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## Report for 1931

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### The Plant in Disease : Control of Disease

#### Rothamsted Research

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become active. After passing the maximum this nitrification diminished gradually, leaving, after a year, a considerable portion of the manure in an unavailable form. This fraction was contained partly in the cells of the micro-organisms themselves and partly in the  $\rho$ -humus which is very resistant to decomposition and which tended to increase slightly during the period.

XLVII. H. L. JENSEN. "*The Microbiology of Farmyard Manure Decomposition in Soil. II. Decomposition of Cellulose.*"  
Journal of Agricultural Science, 1931, Vol. XXI, pp. 81-100.

Addition of farmyard manure to approximately neutral soil (pH 6.5-7.0) gave rise to an abundant development of cellulose decomposing bacteria of the genus *Vibrio*. When it was added to faintly acid soils (pH 5.7-6.2) these organisms were partly replaced by *Spirochaeta cytophaga*. At lower pH values only fungi were active in the decomposition of the cellulose. Similar results were obtained by adding filter paper or straw to soils of different reactions. Cellulose decomposing bacteria did not form humus-like compounds when growing on filter paper in sand culture but at least two fungi *Mycogone nigra* and *Stachybotrys* sp. gave rise to such compounds when growing in sand and in sterilised soil.

XLVIII. H. L. JENSEN. "*The Microbiology of Farmyard Manure Decomposition in Soil. III. Decomposition of the Cells of Micro-organisms.*" Journal of Agricultural Science, 1932, Vol. XXII, pp. 1-25.

The addition of microbial substances to soil resulted in a rapid but temporary increase in bacteria and especially actinomycetes. A fraction of the microbial substance was readily nitrified but there remained a very resistant residue. This was not identical with fungal chitin which is readily nitrified. In the case of *Mycogone nigra* and *Stachybotrys*, the humus-like substance contained in their mycelia formed part of this resistant residue.

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

##### (a) INSECTS, AND THEIR CONTROL.

XLIX. H. F. BARNES. "*Observations on Gall Midges Affecting Fruit Trees.*" Journal of the South-Eastern Agricultural College, 1931, No. 28, pp. 170-177.

Notes on the bionomics and control of *Dasyneura pyri* Bouché, *Contarinia pyrivora* Riley, both on pear; *Thomasiniana oculiperda* Rübs. on rose and apple, and *Dasyneura* sp. on black currant. This information, which deals with recent literature and the author's own investigations, brings up to date the section dealing with the same subject in a previous paper (Barnes, *Material for a Monograph of the British Cecidomyidae or Gall Midges*, Journal of the South-Eastern Agricultural College, 1927, No. 24, pp. 65-146).

- L. H. F. BARNES. "Further Results of an Investigation into the Resistance of Basket Willows to Button Gall Formation." *Annals of Applied Biology*, 1931, Vol. XVIII, pp. 75-82.

Twelve commercial varieties of *Salix triandra* have been proved, under experimental conditions, to be very susceptible to attack by the button top midge (*Rhabdophaga heterobia* H.Lw.); three varieties of *S. purpurea*, one variety of *S. viminalis*, three hybrids of *S. viminalis* and *purpurea*, and *S. alba* var. *vitellina* have proved to be totally immune. It is suggested that hybridisation of *S. triandra* and *S. purpurea* or *S. viminalis* or *S. alba* should be attempted.

- LI. H. F. BARNES. "The Sex Ratio at the Time of Emergence and the Occurrence of Unisexual Families in the Gall Midges (Cecidomyidae)." *Journal of Genetics*, 1931, Vol. XXIV, pp. 225-234.

Unisexual families are shown to occur in *Rhabdophaga heterobia* H.Lw. and *Thomasiniana oculiperda* Rüb.

- LII. H. F. BARNES. "Gall Midges (Cecidomyidae) whose Larvae Prevent Seed Production in Grasses (Gramineae)." *Bulletin of Entomological Research*, 1931, Vol. XXII, pp. 199-203.

Brief notes are given on 18 species of Cecidomyidae, the larvae of which have been recorded from various parts of the world as preventing seed formation in grasses, with a list of the grasses attacked showing the gall midges concerned and the country of origin.

- LIII. A. STEEL. "On the Structure of the Immature Stages of the Frit Fly (*Oscinella frit* Linn.)." *Annals of Applied Biology*, 1931, Vol. XVIII, pp. 352-369.

The morphology of the immature stages of *Oscinella frit* Linn. are described and figured and certain observations of a biological nature are recorded.

- LIV. H. C. F. NEWTON. "On the so-called 'Olfactory Pores' in the Honey-Bee." *Quarterly Journal of Microscopical Science*, 1931, Vol. LXXIV, pp. 647-668.

The structure of the campaniform sensillae on the wing-bases of the honey bee is described together with the essential features of the later developmental phases in the pupae. The observations made lend no support to the view that the nerve fibres of the sensillae are exposed to the air so rendering them specially suitable to the reception of chemical stimuli from a distance. The origin of the cellular elements composing the sensillae is discussed and it is suggested that the neuron of the sensory system connected with these organs is situated in the hypodermis and is in fact the sensory cell itself.

- LIV. MARION A. HAMILTON. "The Morphology of the Water Scorpion, *Nepa cinerea* Linn. (*Rhynchota Heteroptera*)." *Proceedings of the Zoological Society of London*, 1931, pp. 1068-1134.

A description of the morphology and histology of a common freshwater Heteropteran, the "Water Scorpion." A short account

of the biology and life-history is given followed by a detailed account of the anatomy, both external and internal. Particular attention is paid to the muscular and nervous systems not hitherto described, and showing various interesting adaptations and modifications to the unusual mode of life. The respiratory system and some of its peculiar points of anatomy and physiology receive considerable attention. In *Nepa* a great many of the normal functions of insects have become subjugated to the more pressing immediate need for air, with the result that such organs as wings and wing muscles, spiracles, etc., are being used in ways, and for purposes which are almost unique, owing to the adoption of a permanent sub-aqueous habitat. Finally an account is given of the integument and sense organs which have also been rather neglected by morphologists, with the one outstanding exception of the abdominal sense organs. These are again unique structures pertaining to the abdominal spiracles and owing their existence to the unusual needs of the insect.

LVI. R. P. HOBSON. "*Calcium and Hydrogen Ion Concentration and the Interfacial Tension of Pyrethrum Extracts.*" *Journal of Agricultural Science*, 1931, Vol. XXI, pp. 101-114.

The addition of a pyrethrum extract to a petroleum solvent, semi-refined white spirit, considerably lowers its interfacial tension against water. The tension also depends upon the reaction of the aqueous phase, decreasing as the alkalinity increases.

The addition of a small amount of a solution of calcium chloride further lowers the interfacial tension more especially against acid solutions, thereby decreasing the sensitivity of the tension value to the pH of the aqueous phase.

The presence of calcium salts in the aqueous phase raises the interfacial tension of solution of pyrethrum extract.

Alkaline salts counteract the effect of calcium salts and the resulting tension values can be correlated with the ratio of calcium to hydroxyl ion concentration.

LVII. J. T. MARTIN AND F. TATTERSFIELD. "*The Evaluation of Pyrethrum Flowers (Chrysanthemum Cinerariaefolium).*" *Journal of Agricultural Science*, 1931, Vol. XXI, pp. 116-135.

The analytical methods of Tattersfield, Hobson and Gimingham, and Gnadinger and Corl for the determination of the pyrethrins in pyrethrum flowers are compared, and certain modifications in technique suggested.

Good concordances have been obtained between analytical data and insecticidal tests employing *Aphis rumicis*.

A new method for the rapid and approximate evaluation of unadulterated samples, employing small quantities of material, is described.

Observations on the pyrethrin content of individual flowers in the various stages of development are recorded, making use of a modification of the method indicated.

LVIII. F. TATTERSFIELD AND R. P. HOBSON. "*Extracts of Pyrethrum: Permanence of Toxicity and Stability of Emulsions.*" *Annals of Applied Biology*, 1931, Vol. XVIII, pp. 203-243.

Pyrethrum flowers (*Chrysanthemum cinerariaefolium*) both as whole heads and as powder retain their insecticidal properties at ordinary temperatures and at 28°C. for considerable periods if stored in closed vessels. If exposed to the atmosphere in a thin layer as finely ground powder there is risk of loss of toxicity.

Alcohol and petroleum extracts of pyrethrum retain their toxicity in temperate climates over many months. Alcohol extracts readily give permanent emulsions when added to water; petroleum extracts require the incorporation of an emulsifier. Water-miscible petroleum extracts of pyrethrum can be prepared by the addition of certain materials, such as ammoniated Agral W.B. and neutral turkey-red oil.

A study has been made of the degree of permanence of the active principles of alcoholic and water-miscible petroleum extracts at ordinary British temperatures and at 28°C. and also in emulsions of these extracts in alkaline spray fluids of varying pH. The active principles proved more permanent than has usually been supposed.

The readiness with which water-miscible petroleum extracts disperse in the aqueous phase and the stability of the emulsions formed under a variety of conditions have been investigated.

LIX. F. TATTERSFIELD. "*Pyrethrum Flowers: A Quantitative Study of Their Development.*" *Annals of Applied Biology*, 1931, Vol. XVIII, pp. 602-635.

An account is given of the examination of the flowers of pyrethrum plants (*C. cinerariaefolium*) grown in Harpenden. The plants were divided into blocks and randomised, the flowers being harvested from a dozen plants each week over a period of 8½ weeks, the flower heads ranged from the small bud stage in the first week to the over-blown stage in the last week.

The yield in numbers and weight of heads per plant, the diameters of the receptacles and the content of pyrethrin I and II were determined. There was a considerable amount of variation in all the factors in the flowers from different plants.

A statistical analysis showed that:

- (a) there was no significant variation in the numbers of the flowers with time, but that position of the plant in the bed had a significant effect;
- (b) the time of harvesting had a significant effect upon the content of the pyrethrins, whether taken separately or together and whether expressed in percentages, parts per flower head or parts per plant.

There was a quantitative development of the active principles in the flower heads from the small bud stage up to the time of maturity of the flowers, which more than kept pace, on the whole, with the increase in weight of the flowers. Thus the content of pyrethrins, both relatively and absolutely, rises to a maximum at the maturity of the flowers.

The mean percentage content of pyrethrins fell after pollination, and the fading of the flowers; this corresponds with the rapid increase in weight of the heads on the formation of seed. There would appear to be a loss, which might be serious, both in percentage content of active principles and in yield of flowers if harvested before being fully open.

(b) BACTERIAL DISEASES.

- LX. R. H. STOUGHTON. "*The Influence of Environmental Conditions on the Development of the Angular Leaf-Spot Disease of Cotton. III. The Influence of Air Temperature on Infection.*" *Annals of Applied Biology*, 1931, Vol. XVIII, pp. 524-534.

Experiments carried out in the Rothamsted control chambers on the influence of air temperature on the angular leaf-spot disease of cotton plants, resulting from spray inoculation of young plants, show that high air temperatures favour the development of the disease. Maximum infection occurs at an air temperature of 35-36°C. with decreasing incidence at progressively lower temperatures. At a constant air temperature of 39-40°C. cotton plants make no growth, and eventually die.

Infection takes place more readily when the inoculation is carried out during the non-illuminated period.

The relation of these results to the experiments on the influence of soil temperature is discussed.

(c) VIRUS DISEASES

- LXI. J. CALDWELL. "*The Physiology of Virus Diseases in Plants. II. Further Studies on the Movement of Mosaic in the Tomato Plant.*" *Annals of Applied Biology*, 1931, Vol. XVIII, pp. 279-298.

The results of experiments discussed in this paper support the general view that the agent of virus diseases will travel only through living tissue. No entry into the living tissues is possible through the epidermis, the root hair, or the xylem vessel walls. The agent can and does travel, however, in the water stream, if it be injected mechanically into the xylem. The absence of the agent from the hydathode exudate has been demonstrated. The agent cannot enter an unbroken cell nor can it move through areas of dead cells. Traces of toxic substances from the inocula to be tested may prevent the infection of experimental plants, even when the virus agent is present. Movement upwards and downwards in the plant takes place more or less at the same rate. The agent appears to move along the protoplasmic strands rather than to be carried bodily in the phloem strands. The effect of darkness on the development of the virus in the plant and on the plant itself is discussed.

- LXII. F. M. L. SHEFFIELD. "*The Formation of Intracellular Inclusions in Solanaceous Hosts Infected with Aucuba Mosaic of Tomato.*" *Annals of Applied Biology*, 1931, Vol. XVIII, pp. 471-493.

A description is given of the mode of formation of intracellular inclusions produced by aucuba mosaic of tomato in *Solanum nigrum*,

*S. nodiflorum*, *S. lycopersicum*, *Nicotiana tabacum* and *Hyoscyamus niger*.

Soon after infection the rate of streaming of the cytoplasm is increased, then minute particles of protein appear in the cytoplasm, which carries them passively about the cell. These particles aggregate and fuse to form large masses which are still carried passively but more slowly about the cell. These fuse until all the protein material is contained in one or occasionally more granular masses. In the three *Solanum* species examined this mass becomes rounded, and it may lose its granular appearance and become vacuolated. In *N. tabacum* the body does not always round off and in *H. niger* it very seldom does so, but remains as an irregularly shaped granular mass which may, however, become vacuolate.

There is no evidence at any time of autonomous movement, the particles and the fully formed body being carried, as are the cell nucleus, mitochondria, etc., of the normal plant, in the cytoplasmic stream.

After the spherical body is formed a spike-like crystal appears in the cell.

The cell remains at rest for the space of several weeks. Often the rounded inclusion body and the nucleus are juxtaposed, but there is no special significance in this, it is merely the accidental result of the mode of formation of the body. Particles tend to accumulate where a number of strands of plasma meet; usually several strands converge on the nucleus.

Ultimately the body breaks down, giving a number of protein crystals. After some months these dissolve. In *H. niger* the inclusion bodies are confined to the chlorotic areas, where they are abundant in all tissues. In the other species studied they are distributed over green and yellow tissues. They are very abundant in the hairs, less so in the epidermis, and very rare in the palisade and spongy tissues. In *H. niger* the development of the palisade tissue is arrested, in the other species the development is not so obviously affected, although growth is retarded.

These inclusions appear not to be organismal in nature; they seem to be products of reaction of the host cell to the virus, but they may contain the etiological agent of the disease.

## TECHNICAL AND OTHER PAPERS

### GENERAL

- LXIII. G. W. SCOTT BLAIR AND R. K. SCHOFIELD. "On the Anomalous Flow of a Strong Solution of Lithium Chloride through Narrow Glass Tubes." *Philosophical Magazine*, 1931, Vol. XI, pp. 890-896.

In connection with plastometric measurements of clay pastes the behaviour of non-colloidal solutions was investigated in the plastometer. A strong solution of lithium chloride was found not to obey Poiseuille's law for the flow of viscous liquids through glass capillary tubes. It seems that small strains are not immediately dissipated during flow, possibly owing to the tendency of the ions to maintain a non-random distribution. In addition, evidence was