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COPPER MINERALS FOR FERTILIZER USE

R. N. GLENROSS, B.Sc., (Agric.),
Research Officer, Plant Research Division

COPPER fertilizers have an important role in maintaining and increasing Western Australia's agricultural production. On many soils they are essential for cereal growing or pasture production and persistence and for animal health and wool quality. They are also sometimes used for fruit trees, vines, and vegetables.

The most efficient and economic way to provide the essential copper has been to use a copperised fertiliser.

Up to 1947 most of the copper used in fertiliser was bluestone or purified copper sulphate, but because copper is required by plants and animals in minute traces copper materials less soluble in water can be equally as effective. These materials occur naturally in rocks as various copper minerals, mixtures of which are called copper ores. In this State we are fortunate in having several extensive deposits of copper minerals particularly at Marble Bar, Meekatharra and Ravensthorpe.

Copper deposits are generally in the form of a primary mineral, chalcopyrite, a copper iron sulphide compound. From this other copper minerals (copper oxide and carbonates) are formed naturally, and constitute a surface oxidised copper zone. When this oxide and carbonate material is ground to a suitable fineness it becomes readily soluble and is equal to bluestone in providing copper for plants. This material, known as ground copper ore, has been used in Western Australia for copper fertilisers for about 15 years.

In between this surface weathered or oxidised zone and the lower unweathered sulphide zone is an intermediate body of complex sulphide and iron copper minerals such as bornite and copper glance. These have slight solubility and lower availability to plants.

Unfortunately, the oxidised zone of copper minerals has a limited life and will eventually be exhausted. To obtain copper for fertilisers we must either revert to using the expensive purified bluestone or endeavour to make the sulphide minerals more available to plants. It is along the latter line that we are experimenting.

Copper sulphide minerals can be made to become soluble and an effective source of copper for plants—but this must be kept within the realms of economics and practicability.

Insoluble copper sulphides can be made more effective by grinding to extreme fineness or by heating to moderate temperatures. Grinding exposes much more surface, which helps soil and atmospheric agents convert the copper to soluble forms, whereas by heating, more soluble forms are produced artificially.
Experimental work with various sources of copper has been carried out since 1940. It was shown that roasted residues containing 2.5 per cent. copper, mainly as oxide and sulphide, and a pyritic ash with one per cent. copper gave the same improvement in pasture regeneration as copper sulphate. However, this was neither economical nor practical.

Subsequently, other sources were examined, mainly roasted and crushed sulphide ores. The general conclusion was that sulphide sources were inferior for cereal production but did provide some useful copper.

Today the copper position is more critical and conclusive evidence is required. Previous and present trials have shown that less soluble sulphide mineral materials do provide copper slowly and improve with time. But how are we to speed up this solubility and availability?

Tests are now under way on the possibilities of achieving this by finer grinding to make sulphides more rapidly soluble, by roasting to convert part of the minerals to soluble forms or by mixing the more soluble forms with the sulphide sources. Wheat and subterranean clover are the test plants. With this information the copper situation will be much more certain than it is at present.

Modern Chemicals and the Control of Insect Pests on Livestock

By C. F. H. JENKINS, M.A., Government Entomologist

Insect pests have taken toll of man's flocks and herds since very early times. Even now they levy a larger and more consistent tax than the most voracious Commonwealth Department.

How is it that such small and apparently defenceless creatures are able to persist and even thrive, despite the rapid development of modern insecticides? The answer is, of course, that although many insects and allied creatures are small and delicate in structure, they possess some of the most remarkable adaptations for survival to be found anywhere in nature.

Insect damage to animals is usually much more difficult to measure than damage to plants. For instance, it is difficult for the layman, and even for livestock specialists for that matter, to perceive weight losses or gains of say 50 lb.; variations of a lesser amount, although important, may go quite unnoticed.

It is well known however, that the activities of ticks, lice and flies may seriously affect the condition of all types of livestock, quite independently of any diseases which may also be involved. In the U.S.A. alone, direct insect attacks on livestock are estimated to cause a loss of at least £300 million a year. No comparable estimate is available for Australia, but the blowfly alone costs our wool growers millions of pounds a year, and the cattle tick and the buffalo fly are a comparable drain on the beef industry.

For many years arsenic, rotenone and pyrethrum were the staple dips and sprays for use against stock pests. In many instances they gave useful control but offered little promise of complete eradication.

The first real prospect of a major break through came with the development of DDT and B.H.C. These materials gave almost miraculous results against ticks, lice and flies and seemed to offer new hope in the war against insects. But optimism was not well founded, for these earlier materials became less and less efficient, despite repeated increases in the concentrations used.

The ability of certain insects to develop resistance to toxic chemicals has been known for many years. In the early nineteen hundreds certain scale insects were known to be able to resist cyanide fumigation, and some caterpillars and ticks had shown an ability to defy treatments with arsenic. The recent trend is much more rapid, and offers a serious challenge both to the chemist and the entomologist. The rapid development of new chemicals has offered a partial solution and at least ensures a breathing space while more fundamental aspects of the problem are explored.
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But it is disturbing to note that once having developed resistance, say to DDT, an insect may also be resistant to other chlorinated hydrocarbons such as B.H.C., Dieldrin and Chlordane, or at least have a flying start in acquiring such resistance.

A completely new group of insecticides known as the organic phosphates, and containing parathion, malathion and diazinon, has stabilised the position for a time, but some resistance to these materials has already shown up and must inevitably increase.

The use of systemic insecticides has given good results against sap sucking insects of plants for several years, but progress against blood sucking pests has been disappointingly slow.

Such a method is, of course, subject to severe limitations. These are:

- The material used must be relatively harmless to the animal being treated.
- It must accumulate in the blood stream in sufficient quantities to kill blood sucking parasites.
- It must not accumulate in the milk or body tissues of animals later required for human food.

Promising control of the cattle grub or ox warble fly of America has been achieved with systemic sprays, but this is of little interest to Australian cattle men as the pest is unknown in this country.

Work is continuing in the hope that this method may yet be applied to lice, ticks and even blowfly maggots, but the difficulties are many and no immediate success seems likely.

Another line of attack which has been intensified in recent years, and with some promise of success, is the use of insect repellents. Stable flies and march flies are quite annoying to stock even in the South-West, but their activities are negligible compared with the visitations of the buffalo fly, the horn fly and other tropical species. Several of the repellents so far tested are quite expensive, and in all cases the period of relief is quite short. The method has distinct possibilities however, particularly for dairy stock. It is one which may become much more important in the not-too-distant future.

FALLOWING NEW LAND

By H. G. CARISS, B.Sc. (Agric.), Adviser, Wheat and Sheep Division

The key to rapid development of new land and early establishment of a good pasture is the efficiency with which all clearing and cultural (including seeding) operations are carried out.

Each operation is dependent on the preceding ones.

With the development of virgin country the initial clearing must be done in such a way that the minimum of vegetation is left for the plough to handle to prepare a good seed bed.

A sound procedure must be followed. The one recommended by the Department of Agriculture, is briefly this:

- Roll, log or chain the area, preferably during winter and spring to allow as long a drying out period as possible.
- Burn the following autumn.
- Carry out the initial ploughing in the winter and spring, again, as early as possible.
- A second ploughing should be given the next autumn, after the first rains.
- Seed in late April to June, depending on the season.

Many people who have heard Departmental officers stressing the need for fallowing ask:

Why must I fallow? Can’t I plough up as soon as possible after the burn and put my crop in a year earlier, so saving myself a long and possibly expensive wait for my first return?

Others say:

Why all this burning and rolling? Why not put the plough straight in, then plough back and fire harrow the following autumn and save a year?

Some success has been achieved with both alternatives but the longer method is still the best. It is important to realise that the delay only occurs with the first unit of a block being developed. Often this is no hardship or disadvantage, certainly not when weighed against the long term benefits of the recommended method. Why do we advocate fallow?
The key to success on new light land: A clean fallow on well prepared land.

Research and experience on a broadacre basis has clearly shown that ploughing and inverting the sod to expose the under-layer to the action of the elements assists the breakdown of the plant residues. This gives a better seed bed for crops, and for pastures, not only a good seed bed but reduction or even elimination of the seedling mortality of legumes which often seriously affects the speed of development of a good pasture.

Depth of ploughing is not as important as the complete cutting off and turning over of the sod. Ploughing too deep could be a disadvantage, and about five inches is suggested as most suitable.

The second ploughing, which is advocated for the autumn and should be done under moist soil conditions, is still a part (and a vital one) of the fallowing operation. It enables the rough surface from the original ploughing to be broken down and, most important, the seed bed consolidated. This eliminates air pockets, providing good conditions for the actual seeding operation later.

If seed bed preparation is poor low yields can be anticipated. The resulting loss is likely to be more expensive than the cost of good cultivation.

Short-cut, or so-called "cheap" methods of land preparation can be very costly.

THE STATE HERBARIUM AND THE FARMER

By R. D. ROYCE, Officer in Charge, Botany Branch

A museum is an institution which is well known to the great majority of citizens. Its purpose is to accumulate, house and provide the means for studying all types of specimens of historic or scientific importance.

An institution which collects, houses and studies plant specimens exclusively is an Herbarium, and in the State Herbarium of Western Australia we have just such an institution. It is controlled by the Department of Agriculture, and forms part of the Botany Branch.

The flora of W.A., with which the State Herbarium is primarily concerned, consists of some 7,000 species, mostly native to the State, but containing also many species from other lands which are now firmly established here as naturalised aliens. The identification of these is the principal work of the botanists on the herbarium staff. When the large number of plants cultivated in gardens is added to the total it will be seen it is no mean task to keep track of all these plants.
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One may ask why is it so important to name plants.

Many species have what are called “common names” and most people would prefer to use them. This would be very nice if everyone would use the same name, but unfortunately this does not happen.

For instance, “bloom poison” is a name used by farmers in many districts, but usually it refers to a different plant in each district, and some are not even toxic. Similarly “kerosene bush” is a name applied to any plant which burns with a black smoke, while “fire bush” is used for any one of half a dozen species which regenerate rapidly after fire. Again the plant known scientifically as Verbena bonariensis is widely known as wild vervena, but in Victoria it is called cluster-leaved vervain, in New Zealand and Queensland it is known as purple top, and in Western Australia as wild sage.

To overcome this difficulty botanists throughout the world have agreed that every plant shall have a scientific name, that this name shall be formed according to a definite set of rules, it shall be latinised, and it shall be universally applied. In this way no two plants can be confused, and the name of each can just as readily be understood by an Australian botanist as by a German or a French botanist.

The importance of this universal nature of plant names is evident when dealing with introduced species.

Whenever a new plant is recorded as naturalised, the first step is to identify it, that is to determine its correct botanical name. This is a most important step because as soon as it has been named, the whole store of the world’s knowledge concerning this plant can be tapped. By searching the literature, one can find out where the plant grows, whether it is useful or not, and what other people have discovered about it. In other words the whole of the world’s experience can be drawn upon, not only of the present but also from the time the plant was first discovered and given a name.

If the plant were incorrectly named the wrong information would be obtained. The work of the botanists attached to the Herbarium is therefore of the utmost importance, and it is indeed the foundation on which many other botanical processes rest, particularly that of weed control.

Many examples of this could be quoted. Some eight years ago a specimen of an unusual weed was sent in to the Herbarium by an officer stationed at Bunbury. This plant was identified as Alternanthera pungens, or khaki weed, a species which had for many years been listed as a noxious weed for the State. Reference to the weed literature showed that it had proved a particularly objectionable weed in other countries, and immediate steps were therefore taken to destroy the plants in Bunbury, before they had a chance to spread.

In 1948, specimens of two plants were received from a property in the Walpole district. One was identified as Senecio jacobaea, the Ragwort, a plant which was known as a serious weed of pastures, while the other was found to be Cirsium arvense, the Canada Thistle, and one of the worst of this aggressive and objectionable group of weeds. The seriousness of these weeds in other countries was well documented, and within a week the plants had been sprayed with a weedkiller in the first operation of an eradication programme.

These instances demonstrate the significance of the work carried out by the botanists. It is also vital that help should be received in the form of specimens. Every time a strange plant is found in the paddock or anywhere in the district it should be forwarded for identification. It may be a very common plant, but again it may be the first record of a very serious weed.

Only by the identification of the plant, can it be placed in its proper category of just a native plant, a fodder plant, a weed or a poisonous plant.

In Western Australia this category of poisonous plants is a very important one. In the native flora there is a great array of pea flowered plants which are highly toxic. The first of these was identified as poisonous in 1839 by feeding trials with goats carried out in the Williams district, and in 1864 in Vol. II of his Flora Australiensis Bentham listed several toxic species including box, rock, York road, and heart leaved poisons. In the course of agricultural expansion in the State many other species from a wide range of plant families have been identified, and many have been brought to notice during the routine investigations of stock losses.

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When these deaths occur, and the veterinary services are unable to demonstrate any specific disease, a botanist is frequently called in to assist. In the search for evidence of poisonous shrubs, examinations are frequently made of the stomach contents of the dead animals, where there is usually enough recognisable leaf material to give a useful clue to the plant species on which the stock had been grazing. Botanical surveys may also be carried out in the paddocks in which the animals had been running in the hope of finding suspected poisonous plants which the stock had been eating.

The work of botanists in many parts of the world has helped materially in solving a number of puzzling stock diseases. In America, South Africa, Europe and Australia botanists have achieved success in this field, while in Western Australia a botanist of the State Herbarium was a prominent member of the team which succeeded in identifying the cause of the Kimberley Horse Disease, a malady which had for many years caused serious losses amongst the horses on many Kimberley stations.

In 1934 a research team consisting of a botanist and a veterinary pathologist from the Department of Agriculture carried out a survey of the toxic species of the State. Plant material was collected from many districts and was used in feeding trials with sheep at the Avondale Research Station. As a result of this survey a comprehensive list of the toxic native leguminous shrubs of the State was made, and knowledge of each of the many species was greatly increased. In the last few months another research committee has been set up within the Department, again including botanists and veterinarians, to continue and greatly expand the work commenced in 1934.

These are but a few of the activities in which the officers of the State Herbarium play their part. The routine activities consist of the maintenance of the Herbarium collection of plant specimens which at present numbers some 63,000 sheets, and the identification of specimens of plants sent in for comment by farmers, beekeepers, naturalists, and many others including officers of Government Departments whose work involves plant life. Enquiries are received regarding weeds and fodder plants, as well as trees and shrubs for shade and shelter belts, and for the home garden, while very many enquiries are received regarding supposed toxic plants.

On these questions and in many other ways the botanist can assist farmers and the general public. But to be of greatest help in giving advice on plants the botanist himself needs help in the shape of specimens. Without good material, plants cannot be named accurately.

As a concluding thought I would like to suggest that if you find a strange plant on your property or in your district, collect a specimen and send it in for identification. It may be important both to you and your neighbours.

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