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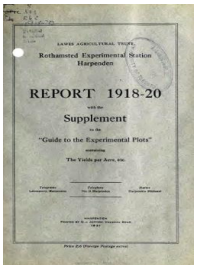
Report 1918-20 With the Supplement to the Guide to the Experimental Plots Containing the Yields per Acre Etc.



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XXXIV. W. B. Brierley. "*Orchid Spot Disease.*" Gardeners' Chronicle, 1919. Vol. LXV. No. 1676.

A consideration of the several diseases of orchid leaves included under the name "Orchid Spot"; with notes on methods of treatment.

XXXV. J. Henderson Smith. "*The Killing of Botrytis Spores by Phenol.*" Annals of Applied Biology, 1921. Vol. VIII. No. 1.

It is shown that if *Botrytis* spores be exposed to the action of 0.4 per cent. phenol, the spores do not all die simultaneously, but some die in a few minutes and some not till two or three hours have elapsed. The curve showing the numbers surviving at different times has a sigmoid shape. If the strength of phenol be progressively raised, the curve becomes less and less sigmoid, approaching the logarithmic type of curve. With the same suspension it is possible to obtain either a logarithmic or a sigmoid curve according to the strength of phenol used. Both types of curve are shown to be explicable on the assumption that the individual spores differ in resistance and that a frequency curve showing the distribution in the resistance grades approaches the normal curve. The influence of the number of spores used is shown to be very considerable; and the consecutive transition from the sigmoid to the logarithmic type occurs, whether we raise the phenol strength, keeping the spore number constant, or reduce the spore number keeping the phenol constant, or use younger and younger spores.

TECHNICAL PAPERS.

CROPS AND CROP PRODUCTION.

XXXVI. Winifred E. Brenchley. "*Useful Farm Weeds.*" Journal of Board of Agriculture, 1918. Vol. XXV. pp. 949-958.

During the war the deficiency in supplies of every kind led to a revival of interest in the uses to which many farm weeds can be applied. If the need ever became sufficiently urgent, weeds might serve many useful purposes, but with the restoration of more normal conditions most of them have again fallen into disuse.

Weeds have their uses in medicine, as dyes, manures, and as fibre plants, but in times of stress they are most valuable as fodder and human food. Couch grass, spurry, bent grass, nettles, chicory, gorse and poppy cake can all serve as fodder, especially as most of them, in addition to being nutritious, are obtainable in large quantities.

Chicory and "salep" *(Orchis mascula)* are the principal weeds used as human food. Chicory has long been employed as a substitute or adulterant for coffee, while salep enters largely into the diet of people of Turkey, Persia and Syria. Many weeds provide leaves that have been used as substitutes for tea and coffee, and the young tops of nettles, garlic and dandelion have been frequently used as green vegetables by country folk.

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XXXVII. WINIFRED E. BRENCHLEY. "*Eradication of Weeds by Sprays and Manures.*" Journal of Board of Agriculture, 1919. Vol. XXV. pp. 1474-1482.

The chemical substances used as weed killers may be divided into two groups :—

1.—Chemicals that merely destroy the weeds and have no direct beneficial action upon the growth of the crops. These substances are usually applied in the liquid form as sprays.

2.—Compounds that not only destroy the weeds but also exercise a manurial action, thus directly benefiting the crop at a later date. These substances are usually very finely ground manures and are applied as dry powders when the leaves are damp.

1.—*Sprays.* Most of these are corrosive in nature and destroy the delicate plant tissues, either killing the weeds outright or so crippling them that they cease to be active competitors with the crop. The chemicals are applied in solution, the strength varying according to circumstances. The most commonly used sprays are copper sulphate, iron sulphate, and sulphuric acid, but other substances are occasionally employed, including nickel sulphate, arsenite of soda, potassium chloride and sodium hydrogen sulphate.

Copper sulphate is effective in eradicating charlock, and is also useful against spurry and poppies. Iron sulphate destroys charlock, but is better than copper sulphate for eradicating poppies and corn buttercup. Sulphuric acid is one of the few sprays that has been found to clear grass land of bracken.

2.—*Manures.* During the last few years attempts have been made to destroy weeds on arable land by the application of finely ground manures, especially cyanamide and kainit, and on grass land by the use of lime, gas-lime and salt, and a fair measure of success is considered to have rewarded the effort. Calcium cyanamide and kainit have been used in eradicating charlock and other weeds, but the results are somewhat variable. Salt is occasionally useful in reducing weeds, especially on grass land, and lime also acts beneficially by making the soil less suitable for some of the worst pests on sour land, as spurry, sheep's sorrel, corn marigold and annual knawel.

Taking all things into consideration, the use of finely ground manures as weed killers offers possibilities, but up to the present the results have been so uncertain and variable that it is not yet advisable to make definite recommendations for their use.

XXXVIII. E. J. RUSSELL. "*Report on the proposed Electrolytic Treatment of Seeds* (Wolfryn process) *before Sowing.*" Journal of the Ministry of Agriculture, 1920. Vol. XXVI. pp. 971-981.

A discussion of the results of pot experiments made to ascertain whether the proposed electrolytic treatment of seed was effective in increasing crop production. In certain cases, increases in yield seemed to be obtained, but in the main the treatment cannot be relied upon to give a successful result : twice, or possibly three times, out of seven it apparently succeeded; once it apparently did harm, and in the remaining cases it did no good.

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XXXIX. E. J. Russell. "*The Composition of Potatoes immune from Wart Disease.*" Journal of the Ministry of Agriculture, 1920. Vol. XXVII. pp. 49-51.

An examination of 32 immune varieties of potatoes grown in 1919 and forwarded by the Glamorgan County Council. A general comparison only can be made with non-immune varieties, but the figures for dry matter and nitrogen content are of the same order as found at Rothamsted for the ordinary varieties of the country. There is nothing to suggest that the value to the purchaser would be any less, or that the supply of food would be adversely affected if immune varieties were substituted for non-immune.

FERTILISERS.

XL. E. J. Russell. "*Report on the possibility of using Nitre-cake in the Manufacture of Super-phosphate.*" Ministry of Munitions, 1918.

An investigation to ascertain the conditions under which nitre-cake could be used as a substitute for sulphuric acid in the manufacture of super-phosphate, and the extent to which the replacement would be possible (see p. 26).

XLI. R. A. Berry, G. W. Robinson and E. J. Russell. "*Bracken as a Source of Potash.*" Journal of the Board of Agriculture, 1918. Vol. XXV. pp. 1-11.

During the war a search was made for possible sources of potash, and bracken ash seemed distinctly promising. Analyses were therefore made of samples obtained from various parts of the country, from which it is concluded that an acre of bracken cut in July or August—the best months for the purpose—might yield from 60 to 290lb. potash (K_2O) per acre according to locality, Ayrshire giving the best results.

XLII. E. J. Russell. "*The Use of Ammonium Nitrate as Fertiliser.*" Journal of the Board of Agriculture, 1919. Vol. XXV. pp. 1332-1339.

The cessation of hostilities enabled the Ministry of Munitions to liberate large quantities of Ammonium Nitrate for fertiliser purposes, and as this possibility had been foreseen, experiments had been put in hand for some time previously. Ammonium Nitrate was found to be highly effective as a fertiliser, but to suffer from two defects :—It tends to attract water from the air (although this tendency can be diminished by suitable factory treatment), and it then sets to a solid which is not easily broken up; and it cannot be sent out in bags, but must travel in barrels, which is always an expensive mode of transit. Its great value is as a top dressing, for which it is particularly well suited, being probably the most rapid nitrogenous fertiliser known.

XLIII. E. J. Russell. "*Synthetic Nitrogen Fertilisers.*" Journal of the Ministry of Agriculture, 1921. Vol. XXVII. pp. 1037-1045.

An account of the following fertilisers now being produced in various factories from the nitrogen of the air :—Nitrate of lime, nitrate of ammonia, ammonium carbonate, ammonium chloride, urea, cyanamide or nitrolim.

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XLIV. G. A. Cowie. "*Decomposition of Cyanamide and Dicyanodiamide in the Soil.*" Journal of Agricultural Science, 1919. Vol. IX. pp. 113-136.

In field practice calcium cyanamide, commonly known in this country as nitrolim, has varied considerably in effectiveness. On the average of all field trials in the United Kingdom, when the effect of nitrate of soda is taken as 100, that of sulphate of ammonia is 97 and of cyanamide 90. But the cyanamide results fall as low as 26 and rise as high as 238. It is now shown that cyanamide under certain conditions contains another substance, dicyanodiamide, which is poisonous not only to plants but to the nitrifying organisms also. It is less toxic towards other bacteria, however, and has little effect on the numbers developing on gelatine plates, or on the rate and extent of the decomposition of dried blood. Nor does it reduce the rate of production of ammonia from cyanamide. In its presence ammonia accumulates in the soil, and the normal oxidation to nitrate does not take place.

Dicyanodiamide, therefore, not only injures the plant but cuts off the supply of nitrate, substituting instead ammonia, which in most cases is less useful, and in some cases directly harmful to the crop. The conditions under which it is formed are known and, fortunately, it can be avoided.

XLV. E. J. Russell. "*Farmyard Manure : its Making and its Use.*" Journal of the Farmers' Club, 1920. 89-106; also in Journal of the Ministry of Agriculture, 1920. Vol. XXVII. pp. 444-449.

A summary specially prepared for farmers of the results of the recent Rothamsted experiments with farmyard manure (see Report 1915-17 for details).

XLVI. E. J. Russell. "*The Influence of Farmyard Manure on the Clover Crop.*" Journal of the Board of Agriculture, 1919. Vol. XXVI. pp. 124-130.

Remarkably few field experiments have been made with the clover crop, but a series recently begun at Rothamsted indicate an unexpected effect on farmyard manure in increasing the yield. Where artificials had been applied to the preceding crops the yield was 19½ cwt. per acre, but where farmyard manure was used it was 32-35 cwt. No explanation can be offered with certainty, but the problem is under investigation in the laboratory.

XLVII. E. J. Russell. "*The Agricultural Value of Organic Manures.*" Journal of the Board of Agriculture, 1919. Vol. XXVI. pp. 228-247.

When Peruvian guano, rape cake and shoddy are compared on the basis of equal amounts of nitrogen per acre :—

Peruvian guano proved the most effective, especially in the year of application.

Rape cake came next.

Shoddy by a small margin came last in its year of application.

Numerically, the values were :—

Peruvian guano	100
Rape cake	91
Shoddy	88

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Shoddy showed a residual effect which would improve its position. The differences are less than might have been expected. No evidence could be obtained that the nitrogen in rape cake is superior in crop-producing power to the nitrogen of sulphate of ammonia or nitrate of soda. No larger crops were obtained from rape cake than from an equivalent of sulphate of ammonia and superphosphate, and actually less was obtained than from nitrate of soda.

There is very little evidence for the view that rape cake and Peruvian guano permanently benefit the soil. Where very large dressings of rape cake (10 cwt. to 1 ton per acre) are applied year after year to the same land there is, in course of time, an accumulation of nitrogen, but this proves of little value to wheat or barley; on the other hand, it may be more useful to mangolds, though the evidence is not conclusive.

In ordinary farm practice, where smaller dressings are given and less frequently than every year, there is little reason to anticipate any residual effect.

If this were the whole case there would be no reason why rape cake and guano should ever sell at prices above those obtaining for sulphate of ammonia or nitrate of soda. Yet farmers and manure makers have always been willing to pay more. There appear to be three reasons for this preference. Rape cake and guano are safer than artificial manures in the hands of inexperienced cultivators. No one would be likely to apply too much owing to high prices, and there is no necessity to mix with other fertilisers.

Further, from the manure makers' point of view, these substances have the enormous advantage of improving the condition of compound fertilisers, a property to which farmers rightly attach great importance in view of the widespread use of manure drills.

Lastly, from the special point of view of the horticulturist, who uses in the aggregate large quantities of manure, rape cake and guano, have the advantage that they can be applied once for all, whilst artificials would have to be given in several small doses, otherwise they might injure the soil.

XLVIII. W. E. Brenchley and E. H. Richards. "*The Fertilising Value of Sewage Sludges.*" Journal of the Society of Chemical Industry, 1920. Vol. XXXIX. pp. 177-182.

The sewage sludges produced by the old methods of tank treatment have very little fertilising value. Two new processes yield sludges of a different class. Slate-bed sludge and activated sludge are aerobically produced while the old precipitation and septic-tank sludges are essentially anaerobic. This difference accounts for the marked increase in manurial value of the newer sludges. The most valuable constituent is nitrogen. The average content in the old sludges tested by the Sewage Commission at Rothamsted and elsewhere, was 1.22%. Harpenden slate-bed sludge contains 2.63% and Withington activated sludge 7.09% of nitrogen; the availability of the nitrogen being 26% in the former and 66% in the latter.

Pot culture experiments made with the two sludges and an equivalent dressing of nitrate of soda showed that activated sludge

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gave a rather higher yield with the first crop of barley than the equivalent of nitrate of soda; slate-bed sludge came a long way behind, but still gave an increase of 22% over the unmanured pots. With the second crop of mustard, activated sludge showed a considerable residual value, while the slate-bed sludge was exhausted. Activated sludge is a fertiliser of great promise, but certain difficulties in drying it must be overcome before its value can be fully realised.

XLIX. H. B. Hutchinson and E. H. Richards. "*The Utilisation of Straw and the Production of Artificial Farmyard Manure.*" Journal of the Ministry of Agriculture, 1921.

The large increase in arable area brought about by the war at one time seemed likely to result in a glut of straw which could not be profitably utilised in agriculture or industry. Experiments have been going on at Rothamsted for some time with the view to making a nitrogenous and humus-forming manure from straw by bacterial decomposition alone. The nitrogen compounds in straw are inert and play little part in the rotting action of the manure heap. A considerable proportion of the carbohydrate material, however, is easily decomposed. This available starch and pentosan may be used to fix atmospheric nitrogen, and under ideal conditions the amount so gained may double the original nitrogen content of the straw. The cellulose and ligno-cellulose are not decomposed, so that the straw retains its tubular character and in no way resembles well rotted manure, even after prolonged storage. Pot-culture experiments and field trials showed that straw treated in this way possessed little fertilising value. In most cases the depressing action of raw straw on a crop sown at the time of application was merely reduced or eliminated, while under the best conditions the increase of crop over the unmanured soil was very small.

The conditions necessary to secure thorough rotting of straw were then investigated. The more important were found to be :—

1.—*Air supply.* Typical rotting occurs only under aerobic conditions. If air is excluded the straw remains unchanged for six months at least.

2.—*Supply of soluble nitrogen compounds in suitable concentration.* The concentration of even the weakest undiluted urine is above the maximum limit for decomposition. No rotting occurs until the concentration of ammonium carbonate has been sufficiently reduced by volatilisation.

3.—*Temperature.* The most rapid changes occur at about 35° C.

If soluble nitrogen compounds are supplied at the rate of 0.72 parts nitrogen per 100 parts of dry straw, all the added nitrogen is converted from a soluble to an insoluble organic form. Rotting will proceed until about 50 per cent. of the dry matter has been lost. Little or no loss of nitrogen occurs, so that the final product contains about 2.0 per cent. calculated on the dry matter. If soluble nitrogen compounds are added in excess of the limit, loss takes place until the concentration is reduced to the necessary extent when the action proceeds normally.

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The new facts brought out by this investigation have several economic applications, some of which have already proved successful under prolonged practical tests. The more important are :—

1.—The production of an artificial farmyard manure.

2.—The recovery of soluble nitrogen from sewage.

3.—The prevention of waste in the usual process of manure making when the beasts are heavily fed with cake.

L. E. J. Russell. "*The Utilisation of Basic Slag.*" Trans. Faraday Society, 1920. Vol. XVI. pp. 263-271.

A discussion of the present position of the basic slag problem (see p. 16).

SOILS.

LI. E. J. Russell. "*Soil Making.*" Journal of the Royal Horticultural Society, 1919. Vol. XLIV. pp. 1-12.

A summary of the process concerned in soil making, with special reference to the means whereby, and the extent to which, the productiveness of devastated areas could be restored.

LII. E. J. Russell. "*The Tractor at Rothamsted.*" Modern Farming, 1920. Vol. IV. No. 6, October.

An account of eighteen months' experience on the Rothamsted farm (see p. 10).

LIII. and LIV. E. J. Russell. "*The Reclamation of Waste Land.*" Journal of the Royal Agricultural Society, 1919. Vol. LXXX. pp. 133-144.

"*The Improvement of Peaty Soils.*" I.—"*The True Peats.*" Journal of the Ministry of Agriculture, 1921. Vol. XXVII. pp. 1104-1113. II.—"*The Silty and Sandy Peats.*" Journal of the Ministry of Agriculture, 1921. Vol. XXVIII. pp. 32-35.

During the past ten years the author has made many examinations of waste soils with a view of devising methods of improvement. The analytical and agricultural results are set out here, and the causes of success and failure are discussed.

The waste lands of the Eastern half of England are mainly light sands or gravels, or thin chalk soils, suffering from defective water supply; while in the Western half they are commonly peats or stony clays, suffering from excess of water, lack of lime, and in case of high districts, from low temperature. To some extent remedial measures are possible.

LV. E. J. Russell. "*The Partial Sterilisation of Soils.*" Journal of the Royal Horticultural Society, 1920. Vol. XLV. pp. 237-256.

It has already been shown that steam and certain poisons are effective in ridding the soil of some of its insect and fungoid pests besides enhancing its fertility.

A more systematic investigation of the problem has now become possible through the recognition that poisons are, more or less, specific in their effects and may be less harmful to some organisms than to others.

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The method of procedure is to analyse the soil population by examination of the plant or of the soil and so to determine what organism or organisms it is desired to suppress. An investigation is then made of the effect of a typical poison (*e.g.*, carbolic acid) on the organism; derivatives are systematically prepared, and the more toxic are followed up. In this way it has been possible greatly to intensify some of the soil sterilisers previously suggested for horticultural use; *e.g.*, carbolic acid becomes three to five times more effective by chlorination.

(Note.—This work is carried out by the W. B. Randall assistant, and full details for nurserymen are published in the Reports of the Nursery and Market Garden Experiment Station, Cheshunt, Herts.)

GENERAL AGRICULTURAL PROBLEMS.

LVI. E. J. Russell. "*British Crop Production.*" Royal Institution Discourses, Feb. 20th, 1920: Nature, 1920. Vol. CV. pp. 176 and 206.

LVII. E. J. Russell. "*The Possibility of Increased Crop Production.*" (Life and its Maintenance: Blackie & Son).

LVIII. E. J. Russell. "*Problems for Research after the War.*" Conference on the improvement of Agriculture. Trans. High. Society, 1918. Series 5. Vol. XXX. pp. 207-214.

LIX. E. J. Russell. "*Regional Factors in Agricultural.*" Geographical Teacher, 1920. No. 56.

LX. E. J. Russell. "*How the Soil was Made.*" Proc. Armstrong College of Agriculture, Students' Assoc., 1917-18. Vol. III. pp. 27-30.

LXI. E. J. Russell. "*Work of the Rothamsted Experimental Station.*" Journal of the Ministry of Agriculture, 1919. Vol. XXVI. pp. 497-507.

BOOKS.

ROTHAMSTED MONOGRAPHS ON AGRICULTURAL SCIENCE.

E. J. Russell. "*Soil Conditions and Plant Growth.*" 4th Edn. (entirely re-cast). Longmans, Green & Co., 1921.

Note.—A French translation by M. Georges Matisse is published in the Bibliothèque de culture generale (Flammarion, Paris). A German translation by Dr. Hans Brehm is published by Steinkopff (Berlin and Dresden). A translation into Finnish is being arranged.

Others in preparation dealing with :—

Soil Physics. B. A. Keen.
Soil Protozoa D. W. Cutler and L. M. Crump.
Soil Bacteria. H. G. Thornton.
Soil Fungi and Algæ. W. B. Brierley, S. T. Jewson and B. M. Bristol.