CHEMICAL WEED CONTROL IN PEAS

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ALL our crop weeds have been introduced into the country and though it is still possible in some districts to avoid weeds by growing peas out of old-established pasture on land with a negligible cropping history, in most cases the weed seed content of the soils of our cropping districts has now built up to a point where some form of weed control is an essential part of crop production. Cultivation before planting, and harrowing before the crop comes through the ground and after it is up, in the past have played and still can play an important part in producing a clean crop. However, by the end of the last war lack of clean land combined with the shortage and high cost of labour and the need for a high standard of weed control for the efficient operation of mechanical harvesting equipment had forced many farmers on some of the best pea growing land to give up growing crops of peas. The possibilities of DNOC were known at this stage, but there was no equipment in the country suitable for applying the high gallonages of water recommended. The advent of the low delivery rate tips and of low cost and low weight equipment in 1947 altered the situation and trials showed that peas could be weeded successfully with DNOC and later DNBP, using as little as 10 gallons of water per acre to spread the chemical. This work was referred to at the Second, Third, and Fourth Conferences. Since then the use of DNBP has become widespread and the conditions for the successful use of this material have been worked out. The basic principles are set out in Department of Agriculture Bulletin No. 329 by L. J. Matthews, and trade literature sets out the does and don'ts for commercial products.

But DNBP is not the perfect weedkiller. It has many faults to offset its virtues of rapid action and ability to control a wide range of weeds. It is poisonous and users are required by law to wear protective clothing; it is an insidious yellow dye; it will not control perennial weeds; results with annual weeds are very dependent on growing conditions and the weather at the time of spraying; and it loses much of its selectivity at volumes of application below 60 gallons per acre, becoming difficult to handle at volumes below 20 gallons per acre due to the decreased margin of tolerance between weeds and peas. Admittedly proper design of equipment, attention to personal safety, and care in application minimise these defects, and three-quarters of the complaints received about the material stem from spraying too late. But perennial weeds are an increasing problem.

This paper presents some of our attempts to get around these difficulties.

TRIAL DATA

In the case of Californian thistle (*Cirsium arvense*) DNBP only singes the foliage and the resulting check is rarely sufficient to give appreciable control of this weed. Hormone weedkillers are much more effective in this respect. Test strips showed that peas were much more tolerant of MCP than 2,4-D, and, as reported by Blair, sampling of comparative strips treated with DNBP and MCP indicated that low rates of hormone would control Californian thistle and give comparable yields to DNBP treated plots.

In 1950/51 trial strips with MCP were sprayed in a number of fields and a field scale trial at Taitapu was sampled for yield.

TABLE 1—GARDEN PEAS (GREENFEAST),
A. R. McLAUGHLAN, TAITAPU

Treatment	Mean yield (bushels per acre)
MCP, mixed salts $\frac{1}{2}$ lb. a.e. per acre	38.3
MCP, mixed salts $\frac{3}{4}$ lb. a.e. per acre	47.5
MCP, mixed salts 1 lb. a.e. per acre	45.4
Unsprayed	47.0

Differences not significant.

Rates of application in lb. acid equivalent per acre.

Rainfall August to January inclusive, 19.28in., compared with an average of 12.23in. for the period.

The sampling was arranged to coincide with the least weedy portions of the controls. Had the paddock not been sprayed, the wet autumn would have prevented the crop being harvested.

COMMENTS

(1) Under favourable conditions Greenfeast peas will tolerate up to 1 lb. acid equivalent per acre of MCP without appreciable reduction of yield.

(2) $\frac{1}{2}$ lb. acid equivalent per acre of MCP assisted by vigorous crop growth will give adequate control of Californian thistle, wild turnip (*Brassica campestris*), and fat-hen (*Chenopodium album*).

Since then we have sprayed over 1000 acres of garden peas at the rate of $\frac{1}{2}$ lb. acid equivalent of MCP per acre when it was considered that Californian thistles were present in sufficient numbers to justify spraying on their own account.

In 1951/52 a trial was laid down:—

(a) To determine the possibility of using MCP to control Californian thistle in purple-flowered field peas (*Pisum arvense*).

(b) To compare DNBP at 10 and 20 gallons per acre of spray mix.

(c) To determine whether further reduction in volume might effect a further saving in DNBP, in view of the fact that $\frac{3}{4}$ lb. of phenol equivalent ammonium DNBP at 20 gallons per acre gave as effective weed control as $1\frac{1}{4}$ lb. of phenol equivalent at 60 to 100 gallons per acre.

TABLE 2—PARTRIDGE PEAS (MARATHON),
J. CARTER, TEMPLETON

Treatment	Mean yield (bushels per acre)
MCP, mixed salts $\frac{1}{4}$ in 10 gals. water	28.5
MCP, mixed salts $\frac{1}{2}$ in 10 gals. water	20.3
MCP, mixed salts $\frac{3}{4}$ in 10 gals. water	15.6
DNBP, ammonium $\frac{1}{2}$ in 10 gals. water	32.7
DNBP, ammonium $\frac{3}{4}$ in 10 gals. water	33.1
DNBP, ammonium $\frac{1}{2}$ in 20 gals. water	30.8
DNBP, ammonium $\frac{3}{4}$ in 20 gals. water	33.9
Unsprayed	32.4

Least significant difference P.05 = 9.4

Rates of application in lb. acid or phenol equivalent per acre.

Rainfall August to January inclusive, 12.02in., average 12.23in.

COMMENTS

(1) Rates above $\frac{1}{4}$ lb. acid equivalent per acre of MCP seriously damaged the peas, though even at the $\frac{3}{4}$ lb. rate there was considerable recovery.

(2) $\frac{1}{4}$ lb. acid equivalent per acre of MCP was not sufficient to control the thistles.

(3) $\frac{3}{4}$ lb. phenol equivalent DNBP per acre gave better weed control than the $\frac{1}{2}$ lb. rate per acre irrespective of the volume of spray mix used.

(4) 20 gallons of spray mix per acre was slightly better than 10 gallons, irrespective of the rate of DNBP used.

In 1952/53 a further trial was laid down on field peas to compare rate and time of application.

TABLE 3—FIELD PEAS (MARATHON),
G. H. BLAIR, UPPER RICCARTON

Treatment		Stage of growth	Mean yield (bushels per acre)
MCP, mixed salts	$\frac{3}{8}$	7 node 7in. tall	45.0
MCP, mixed salts	$\frac{1}{2}$	7 node 7in. tall	46.0
MCP, mixed salts	$\frac{3}{4}$	7 node 7in. tall	39.4
MCP, mixed salts	$\frac{3}{8}$	13/14 node 15in. tall	44.5
MCP, mixed salts	$\frac{1}{2}$	13/14 node 15in. tall	41.1
MCP, mixed salts	$\frac{3}{4}$	13/14 node 15in. tall	29.5
DNBP, ammonium	$\frac{3}{4}$	7 node 7in. tall	47.8
Unsprayed			49.5
Least significant difference P.05			7.7

Rates of application in lb. acid or phenol equivalent per acre.

Rainfall for period August to January inclusive, 21.44in., average 12.23in.

COMMENTS

(1) Recovery of purple-flowered field peas is a function of rate of application and length of time between spraying and harvesting.

(2) MCP retards or kills the terminal bud. Recovery is more rapid when spraying is carried out before the plants tiller, since at this stage of growth, though the main shoot may go "blind", the tillers develop normally, whereas after tillering both primary and secondary vines are retarded.

Two new developments were reported from England early in 1955. Firstly, the fact that triethanolamine DNBP (amine DNBP) was showing up very favourably as a more selective weedkiller for peas than ammonium DNBP and, secondly, the news of the commercial production of Dr. Wain's phenoxybutyric acid weedkilling compound.

Trials were planned to include these chemicals, but due to shipping delays and an exceptionally early season only a limited programme was carried out.

TABLE 4—GARDEN PEAS (GREENFEAST)
F. COX, CLARKVILLE

Treatment	lb. a.e. or phenol a.e. per acre	Yield bushels per acre	Weed ratings (1=none, 10=most)	
			After 2 weeks	At harvest
MCP, mixed salts	1	19.6	5	1
MCP, mixed salts	½	22.0	7	3
MCP, sodium salt	½	25.5	9	7
MCP, sodium salt	1	20.8	7	4
MCP, sodium salt	2	21.5	6	2
DNBP, ammonium	0.81	23.7	2	6
DNBP, ammonium	0.94	24.7	1	5
DNBP, amine	0.81	28.1	4	8
DNBP, amine	1.1	24.8	3	7

Differences not significant.

Rates of application in lb. acid or phenol equivalent per acre.

Rainfall, August-January inclusive, 6.92in., average 12.23in.

No effective rain fell between drilling and late flowering. One inch of water was applied by overhead irrigation at mid-flowering.

No controls were left since the paddock was badly infested with wild turnip and fat-hen and the grower wished to sow lucerne in the autumn after a light top working.

Ammonium DNBP at 0.81lb. phenol equivalent per acre was considered the correct rate for the day and weed problem, and amine DNBP was applied at equivalent rate. The higher rate of ammonium DNBP was designed to give a reasonably safe overdose and the higher rate of amine DNBP to approach 0.81 rate of ammonium DNBP on the basis of weedkilling efficiency.

Weed control was scored on a 1 to 10 point basis. At the first scoring the DNBP plots were rated on kill, 1 being complete kill, while the hormones were rated on loss of vigour of the weeds, 10 being the score for unaffected. At harvest a score of 1 represented no weeds and 10 the most weedy. The weeds on plots rated at 5 or more were sufficient to interfere with harvesting, while a narrow unsprayed strip would have been rated at 20.

The crop was sampled at the green pea stage for pod number per plant and tenderometer rating of the shelled peas. Counts and readings were very uniform and variation between treatments was no greater than variation within treatments.

Germination 3 months after harvest was 99 to 100 per cent. in all cases.

COMMENTS

(1) All hormone treatments caused stem and petiole curvature. MCPB plots recovered more rapidly than MCP plots, being back to normal within 10 days.

(2) MCP plots acquired a yellowish tinge and later turned bluish green. The MCPB did not develop the yellow tinge and except for the 2lb. acid equivalent per acre rate, which approached the ½lb. acid equivalent per acre MCP rate in appearance, did not develop the bluish tint.

(3) Ammonium DNBP gave slight leaf scorch. Amine DNBP plots showed no scorch and later looked slightly more vigorous and paler than the other DNBP plots.

(4) Amine DNBP gave better kill of wild turnip than ammonium DNBP, but inferior kill of fat-hen.

(5) MCPB gave equivalent kill of fat-hen to MCP, but inferior kill of wild turnip at $\frac{1}{2}$ lb. acid equivalent per acre.

DISCUSSION

The object of the trials has been to check the effect of the chemicals on the peas rather than assess the effect on the weeds. The sites of the field pea trials had few susceptible weeds, and in the garden pea trials their effect was reduced by sampling in the first instance and not measured in the second. This explains the fact that no treatment significantly outyielded the unsprayed controls.

Volume per acre: From Trial 2 and several observation trials not reported here it appears that satisfactory weed control can be obtained with ammonium DNBP with as low as 10 gallons per acre, but that there is a falling off in effectiveness below 20 gallons per acre (pressure constant at 50 lb./sq. in.). Ammonium DNBP at 0.81 lb. phenol equivalent per acre seems to be the minimum reliable dose rate in the 60 to 70 degrees F. range.

Some lower foliage scorch has been associated with all effective dosage rates irrespective of volume (up to 60 gallons per acre), using ammonium DNBP. English work indicates that at low volumes ammonium DNBP may reduce yield in some cases and that the more selective amine DNBP, though costing more for equivalent weed control, may in fact give a higher net return. It is of interest in this respect that in the trial reported above, amine DNBP did not cause any burn and gave the highest yield, though differences were not statistically significant.

The 20-gallon lower limit also seems to apply in the case of the hormones, though no yield data are available. A slightly greater curvature was noted in the low volume strips when $\frac{1}{2}$ lb. acid equivalent of MCP in 8 gallons of water per acre was compared with the same quantity of active ingredient in 20 gallons of water.

MCPB has been compared at similar differences in volume and no visual differences in reaction have been noted.

Effect of MCP: It seems that in a season with adequate moisture garden peas will tolerate 1 lb. acid equivalent per acre of MCP without appreciable reduction of yield, but that in a dry year $\frac{1}{2}$ lb. acid equivalent per acre will be the upper permissible dose rate. The latter rate is sufficient to control Californian thistle under average conditions, but there will be regrowth before harvesting for seed in a dry year, and while it controls wild turnip and fat-hen, weeds such as willow-weed and wire-weed will only be checked slightly.

Effect of MCPB: The effects of MCPB are similar to those of MCP, the differences being one of degree, $\frac{1}{2}$ lb. acid equivalent per acre MCP being in our experience equivalent to $1\frac{1}{2}$ lb. acid equivalent per acre MCPB in terms of initial reaction or 2 lb. acid equivalent per acre of MCPB in terms of rate of recovery. This implies that in the case of garden peas MCPB is only $\frac{1}{3}$ to $\frac{1}{4}$ as toxic as MCP. English work rates the toxicity of MCPB at $\frac{1}{4}$ to $\frac{1}{16}$ of MCP. Therefore, if it is allowed that a rate $\frac{1}{2}$ lb. acid equivalent per acre of MCP does not adversely affect yield, a rate of 1 lb. acid equivalent per acre of MCPB would be even safer, and at the same time permitting more effective control of

the susceptible weed. Weeds controlled by MCPB at 1lb. acid equivalent per acre in spring sown peas include Californian thistle, wild turnip, fat-hen, Prince of Wales feathers (*Amaranthus* spp.), black nightshade (*Solanum nigrum*), wireweed (*Polygonum aviculare*), and cornbind (*P. convolvulus*).

Comparison of MCPB and DNBP: MCPB is not poisonous or unpleasant to handle, it is much less dependent on temperature and conditions of growth at time of spraying than is DNBP. As a result it is easier to manage at low gallonage. However, it is much slower acting and is much less effective against willow weed, fumitory, and spurrey. At low rates of application yields are likely to be similar; therefore, MCPB will probably be preferred to DNBP, especially where Californian thistle and Prince of Wales feathers or redroot are troublesome. Further trials are necessary to determine whether amine DNBP can economically replace ammonium DNBP.

TIMING OF APPLICATION

"Catch them young" is the golden rule in crop weed control and is the key to success with DNBP. Peas can be sprayed with DNBP at any time after they come up, using low volume and observing the rules relating to temperature, growing conditions, etc. MCPB should not be applied before the peas are at the 4 node stage or after 3 nodes before flowering. Both limits are arbitrary. The former is suggested since in a pre-emergence trial using MCP, the crop was severely damaged when rain fell shortly after emergence. The latter limit is suggested since seedless pods have been noted on peas sprayed with MCP at flowering. Node number incidentally is a much more reliable guide to age than plant height. A node is the region of the stem where a leaf or branch shoot joins the stem.

Purple-flowered field peas: These appear to be about $\frac{1}{4}$ to $\frac{1}{2}$ as resistant to MCP as garden varieties. Observation plots indicate that they are much more resistant to MCPB, but further trials are required to confirm this. At present $\frac{1}{2}$ lb. acid equivalent per acre of MCPB could be used in the case of severe infestations of Californian thistle, provided spraying is carried out at the 7 to 8 node stage.

CONCLUSIONS

(1) Choice of weed control methods should be such as to give the maximum net return from the crop. The cheapest initial treatment will not necessarily be the best in this respect. Further work is needed to compare MCPB, ammonium DNBP, and amine DNBP on the basis of net return at varying weed levels.

(2) From the evidence available chemical weed control cannot be recommended for lightly infested crops, except where weeds likely to reduce the quality of the crop occur (black nightshade and Californian thistle in peas for canning or quick freezing).

However, where fields are moderately to heavily infested with weeds or the weeds will reduce the quality of the crop chemical weed control is to be preferred to cultivation on the score of greater reliability. Pre-planting cultivation should be designed to give the best possible seed-bed for the peas and not specifically for weed control. No cultivation should be carried out after the peas are up, unless required to free soils compacted by rain.

(3) Because it is non-poisonous, pleasant to handle, and less dependent on temperature and growth conditions at time of spraying than DNBP and because it will control Californian thistle plus the more

troublesome annual weeds MCPB has none of the objectionable features of DNBP and should rapidly replace the latter material as the standard garden pea spray. Further trials are required to determine rates of application, 1lb. acid equivalent per acre being suggested as an interim upper limit.

(4) DNBP will still be used where weeds resistant to MCPB (willow-weed and may-weeds) are present and, in the meantime, in purple-flowered field peas.

(5) MCPB resistant weeds should be sprayed with DNBP as soon after germination as possible, and MCPB should be applied as soon as possible after the 4 node stage.

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DISCUSSION

Q.—Would you agree that a slow kill is better than a quick kill?

A.—Rapid removal of weeds in early stages has given the best results.

Q.—Have you any experience with CMU and PMU on peas?

A.—No.

Q.—Has there been any taint or loss of flavour in peas sprayed with hormones?

A.—No. Trials are being carried out in England at present.

Q.—Have you any experience with different pressures while spraying peas?

A.—Most work has been done with low volume sprays at 60 gallons or less. The majority at 30 gallons and at pressures of 50lb. per square inch. No difference ranging from 30lb. to 70lb. per square inch.