ROTHAMSTED RESEARCH

Report for 1977 - Part 1

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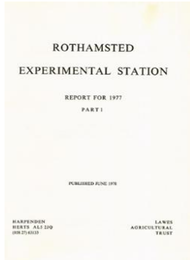
ROTHAMSTED
EXPERIMENTAL STATION
REPORT FOR 1977
PART I

Field Experiments Section

J. McEwen

J. McEwen (1978) *Field Experiments Section ;* Report For 1977 - Part 1, pp 119 - 129 **- DOI: https://doi.org/10.23637/ERADOC-1-134**

FIELD EXPERIMENTS SECTION

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Introduction

The Section continued to provide a service both for sponsors of field experiments and for visitors to the station.

Our service to sponsors starts when an experiment is being planned with advice on practicalities, possible useful co-operation between or within departments and assistance with the presentation of proposals in standard form to appropriate committees concerned with the field experimental programme. We provide a secretarial service to the 12 committees concerned and collate decisions made for each experiment. From these we produce field plans and other documentation needed for the conduct of each experiment. We liaise on a daily basis between the Farm, who are responsible for most field operations, and the sponsors on the progress of experiments during the season. Visual notes are made on the crops and we assist the Statistics Department by providing the non-numerical data for the annual publication *Yields of the Field Experiments*. (Mainly Dyke, McEwen, Barnard and Stafford)

The Small-plots staff of the Section provide a specialised service for sponsors by doing the agricultural operations on experiments with plot sizes too small for normal farm machinery. In addition machinery has been developed for spraying plots without making wheelmarks on treated areas. This service is in great demand on both small-plot experiments and to apply treatment sprays on farm-scale experiments. This year the Small-plots staff did all operations on 45 experiments involving 1340 plots and assisted, mainly by application of treatment sprays, with a further 14 experiments involving 720 plots. In many cases the experiments required repeated spray treatments and this aspect of the work has become a major commitment. (Wilson, with Kerr, Turnell and Allingham)

We have recently been encouraging a multi-disciplinary approach among sponsors. Last year we reported one such experiment with spring beans concerned with seasonal variation and maximum yields. This experiment was repeated this year and members of the same team co-operated in an additional experiment on spring beans. Further teams co-operated on experiments on leafless peas and herbage crops. (McEwen and Yeoman)

Table 1 shows the number of plots on the three farms; the grand total again slightly exceeded 10 000 with little change of emphasis. The trend, previously noted, for fewer root crops at Rothamsted and more at Woburn continued.

We assisted over 3000 visitors to Rothamsted by arranging 385 separate visit programmes. Of these 128 individuals and 12 groups came from overseas. Forty-nine of

https://doi.org/10.23637/ERADOC-1-134

TABLE 1

Number of plots in 1977

	Grain	Roots	Hay and green crops	Total
Full-scale plots (yields taken):				
Classical experiments:				
Rothamsted	329	67	237	633
Saxmundham	240	40	100	380
Long-period rotation experiments:				
Rothamsted	192	16	72	280
Woburn	234	212	200	646
Crop sequence experiments:				
Rothamsted	612	54	396	1062
Woburn	346	534	—	880
Saxmundham	80	—	—	80
Annual experiments:				
Rothamsted	1511	25	50	1586
Woburn	398	16	48	462
Saxmundham	36	—	—	36
Totals:				
Rothamsted	2644	162	755	3561
Woburn	978	762	248	1988
Saxmundham	356	40	100	496
Total	3978	964	1103	6045
Full-scale plots (no yields taken):				
Rothamsted				1079
Woburn				78
Microplots:				
Rothamsted				2375
Woburn				585
All plots total				10 162

the programmes were arranged at short notice for visitors who arrived unannounced. An additional 550 visitors were received at Woburn for the Woburn Centenary. Five talks were given to outside bodies. We continued to develop our visual-aid service for visitors. A film loop was made of the electron microscope at Rothamsted and a set of 65 slides, and accompanying comments, for the Broadbalk experiment was completed. The program for storing information about visitors on the 4-70 computer is now fully operational and has already proved useful when visitors ask for a visit programme to be repeated e.g. for successive visits by a College. (Pattison)

Field Experiments Committees

The field experiments at Rothamsted, Woburn and Saxmundham are controlled by the Field Plots Committee: F. G. W. Jones (Chairman), G. V. Dyke, L. Fowden, I. J. Graham-Bryce, A. E. Johnston, E. J. Lester, T. Lewis, J. McEwen, R. Moffitt, J. A. Nelder, P. B. Tinker, C. P. Whittingham and T. Woodhead.

Until 1977 proposals for field experiments were first considered by the appropriate working parties of the Field Plots Committee – the Working Party for Cereal Crops and Grass and the Working Party for Root Crops. In 1977 these two working parties were replaced by five Commodity Groups:

(i) Wheat
(ii) Barley and Oats
(iii) Forage Crops (grass, clover, lucerne, maize, etc.)

https://doi.org/10.23637/ERADOC-1-134

(iv) Potatoes and Sugar Beet
(v) Field Beans, Pulses and Oilseed Rape

The greater division of the work has allowed additional responsibilities to be undertaken by the Groups. These now include not only consideration of new proposals but also of the full programme, including continuing experiments, with a view to suggestions for remedying omissions or encouraging amalgamations of work, regular visits to the experiments and annual summaries.

While the Field Plots Committee retains overall control of the field experiments particularly for matters of policy, executive authority for routine matters has now been delegated to a new Working Party for Field Experiments which includes in its membership the chairmen of the Commodity Groups.

Other sub-committees of the Field Plots Committee were retained with unchanged functions. These are the Working Party for Classical Experiments (specifically to consider matters concerning the Classical experiments), the Planning Group (concerned with siting experiments and planning the farm rotations, manurial policy, etc.), the Sub-committee for Agricultural Chemicals (to advise on the safe and efficient use of chemicals on our farms) and the Field Methods Group (to consider improvements in the methods we use in field experimentation).

Seasonal effects on the Classical Experiments

Because changes are rarely made on the Classical experiments they afford opportunity to examine seasonal effects unaffected by changes of variety, nutrition etc.

Table 2 shows the yields of crops on selected plots of Broadbalk and Hoos Barley in 1975, 1976 and 1977.

TABLE 2

Broadbalk (BK) and Hoos Barley (HB): Yields of crops from selected treatments

Grain, t ha^{-1} and total tubers, t ha^{-1}

Treatments		Wheat after potatoes, beans			Barley			Beans			Potatoes		
		1977	1976	1975	1977	1976	1975	1977	1976	1975	1977	1976	1975
None	BK	1·3	2·3	3·1	—	—	—	2·4	0·4	1·1	7·0	11·6	5·0
	HB*	—	—	—	2·2	2·6	2·8	1·8	0·5	0·9	9·8	12·3	4·8
	HB†	—	—	—	1·7	1·0	1·1	—	—	—	—	—	—
N3PKMg(Na)	BK	4·7	3·9	6·7	—	—	—	3·5	0·9	1·6	26·1	32·0	11·2
	HB*	—	—	—	6·1	4·5	4·7	2·9‡	0·6‡	1·1‡	—	—	—
	HB†	—	—	—	6·0	3·7	4·5	—	—	—	—	—	—
N4PKMg(Na)	BK	4·6	3·8	6·5	—	—	—	3·8	1·0	2·2	34·9	29·2	15·5
	HB*	—	—	—	—	—	—	—	—	—	43·7	40·3	12·4
FYM	BK	4·2	4·6	6·7	—	—	—	3·3	1·2	1·5	26·9	37·5	13·2
	HB†	—	—	—	5·2	4·6	2·8	—	—	—	—	—	—
FYM+N2	BK	5·3	3·9	7·1	—	—	—	3·0	1·1	2·0	30·2	36·6	16·0
	HB†	—	—	—	6·5	4·4	5·1	—	—	—	—	—	—
								Date of planting			19/4	29/3	7/5
								Variety			Pentland Crown	Pentland Crown	King Edward

* with residues of castor meal, crops in rotation barley, potatoes, beans
† after barley, no castor meal
‡ PKMg(Na)

Symbols: N2, N3, N4 = 'Nitro-Chalk' at 96, 144, 192 kg N ha^{-1}
P = Superphosphate annually, at 35 kg P ha^{-1}
K = Sulphate of potash annually, at 90 kg K ha^{-1}
Mg = Kieserite applied at 35 kg Mg ha^{-1} every third year
(Na) = Sulphate of soda annually until 1973
FYM = Farmyard manure annually, at 35 t ha^{-1}

https://doi.org/10.23637/ERADOC-1-134

Wheat on Broadbalk given neither manure nor fertiliser yielded even less than in 1976 but responses to complete fertiliser were substantially greater and yields from these treatments exceeded those in 1976, although still 2 t ha^{-1} less than in 1975. Yield from FYM alone was inferior to complete fertiliser treatment in 1977 but, unusually, there was a substantial response from adding fertiliser N to FYM plots and this combination of treatments gave the largest yield.

Yields of barley on Hoosfield followed a similar pattern to those of wheat on Broadbalk – larger than average responses to nutrients and benefit from adding fertiliser N to FYM plots. In contrast to Broadbalk the yields attained equalled the best achieved in any year on this experiment.

Yields of spring beans on both experiments were very much larger than in 1976 and 1975 and on Broadbalk nearly equalled the best achieved since the introduction of beans in 1968.

Potatoes, as wheat and barley, responded well to complete fertiliser. On both Broadbalk and Hoosfield, these treatments gave yields greater than in 1976 or 1975. Yields from either FYM or FYM + fertiliser N did not match those from the largest dressings of fertiliser.

Summarising, for well-nourished crops it was a good year for barley and beans, an average year for potatoes and a disappointing one for wheat.

Garden clover. The two varieties of red clover sown in 1976 (S.123, susceptible to clover-rot (*Sclerotinia trifoliorum*), and Hungaropoly, resistant) showed only partial survival during the following winter. S.123, which was expected to fail had a 20% survival where aldicarb had been applied but died without it. Hungaropoly, despite being resistant, only showed 20% survival without aldicarb, 30% with.

Gaps were re-sown in spring and aldicarb re-applied. Four cuts were taken, the first almost entirely from overwintered plants. Total yield of dry matter from S.123 was only 1·3 t ha^{-1} increased to 4·4 t by aldicarb. Hungaropoly gave 2·8 t increased to 6·4 t by aldicarb. (McEwen)

The effects of subsoiling and incorporating P and K into the subsoil

The experiment testing the effects of hand subsoiling and incorporating a large dressing of P and K (1930 kg P_2O_5 ha^{-1} and 460 kg K_2O ha^{-1}) either into the topsoil or the subsoil (*Rothamsted Report for 1974*, Part 1, 132) completed a full cycle of the four-course rotation.

Treatments, applied once only in the summer/autumn 1973, showed substantial effects throughout the four years. Mean yields are shown in Table 3.

Subsoiling alone increased yields of wheat, barley and sugar beet but not of potatoes.

TABLE 3

Deep PK experiment

Mean yields (1974–77), t ha^{-1}

		None	Subsoiling alone	P and K to topsoil	P and K to subsoil	SED
Wheat	Grain	4·3	5·2	4·1	5·1	0·26
	Straw	6·9	7·8	6·9	8·2	—
Barley	Grain	3·4	4·2	3·4	4·9	0·30
	Straw	3·9	4·4	3·9	4·8	—
Potatoes, total tubers		45·4	45·5	48·4	52·5	1·30
Sugar Beet	Sugar	4·6	5·1	4·7	5·3	0·20
	Tops	23·3	25·5	21·7	26·7	1·40

https://doi.org/10.23637/ERADOC-1-134

Incorporating P and K into the subsoil increased yield of potatoes and further increased yields, in addition to the effect of subsoiling, of barley and to a smaller extent sugar beet but not of wheat.

The same rates of P and K applied to the topsoil increased yields of potatoes but had no effect on the other crops.

The experiment had simple treatments and limited objectives and was planned primarily to determine whether research on enrichment of subsoils with P and K was likely to be profitable. The results obtained from subsoiling alone were unexpected, previous tests of conventional farm subsoiling at Woburn had shown little effect, and further work was started in autumn 1977 to study the performance of unconventional machinery either subsoiling or incorporating P and K into the subsoil. (McEwen)

Herbage crops. Factors affecting yield

We are co-operating in a joint ADAS/ARC experiment which is being conducted at some 20 sites and is designed to assess the potential productivity and nitrogen economy of grass/white clover in lowland Britain and to relate variations to climate and soil. We are including additional factors and herbage crops in our experiment to obtain further information on factors affecting yield. The experiment is duplicated at Rothamsted and Woburn. 1977 was the establishment year and many of the proposed treatments will not be applied until 1978. Apart from the different varieties and species we tested a modest irrigation differential, on blocks, and, on plots, a test of stringent pathogen control comprising aldicarb at 10 kg ha^{-1} to the seedbed and phorate at 5 kg plus benomyl at 0·5 kg after each cut. Three cuts were taken at both sites. Table 4 shows total yields averaged over the irrigation test which had little effect. Yields of S.23 ryegrass alone (given a total of 100 kg N ha^{-1}) were very much larger at Rothamsted, controlling pathogens more than doubled yield at Woburn but had no effect at Rothamsted.

TABLE 4

Herbage crops: effects of pathogen control

Total dry matter (3 cuts), t ha^{-1}

	Rothamsted		Woburn	
Crop	No pathogen control	Pathogen* control	No pathogen control	Pathogen* control
Ryegrass (S.23)	6·0	5·8	1·2	2·9
Clover (Blanca)	3·8	4·2	3·1	3·6
S.23/Blanca mixture	3·9	4·7	3·4	3·6
S.23/S.100 clover mixture	3·7	—	2·7	—
Lucerne (Vertus)	3·7	3·7	2·1	2·0

* Aldicarb at 10 kg ha^{-1} to the seedbed. Phorate at 5 kg + benomyl at 0·5 kg after each cut

Clover (given no fertiliser N), either alone or with ryegrass gave substantially more dry matter than ryegrass alone at Woburn but not at Rothamsted and some benefits were shown at both stations from controlling pathogens.

Yields of lucerne were inferior to other crops at both stations and were not improved by pathogen control. (McEwen, with Day, Roughley and Witty, Soil Microbiology Department, Jenkyn and Plumb, Plant Pathology Department, Johnston, Soils and Plant Nutrition Department, Henderson, Entomology Department and Legg, Physics Department)

Grain legumes

Spring beans (*Vicia faba*) seasonal variation and maximum yields. We repeated, on a

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fresh site, the multifactorial, multidisciplinary experiment designed to study the causes of seasonal variation and thereby determine maximum attainable yields on our soil (*Rothamsted Report for* 1976, Part 1, 150–155).

The treatments chosen were similar to those in 1976 but we replaced fenitrothion by the synthetic pyrethroid permethrin, dieldrin by fonofos and applied nitrogen fertiliser at flowering time only. Combinations of eight two-level factors were chosen:

(i) Full irrigation (119 mm) (limiting soil moisture deficit to 25 mm), none.
(ii) N at 150 kg ha^{-1}, as 'Nitro-Chalk', at flowering, none.
(iii) Aldicarb at 10 kg ha^{-1} to the seedbed, none.
(iv) Benomyl at 32 kg ha^{-1} to the seedbed, none.
(v) Fonofos at 5 kg ha^{-1} to the seedbed, none.
(vi) Permethrin at 0·15 kg ha^{-1} as a foliar spray in May and June, none.
(vii) Pirimicarb at 0·14 kg ha^{-1} as a foliar spray in June and July, none.
(viii) Benomyl at 0·6 kg ha^{-1} as a foliar spray in July, none.

The design used was a half replicate of 2^8 in eight blocks of two whole plots (for irrigation treatment) split into eight sub-plots.

The season contrasted greatly with 1976. Although dry in June and July, and all irrigation was applied in July, this was followed by prolonged wet weather. Maturity was delayed, unirrigated plots were harvested on 30 September, 12 weeks later than in 1976, and irrigated plots were harvested on 11 October, 10 weeks later than in 1976. All irrigated plots lodged severely and on average gave a grain yield 1·1 t ha^{-1} less than those not irrigated. Hence the effects of the remaining treatments on unirrigated plots were of most interest. All showed beneficial effects, the largest being given by aldicarb and a benomyl foliar spray which together increased the grain yield, averaged over other treatments which had smaller effects, from 4·27 to 4·94 t ha^{-1} (Table 5).

TABLE 5

Spring beans (unirrigated): effects of aldicarb and benomyl foliar spray on yield

Mean yield of grain, t ha^{-1}

	None	Benomyl
None	4·27	4·60
Aldicarb	4·66	4·94
SED	0·085	

Total above-ground dry matter was determined on three occasions. The first sample on 22 June, 11 weeks after sowing, showed a mean total dry matter of 1·5 t ha^{-1} with little effect of treatments. This had increased to 6·4 t ha^{-1} by 20 July with treatment effects less than 0·4 t ha^{-1}. At the third sampling on 30 August the mean was 10·8 t ha^{-1}, the largest treatment effects coming from irrigation (+ 2·6 t ha^{-1}), aldicarb (+ 1·2 t ha^{-1}) and pirimicarb (+ 0·5 t ha^{-1}).

Results from co-sponsors sampling are reported briefly below. (McEwen and Yeoman)

Sitona. The population of *Sitona* larvae developed more slowly than in 1976 with a peak a month later in mid-July. Eggs were laid over a longer period and all stages of larval development were found on the roots on both sampling dates.

Leaf notching (adult feeding damage) was well controlled by aldicarb and considerably lessened by permethrin but not by fonofos (Table 6). The mean larval population on the roots in July was 7·5 per plant on plots not given aldicarb, fonofos or permethrin. This

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was only half the population per plant found last year but this may have been a result of the larger plant population in 1977. We have evidence from another experiment that *Sitona* density per plant is negatively correlated with plant population.

TABLE 6
Spring beans: effects of aldicarb, fonofos and permethrin on Sitona

	Notches per plant		Larvae on roots, per plant	
Treatments	23 May	23 June	12 July	1 August
None	5·8	8·0	7·5	4·0
Permethrin	2·0	2·7	2·2	1·1
Fonofos	5·7	7·1	4·4	3·0
Fonofos + permethrin	2·3	1·4	1·7	0·7
Aldicarb	0·2	0·1	0·2	0·1
Aldicarb + permethrin	0·2	0·0	0·2	0·3
Aldicarb + fonofos	0·2	0·0	0·2	0·2
Aldicarb + fonofos + permethrin	0·2	0·0	0·0	0·3
SED	0·38	0·31	0·89	0·56

Larvae were almost eliminated by aldicarb. Permethrin also had a substantial though smaller effect, fonofos was only moderately effective. (Bardner and Fletcher, Entomology Department)

Viruses and vectors. No seed-borne infections with broad bean stain or Echtes Ackerbohnenmosaik viruses were found and aphid-borne viruses, other than bean leaf roll, were rare. *Acyrthosiphon pisum*, the main vector of bean leaf roll, was fairly common towards the end of May (46 alatae or adult apterae per 10 m row in plots without aldicarb, permethrin or pirimicarb) and some plants showed leaf roll symptoms before the crop came into flower. Aldicarb was more effective than permethrin or pirimicarb in checking spread, and permethrin was more effective than pirimicarb. Towards the end of July, 17% of plants in plots without aldicarb, permethrin or pirimicarb showed leaf roll symptoms but only 1% did so in plots treated with all three materials. (Cockbain and Bowen, Plant Pathology Department)

Fungal diseases. Roots were much healthier than in the dry season of 1976. The mean disease rating of tap roots (*Rothamsted Report for 1976*, Part 1, 153) was only 1% in June and July compared with 32 and 56% respectively in 1976. By mid-August the disease rating had risen to only 4%, whereas in the previous year most plants were dead or moribund.

Soil application of benomyl or aldicarb decreased disease (Table 7) but irrigation had little effect.

TABLE 7
Spring beans: effects of aldicarb and benomyl applied to the seedbed on percent disease rating (15 August)

	Tap Roots		Lateral Roots	
	None	Benomyl	None	Benomyl
None	7·3	2·6	41·0	34·6
Aldicarb	6·1	0·5	36·6	19·6
SED	1·24		2·48	

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Senescence was delayed noticeably by benomyl applied as a foliar spray and to a lesser extent by soil applied benomyl and by irrigation.

Systemic fungicides have been reported to delay leaf senescence in several species of crops in the absence of known foliar pathogens. In this experiment it is doubtful if delayed senescence resulted from control of chocolate spot (*Botrytis*) which appeared very late and did not become aggressive. Saprophytic fungi, especially *Cladosporium* were common on senescing leaves whereas *Botrytis* was rarely detected. (Salt, Plant Pathology Department)

Nematodes. The total population of root-lesion nematodes, *Pratylenchus* spp., was 1550 litre^{-1} soil at the initial sampling which was less than half that found in the 1976 experiment. The species composition of this population was very different from that previously recorded and varied greatly across the site. The range of percentage composition was *P. neglectus* (6–77%), *P. thornei* (14–63%), *P. pinguicaudatus* (6–21%) and *P. crenatus* (0–25%).

The more-damaging species *P. thornei* and *P. pinguicaudatus* were present in greater proportions than in 1976 and it is therefore likely that the overall population caused more damage than would be suggested by the small total numbers present. The population of *P. pinguicaudatus* was the largest ever recorded in field conditions.

P. crenatus had not previously been recorded in heavy soil but like *P. neglectus* it is less injurious to beans than the other species.

Aldicarb significantly reduced the numbers of all nematodes counted. Of the other treatments only benomyl applied to the seedbed showed any significant activity. This treatment lessened populations of *Tylenchus* spp., *Aphelenchus* spp., Dorylaims and Rhabditids whether or not aldicarb was also applied. These species are predominantly fungal and detritus feeders. (Webb, Nematology Department)

Nodulation and nitrogen fixation. Nitrogenase activity was estimated by the acetylene reduction assay on the first two occasions when total above-ground dry matter was determined.

As in 1976 (*Rothamsted Annual Report*, Part 1, p. 154) the insecticides and nematicides had no effect on nodule formation or function before flowering. Benomyl applied to the seedbed had a small but significant deleterious effect on nodule function, at the first total dry matter harvest (8·0 and 10·3 μ mol ethylene per plant h^{-1} with and without benomyl respectively) but not at the second. Irrigation had the largest influence on nodule function increasing nitrogenase activity from 16 to 25 μ mol ethylene per plant h^{-1}. This effect may have been accentuated by poorer recovery of nodules from the hard dry soil of the non-irrigated plots. Nitrogen fertiliser had little effect on nodule function (19·7 and 21·6 μ mol ethylene per plant h^{-1} with and without nitrogen respectively) but this may be because of small uptake of the applied fertiliser in the dry conditions prevailing between application and the second harvest.

Both aldicarb and permethrin significantly affected the percentage of nitrogen in the grain (from 4·2% with neither to 4·6% with both on unirrigated plots) and total uptake of nitrogen in grain (from 154 kg ha^{-1} with neither to 187 kg ha^{-1} with both on unirrigated plots). (Day, Roughley and Witty, Soil Microbiology Department)

Uptake of aldicarb. Residues of aldicarb (including those of aldicarb sulphoxide and aldicarb sulphone) were determined in plants during the season. On 21 June plants contained 10 μg aldicarb residues per g of stem and leaves. These residues declined to about 4 μg by the end of July but were still detectable towards the end of August at about 2 μg in the top 30 cm of plants. (Briggs and Freeman, Chemical Liaison Unit)

https://doi.org/10.23637/ERADOC-1-134

Spring beans, precision sowing

We compared the performance of our standard Massey-Ferguson drill, which sows seeds randomly spaced within the row, with precision sowing by the Nodet-Gaugis and Stanhay drills. A range of plant populations and spacings between and within rows was included. A test of aldicarb at 10 kg ha^{-1} worked into the seedbed was also made to all sowing methods.

The mean grain yield in the experiment was 3·3 t ha^{-1}. Both the Nodet-Gaugis and Stanhay drills gave larger yields than the Massey-Ferguson, increases of about 0·4 and 0·7 t ha^{-1} respectively for equivalent plant populations. Largest mean yield of 4·4 t came from the Stanhay drill sowing 600 000 seeds ha^{-1} in rows 10 cm apart spacing seeds 17 cm apart in the row. The mean effect of aldicarb was to increase yields by 0·7 t. (McEwen, with Bardner and Fletcher, Entomology Department, A. J. Cockbain and Salt, Plant Pathology Department and Day, Roughley and Witty, Soil Microbiology Department)

Spring beans, red-seeded ticks

Winter horse-bean varieties with dark red seeds have been known for many years (e.g. Suffolk Red) but there are no spring tick varieties showing this character.

In 1973 Messrs. Burns & Co., Seeds Merchants, Staffordshire, noticed occasional red-seeded individuals in their bulk stocks of white-seeded tick beans. About 30 seeds were obtained and these were sent to Rothamsted for growing on. By self-pollinating it was soon evident that the red-seeded character was simply recessive to the white and by 1976 a number of pure lines had been produced.

A small-plot experiment was done to compare the yields of several of these lines with our standard white-seeded tick variety Minden and also with the newer white-seeded tick variety Blaze.

Minden gave 3·9 t ha^{-1} and Blaze 4·4 t. Yields of the red-seeded lines ranged from 3·8 to 4·3 t. (McEwen and Yeoman)

Leafless peas

Two separate experiments were done, one of them duplicated at Rothamsted and Woburn. We used the variety Filby.

The duplicated experiment tested all combinations of:

(1) none, aldicarb at 10 kg ha^{-1} worked in to the seedbed
(2) none, triazophos at 0·34 litre ha^{-1} 'foliar' spray on two occasions
(3) none, benomyl at 0·56 kg + zineb at 1·6 kg ha^{-1} 'foliar' spray once.

At Rothamsted plots without chemical treatments yielded 3·3 t ha^{-1} of grain. The effects of the treatments were small, plots with the full combination yielded 3·6 t ha^{-1}. At Woburn untreated plots gave only 2·8 t ha^{-1} but all the treatments had larger effects than at Rothamsted – the full combination giving a yield of 4·1 t ha^{-1}. (McEwen, with Cockbain and Salt, Plant Pathology Department, Fletcher and Wall, Entomology Department and Whitehead, Nematology Department)

The other experiment, done at Rothamsted only, tested the effects of 'Nitro-Chalk' at 25 or 50 kg N ha^{-1} either applied to the seedbed or at flowering. The mean yield was 3·4 t ha^{-1} and plots given fertiliser nitrogen did not significantly outyield those given none. (McEwen)

A major disappointment with both experiments was the severe lodging experienced. It was expected that the leafless habit, with enhanced tendril intertwining, would keep the plants erect and allow easy combine harvesting. Much rain in August caused almost

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complete collapse of the crop on all sites and yields, taken in late August/early September, could be obtained only by hand harvesting.

Grain lupins (*Lupinus albus*, Kievsky)

We repeated previous work (*Rothamsted Report for 1975*, Part 1, p. 147 and *Rothamsted Report for 1976*, Part 1, p. 155) on pathogen control at Rothamsted and Woburn. Mean yield at both sites was 2·2 t ha^{-1} of grain and there were no significant effects of pesticides. (Wilson, with Cockbain, Plant Pathology Department)

A further experiment tested all combinations of:

(1) Seed rates: 120, 240, 360 kg ha^{-1}
(2) Between-row spacings: 13, 25, 38 cm.
(3) Pathogen control: None, aldicarb at 10 kg ha^{-1} + benomyl at 32 kg ha^{-1} worked into the seedbed + foliar spray of fenitrothion at 0·7 kg ha^{-1}.

The mean yield was 2·0 t ha^{-1} and the effects of the treatments were small. Best yields, 2·2 t ha^{-1}, were given by sowing 240 kg ha^{-1} of seed at 25 cm spacing between the rows. (Wilson, with Cockbain and Salt, Plant Pathology Department)

Both experiments lodged severely after much rain in August leading to a difficult harvest, using a combine harvester, in late October.

Fenugreek (*Trigonella foenum-graecum*)

Small observation plots of three varieties (Barbara, Margaret and Paul) were established at Rothamsted and Woburn. Seed was inoculated with *Rhizobium meliloti* but no treatments were applied and pesticides were not used. Most plants established and grew well but a few had nodules that ceased to function after flowering leading to severe yellowing of the plant. Plots were hand-harvested in October. Mean grain yield at Rothamsted was 0·7 t ha^{-1} and at Woburn 0·6 t ha^{-1}. Largest yield of 0·9 t ha^{-1} came from Margaret at Rothamsted. (Pattison)

Forage maize

Effects of dazomet and nitrogen fertiliser. The experiment started at Woburn in 1971 (*Rothamsted Report for 1972*, Part 1, 254) completed the 3rd year with maize grown continuously as a forage crop. The mean yield of dry matter over the 3 years was 8·7 t ha^{-1} without dazomet and 10·3 t ha^{-1} with. The greatest mean yield without dazomet (9·3 t ha^{-1}) was achieved with 150 kg N ha^{-1} to the seedbed. With dazomet only 100 kg N ha^{-1} were needed for the maximum yield which was 10·6 t ha^{-1}.

The main pathogens known to be present were the free-living nematodes *Pratylenchus* spp., which were found in numbers exceeding 7000 litre^{-1} of soil at harvest on occasion on untreated plots. Populations were limited to no more than one-tenth of this number by dazomet. Common smut (*Ustilago maydis*) was not serious in most years but did lessen numbers of plants in 1977. Stalk rot, *Fusarium spp.*, was found only occasionally. (Barnard, with Hornby, Plant Pathology Department)

Effects of chemical control of pathogens. The experiment on continuous maize started at Rothamsted in 1974 (*Rothamsted Report for 1975*, Part 1, 148–149) showed small benefits this year from aldicarb and phorate and larger benefits from dazomet. Untreated plots gave 8·3 t ha^{-1} increased by dazomet to 9·3 t ha^{-1}. (Barnard, with Fletcher, Entomology Department, Hooper, Nematology Department, and Hornby, Plant Pathology Department)

https://doi.org/10.23637/ERADOC-1-134

Plant populations and forms of nitrogen. In 1976 and 1977 experiments were done at Rothamsted comparing aqueous ammonia treatments, with and without nitrification inhibitors, with 'Nitro-Chalk' single or divided dressings, at two plant populations, 100 000 and 150 000 ha^{-1}. Largest yields came from seedbed applications of 'Nitro-Chalk'. In the drought of 1976 the smaller plant population was best but in the wetter conditions of 1977 this was reversed. (Barnard, with Ashworth, Soils and Plant Nutrition Department)

Staff and visits

McEwen assumed the Headship of the Section for one year from 1 October to permit Dyke to take up other duties.

McEwen attended a Symposium on Field Beans held at the Scottish Horticultural Research Institute and presented a joint paper.

Dyke spent a fortnight in the USSR in May under the Anglo-Soviet Cultural Exchange Scheme administered by the British Council. He discussed field methods, design and analysis of crop experiments at institutes near Moscow and Leningrad.

Stafford attended the British Crop Protection Conference on Pests and Diseases held in Brighton.

Publications

General Paper

1 Dyke, G. V. (1976) Criteria for assessing land for arable farming systems. In: *Suitability mapping*. Ministry of Agriculture Fisheries & Food, *ADAS Technical Report* No. 31, pp. 13–17.

Research Paper

2 Bainbridge, A., Bardner, R., Cockbain, A. J., Day, J. M., Fletcher, K. E., Hooper, D. J., Legg, B. J., McEwen, J., Salt, G. A., Webb, R. M. & Wilding, N. (1977) Recent work at Rothamsted on factors limiting yields of field beans (*Vicia faba* L.). In: *Proceedings of the Symposium on the Production, Processing and Utilisation of the Field Bean* (Vicia faba *L.*) *held at the Scottish Horticultural Research Institute on 9 March, 1977. Scottish Horticultural Research Institute Bulletin* No. 15, pp. 28–38.