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SODIUM CHLORATE AS A WEED-KILLER. No. 2

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In Bulletin No. 20 of this series, published in February, 1931, an account was given of the earliest experiments on sodium chlorate as a weed killer, advice was offered on its use for different weeds, and observations were recorded as to the effect of the poison on subsequent crops. Since that time much experimental work has been done on this particular weed killer both here and abroad, and further facts have been discovered. These, in general, support the original findings, and they have the advantage of offering explanations of what previously appeared to be exceptions and of giving reasons why the chlorate acts differently on different weeds, why sometimes autumn and sometimes spring applications are the more successful, and why the land is sometimes poisoned for two or three years, and sometimes for only five or six months. A study of these reasons may allow a more intelligent application of the weed killer, the reduction of cost, and the avoidance of disappointing failures. Californian thistle and some other deep rooted plants such as Bladder Campion consist of three parts—roots underground stem, and overground stem. The top of the roots may be a foot or 18in below the surface of the ground, and so poisons have to penetrate deeply before they are effective.

How the Poison Enters the Plant

One of the outstanding facts about sodium chlorate as applied to Californian thistle is that it was usually successful in autumn, and usually a failure in spring or summer. This was believed to be due to the fact that in autumn the Californian thistles are sending foodstuffs down from their fading leaves to their underground stems. It was assumed that the poison absorbed by the leaves was carried down with the sap and thus poisoned the roots. But while it is known that in convolvulus cut-off stem tips will draw fluids down several feet, yet downward passage of foreign substances in plants occurs very rarely and the assumption that this was taking place in Californian thistle has not been justified by further experience.

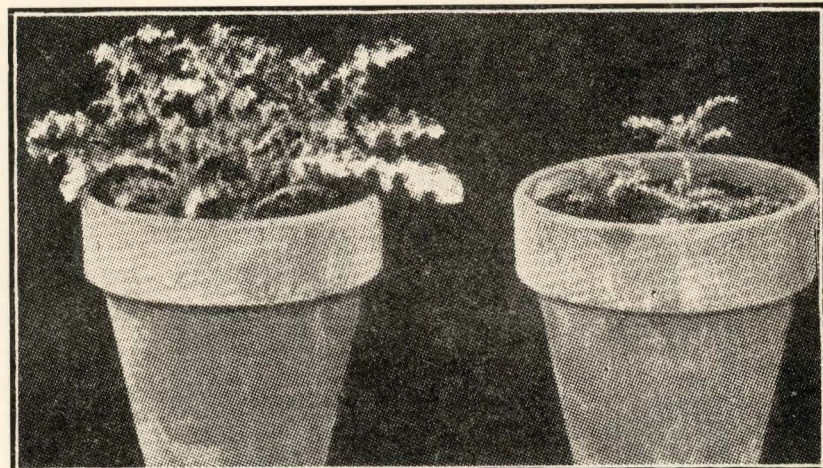
Some of the most successful kills of thistle take place in early winter

after the leaves have entirely disappeared, when absorption by the leaves is out of the question. In the treatment of long or old man twitch it is constantly recommended that the grass should be mown before applying the poison. In spraying perennial sweet peas with their trailing stems among the grass, it is often found that some leaves are missed. The sprayed leaves die, while the unsprayed ones immediately beside them remain green and healthy.

All these facts show that although the poison may kill the leaves it touches, it is unlikely that it enters by the leaves and travels through the stem and roots to kill the whole plant.

It is clear that in this case the poison was absorbed more effectively through the roots than through the leaves.

That the poison is not absorbed through the leaves of Californian thistle does not mean that spraying leaves is never good practice. The leaves of plants such as ragwort are very easily killed by the poison and death of the leaves may mean death of the plant, and beside this, in ragwort and many other weeds the poison easily runs down to the heart of the plant, which is the most easily destroyed. This is in keeping with the observation of the Department of Agriculture that the spraying of ragwort is



At left all chlorate applied to the top; at right all chlorate applied to the soil.

Recent trials by Loomis and others in Iowa make this quite clear for Californian thistle. The plants received 300lb of sodium chlorate to the acre—a moderate dressing. In some cases the poison was placed on the leaves alone, the soil being protected with rubber sheets, and in others the leaves were protected and the ground round the plant alone was wetted. Both lots of plants died down and both recovered; the picture shows the appearance of a plant of each group after recovery.

effective even if rain falls within an hour or two after application, and that it is more effective during showery weather than during particularly dry weather. For many plants of rosette form, spraying of the leaves is the easiest way to get at the crown, which is obviously the most vulnerable part of the plant.

The Iowa observation further shows that in Californian thistle at any rate, it is not necessary to have the leaves present when the spraying is done, and that the poison may, if other

conditions are suitable, be applied much later in the year than had previously been advised.

Fate of Sodium Chlorate in the Soil

Sodium chlorate does not persist as such in the soil indefinitely. It gradually changes into common salt which is relatively harmless, and the time and place of these changes are of importance. On these depend the poisoning effect on plants whose roots go to different depths, and also the effect of the poison on subsequent crops.

The chlorate changes into salt more rapidly when the soil temperature is high. Where the soil is fairly cool and dry the poison retains its strength unimpaired for at least 10 weeks. Where the soil is warm and wet the poisonous effect is reduced at the end of three weeks and entirely disappears at the end of five.

It would seem that poison which is effective for three or five weeks should be enough to kill any plant, but other factors now come into play, namely the movement of the chlorate downwards in the soil, and the depth of the true roots of different plants. When the soil is dry the chlorate stays in the surface layers; when it is wet the chlorate sinks rapidly, and in some experiments it has been recovered in almost full poison strength from a depth of four feet, six months after it was applied to the surface.

In dry weather then shallow rooted plants will be killed before the poison sinks or becomes harmless, but deep rooted plants will survive. In wet weather the poison will sink rapidly so that shallow rooted plants may escape, while deep rooted ones are subjected to the action of the poison before it decomposes. A striking example of this occurred when old man twitch was treated with a moderate dressing of 300lb an acre of chlorate in solution. There was no rain of more than half an inch for the next two months. Result, a 99 per cent. kill. Later another plot was dressed with a greater amount of the poison an acre, and two days later there was a fall of one and a-half inches of rain. The twitch was quite unharmed. Chemical tests here showed the chlorate still in full strength more than a foot down in the soil, beyond the reach of the shallow rooted twitch.

Application of the Experiments

The application of these experiments is obvious. Deep rooted plants of which Californian thistle is the best example, should be treated when the poison will travel down unaltered to the plants' true roots, feet below the surface—that is when the soil is cool and before heavy rains. This fixes the time as late autumn, say May. Previously, when it was thought that the leaves were necessary for the absorption of the poison, it was recommended that the poison should be applied in March, before the leaves died.

Thus it was often applied when the soil was still dry and warm. It did not move down in the dry soil, but was decomposed in the warm surface layers so that the thistles were not killed with any degree of completeness and much useless expense was involved.

On the other hand shallow rooted plants such as twitch on paths, should be treated in dry weather, when the poison will remain near the surface to do its work upon the shallow roots.

Injury to Following Crops

The length of time during which sodium chlorate poisons the ground varies greatly. In some cases an autumn application to Californian thistle on grass land is followed by a good growth of clover and weeds next spring, although this does not usually appear because the stock camps on the bare ground. On the other hand the land may remain bare for two years, especially when it has been ploughed and a crop sown. The explanation of these variations is found in the movement of the chlorates in the soil. If the soil is wet the chlorate is carried down beyond the reach of the shallow rooting plants, which therefore grow freely. But if the soil is drier the chlorate remains in the top layers to check all kinds of growth. Often when the chlorate has sunk to nearly a foot in depth, the land is ploughed so that the chlorate is brought to the surface again, to spoil the land for another season. It is found that the chlorate decomposes more quickly in the presence of organic matter, and therefore it is a good plan when a poisoned patch has to be ploughed, to plough in stack bottom or farm yard manure.

Thus, it appears, Californian thistles are best treated when the land is in grass that will not be ploughed for a year or two. The poison should be applied late in autumn when the land is cool and moist, so that the chlorate will not be disintegrated, but will be carried down by the winter rains to attack the deep roots of the thistle. And finally that the poison should be left deep in the soil to decompose slowly, while the surface soil should be encouraged to grow shallow rooting plants that will not reach down to the poison.

Instructions for Use

For Californian Thistle:—Sodium chlorate costs just over 6d a lb, and at 2oz a square yard this would cost £15 an acre. It is, therefore, clear that chlorate cannot be used on thistle when there is an extensive area of it. It can be profitably used only on small patches. In dry climates like that of Canterbury, the most effective way to attack the Californian thistles is to poison them when they are growing in grass that will not be ploughed up for two years. Apply the poison in May, scattering it broadcast at the rate of 2oz a square yard on all the ground occupied by the thistles, and well beyond their

limits. Next summer (if stock can be kept off) rake and sow with white clover and ryegrass, but do not plough nor sow any deep rooted crop. Treatment of thistles in stubble, etc., depresses the weed, but is rarely followed by complete kills.

Other deep rooted weeds such as Bladder Campion should be treated in exactly the same way.

Shallow rooted weeds, such as old man twitch, should have the poison broadcast on them in dry weather. The quantity varies for different plants. Two ounces a square yard is usually enough for twitch, but more is required for sorrel, which is one of the most resistant weeds observed. Treatment of such weeds is more applicable to garden than to farm practice.

Soft-leaved Weeds:—Most of these, including ragwort, are easily killed by very small quantities of chlorate, so small that they can hardly be applied undiluted. The chlorate, therefore, is usually dissolved in water. It is applied in a fine spray using enough to wet the leaves thoroughly. A recent trial has shown that a given quantity of chlorate applied to the crown is as effective as double the quantity applied to the leaves, and therefore, special attention should be paid to the crown of the plant if it is visible. The spray is most effective on ragwort when it is in flower, and during damp weather. Instead of using water, the chlorate may be mixed with carbonate of lime, 1lb of chlorate to 12lb of lime. This is then dusted on the plants until each plant is about as white as grass when it is being top-dressed with 4cwt of lime an acre. This dusting should be done when plants are in the rosette stage, both because the poison is more effective on the weeds when their crowns are exposed, and because the grass surrounding them more quickly recovers from accidental injury.

Caution

While sodium chlorate is not dangerous when it is used reasonably, there are two conditions under which it may cause serious injury:—

1. If it is mixed with organic matter such as charcoal or sugar, it may explode violently when struck with a steel or wooden implement. It will, however, not explode if struck when it is not so mixed.

2. Clothes which are saturated with chlorate spray and then dried will burn fiercely if a spark falls on them. Clothes so saturated and dried should be thoroughly rinsed to remove all the chlorate before they are used in any place where a spark from a fire, match or cigarette may fall on them.

Copies of this bulletin may be obtained from the secretary, Canterbury Chamber of Commerce, P.O. Box 187, Christchurch.