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## Report for 1930

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### The Plant in Disease ; Control of Disease

#### Rothamsted Research

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cellulose. One species, *Bacterium protozoides*, was able to produce a substance resembling glucose from cellulose in quantities up to 30 per cent of the original cellulose.

XLVIII. JANE MEIKLEJOHN. "The Relation between the Numbers of a Soil Bacterium and the Ammonia produced by it in Peptone Solutions; with Some Reference to the Effect on this Process of the presence of Amoebae." *Annals of Applied Biology*, 1930. Vol. XVII, pp. 614-637.

Using a soil bacteria "YB" alone in liquid cultures, an inverse linear relation was found between bacterial numbers and efficiency, and the greatest rate of production of ammonia was found to correspond to a bacterial content of about 500 million per cc.; the rate was lowered by any increase in numbers above this figure.

A greatly increased lag period was observed as a result of diluting the inoculum ten times.

Comparing a soil protozoo an *Hartmanella* and "YB" against "YB" alone in sand cultures, it was found that the presence of the amoebae, while lowering the bacterial numbers, seemed to increase the rate of ammonia production.

THE PLANT IN DISEASE; CONTROL OF DISEASE  
(Entomological, Insecticides and Fungicides, and Mycological  
Departments)

(a) Insect Pests and Their Control

XLIX. H. F. BARNES. "On the Biology of Gall-Midges affecting Meadow Foxtail Grass." *Annals Applied Biology*, 1929. Vol. XVII, pp. 339-366.

Three midges do serious damage to the seeding of meadow foxtail grass; they are *Dasyneura alopecuri* (Reuter), *Stenodiplosis geniculati* (Reuter) and *Contarinia merceri* n. sp. All three occur almost wherever the grass is grown. "Blindness" or empty husks in meadow foxtail grass is due very largely to attacks of *C. merceri*, which midge does the most extended damage. Keys are given for the separation of larvae, pupae and adults. Control measures are discussed and a method of keeping sheep on the grass until a certain safety date, i.e., a date when the crest of emergence of the female midges is over, is strongly advocated in districts where the bionomics is known.

L. H. F. BARNES. "Unisexual Families in *Rhabdophaga heterobia*." *The Entomologist's Monthly Magazine*, 1929. Vol. LXV, pp. 256-257.

Describes experimental observations showing that unisexual families occur in this midge. This feature is extremely rare among animals with bisexual reproduction and the facts recorded are comparable with Metz's work dealing with various species of *Sciara*.

LI. H. F. BARNES. "A New Thrips-Eating Gall Midge, *Thripsobremia liothripis*, Gen. et. sp. n. (Cecidomyiidae)." *Bulletins of Entomological Research*, 1930. Vol. XXI, pp. 331-332.

This new species of gall midge is described from material received from Trinidad by the Imperial Institute of Entomology. Its

larvae are predaceous upon *Liothrips urichi* Karny, a species of thrips living upon the Melastomaceous plant, *Clidemia hirta*.

- LII. H. F. BARNES. "On Some Factors Governing Emergence of Gall-Midges." Proceedings of the Zoological Society, 1930. Part II, pp. 381-393.

The times of emergence of about 100,000 individual midges has been investigated under several environmental conditions, including those in which both light and temperature have been varied. The effect of extra heat, while causing earlier than normal emergence, decreases the percentage emergence, while that of extra cold is less marked. Hymenopterous parasites appear to be less affected by cold than their host midges. It is suggested that variation in the relative times of emergence of hosts and parasites, due to differential weather effects, causes sudden marked fluctuations in degree of parasitism.

- LIII. H. F. BARNES. "On the Resistance of Basket Willows to Button Gall Formation." Annals Applied Biology, 1930. Vol. XVII, pp. 638-640.

A preliminary account of experiments showing that different varieties of basket willow show different degrees of susceptibility to attack by the midge *Rhabdophaga heterobia*. Whereas the variety "Harrison" showed complete immunity from attack through three generations of the insect in question, five other varieties tested all proved to be heavily attacked.

- LIV. H. F. BARNES. "Gall Midges (Cecidomyiidae Dipt.,) as Enemies of Aphids." Bulletin of Entomological Research, 1929. Vol. XX, pp. 433-442.

Vague statements have been made that in certain outbreaks Aphids have been controlled by the larvae of gall midges, but no exact proofs based on counts of the number of Aphids killed, the fecundity of the midge compared with that of the Aphid, the appetite of the midge larvae, etc., have been given. With a view to stimulating research along these lines, the species of Cecidomyiidae, of which the larvae have been reported, as prey on or parasitising Aphids are enumerated, and an alphabetical list is given of the Aphids attacked by midge larvae (where the Aphid has not been identified, its food-plant is substituted).

- LV. H. F. BARNES. "Gall Midges (Cecidomyiidae) as Enemies of the Tingidae, Psyllidae, Aleyrodidae and Coccidae." Bulletin of Entomological Research, 1930. Vol. XXI, pp. 319-329.

This paper is the second of a series on the zoophagous Cecidomyids of the world. An annotated list is given of the Cecidomyid larvae that have been reported to prey on Tingids, Psyllids, Aleurodids and Coccids, as well as alphabetical lists of the latter insects showing the Cecidomyids attacking them and the country in which the observations were made.

- LVI. E. E. EDWARDS. "On the Morphology of the Larva of '*Dorcus Parallelopipedus*.'" *Journal of the Linnean Society of Zoology*, 1930. Vol. XXXVII, pp. 93-108.

Describes the detailed external morphology of this type and the salient features connected with the digestive and nervous system. Apart from other characters the larva of *Dorcus* can be separated from those of other genera of European Lucanidae by the form and arrangement of the tubercles composing the coxal and trochanteric stridulatory areas. In its digestive system it exhibits affinities with the Scarabaeidae, while the nervous system is of a primitive type approaching that of *Lucanus*. The Malpighian Tubes are exceptional in that their distal extremities are confluent in pairs and assume, in consequence, a looped condition.

- LVII. A. D. IMMS. "Observations on some Parasites of *Oscinella frit*. Part I." *Parasitology*, 1930. Vol. XXII, pp. 11-36.

Describes two years' observations and experiments with reference to the natural infestation of the stem generation of the frit fly by parasites. Four species of parasites were found to attack this host, one of which, *Callitula bicolor*, was previously unknown in this relation. Owing to these several species being little known, and in order to establish their identity as clearly as possible, detailed descriptions are provided and their morphological characteristics fully illustrated. During the two years in which the investigations were carried out, the total destruction of frit fly in Harpenden plots by parasites amounted to 27 per cent in 1926, and 37 per cent in 1927. Evidence afforded by field plot experiments showed that the parasites, collectively, become more abundant as the season advances with the result that frit fly, affecting late sown oats, suffers markedly heavier mortality from parasites than when it attacks oats drilled earlier in the season.

- LVIII. D. M. T. MORLAND. "On the Causes of Swarming in the Honey Bee (*Apis mellifica*); an Examination of the Brood Food Theory." *Annals Applied Biology*, 1930. Vol. XVII, pp. 137-149.

The influence of nitrogenous food is discussed in its bearing on the question of swarming and theories of the origin of the brood-food are examined. The division of labour among bees of various ages is considered in its relation to the brood-rearing cycle. A critical surplus of nurse bees is found to be associated with the formation of queen cells in preparation for swarming, and in this connection swarm control measures are reviewed and also in relation to the brood-food theory.

#### (b) Fungus Pests and Their Control

- LIX. MARY D. GLYNNE. "A Note on Some Experiments dealing with Sulphur Treatment of a Soil and its Effect on Wheat Yield." *Proceedings of the Royal Society (Victoria)*, 1929. Vol. XLII, pp. 30-35.

Sulphur and sulphur derivatives were applied to Australian soil reported to be too badly infested with disease-causing fungi to

support more than a very poor crop of wheat. Remarkable increases in crop up to 821 per cent increase over controls were obtained.

Disease appeared no more common in controls than in untreated plots suggesting a soil deficiency supplied by the treatment. This might be a deficiency of sulphur, of some element or compound set free in the soil or of something supplied by micro-organisms influenced by the treatment. A stimulation of nitrogen fixing organisms is suggested. Soil acidity also received consideration.

- LX. W. A. ROACH. "*Sulphur as a Soil Fungicide against the Potato Wart Disease Organism.*" *Journal of Agricultural Science*, 1930. Vol. XX, pp. 74-96.

Thiosulphuric acid has been shown to exist in a free state. It is relatively stable in dilute solution; an M/200 solution is only half decomposed at the end of one day, and an M/400 solution at the end of ten days only.

This degree of stability is sufficient to account for the fungicidal action of acidified thiosulphate solutions in terms of the liberated thiosulphuric acid.

It can be calculated that it is only necessary to assume 6 per cent of the minimum quantity of sulphur found effective against wart disease in the field to be in the form of thiosulphuric acid over a period of ten days in order to account for its toxicity.

Experiments of a preliminary nature carried out on sulphur-treated soil, proved the formation of pentathionate in Rothamsted soil kept at 30°C., but not in Ormskirk soil kept at the same temperature, nor in either soil at the lower temperatures of 0° and 15°C.

No definite evidence of the accumulation of appreciable quantities of thiosulphuric acid in the soil was obtained, but reasons are given why this negative evidence is by no means final.

Chemical considerations and the work of others suggest that the pentathionate actually identified in the soil solution arose from the thiosulphuric formed in an early stage of the oxidation of the sulphur.

The explanation of the fungicidal action of sulphur towards wart disease in soil in terms of the formation of thiosulphuric acid is alone in harmony with the ascertained facts.

#### (c) Bacterial Diseases

- LXI. R. H. STOUGHTON. "*The Morphology and Cytology of 'Bacterium Malvacearum' E.F.S.*" *Proceedings of the Royal Society*, 1929. Vol. CV, pp. 469-484.

*Bacterium malvacearum*, the causal organism of the "Black Arm" disease of cotton, has been found to possess certain internal structures and a variety of different morphological forms. An internal structure is described, which passes through a division-cycle and is suggestive of a nucleus. Small granules are described, which are found in the wall of the cell and freed by a process of extrusion. These bodies resemble the "gonidia" of other writers. The occurrence and mode of formation of spherical coccus-like bodies is described. Various atypical forms are found to occur in old cultures.

- LXII. R. H. STOUGHTON. "*The Relation of Environmental conditions to Angular Leaf-Spot Disease of Cotton, 'Bacterium Malvacearum' E.F.S.*" *Annals of Applied Biology*, 1929. Vol. XVI, pp. 188-189.

An account of experiments carried out in a small experimental chamber, showing that temperature and humidity are interrelated factors in their effect on disease. An abstract of a paper read to the Association of Economic Biologists.

- LXIII. R. H. STOUGHTON. "*Apparatus for the Growing of Plants in a Controlled Environment.*" *Annals of Applied Biology*, 1930. Vol. XVII, pp. 90-106.

An account of the construction of tanks and chambers for the growing of plants under independently controlled conditions of soil temperature, air temperature and air humidity. Artificial illumination is provided by two floodlights, one over each chamber.

- LXIX. R. H. STOUGHTON. "*Thionin and Orange G for the Differential Staining of Bacteria and Fungi in Plant Tissues.*" *Annals of Applied Biology*, 1930. Vol. XVII, pp. 162-164.

An account of a new and simple method of differentially staining fungal and bacterial parasites in plants.

- LXV. R. H. STOUGHTON. "*The Influence of Environmental Conditions on the Development of the Angular Leaf-Spot Disease of Cotton. II. The Influence of Soil Temperature on Primary and Secondary Infection of Seedlings.*" *Annals of Applied Biology*, 1930. Vol. XVII, pp. 493-503.

Using the apparatus described in the previous paper it is found that the amount of primary infection of seedlings raised from infected seed decreases at soil temperatures above 30°C., but infection is not inhibited at 40°C. Soil temperature has little or no effect on secondary infection resulting from spray inoculation of the leaves.

#### (d) Virus Diseases

- LXVI. J. CALDWELL. "*The Physiology of Virus Diseases in Plants. I. The Movement of Mosaic in the Tomato Plant.*" *Annals of Applied Biology*, 1930. Vol. XVII, pp. 429-443.

A method is described whereby it is shown that the virus agent in an infested area of a plant does not travel across dead tissue even in the water stream; but can pass over if a bridge is left of living cells. Evidence is adduced to show that the agent apparently travels normally in the plant along the protoplasmic connections from cell to cell of the ground tissue, and that it does not travel exclusively in the vascular tissue.

- LXVII. M. A. HAMILTON. "*Notes on the Culturing of Insects for Virus Work.*" *Annals of Applied Biology*, 1930. Vol. XVII, pp. 487-492.

#### (1) Use of Cellophane for Breeding Cages.

Cellophane is recommended as a material to replace muslin or glass for the caging and isolation of small insects. Metal frameworks are described as a basis for the material, and some of its

properties, *i.e.*, permeability to moisture and gases, and ultra violet light, general transparency and shrinkage are discussed.

(2) Artificial feeding of *Myzus persicae*.

A method is described by which *M. persicae* may be fed on artificial media. It consists of a pair of glass capsules, the upper one having a floor of fine gut skin, through which the insects, caged in a lower capsule, will absorb dyes and culture fluids.

LXVIII. P. H. JARRETT. "*Streak—a Virus Disease of Tomatoes.*" *Annals of Applied Biology*, 1930. Vol. XVII, pp. 248-259.

Streak disease of tomatoes, derived from commercial glasshouses, and experimental streak, produced by combined inoculation of the viruses of potato mosaic and tobacco mosaic are compared.

Glasshouse streak and tobacco mosaic show an equal resistance to alcohol, heat and ageing *in vitro* and have, in addition, an identical host range. Treatment for one hour with 90 per cent alcohol, and for ten minutes at 85°C., did not destroy the infectivity of either of these viruses.

Glasshouse streak is shown not to contain the virus of potato mosaic, but is of itself able to produce necrosis in tomatoes without the participation of potato mosaic.

It is concluded that tobacco mosaic and the mosaic of glasshouse streak are probably identical, and that much of the streak occurring in glasshouses is due to a single virus, and not a mixed infection of this with potato mosaic.

LXIX. P. H. JARRETT. "*The Role of 'Thrips tabaci' Lindeman in the Transmission of Virus Diseases of Tomato.*" *Annals of Applied Biology*, 1930. Vol. XVII, pp. 444-451.

A description is given of experiments designed to show the role of *Thrips tabaci* Lindeman in the transmission of virus diseases of tomatoes.

The diseases tested were tobacco mosaic and glasshouse streak singly, and the viruses of each of these two combined with a potato mosaic virus to give a disease termed experimental streak.

The source of the materials used and the methods employed are described in detail.

In no case was transmission of any of the viruses recorded, although the insects had fed freely on all the plants. It is concluded that *Thrips tabaci* does not transmit virus diseases of tomatoes under all conditions. The importance of this insect as a vector of these diseases in commercial glasshouses in England is therefore doubtful.

LXX. F. M. L. SHEFFIELD AND J. HENDERSON SMITH. "*Intracellular Bodies in Plant Virus Diseases.*" *Nature*, 1930. Vol. CXXV, p. 200.

When *Solanum nodiflorum* is infected with yellow or aucuba mosaic of tomato, it is possible to follow the development within the living cell of the protein X-bodies. A few days after inoculation, innumerable small particles appear and move passively in the

cytoplasmic stream. They enlarge, aggregate and fuse until ultimately a single large mass, the X-body, is formed accompanied by a crystalline spike but by no other abnormal inclusions. In old leaves the X-body tends to crystallise out.

LXXI. J. HENDERSON SMITH. "*Intracellular Inclusions in Mosaic of 'Solanum Nodiflorum.'*" *Annals of Applied Biology*, 1930. Vol. XVII, pp. 213-222.

The inclusions formed after inoculation with aucuba mosaic are described in detail and illustrated. They correspond to the vacuolate amoeboid bodies produced in other hosts by other viruses, are protein in nature, and tend to crystallise. Their mode of formation by aggregation of small particles has been followed throughout in individual living cells, and accounts satisfactorily for the appearances which have led other observers to believe that they are parasitic organisms, a view for which no support has been obtained in this work.

## TECHNICAL AND OTHER PAPERS

### GENERAL

LXXII. E. J. RUSSELL. "*Agricultural Science and Arable Farming.*" National Farmers' Union Year Book, 1930, pp.

LXXIII. E. J. RUSSELL. "*Agricultural Research Institutes and Agricultural Colleges. The Rothamsted Experimental Station.*" Superphosphate, 1930, pp. 149-157.

LXXIV. E. J. RUSSELL. "*Winter Keep for Dairy Stock.*" Year Book of the Central Council of Milk Recording Societies, 1930.

LXXV. E. J. RUSSELL. "*Agricultural Developments in South Africa.*" *Geography*, 1930. Vol. XV, pp. 445-451.

LXXVI. E. J. RUSSELL. "*Palestinian Agriculture and its Possibilities.*" *The Monthly Pioneer*, May, 1930, pp. 5-6.

LXXVII. B. A. KEEN. "*New Steps in School Broadcasting.*" *The Listener*, 1930. Vol. IV, p. 452.

### CROPS, SOILS AND FERTILISERS

LXXVIII. E. J. RUSSELL. "*Manuring and Cultivation of Sugar Beet.*" Report of Third Conference held at Harper Adams Agricultural College, March 13th, 1930, pp. 4-9.

LXXIX. E. J. RUSSELL. "*Soils and Fertilisers.*" *Agricultural Research in 1929*, pp. 120-152. (Royal Agricultural Society of England, 1930.)

LXXX. E. J. RUSSELL. "*The Influence of Fertilisers on the field and Composition of Plants.*" British Association, Report of Bristol Meeting, 1930, pp. 418-419.

LXXXI. W. E. BRENCHLEY. "*Mineral Elements in Plant Nutrition.*" British Association, Report of Bristol Meeting, 1930, pp. 401-402.