THE EFFECT OF ORGANO MERCURY COMPOUNDS ON CERTAIN WEEDS

PROGRESS REPORT ON SOME PRELIMINARY EXPERIMENTS

R. V. BLANDY, F. W. Berk & Co. Ltd.,
Tilgate Research Station, Crawley, Sussex.

Summary

The use of organo mercury compounds for the control of certain weeds is now established in the United States. Little research has been carried out in this country on these materials, and the following paper records the preliminary observations on the effect of phenyl mercury chloride on a variety of weeds.

Introduction

In 1946, the effectiveness of the organo mercury compounds on the control of Crab grass (Digitaria sp.) was first reported by Dr. J. A. De France of the Rhode Island Agricultural Experiment Station. Crab grass is one of the most prominent and tenacious of the common annual weeds in the United States, especially in turfed areas. It is particularly insidious in golf greens where it causes bare brown areas when it dies at the first frost. Further trials showed that excellent control can be obtained by the use of phenyl mercury acetate (P.M.A.) without discolouration of the turf. Engel (1) was able to report in 1948 that P.M.A. is safer and more effective than the arsenicals which were being used for its control.

Continuing his work, De France (2) demonstrated that P.M.A. used at 1 part of the active ingredient to 5,000 parts of water with actual toxicant calculated on the basis of 10 gallons of solution to 1,000 square feet used three times at weekly intervals, gave excellent control of Crab grass. Control of weeds, including dandelion, plantain and chickweed were obtained by three treatments at weekly intervals in August.

Little attention has, however, been given to the use of organo mercury compounds for the control of weeds in this country. Following an observation in 1952 that onion plots, which had received several applications of phenyl mercury chloride (P.M.C.) as a foliage fungicide, were very free from Groundsel (Senecio Vulgaris) as compared with unsprayed plots, it was decided to investigate whether other weeds would be controlled at higher rates of application, and whether P.M.C. would be effective as a weedkiller for crops, such as carrots and onions.

It was with this object that the following preliminary experiments were laid down in 1953.

EXPERIMENT 1. Carrots

A plot, sown with carrots variety Scarlet Intermediate on 8th July was split into 10 units, each comprising an area of 10 ft. x 5 ft. - 8 units being subjected to different treatments, and two unsprayed acting as controls.

Material

A proprietary product containing 2½% phenyl mercury chloride precipitated on China clay was applied as a suspension in water with a hand pneumatic sprayer.

Rates of Application

The treatments listed below were carried out at two rates of application - 12 and 24 lbs. in 200 gallons of water per acre.

Times of Application

1. One application at Pre-emergence - 15th July.

2. One application at Post-emergence (Fern leaf stage) 4th August.

3. Applications at Pre and Post-emergence, 15th July, 4th August.

4. Applications at 3-week intervals - 15th July, 5th August, 27th August.

EXPERIMENT 2. Onions

A similar pattern was followed on a further plot sown with onions, variety White Lisbon, on 8th July and subjected to the following treatments at the two rates of application.

Times of Application

1. One application at Pre-emergence, 15th July.

2. One application at Emergence, 20th July.

3. Applications at Emergence and Post-emergence 20th July, 4th August.

4. Applications at 3-week intervals, 15th July, 5th August, 27th August.

RESULTS. 1. Visual observations made on Experiments 1 and 2 on August 11th.

1. None of the treatments had a direct killing effect on the weeds present, but a degree of control was exhibited by the extent to which they had been retarded or stunted in growth.

2. In all treatments, the majority of weeds were retarded, the degree of retardation being greater on those which had received either more than one application or at the higher rate of 24 lbs./acre.

3. It was noticeable that none of the weeds was flowering on the plots which had received two applications at 24 lbs./acre.

4. The treatments were most effective when applied to plants at the seedling stage. When treated at a later stage of development, weeds such as Shepherd's Purse (Capsella bursa-pastoris) and Groundsel (Senecio Vulgaris) were still able to set seed, although they exhibited a chlorotic and stunted condition.

5. The more efficient the retardation and consequent control of weeds, the more Annual Meadow grass (Poa annua) predominated as a weed.

6. It appeared that amongst the weeds, Plantain (Plantago major), Corn Sowthistle (Sonchus arvensis) and Shepherd's Purse (Capsella bursa-pastoris) were the most tolerant once they had become established.

7. Carrots were damaged and retarded by all applications at the rate of 24 lbs./acre after pre-emergence stage.

2. Weed Population

An area of 3 ft. x 8 ft. was marked off each plot and all the weeds were pulled, sorted into their various species and counted on 3rd-11th September. (See Tables).

DISCUSSION

1. It is appreciated that only tentative conclusions may be drawn from this experiment, and much further work is needed before it can have any practical outcome.

2. Phenyl mercury chloride under these conditions has a positive action on a number of weeds, the controlling effect being exhibited by a chlorotic condition of the foliage with a consequent stunting of growth rather than a direct killing action.

3. The timing of the spray is important, the greatest control being obtained when the weeds are at the seedling stage.

4. The predominance of low-growing weeds such as Veronica sp. and Annual Meadow grass (Poa annua) in the treated plots as compared with the controls is a reflection on the degree of stunting and inhibition of growth exerted by the treatments on the taller weeds such as groundsel (Senecio vulgaris) and Shepherd's Purse (Capsella bursa-pastoris).

5. The specificity of organo mercury compounds on certain weeds was again demonstrated, groundsel (Senecio vulgaris) being the most susceptible.

6. It should be noted that the material used was specially formulated as a foliage fungicide. In this connection, the concentration of the wetting agent is important, and very different effects might have been obtained if more wetting agent had been used.

It is also known that severe foliage damage is caused when organo mercury fungicides are applied with oil emulsions. The inclusion of them in herbicidal oils, therefore, appears to be a promising line of investigation.

Acknowledgement

Grateful thanks are due to E. L. Cadmus of F. W. Berk & Co. Inc., New Jersey, U.S.A., for supplying the information on the use of phenyl

mercury acetate for the control of Crab grass (Digitaria sp.) in the United States.

References

1. Ralph Engel, Dale Wolf and G. Ahlgren. Agricultural Chemicals 3, No. 11, 25-27 (1948).

2. J. A. De France. Proceedings of the American Society for Horticultural Science 53, 546-554 (1949).

TABLES

CARROTS

Number of weeds per sampling area

Weed Species	Control Mean of 2 plots	Pre-emergence.		Post-emergence.		Pre-and Post-emergence.		3-week intervals.	
		12lb.	24lb.	12lb.	24lb.	12lb.	24lb.	12lb.	24lb.
Groundsel (Senecio vulgaris)	145	51	8	0	45	5	4	18	2
Shepherds Purse (Capsella bursa-pastoris)	44	10	4	36	74	95	18	71	1
Red Deadnettle (Lamium purpureum)	93	47	84	23	8	13	0	104	11
Plantain (Plantago major)	48	24	9	5	13	0	7	6	0
Corn Sowthistle (Sonchus arvensis)	58	14	3	70	22	8	0	17	22
Veronica Speedwell (Veronica chamaedrys)	142	165	168	71	51	294	58	232	81
Veronica sp.	44	249	264	273	183	384	364	540	483
Chickweed (Stellaria media)	46	105	14	38	38	29	63	211	31
Annual Meadow grass (Poa annua).	7	36	16	69	77	223	333	230	167

TABLES (continued)

ONIONS

Number of weeds per sampling area

Weed Species	Control Mean of 2 plots	Pre-emergence.		emergence.		Pre- and Post-emergence.		3-week intervals	
		12lb.	24lb.	12lb.	24lb.	12lb.	24lb.	12lb.	24lb.
Groundsel (Senecio vulgaris)	87	34	12	88	58	2	2	14	2
Shepherd's Purse (Capsella bursa-pastoris)	100	67	24	138	161	206	4	88	10
Red Deadnettle (Lamium purpureum)	98	24	14	34	16	4	0	58	6
Plantain (Plantago major)	28	12	21	6	1	3	2	23	0
Corn Sowthistle (Sonchus arvensis)	84	88	74	125	63	106	41	28	7
Speedwell (Veronica chamaedrys)	290	228	134	189	18	69	12	223	105
Veronica sp.	539	731	534	855	365	745	435	985	1052
Chickweed (Stellaria media)	74	11	7	11	70	58	12	141	14
Annual Meadow grass (Poa annua)	35	195	217	327	234	378	520	357	162

THE USE OF PENTACHLOROPHENOL FOR PRE-EMERGENCE WEED CONTROL WITH PARTICULAR REFERENCE TO A 15% PCP MISCIBLE OIL FORMULATION*

A. J. LLOYD.
Monsanto Chemicals Ltd., Fulmer, Bucks.

Summary

Experiments carried out during 1953 and 1954 with a PCP miscible oil formulation have shown that at the rate of two gallons in 8 - 28 gallons of water per acre, good control of annual weeds can be obtained in a wide variety of broad leafed vegetable crops by pre-emergence application. Total weed eradication can only be obtained under all conditions if seeds are drilled in a stale seed bed followed by spraying. Lettuce, rape, kale, cabbage, sugarbeet, spinach, parsnips, turnips, carrots, mangolds, radishes, peas and beans have been successfully treated without affecting the subsequent growth of the crop. The cost of this type of spray is of the order of that of the necessary cultivations for weed control. It can be effectively carried out by low volume sprayers.

Introduction

Growers are increasingly aware of the imperative need for a selective herbicide which will eliminate weeds in broad leafed crops whether grown for animal or human consumption. With a steadily diminishing skilled labour force on the land, many farmers find that root crops frequently become so weedy under adverse weather conditions that the seed drills cannot be seen due to overgrowth of weeds and singling becomes difficult. Each mechanised weeding operation merely destroys one crop of weeds but cultivates another by bringing up fresh weed seeds to the surface.

There are two methods of approach to the problem:

A. either the weeds must be eliminated at or near the germinating stage before the crop emerges so that they never present a problem.

or B. both crop and weeds must be sprayed simultaneously after emergence of both, in the hope that the differential action of the spray will be sufficiently great to eliminate the weeds and leave the crop unharmed.

In the former, the action of the chemical is due to contact with the germinating seed or through the roots of the emerging weed seedlings whilst in (B) the primary action of the spray is due to differential response from foliar spray applications. This selective effect may be obtained either by differential contact corrosive action which is dependent on variation of leaf structure or to differences in physiological systemic response.

These two types of applications are currently known as pre- and post-emergence sprays and refer essentially to growth stages of the crop when sprayed.

Pre-emergence sprays however may be applied either to:-

A.1. a stale seed bed in which a varying proportion of the weeds have
or emerged above ground.

A.2. a clean seed bed free of growing weeds.

---

* Experimental Herbicide RD.4194.

According to Robbins et al[1] the original definition of pre-emergence spraying was "a spray treatment of weed seedlings that had emerged before the crop seedlings; the weeds are treated at their most vulnerable stage of development" as in (A.1) above. "With the advent of new organic weed killers a new type of pre-emergence treatment was developed i.e. a chemical treatment of the soil at seeding time or shortly thereafter using the chemical at a rate such that the weeds are killed as they germinated but the crop was left uninjured. Essentially this involves the use of selective herbicides".

Under A.1., a number of materials such as the dinitros, sulphuric and cresylic acids and similar contact materials are being currently tested. The main objection to the use of these materials is that all of the weeds must have emerged above ground before spraying in order to obtain a good kill. They do not possess any appreciable residual action in the soil against weeds subsequently germinating. Under A.2. a great variety of new organic chemicals including CMU, Endothal, SES, IPC etc. are being assayed to find whether their residual action in the soil (as opposed to any direct contact absorption through the leaves of emerged weeds) will provide a differential kill of the weed seeds whilst leaving the crop unharmed.

Pentachlorophenol and Na PCP have been used by various workers in the field on many crops during recent years. Chapell[2] working with soya beans, Detroush and Wauthy[3] and Parker[4] with sugar beet, have obtained good results with various PCP formulations applied pre-emergence (A.2). Kates[5] and Lachman[6] used sodium pentachlorophenate to control weeds similarly in sweet corn and onions respectively. Heydecker and Crawford[7] effectively controlled a wide variety of annual weeds including grasses using a straight PCP mineral oil pre-emergence spray (4 lbs in 25 gallons per acre) in beet, cabbage, lettuce, onions and carrots by pre-emergence application without damage to the crop.

Holstein[8] obtained good control in cotton by post-emergence applications of PCP oil formulations and of course various proprietary preparations are extensively used for both pre- and post-emergence spraying of sugar cane and pineapples in commercial practice.

Careful scrutiny of all the literature shows that it is possible under certain conditions to obtain very effective pre-emergence weed control with either PCP or Na PCP without risks to the crops.

Various workers have shown that Na PCP has a low contact action at economic rates of use and that the main herbicidal effect is due to its residual action in the soil. Owing to the ready water solubility of Na PCP it readily leaches and the toxic effect on weed seeds is of a lower order than that of PCP.

PCP on the other hand, when dissolved in the oil phase of emulsions or in straight oil solutions possesses a marked direct contact effect on emerged plants (as applied in A.1) and the greater amount of PCP in the spray which falls on the soil can only be slowly released by solubilizing in the soil moisture owing to its low water solubility. It is known that variations in soil temperature, moisture, bacterial population, PH, clay and humic fractions (Warren[9] Kratochvil[10], Young and Carroll[11]) and subsequent rainfall and weather conditions all play important roles in the breakdown of PCP and Na PCP in the soil and affect the subsequent success or failure of pre-emergence applications of these chemicals. Since the grower cannot control the majority of the above factors, the aim of this paper is to show how he can minimise

their effect to the point where he can in general obtain a commercially worthwhile control of weeds in a variety of broad leaved crops. The desired result is essentially obtained by applying the minimum quantity of the toxicant (PCP), formulated to provide maximum killing power, to the weeds at their most susceptible growth stage (emerged or emerging) whilst the crop is in its least susceptible condition.

Herbicidal Formulations

PCP as the free phencl is only appreciably soluble in organic solvents including various oils (5% in aliphatic mineral oils) and is usually formulated as an oil water emulsion or in straight oils for spray purposes.

It possesses the limited solubility of 12 p.p.m. at 15°C in water. Sodium pentachlorophenate, on the other hand, is freely soluble in water to the extent of 25% at 20°C and possesses no solubility in cheap organic solvent oils. However, Na PCP water solutions can be emulsified with suitable cheap oils and finally diluted with water for spray purposes.

The inherent properties of the chlorinated phenol and its sodium salt give rise to considerable difficulties in formulation as ready-to-use concentrates suitable for dilution with water. The formulator is left with the choice of either using relatively expensive emulsifiers to provide concentrate oil emulsions for dilution with water or alternatively with the use of expensive solvents to obtain a concentrated solution which can then be diluted with cheap oils for spraying.

These difficulties have however been overcome after considerable research in the form of the PCP miscible oil. In this water-miscible oil formulation the properties of both PCP in the organic solvent phase and Na PCP in the water phase are combined. It contains a total of 15% w/v (1½ lbs per gallon) of total chlorophenols in alkyl phenols. It possesses an average emulsion particle size of approximately 2μ after dilution for spraying and shows no appreciable layering after standing for three weeks. This balanced combination of the free phenol and the sodium salt, provides maximum initial kill with a residual toxicity in the soil of limited duration.

Toxicology

Normal care should be exercised when using PCP in any form. Both PCP and Na PCP in powder form irritate the mucous membranes but, in these liquid formulations, can be mixed with water and sprayed without any deleterious or harmful effects on the user. Any spray residues should be washed off the skin as recommended for most other chemicals.

A comparison of the lethal doses of various chemicals Galley[12] to test animals with the addition of values for pentachlorophenol and sodium pentachlorophenate is shown in Table I.

Kehoe[13], Deichman[14] and Machle[15] proved that the toxicological values of the latter to mammals is of a low order. Kehoe in feeding experiments over 60 weeks could find no evidence of cumulative poisoning either orally or cutaneously. Barnes[16] considers that the lethal dose of PCP is 5 times that of DNC.

TABLE I

Comparison of L.D. Values of Agricultural Chemicals

Material	Approx. Single lethal dose in Mg/kg	Animals tested
Lead arsenate	10	Rats
Mercury salts	10	Rats
Toxaphene	50	Rabbits
PCP in fuel oil	100 - 300	Rabbits
2:4-D acid	200	Rabbits, monkeys
Sodium PCP in water	250 - 300	Rabbits

Technique of Application of PCP Miscible Oil.

Following initial small scale experiments, the following stale seed bed technique (A.1.) was always adopted in all field trials.

1. Some 10 - 14 days before drilling, a seed bed was prepared by good cultivations to fine tilth with mustard broadcast and harrowed to ensure a crop of "weeds".

2. Drilled crop seeds with minimum of soil disturtance.

3. Sprayed plots: (a) immediately if good braird of weed present.

   or (b) if poor weed stand, allow as long a period as possible to elapse before spraying, whilst ensuring that no crop seedlings are emerging when spraying occurs. With most crops the maximum period is seven days (excluding onions).

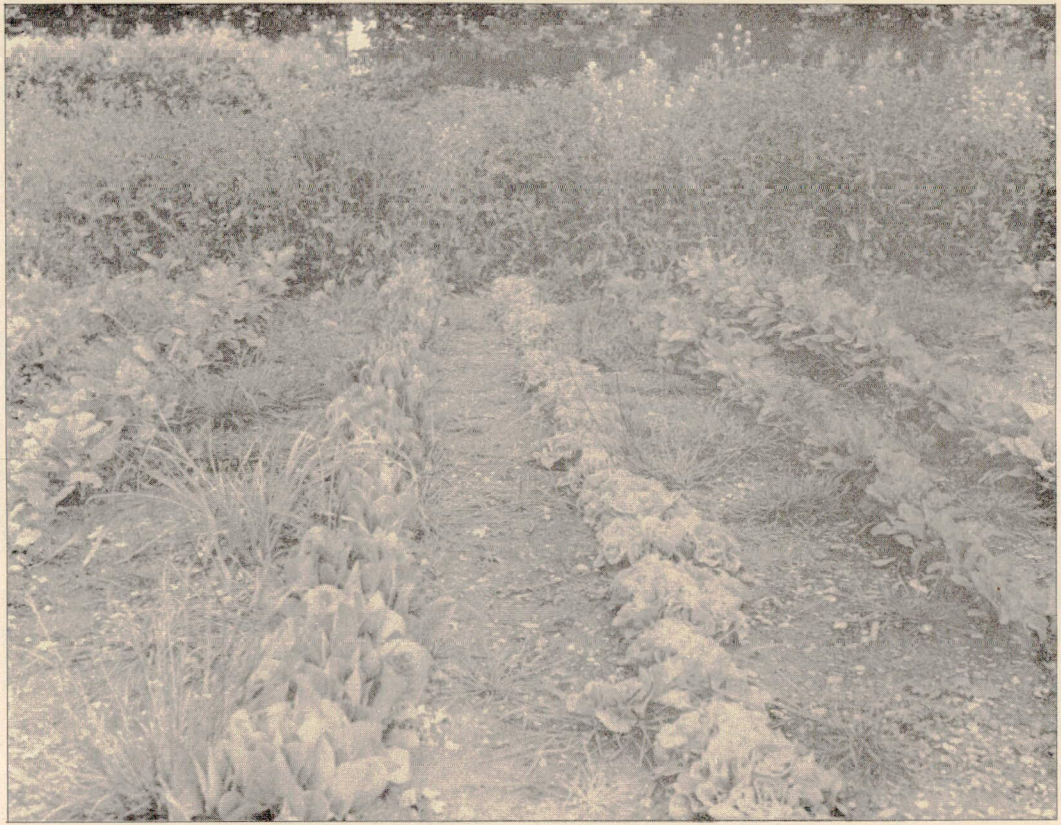
4. Dry warm conditions chosen for day of application normally.

5. Sprayers (whether knapsack or power) always ensured fine evenly distributed spray pattern.

Trials

During the spring and summer of 1953 and 1954 field trials have been carried out both at Fulmer Hall Laboratories and under growers' control PCP miscible oil was normally used at 2 or 3 gallons per acre in 28 gallons of water. At normal spring temperatures (55 - 60°F), both rates of use gave complete weed control in those trials at Fulmer in which the stale seed bed pre-emergence technique was used. One external field trial gave an indication that low volume spraying of 2 gal. PCP miscible oil in 8 gallons of water gave a better control than a similar amount applied in 98 gallons of water per acre.

Table II shows the type of results obtained in trials at Fulmer. Swedes, carrots, kale, rape, cabbage, sugar beet, spinach, beet, peas, beans and onions have been successfully treated by the above described pre-emergence spray technique. During 1954, part of a row of lettuce was damaged at the 2 gallon per acre rate whilst no damage was shown at the higher rate of 3 gallons per acre. This effect was considered to be due to faulty shallow drilling leaving the seeds at the surface (Condon 17). All annual broad leaved weeds



Complete weed control (apart from perennial grasses) in foreground of Fulmer Trial plot photographed eight weeks after pre-emergence spraying with 2 gallons P.C.P. miscible oil per acre; note dense weed cover on unsprayed control plot in background.

and grass seedlings were eliminated at both rates of application. Buried plant rhizomes and creeping thistles gave rise finally to normal plants. No annual weeds appeared on the sprayed areas for 12 and 10 weeks respectively in the years 1953 and 1954 (Plate I) in which time lettuce could have been harvested.

TABLE II

	Varieties	Rate per acre PCP miscible oil		Leaf stage when sprayed	Quadrat randomised weed counts per sq. ft before spraying.			
		2 gals	3 gals					
		Weed Control						
Weeds	Couch	1	1		1,	0,	0,	1
	Annual meadow-grass	0-1	0	2	8,	10,	8,	2
	Chickweed	0	0	4-5	335,	198,	283,	294
	Fat hen	0	0	3	8,	20,	0,	5
	Groundsel	0	0	4	0,	0,	0,	1
	Shepherd's Purse	0	0	4	43,	18,	21,	56
	Cat's ear	0	0	4	6,	12,	15,	8
	Charlock	0	0	4	3,	0,	9,	4
	Mustard (sown on 24/III/1954)	0	0	4	8,	5,	15,	9
		Damage to Crop						
Crop	Crops sown 6/IV/54							
	Red beet	3	3					
	Sugar beet	3	3					
	Spinach beet	3	3					
	Kale	3	3					
	Cabbage	3	3					
	Cos Lettuce	2	3					
	Onions	3	3					
	Carrots	3	3					
	Turnips	3	3					
	Beans (broad)	3	3					
	Beans (scarlet)	3	3					
	Peas	3	3					
	Sweet corn	3	3					

Herbicide applied at 30 gallons/per acre dilution on 7.IV.54 in warm dry conditions and subsequent weather during succeeding fortnight was mainly dry with some showers.

Key: Weed Control and Damage to Crop Rating

0. Complete kill
1. Severe injury
2. Some damage
3. Unharmed

Although no adverse effect on growth was noted in either year at Fulmer, in one co-operative farm trial a perceptible retardation in growth of kale was observable two weeks after pre-emergence spraying under drought conditions. However, the normal 'rolled leaf' symptoms, following damage to the seedling whilst emerging through sprayed soil retaining PCP in quantities above the safe limit, were absent. The crop recovered from this slight check within the following month.

In further trials at Fulmer carried out during September 1954 with day temperatures of 45 - 50°F, it was found that weed emergence in the autumn took place over a longer period than during the spring and summer since even at the highest rate of application of 3 gallons per acre of PCP miscible oil, there was a subsequent emergence of approximately 15% of the total weed population (chickweed species mainly).

However, even under these autumn conditions, the weed kill was sufficiently good to justify commercial application.

Costs

The cost of complete weed control in these various vegetable and forage broad leaved crops bears favourable comparison with that of normal mechanical cultivations. It should also be borne in mind that in a wet season, a number of weed cultivations will be essential whilst with "chemical hoeing", one effective spray gives control over a long period.

Based on the costs of Holmes[17] for a farmer owning a low volume sprayer, spraying 75 acres each year, an operational cost of 7/4 per acre, is given. The same author gave the following Table III of costs of cultivation as produced by Mr. J. K. W. Slater of the National Institute of Agricultural Engineering, to which we have appended the probable cost of chemical weed control with PCP miscible oil including the above figure for application costs.

TABLE III

Crop	Cost per acre		
	£	s.	d.
Roots (other than those below)	2	0	0
Brussels	1	5	0
Sugar beet	2	0	0
Potatoes	2	10	0
Application of 2 gallons PCP miscible oil	2	0	0

Thus it will be seen that the use of PCP miscible oil bears favourable comparison with the present costs of keeping down weeds in these agricultural crops. No costs of the mechanical hoeing of vegetable crops are available but it can be assumed that these would, in most cases, be slightly in excess of those for agricultural crops.

Discussion

It has been shown that both pentachlorophenol and sodium pentachlorophenate can be used to kill weeds selectively. These materials, after absorption in the soil, are detoxified variously by soil bacteria, soil acidity, clay and humus fractions. The rate of breakdown is also largely governed by soil temperature and rainfall. In the presence of all these variables on different soil types under varying climatic conditions it is difficult to apply the exact amount of toxicant to eliminate underground germinating weeds and yet require the material to be broken down to a safe level before the crop seeds germinate and emerge. Under a suitable combination of conditions, this frequently does occur and good control is effected (Parker (4), Ivens(19) and Roberts(20)) but under adverse circumstances, the material may be wasted with consequent disappointment by the user.

However by depending mainly on the direct contact action on emerged weed seedlings, provided there is effective distribution by the spray pattern and all weeds receive a fair cover, effective control is certain. At the same time, the largest proportion of the spray (often over 90%) falling on the surface of the soil, can further eliminate those weeds which are newly germinated, but at the recommended rates of use, its decomposition in the soil occurs under all circumstances before the crop seedlings emerge. This can only be obtained by adoption of the stale seed bed technique or alternatively by delaying spraying until weeds are emerging with slow germinating crops (e.g. onions).

Once complete weed control is obtained by spraying, few further weeds will emerge until the soil is cultivated bringing up weed seeds which will then germinate. This is the main benefit arising from the additional care required to adopt this technique. With the advent of spaced single seed drilling, the growing of root and other crops normally hand singled, becomes a mechanized possibility with no manual operations, when using PCP miscible oil by the stale seed bed technique.

Conclusions

1. The pre-emergence use of PCP miscible oil has been shown to provide control of weeds in a wide range of broad leafed crops.

2. In order to obtain complete weed control, the technique of spraying of a stale seed bed under warm dry weather conditions is advised. By this method, weeds are eliminated more easily by the joint contact and residual action of the toxicant than by reliance on either individual effect.

3. When adverse weather or soil conditions prevent the complete adoption of the technique recommended in (2), as long a period as possible should elapse between drilling seeds and spraying the seed bed in order to obtain prior germination of weed seeds before spraying, as in the spraying of a stale seed bed. Care should be taken that the crop is not emerging when spraying takes place.

4. Two gallons of PCP miscible oil (3 lbs PCP) in 8 - 28 gallons of water is sufficient to give freedom from weeds for a period of some weeks during the spring and summer.

5. No significant adverse effect on crops has been observed under varying conditions.

6. The cost of chemical weed control would not exceed that of normal mechanical cultivations but offers the advantages of semi-permanent weed control and the absence of weed competition.

7. There are no health hazards when using PCP formulations with exercise of the normal precautions adopted when using agricultural chemicals.

References

1. ROEBINS, W. W., Crafts, A.S., and Raynor, R.N. (1953) Weed Control.

2. CHAPPELL, W.E., (1954) Chemical vs. Cultural control of weeds in soya beans. Proc. 8th Ntheast. Weed Control Conf.: 301

3. DETROUX, L. and WAUTHY, R., (1953) Résultats de l'expérimentation en champs d'essais, en 1952, de quelques déshérbants sélectifs susceptibles d'être utilises dans les cultures de betterave. Publ. Vulg. Inst. Belge Amelior. Better. 21. No.1.

4. PARKER, C. (1953) Experiments with various pre- and post-emergence chemical treatments for weed control in sugar beet. Proc. Brit. Weed Control Conf. : 274.

5. KATES, A. H., (1954) A comparison of various herbicides on sweet corn grown under both irrigated and non-irrigated conditions-1953. Proc. 8th Ntheast. Weed Control Conf. : 203.

6. LACHMAN, W. H., (1951) Weed control in set onions and sweet corn. Proc. 5th Ntheast. Weed Control Conf. : 131.

7. HEYDECKER, H., and CRAWFORD, D. V. (1953) Report of Weed-Killer Demonstration. Dept. of Agriculture University of Nottingham.

8. HOLSTUN, J. T., (1952) Post-emergence screening of chemicals and methods for weed control in cotton. Proc. 5th Sth. Weed Conf. : 79.

9. WARREN, G. F. (1950) Chemical weeding possible for direct-seeded tomatoes. Food Packer. 31,. 38.

10. KRATOCHVIL, D. E. (1951) Determinations of the effects of several herbicides on soil micro organisms. Weeds 1, 25.

11. YOUNG, H. C. and CARROLL, J. C. (1951) The decomposition of pentachlorophenol when applied as a residual pre-emergence herbicide. Agron. J.43. : 504.

12. GALLEY, R. A. E. (1952) The toxicity of residual agricultural chemicals. Chem. & Ind. : 342.

13. KEHOE, R.A., GRUEBLEL, W. D., & KITZMILLE, F. V., (1939) Toxic effects upon rabbits of pentachlorophenol and sodium pentachlorophenate. J. industr. Hyg. 21 : 160.

14. DEICHMAN, E. et al. (1942) J. Pharmacol. Exp. Therapeutics, 76 No.2.

15. MACHLE, W. et al (1943) J. Ind. Hyg. 25,

16. BARNES, J. M., (1953) Toxic hazards of certain pesticides to man. W. H. O. Mono. Ser. No.16 Geneva.

17. CONDON, L., (1954) Promising new weed killer for seed beds. Grower 41, 1364.

18. HOLMES, E., (1953) The costs of weeds and the potential value of herbicides in agriculture. Proc. Brit. Weed Control Conf. : 4

19. IVENS, G. W., (1951) Report on weed control experiments at Luddington, Rep. Luddington exp. Hort. Sta. for 44.

20. ROBERTS H. A., (1954) Weeds of vegetable crops and their control. N.A.A.S Quart. Rev. No. 24,

21. GONGGRIJP, J. (1952) Het gebruik Van Minerale Oliepondedende onkruidbestrijdings middelen in Indonesie. Meded. Landb Haogesch, Gent 17

DISCUSSION ON TWO PREVIOUS RESEARCH REPORTS

Mr. Cakebread: Organo mercury compounds started as seed dressings, were then used for foliage sprays, the control of moss in lawns and several other things and now they turn up as weedkillers. I understand that PCP comes from wood preservatives, and is now a selective weedkiller. Perhaps that is the tendency today. There are two questions I would like to ask about these chemicals; first, does Mr. Blandy really think, he seems doubtful from his present paper, that these organo mercury compounds are really going to give us something we want? As far as I can see, for the particular job for which he is using them, there are existing chemicals which perhaps can do rather a better job at a lower cost. The second question is for Dr. Lloyd. Does he think that in PCP we have a weed killer which can be useful to the ordinary gardener as well as to the horticulturists and to the farmers?

Mr. Blandy: I quite agree that the amount of material we have used per acre is out of the question economically, but we feel that as such small amounts of mercury in oil emulsions cause severe foliage damage, there is a possibility that there may be herbicidal oils which, with the addition of mercury, will give a very much better effect than you get at the present.

Dr. A. J. Lloyd: Mr. Cakebread has asked a very relevant question. All we should like to insist is that (a) the man is given the right type of formulated product of pentachlorphenol and (b) he uses it by the recommended "stale seed bed" technique. Its toxicological hazards are nil. Although we ourselves have not used it with watering cans, we understand that in outside trials this method of application has been equally effective to spraying. Although this is important to the small allotment holder we think that PCP is of greater interest to the sugar beet specialists and there is no reason why it should not be used on cotton, tobacco and similar broad leaved crops. At present it is used both pre- and post-emergence in sugar cane and pineapples where the crop can 'take a beating' if the wrong dose is applied, but if other broad leaved crops are sprayed in error after they have emerged there is going to be a nice bare fallow. If the recommended method of use is followed carefully there is no reason why the small man, even the uninitiated, should not handle this material with complete success.

Mr. F. R. Stovell: Most of the treatments mentioned in Dr. Lloyd's paper were applied at the rate of 30 gallons per acre but he does say in the summary that it is satisfactory to reduce the volume to 8 gallons per acre. Was this conclusion based on the single trial reported? Were the experiments all carried out on a soil of fairly low organic content, and has Dr. Lloyd got any experience on high organic soils in the Fens? I feel that the amount of oil he uses with the PCP is rather low for soils high in organic matter.

Dr. Lloyd: The answer to the question of the desirability of high or low volume applications is that we have obtained equally good results from the use of 2 gallons in 8, or in 28 or in 98 gallons of water per acre in different trials provided that there is effective distribution. For weed control in kale we could have shown you photographs of equal weed control obtained by either high or low volume spraying. Actually the Buckinghamshire N.A.A.S. had a farm walk there and showed this trial to farmers although it was the first effort that we had made with an outside collaborator who did not carry out completely our 'stale seed-bed' technique. We were very pleased to find we could get results with low volume applications since that is the important thing. We think that when everybody gets going with this material and finds out how to use it most effectively that the use of 1 gallon per acre will give good results.

We appreciate that the question of the breakdown of a residual soil herbicide by high humus soils in the Fens is important but since we are relying primarily on the contact action in the 'stale seed-bed' technique it is not so important. If the material is to be used on rapidly germinating crops such as lettuce emerging in 3 days possibly, it has got to get away rapidly and still do its job.