FIELD TRIALS ON THE RETENTION OF POTATO STOCKS IN ENGLAND

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INTRODUCTION

Since the early 1930's British potato stocks have improved greatly in health, and especially in freedom from virus diseases, because the regulations for the certification of seed tubers have been made more stringent and ware-potato growers usually buy new "certified" seed every year or other year. Today nearly two-thirds of the ware (table-stock) acreage in England is planted with certified seed and almost all the rest is "once-grown", i.e. in the second year on that particular farm or in a ware-growing area. New certified seed is expensive and may account for about one-third of the cost of growing the crop, so ware-potato growers might decrease this cost if they could grow their stocks for three, four or more years instead of for one or two (BROADBENT, BURT & NIX, 1957).

Experiments with replicated small plots done at Rothamsted since 1949 show that efficient aphicides, applied to a potato crop four or more times beginning soon after the plants emerge through the ground, stop leaf roll virus spreading and check the spread of virus Y (which causes the disease rugose mosaic) by killing the aphids that spread these viruses (BROADBENT, BURT & HEATHCOTE, 1956; 1958). The proximity of unsprayed to sprayed plots in these experiments probably decreased the beneficial effect of spraying and this bias was further increased by surrounding each plot with a strip of unsprayed healthy potatoes which could be a source of aphids but not of viruses.

METHODS

To find whether the results obtained at Rothamsted apply to field crops and in other parts of England, where patterns of aphid movement and virus spread might differ, several trials were arranged in co-operation with officers of the National Agricultural Advisory Service (N.A.A.S.) and with potato growers. To avoid the bias in the small plot trials it was desirable to take two similar fields in each area, allocating at random

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one to be sprayed and one unsprayed. Several trials of this kind were started, but the unsprayed controls had to be abandoned in areas where viruses spread rapidly because infection not only led to loss of crop, but to danger that dispersing aphids would carry viruses to other potato crops. Several growers refused from the first to grow an unsprayed stock for more than one year.

It was, therefore, necessary to seek indirect evidence by using aphid trap catches in many of the trials to indicate whether conditions would have favoured spread had the crops not been sprayed. This is possible because virus spread in standardized experiments was previously correlated with the numbers of winged *Myzus persicae* SULZ. trapped in unsprayed potatoes during the season (BROADBENT, 1950; HOLLINGS, 1955). The traps (BROADBENT, DONCASTER, HULL & WATSON, 1948) were operated in unsprayed potatoes near to sprayed plots and some idea of what the spread would have been was obtained from the numbers of *M. persicae* caught, combined with knowledge of the spread that occurred each year in the unsprayed control areas of statistically designed experiments done at Rothamsted (BROADBENT *et al*, 1956, 1958), Lymington (BROADBENT, HEATHCOTE, BROWN & WHEELER, 1960) and Sprowston (see below).

Growers were asked to plant about two acres of certified seed and to spray and retain seed from this stock to plant a similar acreage during later years until the stock contained up to 10% infected plants. Stocks were usually renewed before this. Plants showing symptoms of leaf roll or rugose mosaic were rogued (removed) in a few trials either by N.A.A.S. officers or by us. When the sprayed area could not be isolated from other potato crops, growers were asked to place it among unsprayed healthy potatoes. They were recommended to spray the remainder of their stocks once during early July to decrease the number of summer migrant aphids, which may carry virus from one crop to another during July and early August. The aphids on sprayed and unsprayed plants were counted several times during each season to check the efficiency of the spraying. The counts are not quoted because past experience shows that they are less related to virus spread than are the trap catches.

Guided by conclusions drawn from the Rothamsted experiments, most growers used proprietary brands of DDT emulsion applied at either high or low volume at the rate of 2 lb. of active ingredient per acre until the potatoes ceased growing rapidly, after which 1 lb. per acre was applied. The other insecticide used occasionally was demeton-methyl ("Metasystox"). The importance of applying the first spray when about 75–90% of the plants had emerged was stressed. The plants are then most susceptible to infection by viruses and aphids are best able to acquire virus from infected plants within the crop.

RESULTS

Introduction of virus into healthy crops

Those trials which were planted with healthy stocks are listed in TABLE 1 together with the incidence of leaf roll or rugose mosaic in them the following year. In 12 trials where seed was saved from unsprayed potatoes adjoining the sprayed, disease inciden-

TABLE 1. Incidences of disease due to virus introduced into healthy stocks during their first year in England

Year *Jahr Année*	Site – *Lage – Localité*	Variety *Sorte Variété*	*M. persicae* trapped *gefangen capturés*	Leafroll *Blattroll enroulement* % S[1]	% U[2]	Rugose mosaic *Kräuselmosaik frisolée* % S[1]	% U[2]
1952	Essex, Clavering	King Edward	10	1,2	1,1	2,6	2,1
1953	Essex, Harlow	King Edward	377	3,7	4,1	0,05	0,05
	Herts., Rothamsted	Majestic	148		1,6		0
1954	Glos., Badminton	Arran Pilot		0	0	0,1	0,5
	Glos., Elkstone	,, ,,		0,01	0,2	0,02	0,1
	Hants., Lymington	Ulster Prince	7	0,2		0,03	
	Herts., Rothamsted	Majestic	8		1,0		0,4
1955	Berks., Drayton	Majestic	12	1,0		6,0	
	Cambs., Guyhirn	King Edward	125	0,4	0,1	0,1	0,2
	Cornwall, Redruth	Arran Pilot	3	0		0	
	Durham, Bish. Auckland	Arran Peak		0	0	0,2	0,2
	Essex, Chelmsford	King Edward	31	0,7		2,8	
	Essex, Corringham	Majestic	21	0,5		0,6	
		Red King		0,1		1,0	
	Essex, Hatfield Peverel	,, ,,		0,3		0,9	
		,, ,,		0,1		0,4	
	Essex, West Mersea	King Edward	65	1,1		0,4	
	Essex, West Thurrock	Home Guard		2,3		20,7	
	Essex, Writtle	King Edward		0,5		3,9	
	Herts., Rothamsted	Majestic	105		0,4		0,7
	Lincs., Grainsby	,,	54	0	0	0	0
	Norfolk, Sprowston	King Edward	13	0,2	0,3	0,2	0,3
	Yorks., High Mowthorpe	,, ,,	22	0	0	0	0
1956	Cornwall, Redruth	Arran Pilot	6	2,4		0	
	Herts., Rothamsted	Majestic	72		1,3		0
	Lincs., Long Sutton	King Edward	136	0,1	0,4	0	0
	Northants., Peterborough	Majestic		0,1		0,1	
		King Edward		0,2		0,1	
	Yorks., Hemingbrough	Majestic		0		0	
	Yorks., Nigh Mowthorpe	King Edward (2nd year)	6	0	0	0	0
1957	Essex, Harlow	King Edward	35	1,5		3,5	
	Herts., Rothamsted	Majestic	121		3,2		7,6
	Northants., Peterborough	King Edward	285	0,5		0,2	
1958	Herts., Rothamsted	Majestic	16		0		0

[1] Sprayed – *gespritzt – pulvérisé.*
[2] Unsprayed – *nicht gespritzt – non pulvérisé.*

TABELLE 1. *Auswirkung der Krankheiten verursacht durch das in gesunde Pflanzungen in England im ersten Anbaujahre eingeführte Virus*

TABLEAU 1. *Incidence des maladies causées par le virus, introduit dans des plantations saines en Angleterre pendant leur première année*

ces in both stocks the next year were similar, indicating that spraying did not prevent aphids that were already infective when they entered the crop from infecting plants. This was expected, for aphicides applied to plants usually take at least an hour to incapacitate an aphid.

In only five trials was no virus introduced; more leaf roll than Y was introduced into eleven trials, and more Y than leaf roll in 13. Although evidence is given later that crops can, occasionally, be seriously infected by aphids during their summer dispersal, the most obvious conclusions from these results are that usually few plants are infected by summer migrants because the health of most potato crops on which they developed is good, which reflects credit on the seed certification schemes. The high incidence of rugose mosaic at West Thurrock, Essex, may be typical of areas in which market garden crops and early potatoes are grown: stocks are normally grown for two years because once-grown crops yield earlier than new stocks; aphids readily survive the winter and virus Y is carried from the once-grown to the new stocks.

Virus spread during the years 1954–1959

Experiments on the control of virus spread were done each year at Rothamsted, starting with about 0,8 % of tubers in each plot infected with leaf roll virus and 0,8 % with virus Y. TABLE 2 shows the catches of *M. persicae* in nearby unsprayed potatoes, and the factors by which the diseases increased, as calculated from samples from each unsprayed plot grown the next year. Similar results were obtained from the Lymington and Sprowston experiments.

Although these experiments were done with small replicated plots and under different conditions at the different places, they confirm past experience that when *M.*

TABLE 2. Disease increase in unsprayed plots during 1954–58

		M. persicae trapped – *gefangen* – *capturés*	Factors by which increased[1]	
			Leaf roll	Rugose mosaic
Rothamsted	1955	105	× 15,3	× 13,6
	1956	72	× 7,4	× 4,9
	1957	121	× 25,0	× 44,2
	1958	16	× 5,2	× 3,5
Lymington	1954	7	× 4,2	× 2,1
	1955	12	× 26,8	× 7,9
	1956	43	× 12,7	× 7,1
Sprowston	1956	144	× 7,0	× 0
	1957	46	× 6,3	× 51,0

[1] *Erhöhende Faktoren für Blattroll bzw. Kräuselmosaik – facteurs d'augmentation de l'enroulement et de la frisolée.*

TABELLE 2. *Krankheitszunahme in ungespritzten Parzellen 1954–1958*
TABLEAU 2. *Augmentations des maladies dans des parcelles sans pulvérisation en 1954–1958*

persicae are numerous, especially during May, June and July, the incidences of both diseases can be expected to increase by at least five times. If viruses do not spread in sprayed plots when aphids are numerous, it is reasonable to conclude that this is a result of the treatment.

Stocks retained for three years or longer

Several unreplicated trials were done in potato-growing areas where *M. persicae* are usually numerous and where viruses were expected to spread rapidly. The farmers normally bought new seed stocks every one or two years but the sprayed stocks provided profitable crops for three or four years (TABLE 3). The Peterborough and Guyhirn stocks could have been grown for a fifth year and the Long Sutton one possibly for several more years.

Aphids became very numerous during September 1957 at both Guyhirn and Peterborough (3320 aphids per 100 leaves on 5 September) after spraying had stopped in mid-July, but they did not spread virus to many plants. The high incidence of leaf roll (9%) at Corringham (Essex) in 1958, and the low incidence of rugose mosaic, suggest that leaf roll virus had been introduced, for had it been spread within the crop virus Y would probably have spread also.

Several other trials were done in areas where aphids are usually few and which, in consequence, might be suitable for growing seed potatoes with or without aphid control by spraying (TABLE 4). Despite adequate spraying, in 1956 virus Y infected many plants in both sprayed and unsprayed Badminton stocks, and leaf roll and Y viruses infected the Elkstone stocks.

The trial at Penallt (Monmouth) was done in an area at present eligible for the production of certificate "A" seed. During 1957 virus Y was introduced into the crop by aphids; had spread been within the crop, more leaf roll virus would have been expected. In 1958 rugose mosaic was prevalent and about 70% of the tubers proved to be infected with virus Y when grown in 1959. The trial near Redruth (Cornwall) started in 1955 with a stock of *Arran Pilot* that had been grown unrogued and unsprayed for six years in an area on Dartmoor approved for growing stock seed and was still healthy. Aphids were very few each year but leaf roll was introduced in 1956 and because spraying did not start until 2 to 6 weeks after the plants had emerged in the different years, it increased to nearly 4% in 1958.

Where aphids were few spraying did not appreciably prolong the life of the stocks, and the trials confirmed previous inferences that spraying does not prevent viruliferous aphids from infecting plants when they invade a crop.

Replicated experiments on degeneration

Two experiments were done to study the increase in virus disease in crops initially free from virus-infected plants and to find whether spraying prolonged the useful life of the stocks. A secondary aim was to find the best times to spray. In both experiments five treatments were tested in 1/5 acre plots in a Latin Square, planted with an "A" stock of the variety *King Edward*, as follows:

TABLE 3. Spraying treatments, *M. persicae* trapped, and disease incidences in trials in areas where *M. persicae* were numerous

Site – *Lage* – *Localité*	Variety *Sorte* *Variété*	Year *Jahr* *Année*	Spray *Spritzung* *Pulvérisation*	*M. persicae* trapped *gefangen capturés*	Leaf roll *Blattrol*[1] *enroulement* % S[1]	Leaf roll % U[2]	Rugose mosaic *Kräuselmosaik* *frisolée* % S[1]	Rugose mosaic % U[2]
Cambs., Guyhirn	King	1955	DDT HV/L6	125	0	0	0	0
	Edward	1956	DDT HV5	235	0,4*	0,1	0,1*	0,2
		1957	MS HV1 DDT HV2	121	0,4*	1,2	0,04*	0,5
		1958	DDT HV1 MS HV1	99	4,2		0,3	
Essex, Corringham	Red King	1955	DDT HV/L5	21	0		0	
	Edward	1956	DDT HV/L2 HV2	209	0,1		1,0	
		1957	DDT HV1	31	?		?	
		1958	DDT HV1	–	9,4		1,0	
Holland, Lincs., Long Sutton	King	1956	DDT HV/L4 HV1	136	0	0	0	0
	Edward	1957	DDT LV2 HV/L2	79	0,1*	0,4	0	0
		1958	DDT LV2 MV/L1	68	1,2*		0,1*	
		1959	DDT MV/L1	–	0,4		0,1	
Norfolk, Sprowston	King	1955	DDT MV1 HV5	13	?		?	
	Edward	1956	DDT MV/L6	144	0,2	0,3	0,2	0,3
		1957	DDT MV/L6	46	0,7	2,1	0	0,1
		1958	DDT MV/L3	–	1,5	13,3	5,3	5,1
Northants., Peterborough	King	1956	DDT MV2 HV/L2	–	0		0	
	Edward	1957	DDT MV2 HV/L1	285	0,2*		0,1*	
		1958	DDT MV1 HV/L3	59	0,6		0,2	
		1959	DDT MV1	36	3,3		1,7	
Northants., Peterborough	Majestic	1957	DDT MV2 HV/L1	285	0		0,02*	
		1958	DDT MV1 HV/L3	59	?		?	
		1959	DDT MV1	36	4,8		0,1	

[1, 2] See notes in TABLE 1 – *siehe Anmerkungen zu* TABELLE 1 – *voir notes du* TABLEAU 1.

HV – high volume, ≥ 70 gal./acre
MV – medium volume, 30–69 gal./acre
LV – low volume, < 30 gal./acre
} overhead jets only.

HV – hohe Gabe ≥ 70 "gal./acre"
MV – mittl. Gabe, 30–69 "gal./acre"
LV – niedr. Gabe < 30 "gal./acre"
} *nur Spritzungen der oberen Blattspreite.*

HV – forte dose ≥ 70 "gal./acre"
MV – dose moyenne 30–69 "gal./acre"
LV – faible dose < 30 "gal./acre"
} *pulvérisations seulement sur le dessus des feuilles.*

/L overhead and underleaf jets – *Spritzungen der oberen und unteren Blattspreite – pulvérisations sur le dessus et le dessous des feuilles.*

1–6 number of sprays – *Anzahl der Spritzungen – nombre de pulvérisations.*

* rogued – *kranke Pflanzen ausselektiert – épuration sanitaire.*

MS demeton-methyl (metasystox).

TABELLE 3. *Spritzbehandlungen, Zahl gefangener M. persicae und Auswirkung der Krankheiten bei Versuchen in Gebieten mit zahlreichen M. persicae*

TABLEAU 3. *Pulvérisations, nombre de M. persicae capturés et incidence des maladies dans des essais effectués dans des régions où M. persicae était nombreux*

TABLE 4. Spraying treatments, *M. persicae* trapped, and disease incidences in trials in areas where *M. persicae* were few

Site – *Lage* – *Localité*	Variety *Sorte* *Variété*	Year *Jahr* *Année*	Spray *Spritzung* *Pulvérisation*	*M. persicae* trapped *gefangen* *capturés*	Leaf roll *Blattroll* *enroulement* % S[1]	Leaf roll % U[2]	Rugose mosaic *Kräuselmosaik* *frisolée* % S[1]	Rugose mosaic % U[2]
Berks., Pusey	Arran Pilot	1955	DDT a.HV5	2	0,2*		0,3*	
			b.HV5		0,2		0,3	
			c. LV5		0,2		0,3	
		1956	DDT a.HV4	9	0	0,3	0,3*	0,8
			b.HV4		0		0,3	
			c. LV4		0		0,8	
		1957	DDT a.HV4	11	?		?	
			b.HV4					
			c. MV4					
		1958	DDT a.HV1	–	1,8		4,8	
			b. HV1		1,0		5,1	
			c. MV1		1,5		6,5	
Cornwall, Redruth	Arran Pilot	'49/54	Unsprayed, unrogued			0		0
		1955	DDT MV2	3	0		0	
		1956	MS MV2	6	0		0	
		1957	MS MV2	1	2,4		0	
		1958	MS MV2	0	3,7		0	
Durham, Bishop Auckland	Arran Peak	1955	DDT HV4	–	0,1	0,1	0	0,1
		1956	DDT HV3	–	0,2	0,1	0,2	0,3
		1957	DDT HV3	0	0,1	0,2	0	0,2
Glos., Badminton	Arran Pilot	1954	DDT HV5	–	0	0,01	0	0
		1955	DDT HV4	17	0	0	0,1*	0,5
		1956	DDT HV4	12	0,1	0,2	4,2	0,6
		1957		–	0,3	0,9	47,5	24,5
Glos., Elkstone	Arran Pilot	1954	DDT HV4	–	0	0	0	0
		1955	DDT HV4	17	0,01*	0,2	0,02*	0,1
		1956	DDT HV3	3	0,2	0,1	3,6	0,6
		1957		–	8,6	11,8	9,7	6,3
Lincs., Lindsey, Grainsby	Majestic	1955	DDT HV/L6	54	0,2	0,2	0	0
		1956	DDT HV/L7	39	0,2	0,3	0	0
		1957	DDT HV/L6	0	1,3		0	
		1958	DDT HV/L1	6	0,6		0,1	
		1959		–	0,7		0,04	
Monmouth, Penallt	Arran Pilot	1955	DDT HV/L4	19	0,1	0,1	0	0
		1956	DDT HV/L4	0	0	0,04	0	0,04
		1957	DDT MV/L2	1	0,01	0,04	0,05	0,09
			HV/L2					
		1958	DDT MV1	1	0,2	0,5	?	?
			HV/L3					
		1959		–	0	0,4	74,3	63,3

[1, 2] See notes in TABLE 1 (for explanation of abbreviations in column 4: see TABEL 3) – *siehe Anmerkungen zu* TABELLE 1 (*zur Erläuterung der Abkürzungen in Spalte 4: siehe* TABELLE 3) – *voir notes du* TABLEAU 1 (*pour explication des abréviations de la colonne 4: voir* TABLEAU 3).

TABELLE 4. *Spritzbehandlungen, Zahl gefangener M.persicae und Auswirkung der Krankheiten bei Versuchen in Gebieten mit nur wenigen M.persicae*

TABLEAU 4. *Pulvérisations, nombre de M.persicae capturés et incidence des maladies dans des essais effectués dans des régions où M'persicae était rare*

1. Unsprayed.
2. Sprayed with DDT 6 times (TABLE 5).
3. Sprayed on 2nd and 4th occasions.
4. Sprayed on 2nd occasion (mid-June).
5. Sprayed on 4th occasion (mid-July).

The experiments were done at the Agriculture Station, Sprowston, Norfolk and the N.A.A.S. Experimental Husbandry Farm, High Mowthorpe, Yorks. At Sprowston the plots in treatment 2 were sprayed soon after emergence, 10 days later and then every 14 days. Aphid control was relatively poor in 1955 when underleaf lances were not used, but was good in subsequent years when they were. Seed tubers from the five plots of a treatment were bulked and redistributed among the plots of that treatment each year.

The stock contained a few infected plants in 1955, and leaf roll virus spread each year in the unsprayed plots until, by 1958, 13,3% of the plants were infected in contrast to only 1,5% in plots sprayed six times (TABLE 5). *M. persicae* were few in 1956 until late July and the second spray in mid-June was less effective in stopping the spread of leaf roll virus than was the fourth in mid-July. The small samples of 1500 plants per treatment taken for disease assessment may account for the apparently low incidence of leaf roll in treatment 3 in 1957. Virus Y spread rapidly in 1957 when winged aphids were unusually numerous early; in 1958 incidence was related to that of the previous year, spraying in 1957 having failed to decrease spread. The results confirm those obtained at Rothamsted in 1955 and suggest that more than two but fewer than six sprays would be optimal.

At High Mowthorpe, in an area eligible for producing Stock Seed the stock was

TABLE 5. Average incidences of disease in plots with different treatments, Sprowston, 1956–8[1]

Treatment – *Behandlung* – *traitement*	Leaf roll % – *Blattroll in* % – *enroulement en* %			Rugose mosaic % – *Kräusel-mosaik in* % – *frisolée en* %		
	1956	1957	1958	1956	1957	1958
1. Unsprayed	0,3	2,1	13,3	0,3	0,1	5,1
2. Sprayed 6 times	0,2	0,7	1,5[2]	0,2	0	5,3
3. Sprayed 2nd & 4th occasions	0,4	0,1	3,9[2]	0,1	0,3	9,8[2]
4. Sprayed 2nd occasion	0,1	1,9	11,5	0	0	3,8
5. Sprayed 4th occasion	0,1	0,8	6,6[2]	0,4	0,9	19,1[2]

[1] Based on 2 samples of 150 tubers each per plot, i.e. 1500 per treatment – *basiert auf 2 Proben von je 150 Knollen pro Parzelle, d.h. 1500 Knollen pro Behandlung – basé sur 2 échantillons de 150 tubercules chacun, c. à d. 1500 par traitement.*

[2] Significantly different from unsprayed at 5% level – *signifikant different von ungespritzt (P 0,05) – significativement différent de non pulvérisé au seuil 0,05.*

TABELLE 5. *Durchschnittliche Auswirkung der Krankheiten in Parzellen mit verschiedenen Behandlungen in Sprowston 1956–1958*[1]

TABLEAU 5. *Incidence moyenne des maladies dans des parcelles ayant subi différents traitements à Sprowston en 1956–1958*[1]

initially healthy and no virus was introduced during the three years of the experiment, although 22 *M. persicae* were trapped during 1955, 6 during 1956 and 3 during 1957.

DISCUSSION

Although some of these trials lacked adequate controls of unsprayed fields, the results confirm the conclusion of the small-plot experiments that growers could often keep their potato stocks healthy for three, four or more years by spraying with insecticides. Although the sprays must be applied carefully and early enough, success will depend largely on whether virus Y is present and on the extent to which viruses are transmitted from one crop to another in the area. Such spread between crops would be decreased by spraying all infected potato crops with a suitable aphicide during the first half of July for this would check the development and dispersal of winged aphids.

Aphids sometimes colonize potato plants as soon as these emerge, and in such condition contact insecticides may not be fully effective. Experiments at Rothamsted in 1957 showed that in these circumstances a systemic is more effective than a contact insecticide for it is carried to aphids hidden beneath leaves near the ground; also many systemic insecticides have a fumigant action. Since 1940 there have been three springs when aphids were numerous early, and because such seasons cannot be predicted, the routine use of a systemic insecticide for the first spray is preferable. In several of the trials aphids were less well controlled by DDT when only overhead nozzles were used than when sprays were applied by both overhead and underleaf nozzles.

One reason why relatively few plants become infected during July and August, when populations of both winged and wingless potato aphids are usually maximal in England, is that plants at this time are less susceptible to infection than when they are young (BROADBENT, GREGORY & TINSLEY, 1952). Another is that old infected plants are less effective sources of leaf roll virus than young plants (KASSANIS, 1952); also, plants infected with virus Y sprawl and die early (BROADBENT & GREGORY, 1948). During the present trials large aphid populations sometimes developed during August and September after the last spraying, for example at Guyhirn and Peterborough in 1957; or when hot weather affected the efficiency of the insecticide as at Rothamsted and Sprowston in 1955. Although numerous, these aphids did not spread virus extensively within the crop. Experiments have not so far given any evidence that spraying after the third week of July is worth while. Four sprays between emergence and mid-July adequately protected potatoes planted during late March and April from spread within the crop.

Many potato inspectors and plant pathologists in England consider that leaf roll virus is the major cause of degeneration in potato stocks, because stocks from Scotland and Ireland sometimes contain a few tubers infected with leaf roll virus but seldom any infected with virus Y. Leaf roll is the disease most commonly seen in new or once-grown stocks, but when stocks are kept longer than this, virus Y becomes in many areas much more important. Leaf roll can be controlled by spraying and roguing, so infection with virus Y is now the principal factor limiting the retention of stocks in

England. As this virus is introduced into stocks mostly in midsummer from nearby potato fields, the need for co-operative action among growers is obvious.

The trials show that there are some areas of England where potato stocks might be kept for three or more years without spraying, although not all of them are recognized as suitable for growing certified seed. Aphids are usually few in these areas, and there is little spread of virus within crops, but some are not distant enough from "degeneration" areas from which viruses can be carried occasionally by dispersing aphids.

The results of these trials did not suggest that roguing, in addition to spraying, decreased disease sufficiently to warrant the labour involved. However, it has been worth while in a small area grown specially for seed in Hampshire (BROADBENT *et al*, 1960) and in a trial at Harlow (BROADBENT *et al*, 1958). As infected potato plants are seldom sources of virus for spread within the crop during the same season that they are infected, there is no need to spray again after thoroughly roguing.

In all these trials seed was obtained as a by-product from a ware crop. This entails spraying a large acreage, which is time-consuming and often difficult or impossible in a wet year. Although a small area grown specially for seed is slightly more costly, it has many advantages, particularly as the work is more likely to be done conscientiously. A small area is also more quickly rogued.

The financial advantages of saving seed from the ware crop or on the ware farm will vary with the relative prices for seed and ware tubers. Growers of first early potatoes are likely to find the system most profitable because home-grown seed often bulks earlier than new seed from the north.

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FIELD TRIALS ON THE RETENSION OF POTATO STOCKS

SUMMARY

Field trials done to supplement replicated small-plot trials showed that the incidence of leaf roll and Y viruses in potato crops remained low for several years in many parts of England when the crops were sprayed with insecticide, and in some parts, where aphids were few, without spraying. Four sprays with DDT emulsion at 2 lb. of active ingredient per acre per application, at intervals of 14 days, starting soon after the plants emerged, were enough to check spread from sources within the crop.

Insecticides did no prevent viruliferous aphids, coming from outside the crop, from infecting sprayed plants. Although many growers could safely keep potato stocks for several years longer than they do now, others could not because virus Y is introduced by aphids from other crops in the same area. Risk from incoming infective aphids will remain until all potato crops are free from virus, but if all infected crops were sprayed with an efficient aphicide before the summer dispersal flight this should greatly decrease the amount of disease introduced into healthy crops.

ZUSAMMENFASSUNG

FELDVERSUCHE IM HINBLICK AUF DIE ERHALTUNG VON KARTOFFELBESTÄNDEN IN ENGLAND

Feldversuche, die zur Ergänzung wiederholter Kleinparzellenversuche durchgeführt wurden, ergaben, daß die Häufigkeit des Auftretens der Blattroll- und Y-Viren bei Kartoffelbeständen mehrere Jahre in vielen Teilen Englands gering blieb, wenn die Bestände mit einem Insektenmittel gespritzt wurden; in manchen Teilen, in denen wenig Blattläuse vorkamen, war dies auch ohne Spritzen der Fall. Viermaliges Spritzen mit DDT-Emulsion zu 2 lb. aktiven Bestandteile pro "acre" pro Applikation in 14tägigen Intervallen, wobei man bald nach dem Aufgang begann, reichten aus, um die Ausbreitung von Quellen innerhalb der Bestände zu hemmen.

Die Insektizide verhinderten nicht, daß virustragende Blattläuse, die von außerhalb der Bestände stammten, die gespritzten Pflanzen infizierten. Obwohl manche Züchter ihre Kartoffelbestände verschiedene Jahre länger halten könnten als sie es jetzt tun, würde anderen dies nicht gelingen, weil das Y-Virus von Blattläusen aus anderen Beständen des gleichen Gebietes eingeführt wird. Die Gefahr ansteckender Blattläuse wird bestehen bleiben, bis alle Kartoffelbestände virusfrei sind; wenn jedoch alle infizierten Bestände mit einem wirksamen Blattlausmittel vor dem sommerlichen Befallsflug gespritzt würden, wäre der Umfang der Infizierung mit dieser Krankheit von gesunden Pflanzungen bedeutend zu verringern.

RÉSUMÉ

ESSAIS EN PLEIN CHAMP SUR LA CONTINUATION DE PLANTATIONS DE POMMES DE TERRE EN ANGLETERRE

Des essais en plein champ, effectués pour compléter des essais à différentes reprises sur petites parcelles, ont démontré que l'incidence des virus Y et de l'enroulement dans les cultures de pommes de terre restait faible pendant plusieurs années dans bien des régions d'Angleterre, pourvu que les cultures aient été traitées par pulvérisation d'un insecticide, et dans certaines régions, où les pucerons sont rares, mêmes sans pulvérisations. Quatre pulvérisations d'une émulsion de DDT à la dose de 2 lb. de substance active par "acre" et par pulvérisation, espacées de deux semaines, dont la première est effectuée peu après la levée, suffisaient pour enrayer la propagation à partir de sources situées à l'intérieur de la culture.

Les insecticides n'empêchaient pas les pucerons porteurs de virus, venant d'en dehors de la culture, d'infecter les plantes traitées. Si bien des cultivateurs pourraient continuer sans inconvénient la culture de pommes de terre de la même semence pendant plusieurs années de plus que d'ordinaire, d'autres ne le pourraient pas parce que le virus Y est apporté d'autres cultures de la même région par les pucerons. Le risque de

pénétration de pucerons infectieux continuera d'exister tant que toutes les cultures ne seront pas exemptes de virus. Mais si toutes les cultures infectées étaient traitées avec un insecticide efficace avant le vol de dispersion en été, il en résulterait une forte diminution de la maladie introduite dans des plantations saines.

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