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CONCENTRATION OF CERTAIN CONSTITUENTS OF THE SOIL SOLUTION UNDER ORCHARD CONDITIONS

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The problem of the maintenance of orchard soil fertility has received a great deal of attention. The principal methods employed have been the addition of fertilizers and the growing of covercrops. The latter method was chosen for the experiment being conducted by the Division of Pomology of the California Agricultural Experiment Station, at Davis. In anticipation of differences in the behavior of the trees under the different treatments, various determinations have been made on the soils in the several plots. The crop history, the arrangement of plots, and a preliminary report on changes in the soil solution have been described in an earlier paper.[(9)] The plots are as follows: three clean cultivated checks, growing a sparse weed covercrop in winter; alfalfa sod; mat bean, which is a summer covercrop planted in May; *Melilotus indica,* and rye and vetch, which are two winter covercrops planted in September and turned under in March. The arrangement of plots is shown for block *A,* in figure 1. Block *B* duplicates block *A* except that Satsuma is used in place of Santa Rosa, and is one year younger. These treatments run across the eight species (now reduced to seven) used in planting. All plots are in duplicate. Pears, prunes, apples, Japanese plums, cherries, apricots, peaches, and almonds were planted; but the last named were removed in 1928 and replaced by pears. The alfalfa was plowed in the fall of 1929 because it was becoming foul with fox-tail and thistle. No data are, however, presented here subsequent to the breaking up of

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the alfalfa sod. The method used in obtaining the soil solution has been presented in detail in a separate paper.[4] In this paper further data on the changes in the soil solution in these plots are presented.

NITRATE

The earlier paper[9] showed that there is a tendency for the nitrate concentration to follow a seasonal curve with a minimum in the spring and a maximum in the fall. A similar spring minimum was shown with apples by Lyon, Heinicke, and Wilson; [6] by Woodbury, Noyes, and Oskamp;[10] and by Oskamp.[8] Gourley and Shunk[5] found a

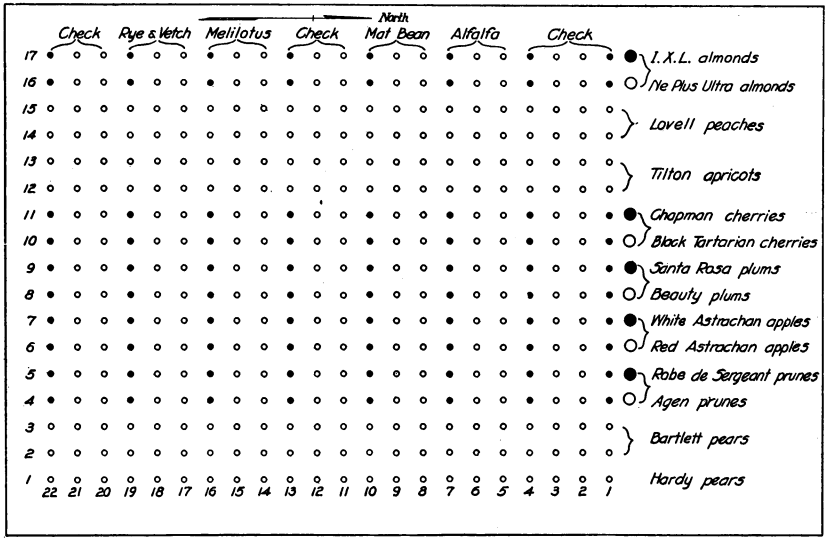

Fig. 1. Planting plan and arrangement of plots, block *A*. Block *B* duplicates block *A*, except as noted in the text.

spring minimum in most of their cultivated plots. This behavior has been observed again during the past season, as shown in tables 1 to 4. The concentration is given to the nearest 10 parts per million because single parts per million are not significant. A more regular sequence of changes is to be noticed than was the case in 1927, and this situation exists with reference to practically every ion studied. The tentative explanation offered is that the roots of the trees have more completely explored the soil mass than was the case when the first samples were taken, the result being the disappearance of the local conditions found in 1927. The higher level of nitrate under pears as compared with peaches has been maintained.

TABLE 1

NITRATE CONTENT OF SOIL SOLUTION IN PEACH SERIES, BLOCK A, IN PARTS PER MILLION OF NO_3 IN DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
October 2, 1928	290	70	300	280	280	240	210
February 28, 1929	130	180	100	150	150	80	180
April 7	180	70	100	100	100	100	150
May 8	110	150	100	100	100	120	150
June 7	230	40	70	120	250	180	160
July 8	230	80	150	130	180	240	190
August 15	180	80	210	270	280	290	250
September 20	300	80	160	190	190	250	240
October 16	280	60	160	200	220	200	220

TABLE 2

NITRATE CONTENT OF SOIL SOLUTION IN PEAR SERIES, BLOCK A, IN PARTS PER MILLION OF NO_3 IN DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
October 6, 1928	540	.....	310	530	310	300	540
March 2, 1929	320	60	190	300	150	150	330
April 10	390	60	210	220	90	100	210
May 10	230	50	190	150	140	140	330
June 11	320	70	210	290	250	210	340
July 9	680	50	370	270	290	270	330
August 19	680	120	380	440	400	540	550
September 24	360	100	330	440	370	360	430
October 18	590	100	410	560	300	280	450

TABLE 3

NITRATE CONTENT OF SOIL SOLUTION IN PEACH SERIES, BLOCK B, IN PARTS PER MILLION OF NO_3 IN DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
September 29, 1928	270	140	220	300	260	.....	370
February 14, 1929	230	60	150	230	140	180	330
March 29	150	40	150	100	70	80	190
May 14	230	50	180	160	110	90	140
June 13	190	50	170	170	180	120	180
July 11	230	40	210	210	230	190	200
August 21	470	180	360	270	320	380	270
September 16	210	110	180	250	260	180	190
October 28	270	70	240	290	200	150	180

TABLE 4

NITRATE CONCENTRATION OF SOIL SOLUTION IN PEAR SERIES, BLOCK B, IN PARTS PER MILLION OF NO_3 IN DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
October 1, 1928	490	90	490	740	480	.....	540
February 16, 1929	330	90	280	410	390	160	410
April 1	200	130	250	330	210	260	290
May 16	360	60	340	250	270	260	260
June 17	310	90	320	340	360	330	320
July 11	530	80	360	510	470	420	410
August 27	790	160	590	600	680	750	920
September 18	540	110	570	560	690	600	540
October 29	650	170	700	680	610	570	740

Data are presented in tables 5 to 8 for the summers only of 1928 and 1929 of the prune and Japanese plum series. Lyon, Heinicke, and Wilson[7] show a spring minimum in nitrate for the plum. Although the data herewith presented are variable, they show a tendency toward higher nitrate in the late summer. Values for the plums and prunes are usually intermediate between those of the peach series and those of the pear series.

In order to determine whether the difference in nitrate content of the soil solution obtained from plots having alfalfa and those without it extended to the other series, a few determinations were made

TABLE 5

NITRATE CONCENTRATION OF SOIL SOLUTION IN PRUNE SERIES, BLOCK A, IN PARTS PER MILLION OF NO_3 IN DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
May 31, 1928	180	90	.....	410	230	310	150
June 27	.....	100	340	.....	370	250	240
July 23	310	90	310	320	270	230	270
May 17, 1929	250	90	230	190	200	190	200
June 19	250	70	210	240	260	330	230
July 20	290	100	280	230	380	350	230
November 4	450	120	530	380	400	290	400

TABLE 6

NITRATE CONCENTRATION OF SOIL SOLUTION IN JAPANESE PLUM SERIES, BLOCK A, IN PARTS PER MILLION OF NO_3 IN DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
May 28, 1928	320	100	290	340	210	250	190
June 25	200	60	260	330	.....	200	220
July 25	300	110	190	390	380	450	430
May 21, 1929	200	90	220	140	140	160	350
June 20	220	60	210	270	240	250	410
July 23	290	80	260	300	280	300	290
November 6	490	80	550	570	320	300	480

TABLE 7

NITRATE CONCENTRATION OF SOIL SOLUTION IN PRUNE SERIES, BLOCK B, IN PARTS PER MILLION OF NO_3 IN DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
June 7, 1928	290	110	310	.....	240	.....	410
August 1	340	100	.....	250	350	420	320
May 22, 1929	200	50	280	170	180	140	280
June 24	300	30	340	280	250	310	390
July 25	260	60	340	270	250	340	280
November 12	380	90	620	420	240	220	450

TABLE 8

NITRATE CONCENTRATION OF SOIL SOLUTION IN JAPANESE PLUM SERIES, BLOCK B, IN PARTS PER MILLION OF NO_3 IN DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
June 4, 1928	320	40	340	310	270	140	290
July 29	310	110	360	290	260	250	340
May 24, 1929	180	80	340	240	230	210	210
June 25	330	90	340	290	340	280	300
July 26	280	60	520	280	380	320	460
November 19	370	130	900	470	530	510	500

in each of the apple, cherry, apricot, and the young pear (formerly almond) plots. These data are presented in table 9. The differences are evidently consistent throughout the entire sixteen comparisons.

It was hoped that the plots in which the pears had been planted in the spring of 1929, after the removal of the almonds, would give the behavior that might be expected of bare ground, since the roots of the young trees occupied but a small portion of the plot area. This

TABLE 9

NITRATE CONTENT OF CENTER CHECK AND ALFALFA PLOTS OF APPLE, CHERRY, APRICOT AND YOUNG PEAR SERIES, BLOCKS A AND B, IN PARTS PER MILLION OF NO_3 IN THE DISPLACED SOLUTION

Date	Plot	Apple	Cherry	Apricot	Pear
May 27, 1929	Center check, A	230	200	160	180
May 30	Alfalfa, A	70	50	50	60
May 31	Center check, B	190	230	250	200
June 3	Alfalfa, B	80	70	50	50
June 27	Center check, A	320	320	190	170
June 28	Alfalfa, A	80	70	90	40
July 3	Center Check, B	210	390	310	360
July 2	Alfalfa, B	80	110	100	80
August 7	Center check, A	420	400	260	340
August 8	Alfalfa, A	140	100	110	100
August 9	Center check, B	300	400	350	390
August 10	Alfalfa, B	100	80	50	70

condition might, by difference, give an idea of the rate of withdrawal of nitrates by the trees. Table 9 shows, however, that the level of nitrates during the summer is no higher in the young pear plots than in those having older trees. This fact may result from the residues of the almond roots. These residues may have supplied enough carbohydrates to stimulate the growth of certain of the soil organisms with a consequent reduction in the amount of nitrate in the soil solution. The results obtained by Conrad[3] with sorghum would suggest this explanation.

SULFATE

The sulfate curves for 1929 are essentially the same as those for the earlier period. The concentration is consistently greater in the solutions from the peach series than in those from the pear series. While less pronounced than in the case of the nitrate ion, the seasonal trend is again evident in most plots. The concentration of sulfates, like that of the nitrates, was less variable in 1929 than in 1927. These points are brought out in tables 10 to 13. As in the nitrate tables,

TABLE 10

SULFATE CONTENT OF SOIL SOLUTION IN PEACH SERIES, BLOCK A, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
October 2, 1928	320	200	240	280	380	230	320
February 18, 1929	120	.....	160	170	210	200	210
April 7	170	70	140	220	230	200	170
May 8	190	130	190	180	190	150	160
June 7	200	90	180	210	270	260	210
July 8	200	150	200	200	190	210	200
August 15	230	170	210	210	240	270	230
September 20	310	110	260	270	330	250	250
October 16	320	170	310	.....	330	290	.....

TABLE 11

SULFATE CONTENT OF SOIL SOLUTION IN PEAR SERIES, BLOCK A, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
October 6, 1928	.....	160	120	250	170	140	130
March 2, 1929	120	120	110	170	130	130	180
April 10	130	140	160	120	100	110	120
May 10	120	110	140	130	150	120	140
June 11	160	140	170	180	150	170	170
July 9	180	140	170	170	150	180	170
August 19	230	240	200	210	150	230	170
September 24	.....	160	230	240	210	190	240
October 18	250	230	210	240	170	190	230

TABLE 12

SULFATE CONTENT OF SOIL SOLUTION IN PEACH SERIES, BLOCK B, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
September 29, 1928	230	110	200	240	190	.....	190
February 14, 1929	140	120	150	170	140	170	170
March 29	200	110	200	210	170	220	180
May 14	150	60	190	200	180	100	140
June 13	230	80	250	220	240	220	180
July 11	180	60	210	170	170	180	170
August 21	190	110	260	200	280	260	230
September 16	240	90	240	240	270	270	210
October 28	310	110	300	290	290	290	270

TABLE 13

SULFATE CONTENT OF SOIL SOLUTION IN PEAR SERIES, BLOCK B, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
October 1, 1928	130	140	160	170	130	90	140
February 16, 1929	110	.....	100	140	90	90	110
April 1	160	170	140	170	140	120	100
May 16	120	80	120	150	160	140	110
June 17	170	100	170	130	140	150	150
July 11	130	120	140	130	160	140	140
August 27	180	130	130	150	130	170	170
September 18	180	100	180	160	160	200	170
October 29	230	110	180	160	200	160	180

the units are omitted to facilitate inspection of the tables. The sulfate concentration in solutions taken from the prune and Japanese plum series, is markedly lower than that of the peach series and, on the average, is lower than that of the pear series. There seems to be no constant difference between plums and prunes, although such differences as there are tend to show the plums to be at a little higher level. These data are shown in tables 14 to 17.

A comparison between the plots having alfalfa and the adjacent clean-cultivated check shows the alfalfa to have the lower sulfate content in all of the sixteen comparisons; i.e., all eight series, in duplicate, follow in this respect the behavior of nitrate. A few excep-

TABLE 14

SULFATE CONTENT OF SOIL SOLUTION IN JAPANESE PLUM SERIES, BLOCK A, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
May 28, 1928	70	.....	90	80	70	90	90
July 25	110	90	120	90	90	170	120
May 21, 1929	130	90	140	100	150	130	150
June 20	170	90	160	160	150	170	140
July 23	130	110	150	140	160	130	90

TABLE 15

SULFATE CONTENT OF SOIL SOLUTION IN PRUNE SERIES, BLOCK A, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
May 31, 1928	110	40	.....	80	80	100	160
June 27	70	.....	.....	.....	80	90	70
July 23	.....	30	80	.....	.....	.....	.....
May 20, 1929	100	80	120	100	120	90	90
June 18	140	90	120	110	130	130	120
July 20	120	100	120	100	120	110	110

TABLE 16

SULFATE CONTENT OF SOIL SOLUTION IN JAPANESE PLUM SERIES, BLOCK B, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
June 4, 1928	70	50	90	90	80	90	60
July 29	90	40	120	100	70	80	120
May 24, 1929	80	50	120	90	90	80	100
June 25	100	120	120	120	130	110	120
July 26	100	50	130	160	90	90	110

TABLE 17

SULFATE CONTENT OF SOIL SOLUTION IN PRUNE SERIES, BLOCK B, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
June 6, 1928	90	70	.....	.....	110	.....	130
August 1	.....	.....	.....	.....	90	90	90
May 22, 1929	90	50	140	90	80	80	100
June 24	110	70	140	110	140	110	110
July 24	70	60	140	90	100	100	80

tions occur in the case of single determinations, probably in consequence of local accumulations from decaying organic matter. The data for apple, cherry, apricot, and young pear plots are not included, for they show nothing striking that is not evident in the tables given.

TABLE 18

BICARBONATE CONCENTRATION OF SOIL SOLUTION, IN PARTS PER MILLION OF HCO_3 IN DISPLACED SOLUTION

Series	Date	Soil treatment						
		Clean cultivated check	Alfalfa sod	Summer cover-crop of mat bean	Clean cultivated check	Winter cover-crop of melilotus	Winter cover-crop of rye and vetch	Clean cultivated check
Peach A	May 9, 1929	100	280	.....	.....	140	120	60
Pear A	May 11	70	240	80	100	100	160	50
Peach B	May 14	80	230	70	.....	140	100	.....
Pear B	May 16	50	.....	70	60	80	70	70
Prune A	May 20	40	180	60	.....	.....	.....	.....
Japanese plum A	May 21	70	170	70	60	70	100	60
Prune B	May 22	60	130	70	.....	70	120	60
Japanese plum B	May 24	.....	.....	70	60	100	140	60
Peach A	June 7	70	170	90	90	90	90	40
Pear A	June 11	50	150	40	50	100	110	50
Peach B	June 13	40	150	40	40	160	100	70
Pear B	June 17	60	170	70	60	90	110	60
Prune A	June 18	50	200	60	60	90	90	60
Japanese plum A	June 20	90	240	70	70	90	90	60
Prune B	June 24	60	240	90	80	150	100	70
Japanese plum B	June 25	50	210	80	60	80	100	40
Peach A	July 8	100	300	80	100	110	100	50
Pear A	July 9	30	220	80	40	50	60	30
Peach B	July 18	110	230	80	100	90	120	80
Pear B	July 11	20	170	20	20	20	70	60
Prune A	July 20	60	290	70	60	70	80	40
Japanese plum A	July 23	40	210	50	50	60	70	30
Prune B	July 25	40	170	50	60	90	60	50
Japanese plum B	July 26	40	200	60	30	60	50	60
Peach A	August 15	40	80	40	30	50	30	30
Pear A	August 17	30	.....	20	30	50	60	30
Peach B	August 21	40	170	30	80	60	30	60
Pear B	August 27	70	200	70	40	40	30	30
Peach A	September 20	50	260	70	80	130	110	60
Pear A	September 24	100	250	70	60	60	90	100
Peach B	September 16	100	200	80	60	130	100	80
Pear B	September 18	60	200	60	80	90	60	60
Peach A	October 16	60	260	80	80	110	200	60
Pear A	October 18	40	140	20	80	80	100	70
Peach B	October 28	90	230	120	.....	120	140	200
Pear B	October 29	60	230	70	50	70	70	30
Prune A	November 4	80	260	60	80	110	140	80
Japanese plum A	November 8	50	200	50	50	80	100	50
Prune B	November 12	40	120	50	60	100	110	100
Japanese plum B	November 19	80	260	80	90	120	120	60

BICARBONATE

For the first time since the beginning of this experiment, complete records of bicarbonate concentration were made for the summer of 1929. The behavior of this ion is quite different from that of nitrate and of sulfate. Bicarbonate ions tend to decrease throughout the growing period, whereas the nitrate and sulfate concentrations increase. A minimum bicarbonate concentration is obtained about August. Furthermore, the concentration is very much greater in the plots having the alfalfa sod treatment in contrast to the other anions noted, irrespective of the sort of trees growing in the plots. In this connection, a slight but perceptible shift of the pH toward the alkaline side has been noted in these plots having alfalfa. Two winter covercrop plots (*Melilotus,* rye, and vetch) are higher in bicarbonate on the average than the adjacent checks. This increase in bicarbonate may be the result either of decomposition of organic crop residues, or, as suggested by Burd,[2] of differential absorption of ions by the plants. The data concerning bicarbonate are combined in table 18.

TABLE 19

CALCIUM CONTENT OF SOIL SOLUTION IN PEACH SERIES, BLOCK A, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
February 10, 1927	45	62	33	14	20	39	.....
April 11	27	29	36	28	39	43	40
May 9	30	32	43	29	40	42	35
June 13	44	35	36	32	59	47	45
July 11	64	59	54	48	76	72	49
August 17	47	.....	.....	57	50	46	39
October 5	70	80	70	62	.....	83	72
December 2	70	62	60	49	80	65	60
January 20, 1928	80	.....	67	74	75	94	80
March 20	91	50	48	42	49	59	46
April 24	64	58	55	41	46	70	37
May 21	50	51	.....	51	73	59	53
June 18	54	.....	44	48	51	60	40
July 9	60	.....	44	47	70	70	52
August 8	75	68	70	85	83	88	84
September 12	79	55	61	55	106	101	77
October 2	80	65	85	73	100	79	81
February 28, 1929	75	.....	57	54	73	68	58
April 7	54	32	50	54	70	67	50
May 8	66	56	52	48	60	54	44
June 7	75	43	54	56	95	88	62
July 8	85	75	74	64	98	97	84
August 15	89	61	93	91	128	122	98
September 20	100	53	68	70	101	91	72
October 16	125	68	94	83	115	140	116

[2] Personal correspondence from John S. Burd.

CALCIUM

The seasonal march of calcium concentration is very regular in comparison with that of nitrate and sulfate. The change in magnitude is less than in the case of nitrates, but is none the less striking because of its regularity. Although there seems to be no consistent difference between peaches and pears, such differences as there are tend to show the solutions from the pear series to have slightly higher average concentrations. The plots with alfalfa sod have a lower calcium concentration than the checks, irrespective of the series, as was shown for nitrate and sulfate.

While the difference in calcium concentration between the alfalfa and check plots is less than that of nitrate in all series, it is nevertheless a consistent difference in every series. The normal change under alfalfa sod is less than that in the other plots, showing the same sort of reduction in variability as has been noted for other ions in

TABLE 20

CALCIUM CONTENT OF SOIL SOLUTION IN PEAR SERIES, BLOCK A, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
March 21, 1927	47	36	29	30	26	26	23
April 18	40	30	32	32	40	46	49
May 16	36	45	44	38	48	39	41
June 20	53	40	39	31	50	61	46
July 18	59	57	58	59	88	128	55
September 19	80	41	63	76	63	71	46
October 24	89	.....	90	.....	75	113	107
January 11, 1928	80	.....	70	.....	.....	.....	86
February 13	74	53	94	76	64	53	75
April 10	49	42	35	44	49	56	58
May 2	50	.....	60	46	70	60	37
May 23	51	51	87	64	50	.....	.....
June 20	53	44	51	54	52	60	70
July 11	64	41	60	49	52	65	59
August 10	78	.....	71	86	89	74	89
September 15	.....	63	.....	77	.....	.....	.....
October 6	.....	65	65	107	64	66	77
March 2, 1929	67	43	52	68	47	48	75
April 10	69	44	59	49	39	45	46
May 10	50	46	53	54	42	58	70
June 11	67	58	63	73	68	74	87
July 9	110	63	89	71	73	87	87
August 16	122	98	92	106	85	134	101
September 24	103	65	80	92	83	77	99
October 18	122	70	94	107	73	87	113

alfalfa sod plots. The calcium concentration apparently tends to be somewhat higher in the winter covercrop plots for both peaches and pears than in the checks. This difference is neither great nor very consistent; it may, therefore, be simply a matter of variability. The maximum value for each series each year has, however, been in the winter covercrop plots, with the exception of the season of 1928

TABLE 21

CALCIUM CONTENT OF SOIL SOLUTION IN PEACH SERIES, BLOCK B, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
March 28, 1927	39	30	29	27	30	11	35
April 25	50	37	46	31	38	39	29
May 23	67	70	50	66	45	60	54
June 27	43	59	60	53	66	.....	66
July 25	82	48	95	61	63	103	64
October 11	65	55	78	60	67	83	82
January 16, 1928	76	62	101	75	90	113	87
February 23	60	61	83	.....	.....	.....	.....
March 13	63	55	80	62	55	69	67
April 12	52	50	40	36	42	61	35
May 14	61	.....	.....	59	72	52	59
June 11	64	40	63	61	54	68	70
July 12	54	36	66	61	67	48	59
August 12	87	59	86	77	74	86	65
September 5	75	31	93	68	70	75	84
September 29	75	42	73	80	73	.....	88
February 14, 1929	65	47	57	59	52	52	66
March 29	64	42	65	55	58	65	64
May 14	56	39	63	52	54	58	49
June 13	73	43	76	70	97	80	64
July 11	75	53	86	72	88	89	76
August 21	103	67	116	103	121	140	98
September 16	83	40	76	78	91	98	64
October 28	95	55	108	102	98	105	110

in three of the series. Tables 19 to 22 contain the data for peaches and pears, and tables 23 to 26 those for prunes and Japanese plums. The concentrations of calcium in the solutions from these latter plots are at the same general level as those from the peach and the pear series.

Interestingly enough, the calcium content appears to be affected more by changes in moisture content of the soil than is nitrate or sulfate. This is brought out in figure 2, where slight drops in concentration are shown in August, 1927, July and September, 1928, and

TABLE 22

CALCIUM CONTENT OF SOIL SOLUTION IN PEAR SERIES, BLOCK B, IN PARTS PER MILLION OF SOIL SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
April 4, 1927	33	27	26	30	38	47	40
May 2	40	32	22	19	21	55	20
May 21			46			50	47
July 5	68	57	56	63	73	85	68
August 1	61	55	86	56	101	91	82
November 1	100		90	68	105	127	80
January 18, 1928	67	52	66	65	89		118
March 16	56	42	48	45	60	45	
April 18	45	39	40	38	54	70	38
May 16	64			73	56	68	70
June 13				76	62		76
July 16	87	43	49	77	114	77	76
August 18	86	47	74	110	90	100	75
September 7	96	40	49	86	88	77	91
October 1	88	46	85	118	94	90	90
February 16, 1929	65	44	50	78	77	55	41
April 1	58	50	65	73	59	57	59
May 16	72	42	62	57	64	71	59
June 17	69	42	77	71	86	96	74
July 11	98	55	72	93	97	120	91
August 27	150	71	101	120	142	165	135
September 18	101	39	93	92	95	103	90
October 29	126	56	118	127	124	114	129

TABLE 23

CALCIUM CONCENTRATION OF SOIL SOLUTION FROM PRUNE SERIES, BLOCK A, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
May 31, 1928	37	34		76	43	55	36
June 27	45				87	34	40
July 23	59	40	62	58	54	58	51
May 17, 1929	47	49	54	41	56	58	42
June 18	56	53	56	53	77	67	53
July 20	61	64	70	49	76	73	51

TABLE 24

CALCIUM CONCENTRATION OF SOIL SOLUTION FROM JAPANESE PLUM SERIES, BLOCK A, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
May 28, 1928	61	.....	67	49	50	50	56
June 25	50	.....	62	58	.....	.....	52
July 25	66	48	62	75	77	92	91
May 21, 1929	59	44	58	42	55	53	75
June 20	62	47	65	66	67	72	88
July 23	74	58	86	73	73	81	70

TABLE 25

CALCIUM CONCENTRATION OF SOIL SOLUTION FROM PRUNE SERIES, BLOCK B, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
June 7, 1928	52	44	.....	.....	52	.....	70
August 1	.....	36	78	59	66	67	69
May 22, 1929	42	33	79	46	47	50	59
June 24	61	50	93	67	81	82	82
July 25	57	44	100	73	75	77	72

TABLE 26

CALCIUM CONCENTRATION OF SOIL SOLUTION FROM JAPANESE PLUM SERIES, BLOCK B, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
June 4, 1928	68	42	72	63	55	61	42
July 29	64	45	88	63	42	80	68
May 24, 1929	41	44	76	50	56	60	50
June 25	74	57	83	67	82	75	59
July 26	68	45	100	60	75	78	85

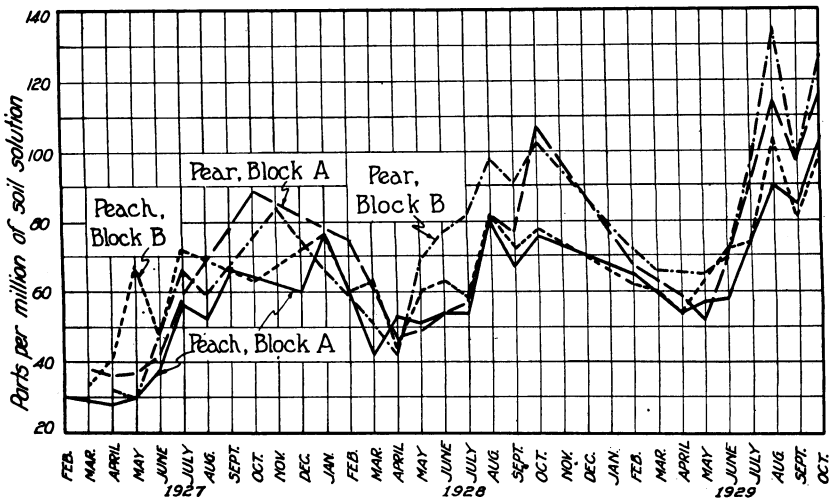

Fig. 2. Calcium content of the soil solution in parts per million of displaced solution from 4-foot composite samples. Average of three clean cultivated checks.

September, 1929, following irrigation. These dips in the curve are not large enough to change the seasonal sequence. Dips in the curves for nitrate and sulfate presented in the earlier paper[9] do not appear at these points. Another matter that should be mentioned is the gradually increasing level of calcium concentration throughout the period dealt with except in the plots having alfalfa. It is noticeable in figure 2.

TABLE 27

MAGNESIUM CONTENT OF SOIL SOLUTION IN PEACH SERIES, BLOCK A, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
July 9, 1928	49	.....	29	48	53	69	48
August 8	63	61	62	60	80	61	63
September 12	80	46	66	66	118	88	80
October 2	84	54	80	87	96	67	77
February 28, 1929	71	.....	59	58	69	65	67
April 7	54	26	48	61	65	61	48
May 8	60	52	53	50	60	52	43
June 7	66	37	55	60	92	88	88
July 8	80	.....	72	62	93	88	.....
August 15	81	50	92	92	115	111	100
September 20	95	52	75	78	105	92	73
October 16	113	70	104	96	118	103	123

TABLE 28

MAGNESIUM CONTENT OF SOIL SOLUTION IN PEAR SERIES, BLOCK A, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
July 11, 1928	58	.....	32	.....	42	.....	42
August 10	63	.....	52	76	86	68	71
September 15	.....	63	.....	70	.....	.....	.....
October 6	.....	92	51	104	68	60	80
March 12, 1929	69	44	42	67	47	46	67
April 10	67	40	59	46	27	40	45
May 10	53	46	52	49	45	59	65
June 11	71	48	57	66	70	76	72
July 9	125	58	.....	59	60	.....	63
August 16	124	95	88	90	88	127	88
September 24	97	72	78	95	89	88	89
October 18	139	86	101	134	83	85	100

TABLE 29

MAGNESIUM CONTENT OF THE SOIL SOLUTION IN PEACH SERIES, BLOCK B, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
July 12, 1928	32	19	36	45	46	39	36
August 12	68	36	63	58	52	61	63
September 5	.....	28	57	90	68	78	85
September 29	90	40	67	86	65	.....	82
February 14, 1929	67	43	53	57	44	44	61
March 29	62	37	63	56	48	56	62
May 14	78	36	59	51	56	55	60
June 13	69	41	72	61	84	68	55
July 11	65	35	80	70	73	76	69
August 21	96	66	98	91	109	126	78
September 16	87	38	74	93	93	100	73
October 28	95	48	106	111	102	106	109

TABLE 30

MAGNESIUM CONTENT OF THE SOIL SOLUTION IN PEAR SERIES, BLOCK B, IN PARTS PER MILLION OF SOIL SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
July 16, 1928	39	30	50	64	102	70	67
August 14	64	43	65	92	78	82	78
September 7	87	37	57	83	86	77	85
October 1	78	43	92	108	85	86	90
February 16, 1929	59	47	54	65	68	47	35
April 1	50	44	73	66	59	54	58
May 16	65	43	57	53	60	64	56
June 17	54	41	78	60	77	85	59
July 11	67	47	61	.....	.....	83	63
August 27	108	73	107	106	130	143	125
September 18	94	43	111	95	103	128	94
October 29	116	61	135	118	121	112	123

MAGNESIUM

A striking thing is noticed in looking at the data concerning magnesium concentration, as presented in tables 27 to 30—namely, the correspondence in values between the calcium and magnesium determinations. What has been said for calcium can be repeated for magnesium with little or no alteration. Magnesium is slightly more variable than calcium. In terms of parts per million, they are almost identical, so that the magnesium content in terms of milli-equivalents per liter is higher than that of calcium. This is a much higher ratio than that of magnesium to calcium in the soils reported on by Burd and Martin,[2] although in their "soil 1" from Davis they find a similarly high magnesium content. That soil being from the same locality is presumably similar to the one under test here.

POTASSIUM

The potassium content of these solutions shown in tables 31 to 38 presents an interesting contrast to that of calcium and magnesium. No significant change in this element occurs during the entire period: it follows in this respect the behavior of phosphate. The level is, moreover, rather low as compared with the solutions displaced from the soils used by Burd and Martin.[2] Although data secured in 1926 and 1927 seemed to indicate a falling off in concentration at the

TABLE 31

POTASSIUM CONTENT OF THE SOIL SOLUTION FROM PEACH SERIES, BLOCK A, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
April 24, 1928	5.8	2.9	5.0	6.2	6.1	10.1	4.1
May 21	4.8	2.5	.....	2.3	5.7	4.1	5.5
June 18	2.7	.....	2.7	3.0	3.0	2.9	2.5
July 9	2.6	.....	2.7	3.0	3.6	3.4	3.7
August 8	5.7	.....	5.1	5.2	5.5	5.9	8.1
September 12	.....	1.7	2.6	3.3	2.5	4.0	3.2
October 2	3.9	.....	8.0	3.1	3.2	6.4	3.0
February 28, 1929	16.1	.....	5.3	3.4	10.7	3.7	3.6
April 7	2.7	1.4	2.3	1.3	2.6	3.9	2.2
May 8	4.3	1.9	3.0	2.5	3.4	3.0	2.1
June 7	4.1	1.8	2.1	2.3	3.9	3.1	2.2
July 8	3.0	4.7	2.9	2.8	3.5	3.0	2.5
August 15	2.6	2.4	3.4	3.3	3.5	2.9	2.5
September 20	3.3	2.2	2.7	2.1	6.3	3.5	2.1
October 16	4.1	3.1	2.9	4.5	4.1	4.4	3.7

TABLE 32

POTASSIUM CONTENT OF THE SOIL SOLUTION FROM PEAR SERIES, BLOCK A, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
April 10, 1928	5.7	5.3	9.2	5.7	.....	.....	.....
May 2	10.6	.....	5.8	3.1	4.9	15.5	6.3
May 23	5.3	5.2	.....	6.6	.....	4.6	5.5
June 20	9.9	2.9	3.6	5.0	4.6	7.8	5.5
July 11	6.6	4.0	4.9	6.4	5.6	9.9	6.3
August 10	9.5	.....	7.7	7.8	4.9	5.6	6.6
September 15	.....	1.9	.....	3.2	.....	.....	.....
October 6	.....	5.3	6.2	6.0	6.5	4.8	4.8
March 2, 1929	6.3	2.7	4.8	4.2	6.3	4.9	14.5
April 10	7.4	1.3	4.8	3.1	2.2	3.2	5.2
May 10	4.4	1.8	4.6	4.5	4.7	5.3	3.4
June 11	3.9	2.8	4.3	4.6	4.7	4.6	5.5
July 9	7.3	2.0	4.8	2.6	2.5	22.4	4.6
August 10	6.3	5.1	3.5	4.3	4.0	5.1	8.1
September 24	3.1	3.7	3.8	4.3	5.0	4.8	6.8
October 18	5.4	2.6	4.6	8.1	4.4	4.7	6.2

TABLE 33

POTASSIUM CONTENT OF SOIL SOLUTION IN PEACH SERIES, BLOCK B, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
May 14, 1928	9.0	.....	.....	4.8	6.1	3.0	2.8
June 11	6.1	4.8	5.6	4.3	3.4	6.0	3.9
July 12	5.5	5.0	5.5	4.4	.....	3.5	5.5
August 12	6.6	.....	6.2	5.5	11.4	6.0	.....
September 29	4.4	2.3	2.6	2.4	5.3	.....	3.9
February 14, 1929	5.0	2.6	3.6	3.4	5.1	3.8	3.6
March 29	7.1	4.4	5.4	4.0	6.0	5.1	5.5
May 14	2.6	5.9	5.2	3.5	4.0	4.0	4.5
June 13	4.3	3.8	5.0	3.4	3.9	5.3	3.2
July 11	5.6	3.5	5.6	3.3	5.5	6.8	4.2
August 21	7.2	4.2	4.8	4.5	6.4	6.1	4.1
September 16	4.8	2.8	4.0	3.8	4.4	6.1	3.8
October 28	4.8	3.1	4.7	4.4	3.9	5.2	4.7

TABLE 34

POTASSIUM CONTENT OF SOIL SOLUTION IN PEAR SERIES, BLOCK B, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
April 18, 1928	6.4	2.8	4.3	4.4	4.4	4.7	3.3
May 16	5.1	3.3	8.7	5.7	5.5	5.3	4.7
June 13	.....	.....	.....	6.6	7.5	.....	5.5
July 16	7.5	5.8	7.8	.....	12.1	7.1	4.5
August 18	9.0	.....	5.9	5.7	8.7	11.9	.....
October 1	2.0	3.3	.....	7.2	3.4	3.4	3.8
February 16, 1929	6.3	.....	2.3	4.1	4.0	.....	.....
April 1	4.2	1.8	2.5	5.4	4.2	4.1	2.9
May 16	4.4	1.8	4.6	4.5	4.7	5.3	3.4
June 17	3.9	2.0	3.8	4.1	3.5	5.4	3.3
July 11	4.1	2.1	3.5	3.8	5.0	7.0	4.7
August 27	8.0	2.4	4.5	7.0	7.0	7.4	5.1
September 18	5.7	2.0	4.3	3.5	6.2	4.0	4.1
October 29	5.2	2.3	3.6	8.0	4.4	3.7	3.8

TABLE 35

POTASSIUM CONTENT OF SOIL SOLUTION IN JAPANESE PLUM SERIES, BLOCK A, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
May 29, 1928					4.4	4.3	5.4
June 25	4.8	4.3	4.4	3.4		3.5	4.3
July 25	3.0	3.3	4.5	4.7	5.6	6.4	5.5
May 19, 1929	3.0	2.3	3.9	2.5	2.7	3.7	2.7
June 20	3.4	2.5	4.3	3.6	5.2	3.2	4.8
July 23	3.5	2.2	3.1	3.5	4.9	4.6	3.1

TABLE 36

POTASSIUM CONTENT OF SOIL SOLUTION IN PRUNE SERIES, BLOCK A, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
May 31, 1928	2.7	3.9			4.9	3.1	4.6
June 27		4.1	5.4		4.5	4.9	5.2
July 23	4.5	4.0	3.5	4.3	3.0	5.4	5.2
May 17, 1929	3.1	4.2	2.5	2.7	2.6	5.8	3.1
June 18	3.8	3.6	3.3	2.6	3.2	4.9	3.9
July 20	4.4	3.4	3.4	2.3	3.9	4.7	3.7

TABLE 37

POTASSIUM CONTENT OF SOIL SOLUTION IN JAPANESE PLUM SERIES, BLOCK B, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
June 4, 1928	2.8	4.6	4.1	4.1	4.4	5.3	3.4
July 29	4.8	4.5	5.7	3.8	4.5	5.3	4.8
May 24, 1929	3.3	4.2	5.3	3.2	2.6	5.0	2.6
June 25	5.8	3.4	4.2	4.6	4.0	7.0	4.8
July 26	3.1	3.2	6.4	3.3	4.0	3.2	4.2

period when the other cations are increasing, the data for 1928 and 1929 show that this cannot be given much weight. Throughout the entire period one finds occasional samples showing high potassium. These determinations have been checked, sometimes the third time and in some cases by different operators, to make certain that the analytical methods could not be held responsible. As only minute amounts of potassium are necessary to give a greatly increased concentration to these solutions, the possibility of contamination of the solution was

TABLE 38

POTASSIUM CONTENT OF SOIL SOLUTION IN PRUNE SERIES, BLOCK B, IN PARTS PER MILLION OF DISPLACED SOLUTION

Date	Soil treatment						
	Clean cultivated check	Alfalfa sod	Summer covercrop of mat beans	Clean cultivated check	Winter covercrop of melilotus	Winter covercrop of rye and vetch	Clean cultivated check
June 7, 1928	4.9	5.0	4.5	.....	4.7	.....	9.7
August 1	3.3	4.2	8.9	5.1	4.3	4.3	5.4
May 22, 1929	2.7	3.1	3.9	3.4	4.1	3.3	6.8
June 24	3.2	1.4	6.9	4.1	5.1	5.4	5.5
July 25	2.5	2.3	5.9	3.3	4.7	3.3	3.9

considered. Possibly individual samples containing ashes from the burning of prunings might add the five to ten milligrams necessary to account for these sudden increases in concentration. This condition is the more likely because most of the increases noted occurred in the winter and early spring when such fresh deposits had dropped from the brush burner and might be included in a sample. In spite of these occasional aberrations, however, the data for the last two years show a remarkable uniformity as compared with those for the other cations.

The potassium content of the solutions from the alfalfa plots is lower on the average than that of the others, but the reduction is not so marked as in the case of some other ions.

IONIC BALANCE

The comparison of the total concentration of cations and anions has yielded some rather interesting data. Although there evidently must be a balance between the total cation and anion concentrations, those ions determined do not show this equality. In agreement with the findings of Burd[1] and Burd and Martin,[2] these data show an

excess of cations in almost every solution analyzed. The excess is variable. It may be as high as six milli-equivalents per liter. In a few cases there is an excess of anions. The total concentration of the ions determined ranges from about eight to about thirty-five milli-equivalents per liter, in the group of solutions covered by these calculations. Only the data from the peach and pear plots covering the six months May to October, 1929, were included in this summary, because the bicarbonate analyses were complete for that period only. A somewhat greater excess of cations over anions in the solutions obtained from the peach series as compared to the pear series is evident. This difference averages one milli-equivalent per liter for the six months' period under consideration. There is a greater excess of cations in the alfalfa plots than in the adjacent checks and a similar excess in the winter covercrop plots. This increase might be a factor in the slight shift of the pH in these plots noted above. If the decrease in nitrates and sulfates were not balanced, partly by decrease in cations and partly by increase in bicarbonate, this shift would be even greater.

Apparently the heavier withdrawal of nitrates by the peach trees has not been entirely compensated for by the increase in sulfates, and the bicarbonates are of too low a concentration to influence the result materially except in the case of the alfalfa plots. What the other anion or anions may be that have been brought into solution to keep the balance has not been determined. The summary of these data is omitted.

Burd[1] has pointed out that ". . . . nitrate, sulfate, and bicarbonate formed during such (biological) oxidations must determine largely the cation concentration of the soil solution . . ." The data herewith given tend to substantiate his statement in a general way, although in certain cases, as in the peach plots, there is obviously at least one other important anion determining cation concentration.

SUMMARY

The data thus far presented may be summarized as follows:

1. The nitrate content of the soil solution varies with the season, having a minimum in the spring and a maximum in the fall.

2. The nitrate content under trees in alfalfa sod has been greatly reduced since the beginning of the experiment.

3. The nitrate content is higher under pears than under peaches.

4. The sulfate concentration also shows a seasonal change of the same type as that of nitrates.

5. The sulfates are lower under trees in alfalfa sod than elsewhere.

6. The sulfates are lower under pears than under peaches.

7. The bicarbonate concentration is higher under trees in alfalfa sod that in any other plot.

8. Bicarbonates tend to fall off rather than to increase during the growing season.

9. The bicarbonate concentration is slightly higher in the winter covercrop plots than in the adjacent checks.

10. The calcium concentration shows a seasonal change like that of nitrate.

11. Calcium is lower under trees in alfalfa sod than elsewhere.

12. The calcium concentration has increased since the beginning of the experiment.

13. Magnesium concentration exhibits practically the same behavior as calcium.

14. Potassium concentration is practically unchanged throughout the season.

15. Potassium is reduced under trees in alfalfa sod as compared with the checks.

16. The summation of the ions determined gives an excess of cations averaging about two milli-equivalents per liter.

17. This excess of cations is greater in the case of peaches than in that of pears.

18. The excess of cations is greater on the average in the alfalfa plots than in the checks.

19. The excess of cations is greater, on the average, in the winter covercrop plots than in the checks.

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