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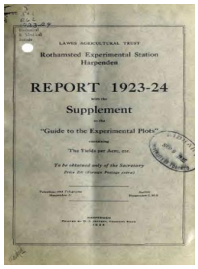
Report for 1923-1924 With the Supplement to the Guide to the Experimental Plots Containing the Yields per Acre Etc.



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constantly proportional to the length of the hypha, but falls off continuously relatively to the length. The extension of branches follows the same process as that of the main hypha, and falls off in rate continuously relatively to the length; but as a rule a branch grows faster than its parent hypha, and in many cases the rate of extension of the total hyphal system (*i.e.*, parent hypha, branches, and sub-branches taken together) is constantly proportional for long periods to the total length. No evidence was found of any actual increase in the growth rate relatively to the amount of substance growing, such as is described in the case of bacteria, nor anything which suggests the formation during the hyphal development of any substance accelerating its growth.

See also "Fungus Pests and their Control, Wart Disease." Papers No. LVI., LVII.

V. THE PLANT IN DISEASE; CONTROL OF DISEASE.

(Entomological, Insecticides and Fungicides, and Mycological Departments.)

(*a*) INSECT PESTS AND THEIR CONTROL.

XLVIII. J. G. H. FREW. "*On the Larval Anatomy of the Gout-fly of Barley* (Chlorops tæniopus Meig.) and *two Related Acalyptrate Muscids, with Notes on their Winter Host-Plants.*" Proceedings of Zoological Society, London, 1923. No. LIV., pp. 783-821.

The metamorphosis of the Gout-fly is fully described with a detailed account of the external and internal anatomy of the mature larva. The structure of the larva in its first and second instars is also discussed. Included in this paper are observations on the metamorphosis of *Meromyza nigriventris* and *Balioptera combinata*—two little known minor pests of winter barley and wheat.

The extent to which all three species utilise wild grasses as winter-hosts has also been examined. *Chlorops tæniopus* has only been found in *Agropyrum repens* among the wild grasses examined. *Meromyza nigriventris* occurs in *A, repens*, *Festuca ovina,* and *Alopecurus pratensis; Balioptera combinata* occurs in *A, repens, Festuca elatior*, *Lolium perenne*, *Holcus lanatus*, and *Agrostis alba.* The following grasses have also been examined but do not appear to function as winter hosts for any species :—*Lolium italicum, Poa pratensis*, *P. trivalis*, *P. annua, Agrostis vulgaris, Alopecurus agrestis*, *Arrhenatherum avenaceum, Anthoxanthum odoratum, Avena pubescens. Cynosurus cristatus*, and *Dactylis glomerata.*

XLIX. J. G. H. FREW. "*On* Chlorops tæniopus Meig." (*The Gout Fly of Barley.*) Annals of Applied Biology, 1924. Vol. XI., pp. 175-219.

Chlorops tæniopus passes through two generations per year. The winter generation is mainly upon couch grass but also occasionally upon winter wheat or upon self-sown wheat or

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barley. The summer generation is mainly upon spring barley, but in seasons unfavourable to the fly couch grass may be utilised. Very rarely wheat is a summer host plant. The life-history is described in detail.

The type of distortion caused to the host plant depends on the stage of growth of the plant when attacked and the degree of distortion of the plants depends upon the rate of growth at the time of attack.

The relation of the fly to the different kinds of host plants is described, particularly as regards the winter generation, and is shown to vary with such factors as date of emergence of the flies, weather conditions during the oviposition period and amount of growth of the different kinds of host plants.

In dull and cool weather the flies will lay few eggs but are stimulated to rapid egg laying by bright and sunny weather. A single fly may lay about 150 eggs. More than one act of coitus is necessary to fertilise all the eggs which a female is capable of laying. The length of life of the imagines is probably about a fortnight for flies emerging in spring, but may be over two months for the autumn emerging flies.

Certain manures (particularly superphosphate) have a marked beneficial effect in reducing the infestation of summer barley by gout fly, owing entirely to their stimulating effect upon the maturing of the ear and the growth of the ear-bearing internode.

While small dressings of nitrogenous manures may reduce infestation, large dressings will not reduce it and may have a tendency to retard growth of the ear and so increase infestation.

Early sowing of spring barley is efficacious in preventing infestation by gout fly.

Preventative measures suggested are early sowing of spring barley, good cultural conditions on the soil, and manuring (*e.g.*, with superphosphate or farmyard manure) to stimulate early growth (*see* paper LXXII.).

L. J. Davidson. "*The Penetration of Plant Tissues and the Source of the Food Supply of Aphids.*" Report International Conference Phytopathology and Economic Entomology, Wageningen (Holland), 1923, pp. 72-74.

The food of aphids is the cell sap of plants, which they obtain by penetrating the tissues by means of their piercing, suctorial mouth-parts. The mechanism of piercing and suction and the action of the insects' saliva on the plant tissues is discussed. With *Aphis rumicis* the phloem is an important source of the food supply but other tissues, including the cortex and mesophyll, may be drawn upon, particularly in the case of heavily infested plants.

LI. J. Davidson. "*Factors which Influence the Appearance of the Sexes in Plant Lice.*" Science, 1924, p. 364.

A short discussion of the observations of Marcovitch on this subject, in relation to results obtained in experiments at Rothamsted.

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LII. H. M. Morris. "*Note on the Wheat Bulb Fly. (Leptohylemyia coarctata).*" Bulletin of Entomological Research, 1925. Vol. XV., pp. 359-360.

The method of control of this pest is based on the assumption that the eggs are laid in the bare or partially bare soil away from the wheat. A recent examination of the soil fauna of the mangold plots of Barn field at Rothamsted has resulted in the discovery of a number of eggs of this insect. This observation affords confirmation of the recent work of Gemmill who first recorded the finding of eggs in field soil in Scotland.

LIII. F. Tattersfield and H. M. Morris. "*An Apparatus for Testing the Toxic Values of Contact Insecticides under Controlled Conditions.*" Bulletin of Entomological Research, 1924. Vol XIV., pp. 223-233.

This apparatus for determining the relative toxicities of contact insecticides is so arranged that successive batches of insects are sprayed under conditions as similar as possible, so that on using various substances at different concentrations, the results are directly comparable. It consists of a glass jar containing in its lid an atomiser, through which is projected by means of compressed air at known pressure a constant quantity of fine spray upon insects placed in a dish inside the jar. Examples are given of results obtained when different concentrations of nicotine are sprayed upon apterous agamic females of *A. rumicis.*

Two notes from the Statistical Department at Rothamsted are included, one analysing the accuracy with which the instrument sprays, and the other giving reasons for regarding the concentrations which kill 50 per cent. of the insects sprayed as the most suitable for the direct comparison of the toxicity of insecticides.

LIV. F. Tattersfield, C. T. Gimingham and H. M. Morris. "*Studies on Contact Insecticides.*" *Part 1. Introduction and Methods. Part 2. A Quantitative Examination of the Toxicity of* Tephrosia Vogelii, *Hook.* to Aphis Rumicis, L. (*The Bean Aphis*). Annals of Applied Biology, 1925. Vol. XII., pp. 61-76.

This paper deals in detail with the insecticidal properties of *Tephrosia Vogelii*, Hook., which, with other species of this genus, occurs abundantly in many parts of the world. The aqueous and alcoholic extracts of its leaves and seeds are shown to be highly toxic to *Aphis rumicis, L.,* the toxicity of the alcohol extract being of the same order as that of nicotine. Extracts of the stems have not proved so poisonous.

The plants of the genus Tephrosia seem to offer possibilities for practical use as insecticides.

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LV. F. TATTERSFIELD, C. T. GIMINGHAM and H. M. MORRIS. "*Studies on Contact Insecticides.*" *Part* 3. *A Quantitative Examination of the Insecticidal Action of the Chlor-, Nitro-, and Hydroxyl Derivatives of Benzene and Naphthalene.* Annals of Applied Biology, 1925. Vol. XII., pp. 218-262.

The toxicities of a number of chlor-, nitro- and hydroxyl derivatives of aromatic hydrocarbons to *Aphis rumicis, L.* (adults) and to *Selenia tetralunaria*, Hufn. (eggs) have been determined.

The order of toxicity to aphides of the hydrocarbons and their chlor- and nitro-derivatives is benzene < toluene < xylene < mono-chlor-benzene < p-dichlorbenzene < o-dichlorbenzene < tri-chlor-benzene < nitro-benzene < m-dinitrobenzene. The mono-chlor-nitro-benzenes have about the same toxicity as nitro-benzene; 1.-chlor-2.4-dinitrobenzene is slightly less toxic than m-dinitrobenzene.

Phenol and the three isomeric cresols are toxic to aphides only at high concentrations. The mono-nitro-phenols and cresols are all more toxic than the parent substances, the order of toxicity of the phenols being o-nitro phenol < m-nitro phenol and p-nitro-phenol < 2.4 dinitro phenol which is greater than tri-nitro phenol; the same order applies to the cresols and their corresponding derivatives.

a-chlor naphthalene proved to be the most toxic of the napthalene derivatives tested.

With few exceptions, the relative toxicities of the various compounds to the insect eggs are approximately in the same order as to the aphides. The nitro-derivatives of phenol and the cresols were specially studied and it was shown that, as in the case of aphides, the dinitro compounds are more toxic to eggs than either the mono- or the tri-nitro compounds.

The toxicity of 3.5 dinitro-o-cresol to adults of *Aphis rumicis* and to the eggs of *Selenia teralunaria* is of the same order as that of Nicotine.

Some of the compounds tested, although injurious to foliage, may prove of value as winter spray fluids for trees in a dormant condition and experiments on a practical scale are in hand.

No simple generalisation as to the correlation of toxicity with any one chemical or physical property seems possible in the present stage of our knowledge. It is probable that the nature of the toxic activity depends on chemical constitution, while the intensity of activity is determined by one or more physical properties.

See also paper LXXV.

(*b*) FUNGUS PESTS AND THEIR CONTROL.

LVI. MARY D. GLYNNE. "*Infection Experiments with Wart Disease of Potatoes,* Synchytrium Endobioticum (*Schilb.*)." Annals of Applied Biology, 1925. Vol. XII., pp. 34-60.

A study of certain conditions controlling infection of potatoes by the winter sporangium of *Synchytrium endobioticum* in the soil and by the summer sporangium in the laboratory has been made with a view to finding a reliable method of pot experiment

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to serve as a basis in soil sterilisation research, and a method for testing immunity or susceptibility more rapidly than is at present done in the field. Experiments on infection by the winter sporangium in the soil have shown that a very high degree of soil moisture is necessary to ensure infection, but this need not be present during the whole of the growth period. It appears most effective when the wet period is in the second month. A high percentage infection is obtained in potato plants grown in soils of very varying physical character. Under the conditions of pot experiments the wart disease organism survives in the soil in the absence of the potato plant for a period of at least a year. There appears to be a dormancy period of about six weeks between soil infection and sporangial germination. The relation of numbers of sporangia in the soil to the incidence of disease is discussed. When favourable conditions were maintained 80-100 per cent. of the plants tested were found to be infected within a period of three months, even in varieties which in the field appear least susceptible. Under conditions less favourable to infection the relative susceptibilities of the several varieties become clearly marked. No wart disease was found under any conditions on immune varieties. Infection of various plants other than the potato was attempted. Small warts were found on three varieties of tomato and on *Solanum nigrum* and *S. dulcamara,* but none on five other varieties of tomato, on *Datura Stramonium*, *Salpiglossis sinuata, Hyoscymus niger, Atropa belladonna, Lycium chinense* or on many common weeds grown in infected soil.

A method is described for infecting sprouting tubers with wart disease by means of summer sporangia. Susceptible varieties subjected to this treatment develop young warts within three weeks, while immunes remain clean. The method can therefore be used for testing immunity or susceptibility in the laboratory.

LVII.—W. A. Roach, Mary D. Glynne, Wm. B. Brierley and E. M. Crowther. "*Experiments on the Control of Wart Disease of Potatoes by Soil Treatment with Particular Reference to the use of Sulphur.*" Annals of Applied Biology, 1925. Vol. XII., pp. 152-190.

As susceptible varieties of potato are still widely cultivated and sporadic outbreaks of wart disease are a serious menace, it was imperative to find a method whereby the winter sporangia of *Synchytrium endobioticum* in contaminated soil could be killed. Previous studies and the unusual difficulties presented by the problem are discussed. Results of experiments extending over four years are recorded.

During 1921-2 pot experiments were carried out to test various chemicals both alone and in conjunction with steam. Steaming the soil proved effective in eliminating the disease, but it offered little hope of being economically possible as a field treatment. The amount of disease was reduced by sulphur, calcium and potassium polysulphides, formaldehyde, dichlor-

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cresol, chlordinitrobenzene and nitrobenzene. Satisfactory infection was not obtained in pot experiments; this method was therefore abandoned in favour of field experiments.

The incorporation of chemicals with the soil in the field was carried out with the Simar Rotary Tiller, great care being taken to ensure very thorough and even distribution. Results suggest that the efficiency of the treatment depends on this thoroughness of incorporation. During 1922 a selection of the chemicals tried in 1921 and others were tested. From these sulphur was selected in 1923 for more extensive study as being the most hopeful because of its efficiency and cheapness.

In 1924, a year of very heavy disease, it was proved at Ormskirk that when the dose of ground sulphur was increased through 1, 2, 3, 4, 5, 10 cwts. per acre the degree of infection was reduced in direct ratio from 73 per cent., the value for untreated soil, to 8 per cent. for an application of 10 cwts. per acre. Doses greater than the latter did not produce proportionate decreases of infection; but there are reasons for thinking that this small amount of disease in certain of the plots was due to recontamination of those plots later in the season. When the results are represented in graphical form the straight line of nearest fit to the experimental values cuts the horizontal axis at a point representing 11.2 cwts. per acre of sulphur; and, in the absence of secondary infection, this quantity of sulphur should be slightly more than the minimum necessary to free the Ormskirk soil of disease.

On the heavy clay soil at Hatfield it was found necessary to use much heavier applications of sulphur (about 40 cwts. per acre) to ensure absolutely clean plots.

Gasworks-spent-oxides, tried as an alternative source of sulphur, proved rather less effective than ground sulphur when equal quantities of sulphur were applied in each case. The result was probably due to the unsatisfactory state of division of the sample of spent oxides.

Sulphur inoculated with *Thiobacillus thiooxydans* showed no increased efficiency over uninoculated sulphur on Ormskirk soils and appeared less effective than the latter on the Hatfield clay.

The elimination of wart disease in the field by sulphur and sulphur compounds was not correlated with the degrees of acidity produced and it would appear that some sulphur product other than sulphuric acid is the active fungicidal agent.

The sulphur treatment will be put to a large scale critical test in 1925-6; but the results to date seem to show that a feasible method of eradication of Wart Disease from contaminated land may have been found.

Many outbreaks are in gardens or allotments situated in the midst of rich potato districts; but owing to legislation limiting the movement of potatoes from relatively large areas surrounding these outbreaks, they are the cause of great losses to neighbouring growers. Hence it is economically possible to spend relatively large sums of money in dealing with these small outbreaks which would be out of the question if treatment at a proportionate cost were to be applied to larger areas. The results described in

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this paper hold out definite hope of the financial possibility of the treatment of small isolated areas and offer some hope even of the possibility of applying such treatment to large areas.

(*c*) PLANT PATHOLOGY.

LVIII. WM. B. BRIERLEY. "*The Relation of Plant Pathology to Genetics.*" Report of Imperial Conference of Botany, London, 1924. (Cambridge University Press.) pp. 111-119.

A critical discussion of the problem. Where disease is due to growth in unfavourable conditions the problem resolves itself into a study of the genetical qualities of the plant in relation to soil, climate, etc. Where disease is brought about by parasites a complete understanding of any particular case involves the genetic and physiological analysis of both host and parasites and the physical and chemical analysis of the conditions under which the host and parasites have developed and at present exist. Assumption of germinal stability by the plant breeder and of germinal instability by the microbiologist are antithetic and require deeper analysis. Immunity and susceptibility relationships are often confined to pure lines of host and physiological strains of parasites and alterations in external conditions may greatly modify the phenotypic expression of this relationship. The primary factors that determine the appearance of disease in any particular case are (1) the genetic qualities of host and parasite; (2) environmental conditions; (3) relative geographic distribution of host and parasite. An additional factor of importance is the relation of the hygiene of the host to the incidence of disease, the commonly held ideas on which are urgently in need of revision. Most of the past analytic work on the genetics of micro-organisms and the disease relationship needs revising in the light of the following: (*a*) the co-existence of distinct physiological strains in morphological units; (*b*) the possibility, and in certain cases probability, of very considerable genetic complexity and genetic segregation in micro-organisms. Genetic research on bacteria and fungi is incommensurable with that on the more evolved organisms which is the basis of present genetical theory and in the study of the former exact criteria and definite concepts are almost entirely lacking.

TECHNICAL PAPERS.

(*a*) SOILS AND FERTILISERS.

LIX. H. J. PAGE. "*The Chemistry of the Soil and of Crop Production,*" in "*Chemistry in the XXth Century.*" (Benn Bros., 1924.) pp. 225-242.

Following a foreword by Sir John Russell, the subject is discussed with special reference to the progress made since 1900, more particularly by British workers.

LX. B. A. KEEN. "*Soil Tilth in Relation to Mechanical Tillage.*" Agricultural Gazette, 1924. Vol. C., pp. 297-298.

An account of the work on soil cultivation being done in the Physical Department. (*See* p. 28.)

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