Table 1. AVERAGE NUMBERS OF TOBACCO NECROSIS VIRUS LESIONS PER ASSAYED PLANT FROM INOCULATION OF LETTUCE ROOTS WITH *Olpidium brassicae* AND TOBACCO NECROSIS VIRUS

Treatment	Total number of plants assayed	Total number of plants infected with virus	Average number of virus lesions per plant assayed
<i>Olpidium</i> + virus	40	38	36.7
Virus only	31	17	0.7
<i>Olpidium</i> only	20	3	0.1*
Nil	14	1	0.1*

* Infection probably resulting from contamination.

root infection by tobacco necrosis virus occurred than when the virus alone was applied. Results in three experiments are summarized in Table 1.

Similar results were secured when cowpea, French bean, cabbage, cucumber, and tobacco were inoculated with *Olpidium* and tobacco necrosis virus. The results have been repeated in water culture in the laboratory with seedlings raised in Petri dishes.

The mode of action of *Olpidium* zoospore suspensions in thus increasing root infection with tobacco necrosis virus is not known. Conceivably, the fungus may act as a virus vector or it may predispose the roots to infection. Zoospore suspensions from lettuce roots infected with both *Olpidium* and tobacco necrosis virus have caused virus infection of roots even without added virus. As tobacco necrosis virus is released naturally by infected roots¹⁰, however, this does not necessarily mean that *Olpidium* is acting as a virus vector.

It is possible, but unlikely, that some factor other than *Olpidium* obtained from lettuce roots is responsible for the increased virus infection; a final decision on this must wait until it becomes possible to grow *Olpidium* in pure culture.

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AGRICULTURE

Contribution of Rainwater to the Nutrient Economy of Soil in Northern Nigeria

THE contribution of rainwater to the nutrient economy of soil in many regions of the world has been studied. At Samaru, Northern Nigeria, 80 litres of rainwater from eight rain gauges were collected in 1959. The water was concentrated by evaporation from dilute sulphuric acid and the concentrate analysed for all major nutrients except sulphur. Forty-two inches of rain fell during the 1959 season. The results are expressed in p.p.m. of each element

Table 1. NUTRIENT CONTRIBUTION OF RAINWATER IN 1959 AT SAMARU, NORTHERN NIGERIA

Nutrient	p.p.m.	lb./acre
Nitrogen		
Ammonium	5.000	47.6
Nitrate	0.230	1.2
Organic	0.125	2.0
Total	5.355	50.8
Phosphorus	0.555	2.3
Potassium	3.500	32.8
Calcium	0.100	0.9
Magnesium	0.110	2.60
Sodium	5.750	53.8

in the total composite sample, and have been converted to pounds per acre (Table 1). Sampling procedure excluded any measure of seasonal distribution.

So far as I am aware, the nitrogen, potassium and sodium figures are the highest recorded. Despite the high values, the sodium/potassium ratio is of the order found in New Zealand by Wilson¹. He has shown that the nutrients present in snow originate from the surface of the ocean where a large number of plankton, etc., in various stages of growth and decomposition are concentrated. These organisms narrow down the potassium/sodium ratio of the underlying sea. The potassium/sodium ratio of sea-water is 1:27, snow-water in New Zealand showed a ratio of 1:2.7 and at Samaru a ratio of 1:1.6 was found. The narrower ratio at Samaru may be due to a higher or different biological activity in the warm ocean around West Africa compared with New Zealand conditions. The low nitrate figure eliminates the possibility of large contributions from dust and electric storms. The lack of seasonal distribution figures makes the evaluation of the various factors impossible. Generally, the figures to date point to the ocean as the main source of rainwater nutrients, but do not exclude contributions from other factors.

The presence of such large and varied quantities of nutrients in the rainwater helps to explain several aspects of soil fertility in Northern Nigeria.

(1) Potassium fertilizers have never shown a positive response on annual crops of the region. Potassium from rainwater is probably adequate for crop growth, and the fertilizer potash aggravates what must be already an imbalance of potassium to other nutrients.

(2) Despite the lack of leguminous plants in bush fallows, build up of organic nitrogen is appreciable. From unpublished soil analysis data at Samaru, it has been calculated that an increase of 0.025–0.03 per cent total nitrogen can be expected over a period of five years. Rainwater, if not lost by run-off, would contribute 0.013 per cent nitrogen.

(3) Light sandy soils in the extreme north of the region show very low levels of total nutrients, and crop growth would seem to be impossible. The contribution of rainwater helps to explain the growth of crops on these soils.

These results indicate the importance of rainwater as a source of nutrients in the soil of Northern Nigeria. More detailed studies are in progress.

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