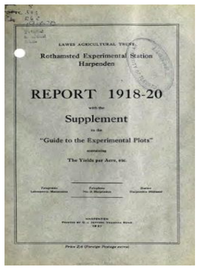
ROTHAMSTED RESEARCH

Report 1918-20 With the Supplement to the Guide to the Experimental Plots Containing the Yields per Acre Etc.



Entomological Department XX, Xxx, Xxxi

Rothamsted Research

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rains warm the soil; on the other hand, autumn rains apparently prevent the soil from cooling as much as it would otherwise have done.

There is no satisfactory substitute for a recording soil thermometer, but a fair estimation of the mean daily temperature at the 6in. depth can be obtained over the greater part of the year by regarding the maximum air temperature as the maximum soil temperature, and the 12in. depth soil temperature at 9 a.m. as the minimum, and then taking the mean.

The relations between the daily temperature rise in the soil and the air have been studied in detail by following the changes in the ratio $\frac{\text{soil amplitude}}{\text{air amplitude}}$ from day to day. These ratios fall into a well-defined frequency curve whose maximum occurs between the values .2—.3. This range of the ratio is prevalent in spring and early summer, and also in early autumn. A similar curve is given by the ratios of the daily cooling of soil and air, the maximum in this case being between .3—.4. The ratio $\frac{\text{soil amplitude}}{\text{air amplitude}}$ of course alters when either, or both, numerator and demominator change. A series of relations between these changes, both for individual and averaged values is given in the paper.

XXVIII. E. A. Fisher. "*Studies on Soil Reaction—I. A résumé.*" Journal of Agricultural Science, 1921. Vol. XI. pp. 19-44.

A critical account of the various hypotheses put forward to explain the phenomena of soil acidity and the methods that have been suggested for estimating it. All present methods are shown to be defective. The hydrogen ion concentration gives useful indications, but the titration methods, lime requirement methods, etc., are defective because the lime requirement is really very complex, being made up of two factors; the lime required to neutralise soil acids, and the lime actually absorbed by the soil. It is impossible at present to differentiate these or to compare with any degree of strictness one soil or one base with another.

XXIX. E. A. Fisher. "*Studies on Soil Reaction—II. The colorimetric determination of the hydrogen ion concentration in soils and aqueous soil extracts.*" Journal of Agricultural Science, 1921. Vol. XI. pp. 45-65.

Details to be observed and difficulties to be overcome in the colorimetric determination of the hydrogen ion concentration in soils. It is shown that the fineness of division of the soil is of considerable importance.

PLANT PATHOLOGY.

XXX. A. D. Imms and M. A. Husain. "*Field Experiments on the Chemotropic Responses of Insects.*" Annals of Applied Biology, 1920. Vol. VI. pp. 269-292.

During the course of these experiments the insects attracted consisted almost exclusively of *Diptera; Hemiptera, Coleoptera* and *Neuroptera* were unrepresented. A small number of *Noctuid Lepidoptera* entered the traps, which however were not adapted for such relatively large insects as many *Lepidoptera*. Beer, cane molasses, and mixtures of these two substances are powerful chemotropic agents for various *Diptera*. Ethyl alcohol, in various concentrations, exhibited little or no chemotropic properties, but with the addition of small amounts of butyric, valerianic or acetic acids it exercised a powerful attraction. Aqueous dilutions of the above acids were not attractive, the respective esters probably being the attractive agents in each case. The remaining substances utilised in these experiments were found to exhibit little or no positive chemotropic properties. Out of considerably over 3,000 *Diptera* attracted during the course of these observations, by far the greater number pertained to one or other of the five families, *Rhyphidæ, Mycetophilidæ, Sepsidæ, Muscidæ* and *Anthomyidæ*. As a general rule, members of both sexes of a species were attracted irrespective of the chemotropic agent employed. In the majority of instances, males predominated over females, but in no case where the number of individuals of a species attracted exceeded 20 was the disproportion greater than 2.9 males to 1 female. *Rhyphus punctatus, Hylemyia strigosa* and *Calliphora erythrocephala* were the dominant species attracted.

XXXI. J. DAVIDSON. "*Biological Studies of Aphis rumicis L.*" Part I.—"*Description of the Species and Life History.*" Bull. Entom. Res., Vol. XI., 1921.

"*Biological Studies of Aphis rumicis L.*" Part II.—(a) "*Appearance of the Winged Forms*"; (b) "*Appearance of the Sexual Forms.*" Proc. Roy. Dublin Soc., 1921.

"*Biological Studies of Aphis rumicis L.*" Part III.—(a) "*Reproduction of Aphis rumicis on different Host Plants*"; (b) "*Influence of Food Plants on the Characters of the Species*"; (c) "*Influence of Temperature and Humidity on the Development of the Species.*" Annals of Applied Biology, Vol. VIII., 1921.

The life history of *Aphis rumicis* is as follows :—

The ova are laid by sexual females on the winter host *(Euonymus)* during September and October [1]. These hatch out in March and April, and the *Fundatrices* produce the first viviparous generation on the winter host. Eventually, w.v.[2] (*migrantes*) develop, which migrate to the intermediate hosts, such as beans, poppies, etc. On these latter plants, they produce a.v. (*alienicolæ apteræ*). Eventually, w.v. (*alienicolæ alatæ*) are produced which fly to other intermediate hosts, of the same kind or different species, such as *Chenopodium*, Mangolds, Beet, *Capsella bursa-pastoris*, *Rumex*, etc. This infestation of the intermediate hosts continues throughout the summer months.

In September, certain of the *alienicolæ apteræ (sexuparæ apteræ)* produce winged sexual males, and at the same period certain of the *alienicolæ alatæ (sexuparæ alatæ)* which morphologically resemble the earlier winged forms but are physiologically different, fly back to the winter host, and there produce apterous females. The males fly back from the intermediate hosts to the winter hosts, the cycle being thus closed.

(1) It is highly probable considering the wide distribution of *Aphis rumicis* that there are other winter hosts.
(2) w.v.—winged viviparous female; a.v.—apterous viviparous female

Experimental evidence indicates that the sequence of winged and apterous agamic females is largely due to some internal inherent tendency. w.v. tend to produce a.v. and a.v. may produce entirely a.v. or a mixed progeny, consisting of a variable percentage of winged forms. The apterous condition is to be regarded as an adaptation, over a long period of time, to seasonal food and temperature conditions.

The appearance of sexual forms in the experiments—especially having regard to the cytological investigations in Aphids—shows that the change from the viviparous parthenogenetic phase to the sexual phase is doubtless associated with the chromozome complex, and not primarily due to food and temperature changes.

The agamic generations appear to be interpolated between the winter egg and the sexual generations as an adaptation to seasonal conditions.

Certain a.v. may produce agamic forms as well as sexual forms. In some cultures which were kept in a greenhouse, a.v. and *sexuparæ alatæ* (mothers of the oviparous females) developed in every generation throughout winter from September to April.

The degree of infestation for different species of plants varies considerably. Thus, experimenting with several plants of the same kind, the maximum total number of aphids produced from one a.v. over a 14-day period, for each kind of plant, is shown in the table below :—

Kind of Plant	Total number of aphids in 14 days.	
	1914 Germany	1920 Rothamsted
Broad Beans . . .	1192	1290
Field Beans . . .	1259	—
Sugar Beet . . .	696	294
Red Beet . . .	546	197
Mangolds	534	201
Peas	200	—
Rumex	252	—
Poppies	243	193

The higher figures obtained in Germany on Sugar Beet, Red Beet and Mangolds, suggests a local adaptation of the species to these food plants. Owing to other factors however, especially temperature, it is difficult to draw fine conclusions from any two series of experiments not carried out under the same experimental conditions.

The relative susceptibility of different varieties of Broad Beans was tested in 1920. Ten varieties were taken and 5 plants of each variety were infected with one a.v.

The average numbers of aphids produced from one a.v. on the 5 plants of each variety over a 14-day period were :—

No. of Variety.	1	2	3	4	5	6	7	8	9	10
Average No. of aphids.	897	1018	813	925	840	858	777	1099	746	1000

The results show that the infestation is slightly less on some varieties than on others. These varieties are, however, too closely related racially, to give striking differences, and the experiments are being continued with other varieties of Beans.

Further investigations are in hand dealing with the effect of the manurial treatment of crops on the degree of the infestation of plants by aphids; the relations between the varying constitution of the cell sap of plants, the food of aphids, and the infestation of plants by them, and the working of the stylets in relation to the cells of plant tissues.

XXXII. W. B. Brierley. "*Some Concepts in Mycology—an attempt at Synthesis.*" Trans. British Mycological Society, 1919. Vol. VI. (part ii.). 204-235.

The paper is divided into two parts which, however, are mutually dependent—the species concept and the concept of the educability of fungi. In the former the thesis is maintained that the morphological characters of an organism are a function of the particular genotype and the environmental conditions, and that the phenotypes of different organisms converge or diverge in constant and definite relation to the physico-chemical factors of the environment. Thus morphological characters are no true criterion of specificity. It is further maintained that the only exact method of species creation and specific determination is by means of quantitative physiological data derived from pure cultural treatment under standardised physico-chemical conditions. In the second part the thesis is put forward that the genotypes of "pure lines" of bacteria and fungi are constant and ineducable, and that genotype changes which have been described are better interpreted in terms of modification, of the selection of strains from a population, of stages in a complex life-cycle, or of segregation from a genetically impure ancestor.

XXXIII. W. B. Brierley. "*On a Form of Botrytis cinerea, with Colourless Sclerotia.*" Phil. Trans. Royal Society of London, 1920. Series B. Vol. 210. 83-114.

The fungus, *Botrytis cinerea,* produces black sclerotia, but in a single spore pedigree culture a colourless sclerotium was formed, which gave rise to a strain having colourless sclerotia. This character proved to be constant. The origin and relationships of this new strain are examined and a comparison made of the morphology and physiology of the colourless derivative with the parent. It is shown that the only apparent character in which the two strains differ is in the absence of pigment in the sclerotial skin.

The nature of the loss of colour is considered in relation to the biochemistry and genetics of albinism. The significance of the colourless form is discussed and the hypothesis brought forward that this and other genotypic changes among fungi are better interpreted in terms of segregation from a genetically impure parent than as true mutations. The possibilities of genetic contamination in sexual and asexual fungi are considered.

XIX. H. B. HUTCHINSON and J. CLAYTON. "*On the Decomposition or Cellulose by an Aerobic Organism (Spirochæta cytophaga n. sp.).*" Journal of Agricultural Science, 1919. Vol. IX. pp. 143-173.

Examination of Rothamsted soils on different occasions has revealed the presence of an organism capable of breaking down cellulose with comparative ease. Morphologically, the organism appears to possess greater affinities with the Spirochætoideæ than with the bacteria, and the name *Spirochæta cytophaga* is therefore suggested.

While the Spirochæt is capable of considerable vegetative growth as a sinuous filamentous cell, it also appears to pass through a number of phases which terminate in the production of a spherical body (sporoid) which differs in a number of respects from the true spores of the bacteria. Germination of the sporoid again gives rise to the filamentous form, which possesses perfect flexibility and is feebly motile. The latter does not apparently possess flagella.

Spirochæta cytophaga is essentially aerobic; its optimum temperature is in the region of 30°. Both the thread and sporoid stages are killed by exposure to a temperature of 60° for ten minutes.

The nitrogen requirements of the organism may be met by a number of the simpler nitrogen compounds—ammonium salts, nitrates, amides and amino-acids. Peptone is also suitable in concentrations up to 0.025%. Stronger solutions, *e.g.*, 0.25% lead to a marked inhibition of growth. The organism fails to grow on the conventional nutrient gelatine or agar.

Comparative experiments with a number of higher alcohols, sugars and salts of organic acids show that none of these is capable of meeting the carbon requirements of the organism. Cellulose is the only carbon compound with which growth has been secured.

Although none of the monoses, bioses and other carbohydrates is able to support growth, many of them exert an inhibitive action on cellulose decomposition if present in other than very low concentrations. This may be correlated with the reducing properties of the carbohydrate. Maltose, for example, has been found to be approximately 70 times more toxic than saccharose.

Of the various by-products of the action of Spirochæta cytophaga may be mentioned: (*a*) a pigment possessing relations to the carotin group, (*b*) mucilage which does not give rise to optically active compounds on hydrolysis, and (*c*) small quantities of volatile acids.

Evidence is also adduced to show the relation of cellulose decomposition to the assimilation of atmospheric nitrogen.

XX. A. W. RYMER ROBERTS. "*On the Life History of Wireworms of the genus* AGRIOTES, *Esch., with some Notes on that of* ATHOUS HÆMORRHOIDALIS, F." Part I. Annals of Applied Biology, 1919. Vol. VI. pp. 116-135.

The biology and life history of the common "wireworm" was studied during the years 1916-1919. In England and probably also in Wales and Scotland, *Agriotes obscurus* is generally the