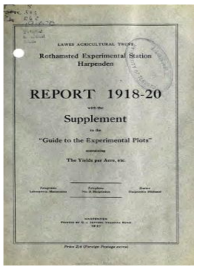
Report 1918-20 With the Supplement to the Guide to the Experimental Plots Containing the Yields per Acre Etc.


Rothamsted Experimental Station
Harpenden

REPORT 1918-20

Supplement

"Guide to the Experimental Plots"

Full Table of Content

Chemcial Department XXI, XXII

Rothamsted Research

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commonest species. The adult beetles hatch from the pupa in August or September and remain in hibernation during the winter. About the middle of May they emerge, feed on the nectar or pollen of flowers and do little or no damage, at least in this country. Oviposition takes place generally from the end of June to the middle of July. The eggs of three species of *Agriotes—obscurus, sputator* and *sobrinus* and *Athous hæmorrhoidalis* were obtained from the soil of pots, in which the beetles had been confined, at depths varying from ¼-inch to 2 inches, either in batches or singly. Attempts to obtain ova from *Ag. lineatus* failed, but from other sources it is known to deposit its eggs in a similar position, and probably the presence of grasses, whether cultivated or growing as weeds, is essential to all five species. This conclusion points to the necessity for clean cultivation in the control of wireworms.

The larvæ on emergence at once burrow into the soil. All are pale in colour and so small (1-2.75mm.) as not to be generally recognised during their first year. The first moult of *A. obscurus* takes place in June, the second in July or August, and it is believed that the larvæ in general moult twice a year, in April or May, and again between July and September. In their first year, the larvæ appear to feed chiefly on partially decomposed vegetable matter and perhaps to some extent on the small roots of living plants, but no evidence of definite damage was obtained. In the later stages they feed on almost any crop and on many weeds. They appear to attack mustard only in the absence of more suitable food, though they are frequently found at the roots of charlock. The larvæ can subsist for a long time on the decaying organic matter in the soil and are able to withstand immersion in water for prolonged periods. During the winter they may be found close to the surface in grass land. But in fallow land they undergo a period of hibernation, sometimes as much as 2ft. from the surface.

Agriotes obscurus has a larval life history extending to five years, as was originally stated by Bierkander.

Pupation takes place in an earthen cell prepared by the larvæ at a depth of from 1 inch up to 7½ or more inches. The pupal stage extends over a period of about 3 weeks, pupæ being found from the end of July to the middle of September.

Wireworms under natural conditions are not parasitized to any great extent. A Proctotrupid, probably *Phænoserphus fuscipes* Hal. was bred from *Athous hæmorrhoidalis,* and a Proctotrupid was also found within a larval *Agriotes obscurus.* The latter species was also found to be the host of a fungus of the genus *Isaria.*

XXI. F. Tattersfield and A. W. R. Roberts. "*The Influence of Chemical Constitution on the Toxicity of Organic Compounds to Wireworms.*" Journal of Agricultural Science, 1920. Vol. X. pp. 199-232.

The relationship between chemical constitution and toxicity to wireworms of organic compounds is found to be of a two-fold nature.

The general effect of a group of compounds of the same type is directly determined by the chemical constitution of the type.

The particular effects of individual members of the groups are limited by their physical properties such as volatility, etc., which may be regarded as indirect consequences of their chemical constitution.

The aromatic hydrocarbons and halides are on the whole more toxic than the aliphatic hydrocarbons and halides. The groups that influence toxicity most when introduced singly into the benzene ring are in order of importance the methylamino (most effective), dimethylamino, hydroxy, nitro, amino, iodine, bromine, chlorine, methyl groups (least effective). But this order is modified in presence of another group; thus when there is a CH_3 already present in the ring the order becomes chlorine (side chain), amino, hydroxy, chlorine (ring), methyl. Chlorine and hydroxy groups together give rise to highly poisonous substances considerably more effective than where present separately. The association of chlorine and nitrogroups in chlorpicrin give rise to one of the most toxic substances tested. Methyl groups substituted in the amino group of aniline increase toxicity more than if substituted in the ring.

Compounds with irritating vapours have usually high toxic values, *e.g.*, Allyl isothiocyanate, chlorpicrin, benzyl chloride. The toxic values of these substances are not closely correlated with their vapour pressures or rates of evaporation.

There is a fairly close relationship between toxicities and the vapour pressure, rates of evaporation and volatilities of compounds of the same chemical type. In a series of similar compounds decreases in vapour pressure and volatility are associated with an increased toxicity. A possible explanation is that condensation or absorption takes place along the tracheal system when insects are submitted to the action of these vapours. On exposure once more to the open air these vapours diffuse out into the atmosphere, the rate at which they do so being a measure of the rapidity with which the insect recovers.

A limit is put upon toxicity by the decrease in vapour pressure, when it sinks too low to allow a toxic concentration in the vapour phase. Chemically inert compounds boiling above 170° C. are generally uncertain in their poisonous effects on wireworms after an exposure of 1,000 minutes at 15° C. Nearly all organic compounds boiling above 215° C. are uncertain in their action, while those boiling above 245° C. are non-toxic. These limits depend on the resistance of the insect, the length of exposure and the temperature at which the experiment is carried out.

XXII. N. N. Sen Gupta. "*Dephenolisation in Soil.*" Journal of Agricultural Science, 1921. Vol. XI.

It is found that phenol and the cresols disappear when added to soil. Three actions seem to be involved:—

1.—An instantaneous disappearance which appears to be non-biological, but its exact nature has not yet been elucidated; apparently it varies directly with the clay content of the soil.

2.—A slow decomposition which continues till all the phenol is exhausted. This is apparently largely brought about by micro-organisms capable of utilising phenol as a source of energy.

3.—There appears, however, to be some non-biological slow decomposition also, since the decomposition in unmanured soil poor in micro-organisms is much slower than in manured soils, and altogether different in character.

Autoclaving the soil at 130° for 20 minutes destroys the cause or causes of the decomposition altogether, but the action proceeds, although much more slowly, than in untreated soil, in the presence of a considerable amount of toluene and mercuric chloride.

Partial sterilisation by treatment with toluene which was evaporated before the addition of phenol increases the rate of decomposition, but steaming does not.

The decomposition takes place even in soil air-dried to 2.4% moisture, but it is extremely slow compared with the rate in normal soil.

When successive doses of phenol are applied to the same soil, each dose is decomposed at a higher rate than the preceding one. This is entirely in accordance with a decomposition mainly biological in character. The same effect has been observed in the case of *m*-cresol.

The treatment of the soil with sulphuric acid (50% by volume) either before or after the addition of phenol greatly augments the instantaneous loss, which may amount to 90% in case of phenol This loss is not affected by autoclaving.

CONDITIONS DETERMINING ENVIRONMENTAL FACTORS IN THE SOIL.

XXIII. B. A. Keen. "*A Note on the Capillary Rise of Water in Soils.*" Journal of Agricultural Science, 1919. Vol. IX. pp. 396-399.

A simple formula for the theoretical maximum rise in an ideal soil, composed of closely packed and uniform spherical grains, may be obtained from a consideration of the triangular pores existing in such a soil. The formula reduces to $h = \frac{.75}{r}$ where h = height of rise and r = radius of spherical grain. The capillary rises given in the following table are calculated on the assumption that a soil is made up entirely of one given soil fraction, and not of a mixture of fractions, and the particles are taken as closely packed spheres :—

Soil Fraction	Diameter in mm.		Capillary Rise in cms.		Average Rise in Ft.
	Max.	Min.	Min.	Max.	
Fine gravel .	3	1	5	15	$\frac{1}{3}$
Coarse sand .	1	.2	15	75	$1\frac{1}{2}$
Fine sand .	.200	.040	75	375	$7\frac{1}{2}$
Silt . . .	.040	.010	375	1500	$31\frac{1}{4}$
Fine silt . .	.010	.002	1500	7500	150
Clay . .	.002	—	7500	—	150 upwards

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