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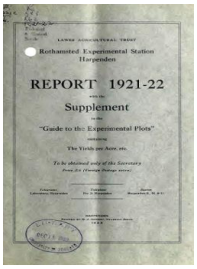
Report 1921-22 With the Supplement to the Guide to the Experimental Plots Containing the Yields per Acre Etc.



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Plant Pathology

Rothamsted Research

Rothamsted Research (1923) *Plant Pathology ;* Report 1921-22 With The Supplement To The Guide To The Experimental Plots Containing The Yields Per Acre Etc., pp 42 - 49 **- DOI: https://doi.org/10.23637/ERADOC-1-110**

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It is possible that the fraction fine silt II., whose upper limit of diameter is .005 mm., has similar effects to the clay fraction.

XXXII. B. A. Keen. *"Evaporation of Water from Soil II. Influence of Soil Type and Manurial Treatment."* Journal of Agricultural Science, 1921. Vol. XI. pp. 432-440.

Further experiments have been done on the evaporation of water from soil, using the same apparatus and technique as described in an earlier paper. The present series of experiments was designed to investigate the effect of clay content and manurial treatment on the evaporation. Two soils have been used, one containing only 6% clay and the other 15%, and from each soil samples were taken from plots which had received (*a*) no manure, (*b*) artificial manure, (*c*) farmyard manure. The rate at which the soils lost water over concentrated sulphuric acid and at a constant temperature was found to depend firstly on the amount of clay present, and secondly on the amount of organic material in the soil. The differences due to content of organic material were more obvious in the soil containing the larger amount of clay; the farmyard manure plot lost water at the slowest rate, and the unmanured plot occupied an intermediate position. In the sandy soil the differences in evaporation due to manuring were small.

There is evidence that the moisture equivalent of these soils measures the percentage of water at which the evaporation is first directly affected by the soil particles, and that at percentages of water in excess of the moisture equivalent evaporation is taking place substantially from a free water surface.

XXXIII. E. J. Russell and B. A. Keen. *"The Effect of Chalk on the Cultivation of Heavy Land."* Journal of Ministry of Agriculture, 1922. Vol. XXVIII. pp. 419-422.

Measurements taken with a dynamometer showed that dressings of chalk applied 8 years ago were still effective in facilitating cultivation, the saving of drawbar pull being in these trials no less than 180 lb. on a three furrow plough (see p. 12).

THE PLANT IN DISEASE.

INSECT PESTS AND THEIR CONTROL.

XXXIV. A. D. Imms. *"Recent Research on the Head and Mouth-parts of Diptera."* Entomologist's Monthly Magazine. 3rd Series, 1920. Vol. VI. pp. 106-109.

A short discussion of the subject from the morphological standpoint.

XXXV. J. Davidson. *"Biological Studies of* Aphis Rumicis *Linn. IV. Reproduction on varieties of* Vicia Faba*—with a Statistical Appendix by* R. A. Fisher." (See No. XV.) Annals of Applied Biology, 1922. Vol. IX. pp. 135-145.

The reproduction of the bean aphis on 18 varieties of field beans was tested and compared with reproduction on Prolific Longpod broad beans.

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The mean values of infestation for the varieties ranged from 37 to 1,037.

These values allow of the varieties being tentatively grouped into classes representing various degrees of susceptibility ranging from 98% to 3%. The results obtained indicate that resistance or susceptibility may be largely determined by genetic factors in the plant.

XXXVI. J. DAVIDSON. *"Biological Studies of* APHIS RUMICIS *Linn. V. The Penetration of Plant Tissues and the Source of the Food Supply of Aphids."* Annals of Applied Biology, 1923. Vol. X. pp. 35-54.

The food of aphids is the juices of plants which they obtain by penetrating the tissues by means of a delicate piercing organ formed by four chitinous stylets.

The piercing organ passes between the cortical cells—occasionally through individual cells—to the vascular bundles.

The saliva secreted by the aphis acts on the middle lamella of the cell wall. It also causes plasmolysis of the cells; and it is able to convert starch into sugar.

The phlœm tissue is the chief source of the food supply, but other cells of the plant, such as cortex and mesophyll, may be tapped for nourishment.

The sucking out process is usually intracellular, although intercellular suction sometimes goes on.

The varying physiological constitution of different plants or even varieties of the same species of plant is important in relation to the biology and physiology of aphids.

The composition of "honey dew"—the sugary excrement of aphids—is in close relationship with the particular species of plant and aphids concerned.

XXXVII. H. M. MORRIS. *"The Larval and Pupal Stages of the* BIBIONIDÆ. *Part I."* Bull. Entom. Research, 1921. Vol. XII. pp. 221-232.

Deals chiefly with the biology and metamorphosis of *Bibio marci* whose larvæ infest grass-land and have been reported to injure various crops.

XXXVIII. H. M. MORRIS. *"On the Larva and Pupa of a Parasitic Phorid Fly—*HYPOCERA INCRASSATA MEIG.*"* Parasitology, 1922. Vol. XIV. pp. 70-74.

Deals with the biology of a species not hitherto investigated, which parasitizes larvæ of *Bibio marci.*

XXXIX. H. M. MORRIS. *"The Larval and Pupal Stages of the* BIBIONIDÆ. *Part II."* Bull. Entom. Research, 1922. Vol. XIII. pp. 189-195.

An investigation of the biology and metamorphosis of DILOPHUS FIBRILIS and D. ALBIPENNIS, the former species being recorded as injuring the roots of various plants.

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XL. H. M. Morris. *"On a Method of Separating Insects and other Arthropods from Soil."* Bull. Entom. Research, 1922. Vol. XIII. pp. 197-200.

Describes an apparatus consisting of a galvanized framework supporting a graduated series of sieves, which enables arthropods to be separated from soil by means of a current of water.

XLI. H. M. Morris. *"The Insect and other Invertebrate Fauna of Arable Land at Rothamsted."* Annals of Applied Biology, 1922. Vol. IX. pp. 281-305.

A detailed study of the soil fauna of Broadbalk field, involving a comparison of the invertebrata of plots 2 (dunged) and 3 (unmanured), their distribution in depth, and relative numbers. The main conclusions are that the bulk of the fauna is concentrated in the first three inches of the soil, and that there are on an average 15,000,000 invertebrates per acre in plot 2 (receiving farmyard manure annually) and 5,000,000 in plot 3 (unmanured since 1839). The dominant organisms are insects which numbered over 7,700,000 in plot 2 and about 2,500,000 in plot 3. The total amount of the nitrogen contained in these organisms works out at 7349.6 gm. (16.2 lbs.) per acre in plot 2 and 3409.2 gm. (7.5 lbs.) per acre in plot 3. It is unlikely that there is any appreciable loss of this nitrogen from the soil. The observations show that although the introduction of farmyard manure greatly increases the invertebrate population of the soil, the organisms which exhibit increased numbers are saprophagons and not directly injurious to the growing crop.

XLII. J. G. H. Frew. *"On the Morphology of the Head Capsule and Mouth-parts of* Chlorops Tæniopus Meig. *(Diptera)."* Journal Linn. Society, 1923.

The head capsule is described and some modifications suggested of the homology of its facial aspect in Cyclorrhapha as put forward by Peterson in 1916.

The following conclusions are arrived at :—

The dorsal and lateral borders of the oval depression mark the position of the arms of the epicranial sature.

All regions of the head dorsal and lateral to the oval depression are derived from the paired sclerites of the head and the frons and clypeus lie within the depression.

The antennæ arise on the vertex.

The superficial plate of the fulcrum is the clypeus or frontoclypeus.

The tormæ are the chitinised plates joining the sides of the clypeus to the sides of the basipharynx.

XLIII. J. C. F. Fryer, R. Stenton, F. Tattersfield, and W. A. Roach. *"A Quantitative Study of the Insecticidal Properties of* Derris Elliptica *(Tuba Root)."* Annals of Applied Biology, 1923. Vol. X. pp. 18-34.

Extracts of *Derris elliptica* are shown to have a high insecticidal value, particularly for caterpillars. They are not so toxic to aphids.

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The principles of the root toxic to insects are the white crystalline derivative, usually called "tubatoxin," and a resin of a golden yellow colour identical with the "derride" of Sillevoldt.

The dry root itself may be used in a finely powdered condition worked up with water together with soap or other emulsifying reagents.

As the pure poisons found in derris root are solids and only slightly soluble in water, their toxicity appears to depend upon their degree of dispersion.

A biological method of determining insecticidal properties quantitatively is described. It depends on dipping insects for a constant period of time in known strengths of highly dispersed emulsions or suspensoids in dilute aqueous solutions of saponin. Results agreeing with those given by the chemical method described below were obtained, and it enabled a comparison to be made between extracts of derris and nicotine. To certain caterpillars, tubatoxin and derride are shown to be of the same order of toxicity as nicotine.

XLIV. F. Tattersfield and W. A. Roach. *"The Chemical Properties of* Derris Elliptica *(Tuba Root)."* Annals of Applied Biology, 1923. Vol. X. pp. 1-17.

The toxic principles of *Derris elliptica* have been isolated and some of the more simple properties examined. A chemical method for evaluating the root has been outlined and a suitable extraction apparatus described.

The most important constituents of the root are a white crystalline derivative, usually called "tubatoxin," and a resin or a series of resins identical with the "derride" of Sillevoldt and the "tubain" of Wray. Besides these two, yellow crystalline derivatives and a liquid resin were isolated.

"Tubatoxin," the yellow crystalline derivatives, and the resins contain methoxyl groups and these compounds appear to be interrelated. "Tubatoxin" by exposure to light, and by prolonged boiling with organic solvents, is converted into three yellow crystalline products and a resin. This suggests that the "anhydroderride" of Sillevoldt may have been formed during the process of extraction and may not exist as such in the root.

The poisons from the root are readily extracted by means of organic solvents. Ninety-five per cent. alcohol extracts them together with non-toxic derivatives. Benzene, dry ether, carbon tetrachloride are also good solvents for extraction purposes and have a selective dissolving action on the poisons. Petroleum derivatives are not suitable for complete extraction. Prolonged boiling with solvents may cause some loss of toxicity in the extracts owing to chemical change in the "tubatoxin." For economic purposes, benzene and its congeners, or alcohol, are probably the most suitable extraction reagents, provided the temperature of extraction is not allowed to rise too high.

The root may be evaluated by chemical means by extracting the dry root with dry ether, and the genuineness of the extracts confirmed by the determination of the methoxyl content by the Zeisel method. Extracts from different deliveries varied between

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7 and 22 per cent., and the content of CH_3O in the extracts between 13.5 and 14.7 per cent. A qualitative test for "tubatoxin," devised by Dr. Durham, is outlined.

The amounts of the non-toxic constituents vary widely in different consignments. They seem to have some value as emulsifying and wetting agents. As the root, however, arrives in this country in a dry state, in which the constituents have probably coalesced, the use of foreign emulsifying and wetting reagents is necessary, and for maximum efficiency the use of organic solvents for preparing highly dispersed suspensoids appears advisable.

FUNGUS PESTS.

XLV. William B. Brierley. *"On Mutation of Species."* British Medical Journal, 1922, Oct. 21st.

The main genetic bases of "higher organisms" are discussed in relation to the concept of mutation and then in relation to hereditary changes in the protozoa, fungi and bacteria. The concepts of mutation held by microbiologists are considered, and it is shown that they cannot be equated with those applied to "higher organisms." Micro-organisms have not yet been found susceptible to factorial analysis and cytological information regarding the genetic structure and behaviour of their hereditary mechanisms is not available. In the protozoa and fungi, and probably in the bacteria, there is the possibility of the origin of apparently new forms in the normal developmental processes, and it is suggested that "mutations" are due to the selective isolation of such forms.

XLVI. William B. Brierley. *"Some Aspects of Vegetable Pathology in Relation to Human Disease."* British Medical Journal, 1922, Nov. 18th.

The need for extreme caution in making comparison of animal and plant diseases is emphasised, and the lines along which animal and plant pathologists may work in common are suggested. These are mainly comparative morphological, physiological and life history studies of the several pathogens in relation to such problems as systematy, infection, immunity and susceptibility, mutation and other genetic aspects, epidemiology, technique, etc. A plea is made for the definite recognition of a science of medical mycology with adequate teaching and research opportunities.

XLVII. William B. Brierley. *"Comparative Pathology of Plants and Animals."* British Medical Journal, 1922.

The idea of disease accepted in general pathology is that of the invasion of a defensive host by an active parasite, a see-saw balance in which there is an inverse relationship between the health and vigour of the host and the incidence and virulence of the disease. This concept is criticised and evidence given that in diseases of plants it is not necessarily true. The data at present do not allow of such a generalisation and each particular disease complex must be considered separately. The disease complex is

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regarded as the co-ordinated resultant of the activities of the host and parasite each, within the limits of its hereditary constitution, being modifiable by the environment. Lines of comparative research in animal and plant pathology are suggested.

XLVIII. J. Henderson Smith. *"The Killing of Botrytis by Heat, with a Note on the Determination of Temperature Co-efficients."* Annals of Applied Biology, 1923. Vol. X.

When a mass of spores of *Botrytis cinerea* is exposed to the action of moist heat by immersion in water, the individual spores are not all killed simultaneously. A few die quickly, a few after prolonged exposure, and the majority at intermediate periods. The whole process, when the numbers dead at successive intervals of time are plotted against the time, gives a smooth curve, of sigmoid and approximately symmetrical shape. The higher the temperature used, the more quickly does the reaction proceed; but at all the temperatures examined, ranging from 37° C. (where 8-10 hours are necessary for its completion) to 50° C. (where the last spore is killed in about 180 seconds) the curve has the same shape, and the process is exactly the same, except for the change in speed. In this respect the action of heat differs from that of phenol, where the shape of the curve changes progressively as the strength of phenol is raised, from the sigmoid type into a J-type and eventually into a strictly logarithmic curve. The difference is assigned to the occurrence with phenol of a stage of penetration, during which the poison is making its way through the external coat of the spore, a stage which is absent in the case of heat.

The shape of the curve agrees excellently with a recognised type of frequency distribution, and can be adequately and reasonably explained by supposing that the individual spores differ in their susceptibility to the action of heat.

The effect of temperature on the velocity of the reaction is unusually great, and is well expressed by the formula of Arrhenius, if the temperature is reckoned from 0° C. instead of from the absolute temperature. By combination of the formula for the curve and the formula for the temperature-velocity relationship, it is possible to express completely for the spores of Botrytis the whole of the killing process within the limits and under the conditions used in these experiments.

XLIX. J. Henderson Smith. *"On the Apical Growth of Fungal Hyphæ."* Annals of Botany, 1923. Vol. XXXVII. pp. 341-343.

The fungal hypha grows in length exclusively at the tip, and the portion of the hypha behind the extreme tip never elongates after it is once formed. This was determined by direct measurements in a series of fungi selected from widely separated and representative genera, and may be taken as a general rule applicable to all, or at least to most, fungi. In algæ, growth may be apical or may be intercalary; in filamentous bacteria it is intercalary, each segment elongating for itself and at the same rate as the others.

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L. Sibyl T. Jewson and F. Tattersfield. *"The Infestation of Fungus Cultures by Mites."* Annals of Applied Biology, 1922. Vol. IX. pp. 213-240.

Mites are a serious pest of fungus cultures. The species that most frequently occur are *Aleurobius farinæ* and *Tyroglyphus longior,* with an occasional infestation with *Glyciphagus cadaverum.*

They can be controlled by exposing the cultures to the vapour of Pyridine, after which treatment the fungi can be sub-cultured safely. An exact description of the application of the method is given. (Commercial Pyridine is as effective as the pure material.)

If these pests occur in laboratory apparatus, they can be eliminated by the application of strong ammonia. Ammonia and its vapour are very rapidly effective against mites, but they should not be allowed to come into contact with cultures of fungi for too long a period of time in too high a concentration.

Pyridine is shown to have a slight toxic action to fungi, and to inhibit growth completely in certain concentrations which, however, are not at all likely to be objectionable in practice, especially if the treated cultures are sub-cultured.

A brief analysis of the toxic action of Pyridine on both mites and fungi is given.

(*a*) In the case of mites, minute doses have so powerful a paralysing action as to render it probable that Pyridine is specific in its toxic effect to these pests.

(*b*) In the case of fungi, the action of Pyridine upon the germination and growth of *Aspergillus niger* was closely studied. It is shown that up to about .25%, Pyridine has apparently very little toxic action and no feeding effect, but that above this concentration the toxicity increases with great rapidity. It is shown, however, that the toxic action is one of inhibition of germination and that the neutralisation of the base up to 0.6%, the highest concentration tested (even though spores have been exposed to its action for three weeks), permits growth to take place rapidly. Pyridine acts chiefly as a poison through its basic properties but not by the change in the pH of the medium which ensues on its addition.

WART DISEASE OF POTATOES.

LI. William B. Brierley. *"Some Research Aspects of the Wart Disease Problem."* Report of International Potato Conference, London, 1921.

The empiricism of present control methods is emphasised. The disease is a complex state depending upon the physiology and genetical constitutions of the host and the fungus, and this dual entity exists in relation to a changing environment. The several factors in this complex and their relation to the immunity or susceptibility of potato plants to wart disease, are discussed. The problems under investigation at Rothamsted—tuber quality of immunes and non-immunes, nature of immunity, germination and infection studies, soil sterilisation, etc.—are indicated, and other aspects of wart disease research suggested.

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LII. W. A. ROACH. *"Studies in the Varietal Immunity of Potatoes to Wart Disease* (SYNCHYTRIUM ENDOBIOTICUM SCHILB., PERC.)." *Part I.—The Influence of the Foliage on the Tuber as shown by Grafting.* Annals of Applied Biology, 1923. Vol. X. pp. 142-146.

Grafting experiments of a preliminary nature have been carried out to throw light on the functions of the various organs of the potato plant in rendering the tubers immune or susceptible to Wart Disease (*Synchytrium endobioticum* Schilb., Perc.).

Composite plants were built up by grafting in the following ways :—

3 plants of the type	Immune	grafted on	Immune
3 ,, ,,	Susceptible	,,	,,
4 ,, ,,	Immune	,,	Susceptible
2 ,, ,,	Susceptible	,,	,,

The results indicate that the character of the foliage has no influence on the immunity or the susceptibility of tubers to Wart Disease.

It follows that no compound synthetised in the leaves is likely to be responsible for separating potatoes into "immunes" and "susceptibles." The investigation is being continued with the view of finding, if possible, the chemical differences corresponding with the biological differences between immune and susceptible varieties.

TECHNICAL PAPERS.

CROPS AND CROP PRODUCTION.

LIII. E. J. RUSSELL. *"The Barley Crop. A Study in Modern Agricultural Chemistry."* Journal Inst. Brewing, 1922. Vol. XXVIII. pp. 697-717.

Barley, like wheat, flourishes best in relatively dry conditions, and the map showing its distribution in England and Wales is much like an inversion of the rainfall map. In Norfolk it occupies no less than 15% of the land in cultivation and in other counties of low rainfall it occupies between 9% and 14%; in the wetter counties, however, it occupies much less. The yield is chiefly determined by the quantity of nitrogen supplied. When barley is grown year after year on the same ground at Rothamsted the yield steadily falls off for some reason which cannot yet be found. This falling off is less with farmyard manure than with artificial fertilisers. In ordinary farm practice there is no indication of falling yields, but rather the contrary; given adequate manuring, however, the yield is still limited by the season and the strength of the straw.

It is often stated that the quality or malting value of the barley is inversely related to the nitrogen content of the grain, and where large differences are concerned this is generally true. But on any given farm it does not appear that the nitrogen content is much affected by the manuring so long as the conditions are not profoundly altered; the valuation also is not influenced in any regular way.

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