Damage caused by hormone-like herbicides

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THE discovery of the selective action of herbicides such as 2,4-D and MCPA resulted in a rapid expansion in the use of these chemicals for agricultural purposes, particularly for the control of weeds in cereal crops.

In a short period of time they have become accepted in a similar manner to insecticides and fungicides and are performing a comparable service. During 1964, in Western Australia, more than one million acres of cereals were sprayed with 2,4-D. As a result, both quality and yield have been improved.

One important advantage of the hormone-like herbicides over some other weed killing chemicals, particularly arsenicals, is that they are relatively non-toxic to animals. Stock may be grazed in paddocks immediately after spraying and no special precautions are necessary for spray operators.

Despite their obvious value to agriculture, however, these chemicals can cause appreciable losses. Plants other than weeds can be destroyed and, for this reason, the term herbicide is preferred to weed-killer. Damage may be caused to the crop being sprayed or to cultivated plants in the vicinity.

In Western Australia, 2,4-D is applied mainly to cereals which are relatively resistant, but instances of injury to the crop do occur. Wheat is more tolerant than oats, with even some variation between the varieties of wheat. The risk is greatest with the ester of 2,4-D, with
Leaves and flower of a rose affected by 2,4-D (right)

Hibiscus is susceptible to 2,4-D. The leaves on the right are showing "shoestring" symptoms.
MCPA the least likely to cause damage and the amine of 2,4-D intermediate.

The recommended growth stage for spraying wheat is when the plants are stooling freely but before the "boot" stage, when the head is evident as a swelling in the leaf sheath.

If sprayed too early, various malformations are likely to appear. Club shaped, twisted or branched heads are formed with an irregular arrangement of the spikelets, referred to as "scatter heads." The glumes may become fused, the number of spikelets in each group reduced and a proportion of the florets aborted. Symptoms also include thickened stems, yellowing, reduction in height and delayed maturity. Spraying at the "boot" stage does not usually cause abnormalities but reduced grain setting has been attributed to it.

Clovers are more susceptible than cereals and when they occur in a crop, particularly in the year of sowing, additional care must be taken. 2,4-D amine or MCPA is then usually recommended, with 2,4-D ester only being used under special circumstances. Even when injury is not apparent, flowering of clovers may be delayed to the extent of preventing seed setting.

Damage to plants other than those being sprayed can be caused in a number of ways—

**Spray Drift**

The extent of spray drift depends on a number of factors, including droplet size, type of formulation, wind velocity and height of release of the spray.

Small droplets are carried for longer distances and the droplet size should be
A normal grape leaf (right) compared with leaves showing moderate and severe effects of 2,4-D damage.

Typical effects of 2,4-D damage are shown by tomato leaf on the right.
kept as large as possible commensurate with effective treatment. This can be done by selecting an appropriate nozzle and not using a pressure higher than is necessary. For most spraying 30 to 40 lb. per square inch is adequate.

Due to a lower evaporation factor, greater drift can be expected with oil-based sprays and when oil is used as a solvent. Spraying should be done under calm conditions, especially when susceptible crops are in the vicinity; spray wands should not be elevated. Drift is accentuated by high mounting of nozzles and also with aerial application.

When the wind velocity is high, plants can be affected at distances of more than a mile.

**Volatility**

Damage has been caused by vapour arising from sprayed herbage or from equipment containing a volatile formulation of 2,4-D or 2,4,5-T.

The risk is greatest with the ester of 2,4-D and increases with rising temperatures. This means that even if the wind direction is away from a susceptible crop at the time of spraying, damage can be caused subsequently by a change in wind associated with the formation of vapour.

**Contaminated Equipment**

Frequently plants have been killed or severely damaged by applying an insecticide or fungicide with equipment used previously for hormone-like herbicides, even after careful cleaning. Separate equipment for herbicides and other pesticides is desirable under all circumstances but particularly with sensitive crops such as tomatoes, vines and cotton.

If the use of the equipment for more than one purpose cannot be avoided it should be cleaned thoroughly and restricted to plants relatively resistant to 2,4-D. Wooden vats, rubber, leather or plastic sections (including hoses) should be replaced.

If amine formulations of 2,4-D have been used the sprayer should be washed thoroughly with water and filled with a solution containing one gallon of household ammonia in 100 gallons of water. After removal 24 hours later, the equipment should again be washed thoroughly with water. With oil formulations, including esters, kerosene should be used for the preliminary washings followed by a solution containing 5 lb. tri-sodium phosphate in 100 gallons of water.

Empty containers should be buried or, at least, dumped where they are unlikely to be salvaged or cause damage due to vaporisation. They should certainly not be used as incinerators or as containers for any material.

**Contaminated Pesticides**

There have been several instances in this State of tomatoes and vines being affected by spraying with pesticides containing small amounts of 2,4-D, even though manufacturers take elaborate precautions to prevent contamination during preparation.

Agricultural chemicals such as insecticides, fungicides and fertilisers should not be stored with hormone-like herbicides, particularly the esters of 2,4-D. They can readily absorb vapour arising from open or damaged containers and only a trace is necessary to damage susceptible crops.

**Symptoms**

As already mentioned, grape vines, tomatoes and cotton are among the most sensitive crops, although many other cultivated plants can be damaged severely. Most vegetables including lettuce, peas and beans are readily affected and lupins have often been damaged.

Effects on wheat have been described and are illustrated.

In general the first indication of damage is usually a twisting or bending of the stems and leaves due to differential growth rates. A thickening of the leaves and stems may occur, often resulting in splitting. Yellowing or reddening of leaves is not unusual and, if enough of the chemical enters the plant, growth will cease, followed by death of the tissue.

With sub-lethal doses, often caused by spray drift or slightly contaminated equipment, interesting secondary growth responses may occur. Normally broad leaves become narrow or finely divided, with the green colour disappearing from the veins. The term “shoestring” is often applied to this condition. Floral parts may be multiplied and fasciations appear. Fruits, including tomatoes, may be formed without seeds.
Slight malformations, particularly in cereals, may not adversely affect production. Severe damage, however, has caused total loss of tomato crops and vine and cotton yields have been reduced considerably.

Enquiries received by the Department of Agriculture indicate that abnormalities caused by hormone-like herbicides are often confused with diseases. This is understandable as some fungal and virus infections can induce similar symptoms.

**Treatment**

When plants are affected by 2,4-D, remedial action that can be taken is very limited, particularly in the case of large-scale crops. Some pruning of malformed portions has assisted with tomatoes and grapes.

If garden shrubs, such as hibiscus, are only slightly affected they can be expected to revert to normal growth without treatment but this can be expedited by removing affected sections and watering regularly.

**RECOMMENDATIONS**

1. Only spray with 2,4-D and 2,4,5-T under calm conditions.
2. Do not use a higher pressure than is necessary.
3. Take added precautions when sensitive crops such as tomatoes, vines and lupins are in the vicinity.
4. Avoid using the volatile ester when it presents additional hazards.
5. Retain spraying equipment used to apply 2,4-D for that purpose only.
6. Do not store 2,4-D along with other pesticides or fertilisers.
7. Destroy empty containers.
8. Do not leave vehicles or equipment used for spraying in the vicinity of gardens or sensitive crops, particularly when the temperature is high.

Cotton leaves react readily to hormone-like herbicides
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