4. To lend assistance to the growers and proper agencies in the possible development of a fire control program. Also to assist in the educational work in fire prevention and suppression.

A cover crop program that growers can follow as a regular practice will be put into effect to provide more ground cover for the citrus groves. This involves a close study of the native volunteer grasses and planted legumes now in use, and the introduction of several additional summer and winter legumes which have been developed by the Florida Agricultural Experiment Station at Gainesville.

The Soil Conservation Service will, in its recommendations, consider the soil type, rainfall distribution, cultural practices, fire hazards, erosion resistance, and water-holding capacity of the residue as well as the partial to complete shading of the ground surface by the citrus trees.

In addition to the production of more cover, the proper management of these crops will be shown. The cultivating equipment now available and any new equipment that might be developed will be used to manage the cover crops in such a way that the ground surface will be left in a condition less susceptible to erosion and at the same time not constitute a serious fire hazard. Cooperation has been obtained from growers to demonstrate the proper use of each type of implement used in cover crop management. During periods of stress, mowing or chopping will successfully control cover crop growth, thereby reducing the competition for moisture and at the same time provide a continuous stubble mulch for the protection of the soil.

Demonstrations of artifically applied mulch will be made. While this method will necessarily be limited it is believed that strip mulching on critical areas should be recommended where materials are available.

A survey of the existing water supply will be made and information gathered relative to the effect which excessive rains and prolonged droughts have on the water table.

Intensive studies are being made to determine the proper time, method and rate to be used in the artificial application of water to citrus groves.

SOURCES OF MAGNESIUM

HOWARD A. THULLBERY, Lake Wales

While the necessity of magnesium as a plant food has been known for nearly a century, it was not used as a plant food in fertilizer to any great extent until 1930 to 1933. Prior to that time a number of materials containing a high percentage of magnesium were used in the regular manufacture of fertilizer but without any particular recognition of the benefits which could be derived from this magnesium content.

Foreign sulphate of potash-magnesia containing about 5 percent magnesium as magnesium sulphate, was rather generally used as a source of potash. Old style kainite containing about 4 percent magnesium as magnesium chloride was generally used also as a source of potash. Dolomitic limestone was coming into more extensive use for direct application, replacing high-calcium limestone, but almost entirely from the standpoint only of raising the pH value of the soil, or "sweetening" the soil as it was generally called, and with very little, if any, recognition of the value of magnesium content. Hardwood ashes containing from 1½ to 3 percent magnesium were in general use for direct application but entirely as a source of potash and for "sweetening" the soil. The use of the above listed materials together with many others containing minor amounts of magnesium was of great benefit in correcting and preventing magnesium deficiencies, but because the purpose of the magnesium was not generally understood the results obtained were haphazard.

Within a few years following 1930, magnesium began to come into general recognition as a direct and important plant food and magnesium-bearing materials began to be used from the standpoint of the magnesium content. About the first of these materials was dolomitic limestone, imported from Tennessee until about 1934, at which time production started in Florida. Within a short time this Florida production supplied all the needs in the state. Dolomitic limestone contains an average of 35 percent magnesium carbonate and 55 percent *calcium* carbonate. The magnesium carbonate is water-insoluble but is slowly broken down by the action of soil acids. It is generally considered that about one year is required before considerable quantities of magnesium from dolomitic limestone will reach the plant in the available form. Within a short period after 1930 small amounts of Epsom salts came into use for supplying an immediately available source of magnesium. Epsom salts contain about 10 percent magnesium as magnesium sulphate, which is readily water-soluble and therefore almost immediately available to the plant. A few years later a material called Emjeo was introduced into Florida and rapidly came into general use as a source of water-soluble magnesium. Emjeo is a calcined kieserite, kieserite being a natural Epsom salts of rather high purity. The Emjeo as received contained about 18 percent magnesium as magnesium sulphate. Emjeo or any other of the magnesium sulphates could be used to any extent desired in the manufacture of mixed fertilizers.

The above is a brief history of the use of magnesium materials up until the beginning of the war. During this time the quantities of these materials used increased rapidly every year. Emjeo, however, being a material imported from a foreign country, was immediately cut off when war was declared.

Seawater Magnesium Oxide

About 1939 a new source of magnesium called Sweetwater Magnesium Oxide was introduced in Florida. Seawater magnesium oxide is an actual magnesium oxide of 90 percent and higher purity and with a 56 percent magnesium content. As the name indicates, it is recovered from evaporation and processing of sea water in California. It is water-insoluble as it stands but reacts rapidly with acid materials and particularly with organic acid in the soil, to become water-soluble. Because it is an oxide, it is extremely alkaline, and when used in quantity can raise pH very rapidly, being much more effective in this regard than dolomite because it is highly reactive due to its chemical composition and its fine state of division. If applied as a separate material to the soil, or after dry mixing in a fertilizer with which it will not react, it must react with organic acids in the soil to become soluble, and where the soil is dry or short of acid materials this reaction may be very slow.

It would be desirable, where possible, to base it with superphosphate and nitrogen solution to make a more water-soluble material, but the limitations in this regard are rather strict, because an excessive amount will raise the pH of the mixture so high as to cause a loss of ammonia nitrogen. The same applies to its use in dry mixes or other fertilizer mixtures; that is to say, the amount that can be used in mixtures is limited to the amount that will not lower the acidity of the mixture enough to release the ammonia nitrogen if this is used. In most fertilizer mixtures two to three units may be used with safety or more can be used if ammoniacal nitrogen from sulphate of ammonia or nitrogen solution is eliminated. This characteristic limits its use in fertilizer mixtures, particularly where large amounts of sulphate of ammonia must be used. This must be closely watched because an excessive amount is likely to result in considerable loss in ammonia nitrogen so that a shortage will show up in the control analysis. As a substitute for a strictly water-soluble magnesium compound such as Emjeo, it is probably not as highly available or as reactive as that material and should be used at a somewhat higher level of availability figure than given by the company making up the mixture. Where it is a dry mix there is probably some reaction before it reaches the grove, but in many mixtures this reaction will not be marked, and most of the water-soluble magnesium developed from magnesium oxide will have to be developed in the soil.

In the latter part of 1942, the Government took over the entire production of seawater magnesium oxide. This material came back on the market again in May, 1943.

Calcined Magnesite

Immediately following this action a magnesium material called Calcined Magnesite came into the market and was generally used as replacing seawater magnesium oxide. Calcined magnesite is produced by roasting magnesite, a magnesium carbonate, producing magnesium oxide. This material is the same chemical compound as seawater magnesium oxide but of somewhat lower analysis. usually averaging about 85 percent magnesium oxide. Its use was, of course, parallel to the use of seawater magnesium oxide in all respects. In the early part of 1943 the Government took over also the output of this calcined magnesite. Since that time other calcined magnesites have been put on the market.

Magnesium Oxide

Immediately following this action another similar material came on the market under the name of magnesium oxide. This material is essentially the same as seawater magnesium oxide and calcined magnesite.

Sulphate of Potash-Magnesia, or Sul-Po-Mag

In the meantime as a very fortunate circumstance to supplement these oxides, which, as explained, could be used to a limited extent only in mixed fertilizers, Sulphate of Potash-Magnesia, which had been imported from foreign countries and which had disappeared from general use in the fertilizer industry, came back into the markets from domestic production under the name of Sul-Po-Mag.

Florida consumption grew from 500 tons in the 1939-40 season to 5500 tons 1940-41, 18,000 tons 1941-42, to 25,000 tons 1942-43. Here rationing began, otherwise probably 30,000 tons would have been used in the state. In the 1943-44 season close to 30,000 tons will be available. The reason more Sul-Po-Mag is not available is due to the fact that the Government built a $16,000,000 plant for the conversion of magnesium chloride (a by-product of sulphate of potash) to metallic magnesium for airplane production. The production will be about the same in 1944-45 as in 1943-44. Dut to shortage of muriate of potash, quite a tonnage was used in other states the past season for its potash content. With a larger amount of muriate of potash available the coming season, this may release more of the Sul-Po-Mag for Florida where it is used for its magnesium content as well. The increased production of Sul-Po-Mag has given a fair replacement of the former Emjeo or magnesium sulphate, as all the magnesium is in the water-soluble form. The material carries 11 percent of magnesium and 21½ percent potash. It is of good mechanical condition. It is particularly desirable for alkaline soils because it does not raise the pH and would be used in preference to the magnesium oxides in overlimed groves, coastal groves with a high pH, and where a quick reaction is desired. The only limitation on its use in Florida at the present time is the supply, as it can be mixed in practically any type of mixture including top dressers and used whenever soluble magnesium is desired.

Actomag

Another material used to a limited degree in the state was Actomag and it is what is known as a selectively calcined dolomitic limestone. As a result of this selective calcining the magnesium carbonate in the dolomitic limestone is converted to magnesium oxide and the calcium carbonate remains as calcium carbonate. The resulting product contains about 11 percent magnesium and about 65 percent calcium carbonate. Under general Florida conditions the calcium carbonate in this material is not considered to have any appreciable value which resulted in a rather high freight charge to be applied against the magnesium content. Since the content of magnesium is only about half that of the usual magnesium oxides, about twice as many pounds were required to produce the same units of magnesium in a mixture and this was another fact which limited the use of Actomag in Florida.

Kemidol

At a comparatively recent date a product called Kemidol was introduced to the Florida market. This material is produced by calcining dolomitic limestone but by complete calcination instead of selective calcination as in the case above. By this complete calcination a product is produced containing about 35 percent magnesium oxide and about 55 percent calcium oxide and both magnesium and calcium are present as actual oxides. It appears from the limited amount of work which has been done in Florida upon the use of this material in mixed fertilizers, that its use will be limited to the extent of a conditioning agent only, which would mean about 30 pounds per ton. Both calcium and magnesium are present in a very alkaline and caustic form and unfavorable reactions would therefore be produced if more than a few pounds per ton should be used.

Brucite Fines

Another product recently introduced in the state is Bricite Fines. This is derived by calcining brucite, a natural magnesium hydroxide mined in Quebec, at a controlled temperature to produce a satisfactory rate of activity. It contains 65 percent magnesium oxide (39 percent Mg.). The word "fines" refers to the screening operation to separate the larger particle sizes more suitable for industrial uses. This gives a product in a granular form, thereby eliminating a great deal of the dustiness found in other forms of magnesium oxides which makes them quite disagreeable to use. Fertilizer manufacturers in other states report 80 to 85 percent conversion to water-soluble magnesium in mixtures under factory conditions according to State of Maine's method of analysis. However, the writer knows of no work done on this product in Florida.

Dolomite

There has been less inclination in the last few years to use excessive applications of dolomite and more of a tendency to limit applications to the amounts necessary to bring the pH back up to around 6.0 once a year, the amounts being used usually running in the neighborhood of 400 to 600 pounds per acre unless large amounts of dolomite have been used in the fertilizer. The inclusion of dolomite in the AAA program resulted in a much wider use of this material, as a grower could receive some remuneration for dolomitic application under the AAA program. In addition to its use as a separate material it has been increasingly used as a filler and is now probably more widely used as a filler in fertilizer than any other material. In this sense it is not strictly a filler, that is, in the sense the term was originally applied to sand or similar materials which served only to bring the mixture up to 2000 pounds. Dolomite in a fertilizer has the same effect that it has in separate application, namely, to control pH and to furnish slowly available magnesium, and in many plantings there has been a tendency toward including enough dolomite in the fertilizer to eliminate the frequent applications of dolomite as a separate material. Prior to the war there was considerable discussion on the possibility of using dolomite in the base pile with phosphate and nitrogen solution and thus obtain soluble magnesium through reaction in the base pile. This was tried experimentally on a small scale but does not seem to have been followed up to any extent during the war period, and dolomite is still generally regarded as a material for separate applications or as a filler in fertilizers and not as a substitute for readily soluble magnesium. The chief difficulty involved in the dolomite situation during the war period has been one of labor, and this has been so acute at times that it has been necessary to import dolomite from other states in order to have sufficient available to satisfy the growers' requirements. Some difficulties along this line are still to be expected during the heavy fertilizer mixing periods and growers wanting dolomite for direct application should time these deliveries to the slack mixing periods.

Summary

It will be observed that there are three general types of magnesium materials which have been and are in general use, as follows: (1) **Carbonates,** which are water-insoluble but which break down slowly under reaction of soil acids and which may be used in general to any extent in compounding mixed fertilizer without producing unfavorable reaction with other materials; (2) **oxides,** water-insoluble or nearly so, very caustic and readily combined with soil acids, applicable to limited use only in compounding mixed fertilizers because of their activity in producing unfavorable reaction with other materials; (3) **sulphates,** readily water-soluble and therefore immediately available, applicable to use in compounding mixed fertilizers to any extent and under all conditions.

All three of these types of materials are needed for proper blending and manufacture of mixed fertilizers to supply magnesium in various percentages; all three types are also needed for application in fertilizers to supply magnesium to fit the various soil conditions and types of plants and trees. With the exception of a short period during 1942, sufficient quantities of these various types of magnesium have been available in Florida to accomplish both of the above ends in at least a satisfactory manner. As the situation is a changing one and new materials are constantly being tried, the remarks in this paper should not be taken as final but merely the judgement at this time as to the relative usefulness and value of the various sources.

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