THE VOLATILITY OF WEEDKILLERS

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It is primarily my lot to give the pros and cons of the subject of volatile hormone weedkillers versus low volatile weedkillers of the same parent acid base. I also intend discussing the effects of other volatile preparations such as the carbamates and phenols. All the physical data presented in this paper have been extracted from overseas literature.

MCP, 2,4-D, and 2,4,5-T.

The salts and amines derived from these acids are low volatile. Esters may be volatile or of low volatility depending largely on the number of carbon atoms in the ester radicle. The following figures are corrected for the actual 2,4-D content and if the butyl ester of 2,4-D equals 100 is used as a basis, the following values are for the relative amounts of 2,4-D volatilised.

Alcohol	Ester	Ratio
C ² H ⁵ OH	Ethyl	283
C ³ H ⁷ OH	Isopropyl	244
C ⁴ H ⁹ OH	N+butyl	100
C ⁴ H ⁹ OC ² H ⁴ OH	Butoxyethanol	33

1. It is also clear that technical esters cause more damage by volatility than esters purified by fractional distillation.
2. Base oils used in formulating the esters may increase or decrease the volatility to different degrees, depending on the base oils and on the ester used.
3. When emulsified in water their volatility relationship may be again altered.
4. Workers also agree that although the vapour pressure of the butoxyethanol ester of 2,4-D is only 1/7, that of the ethyl ester the relative "physiological" volatility is much greater.
5. It is also clear that the esters of 2,4,5-T are less volatile than equivalent esters of 2,4-D.

EFFECTS OF VOLATILE ESTERS

A characteristic of volatile esters that is not inherent in low volatile esters is that these esters can damage neighbouring susceptible plants by the effect of toxic vapours. Work has shown though that the quantity of 2,4-D ester required to induce a plant modification of a given magnitude is 30 to 100 times greater for vapour as compared with direct treatment. The conditions necessary for damage to take place by volatility are rare. Hot, still, humid conditions must prevail for a considerable period. In my experience the only case of damage that could be attributed to the effect of volatility was where a large box that had been used for several years for crating a weed spraying outfit and weedkillers was left in the middle of the summer for a period of

several weeks near a tomato patch in an enclosed area. The closest tomatoes were approximately 6 to 8ft. and the furthest ones away from the box were from 12 to 16ft. The tomatoes at the time were just coming into flower. Some of the terminal shoots were affected and the fruit was pear shaped. Other less susceptible species such as potatoes, hedge plants, etc., were not affected.

SPRAY DRIFT

The most frequent cause of weedkiller damage to associated plants of value is by spray drift. If spray drift does occur, more damage will be done by low volatile preparations than by volatile preparations; that is, low volatile particles adhere together longer and thus tend to drift further than more volatile particles that vapourise and disperse more readily. In other words the more volatile the material is the quicker it disperses if spray drift occurs and hence there is less likelihood of a toxic dose arriving at any one point. Thus in most cases low volatile preparations are possibly more dangerous to use than highly volatile materials.

EFFECTIVENESS OF LOW VOLATILE AND VOLATILE PREPARATIONS

As a contact herbicide for the control of annual plants the lower more volatile esters such as the butyl ester are usually more lethal per unit than the higher low volatile esters. The low volatile esters though probably translocate more effectively in perennial plants than the volatile esters. For example, better results are usually obtained with the butoxyethanol ester of 2,4,5-T on blackberry than with the butyl ester. In the case of gorse where negligible translocation appears to take place esters with a higher toxicity per unit, such as the volatile esters, appear to be the correct materials to employ.

FOLIAGE COVER

Another feature that was brought out in detailed work on gorse was that complete foliage cover was easier to obtain with the volatile materials rather than with low volatile preparations. Whether this was due to volatility, better penetration, greater toxicity per unit, better movement in the gorse, etc., is not known.

APPLICATIONS TO THE SOIL

It is fairly clear that low volatile preparations particularly the water-based salts and amines are less selective and have a longer residual life in the soil than the volatile preparations based on the same parent acid. This would indicate that the volatile materials are broken down by vapourisation as well as other factors such as leaching, soil bacteria, etc., that render low volatile preparations non-toxic.

OTHER ASPECTS

A trial conducted by a research officer at Head Office in conjunction with the Seed Testing Station showed that if grass seed were stored near volatile weedkillers, in a short time the germination of perennial ryegrass in particular was reduced considerably. Other work done overseas indicates that there is a real danger in storing volatile weedkillers next to seed. In fact this technique has been used by Mullison, of Dow Chemical Company, to obtain a quantitative measure of the relative vapour effects of esters of 2,4-D and 2,4,5-T.

RECOMMENDATIONS FOR USE

Low volatile materials should be employed in enclosed spaces and spray drift minimised by using fan nozzles, low pressures, spraying under calm conditions, avoiding atomisation of spray particles, etc. The use of volatile materials cannot be recommended in these areas as there is always the potential danger of contamination from the treated area. This danger, in practice, must be small for the appropriate conditions have to prevail at the time of application and the amount of ester that is not absorbed into the plant in the space of a short period after application is possibly negligible. Provided spray drift is not a factor, and this is a real danger for most nozzles tend to atomise a proportion of the spray, volatile materials should be safe enough to employ in situations other than enclosed spaces where associated plants of value are growing.

CARBAMATES

In both IPC and CIPC the isopropyl ester of carbamic acid is employed. Both these materials are therefore volatile. A great deal of work done by Shaw, at Beltsville, indicates that the major loss of carbamates in the soil is through volatility. This worker has shown that 2- (1-chloropropyl) N-(3-chlorophenyl) carbamate is nearly as toxic as CIPC but much less volatile. These properties would give this chemical different selectivities to CIPC. It has also been demonstrated overseas and in New Zealand that selectivity of CIPC is reduced with increased soil temperatures. For example CIPC has been employed successfully in Southland to eliminate spurrey in swedes at rates up to 2lb. In the North Island rates up to 1lb. have been too severe and have reduced brassica germination. This is more apparent in light sandy soils that heat up more quickly than in heavy clay soils.

PHENOLS

The sec-butyl ester is used in DNBP. This makes this material volatile. The rapid loss of this material when applied to the soil makes it a selective material with a short residual action in the soil. The fact that it is volatile also increases its danger to the user and a less volatile material would be safer to handle.

OKTONE

This is an example of a material that is of value because of its highly volatile nature. The residual effects of this material when applied to the soil as a pre-emergence dressing are extremely small and under hot soil conditions may not last more than an hour or so. This property allows Oktone to be employed for weed control in susceptible crops such as brassicas. Its toxicity to a wide range of germinating seedlings and its independence of associated climatic conditions makes it a valuable material over a wide range of conditions.

CONCLUSION

I consider far too much emphasis commercially is placed on the physical properties of these weedkillers, particularly in the case of volatility. Both forms are of value. We cannot expect the user to understand the significance of these physical properties of hormone preparations if he is presented with contradictory information by various commercial interests. I consider the label for the low volatile

materials as well as recommending their specific use should contain the warning that the commonest cause of damage is by spray drift and that low volatile materials are particularly dangerous in this respect. The label on the volatile materials should contain the warning that these materials should not be used in enclosed places and also point out the dangers of spray drift. Further, if hormone damage continues to occur to neighbouring plants of value there are sufficient people with anti-weedkiller interests to legislate for restrictions in their use. I consider little enough research work is being done in this country in this field at the moment and the more staff required to run regulations the less staff and equipment is likely to be made available for research projects.

DISCUSSION

Q.—Is it possible to take a low volatile ester, for example, butoxy ethanol product, and by its formulation with high volatile solvents make a high volatile product?

A.—No specific information is available.

Comment: Oxygen in the butoxy ethanol product may give a water affinity which other esters may not have. A paraffinic type oil which does not mix readily with the esters may ensure solubility. An aromatic oil may operate in the opposite direction.

Q.—How long can you keep hormone preparations without loss of strength?

A.—There is no evidence that they degenerate. However, early preparations of MCP were not buffered against excess alkalinity, and this often resulted in the corrosion of tins.

Q.—Is it possible that high volatile material can volatilise off a plant surface before it has time to take effect?

A.—The penetration of esters into plants is extremely rapid and entry takes place before it has time to volatilise off.

Comment: Ethyl 2,4-D and butyl 2,4-D have been shown to have equal potency, yet ethyl is three times as volatile as butyl. This supports Mr. Matthews's view.