supplies of the sulphates, and manganese can now be expected to make their way to the leaves. Soil magnesium is still far too low.

The foregoing data illustrate how leaf analyses, supplemented with soils data, can be used to determine corrective nutritional treatments.

Sometimes soils analyses are of no help whatever, as when nematodes, pathogens or salt accumulations damage roots. During the recent protracted drought a condition akin to "witches broom" appeared on St. Lucie bermudagrass at a well maintained golf course. Laboratory analyses of the grass blades quickly established that the afflicted plants contained only one-half ppm of boron. Levels of the remaining major and trace nutrients were satisfactory. In this instance soil boron was adequate, but the roots had been so injured by brackish irrigation water that they could not transport this element. Here a foliar feeding of boron together with soluble major nutrients would keep the grass in reasonably good health until normal rainfall comes, leaches accumulated salt out of the root zone, and allows new roots to be formed.

A similar condition of multiple shoot production at the internodes was found to result from boron deficiency in a St. Augustine sod nursery. Here a Rhizoctonia fungus had almost eliminated the roots. The sod resumed normal growth when given nutritional sprays. The "population explosion" of soil fungi soon ran its course, diminished, and new grass roots appeared.

In summary the presence of ample soil nutrients constitutes no certainty that the plant will get them. On the other hand, foliar analyses may reveal that mobile nutrients such as potassium, nitrogen, copper and phosphorus have been accumulated in the plant in quantities adequate for continued growth even though soil reserves are exhausted. It is predicted that in many nutritional situations soils analyses will come to be regarded as supplemental to the leaf determinations, rather than the reverse.

CONTROLLING INSECT AND FUNGAL PESTS WITH ORGANOTIN

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The increasing demand for specialized and broad spectrum pesticides in the State of Florida has stimulated many investigations in this field. Most of the newly developed applications introduced have been variations of older products such as the organo-phosphates, mercurials and antibiotic types. Old organic standbys such as DDT and BHC have lost much favor by users due to the resistances developed by insect pests. The very effective phosphate, parathion, for insects, and mercurials, for fungus, are limited in their use due to their extremely high order of mammalian toxicity. Antibiotic type bactericides (in many cases bacteriostats) offer a low order of toxicity but their uses are, for the most part, limited.

Although organotin compounds were first studied as early as 1852, it wasn't until 1932 that the first practical use was recognized and that was as stabilizers for transformer oils, an application far afield from our present studies. When we speak of organotin, we are adopting the criterion of the linkage of one tin atom directly to at least one carbon atom. Tin, like carbon, is quadrivalent and preparative chemistry has shown that tin atoms can be linked together in short chains, a considerable field of organic chemistry is possible in which one or more atoms of carbon are replaced by tin atoms. In view of the chemical similarities between tin and carbon, this concept differs somewhat from that of general organometallic chemistry. With this concept in mind, the International Tin Institute in 1950 enlisted the collaboration of the Institute for Organic Chemistry in Utrecht, under the directorship of Van der Kerk to synthesize the industrially usable organotins from among the vast number of possible new compounds. From that time to the present, the work on organotins has progressed rapidly. Besides the work of Van der Kerk, which has been enormous, the council has sponsored research on different aspects of organotin chemistry in the University of Toulouse in France and the Universities of London and Southhampton in England. The council also collaborates with research departments of Universities, technical institutes and manufacturers. We feel fortunate in counting ourselves among the latter and have been active in organotin chemistry since the inception of this program.

Organotin compounds are divided into four main types. They are: tetraalkytin, trialkytin, dialkytin and monoalkytin. Our main concern here will be with the trialkytins. From the standpoint of biological activity, these organotin compounds behave in an entirely different manner from metallic tin or their inorganic salts. Our original interest in these compounds was stimulated by their high fungicidal activity and their relatively low order of mammalian toxicity. Whereas the commonly used organomercury compounds of the phenylmercury group have an LD 50 value of 7 mg./kg. of body weight, organotin as represented by Tributyltin Oxide was found to be only about 1/25th as toxic by this criterion. No serious ill effects have been reported from their use with ordinary laboratory or field precautions. Early fungicidal investigations with Tributyltin Oxide gave erratic results with workers reporting excellent to poor biocidal activity. Our investigations confirmed these findings. On the theory that these erratic results might be due to instability of the tributyl radical and consequent breakdown to the less active dibutyl and tetrabutyl forms this condition was rectified and uniform results were finally obtained. The stabilized formula was found to have long shelf life (over three years), excellent stability and sustained antimicrobial action. Proper formulation was found to be of prime importance for high biocidal activity. When we had definitely proven that we had obtained a uniform, highly biocidal form of organotin, we turned our research activities toward agricultural uses. One of our prime endeavors was toward insect control. It was soon apparent that although Tributyltin Oxide was extremely toxic to a broad spectrum of arthropods, its biocidal properties toward fungi and bacteria were to a lesser degree carried over to higher plants. In a study made on protecting greenhouse paints, we found that plants such as roses, tomatoes, gladiolus, geraniums and various succulents were unaffected by leach-out from the paint film and also by a misting with water containing 1 ppm of Tributyltin Oxide. However, when a formulation for spraying chinch bugs was prepared, it was found that we not only destroyed the chinch bugs, sod webworms and army worms; we also seriously damaged the St. Augustine grass.

It was soon apparent the organotin as Tributyltin Oxide would not be satisfactory as a chinch bug control agent. Several other forms of organotin were tested before we struck on a form which did not harm the grasses. Once again, we were faced with the problem of proper formulation. It was found that although our new organotin was readily soluble in the usual solvent-emulsifier systems, it was not effective against any of the lawn pests in this form. A straight emulsion preparation was found to give the best results. We now had a formula which contained a known effective fungicide with highly insecticidal properties. Field testing was then begun. Using the services of several local spray concerns, we began spraying operations in the Fall of 1958, with the idea of running through several seasons. By following such a long range program and by utilizing the services of many spray men, it was felt that we would encounter most of the soil and weather conditions and spray techniques, as well as all of the stages of the chinch bug's life cycle. Many of the people most closely concerned with this type of an operation were interviewed for their opinions. A broad, long-range program was then initiated. A typical spray operation would be programmed as follows: A suspected badly infested lawn would be located and a field crew would then be dispatched to take actual counts. Plugs of a known area are then sunk into the turf and an actual count is taken and recorded. Lawn area is measured and mapped and the counts recorded on the map. Spraying was then done under supervision using a definite amount of water-insecticide mix. One week to ten days later, counts are again taken and recorded. The counting operation is repeated at definite intervals until a lawn is a known success or failure. If the lawn spraying is successful, counts are taken up to a period of six months or until reinfestation occurs.

Two main types of ground coverings were tested. First, home lawns maintained under varying conditions depending on the home owner; and second, city owned and maintained properties which follow a more definite pattern of maintenance. Observations on private and city properties revealed that the main limiting factor for killing was the amount of water applied prior to treatment. This confirmed the past experiences of other investigators. It was found that the dosage could be reduced to two grams of active material per hundred square feet of sprayed area by a pre-watering of one inch. Effective dosage in grams per hundred square feet of other commonly used insecticides according to manufacturers recommendation are: Parathion, 10; Diazinon, 8.3; and VC-13, 34.5. Lawns sprayed with a dosage of 4 gr./hundred square feet and no pre-wetting were most often ineffective, while those sprayed at one-half that dosage and pre-wet with one inch of water were always found to be highly effective. For example, a pre-wet lawn showing an average chinch bug count for six plugs of 166 chinch bugs per sq. ft. was reduced to an average count of less than 0.3 per square ft. within eight days after spraying and a count of zero at fifteen days. Another lawn with an average of 102 bugs per square foot was sprayed at the four gram level without pre-wetting. Nine days later, this lawn had an average count of 46 bugs. Several months later this same lawn had a mean count of 48 bugs per square foot. This lawn was then pre-wet and sprayed at the rate of 2 grams per hundred square feet. Four days after spraying the count was reduced to a mean of 3.7 bugs per square foot and at the end of thirteen days the count was less than 0.3 per square foot. The cases mentioned are typical of the results obtained during this study and are presented here as an illustration of typical test results. With almost three years of data compiled, we are now firmly convinced that organotin is the safest effective treatment for chinch bug control. Proper formulation of the organotin is of prime importance as is proper pre-wetting of the treated grass. Killing is not restricted to chinch bugs, but covers a wide range of insect pests.

With the chinch bug phase of our studies almost completed, various other applications are being investigated. Fungus and bacterial diseases of ornamental plants, as well as commercial crops are being considered. Laboratory tests have shown potent action on many bacterial and fungal species including many pathogenic and soil forms. It is our belief that organotin compounds offer a possibility of many applications in the control of plant diseases.

A STUDY OF THE DOWICIDE B GLADIOLUS PRE-PLANT CORM DIP TREATMENT

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A study was made of the relative influence of the concentration, dip time, and dip temperature upon the Dowicide B pre-plant corm dip treatment developed by Magie (1).

EXPERIMENTAL MATERIALS AND PROCEDURES

Three plantings were made during the 1958-59 season in either Leon or Immokalee fine sand soil. The usual commercial production cultural procedures were followed in the growth of these three crops. Corms of 2 to 2½ inch diameter of the variety Morning Kiss were planted. This variety was selected as being fairly susceptible to both corm rots and chemical injury. The corms had received the usual commercial pre-storage dusting of a Captan-DDT mixture.

Dowicide B, 85% sodium, 2,4,5 trichlorophenate, was used as the pre-plant corm fungicide. Triton X-100 was employed as the wetting agent at the rate of one pint per 100 gallons. It was not necessary to add sodium hydroxide as a solvent agent as the pH of the water used was above 7.0.

A total of 60 corms were used for each individual treatment. These corms were planted into single replicate plots which were 18 to 20 feet long. The 0 pound rate of the Dowicide B was not included in the G-5 planting.

Yields of commercially acceptable spikes were calculated as total flowers and as mean weight per spike in ounces. The corms were field cured for about three weeks, and all corms under the size of the end of the little finger were discarded. Corm yields were calculated as total number and as mean weight per corm in ounces.