possible. If water moves only as vapour, the ratio mmole salt/g soil will remain constant, but the ratio mmole salt/g water will increase in regions where evaporation occurs and decrease in regions of condensation. Conversely, if water moves only as liquid, the ratio mmole salt/g water will remain constant, but that of mmole salt/g soil will increase in the regions to which the liquid flows and decrease in those from which it flows. The results of Fig. 2 are thus consistent with a vapour flux moving from hot to cold, and a return liquid flux from cold to hot—a circulatory system.

During this work, one of us (R. D. J.) was an O.E.C.D. Fellow.

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Changes in Phosphate Potential on Re-wetting Air-dry Soil

WHEN soil is suspended in dilute calcium chloride solution the calcium dihydrogen phosphate potential ($pH_2PO_4 + \frac{1}{2}pCa$) varies with the soil : solution ratio[1] and with the period for which the soil is in suspension[2]. Air-drying and re-wetting also affect the phosphate potential[2]. Laboratory measurements lacking precision will help little in predicting phosphate availability in field soils.

In Rhodesia arable top soils are always dry after the almost rainless winter, so only the changes on re-wetting were examined here. Using a soil : solution ratio of 1 : 2, a sandy loam derived from micaceous schist was equilibrated in 0·01 M $CaCl_2$ for 1 h at 21° C after the following treatments : shaken by wrist-action in stoppered bottles (soil : solution = 1 : 2), or incubated at field capacity (15 per cent moisture) at either 21° or 35° C, each treatment being continued for different periods up to 12 days, with and without adding 120 μmole KH_2PO_4/100 g soil. Changes due to microbial action during the final 1 h equilibration were probably negligible[3]. pH was measured in the suspensions, and the concentrations of P and Ca + Mg (expressed as Ca) in the filtrates; activities were calculated by the Debye–Hückel equation (using Aslyng's[4] correction for pH_2PO_4). Total mineral nitrogen was determined in similarly treated samples.

Fig. 1 shows that in all treatments $pH_2PO_4 + \frac{1}{2}pCa$ initially increased with time, that is, soluble phosphate decreased. On moistening soil to field capacity the phosphate potential approached a constant value after 4–5 days, but in suspension it changed more, over a longer period. This may be due to microbial action[3], but the mineral nitrogen content changed more at field capacity than in suspension (Table 1); incubation at 35° gave more mineral nitrogen than at 21° C, but had little effect on the phosphate potential. If the effects of microbial action differ between soils in suspension and at field capacity, the latter is closer to conditions in field soils.

Table 1. CHANGES IN pH AND MINERAL NITROGEN CONTENT OF SOIL WITH TIME OF INCUBATION

Days of treatment	Field capacity pH	Field capacity Min N (p.p.m.)	1 : 2 Suspension pH	1 : 2 Suspension Min N (p.p.m.)
0	5·55	15 (15)	5·55	15
1	5·60	18 (32)	5·61	14
3	5·85	31 (43)	6·04	20
6	5·87	38 (48)	6·41	18
12	5·88	44 (50)	6·43	—

Figures in parentheses obtained at 35° C, all others at 21°.

Table 2. EFFECT OF SOIL : SOLUTION RATIO ON pH AND $pH_2PO_4 + \frac{1}{2}pCa$

g soil/l.	$pH_2PO_4 + \frac{1}{2}pCa$	pH
10	8·21	5·30
38	7·56	5·10
138	7·08	4·90
470	6·90	4·80

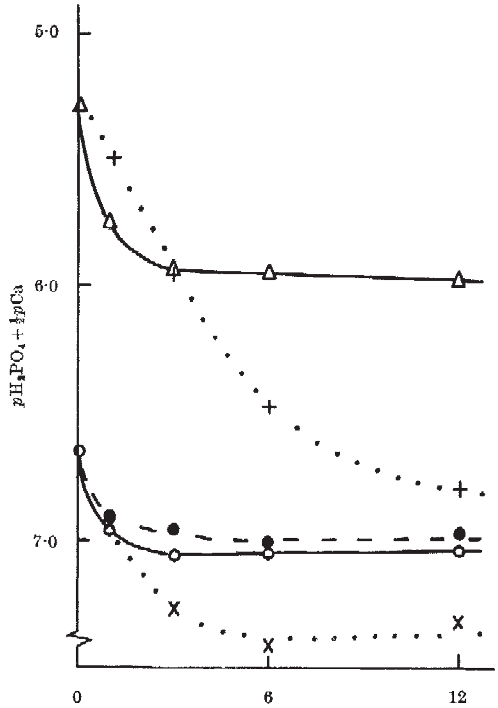

Fig. 1. Changes in phosphate potential with time of incubation. △, + P (field capacity, 21°); + P (suspension, 21°); ●, − P (field capacity, 35°); ○, − P (field capacity, 21°); ×, − P (suspension, 21°)

Larsen and Widdowson[1] suggested that increasing soil : solution ratios decreased pH and the phosphate potential in soil suspensions because more CO_2 was produced. Presumably more CO_2 is produced after longer periods in suspension, but in the present work pH and phosphate potential (Table 1 and Fig. 1) both increased with longer suspension, more so than with aerobic incubation at field capacity.

Another sandy soil was incubated at field capacity for 7 days at 21° C, then equilibrated in 0·01 M $CaCl_2$ for 1 h (21° C), using 10, 38, 138 or 470 g soil/l. Table 2 shows that pH and phosphate potential decreased with increasing soil : solution ratio, as reported by Larsen and Widdowson[1], although changes in CO_2-pressure must have been negligible[3]. The effects of soil : solution ratio were almost certainly due to the soil being changed more from its original state in attaining equilibrium at smaller soil : solution ratios.

Where there are distinct dry and rainy seasons, so that field soils are naturally air-dried before cropping, moistening samples to field capacity at room temperature for at least 4 days (7 days is convenient for routine measurements) before equilibrating for 1 h in suspension gives steady values of the phosphate potential (or of phosphate concentration, if this is preferred[5]). These may enable the relationships between soil solution measurements and plant composition to be tested more reliably than by methods previously proposed.

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