projected "picture" of a 35 mm slide covers an area 5 feet wide. At this distance your projector gives about 40-power magnification. Place the slides which have been prepared in the projector and focus.

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Southern Weed Conference Set for Memphis, Jan. 15-17

"Winter Weed Removal from Dormant Turf," is one of several key subjects to be discussed at the annual Southern Weed Conference when it meets January 15-17 at the Heidelburg Hotel in Jackson, Miss.

Also of particular interest to urban/industrial vegetation managers are talks on "Tolerance of Warm Season Turf Grasses to Herbicides," by Dr. E. O. Burt of the Florida Agricultural Experiment Station in Ft. Lauderdale, and "Crabgrass Control in Turf," by three researchers from Virginia Polytechnic Institute, Blacksburg.

The Southern Weed Conference is open to all interested applicators, and others, who may obtain additional information by writing to James M. Brown, Chairman, Public Relations Committee, Southern Weed Conference, P.O. Box 12285, Memphis, Tenn. 38112.