Second Assessments

Scores for weed control and crop damage at the second assessment had been submitted for only three centres when this paper was prepared, and therefore no data is presented.

DISCUSSION

The three herbicides are of low mammalian toxicity at the rates used and can be applied at medium volume through a farm sprayer. Agitation must, however, be efficient, and any herbicide remaining in the tank after treatment may solidify after settling.

Each reduced infestations of some of the more important weed species commonly found in the kale crop, but complete kills were rare. The outstanding success was in the control of Chenopodium album, the worst weed encountered over the country as a whole, which hitherto could only be killed with any degree of reliance by sulphuric acid. The latter is a costly operation usually carried out as a contract service which is becoming increasingly difficult to obtain. Limited evidence shows that Sinapis arvensis may be resistant, but although this species occurs much more widely in the kale crop than is indicated in these experiments, a satisfactory control of young plants can, under dry conditions, usually be obtained at relatively low cost with sodium monochloroacetate, which can be applied through a farm sprayer. The results for Polygonum persicaria will be of particular interest in northern and western districts. On present evidence, there is a good chance of killing seedlings, whilst more mature plants may at least be checked sufficiently to be kept below the level of the growing crops. This degree of control will probably be acceptable to most farmers as an alternative to sulphuric acid and sodium monochloroacetate - the only other effective treatments.

Plant counts at Pangbourne show that crop mortality can be severe in a stand of kale containing a high proportion of young plants. Observations at several centres provide supporting evidence that young plants are more easily killed than those which are more mature, and the data from all the trials indicates a possible trend towards greater initial damage in crops sprayed at the 2-3 leaf stage than in those treated later. It remains to be seen whether this will be reflected in the yield figures. Where damage of any kind occurs, the effects are most marked at the 6 oz/ac dose, but can be severe with ametryne and simetryne at 4 oz/ac. Damage was, however, appreciably less on average than that associated with normal application rates of sulphuric acid and sodium monochloroacetate, and in several trials good weed control was obtained with no more than a slight check to the stand. A nitrogenous top dressing applied after treatment would no doubt help recovery when damage is severe, and assist the additional control resulting from crop competition.

The use of 'G 34360' against the more susceptible weeds would tend to keep crop damage to a minimum. An application of 4 oz/ac appears to be adequate in most cases. The data at present available is insufficient to indicate whether ametryne and simetryne at 4 oz/ac would have sufficient additional advantages in the control of the more resistant species to make them competitive with 'G 34360' at 6 oz/ac.

The fact that seedlings of Polygonum persicaria are more easily killed than older plants has been mentioned, but no other relationship between the stage of growth of the more important weeds and the effectiveness of the treatments could be established from the scores, mainly because the range of size of the weeds was appreciable at many centres.

The effects of the type of growth of the crop when treated (slow or active), and of the weather after spraying have not been examined, because the evidence of the second assessments is needed for a complete statement.

These herbicides do not solve the recurrent problem of re-infestation after the spraying of slow growing crops, such as occurred with Chenopodium album at Holsworthy and Fumaria officinalis at Castle Combe. The encouragement of crop competition by good husbandry is still the only partial solution to this difficulty.

Acknowledgments

The assistance of the farmers who provided sites for the trials is gratefully acknowledged. Thanks are also due to Mr. J. G. Elliott and Dr. K. Holly of the Weed Research Organisation, for their help in the planning of the experiments, and to the following members of the N.A.A.S.: Messrs. D.W.Beesley, J.E.Brooke, E.R.Bullen, W.Q. Connold, G.A.Dowse, S.A.Evans, G.L.Gladwell, D.Hardy, E.Harris, B.Helmsing, R.J.Hughes, F.W.Jameson, M.J.A.Jenkins, G.W.Jones, D.J.MacDougall, E.O.Moore, J.R.Neild, J.B.Page, J.Park, J.Proctor, R.J.Tate, G.A.Toulson and G.R.Wilson who have all been concerned with the work at various stages.

TABLE I. DETAILS OF EXPERIMENTS

Site		1 Truro (Cornwall)	2 Holsworthy (Devon)
N.A.A.S. Region		South West	South West
Crop		Rape	Kale
Variety and/or Strain		Giant	Marrow Stem
Date and method of sowing		6/7 Broadcast	5/6 Drilled
Date of spraying		7/8	12/7
Crop at Spraying	Av no of leaves	3.9	2.9
	Type of growth	Rapid and soft	Slow and hard
Weeds at Spraying	Main species present; growth stages, density sq ft	Chenopodium album 2 - 6 leaf, 10 Veronica spp. 2 - 4 " , 15 Polygonum persicaria 2 - 6 " , 5 Stellaria media 2 - 10 " , 6	Chenopodium album Seedling - 5 leaf, 50 Spergula arvensis " - 2 " , 16 Polygonum persicaria " - 3 " , 4.6
	Av density of all weeds per sq ft	39	70
Weather	Before spraying	Dry	Dry
	Foliage at spraying	Dry	Dry
	Spraying to 1st assessment	Dry for 3 days then showery	Mainly dry for 5 days then showery
Special features of trial			Heavy germination of weeds after spraying made cleaning essential before 2nd assessment

TABLE I. DETAILS OF EXPERIMENTS (Cont'd.)

Site		3 Lapford (Devon)	4 Broadmayne (Dorset)
N.A.A.S. Region		South West	South West
Crop		Kale	Kale
Variety and/or Strain		Thousand Head	50% Marrow Stem 50% Thousand Head
Date and method of sowing		10/7 Broadcast	23/6 Broadcast
Date of spraying		16/8	1/8
Crop at Spraying	Av no of leaves	3.5	2.2
	Type of growth	Rapid and soft	Slow and hard
Weeds at Spraying	Main species present; growth stages, density sq ft	Chenopodium album Seedling-3 leaf,- Stellaria media " -2 " ,- Capsella bursa-pastoris " -3 " ,-	Chenopodium album 5 leaf, 12 Stellaria media 6 " 15 Capsella bursa-pastoris Seedling, 13 Urtica urens " , 1
	Av density of all weeds per sq ft	8	40
Weather	Before spraying	Showery	Dry
	Foliage at spraying	Dry	Dry
	Spraying to 1st assessment	Showery	Variable. Rain on 2nd day
Special features of trial		Plant irregular Weed control figures unreliable because of difficult weather conditions during recording	2nd assessment 18/9. Vol. doubled for 'G 34360' at 6 oz. rate because of 'frothing'

TABLE I. DETAILS OF EXPERIMENTS (Contd)

Site	5 Castle Combe (Wiltshire)	6 Stourton (Wiltshire)
N.A.A.S. Region	South West	South West
Crop Variety and/or Strain	Kale Marrow Stem	Kale & Swedes (1 row in 8) Thousand Head
Date and method of sowing	11/7 Drilled	22/6 Drilled
Date of spraying	15/8	16/8
Crop at Spraying Av no of leaves	3.0	4.5
Crop at Spraying Type of growth	Rapid and soft	Rapid and soft
Weeds at Spraying Main species present; growth stages, density sq ft	Chenopodium album 4 - 6 leaf, 5 Fumaria officinalis 2 - 6 " , 10 Stellaria media Seedling , 5	Chenopodium album 9 in. av, 9 Stellaria media 2 in. " 3 Taraxacum officinale 1½ in." - Capsella bursa-pastoris 1 in. " 2
Av density of all weeds per sq ft	19	23
Weather Before spraying	Wet	Showery
Foliage at spraying	Wet	Mainly wet
Spraying to 1st assessment	Heavy rain immediately then variable	Shower same evening, then variable
Special features of trial	Some trouble due to 'frothing'. Value of results spoilt by heavy 2nd germination of fumitory and irregular kale crop	Some trouble due to 'frothing'

TABLE I. DETAILS OF EXPERIMENTS (Contd)

Site	7 Ilminster (Somerset)	8 Oernant (Cardigan)
N.A.A.S. Region	South West	Wales
Crop Variety and/or Strain	Kale Thousand Head	Kale Marrow Stem
Date and method of sowing	26/7 Drilled	-
Date of spraying	28/8	16/7
Crop at Spraying — Av no of leaves	2.2	3.8
Crop at Spraying — Type of growth	Rapid and soft	Rapid and soft
Weeds at Spraying — Main species present; growth stages, density sq ft	Stellaria media 6 leaf, 6 Matricaria maritima var indora 2 " , 2 Capsella bursa-pastoria 4 " , 4	Spergula arvensis 4 in. av, 5 Stellaria media 2 in. ", 3 Chenopodium album 4 in. ", 3 Fumaria officinalis 6 in. ", 2.6 Urtica urens - ", 1
Av density of all weeds per sq ft	28	17
Weather — Before spraying	Showery	Dry for 24 hrs.
Foliage at spraying	Dry	Dry
Spraying to 1st assessment	Dry for 5 days then variable	Dry for 24 hrs.
Special features of trial	Occasional blockages to sprayer - esp. at 6 oz. rates	

TABLE I. DETAILS OF EXPERIMENTS (Contd)

Site		9 Llantilio (Monmouth)	10 Pangbourne (Oxfordshire)
N.A.A.S. Region		Wales	South East
Crop Variety and/or Strain		Kale Marrow Stem	Kale Marrow Stem + few swedes (1st sowing) Thousand Head (2nd sowing)
Date and method of sowing		27/5 Drilled	24/6 (1st) 22/7 (2nd) Both drilled
Date of spraying		6/8	8/8
Crop at Spraying	Av no of leaves	4.4	3.2
	Type of growth	Hard	Rapid and soft
Weeds at Spraying	Main species present; growth stages, density sq ft	Chenopodium album 4 leaf, 10 Matricaria maritima var inodora 6 " , 3 Polygonum persicaria 4 " , 2 Sinapis arvensis 6 " , -	Chenopodium album Seedling - 6 leaf, 13.2 Stellaria media 2 - 4 " , - Polygonum persicaria 2 - 4 " , - Capsella bursa-pastoris Seedling -
	Av density of all weeds per sq ft	19	-
Weather	Before spraying	Showery	Showery
	Foliage at spraying	Dry	Dry
	Spraying to 1st assessment	Showery and mild	Fairly heavy rain on p.m. of following day
Special features of trial		2nd assessment 18/9	Assessment methods differ from those used in other trials

TABLE I. DETAILS OF EXPERIMENTS (Contd)

Site	11 Hertford (Hertfordshire)	12 Westoning (Bedfordshire)
N.A.A.S. Region	Eastern	Eastern
Crop Variety and/or Strain	Kale Marrow Stem	Kale Mixed Marrow Stem Thousand Head
Date and method of sowing	2/7 Broadcast	- 7" drills
Date of spraying	9/8	10/7
Crop at Spraying Av no of leaves	3.3	3.0
Crop at Spraying Type of growth	Recovering from drought	Rapid and soft
Weeds at Spraying Main species present; growth stages, density sq ft	Chenopodium album up to 8 leaves, 2.3 (Numerous other species in small numbers)	Chenopodium album Seedling - 4 leaf, 4 Capsella bursa-pastoris " - 3 " , - Urtica urens 0 - 3 " , - Polygonum persicaria 0 - 5 " , - Polygonum lapithifolium 0 - 5 " , -
Av density of all weeds per sq ft	5.4	Very variable
Weather Before spraying	Rain during night	Rain overnight
Foliage at spraying	Dry	Dry
Spraying to 1st assessment	Shower same evening	4 hrs. rain in following night
Special features of trial		Weed distribution very variable

TABLE I. DETAILS OF EXPERIMENTS (Contd)

Site		13 Thulston (Derbyshire)	14 Lancaster (Lancashire)
N.A.A.S. Region		East Midland	York & Lancs.
Crop		Kale	Kale
Variety and/or Strain		Thousand Head	Marrow Stem
Date and method of sowing		7/5 Broadcast	App. 25/6 Drilled
Date of Spraying		14/6	13/8
Crop at Spraying	Av no of leaves	2.5	4.2
	Type of growth	Hard and slow	Rapid and soft
Weeds at Spraying	Main species present; growth stages, density sq ft	Chenopodium album 2 - 7 leaf, 8 Matricaria maritima inodora 2 - 6 " , 6 Polygonum aviculare 2 - 8 " , -	Chenopodium album 8 - 12 leaf, - Stellaria media 6 " , - Sinapis arvensis 5 " , -
	Av density of all weeds per sq ft	38	Very variable
Weather	Before spraying	Dry	Not known
	Foliage at spraying	Dry	Dry
	Spraying to 1st assessment	Dry	Not known
Special features of trial			

TABLE I. DETAILS OF EXPERIMENTS (Contd)

Site		15 Dewsbury (Yorkshire)	16 Penrith (Cumberland)
N.A.A.S. Region		York & Lancs.	Northern
Crop		Kale	Kale
Variety and/or Strain		Marrow Stem	Marrow Stem
Date and method of sowing		Mid-June Drilled	1/5 Drilled
Date of spraying		14/8	5/6
Crop at Spraying	Av no of leaves	3.7	2.0
	Type of growth	Rapid and soft	Slow
Weeds at Spraying	Main species present; growth stages, density sq ft	Stellaria media Seedling - - mature plant Chenopodium album Seedling -	Chenopodium album Seedling - 4 leaf, 7 Spergula arvensis up to 1 leaf, - Matricaria maritima var inodora - Stellaria media - Polygonium persicaria 1 - 2 leaf, 43
	Av density of all weeds per sq ft		68.7
Weather	Before spraying	Not recorded	Dry
	Foliage at spraying	Dry	Dry
	Spraying to 1st assessment	Not recorded	1st rain 6 days after spraying, followed by period of rain & low temps.
Special feature of trial		Weed counts unreliable because of inter-row cultivations between spraying and 1st assessment.	2nd assessment 23/7

T A B L E II. MEAN SCORES FOR WEED CONTROL

0 = complete kill of crop or weed
10 = plants unaffected

	Treatment oz/ac	Ametryne							
		2		4		6		2	
		W	C	W	C	W	C	W	C
	1. Truro	2.3	4.3	1.0	3.0	0.3	1.0	2.5	5.3
*	2. Holsworthy		8.3		7.6		6.0		7.3
**	3. Lapford		10.0		10.0		10.0		10.0
	4. Broadmayne	3.0	7.6	2.0	3.6	1.2	4.3	4.3	6.3
+	5. Castle Coombe	3.0		1.6		0.8		3.3	
	6. Stourton	4.6	7.6	5.3	4.6	3.0	6.0	5.3	5.6
	7. Ilminster	6.0	6.6	6.6	4.3	3.6	3.3	7.0	8.3
	8. Oernant	2.3	7.7	3.3	8.0	1.3	6.0	2.7	7.7
	9. Llantilio	3.3	7.7	3.2	6.0	1.3	5.7	2.5	7.3
	10. Pangbourne			1.6	3.4			7.3	4.1
	11. Hertford	4.6	10.0	0.7	10.0	0.0	10.0	3.0	10.0
++	12. Westoning		7.0		3.6		1.8		8.0
	13. Thulston	4.0	5.0	5.0	5.0	1.0	1.0	6.0	4.0
	14. Lancaster	7.3	10.0	7.3	10.0	8.0	9.6	7.3	10.0
ø	15. Dewsbury		10.0		10.0		10.0		10.0
	16. Penrith	5.6	10.0	3.3	9.6	.X.	.X.	6.0	10.0
	Mean of all sites	4.4	8.0	3.4	6.6	2.0	5.7	4.7	7.6

* Weed scores omitted because of heavy second germination after spraying.

** Weed scores omitted because of difficulties in recording.

\+ Crop scores omitted because of uneven growth.

('GENERAL CLEANLINESS') AND CROP DAMAGE AT FIRST ASSESSMENT

W = weeds
C = crops

Simetryne				'G 34360'						Control (unsprayed & not weeded)	
4		6		2		4		6			
W	C	W	C	W	C	W	C	W	C	W	C
1.0	3.5	0.5	3.3	1.6	6.2	0.8	4.0	0.2	3.0	9.0	10.0
	6.0		4.3		9.0		8.6		8.3		10.0
	10.0		10.0		10.0		10.0		10.0		10.0
3.3	4.0	1.3	3.0	3.6	5.3	6.0	6.3	4.6	5.3	7.3	4.0
3.2		2.1		3.0		1.6		1.6		10.0	
3.6	5.0	2.0	6.6	4.0	6.3	5.0	6.6	3.6	6.3	9.0	7.0
5.3	5.3	4.6	4.6	7.6	8.0	6.3	7.0	5.3	4.0	10.0	10.0
2.7	7.3	2.0	6.3	4.0	7.7	6.7	7.0	1.7	6.7	9.3	8.3
3.2	6.0	5.2	1.3	5.0	7.7	6.0	6.8	3.9	7.3	9.0	7.7
2.7	4.1	1.2	2.7	3.2	8.0	1.9	5.1	1.9	2.9	10.0	10.0
2.0	10.0	0.4	10.0	3.3	10.0	1.6	10.0	0.0	10.0	10.0	10.0
	5.3		4.5		8.6		5.6		2.7		8.8
5.0	5.0	4.0	6.0	5.0	6.0	4.0	6.0	3.0	6.0	7.0	5.0
6.0	10.0	7.6	9.0	8.0	10.0	7.3	9.2	7.3	8.3	10.0	10.0
	10.0		10.0		10.0		10.0		10.0		10.0
.X.	.X.	2.2	10.0	7.0	10.0	.X.	.X.	2.0	10.0	11.0	10.0
3.4	6.1	2.8	5.9	4.6	8.2	4.3	7.3	2.8	6.6	8.5	8.7

++ Weed scores omitted because of uneven distribution.

ø Weed scores unreliable because of inter row cultivations before assessment.

.X. Plots wrongly sprayed.

TABLE IV.

0 = complete kill of weed

Weed	Centre	Days from Spraying	At Assessment: Per sq. ft.	
			Max. No. of plants (=score of 10)	Max. No. of all weeds (=score of 10)
Chenopodium album	1. Truro	24	12.0	39.0
	2. Holsworthy	21	42.0	38.0
	4. Broadmayne	30	3.3	10.0
	5. Castle Coombe	21	3.0	66.0
	6. Stourton	26	13.0	-
	8. Oernant	17	-	-
	9. Llantilio	29	-	-
	10. Pangbourne	33	-	-
	11. Hertford	21	-	-
	12. Westoning	51	-	-
	13. Thulston	21	-	-
	14. Lancaster	32	-	-
	15. Penrith	21	17.0	96.0
				Mean
Stellaria media	1. Truro	24	7	3.9
	4. Broadmayne	30	4.0	10.0
	5. Castle Coombe	21	5.0	66.0
	6. Stourton	26	7.0	-
	7. Ilminster	21	5.0	-
	8. Oernant	17	-	-
	15. Penrith	21	-	-
				Mean
Polygonum persicaria	1. Truro	24	7.0	39.0
	2. Holsworthy	21	40.0	38.0
	3. Llantilio	29	-	-
	15. Penrith	21	27.0	96.0
				Mean

MEAN SCORES FOR INDIVIDUAL WEED SPECIES AT THE FIRST ASSESSMENT

10 = plants unaffected

Ametryne oz/ac			Simetryne oz/ac			'G 34360' oz/ac			Control (un-sprayed) and not weeded
2	4	6	2	4	6	2	4	6	
2	0	0	1.6	0.3	0	1.3	0.3	0.0	8.6
5	6.3	6.3	9.3	8.6	6.3	8.3	8.0	6.3	9.0
4	0.6	1.0	4.3	1.3	0.0	1.6	6.0	3.3	6.3
2.6	1.3	1.6	2.3	5.3	1.3	3.6	2.6	1.6	10.0
4.0	5.0	1.6	5.0	3.3	1.5	4.0	4.6	3.3	8.6
2.7	2.3	1.0	1.5	1.7	0.7	3.3	4.0	1.7	6.0
2.7	2.0	1.5	2.3	1.7	2.2	4.0	3.0	3.0	6.3
	0.6		1.6	1.0	0.5	1.4	0.8	0.5	10.0
4.6	0.7	0.0	3.0	2.0	0.4	3.3	1.6	0.0	-
2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3
1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	8.0
2.3	5.2	4.8	3.3	2.8	6.0	5.6	3.8	1.0	10.0
1.0	0.6	-	0.0	-	0.0	1.6	-	0.0	10.0
3.0	1.8	1.5	2.6	2.1	1.5	2.9	2.9	1.6	7.5
1.6	0	0.3	2.3	1.0	0.3	3.0	6.0	0.3	9.6
2.0	2.0	1.0	5.0	2.3	2.6	4.0	6.3	4.0	5.3
2.6	0.6	0.0	3.3	3.6	1.0	4.3	1.3	1.0	10.0
3.0	0.3	0.0	1.3	2.3	0.0	0.3	1.3	0.0	3.3
0.6	0.0	0.0	0.3	0.0	0.0	1.0	0.0	0.0	-
0.7	2.3	1.3	1.0	1.0	0.7	2.0	4.3	1.3	5.3
0.0	0.0	-	0.0	-	0.0	3.6	-	0.0	6.3
1.5	0.4	0.4	2.2	1.7	0.7	2.6	3.2	0.9	6.6
5.0	2.0	1.0	6.0	2.3	1.3	4.3	2.0	0.3	9.6
9.6	9.3	8.3	9.0	7.6	8.3	9.3	8.6	8.3	10.0
1.0	1.0	0.0	1.0	0.3	0.3	1.3	1.7	1.3	4.3
7.0	4.0	*-	6.3	*-	4.0	8.6	-	3.6	10.0
5.6	4.1	3.3	5.6	3.4	3.5	5.9	4.1	3.4	8.5

TABLE IV (Contd)

Weed	Centre	Days from Spraying	At Assessment: Per sq. ft. Max. No. of plants (=score of 10)	Max. No. of all weeds (=score of 10)
Matricaria maritima	7. Ilminster	21	3.0	-
	9. Llantilio	29	-	-
var. inodora	13. Thulston	21	-	-
	16. Penrith	21	20.0	96.0
				Mean
Capsella bursa pastoris	4. Broadmayne	30	3.6	4.0
	6. Stourton	26	15.0	7.0
	7. Ilminster	21	6.0	-
Urtica urens	8. Oernant	17	-	-
Spergula arvensis	2. Holsworthy	21	30.0	38.0
	8. Oernant	17	-	-
	16. Penrith		12.0	96.0
Sinapis arvensis	14. Lancaster	32	-	-
Veronica Spp.	1. Truro	24	12.0	39.0
Fumaria officinalis	5. Castle Coombe	21	50.0	66.0
	8. Oernant	17	-	-

Ametryne oz/ac			Simetryne oz/ac			'G 34360' oz/ac			Control (un-sprayed) and not weeded
2	4	6	2	4	6	2	4	6	
6.3	5.0	4.0	7.0	5.3	5.0	7.0	6.0	4.6	10.0
3.7	2.3	1.5	2.0	2.0	1.3	3.3	3.0	4.3	5.7
8.0	9.0	5.0	9.0	8.0	7.0	6.0	7.0	4.0	7.0
4.0	4.3	-	3.0	-	2.6	6.6	-	1.6	7.6
5.5	5.4	3.5	5.2	5.1	4.0	5.7	5.3	3.6	7.6
1.6	1.6	0.3	5.0	4.3	1.3	4.0	5.0	3.3	5.3
2.6	1.0	0.3	1.0	1.6	1.6	0.6	2.6	3.0	3.0
6.3	4.0	2.6	7.0	5.3	4.6	7.3	5.6	3.6	-
2.3	2.7	1.5	2.0	2.0	2.3	2.7	3.3	1.3	3.7
9.0	4.3	3.6	6.6	7.3	6.6	6.0	6.0	4.6	8.3
0.7	1.3	0.0	0.7	0.3	0.0	2.0	4.7	0.3	5.1
7.3	4.3	-	9.0	-	2.0	7.6	-	4.3	10.0
7.6	9.0	9.0	9.5	7.7	7.0	5.6	3.8	1.0	10.0
2.6	0.6	1.0	2.6	1.3	1.0	2.0	1.0	0.6	9.6
1.2	0.6	0.2	3.0	3.6	1.3	3.6	0.0	1.0	10.0
2.7	3.0	2.3	4.0	4.3	2.0	4.0	4.3	2.0	4.3

Discussion of preceding three papers

Mr. G.E. Furse In regard to Mr. Powell's paper, our S.W. Region N.A.A.S. centres included weed control in a range of kales - Marrow Stem, Thousand Head; a mixture of Marrow Stem and Thousand Head; kale with a few swedes; and rape - all of which are important to us in our big acreage of agricultural Brassica crops in the S.W. Fathen has long been a major problem with us in these crops. Mr. Elliott suggested in one of his remarks that if fathen is rather forward in growth the results may be poor. We had some evidence on small plots at Bristol, which, for various reasons, were sprayed late when the fathen was almost in flower and the kale well advanced; we obtained excellent control of the fathen, with less damage to the kale than when sprayed earlier. This could be of great importance to us in the years immediately ahead as most of our advisory queries on this weed come to us when the fathen is forming a canopy over the kale of 1ft to 2ft high. At one of our centres (Holsworthy, Devon) although control of fathen seedlings present at the time of spraying was good, late-germinated seedlings, which occur very commonly in the S.W., came in a few weeks later and the final appearance of the plots suggested no control at all. Later spraying than was done in these plots may be the ultimate answer to fathen, which tends to germinate late in the season. I would like to put one question to Mr.Elliott or to Messrs. Fisons representatives about the likely toxicity of the herbicide. We have been told that there is no toxicity hazard to stock where early sprayed kale is later fed at the normal winter feeding time, but what are the risks if cattle and sheep "break into" crops soon after spraying has been done.

Dr. R.K. Pfeiffer As far as toxicity is concerned, I cannot make an official statement; but I am quite prepared to eat kale the day following spraying with these herbicides!

Mr. J.G. Elliott We need more experience of methods of dealing with second germinations of weeds which occur usually as a result of wet, warm weather following a dry spell. Where herbicides are to be used in kale, the weeds must be encouraged to germinate and grow with the crop, because this is the situation that a selective herbicide requires. To achieve this we will have to educate farmers away from their present tendency to work the land before planting which may lead to irregular emergence of crop and weeds due to moisture loss in the seedbed. We are working out costs of production on the basis of the new concept of using herbicides in kale growing. When compared with maize, it may be that kale will be the cheaper form of starch equivalent.

Mr. H.A. Roberts I should like to draw attention to another important potential use of "G34360" in the horticultural Brassicas, which represent a large acreage. There is an increasing tendency to direct-drill these crops rather than transplant, and success with this method presupposes effective weed control. Our preliminary experiments at Wellesbourne with such crops as cabbage and Brussels sprouts confirm the results described for kale, both as regards crop tolerance and weed control, although we find that Poa annua and Polygonum aviculare tend to be tolerant. It would be interesting to know whether Dr. Pfeiffer and his colleagues have carried out any work with the horiticultural Brassicas.

Dr. R.K. Pfeiffer Not yet, but we plan to investigate this next year, in co-operation with other people.

Mr. S.G. Jary Trials have been carried out in Kent with G34360 and simetryne on 7 varieties of broccoli and 3 of cauliflower. Both compounds were regarded as safe, though there was a very slight phytotoxic effect on some varieties. This damage was, however, of no practical significance.

Mr. A.L. Abel May I first comment on the additional value conferences have in bringing forth from one's colleagues results they have not reported! Regarding other crops so far tested for their resistance to G34360, turnips and swedes appear to be severely damaged at the doses recommended for kale.

Professor G.E. Blackman If this compound is coming on to the market, the fact that it is effective at 4 oz/ac seems to me to put a lot of temptation in the way of commercial colleagues in deciding on what price it should be.

Research Report

FIELD TRIALS WITH N-PROPYL-ETHYL-n-BUTYLTHIOL CARBAMATE FOR THE CONTROL OF SEEDLING WEEDS IN SUGAR BEET AND MANGOLDS

B.H. Bagnall, J.J.B. Caldicott and D.J. Minter

The Murphy Chemical Co. Ltd., Wheathampstead, St. Albans.

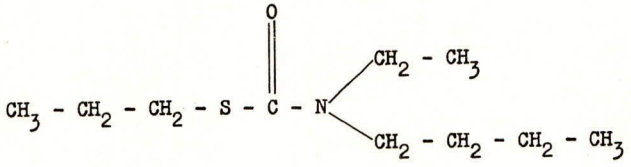
Summary: Applications of n-propyl-ethyl-n-butylthiolcarbamate* were made just prior to drilling or shortly after drilling with incorporation by various implements in the top one or two inches of soil. The material was used as a granule as well as in spray form on a range of soil types as both band application and overall applications. The material proved to be sufficiently safe for use on sugar beet and mangolds at 4 lb a i/ac. Weed control varied considerably and is believed to be dependent on the degree of incorporation of the herbicide into the soil. Certain weed species appear more susceptible than others. Granule or spray formulations seemed to be equal in activity. Soil type, soil moisture and rainfall after application do not appear to affect the results greatly. Further work is necessary to improve the range of weed control by the possible admixture of this material with another herbicide.

INTRODUCTION

N-propyl-ethyl-n-butylthiolcarbamate, a selective herbicide related to EPTC, has been developed by the Stauffer Chemical Co. for the control of grasses and certain broad-leaf weeds in the U.S.A. The safety of this new thiolcarbamate to sugar beet has been shown both in private communications from the Stauffer Chemical Co. and by report from Burtch (1962). This paper presents the results of field tests on sugar beet and mangolds in 1962, using the chemical as both a miscible and in granular form in comparison with an endothal + propham mixture/. The tests were designed to ascertain the weed control spectrum of the new material.

METHODS AND MATERIALS

N-propyl-ethyl-n-butylthiolcarbamate has the following structural formula:-



* as "Tillam" (Stauffer Chemical Co.)

/ as 'Murbetex' (Murphy Chemical Co. Ltd.)

The pure material is a clear liquid. Its water solubility is 92 ppm at 21°C. The boiling point at 20 mm Hg is 142.5°C. The compound has an acute oral LD50 to rate of 1120 mg/kg (Stauffer 1961). The compound was used in the form of existing formulations supplied by the Stauffer Chemical Co. which were an emulsifiable concentrate containing 72 per cent wt/vol active ingredient and a granular formulation containing 10 per cent wt/wt active ingredient. Since n-propyl-ethyl-n-butylthiolcarbamate has no accepted common name or abbreviation at present, use will be made of its early reference number 'R 2061' for convenience in tables and discussion of results.

Endothal/propham mixture was either the commercial formulation as now available or a special granular formulation containing 4 per cent wt/wt endothal a.e. and 3 per cent wt/wt propham. In each case the endothal/propham mixture was used at doses appropriate to the soil type (Caldicott 1962 and Hunnam and Hey, 1962). All rates of endothal are as lb acid equivalent, propham and 'R 2061' as active ingredient. All are quoted on the basis of overall treatment.

Four series of trials are included in the results section. Layout and technique varied somewhat for each series and therefore it is necessary to describe them in some detail. One factor common to all was that 'R 2061' was used at 4 lb/per ac of area treated. This dose was used since it had been shown to be safe in earlier tests in U.S.A., whereas the 6 lb/ac rate can cause adverse effects to sugar beet, and rates lower than 4 lb/ac have not been sufficient to control weeds.

Replicated Spray Trials

These trials at ten sites were experiments involving many chemicals. There were 4 randomised blocks containing plots of 84 sq yd. (12 rows x 12 yd). The treatments were applied in 21 gall water per acre treated, as a 7 in. band over the seed row by a small sprayer described by Bagnall and Minter (1962). 'R 2061' was incorporated into the surface of the soil with a miniature harrow immediately after application. Since spraying was after seeding, it was necessary to use the miniature harrow with care to avoid damage to the beet seed. Incorporation was, therefore, only to a depth of about one inch in these trials. Counts of weeds and beet were made just before singling, when the beet had 2 to 4 leaves. Assessments were made at 5 points within each plot (20 per treatment) using a 50 x 2 in. quadrat, the count being taken along the row. Crop emergence figures were, therefore on a 50 in. length of row and the total of each weed species was recorded for each 100 sq. in. Population counts and vigour assessments were carried out after thinning had taken place.

Replicated Granule Trials

These trials, carried out at 3 sites, comprised 4 blocks, containing individual plots of 120 sq yd (16 row x 12 yd). A seven inch band of granules was applied over the seed row by a Noble granular applicator mounted on a wheelbarrow frame and adapted to treat two rows at a time. The granules were incorporated into the soil above the seed with a miniature harrow drawn along the row after the machine. Assessments were the same as for the spray trials.

Non-replicated Trials

These trials at 3 centres, were simplified to allow greater incorporation of the 'R 2061' in the top 2 in. of seed bed by applying the material at the time of

seed bed preparation. The spray was applied by a hand-operated Knapsack sprayer and granules were applied by hand using a large tin with a "pepper-pot" lid. The soil was then harrowed several times in two directions to obtain incorporation to a depth of about 2 in. The sugar beet was drilled within a few days. Plot size varied from 75 to 240 sq yd.

Replicated Trials on Mangolds

Two trials conducted on this crop were slightly different in design. At the first site the trial was a 4 x 4 latin square, in which 3 materials in granule form were compared with an untreated control. The third material was a compound related to 'R 2061' but the results were not of interest. The plots were each 60 sq yd. At the second site the two thiolcarbamates were compared within a 3 block design, but only the results for 'R 2061' are shown. The granules in each case were applied by hand, using the "pepper-pot" and incorporation was achieved by harrowing the land several times in two directions after application.

Further Incorporation Trials

It was considered necessary to improve the method of incorporation of the herbicide into the seed bed and a machine was constructed to provide means of incorporating the herbicide in a seven inch band just before drilling. The machine had to be readily transportable from site to site and, therefore, it was necessary to keep it as light as possible. Considering the length of the machine described by Fryer et al. (1960) a shorter machine was designed for these tests which comprised a unit of four small mid-mounted rotary incorporators with a spray nozzle mounted just in front of each rotavator so as to apply a seven inch band of spray on to the soil. This was incorporated to a depth of 2 in. A normal power-operated precision drill was mounted behind the tractor. A drill unit was in line with each small rotavator. A pulley was fitted to the tractor P.T.O. to allow a drive shaft for both the rotavators and the precision drill.

The spray was supplied from a 30 gal front mounted tank with a $3\frac{1}{2}$ g.p.m. pump operated from the drive on the precision drill. Controls and pressure gauges were mounted on the tractor within easy access of the driver. The machine was operated at 2 mph. Unfortunately the trials were adversely affected by the method of incorporation which was found to distribute the chemical unevenly.

RESULTS

Site data, weed and crop seedling populations are shown in Tables I to V. The sites shown in Table I range from light sand to heavy clay loam, with three very black organic soils. Early sown sites suffered badly from the very cold weather in March of this season. Table II shows the results for 3 sites where granules were used. Table III gives more specific weed detail concerning the sites in Tables I and II. Other weeds occurred but only at a limited number of sites. Therefore, they have not been included in this list of results. Tables IV and V give results of pre-drilling applications of 'R 2061'. The weeds occurring in sites referred to in Table IV were chiefly Stellaria media, Chenopodium album, Polygonum convolvulus, and Veronica persica. S. media and V. persica were well controlled, the others to a much lesser extent. Endothal + propham was used as a comparison treatment since the mixture has a wide spectrum

of weed control which serves as a useful guide to the standard required or the improvement to be looked for in any new material.

DISCUSSION

Effect on Sugar Beet and Mangolds

No significant reduction in seedling emergence was found at the rate used under a wide range of soil types and weather conditions. 'R 2061' occasionally causes slight leaf distortion in the early true leaves, but normal growth is resumed later. Generally slow growth in the spring, in which these trials were conducted, exaggerated any adverse symptoms. Therefore, the results obtained would seem to be a satisfactory sign of the safety of 'R 2061' as a herbicide for use on these root crops. Granular and spray forms of the material show equal safety.

Effects on Weeds

Results appear extremely varied even for given weed species. In general there were no outstanding differences between granule and spray results and therefore the material can be considered in this discussion regardless of formulation.

Reasonable control of some weeds such as S. media, C. bursapastoris and V. persica has been obtained in many circumstances. It is difficult to understand some of the instances of failure to control them because Urtica urens, Poa annua, Geranium pratense and Lamium amplexicaule were well controlled on such occasions. C. album and Polygonum species have been controlled to a rather varied extent. Solanum nigrum where it occurred was not controlled to any noticeable extent.

The value of 'R 2061' for seedling grass control has not been adequately confirmed owing to limited occurence of such weeds in the trials. The control of C. album, however, was not as good in these trials as that reported from U.S.A. For this reason, as well as the variation in control of other weeds it may be concluded that incorporation was not sufficiently thorough in these early trials where a miniature harrow was used. It is less easy to understand failures where normal farm spike-toothed harrows were used within a short interval of application. The results in Tables IV and V are admittedly more promising than the earlier tests but are rather few in number by comparison. They do appear to offer promise of 'R 2061' providing control of some of the important weeds in root crops.

Effects of Soil Type and Rainfall

Whereas it has been shown in trials reported by Caldicott (1962) that endothal/propham has an optimum dosage rate dependent on soil type, this is not indicated for 'R 2061'. Indeed even highly organic soils appear to have a less limiting effect on this compound than on many other herbicides. From observations at the time of treatment, variation in soil moisture does not appear to affect the efficiency of 'R 2061'. Rainfall was generally sufficient for the full efficiency of non-incorporated herbicides such as endothal/propham and only at site 18 in Table V was there in fact insufficient rainfall to allow good weed control from an application of endothal/propham in an adjacent trial. The

results at this site show weed control by 'R 2061' to be of a similar order to that obtained at other sites where higher rainfall was recorded in the 1 or 2 weeks after treatment.

From these results it was considered that further trials should be arranged with a more thorough system of incorporation for 'R 2061'. Such trials were carried out at 6 sites, but the rotary incorporators did not give the degree of even distribution of chemical that was required. Tests using polystyrene granules which were spread as a band in front of the rotary devices were later recovered from soil samples taken at different depths. More than twice as many granules were found at 2 in. deep than at 1 in. deep, which served to indicate that the existing blades used on the rotavators were carrying the material down into the soil but not distributing it evenly.

CONCLUSION

N-propyl-ethyl-n-butylthiolcarbamate has shown promise for the control of some weeds in sugar beet and mangolds. It seems essential to obtain a more thorough incorporation of the material into the soil than obtained by harrows, springtines or flat-bladed rotary devices. From the results it would seem necessary to mix some other herbicides with this new material to obtain the control of all important weeds which occur in sugar beet and mangolds in Great Britain. If such a mixture can be found, it would have the benefit of giving satisfactory weed control with less dependence on adequate rainfall after treatment, which is a requirement of most existing residual herbicides.

Acknowledgements

The authors are indebted to farmers who so willingly co-operated in allowing facilities for trials. Also to Messrs. Dorman Sprayers Ltd., Horstine Farmery Ltd., Stanhay (Ashford) Ltd., and Ernest A. Webb Ltd., for assistance in the supply of machinery. Thanks are also due to Dr. R. Heap of Messrs. Charles Page Ltd., for advice in the early stages of the trials and to the Stauffer Chemical Co. for supply of material.

REFERENCES

BAGNALL, B.H. and MINTER D.J. (1962) Experiments in 1962 with salts of endothal in comparison with an endothal/propham mixture, for controlling weeds in sugar beet. Proc 6th Brit Weed Control Conference.

BURTCH, L.M. (1961) Chemical weed control in sugar beets - current status. Proc 13th Ann California Weed Conf 1961 54-6.

CALDICOTT, J.J.B. (1962) Further investigations into the field use of a mixture of endothal and propham for pre-emergence application to sugar beet. Weed Research 2 100-109.

FRYER, J.D., PARKER, C., and WOODFORD, E.K. (1960) The spray-incorporating drill. A machine designed to improve the reliability of soil-acting herbicides. Proc 5th Brit Weed Control Conf 1960 637-643.

HUNNAM, D., and HEY, G.L., (1962) The control of weeds in sugar beet by an endothal/propham mixture applied at drilling. J Amer Sugar Beet Technologists Report on Proceedings of Conference at Denver 1962.

STAUFFER Chemical Co. (1961) Tillam, a selective herbicide. Technical Information Sheet June 1961, pp2.

TABLE I - REPLICATED SPRAY TRIALS - SITE DETAILS AND EFFECTS OF HERBICIDES ON WEEDS AND SUGAR BEET

SITE		1 Herts	2 Lincs	3 Beds	4 Herts	5 Suffolk	6 Norfolk	7 Beds	8 Cambs	9 Essex	10 Essex
Weed Control: survivors as per cent of untreated control	'R 2061' 4 lb/ac	70.7	59.2	25.3	27.4	41.3	77.9	116.9	51.7	57.6	68.5
	endothal + propham (D)	21.4 L	10.1 L	1.2 L	1.9 L.M.	13.9 M	36.5 H	89.7 H	24.8 H	9.0 H	21.0 M.H.
S.E. per plot (as per cent of mean)		48.1	30.8	74.0	32.0	35.7	47.4	9.1	32.2	43.3	52.8
No weeds/sq yd on untreated control		152	266	327	158	89	72	197	278	127	206
Beet population as per cent of untreated control	'R 2061' 4 lb/ac	98.7	93.3	88.3	108.3	92.2	101.4	93.5	112.6	96.2	101.7
	endothal + propham (D)	74.1 L	110.0 L	88.6 L	93.9 L.M.	95.2 M	102.1 H	97.1 H	115.9 H	96.5 H	107.5 M.H.
No seedlings/yd of row on untreated control		9	20	39	20	23	27	17	13	12	15
Drilling Date		23.3	26.3	10.4	24.4	20.3	9.4	11.4	24.4	24.4	30.4
Spraying Date		27.3	28.3	12.4	1.5	22.3	10.4	16.4	30.4	27.4	2.5
Seed bed condition		Fluffy Stony	Fluffy Stony	Good	Dry Rough	Good	Good	Good Moist	Good Dry	Dry Crumbly	Dry Firm

TABLE I - (cont'd.)

SITE	1 Herts	2 Lincs	3 Beds	4 Herts	5 Suffolk	6 Norfolk	7 Beds	8 Cambs	9 Essex	10 Essex
Soil analysis (per cent)										
Coarse sand	40.1	47.7	43.2	18.1	19.7	7.1	34.8	19.3	10.3	15.1
Fine sand	25.5	32.1	39.8	33.9	35.3	43.9	32.6	-	34.1	31.9
Silt	19.0	13.2	16.4	24.0	18.4	31.0	27.3	-	24.6	24.0
Clay	15.4	7.0	10.6	24.0	26.6	18.0	5.3	10.8	31.0	29.0
Organic matter	4.7	5.0	3.4	5.6	3.0	18.7	17.4	32.3	2.8	5.6
Rainfall after spraying (in.)										
Week 1	1.13	0.37	0.40	0.18	0.22	0.57	0.40	0.11	0.11	0.55
Week 2	1.10	0.93	0.38	0.53	0.68	0.56	0.38	0.47	1.71	0.32
Week 3	0.06	0.71	0.00	0.49	0.70	0.00	0.00	0.43	0.06	0.70
Week 4	0.64	0.60	0.75	0.06	0.29	0.41	0.70	0.61	0.67	0.39

(D) = Dose appropriate to soil type:

E.L. = $1\frac{1}{2}$ + $1\frac{1}{8}$: L = 2 + $1\frac{1}{2}$: L.M. = 3 + $2\frac{1}{4}$:

M = 4 + 3: M.H. = 5 + $3\frac{3}{4}$:

H = 6 + $4\frac{1}{2}$ lb/ac endothal + propham.

TABLE II - REPLICATED GRANULE TRIALS

SITE DETAILS AND EFFECTS OF HERBICIDES ON WEEDS AND SUGAR BEET

SITE		11 Suffolk	12 Norfolk	13 Cambs
Weed Control Survivors as per cent of untreated control	'R 2061' granules 4 lb/ac	41	23	86
	endothal + propham granules 4 + 3 per cent w/w 50 lb/ac	52	21	81
	endothal + propham granules 4 + 3 per cent w/w 50 lb/ac	35	4	62
No of weeds/sq yd on untreated control		186	143	146
Beet Population per cent of untreated control	'R 2061' granules 4 lb/ac	118	102	88
	endothal + propham granules 4 + 3 per cent w/w 25 lb/ac	94	91	117
	endothal + propham granules 4 + 3 per cent w/w 50 lb/ac	100	90	102
No of seedlings/yd of row on untreated control		24	20	14
Drilling date		11.4	9.4	10.4
Application date		18.4	11.4	17.4
Seed bed condition		Rough moist	Dry fluffy	Sticky
Soil Analysis per cent	Coarse sand Fine Sand Silt Clay Organic Matter	32.6 30.3 15.4 21.6 3.9	48.7 37.2 9.2 2.0 3.0	29.0 31.3 36.8 2.3 33.2
Rainfall after application (in.)	Week 1 Week 2 Week 3 Week 4	0.26 0.00 0.37 0.45	0.32 0.26 0.00 0.78	0.60 0.00 0.50 0.20

TABLE III - CONTROL OF THE MOST FREQUENTLY OCCURING INDIVIDUAL SPECIES RELATIVE TO SITES IN TABLES I AND II

(SURVIVORS AS PER CENT OF UNTREATED)

Site	Weed Species	No per sq/yd (untreated)	Spray Treatment		Granular Treatments		
			'R 2061' Misc. 4 lb/ac	endothal + propham (D)	'R 2061' 4 lb/ac	endothal + propham 1 lb + ¾ lb/ac	endothal + propham 2 lb + 1½ lb/ac
1	Stellaria	40	52	41			
2	media	20	15	24			
3		23	19	2			
4	(Chickweed)	15	33	0			
5		6	15	15			
7		30	100	58			
8		28	65	33			
10		89	62	9			
11		23			52	56	26
12		21			31	90	12
13		42			75	86	46
1	Polygonum	16	100	3			
2	convolvulus	16	100	6			
4		42	40	3			
7	(Black	28	60	100			
8	Bindweed)	91	39	26			
10		5	100	50			
11		7			50	86	93
13		8			65	41	82
1	Polygonum	9	100	0			
2	aviculare	7	100	0			
3		9	22	0			
4	(Knotgrass)	50	20	0			
5		26	44	6			
7		16	100	50			
9		51	50	1			
10		14	43	0			
11		105			43	44	26

TABLE III - (cont'd.)

Site	Weed species	No per sq/yd (untreated)	Spray Treatment		Granular Treatments		
			'R 2061' Misc. 4 lb/ac	endothal + propham (D)	'R 2061' 4 lb/ac	endothal + propham 1 lb + $\frac{3}{4}$ lb/ac	endothal + propham 2 lb + $1\frac{1}{2}$ lb/ac
2	Veronica	21	30	0			
4	persica	34	31	1			
6		15	87	0			
10	(Speedwell)	5	68	0			
11		10			19	57	52
12		63			15	5	2
13		5			9	27	45
2	Chenopodium	21	79	86			
5	album	7	33	13			
6		28	73	73			
7	(Fat Hen)	63	100	100			
9		7	36	100			
10		22	100	57			
11		17			50	56	44
13		13			100	100	96

(D) Dose appropriate to soil type, see Table I

TABLE IV - CONTROL OF WEEDS IN NON-REPLICATED PLOTS WITH 'R 2061' AS AN INCORPORATION TREATMENT BEFORE DRILLING SUGAR BEET

Site		14 Beds	15 Essex	16 Beds
Weed Control Survivors as per cent of untreated control	'R 2061' spray 4 lb a.i./ac	-	-	42
	'R 2061' granules 4 lb a.i./ac	59	25 *	32
	endothal + propham spray (R)	74 (L)	21 (M.H.)	-
No of weeds/sq yd on untreated control		250	360	190
Beet seedlings/yd of row on untreated control		10	13	42
Application date		26.4	26.4	12.4
Drilling date		27.4	30.4	13.4
Soil Analysis per cent	Coarse Sand	28.4	15.1	43.2
	Fine Sand	32.3	31.9	39.8
	Silt	31.6	24.0	16.4
	Clay	7.6	29.0	10.6
	Organic Matter	13.7	5.6	3.4
Rainfall after application (in.)	Week 1	0.40	0.55	0.40
	Week 2	0.38	0.32	0.38
	Week 3	0.00	0.70	0.00
	Week 4	0.70	0.39	0.75

* 11 per cent reduction in sugar beet population, other treatments had little if any effect on the beet.

(R) For detail see note at bottom of Table I.

TABLE V - CONTROL OF WEEDS IN MANGOLDS USING 'R 2061' GRANULES IN COMPARISON WITH ENDOTHAL + PROPHAM IN GRANULE FORM

Site	Treatment date	Drilling date	Mangolds - No sq/yd on untreated control	Weed species	Survivors as per cent of untreated control	
					'R 2061' granules 4 lb/ac	endothal + propham granules $1\frac{1}{2}$ lb + $1\frac{1}{8}$ lb/ac
17. Flitton Beds.	30.4	30.4	26	Stellaria media	9	28
				Urtica urens	13	3
				Capsella bursapastoris	16	0
				Lamium amplexicaule	23	14
				All weeds	47	15
18. Welby Lincs	2.5	4.5	7	Stellaria media	67	Not used
				Veronica persica	10	
				Polygonum aviculare	30	
				Chenopodium album	21	
				Capsella bursapastoris	40	
				Poa annua	0	
				All weeds	29	

Site	SOIL ANALYSIS per cent					RAINFALL (IN.)			
	Coarse Sand	Fine Sand	Silt	Clay	O.M.	Week 1	Week 2	Week 3	Week 4
17	65.0	16.8	7.8	10.4	3.8	0.24	0.38	0.52	0.76
18	39.9	29.7	9.0	21.4	4.3	0.24	0.13	0.53	0.35

Mangold population figures showed no reduction in stand due to 'R 2061' or endothal + propham. There was, however, a 25 per cent reduction in vigour of mangolds at site 17 due to 'R 2061'.

Research Report

2,4-DICHLOROPHENYL 4-NITROPHENYL ETHER: A NEW RESIDUAL HERBICIDE

D. Tyson and C.H.P. Wood.

Pan Britannica Industries Limited, Waltham Cross, Herts.

Summary: 2-4-dichlorophenyl 4-nitrophenyl ether ('FW.925') has been found to control successfully a range of common weeds occurring as competitors in a number of important horticultural crops when applied prior to weed and crop emergence. This new residual herbicide possesses three important and unusual properties: a) It is chemically distinct from the residual herbicide at present available. b) Its herbicidal activity is not influenced by the degree of soil moisture at application time. c) Its herbicidal activity is not materially influenced by the type of soil.

In pre-emergence applications garden beet tolerated 2.5 lb/ac 'FW.925' on most soil types although sugar beet was damaged by this dose; Brassicae and peas were not affected by 5 lb/ac 'FW.925' but lettuce was occasionally damaged by 2.5 lb/ac 'FW.925'. Weeds controlled at doses of 2.5-10 lb/ac of 'FW.925' per acre included Urtica urens, Poa annua, Veronica spp., Chenopodium album, Polygonum persicaria, P. aviculare, Lamium purpureum, and L. amplexicaule. The effect upon Capsella bursa-pastoris and Senecio vulgaris increased as the dose was increased. Stellaria media was resistant to 10 lb/ac 'FW.925'. The effect of 'FW.925' on susceptible weeds persisted for 6 weeks. The weed spectrum controlled was improved by mixing 'FW.925' with minimum amounts of chlorpropham, CDEC, or N'-4-(4-chlorophenoxy) phenyl-NN-dimethyl urea ('1983') although at the expense of the selectivity on some soil types. Post weed and crop emergence applications of 'FW.925' at 2.5 lb/ac controlled Urtica urens, Calystegia sepium and Convolvulus arvensis, although regrowth occurs afterwards from roots of the latter two. Peas and carrots, gooseberry and rose bushes tolerated 2.5 lb/ac 'FW.925' and Brassicae were not affected by 5 lb/ac 'FW.925' as post-emergence applications.

INTRODUCTION

2-4-dichlorophenyl 4-nitrophenyl ether ('FW.925') has shown promise as a selective herbicide in trial work in the U.S.A. 'FW.925' is extremely insoluble in water and has an acute oral toxicity of the technical grade to rats of approximately 2630 mg/kg body weight.

It was apparent from the American screening work that the herbicidal effect of 'FW.925' is exerted on the young shoot as it emerges above the soil. Primary work in Great Britain agreed with the American findings that optimum weed control was obtained by leaving 'FW.925' undisturbed on the soil surface-incorporation into the soil invariably resulted in very poor herbicidal action. The weed spectrum controlled was comprehensive, although Senocio vulgaris and Capsella bursa-pastoris appeared moderately resistant, and Stellaria media resistant to normal application rates.

The 1961/1962 field evaluation work was planned to investigate the herbici-

dal effect of 'FW.925' when used on different soil types growing a variety of crops for which residual herbicides were either not available or not recommended.

Collateral work was also undertaken to determine the value of mixtures of 'FW.925' with chlorpropham because of its known ability to control Stellaria media at low application rates, with CDEC as a result of observations that it might enhance the herbicidal action of 'FW.925', and with '1983' which had given indications of good control of Capsella bursa-pastoris, Senecio vulgaris and Stellaria media.

The experimental results given below are typical of those achieved in 1961/1962.

METHODS AND MATERIALS

'FW.925' - 2-4-dichlorophenyl 4-nitrophenyl ether, formulated as an emulsifiable concentrate,

CDEC - 2-chloroallyl-NN-diethyl-dithiocarbamate, formulated as an emulsifiable liquid,

'1983' - N'-4-(4-chlorophenoxy)phenyl-NN-dimethyl urea, formulated as a wettable powder,

chlorpropham - Isopropyl-N-(3-chlorophenyl)carbamate, formulated as an emulsifiable liquid.

The herbicides were applied through an Oxford Precision Sprayer at doses ranging from 40 to 300 gal water/ac, usually at 100-150 gal/ac using size 0 nozzles. The plot layout was generally in randomized blocks with fourfold replication. Weed control data was based upon six or more quadrat counts from each plot. The grading of the crop seedlings was based on visual assessment by at least two observers using the control plots as the standard for comparison. The grades used were:-

0 - no noticeable effect upon germination or subsequent appearance. The crop can be expected to mature without any loss in yield.

1 - a noticeable effect but no sign of severe damage. In some cases the affected crop matures normally with no loss in yield.

2 - severe damage or completely killed. Invariably the affected crop will either not mature or show depressed yields.

RESULTS

Application prior to crop and weed emergence

The results are presented in tables I to XI

TABLE I - RED GLOBE BEET

Peat fen (50.3 per cent organic matter, pH 6.2). Soil prepared May 15; crop sown May 18; sprayed May 18 after sowing - soil surface very dry with some moisture underneath; 0.56 in. rain within 24 hr., then dry for 6 days.

Herbicide and dose in lb/ac	Application volume gal/ac	Percent weed control on June 12					Grading of crop on June 12
		All weeds	Chenopodium album	Urtica urens	Stellaria media	Polygonum persicaria	
5 lb 'FW.925'	100	62	33	89	0	45	0
5 lb 'FW.925'	300	69	39	91	0	43	0
5 lb 'FW.925' + 2 lb chlorpropham	100	73	36	89	88	49	0
5 lb 'FW.925' + 2 lb chlorpropham	300	75	32	90	84	45	1
5 lb 'FW.925' + 1 lb '1983'	100	71	46	90	59	41	1
5 lb 'FW.925' + 1 lb '1983'	300	72	43	91	52	43	1
10 lb 'FW.925' + 2 lb chlorpropham	300	86	78	95	74	53	2
18.8 lb CDEC *	100	74	68	73	95	32	2

* incorporated into soil to 1 in.

TABLE II - RED GLOBE BEET, BRUSSEL SPROUTS, LETTUCE

Peat fen (50.7 per cent organic matter, pH 6.1). Soil prepared August 8; crop sown August 10; sprayed August 10 after sowing - soil surface dry, moist underneath; no rain until 5 days after, then 0.12 in. Application volume 100 gal water/ac except * = 150 gal/ac.

Herbicide and dose in lb/ac	Percent weed control of August 31			Grading of crop on August 31		
	All weeds	Stellaria media	Urtica urens	Beet	Brussel Sprouts	Lettuce
5 lb 'FW.925'	38	0	78	0	0	0
2.5 lb 'FW.925' + 2 lb chlorpropham	54	32	87	0	0	0
5 lb 'FW.925' + 1 lb chlorpropham	64	35	87	0	0	0
5 lb 'FW.925' + 2 lb chlorpropham	62	38	90	1	0	0
* 5 lb 'FW.925' + 2 lb chlorpropham	70	53	92	1	0	0
10 lb 'FW.925' + 1 lb chlorpropham	60	38	94	2	0	2
4 lb chlorpropham	78	67	90	2	2	0

TABLE III - RED GLOBE BEET, CABBAGE, LETTUCE

Silt loam (9.1 per cent organic matter, pH 6.8). Soil prepared May 11; crop sown May 18; sprayed May 18 after sowing - soil surface fairly dry, moist underneath; 0.46 in. rain within 24 hr.

Herbicide and dose in lb/ac	Percent weed control on June 19							Mean wt of cut fresh weed in g/sq ft on June 28	Grading of crop on June 19		
	All weeds	Stellaria media	Capsella bursa-pastoris	Urtica urens	Chenopodium album	Veronica spp	Lamium amplexicaule		Bt.	Cab.	Let.
2.5 lb 'FW.925'	60	0	15	78	64	80	88	49.0	0	0	1
5 lb 'FW.925'	64	0	27	94	58	92	88	48.9	0	0	1
5 lb 'FW.925' + 1 lb '1983'	72	10	62	95	75	96	95	27.9	1	0	1
5 lb 'FW.925' + 1 lb chlorpropham	69	47	24	98	60	82	85	30.2	0	0	1
5 lb 'FW.925' + 2 lb chlorpropham	80	77	50	95	70	96	75	20.0	2	0	2
3 lb chlorpropham	77	98	77	98	60	81	0	22.1	2	0	0
Untreated	-	-	-	-	-	-	-	89.5	0	0	0

TABLE IV - RED GLOBE BEET, SAVOY, LETTUCE

Sandy loam (3.9 per cent organic marrer, pH 6.6). Soil prepared June 14; crop sown June 14; sprayed June 14 after sowing - soil surface very dry with little moisture underneath - irrigated June 18 and June 22 with 0.25 in. - 0.50 in.

Herbicide and dose in lb/ac	Percent weed control on July 11								Mean wt of cut fresh weed in g/sq ft on July 27	Grading of crop on July 11		
	All weeds	Senecio Vulgaris	Capsella-bursa pastoris	Urtica urens	Polygonum persicaria	Chenopodium album	Poa annua	Veronica spp.		Bt.	Sav.	Let.
2.5 lb 'FW.925'	66	10	35	100	71	91	82	78	37.0	0	0	0
5 lb 'FW.925'	87	45	91	100	98	93	95	100	13.5	2	2	2
2.5 lb 'FW.925' + 2.35 lb CDEC	77	56	72	100	64	96	93	100	22.6	0	1	0
2.5 lb 'FW.925' + 1 lb '1983'	86	41	80	100	76	91	87	92	34.0	0	0	0
2.5 lb 'FW.925' + 2 lb '1983'	86	55	92	100	85	100	93	95	39.0	1	2	0
5 lb 'FW.925' + 1 lb chlor-propham	85	6	80	100	93	93	100	100	16.0	2	1	0
4 lb chlor-propham	86	0	97	100	100	100	100	50	59.6	2	2	0

TABLE V - RED GLOBE BEET, BRUSSEL SPROUTS, LETTUCE

Sandy loam (3.7 per cent organic matter, pH 6.5). Soil prepared August 15, crop sown August 17; sprayed August 17 after sowing - soil surface fairly moist, moist underneath; slight rain on August 20 and August 21.

Herbicide and dose in lb/ac	Percent weed control of Sept. 12				Grading of crop on September 12		
	All weeds	Stellaria media	Chenopodium album	Urtica urens	Bt.	Br.Spt.	Let.
2.5 lb 'FW.925'	50	13	73	100	0	0	0
2.5 lb 'FW.925' + 2.35 lb CDEC	69	46	88	100	2	0	1
2.5 lb 'FW.925' + 1 lb '1983'	59	36	80	100	1	0	0
1.25 lb 'FW.925' + 1.25 lb '1983'	75	47	44	100	0	0	0
2.5 lb 'FW.925' + 1 lb chlorpropham	88	98	78	100	2	0	0
3 lb chlorpropham	85	100	76	100	2	2	0

TABLE VI - RED GLOBE BEET

Light loam (4.1 per cent organic matter, pH 7.1). Soil prepared May 7; crop sown May 9; sprayed May 16 - soil surface dry, fairly dry underneath; irrigated June 5 with 0.5 in.

Weeds present:- Senecio vulgaris, Veronica spp., Chenopodium album, Polygonum persicaria, Lamium amplexicaule, Poa annua

Herbicide and dose in lb/ac	Cultivation of soil	Percent weed control on June 12	Mean fresh wt of crop leaves in g per 3 ft of row on June 26	Mean fresh wt of harvested crop in g per 5 roots on August 17
1.25 lb 'FW.925'	Ground hoed every 21 days after June 26	65	4.1	760.6
2.5 lb 'FW.925'		74	4.2	836.2
5 lb 'FW.925'		86	2.5	672.1
2.5 lb 'FW.925' + 1 lb. '1983'		86	4.0	768.8
2.5 lb 'FW.925' + 1 lb chlorpropham		73	3.6	760.9
Untreated	Ground hoed every 21 days after crop emergence	-	3.2	743.6

TABLE VII - PEAS, var. ONWARD

Medium loam (4.2 per cent organic matter, pH 6.7). Crop sown May 2; sprayed May 10 - soil surface dry with moisture underneath. No rain until May 23.

Herbicide and dose in lb/ac	Percent weed control on June 20					Percent reduction in fresh wt of *Chenopodium album* seedlings as compared with control seedlings.	Grading of crop on June 20
	All weeds	*Stellaria media*	*Chenopodium album*	*Poa annua*	*Polygonum aviculare*		
5 lb 'FW.925'	37	0	55	66	74	47	0
5 lb 'FW.925' + 0.75 lb chlor-propham	64	83	59	76	70	43	0

TABLE VIII - THE EFFECT OF IRRIGATION ON THE ACTIVITY OF 'FW.925'

Heavy loam (3.1 per cent organic matter, pH 7.0). Soil prepared June 5; crop sown June 12; sprayed June 12 after sowing - soil surface very dry, very little moisture underneath. No rain for 4 weeks following spraying; some plots irrigated 2 hr after spraying.

	Herbicide and dose in lb/ac	Rainfall equivalent of water applied 2 hr after treatment	Percent weed control on July 31				Grading of crop of July 31		
			All weeds (excluding *Stellaria media*)	*Lamium purpureum*	*Chenopodium album*	*Veronica spp.*	Bt.	Cab.	Let.
a	(Untreated	0.25 in	-	-	-	-	0	0	0
	(5 lb 'FW.925'	0.25 in	73	95	73	85	2	0	1
b	(Untreated	None	-	-	-	-	0	0	0
	(5 lb 'FW.925'	None	76	96	60	88	2	0	1

TABLE IX - THE EFFECT OF VOLUME RATE OF APPLICATION ON THE ACTIVITY OF 'FW.925'

Medium loam (4.2 per cent organic matter, pH 6.7). Crop, Peas, var. Onward, sown May 2; sprayed May 10 - soil surface dry, moist underneath. No rain until May 23.

Herbicide and dose in lb/ac	Application volume gal/ac	Percent control of *Chenopodium album* on June 14	Mean fresh wt. in g of 50 *Chenopodium album* seedlings on June 8	Grading of crop on June 21
2.5 lb 'FW.925'	40	30	17.8	0
2.5 lb 'FW.925'	80	38	19.6	0
5 lb 'FW.925'	40	50	13.6	0
5 lb 'FW.925'	80	41	11.2	0
Untreated	-	-	36.0	0

TABLE X - THE EFFECT OF VOLUME RATE OF APPLICATION ON THE ACTIVITY OF 'FW.925'

Medium loam. Crop, sugar beet sown April 20; sprayed April 30 - soil surface dry with a very poor tilth, moist underneath. No appreciable rainfall for 4 weeks following spraying.

Herbicide and dose in lb/ac	Application volume gal/ac	Percent weed control			Mean no emerged beet per yard on May 25	Effect upon crop
		All weeds	All weeds excluding *Stellaria media*	*Chenopodium album*		
2.5 lb 'FW.925'	40	31	66	28	15.2	Visibly effected upon emergence but fully recovered by August 17
2.5 lb 'FW.925'	80	43	72	52	14.2	
5 lb 'FW.925'	40	52	80	51	16.4	
5 lb 'FW.925'	80	44	90	46	14.5	
Untreated	-	-	-	-	15.7	

TABLE XI - THE EFFECT OF VOLUME RATE OF APPLICATION ON THE ACTIVITY OF 'FW.925'

Sandy loam (3.5 per cent organic matter, pH 6.5). Soil prepared August 15; crops, red globe beet, brussel sprouts, lettuce, sown August 17; sprayed August 17 after sowing - soil surface fairly moist, moist underneath; slight rain on August 20 and 21.

Herbicide and dose in lb/ac	Application volume gal/ac	Percent weed control on September 12, excluding *Stellaria media*	Grading of crop on September 12		
			Beet	Brussel Sprouts	Lettuce
5 lb 'FW.925'	40	73	2	0	1
5 lb 'FW.925'	80	77	2	0	1
5 lb 'FW.925'	100	71	2	0	1
5 lb 'FW.925'	160	75	2	0	1
5 lb 'FW.925' *	100	74	2	0	1

* applied through '3' nozzles

Application after weed emergence

2-6 lb/ac of 'FW.925' controlled *Urtica urens*, and checked *Veronica spp.* but did not control *Chenopodium album*, *Polygonum persicaria*, *Stellaria media*, *Capsella bursa-pastoris*, *Senecio vulgaris*. Aerial growth of *Calystegia sepium* and *Convolvulus arvensis* was killed by 2.5 lb/ac but regrowth occurred later from the roots.

Application after crop emergence

Peas, carrots, gooseberry and rose bushes were not affected by 2.5 lb/ac of 'FW.925', while Brassica crops were unaffected at 5 lb/ac.

DISCUSSION

The herbicidal effect of 'FW.925'

The trials where 'FW.925' was applied prior to weed emergence have shown that it can give acceptable control of certain weed species such as *Urtica urens*, *Polygonum persicaria*, *Veronica spp.*, and *Poa annua*, which are a problem in market garden crops under a wide variety of soil moisture conditions. *Chenopodium album* was adequately controlled in the trials, especially where climatic or cultural conditions encouraged the rapid emergence of the weed shortly after spraying; as occurred in III, IV, V and III. In Tables VII, VIII and IX where adverse conditions gave a delayed or prolonged emergence of *C. album* this weed was significantly checked in growth for at least 42 days, thus demonstrating the persistence of the herbicide.

'FW.925' did not control *Stellaria media* at the doses used; also *Capsella bursa-pastoris* and *Senecio vulgaris* were not well controlled - although the con-