ROTHAMSTED RESEARCH

Report for 1937

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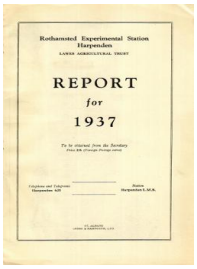

Scientific Papers Published in 1937

Rothamsted Research

Rothamsted Research (1938) *Scientific Papers Published in 1937 ;* Report For 1937, pp 90 - 104 **- DOI: https://doi.org/10.23637/ERADOC-1-69**

SCIENTIFIC PAPERS

(Published 1937, and in the Press)

PLANT GROWTH, AND ACTION OF MANURES.

(Departments of Botany, Chemistry, General Microbiology, Plant Pathology and Field Experiments Section).

(*a*) PLANT GROWTH

I. E. J. RUSSELL. "*La Station Experimentale de Rothamsted ; Son Organisation et Ses Resultats.*" Transactions of the Seventh International Congress of Tropical and Sub-Tropical Agriculture, Paris, 1937.

II. E. J. RUSSELL. "*The Restoration of Soil Fertility.*" Symposium, Chartered Surveyors' Institution Conference of Agricultural Members. Journal of the Chartered Surveyors' Institution, 1938, Vol. XVII, pp. 479-486.

III. E. J. RUSSELL. "*Report on the Work of the Imperial Council of Agricultural Research in Applying Science to Crop Production in India.*" Published by the Manager of Publications, Delhi, 1937.

IV. D. J. WATSON. "*The Estimation of Leaf Area in Field Crops.*" Journal of Agricultural Science, 1937, Vol. XXVII, pp. 474-483.

It is shown that the leaf area : leaf weight ratio decreases with increasing leaf weight. The relation between the leaf area : leaf weight ratio and leaf weight is well fitted by a linear regression equation. A method of estimating the mean leaf area per leaf or per plant of a field crop by means of this regression is described. The mean weight per leaf is determined by a large sampling, and the leaf area : leaf weight ratio and its regression on leaf weight are estimated on a small subsidiary sample. Alternative methods of estimation from the mean leaf weight and either the unweighted or the weighted mean leaf area : leaf weight ratio are shown to give positively biassed estimates of mean leaf area. It is emphasized that the small sample, from which the leaf area : leaf weight ratio and its regression on leaf weight are determined, must be a strictly random selection from the whole population.

V. K. WARINGTON. "*Observations on the Effect of Molybdenum on Plants with Special Reference to the Solanaceae.*" Annals of Applied Biology, 1937, Vol. XXIV, pp. 475-493.

In view of the similarity between certain cytological changes induced by virus disease and treatment with molybdenum, pot- and water-culture experiments were carried out to determine further the effect of this element on plant growth. Sodium molybdate was used throughout.

Toxic symptoms were produced with the larger dressings of molybdate, injury being shown at much lower concentrations in solanaceous species than in barley. The shoots of tomato and *Solanum nodiflorum* turned a golden yellow, and potato tubers a reddish yellow colour when the plants were grown with the larger quantities of molybdate. These colour changes were shown to be due to the presence of yellow globules of a tannin-molybdenum compound which had formed within the tissues. Blue granular accumulations occurred in large numbers in molybdenum-treated plants. Their distribution was confined to tissues that contained anthocyanin pigment, and their composition was apparently of an anthocyanin-molybdenum nature.

The formation of these compounds does not appear to be the cause of the injury which results from the stronger doses of molybdenum, as toxic effects occur in plants where no such compounds are found. Conversely, granules may be present to a quite considerable extent in apparently healthy plants.

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Molybdenum, therefore, evidently plays a part in the cytological and morphological behaviour of the plant, although its precise function remains to be determined.

VI. W. E. BRENCHLEY and D. J. WATSON. *"The Influence of Boron on the Second Year's Growth of Sugar Beet Affected with Heart-Rot."* Annals of Applied Biology, 1937, Vol. XXIV, pp. 494-503.

Heart-rot of sugar beet occurred on experimental plots at Rothamsted during 1935, the severity of the attack decreasing steadily with later sowing, but the effects of spacing of the rows and of treatment with sulphate of ammonia were not significant. Where the number of affected plants per row was high, a higher proportion of affected plants showed severe symptoms.

Unaffected sugar beets and others showing slight and severe symptoms of heart-rot were transplanted to sand cultures and treated with light and heavy dressings of boric acid or with none In the absence of boric acid the characteristic signs of boron deficiency appeared in the shoots, the apices of the stems and the flower buds blackening and dying. This occurred even when no symptoms were present before transplanting. In the presence of boric acid all plants produced healthy shoots, with no deficiency symptoms. Where heart-rot was originally present and the main axis killed, a number of healthy, lateral shoots was produced.

The proportion of plants failing to survive transplanting was greatest with the heavy dose of boric acid, with which one-half of the plants died. This suggests a possible toxic action of the heavy dose which did not come into play if the plants were constitutionally able to withstand the initial poisoning and start away into growth. The later addition of boron did not improve the condition of the roots of affected plants, as irremediable damage had been done before transplanting.

From the point of view of seed production, small amounts of boron compounds may thus enable affected roots to produce healthy shoots in the second year which will set seed.

VII. A. NOWOTNÓWNA (NOWOTNY). *"An Investigation of Nitrogen Uptake in Mixed Crops not Receiving Nitrogenous Manure."* Journal of Agricultural Science, 1937, Vol. XXVII, pp. 503-510.

Experiments on the nitrogen uptake of mixed crops not receiving nitrogenous manure were carried out at Pulawy, Poland, and at Rothamsted, with rye grass. The total yield, the nitrogen percentage and the total yield of nitrogen were much increased when peas, clover or serradella were grown in association, peas giving the highest, and serradella the lowest, amount of assimilated nitrogen.

With barley, peas were the only crop which produced a beneficial effect, red clover and lucerne having no influence. This was probably due to the fact that the period of most vigorous fixation of nitrogen by clover and lucerne nodule bacteria almost coincided with the period of ripening of barley, and at this stage of growth barley was unable to utilize the available nitrogenous compounds. Also, barley made less use than rye grass of the nitrogen provided by peas grown in association.

An extensive root interpenetration in the clover-rye grass pots was noted. There was little or no root interpenetration in the other series of experiments with barley.

VIII. J. CALDWELL and J. MEIKLEJOHN. *"Observations on the Oxygen Uptake of Isolated Plant Tissue. I. The Effect of Phosphate and of added Carbohydrate."* Annals of Botany, 1937, New Series, Vol. I, pp. 477-486.

The oxygen uptake of thin slices of tomato stem tissue was measured in Barcroft respirometers, and found to be maintained at a constant rate over a six-hour period. The highest values for oxygen uptake were observed in presence of M/20 potassium dihydrogen phosphate ; measurements in distilled water gave slightly lower values, and stronger solutions of phosphate produced a marked depression of oxygen uptake. Tissue from very young plants, in

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the fifth leaf stage, showed a lower level of oxygen uptake than tissue from slightly older plants, up to the twelfth leaf stage. A low level of oxygen uptake was also observed in tissue from old plants that had flowered.

The small oxygen uptake of tissue from very young plants was markedly raised by the addition of glucose or fructose, but no such rise was observed on adding sugar to tissue from very old plants. It is concluded that the oxygen uptake is limited in old plants by the activity of the respiratory enzyme system, and in very young plants by the amount of available respiratory substrate.

IX. J. CALDWELL and J. MEIKLEJOHN. *"Observations on the Oxygen Uptake of Isolated Plant Tissue. II. The Effect of Inhibitors."* Annals of Botany, 1937, New Series, Vol. I, pp. 487-498.

Substances known to inhibit enzyme action were added to slices of tomato stem tissue, and their effect on the oxygen uptake of the tissue was measured. All the substances showed an inhibiting action which increased with their concentration. Concentrations lower than those which inhibited oxygen uptake were found to have no stimulating effect. Cyanide (M/300) produced a reversible inhibition of about 85 per cent. of the total oxygen uptake; no greater inhibition was produced by M/30 cyanide than by M/300. Sodium fluoride and iodoacetic acid had an irreversible inhibiting action, and sodium azide a reversible one stronger in acid than in alkaline solution. Malachite green was effective in very small doses, but the urethanes only in high ones. Amyl alcohol was ineffective at 1/3,000, but produced almost complete inhibition at 1/30.

(*b*) ACTION OF MANURES

X. H. L. RICHARDSON. *"The Nitrogen Cycle in Grassland Soils: with Especial Reference to the Rothamsted Park Grass Experiment."* Journal of Agricultural Science, 1938, Vol. XXVIII, pp.73-121.

A three years' examination of Park Grass soils and shorter studies of other grassland soils showed that fresh soil always contained more ammonia than nitrate. Both levels were low and sufficiently constant to suggest equilibrium conditions in the nitrogen cycle. "Mineralizable" nitrogen, produced by incubating the fresh soils under standard conditions, showed a seasonal rhythm the opposite of the annual temperature rhythm. This was related to the addition and decay of organic residues in the soil. An extremely acid soil produced as much mineralizable nitrogen on incubation as more normal plots. Soils with pH values below 6.0 produced chiefly ammonia while the less acid soils produced chiefly nitrate on incubation.

Nitrogen added in the field as sulphate of ammonia or nitrate of soda disappeared rapidly, one-half being removed in a few days in late spring or in a week or two in winter or early spring. The rapid disappearance of ammonia, even on plots in which nitrification was poor or lacking, suggested that it was taken up directly by the herbage. When the herbage was removed, added ammonia remained in the soil for several weeks.

Under Rothamsted soils laid down to grass from arable, about twenty-five years are required for the total nitrogen content to reach half that of very old grassland.

The number of worm casts was greatest on plots with organic manures, and limed plots usually had more than unlimed. Worms were absent from the extremely acid matted plot and the formation of mat appeared to depend on the effect of acidity on the worms rather than on the microbiological decomposition of the organic matter.

XI. W. E. BRENCHLEY. *"Correlation of Manuring and Botanical Composition of Continuous Hay Crops."* Report of the Fourth International Grassland Congress, Aberystwyth, 1937, pp. 441-445.

The botanical composition of herbage varies widely in different seasons. Moreover, seasonal and manurial effects need careful discrimination.

Repeated treatment with the same fertilizer affects the botanical composition and the relative proportions of species present, the latter effect often

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being the more striking. On heavy clay loam at Rothamsted, although the qualitative composition is not seriously altered by mineral manures, some species are much encouraged and others are considerably reduced, the relative variation being influenced by season. The addition of nitrogen eliminates many species, and with heavy dressings a few grasses develop strongly at the expense of the rest. Nitrate of soda and ammonium sulphate do not encourage the same association of species on account of the difference in soil reaction. The acidity induced by heavy doses of ammonium sulphate much favours *Holcus lanatus*, but the addition of lime brings *Alopecurus pratensis* and *Arrhenatherum avenaceum* into predominance, leguminous and other plants being drastically reduced. With the neutral reaction induced by sodium nitrate *Alopecurus* and *Arrhenatherum* flourish without lime, shade being here more effective than liming in changing the proportion of species.

With organic fertilizers the yield may be reduced by heavy dressings of lime without very marked alterations in herbage composition. The response to lime is rapid, as the species affected usually show a variation in their relative proportion at the first cutting, although in some conditions the change may be delayed.

Certain species afford some indication of soil and manurial conditions. *Taraxacum vulgare* is prolific on well manured soils with a tendency to alkalinity; *Scabiosa arvensis* flourishes where potash is deficient and no nitrogen is applied; *Rumex acetosa* is possibly associated with scarcity of phosphate on soil which is otherwise well manured; while Leguminosae may form a third of the herbage where minerals without nitrogen are given.

STATISTICAL METHODS AND RESULTS

(Department of Statistics)

(*a*) Design of Experiments

XII. F. Yates. "*The Gain in Efficiency Resulting from the Use of Balanced Designs.*" Supplement to the Journal of the Royal Statistical Society, 1938, Vol. V, pp. 70-74.

The comparative efficiency of a balanced design, which was actually used in a nutritional experiment on human beings, and other alternative and simpler designs, is assessed. It is shown that the balanced design is considerably more efficient than the others.

XIII. W. G. Cochran. "*Note on J. B. S. Haldane's paper 'The Exact Value of the Moments of the Distribution of* χ^2.'" Biometrica, 1938, Vol. XXIX, p. 407.

A discrepancy noted by Haldane between his and the writer's values for the mean and variance of χ^2 in a $2 \times$ n-fold contingency table with known expectations is shown to be entirely due to a difference in the definition of χ^2.

(*b*) Analysis of Data

XIV. F. Yates and W. G. Cochran. "*The Analysis of Groups of Experiments.*" Journal of Agricultural Science, 1938, Vol. XXVIII, in the press.

When a set of experiments involving the same or similar treatments is carried out at a number of places, or in a number of years, the results usually require comprehensive examination and summary. In general, each set of results must be considered on its merits, and it is not possible to lay down rules of procedure that will be applicable in all cases, but there are certain preliminary steps in the analysis which can be dealt with in general terms. These are discussed in the present paper and illustrated by actual examples. It is pointed out that the ordinary analysis of variance procedure suitable for dealing with the results of a single experiment may require modification, owing to lack of equality in the errors of the different experiments, and owing to non-homogeneity of the components of the interaction of treatments with places and times.

XV. W. G. Cochran. "*Some Difficulties in the Statistical Analysis of Replicated Experiments.*" Empire Journal of Experimental Agriculture, 1938, Vol. VI, pp. 157-175.

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The analysis of variance is now widely applied in interpreting the results of replicated experiments. Sometimes, however, a combined analysis on the original data has little meaning and gives misleading results, because the treatments have different variances. A numerical example is given to illustrate such a case.

These cases may be divided into two groups. (1) With yield-data, or whole-number counts of over 100 per plot, they occur very rarely, but may do so if some treatment differences are of the order of several hundred per cent., or if there is a partial failure of certain treatments or plots. The analysis is best carried out by omitting some treatments or plots. (2) With small whole numbers or percentages, the distributions tend to follow the Poisson and binomial types, respectively, and there is a known relation between the variance and the mean. Data of this type should be transformed before an analysis to a scale on which the variances are equal.

Three transformations have proved particularly useful in practice. (*a*) The square root, for whole numbers per plot between 10 and 100. If the majority of the plot-yields are under 10, one-half should be added to each plot-yield before taking the square root. (*b*) The inverse sine, i.e. the angle whose sine is the square root of the fraction, for percentages and fractions based on the ratio of small numbers. Percentages can, however, often be dealt with either by square roots, for small percentages, or by a direct analysis, for percentages from 30 to 70. (*c*) The logarithm, for distributions in which the standard error is proportional to the mean.

Numerical examples are worked, illustrating the use of each of these transformations and the way in which to present the results of the experiment.

A brief discussion is given of the analysis when the results consist of the number of plants in each of a number of grades (e.g., healthy, slightly diseased, severely diseased).

With factorial experiments in which the main effects produce large differences, the experimenter must consider what is the most natural definition of the independence of two factors, since the conventional test of interactions in either the original or the transformed scale may have little relation to this. A numerical example is given illustrating this point.

XVI. W. G. COCHRAN. "*Recent Work on the Analysis of Variance.*" Journal of the Royal Statistical Society, 1938, Vol. CI, pp. 434-449.

This review covers the period 1934-7. The principal topics summarised are experimental design, the discriminant function and its uses, the analysis of covariance and the use of transformations with non-normal data.

XVII. H. FAIRFIELD SMITH. "*An Empirical Law Describing Heterogeneity in the Yields of Agricultural Crops.*" Journal of Agricultural Science, 1938, Vol. XXVIII, pp. 1-23.

The object of the paper was to investigate the relationship between the plot size and the variance of the plot yields. Using data from a blank experiment with wheat it was found that the regression of the logarithms of the variances for plots of different areas on the logarithms of their areas was approximately linear. A graphical review of variances, etc., reported in the literature for thirty-nine other blank experiments indicates that the results of most such experiments conform to the same law.

It is shown that the above law can be generalised (so as to be applicable to any size of field) by applying a certain adjustment to the regression coefficient b', so as to give a modified coefficient b applicable to an "infinite" field.

From this generalized relationship there has been deduced an expression to indicate average relative efficiencies to be expected for randomized block experiments with varying numbers of plots per block in a field for which the coefficient b is known.

A formula, which may be used to estimate the most efficient size of plot for any given experiment, has also been deduced. The cost of using plots of other than the most efficient size is indicated graphically.

(*c*) SAMPLING

XVIII. W. G. COCHRAN. "*Crop Estimation and its Relation to Agricultural Meteorology.*" Supplement to the Journal of the Royal Statistical Society, 1938, Vol. V, pp. 1-25.

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This is one of three papers read to the Industrial and Agricultural Section of the Royal Statistical Society, with discussion. The first paper, by Dr. Irwin, describes critically the official methods of crop estimation in the United Kingdom, the United States and India and outlines the early work of the crop-weather scheme of the Agricultural Meteorological Committee. In the second paper, by Mr. Cochran, the use in crop forecasting of the correlation of yields with weather factors and with previous measurements on the crop is discussed. A prediction formula is presented for wheat, based on the results of the wheat sampling observations under the crop weather scheme. This formula is as yet unsatisfactory in forecasting variations in yield from year to year, but may be improved by the inclusion of weather effects when sufficient data become available. In general, however, much research is still needed on the possibility of crop forecasting by this method.

The estimation of crop yields at harvest by taking small samples from a number of fields is considered and the results obtained from an extension to commercial crops of the wheat sampling scheme are presented. The chief difficulties here appear to lie in the selection of fields to be sampled and in a positive bias which persists in the sampling yields as compared with the harvested yields of whole fields. The use of a fixed panel of forms for each crop is recommended as the most practicable method of organising the work.

The third paper, by Dr. Wishart, sums up several points in the first two papers and describes the system of crop estimation in China.

THE SOIL

(Departments of Chemistry, Fermentation, and Physics)

(*a*) Cultivation

XIX. E. W. Russell and B. A. Keen. "*Studies in Soil Cultivation. VII. The Effect of Cultivation on Crop Yield.*" Journal of Agricultural Science, 1938, Vol. XXVIII, pp. 212-233.

The yields of wheat, barley and mangolds were not appreciably affected whether the seed beds were prepared by ploughing and harrowing, by using the grubber (or cultivator) and harrowing, or by using the Rototiller, provided that the grubber and Rototiller were used for one year only. If used for several years in succession deterioration of yield sometimes sets in, possibly due to the increased weediness of the non-ploughed plots.

There was no advantage in ploughing deeper than 4 in. but it is advantageous to use the grubber or Rototiller deeper.

For spring-sown crops, cross-ploughing, subsoiling, or heavy rolling of the seed bed were without effect on the yield.

Spring rolling and harrowing improved the yield of winter wheat but had little effect on the yield of straw. Rolling alone produced a slightly increased yield of grain. The straw yield was increased by rolling but depressed by harrowing.

There was strong evidence that intensive hoeing of sugar-beet or kale is detrimental to the yield. Two to three hoeings appear to be ample.

XX. E. W. Russell and N. P. Mehta. "*Studies in Soil Cultivation. VIII. The Influence of the Seed Bed on Crop Growth.*" Journal of Agricultural Science, 1938, Vol. XXVIII, pp. 272-298.

Crops germinate faster on the looser seed bed prepared by a Rototiller than on the more compact ones prepared by a plough or a grubber. The total number of plants that germinate is, however, the same for all treatments unless the land is too foul with weeds, when higher germination is obtained on the cleaner plots.

Cereals tend to ripen a little sooner on land that has been ploughed than on land that has been either rototilled or grubbed.

The roots of mangolds were longest and thinnest on the deep-ploughed plots and were always squatter on the shallow-tilled than on the deep-tilled plots. The roots were heaviest on the deep-ploughed plots and lightest on the rototilled plots. On the rototilled and the grubbed plots the depth of tillage had no effect. The plants on the shallow-grubbed plots seemed, however, to have no reserve of strength, for they could not make better growth if given more room, while those on the deep-grubbed plots could make

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some use and those on the ploughed or rototilled plots appreciable use of extra space.

Weeds tend to accumulate on the rototilled and the grubbed plots since neither grubbers nor rotary cultivators carrying tines mounted on a horizontal shaft can bury weeds and weed seeds in the way that the plough can. If the land is fairly clean and in good heart this probably does not matter for several years, but it prevents either implement from completely displacing the plough.

A subsidiary result that emerged from these experiments is that if a thin crop is given a nitrogenous top dressing, the fertiliser may benefit the weeds more than the crop.

(*b*) Physical Properties

XXI. R. K. Schofield and J. V. Botelho da Costa. "*The Measurement of* p*F in Soil by Freezing Point.*" Journal of Agricultural Science, 1938, Vol. XXVIII, in the press.

Two procedures are described for ascertaining the relationship between the freezing point and moisture content of a soil. As the process of freezing dries the soil sample, it is necessary to estimate how much water has been frozen out of the soil at the moment when the freezing temperature is recorded.

One procedure embodies all the precautions which appear desirable when the greatest accuracy is required. The other is simple and rapid and yet accurate enough for routine estimation of the wilting coefficient.

XXII J. V. Botelho da Costa. "*A Critical Survey of Investigations on the 'Wilting Coefficient' of Soils.*" Journal of Agricultural Science, 1938, Vol. XXVIII, in the press.

The experiments of Briggs and Shantz led them to conclude that the "wilting coefficient" is a soil "constant" which is (*a*) independent of the kind of plant used as indicator; (*b*) independent of the conditions under which the plant was grown and (*c*) directly related to several other soil constants.

Subsequent research as well as an examination of their own results has shown that (*c*) is untrue, while (*a*) and (*b*) are substantially correct for hygrophytes and mesophytes. Earlier writers have been led to wrong conclusions regarding (*a*) and (*b*) through assuming (*c*) to be correct and through disregarding the particular nature of "permanent wilting" as defined by Briggs and Shantz.

The fact that considerable variation is to be found between the osmotic pressure in different plants, in different parts of the same plant and in the same part under different conditions, is not at variance with conclusions (*a*) and (*b*) when properly understood.

An important factor making for the substantial constancy of the "wilting coefficient" for a given soil is the extreme steepness of the curve connecting suction pressure and soil moisture content, in consequence of which differences of suction pressure of unquestionable significance from the standpoint of plant physiology give rise to differences in soil moisture content that are too small to be detected.

XXIII. J. V. Botelho da Costa. "*The Indirect Determination of the 'Wilting Coefficient' by the Freezing Point Method, and the Influence of the Salts upon the* p*F at that Critical Moisture Content.*" Journal of Agricultural Science, 1938, Vol. XXVIII, in the press.

The results obtained in the preliminary investigation were entirely confirmed, the *p*F at the "wilting coefficient," as measured by the modified freezing point method, varying from 4.0 to 4.4 (round figures), with an average of 4.2.

The variation observed bears no relation to the soil texture, neither can it be explained by uncertainties in the freezing point determinations which have proved to be accurately reproducible. Freezing point measurements after leaching, conductivity measurements and freezing point determinations in saturated soil and at the moisture equivalent proved that part of the variation is due to the presence of soluble salts, the more saline soils having a higher *p*F at the "wilting coefficient." When the salt content does not exceed about 500 p.p.m. the influence of the salts is hardly detectable, and the *p*F at the

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" wilting coefficient " lies between 4.0 and 4.3. Besides unavoidable errors in the wilting experiments* several other factors may account for this variation. They are all the factors that have any rôle in the " history " of the soil. In view of these uncontrollable sources of error a variation of 0.3 *p*F units can be considered very small.

It can therefore be confidently concluded that in ordinary agricultural soils with a salt content of less than about 500 p.p.m. permanent wilting occurs when a critical *p*F value lying between 4.0 and 4.3 is reached.

This knowledge affords a new indirect method of determining the "wilting coefficient " by freezing point measurements in soils having less than about 500 p.p.m. of soluble salts. Both procedures described in Paper XXI above, are equally satisfactory for this purpose. As the *p*F curve is practically straight in the neighbourhood of the " wilting coefficient," two freezing point measurements (round about 1-2°C. freezing point depression) are enough for the indirect determination of the " wilting coefficient."

The method is incomparably less laborious than the direct determination by wilting experiments and highly accurate.

XXIV. G. W. SCOTT BLAIR. *" Compressibility Curves as a Quantitative Measure of Soil Tilth."* Journal of Agricultural Science, 1937, Vol. XXVII, pp. 541-556.

A preliminary account is given of experiments on the compressibility of soils in field condition, and two methods for obtaining compressibility curves, one for the field and one for the laboratory, are described. The laboratory apparatus automatically draws a curve relating deformation to the square root of the load built up. The theoretical relationship between load and deformation is discussed, the conclusions reached being at this stage semi-quantitative. Laboratory compression curves indicate the characteristics of soils in various states of tilth, and the effects of drainage condition, frost action, etc. Such factors as size of soil crumb, depth of layer tested, and moisture content of soil samples for laboratory studies are considered.

Preliminary field experiments are described in which the effects of simple cultivation processes on soil compressibility were measured.

XXV. G. W. SCOTT BLAIR and G. H. CASHEN. *" Compressibility Curves as a Quantitative Measure of Soil Tilth. II."* Journal of Agricultural Science, 1938, Vol. XXVIII, pp. 367-378.

The method described in an earlier paper for measuring the compressibility of soils *in situ* has been used to study the gradual consolidation of soil following digging with a fork, and a new method is described in which the rate of flow of water through rubber tubes buried in the soil gives a measure of compression.

By means of this latter method some measure can be obtained of the changes that take place in the soil after it has been loaded and trampled.

The results of the experiments confirm and amplify the earlier conclusions. At present it is hard to distinguish quantitatively the effects of moisture and time ; but it appears that differences in moisture for the range of stress used hardly affect the compressibility of newly dug soils, whereas in soils which have rested for some time since cultivation the compressibility is much increased by an increase in moisture content.

XXVI. J. R. H. COUTTS. *" The Measurement of Soil Colours."* Soil Research, 1937, Vol. V, pp. 295-307.

Four means were used to obtain quantitative measures of the colours of a group of Natal soils : (1) the Ostwald colour atlas ; (2) the Ridgway colour atlas ; (3) the Maxwell spinning disc ; and (4) the Lovibond tintometer. The relative advantages of the different methods are discussed. A direct comparison with the colour atlases gave the least dependable results. The Maxwell disc in the form recommended by the Soil Colour Committee of the American Soil Survey Association does not enable all soil colours to be matched. The Lovibond tintometer is convenient, and no failures to obtain a match with it have been found. It is suggested that the suitability of the tintometer should receive further consideration.

* A difference of 1 per cent. moisture content corresponds to a difference of 0.1 to 0.2 *p*F units in the neighbourhood of the " wilting coefficient."

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(*c*) ANALYSIS

XXVII. G. NAGELSCHMIDT. "*X-Ray Investigations on Clays, Part III. The Differentiation of Micas by X-Ray Powder Photographs.*" Zeitschrift für Kristallographie, 1937, Vol. (A) XCVII, pp. 514-521.

In using the X-ray powder method for studying the minerals in soil fractions it is desirable to know the variability of the powder diagrams of minerals which vary in chemical composition but belong to one mineral family. Powder diagrams of eight micas of different chemical composition, including two lithium micas and sericite, are recorded. They all belong to either of two types, muscovite and phlogopite-biotite. From powder diagrams it should be possible to recognise mica in mixtures with either quartz or kaolin, and, if the mica forms half or more of the mixture, to distinguish between the two types of mica.

XXVIII. L. A. DEAN. "*An Attempted Fractionation of the Soil Phosphorus.*" Journal of Agricultural Science, 1938, Vol. XXVIII, pp. 234-246.

Soils were extracted by sodium hydroxide and colorimetric methods employed to estimate the organic and inorganic phosphorus in the extract. The amount of phosphorus soluble in sodium hydroxide solution is influenced by the active soil calcium and it is suggested that sodium-saturated soils should be used when studying the alkali-soluble phosphorus. Relatively large amounts of organic phosphorus were found in most soils and generally followed the carbon contents of the soils. The acid-soluble phosphorus remaining after alkaline extraction appears to be similar to apatites. The largest fraction of the soil phosphorus was not dissolved by the sodium hydroxide and acid extractions. This fraction was not influenced by the long-continued use of phosphatic fertilisers at Rothamsted and Woburn.

XXIX. E. B. KIDSON. "*Some Factors Influencing the Cobalt Contents of Soils.*" Journal of the Society of Chemical Industry, 1938, Vol. LVII, pp. 95-96.

Evidence has been obtained to show that the cobalt content of a wide variety of soils is in general related to the magnesium contents of their parent rocks: e.g., serpentine, rich in magnesium, gives soils with high cobalt contents and soils derived from granite have low cobalt contents. Manurial treatments for long periods on the Rothamsted and Woburn continuous wheat and barley plots have negligible effects on the cobalt contents of the soils. Soils from the Dartmoor area, on which sheep suffer from "pining" disease, have low contents (3-4 p.p.m.) of cobalt whereas healthy soils contain 11-30 p.p.m. This series of soils forms an interesting comparison with soils from New Zealand on which "bush sickness" occurs.

XXX. C. N. ACHARYA. "*Determination of the Furfuraldehyde Yield of Soils and of Plant Materials admixed with Soil.*" Biochemical Journal, 1937, Vol. XXXI, pp. 1800-1804.

A comparison is given of the bromine titration method of Powell & Whittaker and the gravimetric phloroglucinol method for the estimation of the total furfuraldehyde yield of soils and plant materials admixed with soil. In the absence of soil, the two methods were found to give concordant results. In presence of soil, however, low results were obtained by both methods, owing to the presence of oxidizing agents such as ferric and manganese compounds and nitrate in the soil, which apparently oxidize a portion of the furfuraldehyde during the course of distillation with 12 per cent. HCl. The addition of stannous chloride in regulated amounts reduces the oxidizing agents and prevents their interference.

It is concluded that for soils and plant materials mixed with soil estimation of the furfuraldehyde by precipitation with phloroglucinol, followed by extraction of the precipitate with boiling alcohol, is preferable to the bromine titration method of Powell & Whittaker.

XXXI. S. G. HEINTZE. "*Readily Soluble Manganese of Soils and Marsh Spot of Peas.*" Journal of Agricultural Science, 1938, Vol. XXVIII, pp. 175-186.

Marsh Spot disease of peas in the Romney Marsh area is more closely related to soil reaction than to soil series or soil texture. It was not found on any acid soil but on most of the alkaline ones in a representative set of 35 samples. Most of the soils contained appreciable amounts of free oxides of manganese and of salt-soluble manganese. The soils with Marsh Spot contained less salt-soluble manganese than the soils on which peas were healthy, but this relationship depended essentially on the contrast between acid and alkaline soils. Peas grown in pot cultures in manganese-deficient soils and in a sand-bentonite mixture developed Marsh Spot. Addition of manganese sulphate increased the manganese content of the seeds and controlled the disease.

Soils on which oats suffered from Grey Speck disease and sugar beet from "Speckled Yellow" contained little or no salt-soluble manganese.

THE PLANT IN DISEASE: CONTROL OF DISEASE

(Departments of Entomology, Insecticides and Fungicides and Plant Pathology)

(*a*) Insects and Their Control

xxxii. C. B. Williams. "*The Migration of Day-flying Moths of the Genus* Urania *in Tropical America.*" Proceedings of the Royal Entomological Society of London, 1937, Vol. XII, pp. 141-147.

A number of new records of migration of *Urania leilus* and *Urania fulgeus* is given, and it is shown that the latter species is known in nearly all the central American countries from Mexico to Panama, and also in Columbia, Ecuador and Peru in western South America. There appear to be two flight seasons, and there is some evidence that the flights are more or less to the north in March and April and more or less to the east or south-east in June to September.

xxxiii. K. J. Grant. "*Some Recent Migrations of the Silver-Y. Moth.*" Transactions of the South Eastern Union of Scientific Societies, 1937, pp. 1-8.

An account is given of the evidence available on the migrations of *Plusia gamma* in 1932 to 1936. In 1936 there was a remarkable immigration and the species was seen as far north as the Shetland Islands. Immigrant swarms arrived in May and June and extensive damage was done to the sugar beet fields of Norfolk and Lincolnshire by the resulting larvae. During August and September migrations on a large scale were noted to both south and west.

The effect of wind on the flights is discussed and also the evidence that the Silver-Y. moth may survive the winter.

xxxiv. K. J. Grant. "*An Historical Study of the Migration of* Celerio lineata lineata *Fab. and* Celerio lineata livornica *Esp.* (*Lepidoptera*)." Transactions of the Royal Entomological Society of London, 1937, Vol. LXXXVI, pp. 345-357.

The distribution and outbreaks of the sub-species *Celerio lineata lineata* in America and *Celerio lineata livornica* in the Old World are described. It is suggested that both sub-species originate in semi-desert areas, and this idea is supported in the case of the American sub-species by the fact that a correlation exists between outbreaks of moths and a certain sequence of direct rainfall.

The main occurrences and outbreaks of both races in the past century are listed, and it is shown that a correlation exists between years of unusual abundance and unusual absence in the two continents. Outbreaks tend to occur simultaneously, and therefore their causes must be sought in some factor common to the two continents.

xxxv. C. B. Williams. "*The Use of Logarithms in the Interpretation of Certain Entomological Problems.*" Annals of Applied Biology, 1937, Vol. XXIV, pp. 404-414.

It is found that where catches of insects in a light trap are being examined statistically more consistent results are obtained if the logarithm of the catch

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number is used instead of the number itself. This also has the effect of reducing the swamping of a series of values by a single exceptionally large catch. The transformation appears to be made necessary by the fact that unit changes in the factors of the environment, such as temperatures, produce similar geometric or percentage changes in the catch.

XXXVI. H. F. BARNES. "*Methods of Investigating the Bionomics of the Common Crane Fly,* Tipula Paludosa, *together with some Results.*" Annals of Applied Biology, 1937, Vol. XXIV, pp. 356-368.

Full grown larvae were obtained by the O.D.B.C. method and reared to the adult stage on young wheat. The crane flies were mated and oviposition took place in glass tubes. The eggs were kept in solid watch glasses. The young larvae were reared on wheat rootlets, clover or chickweed leaves, pieces of cabbage leaf, slices of potato and bran in petri dishes. The breeding potential was as follows : 51 per cent. of the larvae emerged as adults, 75 per cent. of the available eggs were laid, 46 per cent. of the eggs hatched and 46 per cent. of the larvae survived the two first instars.

XXXVII. H. F. BARNES. "*The Asparagus Miner* (Melanagromyza Simplex H. *Loew*) (*Agromyzidae ; Diptera*)." Annals of Applied Biology, 1937, Vol. XXIV, pp. 574-588.

The asparagus miner has two generations a year at Harpenden. The flies are on the wing from early June to the end of July and again from the beginning of August to mid-September. The larvae mine the stems of asparagus, but the damage is not serious except when it occurs in seedling beds or when it is followed by an attack of the larvae of *Lonchaea flavidipennis* Zett. Three parasites, a braconid *Dacnusa ?bathyzona* Marsh, a pteromalid *Sphegigaster* sp. and a eulophid *Pleurotropis epigonus* Walk were found. The fly is generally distributed in asparagus growing areas in England, U.S.A. and Europe.

XXXVIII. H. F. BARNES. "*The Hollyhock Seed Moth* (Platyedra malvella) *together with Notes on the Distribution of* Apion radiolus *Kirby and an Associated* Clinodiplosis *Species.*" Annals of Applied Biology, 1937, Vol. XXIV, pp. 589-599.

The life cycle of the moth is described. There is one generation a year, the moths being on the wing late in June until the beginning of August. The larvae feed on the seeds of hollyhock perforating them characteristically. The winter is spent in the soil, in May they become active again pupating towards the end of May and in June. An ichneumonid parasite *Angitia rufipes* Grav. was recorded. The moth is only found in the south-eastern counties of England. The *Apion* beetle and *Clinodiplosis* midge are found all over England, the latter also occurring in Wales and Ireland.

XXXIX. A. M. LYSAGHT. "*An Ecological Study of a Thrips* (Aptino Thrips Rufus) *and its Nematode Parasite* (Anguillulina Aptini)." Journal of Animal Ecology, 1937, Vol. VI, pp. 169-192.

Aptino Thrips rufus is abundant on the grass plots of the classical Park Grass at Rothamsted. Sampling has been carried out for two years on a number of plots and population counts made. *A. rufus* is parasitised by an eelworm *Anguillulina aptini*, on which some experimental work is described.

The nematode was rarely found on two of the plots and this difference was found to be constant in two years. There is a rank growth of *Holcus lanatus* on these plots and this seems to have an unfavourable influence on the eelworm. Infected insects have, however, been found on *H. lanatus* under greenhouse conditions. Other factors, and particularly liming, that might affect the distribution are discussed.

XL. B. LOVIBOND. "*Investigation on the Control of Leather Jackets. II. Notes on Crane flies and their Larvae.*" Journal of the Board Greenkeeping Research, 1937, Vol. V, pp. 12-17.

Several species of crane flies have been reported as injurious in the larval stages in this country. An attempt is being made, by the rearing of samples of grubs, to determine the species which are injurious to golf greens—it being

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impossible at present to distinguish the species from an examination of the larvae. Suggestions have been put forward that the trapping of adults by light traps would serve to reduce the larval population. Examination of light trap material shows that in the case of *T. paludosa* the females had laid approximately 95 per cent. of their eggs before trapping. Hence this control measure is valueless for this species. Experiments with the St. Ives exterminator show that there is a tendency for the efficiency of the exterminator to vary with the age of the grubs. Thus the time of application is important from the point of view of efficient control.

XLI. B. LOVIBOND. "*Investigations on the Control of Leather Jackets. III. Some Results of Breeding and Sampling Experiments during the Current Season.*" Journal of the Board of Greenkeeping Research, 1937, Vol. V, pp. 107-112.

The rearing of samples of leather jackets from various golf courses confirms the view that *T. paludosa* is the most prevalent species, although other species do occur. In many cases there is a considerable amount of parasitism, but it is not sufficient to effect any appreciable decrease in the population. It is easy to distinguish between the eggs of *T. paludosa*, *T. oleracca* and *T. vernalis*. These species also differ in such details as number of eggs and incubation period, etc.

Repeated sampling of shows that there is a tendency for grubs to move to free areas from adjacent populated areas.

XLII. F. TATTERSFIELD. "*Modern Developments in Research on Insecticides. Part I. General Survey.*" Journal of the Society of Chemical Industry, 1937, Vol. LVI, pp. 79T-85T.

A critical survey of recent work on insecticides. It covers many of the more important researches carried out here and in America.

Means of assessing toxicity of contact and stomach insecticides, the recently developed statistical technique, field trials, chemical developments, soil fumigation and mode of action of insecticides are dealt with.

XLIII. J. T. MARTIN. "*Modern Developments in Research on Insecticides. Part II. Insecticidal Plant Products.*" Journal of the Society of Chemical Industry, 1937, Vol. LVI, pp. 85T-91T.

An account of recent research work on these insecticides. The chemistry and proposals for the chemical evaluation of fish-poison plants and pyrethrum are surveyed.

XLIV. S. G. JARY, J. T. MARTIN and F. TATTERSFIELD. "*The Artificial Drying of Pyrethrum Flowers.*" Journal of the South-Eastern Agricultural College, Wye, Kent, 1937, pp. 108-114.

An account of a joint experiment between the South-Eastern Agricultural College, Wye, Kent, and Rothamsted Experimental Station upon the drying of pyrethrum flowers at different temperatures in an experimental hop kiln.

The apparatus used is described and the pyrethrin content of the kiln-dried flowers given for a comparison with their air-dried controls.

There is a loss of pyrethrins in the sample dried at 45°C. (113°F.) for 21 hours and in those dried at 68°C. (154°F.) and 75°C. (167°F.) for $5\frac{3}{4}$ and $3\frac{1}{2}$ hours respectively. There is little or no loss of pyrethrins in samples dried at temperatures of 52°C. (126°F.) and 60°C. (140°F.), when comparisons are made with their air-dried controls.

XLV. J. T. MARTIN and C. POTTER. "*A Colourless Active Extract of Pyrethrum Flowers.*" Journal of the Society of Chemical Industry, 1937, Vol. LVI, pp. 119-120.

A brief account of the preparation of a colourless extract of pyrethrum by extracting the powdered flowers in the presence of absorbent charcoal with light petroleum. The colourless extract was highly toxic to larvae of *Plodia interpunctella*.

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XLVI. F. TATTERSFIELD and J. T. MARTIN. "*An Optically Active Constituent of* Derris *Resin related to Toxicarol.*" Journal of the Society of Chemical Industry, 1937, Vol. LVI, p. 77T.

A brief account of the isolation and some of the properties of the crystalline precursor of toxicarol.

(*b*) FUNGUS DISEASES

XLVII. G. SAMUEL and F. J. GREANEY. "*Some Observations on the Occurrence of* Fusarium Culmorum *on Wheat.*" Transactions of the British Mycological Society, 1937, Vol. XXI, pp. 114-117.

This fungus, which is known to be significantly pathogenic on oats and wheat under certain conditions, was found present on healthy wheat plants at the time of flowering, and increased in amount as the season advanced, as many as 70 per cent. of the plants examined being found infected before harvest. Although the fungus must have been present in the soil from the start, and was shown to be potentially parasitic, it had invaded the plants parasitically, only as the roots began to lose viability after flowering. Yet in other districts, e.g., the North of England, it causes appreciable injury. The cause of the difference, perhaps a soil condition, is not known.

XLVIII. S. D. GARRETT. "*Soil Conditions and the Take-all Disease of Wheat. II. The Relation between Soil Reaction and Soil Aeration.*" Annals of Applied Biology, 1937, Vol. XXIV, pp. 747-751.

By forced aeration acid soils can be rendered quite as favourable for the growth of *Ophiobolus graminis* along the roots of wheat seedlings as alkaline soils. This agrees with the hypothesis that such growth along the wheat roots in acid soils is retarded by the accumulation of respiratory carbon dioxide.

XLIX. S. D. GARRETT. "*Brom-thymol Blue in Aqueous Sodium Hydroxide as a Clearing and Staining Agent for Fungus-infected Roots.*" Annals of Botany, 1937, Vol. I, p. 563.

A note on a useful method.

L. J. SINGH. "*Soil Fungi and Actinomycetes in Relation to Manurial Treatment, Season and Crop.*" Annals of Applied Biology, 1937, Vol. XXIV, pp. 154-168.

A direct correlation was found between soil fertility as measured by crop growth (mangolds, wheat) and the number of fungi and actinomycetes in the soil; but evidence as to periodicity in these numbers was inconclusive. There is no support for the view that particular manurial treatments produce specific fungus flora.

(*c*) VIRUS DISEASES

LI. J. HENDERSON SMITH and F. C. BAWDEN. "*Discussion on Recent Work on Heavy Proteins in Virus Infection and its Bearing on the Nature of Viruses.*" Proceedings of the Royal Society of Medicine, 1938, Vol. XXXI, pp. 199-210.

Our knowledge of the nature of viruses has been greatly deepened in the last few years. The virus of tobacco mosaic has now been shown to be a nucleo protein, which when sufficiently purified exists in a liquid crystalline state, showing permanent birefringence if in relatively high concentration and anisotropy of flow when the concentration is reduced. This indicates that the constituent particles are rod-shaped, and X-ray analysis has given the measurements of their width. From solutions of the protein needle-shaped paracrystals or fibres are readily obtained, which are visible under the microscope, and in certain conditions mesomorphic fibrils are produced which are visible to the naked eye. In the process of purification the protein undergoes a linear aggregation, but in the plant there is good reason to believe that it exists in a less aggregated state. When fully purified it appears to be homogeneous, and there is no valid reason to doubt that the protein is actually the virus. It has all the properties of tobacco mosaic virus, except for a loss of filterability due to the aggregation, and reproduces the disease in indefinitely extensible series. It does not occur in normal plants, but in

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the infected plant it is found in quantities as large as 2g. per litre of sap, and has a molecular weight of the order of 20 millions. Similar proteins have been isolated from three strains of tobacco mosaic and two strains of cucumber mosaic, the individual proteins exhibiting characteristic differences just as the diseases they produce are characteristically distinct.

LII. F. C. BAWDEN and N. W. PIRIE. *"The Isolation and Some Properties of Liquid Crystalline Substances from Solanaceous Plants Infected with Three Strains of Tobacco Mosaic Virus."* Proceedings of the Royal Society of London, 1937, Vol. CXXIII, pp. 274-320.

Nucleo-proteins with characteristic optical properties were isolated from solanaceous plants infected with three strains of tobacco mosaic virus, but not from healthy plants. They are infective at a dilution of $1/10^{10}$, and give specific precipitates with antisera at a dilution of $1/10^{7}$. Solutions of the purified proteins separate into two layers if the protein content is raised above about 2 per cent. The lower layer is the more concentrated and is birefringent, while the upper shows anisotropy of flow. There is no essential difference in the virus activity, expressed in solid content, of the two layers. The anisotropy of flow can be easily recognised in solutions containing only 0.02 per cent. of protein. When centrifuged at high speed these solutions deposit the protein in the form of a birefringent jelly.

No enzyme preparation has yet been found which attacks these proteins at an appreciable rate, but the activity can be affected by a number of chemical agents. The stability towards heat and drying has been studied, and the conditions under which the nucleic acid-protein complex breaks down.

The physical properties of virus preparations and the X-ray measurements on them are interpreted on the theory that in purified preparations the constituent particles are rod-shaped, and it is suggested that these rods are built up by the linear aggregation of smaller units. There is evidence that, in the plant, part at least of the virus is not aggregated, for filters which pass an infectious filtrate with untreated plant sap do not do so with purified preparations

LIII. F. C. BAWDEN and N. W. PIRIE. *"The Relationships between Liquid Crystalline Preparations of Cucumber Viruses* 3 *and* 4 *and Strains of Tobacco Mosaic Virus."* British Journal of Experimental Pathology, 1937, Vol. XVIII, pp. 275-290.

Methods are described for the isolation of nucleo-proteins from cucumber plants infected with cucumber viruses 3 and 4. These have not been isolated from uninfected plants, and the evidence available indicates that they are the viruses themselves. Infections were obtained with 10^{-10}g., and specific precipitates with antiserum with $1/8 \times 10^{-6}$g. Concentrated solutions are spontaneously birefringent and dilute solutions show anisotropy of flow; when sedimented by high-speed centrifugation they form birefringent jellies, and when precipitated with acid or ammonium sulphate they form needle-shaped para-crystals. Although these viruses have a distinct host range from tobacco mosaic virus, the purified preparations have similar chemical compositions and many properties in common with purified preparations of strains of tobacco mosaic virus; they differ from tobacco mosaic virus, however, more widely than the recognised strains of tobacco mosaic virus differ from each other. The cucumber viruses and the tobacco mosaic viruses have certain antigens in common; the results of cross-absorption experiments between the various viruses and their antisera are described and provisional antigenic formulae suggested. Possible methods of relating and distinguishing between viruses and the relationship between the cucumber and tobacco viruses are discussed.

LIV. F. C. BAWDEN and N. W. PIRIE. *"A Note on Anaphylaxis with Tobacco Mosaic Virus Preparations."* British Journal of Experimental Pathology, 1937, Vol. XVIII, pp. 290-291.

Normal tobacco protein is anaphylactogenic but tobacco mosaic virus is not. That virus purified by ammonium sulphate precipitation may still retain a normal protein impurity which is removable by tryptic digestion can be demonstrated by the anaphylactic reaction.

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LV. M. A. WATSON. "*Field Experiments on the Control of Aphis-transmitted Virus Diseases of* Hyoscyamus Niger." Annals of Applied Biology, 1937, Vol. XXIV, pp. 557-573.

Aphis-infestation of the first year's growth of *Hyoscyamus* (grown as a biennial crop) was reduced by spraying with nicotine and soft soap for the first eight or nine weeks. The greatest effect was obtained by spraying at weekly intervals. The percentage of infection was lower on the sprayed than on the unsprayed plots. The first cropping in the first year showed no effect on yield as the result of the treatment; but in the second year a 30 per cent. increase of yield was obtained.

APICULTURAL PROBLEMS

(Sections for Bee Investigations and Biochemistry, and Bacteriology Department)

LVI. H. L. A. TARR. "*Studies on European Foul Brood of Bees. III. Further Experiments on the Production of the Disease.*" Annals of Applied Biology, 1937, Vol. XXIV, pp. 614-626.

Evidence is submitted which supports the theory that European Foul Brood is a single disease caused by *Bacillus pluton* White. The course of the disease can be modified by introducing cultures of certain secondary invading bacteria into colonies of bees infected with *B. pluton*. A certain "mass inoculum" of *B. pluton* organisms is required to induce the disease in healthy colonies. The causal organism is present in a virulent form in the rectal ampullae of young bees in affected colonies; but does not appear to exist elsewhere in the bee, or to multiply in its intestinal tract. It appears as if *B. pluton* is a strict parasite which will only multiply in the intestines of young larvae.

LVII. H. L. A. TARR. "*Studies on American Foul Brood of Bees. I. The Relative Pathogenicity of Vegetative Cells and Endospores of* Bacillus Larvae *for the Brood of the Bee.*" Annals of Applied Biology, 1937, Vol. XXIV, pp. 377-384.

Vegetative cells of *Bacillus larvae* have not produced American Foul Brood in healthy nuclei of bees even when a dose almost three thousand times greater than an inoculum of spores of the organism capable of causing the disease has been sprayed over the developing brood. A very much smaller inoculum of spores of *Bacillus larvae* is effective in producing American Foul Brood when the developing larvae of healthy nuclei are sprayed directly with them, than when the spores are fed in syrup to the bees.

LVIII. H. L. A. TARR. "*Addled Brood of Bees.*" Annals of Applied Biology, 1937, Vol. XXIV, pp. 369-376.

It is shown that "Addled Brood" of bees is not of an infectious nature but is produced by a defective queen and can be cured by re-queening.

LIX. C. R. MARSHALL and A. G. NORMAN. "*The Analysis of Mixtures of Glucose and Fructose with Special Reference to Honey.*" The Analyst, 1938, Vol. LXIII, pp. 315-323.

A procedure for the direct determination of glucose and fructose in mixtures is described, involving hypoiodite oxidation for glucose followed by a micro-copper reduction method for fructose. The behaviour of these sugars in a mixture is not precisely that of the sum of the individual components taken separately. No constant correction can be applied for fructose oxidised by the hypoiodite. From the analysis of known mixtures equations have been derived for amounts of glucose and fructose within the limits of 0.08-0.04 g. of each. The presence of small amounts of sucrose is without effect. Examples of the application of this method to some typical honeys are given.

LX. HUGH NICOL. "*A Test of Gas Tightness of Honey Jars.*" The Bee World, 1937, Vol. XVIII, pp. 103-105.

Some standard metal-capped glass containers for honey were tested by putting the closed containers in an atmosphere containing ammonia and watching for change of colour of a faintly acid indicator solution inside the honey-jars. No jar was found to be gas-tight. Hence, when fermentation occurs in storage the cause may possibly be due to absorption of atmospheric moisture through imperfect closures.

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