RECENTLY DEVELOPED HERBICIDES

by

Emilio Levi

(Division of Plant Industry,
C.S.I.R.O.)

A glance at the Summary Tables of biological tests by the U.S. National Research Council will indicate the large number of chemical compounds being tested for plant growth activity, and a perusal of U.S. Weed Control Conferences will show the quantity of compounds actually used or being tested to-day for their herbicidal action.

It is very difficult to decide in the field of herbicides what is a recent accession. 2,4-D is not much more than 10 years old, and yet to us it is not a recent discovery. Since then, three chemicals in particular have shown special interest; they are Maleic hydrazide (1,2 dihydro pyridazine 3,6 dione), Trichloroacetic acid and 3(p-chlorophenyl)-1,1-dimethyl urea. There are a number of other chemicals that might be noted, Cl I PC (3 chloro isopropyl phenyl carbamate), Crag EH 1(2,4-dichlorophenoxyethyl sulphate), Endothal (3,6 endoxohexahydrophthalate), etc., but they are either poorly understood, or of limited potential value at this time. Dalapon (2,2 dichloropropionic acid) the most recent discovery of Dow Chemicals, is heralded as the herbicide to control perennial grasses. Although we have started some tests in the Murrumbidgee Irrigation Area, no results are yet available from Australian work.

<u>Maleic hydrazide</u> has been formulated in a variety of salts but is most commonly available as a diethanol amine or a sodium salt. This sodium salt being less toxic to mammals and not appreciably less effective.

The response to M.H. has been uniform among both monocotyledon and dicotyledonous plants. The effect on perennials, however, seems slightly erratic. It has been shown that the chemical is picked up by both roots and leaves. A general inhibition of growth follows, accompanied by an accumulation of sugars in the leaves, anthocyanin formation, and in many species an almost complete cessation of growth may result without causing death of the plant. M.H. also activates axillary buds in some cases, and delays or prevents flowering in many species. It is assumed that M.H. inhibits growth by stopping cell division, and evidence exists of its antagonistic action to I.A.A. and N.A.A.

In its use as a herbicide, it seems that M.H. was supposed to eradicate plants, and to this effect, in the case of perennial grasses anyway, it has been far from successful. Another use of M.H. in weed control, namely as a growth inhibitor, has not yet been fully investigated. Research by C.S.I.R.O. has shown that it can effectively retard the growth of Paspalum dilatatum, P. distichum, Sorghum halepense, Phragmites communis and Penisetum clandestinum in greenhouse and/or field tests, for varying periods of time. Later the plants gradually recovered and grew again normally. Unfortunately the period of inhibition is not long enough to last through a growing season, and further experiments may show a possibility of lengthening this period. Another aspect of this ability of M.H. to inhibit growth has been its successful use in the U.S. to reduce the required number of mowings for lawns. It is also interesting to note the advantage of growth inhibitors when compared with soil sterilants for the control of perennial weeds in locations where soil erosion may be a problem.

Trichloroacetic acid is not a recently developed chemical but its value as a herbicide had not been discovered until recently. The sodium salt is the most common formulation used.

Its action appears to be two-fold, a scorching effect on the foliage and a systemic effect through root absorption. The major effect seems to be through the root system, yet some workers believe that it is translocated through the foliage. T.C.A. is toxic to cell protoplasm, and by killing the tissues it prevents or greatly hinders its downward translocation in perennial grasses. It is quite certain that the action of T.C.A. is much more rapid when absorbed through the roots.

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The mechanism of its herbicidal action is not certain, but it is believed to be related to its ability to precipitate proteins.

Soil moisture has been shown to be an essential factor in the effective use of T.C.A. Too little or too much water reduces its effectiveness by either not making it available in the soil solution, or by leaching it out of the root zone. It has an apparent selectivity being more toxic to monocotyledonous plants.

The actual effects on plants vary. It is not fast, but when it does occur, it may cause a tendency of the foliage to turn darker green, or chlorotic in patches, with leaf tip burn and die back following. Slight malformations of new growth also may occur. The root system begins to rot after appearance of the symptoms, and often heavy fungus growth occurs on it.

An interesting aspect of T.C.A. is its use in combination with growth regulators. Various reports indicate that it facilitates their entry into leaves. This may be due to damage to the cuticular layer which produces a water to water phase or it may be due to T.C.A. acting as an anaesthetic on cell membranes and so increasing the permeability of the leaves. Results of experiments in Australia with T.C.A. on *Cynodon dactylon* and *Sorghum halepense*, by Moore and Myers, showed the possibilities of this chemical and the importance of adequate soil moisture for its herbicidal activity. Subsequent experiments by C.S.I.R.O. have proved its effectiveness on the control of *Paspalum dilatatum* and *Phragmites communis*. In both cases root absorption and soil moisture were the most important factors. An indication that soil temperature may be an additional factor was also noted.

The selectivity of T.C.A. coupled to its short soil sterilizing action usually allows the growth of volunteer dicotyledonous crops which may prove an advantage.

It is also worth mentioning that preliminary experiments by C.S.I.R.O. have shown that Trichloroacetyl urea and trichloro acetanylide were very close to T.C.A. in their soil toxicity behaviour.

C.M.U. stands for 3(para chlorophenyl) 1,1 dimethyl urea. It is a fairly recent discovery of Dupont Chemicals. It has a low solubility in water at room temperature and is formulated as a wettable powder. It has the great advantage of being of very low toxicity to mammals, non irritating to the skin, and not corrosive to metals.

A large number of reports have appeared relating to its use as a selective and non selective weed killer. From evidence obtained in Australia by C.S.I.R.O., C.M.U. could be classified as an extremely toxic and persistent soil sterilant. Its action appears to be entirely through the root system, but it can cause a scorching effect on foliage. The initial symptoms produced by C.M.U. usually are a dieback of leaf tip and a burn of the leaf margins. This is followed by chlorosis, retardation of growth and may end with death of the plant. It has been reported that the initial symptoms occur first on older leaves, but evidence available in Australia does not confirm this point.

The mechanism of C.M.U. action is unknown as yet. The importance of the soil factor in the study of C.M.U. as an herbicide is obvious in view of the fact that its main entry into the plants is through the root system. Research by C.S.I.R.O. has shown conclusively that C.M.U. toxicity is not affected by the clay content of soils, but by their organic matter content. The C.M.U. being fixed on the colloidal phase of this soil component. Its normal distribution pattern in soils can also be correlated to their organic matter content. Toxicity is very high and persistent. 8 p.p.m. (air dry soil basis) is still lethal to germinating oats 2 years after treatment. Leaching with as much as 60 surface cms. of water did release some of the fixed C.M.U., but did not leach it out of a sandy soil.

A feature of the C.M.U. toxicity is its lack of effect on seeds. Germination and growth of oats are normal for 9 days, but reduction in growth starts during the 10th day.

No selectivity has been found among 10 species germinating in soil containing C.M.U.

In its use as a soil sterilant, therefore, soil organic matter and rainfall would be the most important factors to be considered.