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The Plant in Disease : Control of Disease

Rothamsted Research

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oxygen uptake rises continuously ; after a preliminary period of adjustment this rise is logarithmic. The rise in oxygen uptake in a growing suspension is proportionately greater than the rise in bacterial numbers ; it is therefore suggested that the respiration of a growing culture can be divided into two parts—"maintenance" respiration and "growth" respiration ; and a technique is outlined for estimating the amount of oxygen uptake due to each factor.

XLVII. S. H. JENKINS. "*The Biological Oxidation of Stearic Acid in Percolating Filters.*" *Journal of the Society of Chemical Industry*, 1936, Vol. LV, pp. 315T-319T.

Stearic acid in the form of soap is a constituent of domestic sewage and its decomposition by methods which are ordinarily used for purifying sewage is therefore of interest. The decomposition of the acid in biological filters was studied with and without the addition of sewage using percolating filters made of glass and filled with glass medium.

The first filter without sewage developed a thick white film in the upper half and after operating for four months became clogged with growths. The growths consisted of fungal hyphae, bacteria and yeasts, and half of the film was stearic acid. About 80 per cent. of the stearic acid was removed from the crude liquid supplied to the filter. With domestic sewage over 90 per cent. of the impurity present in the crude liquid was removed by filtration, and as there was considerably less stearic acid present in the film in this filter than in the filter supplied with stearic acid alone it is assumed that the fatty acid was more completely oxidised in the presence of sewage. Thick growths of film containing bacteria, yeasts and algae developed in the upper part of the filter supplied with stearic acid and sewage, and in three months' time almost clogged the filter.

The experiments showed that high concentrations of stearic acid could be readily decomposed in percolating filters in the absence of sewage, and that the acid was more completely decomposed when it was present together with sewage liquors.

THE PLANT IN DISEASE : CONTROL OF DISEASE

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

(a) INSECTS AND THEIR CONTROL

XLVIII. C. B. WILLIAMS. "*Collected Records Relating to Insect Migration. Third Series.*" *Proceedings of the Royal Entomological Society of London, A*, 1936, Vol. XI, pp. 6-10.

Information is given relating to eighteen movements of butterflies and one of dragonflies, of which accounts have been sent in by correspondents in different parts of the world.

XLIX. K. J. GRANT. "*The Collection and Analysis of Records of Migrating Insects. British Isles 1931-1935.*" *Entomologist*, 1936, Vol. LXIX, pp. 125-131.

An analysis of records collected through the Insect Immigration Committee of the South Eastern Union of Scientific Societies, shows considerable evidence for a northerly flight of Red Admiral Butterfly (*Vanessa atalanta*) in Great Britain in May, June and the beginning of July, and a southerly return flight in September and October.

L. P. S. MILNE. "*A Device for the Rapid Counting of Large Numbers of Small Insects.*" *Bulletin of Entomological Research*, 1936, Vol. XXVII, pp. 269-271.

The device is a large rotating trough which can be passed under the field of a low power binocular microscope. When the insects are counted they are drawn back into the storage box by suction current of air.

- LI. C. B. WILLIAMS. "The Influence of Moonlight on the Activity of Certain Nocturnal Insects, particularly of the Family Noctuidae, as indicated by a Light Trap." Philosophical Transactions of the Royal Society of London, B, 1936, Vol. CCXXVI, pp. 357-389.

Catches of insects in a light trap are definitely influenced by moonlight. The catches are lower at full moon and higher at no moon. The curve of lunar influence is asymmetrical and these asymmetries can be explained by the combined effect of intensity and duration of moonlight, and by asymmetries in the rate of change of the duration of moonlight during the hours of darkness.

The effect is greater in some groups of insects than in others. It is particularly high in the family Noctuidae and is not found in dark and dawn flying groups.

The effect is greater in the autumn than at mid-summer, corresponding to the higher altitude of the full moon in the sky.

- LII. R. D. PINCHIN and J. ANDERSON. "On the Nocturnal Activity of Tipulinae Diptera as Measured by a Light Trap." Proceedings of the Royal Entomological Society of London, A, 1936, Vol. XI, pp. 69-78.

The times of appearance of eleven species of crane flies in a light trap in 1933 and 1934 are discussed, also their time of flight during the night, proportion of sexes and the influence of cloud, moonlight and temperature on their changes of abundance from night to night.

- LIII. W. R. S. LADELL. "A New Apparatus for Separating Insects and other Arthropods from the Soil." Annals of Applied Biology, 1936, Vol. XXIII, pp. 862-879.

The soil is stirred up with a strong solution of magnesium sulphate (Sp. Gr. 1.11) which is denser than any of the soil animals. These rise to the top of the solution in a froth produced by a stream of fine air bubbles passing from the bottom upwards through the liquid. The froth is passed on to a filter paper in a Buchner funnel where the soil animals are retained.

By the use of this apparatus a large number of samples can be examined in a short time. Very high figures have been obtained for the soil population much in excess of those recorded by other workers.

The maximum catch was obtained on grass-land indicating a population of 487 million soil animals per acre, including 475 million insects.

- LIV. H. F. BARNES. "Notes of Cecidomyiidae.—11." Annals and Magazine of Natural History, 1936, Vol. XVII, pp. 272-279.

Descriptions and notes on gall midges of economic importance received for identification from Uganda, Sierra Leone, India, New Zealand, Kenya Colony and Egypt. Four species, *Dasyneura lini*, *Hyperdiplosis triticina*, *Stephodiplosis nothofagi* and *Lestremia ugandae* are described for the first time.

- LV. H. F. BARNES. "Almond and Peach Buds Attacked by a Gall Midge in Greece." Journal of the South-Eastern Agricultural College, Wye, Kent, 1936, No. 38, pp. 75-77.

Notes and description of *Odinadiplosis amygdali* (Anagnos.), a midge which is responsible for the "blastomanie" or "gommose" disease of almond trees.

- LVI. H. F. BARNES and S. P. MERCER. "Damage to Panicles of *Alopecurus pratensis* L. by *Apamea secalis* L." Annals of Applied Biology, 1936, Vol. XXIII, pp. 653-657.

A new type of damage to the panicles of meadow foxtail grass by *Apamea secalis* is reported from Hertfordshire and Northern Ireland. This caterpillar usually damages the central shoots of grasses.

- LVII. J. T. ANDERSON. "Gall Midges (Cecidomyiidae) whose Larvae attack Fungi." Journal of the South-Eastern Agricultural College, Wye, Kent, 1936, No. 38, pp. 95-107.

An annotated list of gall midges throughout the world whose larvae have been recorded as feeding on fungi, rusts and mildews.

- LVIII. A. C. EVANS. "A Note on the Hibernation of *Micraspis sedecimpunctata* L. (Var. 12-Punctata L.), (Col. Cocc.), at Rothamsted Experimental Station." Proceedings of the Royal Entomological Society of London, A, 1936, Vol. XI, pp. 116-119.

The activity of a group of lady-birds during hibernation on an exposed post at Rothamsted in the winter of 1935-36 is shown to depend on climatic factors, chiefly temperature. Dispersal occurred during a hot day in May.

- LIX. A. M. LYSAGHT. "A Note on the Adult Female of *Anguillulina aptini* (Sharga), a Nematode Parasitising *Aptinothrips rufus* Gmelin." Parasitology, 1936, Vol. XXVIII, pp. 290-292.

Notes are given on certain structures in which the female eel-worms as examined by the writer appear to differ from the original description by Sharga.

- LX. A. M. LYSAGHT. "A Note on an Unidentified Fungus in the Body Cavity of Two *Thsanopterous* Insects." Parasitology, 1936, Vol. XXVIII, pp. 293-294.

The presence is recorded of spores of an unidentified fungus in the body cavity of *Limothrips cerealium* and *Aptinothrips rufus* at Rothamsted. No trace of mycelium was found, nor could the spores be cultivated on any medium. Thirty-five *A. rufus* were found infested out of about 17,000 examined and one *L. cerealium* out of about 100 examined.

- LXI. A. G. NORMAN. "The Destruction of Oak by the Death-watch Beetle." Biochemical Journal, 1936, Vol. XXX, pp. 1135-1137.

Certain of the oak timbers of Rothamsted House which had been extensively damaged by wood boring insects were analysed and compared with sound timber and the borings or frass to which much of the wood had been reduced. The carbohydrates of the cell-wall had been utilised to a considerable extent, the cellulose loss accounting for about 80 per cent. of the total loss which must have been in the region of one-third of the weight. Lignin is apparently resistant and had consequently accumulated.

- LXII. J. T. MARTIN and F. TATTERSFIELD. "The Problem of the Evaluation of Rotenone Containing Plants. II. *Derris elliptica*, *Derris malaccensis* and the Sumatra-Type Roots." Annals of Applied Biology, 1936, Vol. XXIII, pp. 880-898.

The determination of purified rotenone, ether extract, dehydro compounds, ether-soluble resin after potash treatment, and of the rotenone plus "deguelin concentrates" are each shown to be inadequate as a means of assessing the relative insecticidal activities of the "Sumatra-type," *D. malaccensis*, and *D. elliptica* roots.

The toxicarol present in the "Sumatra-type" *derris* appears to play a small but definite part in the insecticidal activity of the root.

The resin recovered from the material precipitated by potash from an ether extract of the "Sumatra-type" root is optically active, and appears to be rich in the precursor of inactive toxicarol.

Rotenone, if present, will separate readily from a carbon tetrachloride solution of "Sumatra-type" resin from which the toxicarol has been removed. The possibility of a standard method of rotenone determination, dependent on suitable pretreatment of the resins, is suggested.

- LXIII. F. TATTERSFIELD and J. T. MARTIN. "The Problem of the Evaluation of Rotenone Containing Plants. III. A Study of the Optical Activities of the Resins of *D. elliptica*, *D. malaccensis* and the 'Sumatra-type' Roots." Annals of Applied Biology, 1936, Vol. XXIII, pp. 899-916.

A study has been made of the rotations of the resins from three types of *derris* root, and of a fraction rich in toxicarol separated from two of them. No strictly quantitative relationship between their rotations and their toxicities to *Aphis rumicis* has been found. The addition of caustic potash in methyl alcohol to the benzene solutions of the resins induces a characteristic change from laevo- to dextro-rotation in the samples rich in toxicarol. The induced dextro-rotation then declines in value with time. This effect is shown by the "toxicarol" resin. The rate of the decline is accelerated by increasing the amount of methyl alcohol.

(b) FUNGUS DISEASES.

- LXIV. M. D. GLYNNE. "Some New British Records of Fungi on Wheat. *Cercospora herpotrichoides* Fron., *Gibellina cerealis* Pass., and *Ophiobolus herpotrichus* (Fr.) Sacc." Transactions of the British Mycological Society, 1936, Vol. XX, pp. 120-122.

Three fungi not previously recorded on cereals in this country, were observed on wheat at Rothamsted in 1935. These are briefly described with spore measurements. *Cercospora herpotrichoides* Fron., considered one of the most important of the fungi causing foot-rot in parts of Europe and America was found fairly commonly on Broadbalk and occasionally on other fields. *Gibellina cerealis* Pass., recorded in Northern Italy causing "white straw disease" was found on the "alternate wheat and fallow" plot on Hoos field. *Ophiobolus herpotichus* (Fr.) Sacc. generally regarded as a weak parasite, was found on stubble.

(c) VIRUS DISEASES.

- LXV. M. A. WATSON. "Factors Affecting the Amount of Infection Obtained by *Aphis* Transmission of the Virus Hy. III." Philosophical Transactions of the Royal Society of London, 1936, Vol. CCXXVI, pp. 457-489.

In the one plant, leaves of different ages differ in susceptibility to infection and in infected plants differ in concentration of the contained virus. It is, therefore, desirable to use leaves of corresponding ages in all comparative feeding experiments with insects. A maximum percentage infection was obtained during the winter months and a minimum during the summer months.

The percentage infection increases with the number of aphids used per plant; and the infections obtained are local and independent. The percentage infection increases with increased feeding time on the healthy plant, but there is nothing to indicate a preliminary time period where no infection is obtained. Infection decreases rapidly with increasing time on the infected plant from 2 minutes to 1 hour, after which period it increases slightly with increased feeding periods. The time required for the insect to effect penetration of the leaf increases with decreasing external humidity. The insect is capable of infecting two consecutive healthy plants without intermediate access to a source of infection, but the number of second infections falls rapidly with increasing time on the healthy plant, and is negligible after 1 hour.

- LXVI. F. C. BAWDEN, N. W. PIRIE, J. D. BERNAL and I FANKUCHEN. "Liquid Crystalline Substances from Virus-infected Plants." Nature, 1936, Vol. CXXXVIII, pp. 1051-1052.

The sap of tobacco and tomato plants infected with strains of tobacco mosaic virus contains from five to ten times as much protein as sap from uninfected plants. This extra protein can be precipitated by treatment which does not precipitate the protein of uninfected plants, and from 1 to 2 gm. can be isolated from a litre of sap. It is usually infectious in dilution of 10^{-9} ; and sediments in a centrifugal field of 23,000 times gravity. Highly purified solutions of over 2 per cent. strength separate on standing into two layers, of which the lower is liquid crystalline, and the upper shows anisotropy of flow on agitation. X-ray analysis shows a pattern suggesting an arrangement of parallel rod-like molecules in the solution. The minimum cross-section area of the rods is 20,100 sq. A. for the dry gel; the length appears to be not less than ten times the width.

- LXVII. R. J. BEST and G. SAMUEL. "The Reaction of the Viruses of Tomato Spotted Wilt and Tobacco Mosaic to the pH Value of Media containing them." Annals of Applied Biology, 1936, Vol. XXIII, pp. 509-537.

In the absence of oxygen and at 0°C., spotted-wilt virus is rapidly inactivated above pH 10 and at or below pH 5. At pH 7 it retains its activity for 6 hours as a rule, and sometimes for as long as 11 hours. Tobacco mosaic virus is inactivated above pH 8.2 and below pH 2, the extent of inactivation varying with the acidity and being complete at pH 11 and 0.5. At pH 9 there is a rapid fall for a time until a state is reached which then remains steady. Readjustment to pH 7 brings about a reactivation, which gets less as the time at pH 9 is prolonged.

- LXVIII. R. J. BEST and G. SAMUEL. "The Effect of Various Chemical Treatments on the Activity of the Viruses of Tomato Spotted Wilt and Tobacco Mosaic." *Annals of Applied Biology*, 1936, Vol. XXIII, pp. 759-780.

The virus of tomato spotted wilt is inactivated rapidly in the presence of free oxygen, and at room temperature even in its absence. Addition of reducing agents protected against inactivation for a time, but oxidising agents accelerated it. The effect of a number of other substances was examined. Tobacco mosaic virus was similarly tested with fifteen chemicals, of which only $KMnO_4$ and chlorazene caused rapid inactivation.

- LXIX. J. CALDWELL. "Factors Affecting the Formation of Local Lesions by Tobacco Mosaic Virus." *Proceedings of the Royal Society of London, B*, 1936, Vol. CXIX, pp. 493-507.

A possible method is suggested for determining whether the reducing effect on infection caused by additions to virus juice is an action on the virus itself or on the host plant. The effect of various enzymes, of normal serum and of silver nitrate is examined experimentally and found to be due to action on the virus.

- LXX. F. M. L. SHEFFIELD. "The Susceptibility of the Plant Cell to Virus Disease." *Annals of Applied Biology*, 1936, Vol. XXIII, pp. 498-505.

Spraying experiments show that virus cannot enter a plant unless some of the cells are injured, the number of infections falling off as the time after the injury increases. Micropipette inoculation into single cells gives only about 10 per cent. of successful infections.

- LXXI. F. M. L. SHEFFIELD. "The Rôle of Plasmodesms in the Translocation of Virus." *Annals of Applied Biology*, 1936, Vol. XXIII, pp. 506-508.

Although intracellular inclusions may occur in every cell over large areas of the epidermis, none has been found in the guard-cells of the stomata. No protoplasmic connections could be found between the guard-cells and the surrounding tissues. These facts support the view that virus is carried from cell to cell by the protoplasmic bridges, when it moves in the ground tissue of the host.

APICULTURAL PROBLEMS

(Section for Bee Investigations, and Physics Dept.)

- LXXII. H. L. A. TARR. "Bacillus alvei and Bacillus para-alvei." *Zentralblatt Bakteriologie*, 1936, Vol. XCIV, pp. 509-511.

It was found that *B. alvei* can be distinguished from *B. para-alvei* by the change in shape of the vegetative cell during sporulation, and by the form of the endospore produced. In other respects the organisms were apparently identical.

- LXXIII. H. L. A. TARR. "Studies on European Foul Brood of Bees. II. The Production of the Disease Experimentally." *Annals of Applied Biology*, 1936, Vol. XXIII, pp. 558-584.

Experiments showed that *Bacillus alvei* and *Streptococcus apis* would not infect healthy colonies of bees directly, but would do so when first used to inoculate larvae which were starved and were subsequently introduced into the colonies after infection had developed. It was also found that a filterable virus is in no way implicated as cause of the disease, the etiology of which is not yet certain. Two varieties of *S. apis* were found and these have recently been shown to be apparently identical with *S. liquefaciens* and *S. glycerinaceus*.

- LXXIV. G. W. SCOTT BLAIR and D. MORLAND. "A Physical Test for Ling Honey." *Journal of the Ministry of Agriculture*, 1936, Vol. XLIII, pp. 653-657.

There is considerable confusion among bee-keepers as to the distinction between density and viscosity of honey. The general significance of the two properties is explained, and the importance of viscosity is discussed. Honeys