

REPORT OF RECOMMENDATIONS COMMITTEE

1954

BRITISH WEED CONTROL COUNCIL

Report of the Recommendations Committee

This report is issued by authority of the British Weed Control Council. It is based on the first report of the Recommendations Sub-Committee and incorporates suggestions received from the delegates to the British Weed Control Conference 1954.

The Committee thought that it was desirable to increase the scope of the report and to include various aspects of selective and non-selective weed control which were not included in the 1953 report.

The report is divided into three parts. The first two are concerned with recommendations; the first for selective weed control in growing crops, the second for the non-selective use of chemicals. Statements made in these two parts *should* be taken as firm recommendations unless qualified by the word 'Tentative' in the left-hand margin.

The third part contains sections on Application, the Law and New Herbicides. The material presented in this part is for information only and *should not* be taken as recommendations.

Notes on abbreviations and terms used in the text are given on page 9. These should be studied carefully before reading the recommendations given in Parts I and II.

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INTRODUCTORY NOTES

(1) Where 'Tentative' is inscribed in the left-hand margin it indicates that the contents of the accompanying paragraph are for general guidance and that much more research and experience must be gained before the recommendation can be regarded as completely free of risk.

(2) The chemical names of the common or abbreviated herbicide names used in the text are:-

MCPA	2-methyl-4-chlorophenoxyacetic acid
2,4-D	2,4-dichlorophenoxyacetic acid
2,4,5-T	2,4,5-trichlorophenoxyacetic acid
CIPC	isopropyl-N(3-chlorophenyl) carbamate (Aldisprogen)
DNC	2,4-dinitro-6-methylphenol 3,5-dinitro-o-cresol
dinoseb (DNBP)	2-sec-butyl-4,6-dinitrophenol 2,4-dinitro-6-sec butylphenol
PCP	pentachlorophenol
BOV	Brown oil of Vitriol 77% V/V Sulphuric acid

Chemical names and formulae of the newer herbicides are listed in Table VII page 65.

(3) All amounts of synthetic growth regulators are in terms of ounces of acid equivalent per acre, and, in the case of water-soluble formulations, refer to products not containing added surface active agents. All amounts of MCPA are in terms of the active 2,4 isomer. Amounts of MCPA and 2,4-D are as determined by the official methods of analysis.* The derivative of MCPA usually quoted is the sodium salt but the sodium, potassium and amine salts do not differ appreciably in effect at the same doses, according to available information.

(4) All amounts of DNC and dinoseb are in terms of pounds of the actual nitrated phenol per acre, as determined by the official methods of analysis.*

(5) All amounts or concentrations of sulphuric acid are in terms of 100% pure acid.

(6) High volume refers to spray application rates above 60 gallons per acre, with 100 gallons per acre as the generally accepted high volume rate.

(7) Low volume refers to spray application rates of 20 gallons per acre and below.

* See Tech. Bull. No. 1. "Specifications and methods of analysis for certain insecticides, fungicides and weedkillers" New edition to be published by the Ministry of Agriculture and Fisheries early in 1955.

PART I
RECOMMENDATIONS FOR WEED CONTROL IN GROWING CROPS

Section I

Selective Weed Control in Agricultural Crops

(1) RECOMMENDATIONS FOR THE USE OF SELECTIVE HERBICIDES IN FIELD AND VEGETABLE CROPS

This section of the report presents recommendations concerning the use of selective herbicides in twenty-eight different crops. If information is required on a particular crop or chemical first consult Table I which is an index to the forty-five paragraphs that follow. The numbers in the table refer to the paragraphs wherein the detailed recommendations for the use of the particular chemical on the crop may be found.

In order to obtain information on how to deal with a particular weed problem in a specific field or vegetable crop, proceed as follows:-

- (1) Turn to the Index Table (Table I)
- (2) Find the crop in the list on the left-hand side and consult the paragraphs quoted to determine the herbicides recommended for the crop concerned and the precautions that are necessary.
- (3) Turn to the Weed Susceptibility List (Table III)
- (4) Select the herbicide likely to give the most efficient control of the weed(s) present and which at the same time is safe for use on the crop.

If the weed is a perennial, Table III may refer to Sub-Section (111) where more detailed recommendations concerning the control are given.

The recommendations given delimit the conditions within which it is safe to apply the stated chemical to the crop concerned without fear of damage. Applications made outside any of the stated limits may lead to serious reduction in crop yield.

All amounts quoted are MAXIMUM safe doses. The correct dose to use, below this maximum will depend on the susceptibility of the weed or weeds that it is desired to kill.

Table I

Index to recommendations for the use of selective herbicides in field and vegetable crops

The figures in the table refer to the numbers of the paragraphs in which recommendations are given

	MCPA (sodium)	2,4-D (amine)	2,4-D (ester)	DNC	Dinoseb	Sulphuric acid	Other ccmpounds
1. Asparagus	44	-	-	-	-	-	-
2. Barley, winter and spring sown	1-3,5	1-3,5	1-3,5	1,2,4,6,7	1,2,4	1,2,4	-
3. Bean, field	-	-	-	-	23	-	-
4. Beet, fodder, sugar and red	-	-	-	-	-	-	43
5. Carrots	-	-	-	-	-	-	40
6. Cereals, undersown	10,1-7	10,1-7	10,1-7	9,1-7	9,1-7	8,1-7	-
7. Cereals, not undersown: see separate crops	-	-	-	-	-	-	-
8. Clovers, direct sown seedlings	-	-	-	-	26	-	-
9. Dredge corn, including cereal- legume mixtures	11,15,1-7	11,1-7	11,1-7	11,1-7	12,14,1-7	11,1-7	-
10. Flax	17	-	-	18	-	-	-
11. Grasses for seed production	31	31	31	-	-	-	-
12. Grassland, permanent	28,29	28,29	28,29	-	-	-	-
13. Grassland, established long- term leys	28,29	28,29	28,29	-	-	-	-
14. Grassland, leys in first year	30	30	30	-	-	-	-
15. Kale	-	-	-	-	-	27	-
16. Leeks	-	-	-	-	-	38,39	-
17. Linseed	15	-	-	16	-	-	-
18. Lucerne	-	-	-	-	24	-	-
19. Oats, winter sown	1-3,5,7	1-3,5,7	1,3,5,7	1,2,4,6,7	1,2,4	1,2,4	-
20. Oats, spring sown	1-3,5,7	-	-	1,2,4,7	1,2,4	1,2,4	-
21. Onions	-	-	-	-	-	32-37	-
22. Parsley	-	-	-	-	-	-	42
23. Parsnips	-	-	-	-	-	-	41
24. Peas, field, drying and vining	-	-	-	-	19-21	-	-
25. Peas, market garden	-	-	-	-	22	-	-
26. Potatoes	45	-	-	-	-	-	-
27. Rye	1-3,5	1-3,5	1-3,5	1,2,4	1,2,4	1,2,4	-
28. Sainfoin	-	-	-	-	25	-	-
29. Wheat, winter and spring sown	1-3,5	1-3,5	1-3,5	1,2,4	1,2,4	1,2,4	-

NOTE All amounts quoted are MAXIMUM safe dosages.
 Amounts of growth regulators are in terms of acid equivalent.
 Amounts of DNC and dinoseb are in terms of parent nitrated phenol.

CEREALS

- The different types of herbicides recommended for selective weed control in cereal crops are listed as column headings in Table II. The safe amount of each herbicide that can be applied to each cereal is shown in the body of the table. The amounts shown in Table II refer to the safe amounts when the cereal is at the most resistant stage prior to 'shooting'. In general, winter sown cereals (when treated during the spring following sowing) are more resistant to all herbicides, than are spring sown cereals.

Table II

MAXIMUM SAFE AMOUNTS OF HERBICIDES APPLIED
AS SPRAYS TO CEREAL CROPS

Volume Dcse	MCPA ^o (sodium) 5-100 gal/acre oz./acre	2,4-D ^o (amine)(ester) 5-100 gal/acre oz./acre		DNC* 50-100 gal/acre lb./acre	dinoseb+ 50-100 gal/acre lb./acre	H ₂ SO ₄ 100 gal/acre gal/acre
Wheat Spring	32	16	8	8	1	10
Winter	32	24	16	8	1	11.5
Barley Spring	32	16	8	8	1	10
Winter	32	16	8	8	1	10
Oats Spring	24	NR	NR	8	1	8
Winter	32	16	4	8	1	10
Rye Winter	32	24	16	8	1	10

NR - Not recommended

^o - When MCPA or 2,4-D are applied in a dust carrier twice the quantities can be used.

* - Unactivated. Where an activated product is used the maximum amount must be reduced by 25%.

+ - This maximum should be decreased by 20% in warm, wet weather, and may be increased by 20% in cold, dry weather.

Stages of growth

- For the timing of herbicide applications the morphological stage of development is a better criterion of stage of growth than is crop height. The growth of cereals can be divided conveniently into five periods as follows: (1) emergence to two-leaf; (2) three-leaf to four expanded leaf, during which stage tillering commences; (3) five-leaf to start of shooting - during this stage tillering is generally completed; (4) shooting to fully headed; (5) milk stage of grain to full maturity. Leaf number refers only to the main shoot. Primary tillers may be counted instead of the leaves in the axils of which they arise as these leaves frequently shrivel and may be missed. Extreme care is necessary in the counting of leaves and where tillers are few or absent the

shrivelled lower leaves are most important. Secondary tillers are not to be counted, nor tillers arising below the mesocotyl.

3. Synthetic growth regulators (MCPA, 2,4-D). Wheat, barley and rye are most resistant at stages 3 and 5. They should be sprayed for the control of annual weeds during stage 3. In any case, crops for seed and malting barley should not be sprayed at stage 5. Spring oats may be sprayed with MCPA at any stage between the development of the first true leaf and the start of shooting.
4. DNC, dinoseb and sulphuric acid. Treatment of cereals with DNC and dinoseb is as safe at stage 2 as at stage 3, and the earlier treatment may be preferable to obtain a greater degree of weed control. Dinoseb is less selective in cereals than is DNC. Sulphuric acid should be applied during stage 3.

Malformities

5. Malformity of the head, stem and leaf may result in wheat and barley from application of MCPA and 2,4-D during stages 1 and 2. The degree of malformity increases with dose applied. Malformities are not normally obtained if treatment is made during stages 3 and 5. 2,4-D induces more malformity than MCPA at equivalent rates of application. These malformities are not necessarily correlated with yield but may affect grain quality, particularly in malting barley. Barley is particularly likely to develop malformities if treated at an early stage of growth and if required for malting extra care should be taken to ensure that it has fully tillered before treatment. The degree of malformity of the panicle occurring from MCPA treatment of spring oats is usually unimportant and does not result in yield reduction.

Varietal differences

6. Differences between varieties in susceptibility to the recommended herbicides exist but have not been investigated in sufficient detail to justify recommendations in wheat, barley and rye. The winter oat varieties S147 and S172 are more susceptible to damage from DNC.

Oats

7. The margin of safety with oats is less than with other cereals and special care must be taken. Under normal conditions the crop should not be harrowed or rolled during the ten days before or seven days after spraying, nor should it be sprayed with DNC when wet or when frost is imminent.

CEREALS UNDERSOWN WITH GRASS AND CLOVER SEEDS

8. Sulphuric acid can be used either before the seeds are drilled or after drilling and before germination.
9. DNC and dinoseb are safe, as used for cereals, if the under-sown seeds are drilled (not broadcast), and spraying takes place before the grass and clover seeds are drilled or in the period between their drilling and seven days before their emergence.
10. MCPA and 2,4-D are not recommended for routine use as seedling clovers are very susceptible to these herbicides and insufficient is known concerning the factors affecting their susceptibility. In emergency, application of low doses of dust or liquid preparations may be made to control susceptible weeds (see Table III). The treatment should be applied after the clovers have reached the trifoliate stage and the weeds have grown sufficiently to shield the seedlings. Insufficient evidence is available to indicate whether high or low volume application is safest.

NOTE All amounts quoted are MAXIMUM safe doses.
Amounts of growth regulators are in terms of acid equivalent.
Amounts of DNC and dinoseb are in terms of parent nitrated phenol.

DREDGE CORN

Cereal mixtures

11. Dredge corn containing cereals only may be treated in the same way as straight cereal crops, provided that the maximum permissible dose (Table II) for the most susceptible cereal in the mixture is not exceeded.

Cereal-legume mixtures

12. Mixtures containing peas may be treated with dinoseb provided the conditions specified under peas are complied with and provided weed infestation is high enough to offset any slight scorch of the cereal.
13. Up to 24 oz. per acre MCPA may be applied as a dust to mixtures containing peas provided the peas are about eight inches high.
- Tentative
14. Mixtures containing beans or vetches may be sprayed with the ammonium salt of dinoseb at 1 to 1½ lb. per acre at high volume, provided the growth of the legume has not been too rapid and that it is protected to some extent by the cereal and weeds. Such treatment may cause slight damage to beans and a certain amount of scorch to oats.
- Tentative

LINSEED

15. MCPA. The sodium salt of MCPA can be used at rates up to 32 oz. per acre as liquid sprays or 48 oz. per acre as dusts. Sprays must be applied in high volume and the crop must be not less than 1-2 inches and not more than 8-10 inches high. This recommendation applies to the varieties Royal, Redwing, Valuta, Dakota. Other varieties may be more susceptible.
16. DNC. DNC (sodium) can be applied at 6 lb. per acre in about 100 gallons of water at the same stages as for MCPA (sodium).

FLAX

17. MCPA. MCPA (sodium) may be applied at doses up to 12 oz. per acre in a high volume spray or 24 oz. per acre as dusts. Application should be made when the flax is between 1-2 inches and 6-7 inches high. 2,4-D should not be applied to flax.
18. DNC. DNC (sodium) may be applied at up to 6 lb. per acre in about 100 gallons of water at the same stage of growth as for MCPA (sodium).

PEAS (field, drying and vining)

19. Dinoseb as its ammonium salt may be used at doses up to 2 lb. per acre applied at high volume. Where good growing conditions have prevailed during the days preceding spraying and temperature is high on the day of spraying, it may be necessary to reduce this maximum; at over 70°F and where pea growth is 'soft' 1 lb. per acre should be regarded as the maximum. Spraying is not recommended at temperatures below 55°F.
20. Peas should be sprayed after they are 4 inches high with four expanded leaves, but before reaching a height of 10 inches. The crop should not be sprayed when wet.

There are some varietal differences in susceptibility with field peas most resistant, and peas for picking green generally most liable to scorch, but there is insufficient information available to make definite recommendations regarding individual varieties.

PEAS (Market Garden, for picking green)

22.
Tentative Dinoseb as the ammonium salt can be used as described in paragraphs 19-21. However, varieties grown for market are, on the whole, more susceptible to injury by dinoseb than are those of the other groups of peas. Also, even a slight check to growth which the spray may cause can result in the grower missing the early market and thus incurring considerable financial loss. Until further work on varietal differences has been carried out great caution is needed in using dinoseb on market garden peas.

FIELD BEANS

23.
Tentative Dinoseb as its ammonium salt can be used on winter (not spring) crops of field beans, at doses of 1 to 1½ lb. per acre applied at high volume. The beans should only be sprayed when they are about 3 inches high, while growth is still 'hard', i.e. before rapid spring growth starts.

LUCERNE

24. Dinoseb as its ammonium salt may be applied to seedling lucerne at doses up to 1½ lb. per acre applied at high volume. Where good growing conditions have prevailed during the days preceding spraying and temperature is high on the day of spraying it may be necessary to reduce the dose (e.g. to 1 lb. per acre at over 70°F). The seedlings should have developed two trifoliate leaves before spraying. Spraying of lucerne-grass mixtures in this way may alter the balance between the two components of the mixture.

SAINFOIN

25.
Tentative Dinoseb may be applied to seedling sainfoin which has developed two trifoliate leaves, along the lines of the lucerne recommendations.
- #### CLOVERS (direct sown)

26.
Tentative Dinoseb as its ammonium salt may be applied to young stands of red and white clovers which are well established with several trifoliate leaves, at doses up to 1½ lb. per acre in high volume. Where good growing conditions have prevailed during the days preceding spraying and temperature is high on the day of spraying, it may be necessary to reduce the dose (e.g. to 1 lb. per acre at over 70°F). This treatment is liable to cause some leaf scorch and should only be applied where justified by a dense weed stand.

KALE

27.
Tentative Sulphuric acid at up to 100 gallons per acre of 10% v/v solution may be applied to kale at the three- to six-leaf stage when the weed infestation is such as to justify the risk of some crop scorch and no other method of weed control is practicable. Application should only be made when growing conditions for the crop are good. Crop scorch is lessened where the weed growth and density is such as to provide physical protection to the crop against the spray.

NOTE All amounts quoted are MAXIMUM safe doses.
Amounts of growth regulators are in terms of acid equivalent.
Amounts of DNC and dinoseb are in terms of parent nitrated phenol.

PERMANENT GRASSLAND AND ESTABLISHED LONG-TERM LEYS

28. The following compounds may be safely applied up to the doses indicated below:-

MCPA, sodium and amine salts - 32 oz. per acre
2,4-D, sodium and amine salts - 32 oz. per acre
2,4-D, esters - 16 oz. per acre.

All compounds and formulations may be applied at high or low volume rates. Treatment may be made at any time during the spring and summer. Where grass is to be cut for hay, spraying should either take place in early spring (for buttercups etc.) or be delayed until regrowth of weeds has occurred after mowing (for thistles etc.)

29. As a result of treatment there is usually a check to the growth of the clovers and sometimes a slight check to the grass; under correct management, the grass soon grows away again and the clover content is restored. If however it is desired to maintain a very high clover content in the sward during the current season only doses up to half of the maximum should be used, or the sward not sprayed at all. Pastures in which the clover is only just surviving under very adverse conditions should be treated with special caution. On the other hand, in exceptional circumstances where only slightly susceptible weeds are to be controlled higher doses than those indicated may be applied, but risk of depression of the legume content of the sward is correspondingly greater. It is essential that in grassland, improvement programmes relying on the use of chemical weedkillers, correct management and improvement practices should also be employed. These may include drainage improvement, application of lime and fertilisers, correct stocking and mechanical measures such as cutting and harrowing, according to circumstances. The aim should be to promote the rapid growth of the better grasses and clovers in order to fill in the bare patches left as a result of successful weed control and to obtain and maintain a dense sward to prevent re-invasion.

LEYS IN THEIR FIRST YEAR

30. Tentative Only under very exceptional circumstances should leys in their first year be sprayed with MCPA or 2,4-D. Where the ley has become dominated by a susceptible weed it may be permissible to use up to half the doses indicated for permanent grassland, provided spraying is postponed until the clovers are well established.

GRASSES FOR SEED PRODUCTION

31. Tentative Not more than 24 oz. per acre MCPA (sodium), 16 oz. 2,4-D (amine) or 8 oz. 2,4-D (ester) may be used on established grass stands. They should not be sprayed before active spring growth of the plants is well advanced and the inflorescence well developed within the shoot, nor after 'shooting'. Species and strains of grasses differ appreciably in their time of development during spring and early summer and no one time is likely to be suitable for spraying all crops.

ONIONS (Bulb, direct-seeded)

32. Sulphuric acid pre-emergence. A 10% v/v solution may be applied at 100 gal. per acre just before onion emergence, to kill the weed seedlings already emerged. A wetting agent, preferably of the sulphonated oil type, should be incorporated at the rate of 1 pint per 100 gallons of spray solution.

33. As an alternative to the above, concentrated acid may be applied pre-emergence at 15 - 18 gal. per acre of B.O.V. or 11.5 - 14 gal. per acre of pure acid with a machine giving good coverage at these volume rates (concentrated acid is less corrosive to metals than is the diluted acid).

34. Sulphuric acid post-emergence. If further weeds appear after onion emergence, a post-emergence spray of sulphuric acid may be applied provided the onions have passed the 'loop' and 'crook' stages and have straightened up. The strength of the spray solution used depends on the weed species present, but is usually from 5.5 - 10% v/v applied at about 100 gallons per acre. If resistant species are present, a wetting agent may be added. Sulphuric acid does not kill *Poa annua*, often a major weed in onions. If wet conditions in early summer cause extensive germination of weeds, a second application of sulphuric acid may be made.

ONIONS (For production of sets)

35. The seedbeds may be treated with a pre-emergence application of sulphuric acid as above.

ONIONS (Grown from sets)

36. Sulphuric acid is not recommended.

ONIONS (Salad, spring or green)

37. Pre-emergence application of sulphuric acid may be carried out as above. Post-emergence treatment is not recommended.

LEEKS

38. Sulphuric acid pre-emergence. 10% v/v acid at 100 gallons per acre, with a wetting agent, may be used as for onions.

39. Sulphuric acid post-emergence. If necessary, sulphuric acid may be applied post-emergence at the same rates used for onions. The leeks must be small at the time of treatment, that is, not later than a month after planting out.

CARROTS

40. Proprietary oils produced for the purpose, having a distillation range between 140 and 210°C and an aromatic content of between 15 and 25% and approved by the Crop Protection Products Approval Scheme, may be used at rates of from 40 to 80 gal. per acre (or lower rates if only applied between the rows) applied after the carrots have developed their cotyledons and while the weeds are still small. Spraying should not be attempted after the carrots reach 'pencil thickness'. Frame-grown carrots may be similarly treated provided that adequate ventilation can be provided in the period following treatment and there is no risk of frost. Most tractor vaporising oils can be used in a similar manner on carrots not grown for 'bunching' providing a sample is tested on a small area first, and particular attention is paid to avoid late spraying which incurs risk of tainting.

PARSNIPS

41. The same oils may be used as for carrots, applying when the parsnips are in the 2 - 4 true leaf stage. Parsnips are rather more susceptible than carrots and more likely to suffer a check.

NOTE All amounts quoted are MAXIMUM safe doses.
Amounts of growth regulators are in terms of acid equivalent.
Amounts of DNC and dinoseb are in terms of parent nitrated phenol.

PARSLEY

42. The same oils may be used as for carrots, but this crop is again more susceptible than carrots.

BEEET (Fodder, sugar and red)

- Tentative 43. Successful weed control may be obtained in some instances with 2.5 - 3 cwt. of sodium nitrate applied in 100 gallons of water per acre. The spray should incorporate a wetting agent and be applied when the beet have three true leaves. It is important that there should be 24 hours of fine weather after spraying. Some weeds, notably species of Chenopodiaceae, are unaffected by the spray and must be removed mechanically.

ASPARAGUS

- Tentative 44. MCPA (sodium) may be applied to the beds at up to 32 oz. per acre before 'spear' emergence or after cutting.

POTATOES

- Tentative 45. In exceptional circumstances where a chemical weed control treatment is necessary, up to 16 oz. per acre of MCPA (sodium) may be applied in high or low volume at any time before the haulm is fully grown. Varietal difference in susceptibility to growth regulator herbicides exist in potatoes but insufficient information exists for the listing of the relative susceptibilities of British varieties.

(11) THE RESPONSE OF COMMON AGRICULTURAL WEEDS TO MCPA, 2,4-D, DNC AND DINOSEB

An attempt is made in this section to classify the general response of common weeds to the herbicides MCPA, 2,4-D, DNC and dinoseb. The weed susceptibility list (Table III) is intended to provide indications of the usefulness of these herbicides and should help in the selection of the appropriate chemical. In addition, it may assist in determining the method of use, although it is essential that the crop tolerance indicated in the previous section should be referred to before deciding on any weed treatment.

The DNC and dinoseb classification has remained unaltered since 1953, whereas that for MCPA and 2,4-D has been revised to incorporate for each weed and chemical the approximate dose or dose range that will bring about a stated response. Distinction is now made between MCPA (sodium), 2,4-D (amine) and 2,4-D (lower alkyl esters). It has been agreed by the committee that until further evidence is available, it may be assumed that the weed susceptibility categories and doses (a) for MCPA (potassium) and MCPA (amine) are similar to those for MCPA (sodium) and (b) for other 2,4-D esters are similar to those for the lower alkyl esters.

(a) MCPA and 2,4-D

- (1) Susceptibility or resistance to MCPA and 2,4-D has been categorised as follows:-

- V.S. Very susceptible. Consistently killed at all stages of growth.
S. Susceptible. Consistently good control of annuals at all stages of growth up to beginning of flowering and of perennials at the recommended time.

- M.S. Moderately susceptible. Good control of annuals while in the seedling stage only; good control of perennials only when at the recommended stage of growth and when conditions are favourable.
- M.R. Moderately resistant. Annuals checked if in seedling stage; some useful effect on perennials only under favourable conditions.
- R. Resistant. No useful effect on annuals, once they have passed the cotyledon stage, or on perennials with up to 2 lb. acid equivalent per acre.

(11) Each weed in the susceptibility list has been assigned a susceptibility category in accordance with the above classification. In addition, a dose or dose range is given for each weed to indicate the approximate amount of herbicide required to produce the response indicated. The maximum dose has been fixed at 32 oz. per acre to conform with general usage.

(111) The response produced by a given dose of MCPA or 2,4-D is influenced by many factors, including weather conditions, stage of growth and chemical formulation. Conversely the dose required to produce a given response in any weed varies with the same factors and cannot be defined precisely. A dose range is, therefore, included for many weeds. Where a single dose is given it is either the maximum (32 ozs.) or a point in a dose range, the limits of which have been omitted because of insufficient information.

(iv) Reference to perennial weeds in the table indicates the susceptibility of established plants only, except where seedlings or young plants are specifically mentioned. Detailed notes on certain perennial weeds are given in sub-section (111) page 30.

(v) The categories relate only to weeds in the post-emergence phase, i.e. after the first true leaf has formed. Many plants are more susceptible than is indicated when they are in the cotyledon stage.

(vi) Categories and doses in brackets, e.g. (MR 32), refer to weeds for which there is no information from Great Britain but about which the literature from other European countries is in general agreement.

(vii) With certain weeds, there appear to be special advantages in using ester formulations. These are distinguished in the table by the letter E.

(b) DNC and dinoseb

The categories refer to the response of weeds to the following dosages:-

DNC 6-8 lbs. unactivated DNC per acre (approximately equivalent to 4-6 lbs. activated DNC)

Dinoseb 1.6 lb. ammonium salt dinoseb per acre.

They are as follows:-

- V.S. Very susceptible. Killed up to the flowering stage; lower limit may be used at the seedling and cotyledon stages.
- S. Susceptible. Killed up to flower bud stage; lower limit may be used at the seedling and cotyledon stages.
- M.S. Moderately susceptible. Killed at the cotyledon, seedling and young plant stages.

M. R. Moderately resistant. Killed at the cotyledon and seedling stages only.

R. Resistant. Not normally killed.

(i) An asterisk with the category indicates that the addition of a wetter to the spray is likely to improve the degree of control obtained.

(ii) The effects of DNC and dinoseb on annual weeds only are considered in the Table. These herbicides will not generally kill established perennial weeds, but may kill back the aerial growth in varying degrees according to the species. Seedlings of perennial weeds may or may not be susceptible.

(iii) The susceptibility of weeds to scorch by DNC and dinoseb varies with climatic and other factors operating both before and after spraying. Warm, wet weather produces soft growth which is easily killed, so that lower doses can be used; dry weather produces hard growth and doses must be increased.

(iv) Variation in dose with climatic conditions is particularly necessary with dinoseb. In warm weather (60°-70°F) following heavy rain or a continuously rainy period, the dose should be reduced by 33%. After dry weather (at least 10 days hot sun, or 14 days without rain), it should be increased by 33%.

Table III

THE SUSCEPTIBILITY OF COMMON AGRICULTURAL WEEDS TO
MCPA, 2,4-D, DNC AND DINOSEB

General Notes

(a) For interpretation of the categories see introductory notes page 19.

(b) The botanical names used are those adopted by Clapham, Tutin and Warburg in 'Flora of the British Isles' 1952.

(c) The letters A, B or P inserted in a bracket after the botanical name indicate respectively that the plant is an Annual, a Biennial or a Perennial.

(d) Weeds for which no categories are given are considered important but information concerning their susceptibility is inadequate.

(e) An Index of common names is given at the end of the report. Table VIII

Botanical Name	MCPA sodium	2,4-D		DNC	Dinoseb
		amine	ester		
1. <i>Achillea millefolium</i> (P) (Yarrow)	R	R	R	-	-
2. <i>Aegopodium podagraria</i> (P) (Ground elder)	R	R	R	-	-
3. <i>Agrimonia eupatoria</i> (P) (Common agrimony)	R	R	R	-	-
4. <i>Agropyron repens</i> (P) (Couch grass)	R	R	R	-	-
5. <i>Agrostemma githago</i> (A) (Corncockle)	R	R	R	-	-

The crop tolerance indicated in Sub-Section (i) should be referred to before deciding on any weed treatment.

Botanical Name	MCPA sodium	2,4-D		DNC	Dinoseb
		amine	ester		
6. <i>Agrostis stolonifera</i> (P) (Florin)	R	R	R	-	-
7. <i>Ajuga reptans</i> (P) (Bugle)	R	R	R	-	-
8. <i>Alchemilla arvensis</i> (A) <i>Aphanes arvensis</i> (Parsley piert)	see Turf Weeds Section			S	-
9. <i>Allium vineale</i> (P) (Crow garlic)	MR 32	MR 32	MR 20	-	-
10. <i>Alopecurus myosuroides</i> (A) (Black grass)	R	R	R	-	R
11. <i>Anagallis arvensis</i> (A) (Scarlet pimpernel)	MS 24-32	MS 24-32	MS 8-16	S	S
12. <i>Anthemis arvensis</i> (A) (Corn chamomile)	MR 24-32	MR 24-32	MR 8-16E	MS	MR
13. <i>A. cotula</i> (A) (Stinking mayweed)	MR 24-32	MR 24-32	MR 8-16E	MR	MR
14. <i>A. tinctoria</i> (B or P) (Yellow chamomile)	-	-	-	-	-
15. <i>Anthriscus sylvestris</i> (P) (Cow parsley)	see Notes on Perennial Weeds			-	-
16. <i>Arctium lappa</i> (B) (Great burdock)	MR 32	MR 32	MR 32	-	-
17. <i>Arctium minus</i> (B) (Lesser Burdock)	MS 32	MS 32	MS 32	-	-
18. <i>Arrhenatherum elatius</i> (P) (Oat-grass)	R	R	R	-	-
19. <i>Artemisia vulgaris</i> (P) (Mugwort)	MS 24-32	MS 24-32	MS 16	-	-
20. <i>Atriplex patula</i> (A) (Common orache)	MS 12-24	MS 10-24	MS 8	MS	MS
21. <i>Avena fatua</i> (A) (Wild oat)	R	R	R	R	R
22. <i>A. ludoviciana</i> (A) (Wild oat)	R	R	R	R	R
23. <i>Bellis perennis</i> (P) (Daisy)	MS 32	MS 32	MS 16	-	-
24. <i>Brassica nigra</i> (A) (Black mustard)	S 8-16	S 8-16	S 8	S	MS
25. <i>B. rapa</i> ssp. <i>campestris</i> (A) (Field cabbage)	MS 16	MS 16	MS 8	-	-

The crop tolerance indicated in Sub-Section (1) should be referred to before deciding on any weed treatment.

Botanical Name	MCPA sodium	2,4-D		DNC	Dimoseb
		amine	ester		
26. <i>B. juncea</i> (A)	MS 24-32	-	-	-	-
27. <i>Calluna vulgaris</i> (P) (Ling)	MR 32	MR 32	MS 32E	-	-
28. <i>Calystegia sepium</i> (P) (Larger bindweed)	MS 32	MS 32	MS 24	-	-
29. <i>Capsella bursa-pastoris</i> (A) (Shepherd's purse)	S 12-20	S 12-20	S 8	S	S
30. <i>Cardaria draba</i> (P) (Hoary pepperwort)	see Notes on Perennial Weeds			-	-
31. <i>Carduus nutans</i> (P) (Musk thistle)	MS 24-32	MS 24-32	MS 16	-	-
32. <i>Carex</i> spp. (P) (Sedges)	R	R	R	-	-
33. <i>Centaurea cyanus</i> (A) (Cornflower)	MS 16-32	MS 12-32	MS 8	MS	-
34. <i>C. nigra</i> (P) (Knapweed)	MS 32	MS 32	MS 16-24	-	-
35. <i>C. scabiosa</i> (P) (Greater knapweed)	MR 32	MR 32	MR 32	-	-
36. <i>Cerastium vulgatum</i> (A) (Mouse-ear chickweed)	MR 32	MR 32	MR 16	MR	MR
37. <i>Chaerophyllum temulum</i> (B) (Rough chervil)	-	-	-	-	-
38. <i>Chamaenerion angustifolium</i> (P) (Rosebay willow-herb)	-	MR 32	MR 32	-	-
39. <i>Chenopodium album</i> (A) (Fat hen)	MS 16-24	MS 12-24	MS 8E	MS	MS
40. <i>Chrysanthemum leucanthemum</i> (P) (Ox-eye daisy)	MR 32	MR 32	MR 16	-	-
41. <i>C. segetum</i> (A) (Corn marigold)	R	R	R	MS*	MR
42. <i>Cirsium acaule</i> (P) (Stemless thistle)	MR 32	MR 32	MR 16	-	-
43. <i>C. arvense</i> (P) (Creeping thistle)	see Notes on Perennial Weeds			-	-
44. <i>C. palustre</i> (B) (Marsh thistle)	MS 16-24	MS 16-24	MS 16	-	-
45. <i>C. vulgare</i> (B) (Spear thistle)	MS 12-24	MS 12-24	MS 16	-	-
46. <i>Colchicum autumnale</i> (P) (Meadow saffron)	MR 32	MR 32	MR 32	-	-

The crop tolerance indicated in Sub-Section (1) should be referred to before deciding on any weed treatment.

Botanical Name	MCPA sodium	2,4-D		DNC	Dinoseb
		amine	ester		
47. <i>Conium maculatum</i> (P) (Hemlock)	MS 32	MS 32	MS 32	-	-
48. <i>Conopodium majus</i> (P) (Pignut)	R	R	R	-	-
49. <i>Convolvulus arvensis</i> (P) (Field bindweed)	see Notes on Perennial Weeds			-	-
50. <i>Crepis</i> spp. (A, B or P) (Hawk's-beard)	MS 16-32	MS 16-32	MS 16	-	-
51. <i>Cuscuta epithymum</i> (A) (Common dodder)	-	-	-	-	-
52. <i>Datura stramonium</i> (A) (Thorn apple)	-	-	-	-	-
53. <i>Daucus carota</i> (B) (Wild carrot)	MR 32	MR 32	MR 16	-	-
54. <i>Echium vulgare</i> (B) (Viper's bugloss)	MR 32	MR 32	MR 32	-	-
55. <i>Epilobium</i> spp. (P) (Willow herb)	MR 32	MR 32	MR 32	-	-
56. <i>Equisetum arvense</i> (P) (Horsetail)	see Notes on Perennial Weeds			-	-
57. <i>E. palustre</i> (P) (Marsh horsetail)	see Notes on Perennial Weeds			-	-
58. <i>Erica cinerea</i> (P) (Bell-heather)	R	R	R	-	-
59. <i>Erigeron canadensis</i> (A) (Canadian flea-bane)	(S 16-32)	(S 16-32)	-	-	-
60. <i>Erodium cicutarium</i> (A) (Common storksbill)	MR 32	MR 32	MR 32	-	-
61. <i>Erysimum cheiranthoides</i> (A) (Treacle mustard)	VS 8-12	VS 8-12	VS 4	S	S
62. <i>Euphorbia helioscopia</i> (A) (Sun spurge)	(MR 24-32)	MR 24-32	MR 16-24	-	-
63. <i>Filipendula ulmaria</i> (P) (Meadow sweet)	MR 32	MR 32	MR 32	-	-
64. <i>Fumaria officinalis</i> (A) (Fumitory)	MS 16-32	MS 16-32	MS 8-16	S*	S
65. <i>Galeopsis tetrahit</i> (A) (Hempnettle)	MS 16-24	MR 24-32	MR 12-16	S	S
66. <i>Galinsoga parviflora</i> (A) (Gallant soldier)	(MS 32)	-	-	-	-

The crop tolerance indicated in Sub-Section (1) should be referred to before deciding on any weed treatment.

Botanical Name	MCPA sodium	2,4-D		DNC	Dinoseb
		amine	ester		
67. <i>Galium aparine</i> (A) (Cleavers)	R	R	R	MS	MS
68. <i>G. hercynicum</i> (P) (Heath bedstraw)	MR 32	-	MR 16	-	-
69. <i>G. mollugo</i> (P) (Hedge bedstraw)	R	R	R	-	-
70. <i>G. verum</i> (P) (Ladies bedstraw)	R	R	R	-	-
71. <i>Geranium dissectum</i> (A) (Out-leaved cranesbill)	MR 32	MR 32	MR 16	-	-
72. <i>G. molle</i> (A) (Dove's foot cranesbill)	MR 32	MR 32	MR 16	MR	-
73. <i>G. pratense</i> (P) (Meadow cranesbill)	MR 32	MR 32	MR 16	-	-
74. <i>Heracleum sphondylium</i> (P) (Cow parsnip)	MR 32	MR 32	MR 32	-	-
75. <i>Hieracium pilosella</i> (P) (Mouse-ear hawkweed)	see Turf Weeds Section			-	-
76. <i>Holcus mollis</i> (P) (Creeping soft-grass)	R	R	R	-	-
77. <i>H. lanatus</i> (P) (Yorkshire fog)	R	R	R	-	-
78. <i>Hyoscyamus niger</i> (A or B) (Henbane)	MR 32	MR 32	MR 32	-	-
79. <i>Hypochaeris radicata</i> (P) (Cat's ear)	see Turf Weeds Section			-	-
80. <i>Iris spp.</i> (P) (Iris)	MR 32	MR 32	MR 32	-	-
81. <i>Juncus articulatus</i> (P) (Jointed rush)	see Notes on Perennial Weeds			-	-
82. <i>J. effusus</i> (P) (Common rush)	see Notes on Perennial Weeds			-	-
83. <i>J. conglomeratus</i> (P) (Common rush)	see Notes on Perennial Weeds			-	-
84. <i>J. inflexus</i> (P) (Hard rush)	see Notes on Perennial Weeds			-	-
85. <i>Juncus squarrosus</i> (P) (Heath rush)	see Notes on Perennial Weeds			-	-
86. <i>Knautia arvensis</i> (P) (Field scabious)	MS 16-32	MS 16-32	MS 8-16	-	-

The crop tolerance indicated in Sub-Section (1) should be referred to before deciding on any weed treatment.

Botanical Name	MCPA sodium	2,4-D		DNC	Dinoseb
		amine	ester		
87. <i>Lamium album</i> (P) (White dead-nettle)	MR 32	MR 32	MR 32	-	-
88. <i>L. amplexicaule</i> (A) (Henbit)	S 32	MS 32	MS 32	-	-
89. <i>L. purpureum</i> (A) (Red dead-nettle)	MR 32	MR 32	MR 32	-	-
90. <i>Lapsana communis</i> (A) (Nipplewort)	R	R	R	-	-
91. <i>Leontodon autumnalis</i> (P) (Autumnal hawkbit)	MR 32	MR 32	MR 16E	-	-
92. <i>Lithospermum arvense</i> (A) (Corn gromwell)	MR 32	MS 32	MS 16	S	S
93. <i>Lotus corniculatus</i> (P) (Birdsfoot trefoil)	MR 32	MR 32	MR 16E	-	-
94. <i>Luzula campestris</i> (P) (Field woodrush)	R	R	MR 32E	-	-
95. <i>Matricaria chamomilla</i> (A) (Wild chamomile)	R	R	R	MS	MS
96. <i>M. maritima</i> ssp. <i>inodora</i> (A) (Scentless mayweed)	MR 24-32	MR 24-32	MR 16E	MS	MR
97. <i>M. matricarioides</i> (A) (Pineapple weed)	R	R	R	-	-
98. <i>Medicago lupulina</i> (A or P) (Black medick)	MR 32	MR 32	MR 16	-	-
99. <i>Melandrium album</i> (A, B or P) (White campion)	R	R	R	-	-
100. <i>M. rubrum</i> (B or P) (Red campion)	-	R	R	-	-
101. <i>Mentha arvensis</i> (P) (Corn mint)	MR 24-32	MR 24-32	MR 16	-	-
102. <i>Odontites verna</i> (A) (Red bartsia)	-	-	-	-	-
103. <i>Oenanthe crocata</i> (P) (Hemlock water dropwort)	-	-	-	-	-
104. <i>Orobanche minor</i> (A) (Lesser broomrape)	-	-	-	-	-
105. <i>Oxalis acetosella</i> (P) (Wood sorrel)	R	R	R	-	-
106. <i>O. cernua</i> (P) (Bermuda buttercup)	R	R	R	-	-

The crop tolerance indicated in Sub-Section (1) should be referred to before deciding on any weed treatment.

Botanical Name	MCPA sodium	2,4-D		DNC	Dinoseb
		amine	ester		
107. <i>O. corniculata</i> (P) (Creeping oxalis)	R	R	R	-	-
108. <i>Oxalis stricta</i> (P) (Upright yellow sorrel)	R	R	R	-	-
109. <i>Papaver rhoeas</i> (A) (Corn poppy)	MS 16-24	MS 12-24	S 8-16E	S	MS
110. <i>Petasites hybridus</i> (P) (Butterbur)	-	-	-	-	-
111. <i>Picris echioides</i> (A or B) (Bristly ox-tongue)	-	MS 32	MS 16	-	-
112. <i>Plantago coronopus</i> (A, B or P) (Starweed)	MS 16-32	MS 16-32	S 16	-	-
113. <i>P. lanceolata</i> (P) (Ribwort)	S 16-32	S 16-32	S 16	-	-
114. <i>P. major</i> (P) (Greater plantain)	S 16-32	S 16-32	S 16	-	-
115. <i>P. media</i> (P) (Hoary plantain)	S 16-32	S 16-32	S 16	-	-
116. <i>Poa annua</i> (A) (Annual meadow grass)	R	R	R	-	-
117. <i>Polygonum aviculare</i> (A) (Knot grass)	MR 24-32	MR 24-32	MS 8E	MR	MR
118. <i>P. bistorta</i> (P) (Bistort)	-	-	-	-	-
119. <i>P. convolvulus</i> (A) (Black bindweed)	*MS 24-32	*MS 16-24	*MS 8	MS	MS
120. <i>P. lapathifolium</i> (A) (Pale persicaria)	*MS 16-32	*MS 12-32	*MS 8-16	MR	MR
121. <i>P. persicaria</i> (A) (Willow weed)	*MS 16-32	*MS 12-24	*MS 8E	MR	MR
122. <i>Potentilla anserina</i> (P) (Silverweed)	MR 32	MR 32	MR 16E	-	-
123. <i>P. erecta</i> (P) (Common tormentil)	-	-	-	-	-
124. <i>P. reptans</i> (P) (Cinquefoil)	MR 32	MR 32	MR 16	-	-
125. <i>Poterium sanguisorba</i> (P) (Salad burnet)	MR 32	MR 32	MR 16	-	-
126. <i>Prunella vulgaris</i> (P) (Self-heal)	MS 32	MS 32	MS 16	-	-

*MS when small seedlings; otherwise MR

The crop tolerance indicated in Sub-Section (1) should be referred to before deciding on any weed treatment.

Botanical Name	MCPA sodium	2,4-D		DNC	Dinoseb
		amine	ester		
127. <i>Pteridium aquilinum</i> (P) (Bracken)	R	R	R	-	-
128. <i>Pulicaria dysenterica</i> (P) (Fleabane)	MS 32	-	-	-	-
129. <i>Ranunculus acris</i> (P) (Crowfoot)	see Notes	on Perennial Weeds		-	-
130. <i>Ranunculus arvensis</i> (A) (Corn buttercup)	S 16-24	S 12-24	S 8-12	MR	MR
131. <i>R. bulbosus</i> (P) (Bulbous buttercup)	see Notes	on Perennial Weeds		-	-
132. <i>R. repens</i> (P) (Creeping buttercup)	see Notes	on Perennial Weeds		-	-
133. <i>Raphanus raphanistrum</i> (A) (Wild radish)	S 12-24	S 12-24	S 8	S	MS
134. <i>Rhinanthus spp.</i> (A) (Yellow rattle)	MR 32	MR 32	MR 32	-	-
135. <i>Rumex acetosa</i> (P) (Sorrel)	MS 16-24	MS 16-24	MS 8-16	-	-
136. <i>Rumex acetosella</i> (P) (Sheep's sorrel)	MS 16-24	MS 16-24(8)	MS 8-16	-	-
137. <i>R. crispus</i> (P) (Curled dock)	see Notes	on Perennial Weeds		-	-
138. <i>R. obtusifolius</i> (P) (Broad-leaved dock)	see Notes	on Perennial Weeds		-	-
139. <i>Sagina procumbens</i> (P) (Pearlwort)	see Turf Weeds Section			-	-
140. <i>Scandix pecten-veneris</i> (A) (Shepherd's needle)	MS 16-32	MS 16-32	MS 12-16	MS	MS
141. <i>Senecio aquaticus</i> (B) (Marsh ragwort)	-	-	-	-	-
142. <i>S. jacobaea</i> (B or P) (Ragwort)	see Notes	on Perennial Weeds		-	-
143. <i>S. vulgaris</i> (A) (Groundsel)	MR 24	MR 24	MR 16	MS	MS
144. <i>Silene cucubalus</i> (P) (Bladder campion)	R	R	R	-	-
145. <i>Sinapis alba</i> (A) (White mustard)	VS 8-12	VS 8-12	VS 4-8	VS	VS
146. <i>S. arvensis</i> (A) (Charlock)	VS 8-12	VS 8-12	VS 4	VS	VS

The crop tolerance indicated in Sub-Section (1) should be referred to before deciding on any weed treatment.

Botanical Name	MCPA sodium	2,4-D		DNC	Dinoseb
		amine	ester		
147. <i>Sisymbrium officinale</i> (A) (Hedge mustard)	S 16-24	S 16-24	S 16-24	-	-
148. <i>Solanum nigrum</i> (A) (Black nightshade)	MR 32	MR 32	MR 32	MR	MR
149. <i>S. dulcamara</i> (P) (Bittersweet)	MR 32	MR 32	MR 32	-	-
150. <i>Sonchus arvensis</i> (P) (Perennial sowthistle)	*MS 16-32	*MS 16-32	*MS 8-16	-	-
151. <i>S. asper</i> (A)	-	-	-	MR	MR
152. <i>S. oleraceus</i> (A) (Annual sowthistle)	MS 24-32 (16)	MS 24-32 (12)	MS 24-32	MR	MR
153. <i>Specularia hybrida</i> (A) (Venus's looking-glass)	(MS 24-32)	MR 16-24	-	-	-
154. <i>Spergula arvensis</i> (A) (Corn spurrey)	†MS 16-32	†MS 16-32	†MS 16	MS	MR
155. <i>Stellaria media</i> (A) (Chickweed)	MR 24-32	MR 24-32	MR 16	MS	MS
156. <i>Symphytum officinale</i> (P) (Comfrey)	MR 32	MR 32	MR 32	-	-
157. <i>Taraxacum officinale</i> (P) (Dandelion)	see Notes on Perennial Weeds			-	-
158. <i>Thlaspi arvense</i> (A) (Field pennycress)	VS 8-12	VS 8-12	VS 4	S	S
159. <i>Tragopogon pratensis</i> (A, B (Goat's-beard) or P)	MS 32	-	-	-	-
160. <i>Trifolium repens</i> (P) (White clover)	MR 32	MR 32	MR 16	-	-
161. <i>Tussilago farfara</i> (P) (Coltsfoot)	MR 32	MR 32	MR 16	-	-
162. <i>Urtica dioica</i> (P) (Perennial nettle)	MR 32	MR 32	MS 16	-	-
163. <i>U. urens</i> (A) (Small nettle)	MR 32	MR 32	MR 16	MS	MR
164. <i>Veronica agrestis</i> (A) (Procumbent speedwell)	MR 32	MR 32	MR 16	S	MS
165. <i>V. anagallis-aquatica</i> (P or A) (Water speedwell)	-	-	-	-	-
166. <i>V. arvensis</i> (A) (Wall speedwell)	MR 32	MR 32	MR 16	S	MS

*MS When small seedlings or for knockdown effect in cereal crops; otherwise MR
†MS Young seedlings only; otherwise MR

The crop tolerance indicated in Sub-Section (1) should be referred to before deciding on any weed treatment.

Botanical Name	MCPA sodium	2,4-D		DNC	Dinqseb
		amine	ester		
167. <i>V. chamaedrys</i> (P) (Germander speedwell)	MR 32	MR 32	MR 16	-	-
168. <i>V. hederifolia</i> (A) (Ivy-leaved speedwell)	MS 24-32	MR 24-32	MR 16	S	MS
169. <i>V. persica</i> (A) (Buxbaum's speedwell)	-	-	-	S	MS
170. <i>V. serpyllifolia</i> (P) (Thyme-leaved speedwell)	MR 32	MR 32	MR 16	-	-
171. <i>Vicia cracca</i> (P) (Tufted vetch)	MS 20-32	MS 20-32	MS 16-24	-	-
172. <i>V. sativa</i> (A) (Common vetch)	MS 20-32	MS 20-32	MS 16-24	-	-
173. <i>Viola arvensis</i> (A) (Field pansy)	MR 24-32	MR 24-32	MR 16E	MR	MR
174. <i>V. tricolor</i> (A) (Heart's ease)	MS 20-32	MR 24-32	MS 8-16E	MR	MR

The crop tolerance indicated in Sub-Section (1) should be referred to before deciding on any weed treatment.

(111) NOTES ON CERTAIN PERENNIAL WEEDS

To be read in conjunction with sub-section (1) - Recommendations for field and vegetable crops

The following notes refer only to MCPA (sodium), 2,4-D (amine) and 2,4-D (ester). For other derivatives please refer to the Introduction Notes (page 9, para. 3).

1. *Anthriscus sylvestris* (Cow parsley)

This important constituent of the flora of many roadside verges has given variable results when sprayed with a wide range of 2,4-D formulations.

The shoots are moderately susceptible to 2,4-D at 32-64 oz. per acre when applied after growth has started in spring and up to the beginning of flowering. This treatment is ineffective if applied after the flowering stage. There is, as yet, no evidence to suggest that any long term control of *Anthriscus* results from either a spring application alone or from a spring and an autumn application made in the same year.

2. *Cardaria draba* (Hoary pepperwort)

Hoary pepperwort cannot be eradicated by a single treatment with MCPA or 2,4-D but well over 90% control can be obtained by treatment in a winter cereal in two successive seasons. If this is done, MCPA and 2,4-D are equally effective and should be applied at 12-16 oz. per acre during the period after the shoots are a few inches high up to the flowering stage.

To ensure eradication of the weed after two years spraying, it is advisable to plant a spring cereal or other crop resistant to MCPA and 2,4-D in the third year so that a spray treatment can again be made if a few remaining shoots appear.

If only a single year's treatment can be made, the rate of application should be increased up to 32 oz. per acre according to formulation and crop, and MCPA used in preference to 2,4-D if treatment is made shortly after the pepperwort shoots have emerged. If the weed is treated at the flowering stage, MCPA and 2,4-D are equally effective.

3. *Cirsium arvense* (Creeping thistle)

In treating creeping thistle with MCPA or 2,4-D it is important to make the application at the correct time - i.e. at the early bud stage. Treatment at an earlier stage of growth will kill the shoots that are sprayed but may be followed by considerable regrowth.

As complete eradication is seldom achieved by a single application it may be necessary to repeat the treatment occasionally in subsequent years.

Creeping thistle is often found in grassland that is overgrazed in early spring or winter and undergrazed in summer. It is emphasized that gradual reinfestation from the few plants surviving the spray treatment may take place unless the vigour of grass and clover is improved by better management.

Both MCPA and 2,4-D can be used with equal success.

Recommended rates of application: 8-12 oz. per acre for shoot kill, 16-24 oz. for maximum effect on the rhizomes. Treatment, (a) in crops should be postponed as long as possible but must of course be made before the crop reaches a sensitive stage, (b) in grassland should be made at the early bud stage.

4. *Convolvulus arvensis* (Field bindweed)

In cereal crops, *Convolvulus* generally emerges too late to be much affected by MCPA and 2,4-D sprays, although its growth may be checked. Where spraying can be carried out at the optimum stage, the *Convolvulus* shoots should be well developed. Under these conditions, the shoots will be killed and there will be an appreciable reduction in shoot numbers the following year. Promising results have been obtained by spraying *Convolvulus* in cereal stubble, two to three weeks after harvesting, after new growth has been made and where the field was not to be ploughed for at least two weeks after spraying.

Recommended rates of application: MCPA (sodium) 24-32, 2,4-D (amine) 24-32, 2,4-D (ester) 16-24 oz. per acre. 2,4-D is more effective than MCPA.

5. *Equisetum spp.* (Horsetail)

The two most important weed species of *Equisetum* are *E. arvense* and *E. palustre*. The shoots of both species are readily killed by MCPA and 2,4-D but there is generally strong regrowth from the underground rhizomes the year following treatment. For *E. arvense* a partial 'kill' of the root system may be obtained by a single application; for *E. palustre* a single application is unlikely to produce any permanent effect. Available evidence suggests that some long term reduction of *E. palustre* is most likely to follow spraying if competition from the grass components of the sward is increased by suitable grazing management and fertiliser treatment. In general the aerial shoots should be treated when they have made maximum growth.

Recommended rates of application:

- (a) for kill of aerial shoots only, 12-20 oz. MCPA or 2,4-D (sodium or amine) per acre; 8-12 oz. 2,4-D (ester)
- (b) for kill of aerial shoots and for partial suppression of regrowth, 32 oz. MCPA or 2,4-D (sodium, amine or ester) per acre.

For the control of *E. palustre* in grassland required for hay or silage, MCPA or 2,4-D applied a week or more before the grass is to be cut will successfully kill *Equisetum* shoots thus allowing a crop to be taken.

6. *Juncus* spp. (Rushes)

Many species of rush occur in Great Britain but only one, *Juncus effusus*, the common rush, has so far been found to be readily killed by MCPA, and 2,4-D. *J. conglomeratus* is closely allied to *J. effusus* but no information is available regarding the effect of herbicides. Other species which can be important as weeds but which are generally resistant to applications of MCPA and 2,4-D at doses up to 32 oz. per acre are *J. articulatus*, *J. inflexus* and *J. squarrosus*.

Spraying of *J. effusus* should take place preferably just before flowering; earlier or later treatment gives inferior results. It is strongly recommended that the rushes are cut about four weeks after treatment; this not only improves the kill obtained but helps the sward to develop over the dead rush clumps. If desired, cutting may take place a month before spraying with equally good results, but if this is done the cut litter must be removed before spraying. Spraying uncut rushes will only give good results under favourable conditions, e.g. where the rush has been weakened by cutting in previous years - or if the higher doses of the dose ranges given below are used. Cutting immediately before spraying is not recommended.

For the permanent eradication of rushes, spraying must often be followed by measures such as liming and draining which will improve the sward and help to prevent reinfestation by seedlings.

Recommended rates of application:

MCPA (sodium) and 2,4-D (amine), 24-32 oz. per acre
2,4-D (ester), 16-24 oz. per acre.

Good results have been obtained with volume rates varying from 7 to 100 gallons per acre. There is insufficient evidence to make a definite recommendation that one volume rate is preferable to another.

7. *Ranunculus* spp. (Buttercups)

Creeping buttercup, *R. repens*, crowfoot, *R. acris*, and bulbous buttercup, *R. bulbosus*, are the most important species. As each species differs in its reaction towards MCPA and 2,4-D it is important to identify the type of buttercup correctly before treatment.

Creeping buttercup: is easily controlled by MCPA or 2,4-D, the former being more effective. The best time for treatment is in spring or early summer up to flowering, during which time 12-24 oz. per acre are recommended. Successful treatment may however be made at any time of the year during active growth of the weed, but the rate of application should be increased to 24-32 oz. per acre.

Crowfoot: is slightly less susceptible than creeping buttercup. The recommendations for treatment are similar.

Bulbous buttercup: is much more resistant than the other species. Treatment in spring will usually prevent flowering the same season but is unlikely to result in a significant reduction in population the year after treatment.

8. *Rumex crispus* and *Rumex obtusifolius* (Curled and Broad-leaved dock)

These are the two most important species of 'dock'. In the seedling stage, i.e. before a large tap root has formed, both species are readily killed by MCPA and 2,4-D; in arable fields, e.g. a cereal crop, where they occur as seedlings* or as shoots from old rootstocks, they can be severely checked or even killed, seed production in any case being reduced or prevented. Established *Rumex obtusifolius* in pasture or waste land is very difficult to kill with either chemical and may be classed as 'resistant'. *Rumex crispus*, on the other hand, is moderately susceptible when established and can be killed or severely checked.

* included in the term 'seedlings' are shoots resembling seedlings, that may grow from root fragments that have survived the death of older plants.

Recommended rates of application:

(i) seedlings and regrowing rootstocks in cereal fields:

R. crispus - MCPA (sodium) and 2,4-D (amine) 16-24 oz., 2,4-D (ester) 16 oz. per acre

R. obtusifolius - MCPA (sodium) and 2,4-D (amine) 24-32 oz., 2,4-D (ester) 16-24 oz. per acre.

(ii) established plants

R. crispus - MCPA (sodium) and 2,4-D (amine) 24-32 oz., 2,4-D (ester) 16-24 oz. per acre

R. obtusifolius - Resistant.

9. *Senecio jacobaea* (Ragwort)

MCPA and 2,4-D at the recommended doses will normally kill ragwort plants (all stages of growth) present at the time of spraying, but results may be masked because (i) the flowering shoots may continue to produce flowers and viable seed in the season of spraying, although they die during the winter, (ii) new seedlings* may appear under favourable conditions soon after spraying. The success of a spray treatment depends therefore to a large extent on whether or not the field becomes recolonised by seedlings* following spraying. A single treatment may or may not therefore be successful and repeat applications must be allowed for in any programme of chemical ragwort control. A close and vigorous sward is likely to hinder the re-establishment of ragwort following spraying.

Recommended rates of application:

MCPA (sodium) and 2,4-D (amine) 24-32 oz. per acre, 2,4-D (ester) 16-24 oz. per acre.

2,4-D has generally given better results than MCPA.

The best time for treatment appears to be in June or early July, when the flowering shoot is developing rapidly and seedlings and rosettes are growing strongly. Spraying should not be deferred until the flower buds are well formed.

10. *Taraxacum officinale* (Dandelion)

The best time to treat dandelion with MCPA or 2,4-D is in spring when at the flower bud stage, but good results may be obtained at any time provided the weed is growing strongly. 2,4-D gives more consistent results than MCPA. Rates of application recommended are: 2,4-D (amine) 16-24 oz. per acre, 2,4-D (ester) 16 oz. per acre, MCPA (sodium) salt 32 oz. per acre.

* included in the term 'seedlings' are shoots resembling seedlings, that may grow from root fragments that have survived the death of older plants.

Section II

Weed Control in Lawns and Sports Turf

SYNTHETIC GROWTH REGULATORS (MCPA AND 2,4-D)

Rates of application

MCPA and 2,4-D may be applied to fully established turf up to the following maximum doses:-

MCPA	Sodium and amine salts	-	80 oz. per acre
2,4-D	Sodium and amine salts	-	64 oz. per acre
2,4-D	Esters	-	40 oz. per acre

Doses generally range between 16 and 32 oz. per acre, the lower rate applying to 2,4-D ester and amine formulations, the upper to MCPA formulations.

During periods of low temperature doses may with advantage be increased. For the more resistant weeds several sprayings at doses which should never exceed half the maximum, given at 4 to 6 week intervals are likely to be more satisfactory than a single large dose. Weeds which are normally susceptible, but which have developed a greater degree of resistance because they have grown under 'hard' conditions, will require higher rates or repeated dressings. When spot treating local patches of weeds with either herbicide care should be taken not to use excessive doses in order to avoid (a) grass scorch, and (b) scorch of weed foliage resulting in decreased translocation of the herbicide.

Application:

Herbicides are best applied as aqueous sprays in machines built for the purpose. When a watering can is used it is generally necessary to use more herbicide.

The volume of liquid applied can vary from 5 - 100 gallons per acre, but volumes below 20 gallons per acre are generally less effective. High pressures should be avoided because of the danger of drift.

Where valued plants surround small confined lawn areas application by watering-can is recommended.

Although dust applications are less efficient weight for weight of active material than sprays and have their own particular storage hazards, their convenience for the spot treatment of very local areas may outweigh reduced efficiency.

To ensure maximum efficiency, economy and safety in the application of herbicides by hand sprayer and watering-can some method of marking out is recommended. When using field sprayers due attention should be paid to the points raised in Section VIII "Application of Herbicides".

Fine, warm weather, moist soil and active growth are conducive to the best results. Cold periods and drought are the conditions most likely to lead to unsatisfactory results, though if the drought is not prolonged the weeds will quickly respond to the weedkiller with the advent of rain. Application during drought when temperatures are high may cause as much damage to the grass as to the weeds. As long as the weedkiller has dried on the foliage no appreciable loss in efficiency will be caused by light showers of rain following application. It is inadvisable to spray during rainy weather.

Applications may be made at any time of the year when optimum conditions may be expected, ideally during late spring and summer. Although excellent results may follow late autumnal application the turf fills in very slowly.

Selective weedkillers are best applied to turf shortly after treatment with fertilizer containing nitrogen since vigorous growth is essential for the most satisfactory results. It is worthwhile giving a special dressing of fertilizer

10 to 14 days before spraying where it is inconvenient to spray after a routine fertilizer treatment. If no fertilizer has been given before spraying, a dressing shortly afterwards will help thicken the turf.

Weedkiller treatment should be arranged so as to leave at least two days between mowing and spraying. Much depends on the height of cut, weed habit and weather conditions. Clover may need three days before it is sufficiently in evidence to be worth spraying.

After spraying it is recommended to leave at least one day before mowing, preferably up to three days where possible. Again much depends on height of cut and weed habit.

Grass seed should not be sown until 6-8 weeks after 2,4-D application or 8-12 weeks after MCPA. Bare patches may be reseeded earlier to prevent reinvansion by weeds and a heavier dressing of seed given to offset impaired germination occurring from traces of the herbicide.

Newly laid, good quality turf should not be treated with selective weedkillers until at least six months after laying, unless conditions for establishment are particularly favourable.

Newly seeded turf should not be treated for at least six months and even after this interval it may be unwise to go up to the maximum permitted dosages during the following few months.

It is most essential that good management be practised or long term results are likely to be disappointing.

Precautions:

Great care should be taken that no drift is allowed to reach vegetable and flower beds, shrubberies, etc., results can be disastrous. It is advisable to use protective barrier such as a board when treating edges of lawns which tend to be overhung by edging plants.

The first cut of mowings after weedkiller application should not be used for mulching purposes.

Wherever possible spraying equipment should be used solely for the application of herbicides.

After use all equipment should be washed out thoroughly and stored separately from general horticultural appliances.

Care should be taken that greenhouse and other garden water supplies are not contaminated by the dipping of weed control watering-cans and other equipment.

Care should be taken when spraying near greenhouses. Doors and ventilators should be closed.

Containers in which the herbicides are packed, particularly dusts, should be stored away from fertilizers, other garden preparations, seeds or planting materials.

Storage of either full or empty containers of weedkiller in greenhouses should be avoided; the effect of vapour can be serious.

Apart from the toxic effect of small doses of MCPA and 2,4-D on cultivated plants there have been reports of tainting of Tomatoes caused by sub-lethal doses of MCPA presumed due to the presence of chlorocresol impurities.

Lawn Sands:

Lawn Sands based on calcined ferrous sulphate and/or ammonium sulphate with sand or other carrier can be used for the control of some weeds in turf,

e.g. pearlwort and moss (see notes on moss). A typical mixture for broadcast application at up to 1200 lbs. per acre (4 oz. per square yard), is:-

3 parts ammonium sulphate
1 part calcined ferrous sulphate
20 parts carrier

For spot treatment of tap-rooted weeds or isolated patches of pearlwort, a mixture of:-

3 parts ammonium sulphate
1 part calcined ferrous sulphate

may be applied at 1 oz. per square yard without carrier.

Lawn sands should ideally be applied on a dewy morning when the soil is moist and the weather fine and warm. They may be applied at any time during the growing season, but late spring or early summer are preferred. If application is followed by drought, artificial watering should be given after a few days.

Moss:

Chemical control is of only a temporary nature unless combined with cultural improvements.

Chemical Methods which can be used:

- (1) Lawn sand as above.
- (2) Where the presence of moss is thought to be due to infertility, calcined ferrous sulphate should be applied in late March or early April after the first mowing at $\frac{1}{4}$ - $\frac{1}{2}$ oz. in 3 oz. sand or 1 gallon of water per square yard. This should be followed by a general application of fertilizer.
- (3) Potassium permanganate when applied at 1 oz. per square yard either dry with sand or with a gallon of water gives a fair control, but some species of moss are resistant to the treatment. Permanganate of Potash tends to oxidise half decayed organic matter in the turf thereby increasing aeration and fertility.

Cultural Methods include:

- (1) Avoidance of too frequent rolling.
- (2) Improvement of drainage.
- (3) Improvement of grass vigour by
 - (a) Increasing depth of soil where necessary
 - (b) Watering in dry periods
 - (c) Application of fertilizer in spring and autumn
- (4) Reduction of shade
- (5) Control of weeds, worms, pests and diseases
- (6) Care in mowing
 - (a) not too closely in summer,
 - (b) use of the box to collect spores
- (7) Raking in late winter
- (8) Avoidance of lime and calcareous fertilizers unless pH is below 4.5