cides, washed, and a portion of the wash water was spread on plates of a selective growth medium. The number of *E. amylovora* colonies on the plates was counted, and the number of bacterial cells per flower was calculated.

There was good correlation between the percentage of healthy blossoms infested with *E. amylovora*, the type and rate of chemical applied, and subsequent disease incidence (table 5). For example, 52% of the blossoms from the untreated plots were infested with fireblight bacteria and 3.2 strikes per tree were observed while only 15 to 16% of the blossoms from the MBR 10995 plots were infested and only .4 strikes per tree occurred. The average number of bacteria per blossom was also a good indication of the efficacy of a particular chemical (table 5). Flowers from the untreated block contained an average of 760,000 bacteria per blossom, but only 23,000 cells per blossom were detected in the flowers from the block treated with MBR 10995 (1 lb per acre). The per cent of blossoms contaminated with fireblight bacteria and the actual population of bacteria per blossom were good indicators of the efficacy of a chemical application.

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TABLE 5. EFFECT OF EITHER SAPROPHYTIC BACTERIA OR CHEMICALS ON THE EPIPHYTIC POPULATIONS OF **ERWINIA AMYLOVORA** IN BLOSSOMS AND DISEASE INCIDENCE IN BARTLETT PEAR TREES

Treatment	Amount applied per acre	No. of bacteria/ blossom x 10^5**	Percent of blossoms infested with **E. amylovora****	No. of infections per tree**
Check	. .	7.6 a	52a	3.2a
Citcop	1 gal	6.6 ab	51a	1.7bc
Citcop	2 gal	5.9 ab	48ab	2.2ab
Streptomycin	10 oz	5.7 ab	37ab	0.8cd
Saprophytic bacteria	50 gal*	4.6 abc	45ab	1.0bcd
Terramycin	10 oz	3.6 bc	40ab	0.8cd
Kocide	0.5 lb	2.5 cd	32ab	1.0bcd
Kocide	2 lb	1.2 d	28bc	0.4d
MBR 10995	0.25 lb	0.62d	16c	0.4d
MBR 10995	1 lb	0.23d	15c	0.4d

* 10^6 bacteria per ml.
** Values followed by different letters are significantly different at 0.05 level.

TABLE 1. CHEMICAL ANALYSES OF SOIL SOLUTIONS FROM SUBFLOOR MONITORING OF SHADY GROVE LIQUID MANURE HOLDING POND

Depth	EC*	TDS**	NO_3-N†	NO_3‡
ft.	mmhos	ppm	ppm	ppm
0–1	1.40	896	15.0	66
1–2	1.00	640	15.0	66
2–3	1.00	640	10.0	44
3–4	0.91	583	8.0	35
4–5	0.67	439	7.8	34
5–6	1.40	896	32.0	141
6–7	0.72	461	9.5	42
7–8	1.50	960	38.0	167
8–9	1.30	831	24.0	106
9–10	0.69	442	6.2	27

* EC = electrical conductivity.
** TDS = total dissolved salts.
†NO_3-N = nitrate nitrogen.
‡ NO_3 = nitrate.

TABLE 2. CHANGES IN EC, TDS, NO_3-N, AND pH AT 2-FT DEPTH BELOW MANURE POND CERAMIC CUP EXTRACTS

Date	EC	TDS	NO_3-N	pH
	mmhos	ppm	ppm	
6/11/72 (clean water, 2 ft deep in pond)	.75	480	16	8.2
6/14/72 (brown water, 2 ft deep in pond)	.74	473	15	9.3
6/16/72	1.10	704	19	8.4
6/20/72	1.50	960	17	8.2
6/27/72	1.90	1216	15	8.5
7/4/72	3.20	2048	102	7.8
7/13/72	2.60	1664	67	8.1
7/18/72	2.00	1280	8	8.3
7/25/72	2.10	1344	1	8.1
8/2/72	2.20	1408	1	7.4
8/9/72	**	**	**	**

** No solution extract.

SUBFLOOR OF SHADY LIQUID HOLDING

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This report of the subfloor monitoring of the Shady Grove Dairy liquid manure holding pond near Chino offers further proof that such ponds are self-sealing and allow little or no seepage.

Subfloor monitoring of, the Shady Grove Dairy liquid manure holding pond, located about three miles east of Chino, California, was begun in June 1972 with the installation of duplicate tensiometer cups at 2, 4, 6, 8, and 9 ft below the pond floor (see sketch). The retention pond is 216 ft long, 121 ft wide, 10 ft deep, and has a storage capacity of 4.3 acre ft (see cover photos). Dual nylon spaghetti tubes lead from each cup to a mercury manometer station on the pond levee. This procedure permits the taking of soil extracts as well as measuring the vertical hydraulic gradient (pressure over depth). To insure uniform hydraulic factors, wetting of the cups, and initial infiltration, a 5-ft-square by 12-inch-deep infiltrometer was installed above the tensiometer cups and later removed before clean water was added to a depth of 2 ft in the pond.

Core samples of soil (53mm in diameter and 60mm in length) were taken from beneath the pond floor in one foot increments. These samples showed greater stratification than had been anticipated, with loamy sand present down to 2 ft, fine sand between 2 and 6 ft, silt between 6 and 8 ft, fine sand again between 8 and 9 ft, and coarse sand and gravel between 9 and 10 ft.

Extracts for subsequent analysis were collected weekly from ceramic cups for the first six weeks after the pond was filled with manure water. Chemical analyses of soil solution extracts from beneath the pond were shown in table 1. Manometers were also read and recorded daily during the first six weeks. Thereafter, manometer readings were made two or three times weekly, and soil extracts were collected every other week. Changes in electrical conductivity, total dissolved salts, nitrate nitrogen, and pH at the five ceramic cup depths are shown in tables 2, 3, 4, 5, and 6.

Hydraulic gradient is the driving force which causes movement of moisture between two specified points (2-ft to 8-ft probes). When hydraulic gradient reaches zero, indicated by Φ/L (the difference of gradients/distance), there is no water movement. This is considered a sealed condition. Data plotted from the 2-ft to 8-ft probes shown in the graph

MONITORING GROVE DAIRY MANURE POND

W. C. FAIRBANK

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indicate a sealed condition was reached in 55 days. Normally, dairy waste ponds in central California have experienced faster sealing, as indicated by the "normal" curve in the graph.

The slower sealing rate at the Shady Grove Dairy pond is believed due to the use of a separator screen which removed much of the suspended debris ahead of ponding. This subfloor monitoring technique established that this dairy waste pond became effectively sealed. The soil solution analysis, as compared with original soil analysis data, leads to the conclusion that sealing of ponds takes place essentially in the upper 6 ft of soil in a pond bottom.

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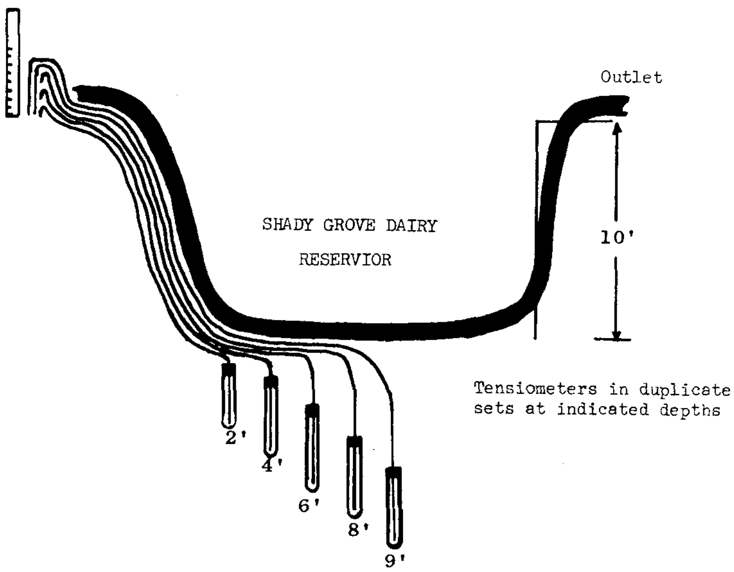

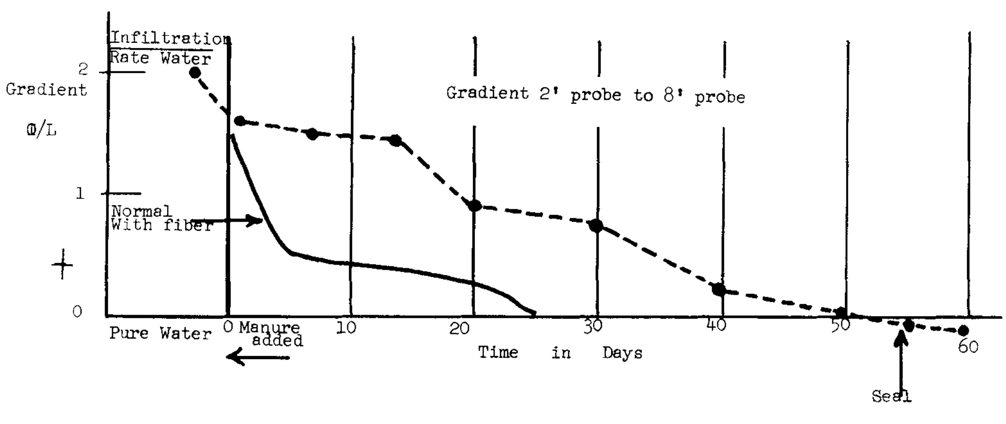

TABLE 3. CHANGES IN EC, TDS, NO_3-N, AND pH AT 4-FT DEPTH BELOW MANURE POND CERAMIC CUP EXTRACTS

Date	EC	TDS	NO_3-N	pH
	mmhos	ppm	ppm	
6/11/72 (clean water, 2 ft deep in pond)	1.30	832	54	8.[illegible]
6/14/72 (brown water, 2 ft deep in pond)	1.10	704	34	8.[illegible]
6/16/72	*	*	108	[illegible]
6/20/72	**	**	**	**

* Insufficient solution.
** No solution extract.

TABLE 4. CHANGES IN EC, TDS, NO_3-N, AND pH AT 6-FT DEPTH BELOW MANURE POND CERAMIC CUP EXTRACTS

Date	EC	TDS	NO_3-N	pH
	mmhos	ppm	ppm	
6/11/72 (clean water, 2 ft deep in pond)	.80	512	19	8.4
6/14/72 (brown water, 2 ft deep in pond)	.82	524	16	8.3
6/16/72	.85	544	19	8.6
6/20/72	.94	601	18	8.4
6/27/72	1.20	768	18	8.6
7/4/72	1.80	1152	18	8.6
7/13/72	1.20	768	8.2	8.6
7/18/72	1.20	768	6.5	8.6
7/25/72	1.40	896	2.8	7.3
8/2/72	1.60	1024	4.4	7.2
8/9/72	1.90	1216	2.2	7.0
8/23/72	1.80	1152	0.9	6.8
9/6/72	**	**	**	**

** No solution extract.

TABLE 5. CHANGES IN EC, TDS, NO_3-N, AND pH AT 8-FT DEPTH BELOW MANURE POND CERAMIC CUP EXTRACTS

Date	EC	TDS	NO_3-N	pH
	mmhos	ppm	ppm	
6/11/72 (clean water, 2 ft deep in pond)	.74	473	17	8.2
6/14/72 (brown water, 2 ft deep in pond)	.74	473	16	8.2
6/16/72	.76	486	16	8.3
6/20/72	.75	480	18	8.7
6/27/72	.89	569	16	8.7
7/4/72	1.10	704	15	8.0
7/13/72	.76	486	2.5	8.5
7/18/72	.95	608	3.5	*
7/25/72	*		4.0	*
8/2/72	**	**	**	**

* Insufficient solution.
** No solution extract.

TABLE 6. CHANGES IN EC, TDS, NO_3-N AND pH AT 9-FT DEPTH BELOW MANURE POND CERAMIC CUP EXTRACTS

Date	EC	TDS	NO_3-N	pH
	mmhos	ppm	ppm	
6/11/72 (clean water, 2-ft deep in pond)	.75	480	17	8.5
6/14/72 (brown water, 2-ft deep in pond)	.74	473	17	8.1
6/16/72	.75	480	18	8.4
6/20/72	.75	480	15	8.7
6/27/72	.82	524	15	8.6
7/4/72	.90	576	17	8.2
7/13/72	.83	531	12	8.6
7/18/72	.82	524	12.8	8.5
7/25/72	1.00	640	8.2	7.7
8/2/72	.99	633	5.0	7.5
8/9/72	1.00	640	1.5	7.5
8/23/72	.91	582	5.6	7.5
9/6/72	1.00	640	0.5	7.5
9/19/72	1.10	704	0.8	7.8
10/4/72	1.10	704	3.2	7.6
10/18/72	1.20	768	1.8	7.8
11/1/72	1.30	832	1.6	7.8
11/14/72	1.40	896	1.6	7.4
11/29/72	1.80	1152	6.5	7.5
12/13/72	1.70	1088	7.3	7.6
12/27/72	**	**	**	**

** No solution extract.