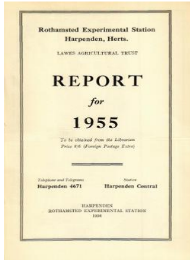
Report for 1955

Full Table of Content



Chemistry Department

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CHEMISTRY DEPARTMENT

R. K. Schofield

Fertilizer Placement

(G. W. Cooke and F. V. Widdowson)

Peas and Beans

In experiments on broad beans and peas both crops were picked green for market. Dressings of superphosphate and muriate of potash and a mixture of the two fertilizers were broadcast and worked into the seedbed and compared with dressings placed in a single band beside the seed. For both crops broadcasting of P, K and PK fertilizers gave only small increases in yield. Placed superphosphate gave several times the increases from broadcast dressings, while placed K and PK fertilizers were about twice as effective as broadcast dressings. The experiments also tested a mixture of complete NPK fertilizer. There was no consistent gain from nitrogen dressings used for either crop. Adding nitrogen to the PK fertilizer depressed yields when the dressings were broadcast and had practically no effect when they were placed beside the seed.

Potatoes

One experiment on potatoes compared ammonium sulphate and muriate of potash broadcast over the seedbed with dressings placed at the side of the seed. With potassium fertilizer, placing the dressings beside the seed gave consistently higher yields than broadcasting. Placing and broadcasting of nitrogen gave closely similar increases in yield.

Combine-drilling potassium fertilizers for cereals

Four field experiments on barley compared combine-drilled dressings of potassium fertilizers with dressings broadcast and harrowed into the seedbed. There were good responses to potassium in all the experiments. At each centre a single dose combine-drilled gave higher yields than twice as much potassium broadcast. The experiments confirm earlier work carried out by the National Agricultural Advisory Service on chalky downland soils and suggest that all potassium dressings needed for spring-sown cereals should be drilled with the seed.

Comparisons of Methods of Application and Forms of Nitrogen Fertilizers

(G. W. Cooke and F. V. Widdowson)

Winter wheat

Three experiments on three varieties of stiff-strawed winter wheat compared three rates of " Nitro-Chalk " applied as a spring top-dressing. There were good responses to nitrogen at each centre. In one experiment 3 cwt./acre of " Nitro-Chalk " was sufficient for maximum yields, at the other two centres yields continued to rise as " Nitro-Chalk " top-dressings were increased to 9 cwt./acre. There were no consistent gains from splitting the nitrogen dressing and drilling 1 cwt./acre of "Nitro-Chalk" with the seed in autumn, the remainder being applied in spring.

Spring cereals

Combine-drilling and broadcasting of ammonium sulphate was compared in experiments on spring cereals, and the additional effects of "Nitro-Chalk" top-dressings applied in May were measured. In the absence of top-dressings the overall increases given by combine-drilled and broadcast nitrogen were similar. When top-dressings were also given, broadcasting of the seedbed dressing gave consistently higher yields than combine-drilling. Conclusions on the value of different methods of application in individual experiments were conflicting. In one barley experiment heavy seedbed dressings gave large increases in yield, and additional top-dressings had little effect; in a second barley experiment both seedbed dressings and late top-dressings gave yield increases of roughly the same order. In a wheat experiment nitrogen applied at sowing-time had little effect on yields, but additional top-dressings gave sizeable increases. The only consistent conclusions were that when 0·4 cwt. N/acre applied on the seedbed was followed by 0·45 cwt. N as a late top-dressing yields were increased by roughly 50 per cent at each centre. Increases in yields of straw from nitrogen applied in various ways were generally similar to corresponding increases in yields of grain, but in one barley experiment late top-dressings increased the yields of straw, but had little effect on grain yields. The increases in straw yields given by top-dressings of "Nitro-Chalk" applied in May were of the order of the corresponding increases given by dressings of ammonium sulphate applied at sowing. The experiments suggest that for spring cereals late top-dressings of nitrogen are not a certain method of increasing grain yields without proportionate increases in straw.

In other experiments on spring wheat and barley, combine-drilling and broadcasting of both ammonium sulphate and calcium nitrate were compared. On the averages of two barley experiments and of three wheat experiments, the two forms of nitrogen gave closely similar increases in yield. There were no clear and consistent differences between yields given by combine-drilling and by broadcasting ammonium sulphate. When calcium nitrate was used, drilling gave slightly higher yields than broadcasting in the barley experiments, but for wheat broadcasting was somewhat superior. In 1954 experiments combine-drilling of ammonium sulphate gave consistently higher yields than broadcasting; this conclusion is not supported by the 1955 series. The work emphasizes the difficulties in recommending the "best" rates, times and methods of applying nitrogen for cereals. The value of any particular method must depend on soil and weather. By splitting dressings of nitrogen for spring cereals and applying part at seeding and the remainder as a top-dressing in May, it may be possible to obtain maximum responses over a run of seasons.

Potatoes

Seven experiments on main-crop potatoes tested three levels of dressing of ammonium sulphate and calcium nitrate. Yields increased steadily with increasing dressings up to the maximum rate used (1·5 cwt. N/acre). At each rate of dressing calcium nitrate gave lower average yields than equivalent ammonium sulphate, and the high dressing of calcium nitrate (1·5 cwt. N/acre) was inferior to the medium dressing.

These experiments also tested the effect of splitting the dressing of nitrogen, part being applied on the seedbed and part as a top-dressing of "Nitro-Chalk" immediately before earthing up the potatoes. At both levels of manuring, split applications gave lower average yields of potatoes than dressings applied wholly before planting; this was true whether the spring-time dressing was ammonium sulphate or calcium nitrate.

Seven experiments on potatoes in each of the last three years have tested late top-dressings of "Nitro-Chalk". The results are summarized below in Table 1.

TABLE 1

Effect of late top-dressing on the yields of main-crop potatoes

Nitrogen fertilizer applied* cwt. N/acre to seedbed	as top-dressing	Yields of potatoes, tons/acre 1953	1954	1955	Mean (3 years)
none		9·0	8·8	7·2	8·3
0·5	—	10·7	9·8	8·4	9·6
1·0	—	11·8	10·1	9·3	10·4
0·5	0·5	11·3	9·9	8·9	10·0
1·5	—	—	9·9	9·7	(9·8)†
1·0	0·5	—	9·5	9·4	(9·4)†

* Seedbed dressings were in the form of ammonium sulphate, "Nitro-Chalk" was used for top-dressings.

† Averages of two years only.

In each year, higher yields of potatoes have been obtained by applying all the nitrogen before planting, than by saving a portion and applying it before earthing up the potatoes. In addition, another series of experiments carried out in 1953 showed that, when sufficient nitrogen was given before planting, late top-dressings failed to increase yields at all.

Kale

In two experiments on kale, almost identical increases in yields were given by calcium nitrate and by ammonium sulphate at both centres. The experiments also tested the effect of splitting the dressings of nitrogen fertilizers, part being applied before sowing and part as a top-dressing of "Nitro-Chalk" at the beginning of July. Split applications gave slightly higher yields than dressings applied wholly at planting.

MEASUREMENT OF "SUPERPHOSPHATE EQUIVALENTS" OF OTHER PHOSPHATE FERTILIZERS

(G. E. G. Mattingly)

In a series of pot and field experiments started in 1952 and now concluded, the "superphosphate equivalents" of other phosphate fertilizers have been estimated from (*a*) the crop yields, (*b*) the phosphorus contents of the crop and (*c*) percentage of phosphorus in the crop derived from the fertilizer. In order to obtain estimate (*c*) the same small amount of ^{32}P-labelled phosphate was introduced into every pot or plot.

In the pot experiments ^{32}P-labelled monocalcium phosphate was applied in solution and the soil thoroughly mixed. The superphosphate (given at two rates) and the other phosphate fertilizers (given at an intermediate rate) were then mixed in as powders immediately before sowing. Table 2 gives a summary of some results from an experiment with radish on acid soil (pH 5·3), comparing dicalcium phosphate and Gafsa rock phosphate with superphosphate as standard.

TABLE 2

Comparisons of "superphosphate equivalents" of dicalcium phosphate and rock phosphate in pot experiments on radish

(All pots received 2·00 mg. P as ^{32}P-labelled mono-calcium phosphate per pot)

Inactive fertilizer	P applied, mg. P/pot	(*a*) Yield, g./pot	(*b*) P in crop mg./pot	(*c*) percentage P from, fertilizer	"Superphosphate equivalent" (*a*)	(*b*)	(*c*)
None	0	2·34	2·91	9·24	—	—	—
Superphosphate ...	15	5·16	7·57	5·68	—	—	—
Superphosphate ...	30	7·36	14·35	3·89	—	—	—
Dicalcium phosphate	22·5	6·25	9·66	4·58	22·1	20·3	23·1
Gafsa rock phosphate	22·5	5·74	12·13	3·50	1·87	25·9	35·4

Results by the three methods agree for dicalcium phosphate, but not for rock phosphate. It is suggested that phosphate diffuses only slowly from rock phosphate dissolving in an acid soil, and that local concentrations of phosphate are produced. If phosphate is taken up preferentially from these phosphate-enriched spots, the specific activity of the phosphate entering the plant would be lower than in plants grown in pots through which the unlabelled fertilizers had spread more evenly. This result, which was obtained with several samples of rock phosphate in this experiment, confirms similar observations in a previous experiment with ryegrass.

A field experiment with F. V. Widdowson used the same three methods to estimate "superphosphate equivalents" of fertilizer residues from heavy dressings of superphosphate on the same acid soil. Superphosphate was applied broadcast on plots at three rates of application and rock phosphate at a single rate in 1954; the site was cropped with barley in 1954 and ploughed in the autumn. In 1955 superphosphate, at four rates, was broadcast and harrowed into plots that did not receive any phosphate in 1954. 0·1 cwt. P_2O_5 as ^{32}P-labelled superphosphate was drilled with the seed on all plots in 1955, which were cropped again with barley. Results are given in Table 3 for a sampling 6 weeks after sowing and at harvest.

"Superphosphate equivalents" of the residues by all three methods at the first sampling were about one-quarter of the amount of superphosphate applied one year previously. At harvest, however, while "superphosphate equivalents" from yield measurements had not increased, those from phosphorus uptake and from measurements of specific activity had increased considerably. It is considered that this may indicate uptake of phosphorus in the late stages of growth from fertilizer residues that were buried by ploughing.

The "superphosphate equivalent" of rock phosphate applied a year before was very small in this experiment, both at the first sampling and at harvest. Further measurements will be made in 1956 on the same site, using ryegrass as the test crop.

Table 3

Field experiments on barley 1955

All plots received 0·1 cwt. P_2O_5/acre as ^{32}P-labelled superphosphate drilled with the seed. Measurements: (i) 6 weeks after sowing; (ii) at harvest (grain only).

Inactive fertilizer (broadcast)	Year applied	P applied, cwt.P_2O_5/acre		(*a*) Yield, cwt./acre	(*b*) P in crop, cwt.P_2O_5/acre	(*c*) Specific activity *	Superphosphate equivalent, cwt.P_2O_5/acre (*a*)	(*b*)	(*c*)
None		0	i	1·95	0·0082	41·8	—	—	—
			ii	11·2	0·0923	9·44	—	—	—
Superphosphate	1955	0·375	i	3·72	0·0247	20·8	—	—	—
			ii	19·7	0.139	6·86	—	—	—
,, ,,	,,	0·75	i	4·78	0·0364	14·6	—	—	—
			ii	23·3	0·162	6·16	—	—	—
,, ,,	,,	1·50	i	5·22	0·0492	9·5	—	—	—
			ii	25·1	0·176	4·77	—	—	—
,, ,,	,,	3·0	i	6·42	0·0694	6·4	—	—	—
			ii	29·1	0·211	3·55	—	—	—
,, ,,	1954	0·75	i	2·78	0·0156	29·8	0·16	0·16	0·12
			ii	16·4	0·133	7·06	0·19	0·34	0·38
,, ,,	,,	1·50	i	3·39	0·0227	23·9	0·30	0.34	0·25
			ii	19·9	0·152	5·94	0·41	0.60	0·75
,, ,,	,,	3·0	i	4·82	0·0373	12·9	0·87	0·82	0·92
			ii	23·0	0·180	4·81	0·74	1·30	1·41
Rock phosphate	,,	3·0	i	2·34	0·0121	33·4	0·12	0·08	0·07
			ii	17·0	0·134	7·18	0·22	0·35	0·35

* As percentage of specific activity of the placed superphosphate.

Determination of Labile Orthophosphate by Isotopic Exchange

(O. Talibudeen)

Isotopic exchange experiments reported previously were extended during the year to several soils from Rothamsted and forest nurseries. In these experiments the isotopic exchange of orthophosphate ions was measured in a suspension of 0·5 g. soil with 100 ml. 0·0001*M*-citrate + 0·02*M*-KCl adjusted to the acidity of the soil. The composition of this solution was designed to replace the exchangeable polyvalent cations in the soil by K^+ or NH_4^+ and keep the ionic strength of the solution at a reproducible constant level. Using this procedure isotopic exchange was practically completed in 150 hours at 25° C.

In an alternative procedure, the polyvalent cations were exchanged by leaching with a small volume of *M*-KCl, and the samples were then suspended in 0·001*M*-KCl. Although equilibrium was reached more slowly, the results indicate that citrate at only 0·001*M* does not actually dissolve any orthophosphate that was non-labile in the original sample.

If orthophosphate is added to the solution containing 0·001*M*-citrate and 0·02*M*-KCl, isotopic exchange is not complete in 150 hours at 25° C.

Measurements made to test the effect of pH on the pool of labile P emphasize the importance of controlling the pH of the sytem during isotopic exchange experiments. They suggest that the labile P is very sensitive to pH changes in the range 7·0–7·5 for calcareous

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soils and 5·5–7·0 for acid soils. The simple expedient employed in these isotopic exchange experiments is that the original pH of the solution is adjusted to the acidity of the soil, so that it does not change by more than 0·1 unit after equilibration with the soil.

During the year, considerable attention was given to the possibility of deriving diagnostic information regarding the status of phosphate residues in soils from curves for the rate of isotopic exchange with radioactive phosphorus obtained during the last three years. These curves suggest that the rapid interchange of orthophosphate ions ends after approximately 24 hours, whereas a slower exchange ends around 150 hours. Values of labile P measured after 24 and 150 hours exchange are tabulated for groups of soils which afford interesting comparisons. (Table 4.)

TABLE 4

Labile orthophosphate in Rothamsted and Forest Nursery soils

Expressed as mg. P/100 g. soil

		24 hours	150 hours	P_{24}/P_{150}
1. Hoosfield Exhaustion Land.	(*a*) No phosphate	2·9	4·8	0·61
	(*b*) FYM before 1901	7·7	11·0	0·70
	(*c*) Superphosphate before 1901	6·7	9·2	0·73
2. Broadbalk	(*a*) No phosphate or $(NH_4)_2SO_4$	2·6	4·5	0·58
	(*b*) Superphosphate	59·5	80·4	0·74
3. Highfield	Slightly acid	13·6	16·0	0·85
4. Sawyer's	Very acid	5·0	9·0	0·56
5. Four-course Rotation	Superphosphate			
	(*a*) 1st year	7·7	8·4	0·92
	(*b*) 2nd year	5·9	7·8	0·76
	(*c*) 5th year	3·9	8·0	0·49
6. Wareham	No phosphate	0·88	1·3	0·68
	Superphosphate	3·8	4·0	0·95
7. Kennington	No phosphate	8·1	12·4	0·65
	Superphosphate	14·1	15·5	0·91
8. Ringwood	No phosphate	8·0	8·7	0·92
	Superphosphate	14·7	14·7	1·00

Generally the application of fertilizer superphosphate is reflected in the increase in labile phosphorus measured at 24 and 150 hours. However, the labile phosphorus at 24 hours, expressed as a fraction of the total labile phosphorus, appeared to be a good index of the status of residual phosphate. Soils with recent applications of fertilizer phosphate showed substantial increases in this fraction. The effect of the year of application is clearly shown in the Hoosfield Exhaustion Land soils and the Four-course Rotation soils fertilized with superphosphate.

Assay of "soft" β-particle emitters

Work reported last year was repeated and extended to ^{35}S and ^{14}C estimated as $BaSO_4$ and $BaCO_3$ respectively. Self-absorption curves for ^{45}Ca, ^{35}S and ^{14}C were worked out, which used in conjunction with the gas proportional counter now make the absolute determination of these elements possible. During the year the proportional counter was set up and standardized against ^{32}P measurements.

Nutrition Problems in Forest Nurseries

(B. Benzian and R. G. Warren)

Needle tip-burn

In the Rothamsted Report for 1953 mention was made of a symptom called " needle tip-burn " which had been observed for a number of seasons in Sitka spruce seedlings and transplants at Sugar Hill Nursery, Dorset. This nursery is on a very acid sandy soil which had previously carried *Calluna* and scrub pine. The symptoms tend to appear after a hot spell in midsummer. They occur on many of the fertilizer plots, but have only rarely been observed on plots which have received a dressing of a standardized compost made from bracken and hop waste.

During the 1955 season foliar applications of several micronutrients, i.e., copper, zinc, manganese and molybdenum, were tested on Sitka spruce seedlings at Sugar Hill Nursery. On plots which had received a foliar spray of copper sulphate applied in June at the rate per square yard of 0·16 g. Cu. in 300 ml. water, tip-burn symptoms were completely absent until the middle of August and developed only slightly during the remainder of the season. Plots without copper sulphate showed tip-burn from the beginning of August, the symptoms increasing in severity throughout the summer and autumn. At the end of the season the mean height of the " no copper " plots was 1·9 and of the " copper " plots 2·8 inches. None of the other micro-nutrients appear to have reduced the symptoms.

In experiments on both Sitka seedlings and transplants raised in 1955 testing fertilizer and compost made from bracken and hop waste, tip-burn developed on fertilizer-treated plots but was absent from compost plots. Beds which had received both compost and fertilizer together showed slight symptoms. The hop waste used in the making of compost is known to contain several hundred parts per million of copper, and a compost dressing of 10 lb./square yard generally prevents the appearance of the symptoms.

Methods of formalin applications

Although formalin applied as a drench (formalin diluted with water approx. 1 in 20) has proved consistently good in experiments extending over many seasons and soils, it has not been found easy to use the method on a large scale in Conservancy Nurseries because of the difficulty of applying large volumes of liquid by machine and the lack of a sufficient water supply in some of the nurseries. In 1955 neat formalin was placed in drills approximately 2 inches deep and 1½ inches wide with 9 inches between the drills. The treatment was applied either in December or in February at rates of 25 and 50 ml./yard of drill. The seedlings above the formalin drills compared favourably with those on plots raised with formalin drench. As there was little sideways-spread of the effect of neat formalin, the test will be repeated in 1956 with closer spacing of the drills.

D

Root examination

Mr. D. M. Griffin, working under Dr. Garrett, Director of the Sub-Department of Mycology, Botany School, Cambridge, has continued mycological examinations of plants from many of the experiments. The summary of the main result of his investigation is the conclusion that stunting in coniferous seedlings is not due to root-rot. J. B. Goodey, Nematology Department, has continued his study of nematodes in experiments at Ringwood Nursery.

Fertilizer Experiments on Oil Palms

(W. B. Haines)

The results from fertilizer experiments on oil palm in Africa, designed and directed by the late Dr. E. M. Crowther and referred to in the Report for 1949 have been reassessed. Some of the experimental fields have reached the end of their economic life, and all have revealed most of the information to be expected from them. The volume of the records available must be exceptional in the annals of field experimentation, for in 10 various sites a total of nearly 16,000 palms were individually recorded for 14 years; this has entailed nearly a million weighings of fruit bunches. Response to potassium was the most important and consistant result, showing highly economic possibilities. Phosphorus had good effects on a soil of very sandy type, but there were anomalies on a gravelly clay apparently connected with the variety of palm. Nitrogen did not prove to be markedly deficient, nor did limestone or magnesium produce positive results. The responses to applications of phosphate or potash were reflected more in the total phosphorus and potassium contents of these soils than in the amounts extracted by dilute acetic acid.

A feature of theoretical interest and of great importance to experimentalists working with this crop emerged from these records because of their long unbroken continuance. Earlier records from oil-palm experiments appeared to be statistically intractable. It is now found that much of the difficulty had arisen from cyclic fluctuations of yield with periods of three, four or five years. A three- to four-year period is most marked in the individual palm. Apparently the environment tends to keep them in phase, for the cycles do not disappear by smoothing when examining results from plots of 48 palms. Unless results are taken for the period of a complete cycle the estimate of error may be unduly large, and natural rhythmic fluctuations may be mistaken for experimental effects. Most unusual sub-normal items of variance also make their appearance. The climate of Nigeria, where most of the experiments were situated, has a very marked annual rain cycle, and it is considered that the three-year yield rhythm may be a compounding of this with a shorter cycle in the palm itself of nine months effective period. Yields from large bodies of palms tend to fall into a five-year cycle, which has a possible explanation in an alternation of activity between the formation of flower-bud and fruit, very roughly analogous to that which produces an alternation of crops in some varieties of apple. In this case the half-period is 2½ years between bud formation and ripening of fruit. The five-year cycle has sometimes been so marked that the years of minimum yield have caused alarm.

The records of these experiments have also supplied valuable measurements of the increase of poaching of fertilizers by root action extending across plot boundaries, and of the rate of fading of well-established effects after the treatment has been stopped.

Soil Nitrogen

(J. M. Bremner and K. Shaw)

It is well established that a considerable amount of the nitrogen applied as fertilizer cannot be accounted for by analysis of the crop and soil. For example, about two-thirds of the nitrogen applied annually to the Broadbalk wheat plots is not recovered by such analysis. So far it has not been possible to estimate how much of this loss is due to drainage and how much to gaseous loss of nitrogen, but recent work in America has suggested that gaseous loss of soil nitrogen is much greater than previously suspected, and that under some conditions this loss may be very serious. J. M. Bremner and K. Shaw have therefore started an investigation of the factors affecting denitrification in soil in which particular attention has been given to soil samples from the Broadbalk plots. Preliminary work in which samples from these plots were treated with nitrate and incubated at 25° C. for 80 days showed that no serious loss of nitrate occurred whatever the moisture content. It was found, however, that extensive loss of nitrogen occurred when small amounts of glucose, cellulose or straw were added to water-saturated soils. For example, total nitrogen analyses showed that more than 70 per cent of nitrogen added as nitrate to Broadbalk plot 7 was lost in 2 days when the soil was treated with glucose, saturated with water and incubated at 25° C. A study of the effect of adding different amounts of glucose to water-saturated Broadbalk soil showed that maximal loss of nitrogen occurred when the amount of carbon added as glucose was about three times the amount of nitrogen added as nitrate. When smaller or greater amounts of glucose were added the loss of nitrogen decreased. Investigations of the factors affecting loss of nitrogen on addition of glucose and nitrate to water-saturated Broadbalk soil gave the following results :

1. The percentage loss of added nitrogen was about the same whatever the rate of application of nitrate.
2. Denitrification was very rapid at 25° C.; the loss of nitrogen after 3 days was practically the same as after 20 days (80–85 per cent).
3. The rate of denitrification increased with temperature; practically no denitrification occurred at 2° C.

Most of the nitrate-nitrogen not lost as gas on addition of nitrate and glucose to water-saturated Broadbalk soil could be accounted for as ammonia-nitrogen in the soil.

No loss of nitrogen occurred when ammonium salts or organic nitrogen compounds such as glycine, alanine or urea were added instead of nitrate. A study now in progress of the effect of the soil pH on denitrification indicates that the rate of denitrification of nitrate increases with pH and that no denitrification occurs below pH 4·5.

Denitrification of nitrate upon addition of straw to water-saturated soils is markedly slower than when glucose is added, but the loss in 20 days can exceed 80 per cent if sufficient straw is added. No extensive loss of nitrogen was detected when soils treated with nitrate and glucose were incubated at moisture contents below their water-holding capacities. Denitrification of nitrate appears to be entirely due to the activities of soil micro-organisms, as it is completely inhibited by toluene.

In continuation of earlier work on amino sugars in soil, J. M. Bremner investigated the nature of the 2-amino sugars present in soil hydrolysates. Glucosamine and galactosamine were identified, the former being isolated by ion exchange techniques.

Work by K. Shaw on the decomposition of " mat " on permanent pasture has been extended to include samples taken from two areas in North-West England where the problem of " mat " formation is an important factor in soil fertility. The sites were carefully chosen so that the samples obtained were taken from under pure stands of *Nardus* and *Deschampsia Flexuosa*. Analyses and fractionations of the two samples of " mat " showed that they were very similar in composition to the " mats " produced under the rather artificial conditions of the Park Grass Plots.

Organic Phosphorus in Soils

(P. W. Arnold)

Work on the characterization of the organic phosphorus-containing material which can be extracted from soils has been continued. Attention has been given to that part of the organic phosphorus which, although isolated along with the inositol phosphate, does not behave as inositol phosphate on paper electrophoretograms. This fraction of unknown constitution possesses considerable electrophoretic mobility but does not migrate as a compact spot. Attempts to release recognizable organic phosphorus-containing substances from this fraction by hydrolysis, etc., have not, as yet, been successful.

A quantitative study of the products of the progressive hydrolysis of phytic acid at pH 3 (120° C.) has been made, using a paper electrophoretic technique. Experimental results have been compared with calculated figures based on a dephosphorylation involving six consecutive first-order reactions with a single velocity constant. It was concluded that, although values for the velocity constants in the successive stages of the dephosphorylation were all of similar magnitude, the tetra-, tri- and di-phosphates of inositol were slightly less stable than the hexa- and/or penta-phosphate of inositol. Peak concentrations of tetra-, tri-, di- and mono-phosphates occurred at the stages when 29, 43, 63 and >80 per cent of the total phosphorus respectively had been released as inorganic phosphate.

Soil Manganese

(S. G. Heintze)

Results of applying various manganese materials to an alkaline manganese-deficient " skirt " fen in pots and growing oats showed that highly significant increases in grain yields could be obtained from application of manganese versenate, manganese hydroxyquinolate, manganese pyrophosphate and manganese sulphate, despite the plants exhibiting signs of greyspeck. Manganese versenate was somewhat superior to other materials for increasing grain and stem yields, while manganese sulphate was outstanding for its effect on leaf yield. Rhodonite increased grain yield below the level of significance and had no effect on leaf and stem yields or on manganese content of grain. The increase in total manganese content of grain was smallest where manganese versenate had been applied.

Estimation of various soil manganese fractions at the end of the experiment showed that manganese added as versenate or hydroxyquinolate had been converted into forms partly extractable by ammonium acetate with hydroquinone. Recovery of manganese added as pyrophosphate was found only in alkaline pyrophosphate and neutral versenate extracts.

The effect of liming on various soil manganese fractions of a manganiferous clay loam was studied by analysing soil samples before and at intervals after liming of plots from Agdell Field, which had become acid in parts. All acid plots contained more manganese in the various fractions than corresponding alkaline plots. The decrease in exchangeable and alkaline pyrophosphate-soluble manganese as a result of liming was markedly less at comparable pH values on the half of the field which contained more accumulated organic matter, the clover side, than on the fallow side. More readily reducible manganese higher oxides were found after liming on the fallow side. The readily reducible fraction constituted a much larger proportion of total manganese than the neutral pyrophosphate soluble fraction on acid and alkaline plots. This fraction showed only small differences with time after a first initial decrease after liming.

The study of the nature of organic manganese complexes was continued. The behaviour of manganese of various extracts subsequent to sodium chloride extraction of organic soils was followed by paper electrophoresis and by dialyses of such extracts against salt solutions. It was found that the direction of migrating manganese depended, amongst other factors, on the nature of the extract and the reaction. The retention of non-dialysable manganese, whether present in or added to extracts or humic acid preparations, was not related to readily oxidizable carbon content of the organic matter, and was in some cases not affected by pre-removal of dialysable organic matter.

General

A. C. D. Newman joined the staff in October, and A. Penny was appointed to assist with the experimental field work. J. E. A. Ogborn resigned to take up a post with the Abyan Board in the Aden Protectorate, and was replaced by the appointment of B. Harrington.

P. W. W. Daborn of the Forestry Commission was further seconded for the field work on nutrition problems in forest nurseries. J. C. Wilcox, who had been seconded to the Department for training in field work, returned to the National Agricultural Advisory Service. J. A. R. Bates, P. B. Tinker and J. B. M. Vogt of the Colonial Agricultural Research Service worked in the Department for varying lengths of time while being trained in field experimentation. R. K.

Cunningham and A. Pinkerton, also of the Colonial Agricultural Research Service, were seconded for a year's training in soil fertility. R. A. Christ of Basle University worked in the department for 9 months. G. W. Cooke carried out a study for the European Productivity Agency of the Organization for European Economic Co-operation on "The agronomic value of non-sulphuric acid phosphate fertilizers". He visited research institutes in Denmark, Sweden and Norway to collect information for this study. He also attended the Meeting of the Association Internationale d'Études Phosphatières held in Blois, France and contributed a paper. A. W. Taylor, who had leave from the Physics Department during the tenure of a post-doctorate fellowship at the University of Wisconsin, was transferred to the Chemistry Department on his return.