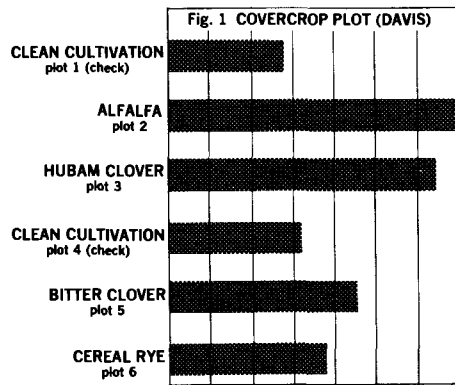


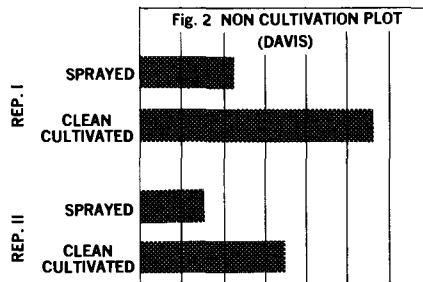
Cover Crops Improve Infiltration Rates

Spray Noncultivation and Sawdust Mulches Ineffective in Orchard Trials

Graph 1—Accumulative water intake in 90 minutes. Each bar on graph represents the arithmetic mean of eight infiltrmeters in a Davis apricot orchard.



Graph 2—Accumulative water intake in 45 minutes. Each bar on graph represents the arithmetic mean of six infiltrmeters in a Davis walnut orchard.



Cover crops can improve water penetration in orchard soils, as compared with clean cultivation, according to Davis tests. Alfalfa and Hubam clover performed best. Clean noncultivation by use of chemical sprays had an adverse effect on soil surface structure and water penetration in tests at Davis and Fresno. Use of sawdust mulch did not affect water penetration in comparisons with normal cultivation and sod in El Dorado County orchards.

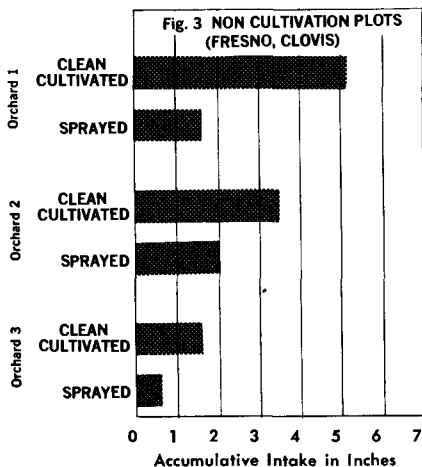
THE PROBLEM of slow water penetration into California soils is particularly important in orchards, where compaction layers interfere with downward water movement and cannot be broken up by deep plowing. In this study, cover crops, sawdust mulch and non-tillage soil management practices in orchards were investigated.

The ring infiltrometer method was used to measure water penetration. It consists of placement of a metal cylinder (infiltrator) about 4 to 5 inches into the ground. The infiltrator is then filled with water. The rate of disappearance of the water in the cylinder represents the infiltration rate of the soil. A modification from customary methods consisted of increasing the diameter of the infiltrator from the usual 6 inches to 18 inches to cut down the variability associated with the smaller infiltrators.

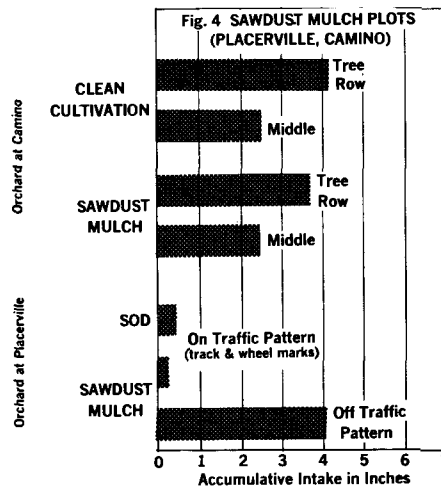
The infiltrometers were placed halfway between trees (unless otherwise indicated) to avoid being superimposed on the traffic pattern caused by tractor wheels or tracks.

Davis cover crop plots

The effect of different cover crops on infiltration was evaluated at Davis from what is believed to be the oldest orchard cover crop plot with a continuous record anywhere in the world. Differential cover



Graph 3—Accumulative water intake in 20 minutes (orchard 1) and 60 minutes (orchard 2 and 3). Each bar on graph represents the arithmetic mean of four infiltrmeters in Fresno fig orchards.



Graph 4—Accumulative water intake in 15 minutes (Camino pear orchard) and 60 minutes (Placerville pear orchard). Bars on graph represent the arithmetic mean of four infiltrmeters for the Camino orchard and for the Placerville orchard, the mean of five infiltrmeters (sod on traffic), the mean of six infiltrmeters (sawdust on traffic pattern) and the mean of three infiltrmeters (sawdust off traffic pattern). Tree rows show better intake than middles because of less traffic.

crop treatments were started in 1924 and carried on continuously until 1961. They consisted of:

1. Clean cultivation (Check): One cultivation was done after each irrigation.

2. Summer cover crop (*Melilotus alba annua*, Hubam sweet clover): The cover crop was planted in the spring and chopped during the growing season. It reseeded itself well and was usually not disked and replanted before the third year after planting.

3. Winter cover crop (*Melilotus indica*, bitter clover): The bitter clover was seeded in September or October and disked under in March or early April.

4. Winter cover crop (*Secale cereale*, cereal rye): The rye was planted and disked under at the same time as the bitter clover.

5. Permanent cover crop (*Medicago sativa*, alfalfa): Alfalfa was planted in the spring, chopped in the summer, disked and replanted every five or six years.

Earlier work had shown that the rate of infiltration, as determined by visual observation of the disappearance of a 6-inch irrigation in rectangular basins or by 6-inch infiltrometers, was much greater under cover crop management. A well-developed plow pan condition had been corrected much more quickly by cover cropping. Specific gravity determinations also confirmed these observations.

Soil type

The soil type at the Davis plots was Yolo loam. Irrigation in recent years was by contour flooding. At the time the infiltration test was conducted (Dec. 1960) no visible difference in the structure of the soil surface was noticeable between the check and the Hubam plots. The bitter clover had just emerged and the rye was 6 inches high. The alfalfa was semi-dormant and the soil surface showed litter and signs of worm activity. Soil moisture was around field capacity since the tests were preceded by heavy rains.

Graph 1 shows total measured infiltration into the soil in 90 minutes for the five different plots. Alfalfa and Hubam plots were more than twice as high as the checks in their infiltration capacity. Bitter clover was better than the checks, but rye showed little difference.

Extrapolated mean intake rates were computed for the 12th hour after the start of an irrigation for the treatment with the lowest and one of the treatments with the highest infiltration rates. These low and high rates were: (1) Check, 0.55

inch per hour and (2) Hubam clover, 1.4 inches per hour. The 12th-hour infiltration rates may be useful for sprinkler system design since they represent approximately the upper limit of permissible application rates in customary 12-hour sets.

Spray treatment

Clean noncultivation with sprays and effects on water infiltration were evaluated at four test plots—one at Davis and the others near Fresno.

The Davis-Straloch plot, in walnuts, consisted of two replications of two treatments. The soil was a Yolo loam. Irrigation was by contour basins. The differential treatments started in 1954 were:

1. Clean cultivation plus winter cover crop (Check): Three irrigations during the irrigation season, each followed by a cultivation. A volunteer winter cover was disked under in the spring.

2. Clean noncultivation: Three irrigations each followed by a spraying of a mineral oil for weed control. Other than sparse volunteer plant population, no winter cover crop.

The infiltration test was run in November 1962, after a rain storm in October which wetted the soil several feet deep. The volunteer cover crop had not emerged yet. The surface of the sprayed plots was somewhat harder than the surface of the cultivated plots.

Results (Graph 2) show that the intake of the cultivated plot was significantly higher. The computed intake rates for the 12th-hour (Rep 1) were: Clean noncultivation—0.85 inch per hour; and clean cultivation—2.2 inches per hour.

Fresno-Clovis plots

The Fresno-Clovis plots, in fig orchards, consisted of two differential treatments which were started in 1959 in three different orchards: (1) Cultivation (two to three cultivations per year); and (2) noncultivation (one Diuron spray per year). The soil type in orchards 1 and 3 was San Joaquin sandy loam and in orchard 2, Madera loam. Water application was by flooding on orchards 1 and 3. Orchard 2 was nonirrigated.

The infiltration tests were carried out in January 1962. Some volunteer cover crop was evident on the cultivated plots only. The surface of the sprayed plots consisted of a solid crust 1 to 2 inches thick.

Results (Graph 3) again show the intake is considerably greater on the cultivated plots. The difference is highly

significant. The computed basic intake rates (for the 12th hour) are:

Orchard	Sprayed	Clean cultivated (summer)
1	1.6"/hr.	5.2"/hr.
2	0.67"/hr.	1.0"/hr.
3	0.29"/hr.	0.60"/hr.

These 12th-hour rates have only comparative value. On soil series with hardpans such as San Joaquin and Madera, high infiltration rates, such as in orchards 1, 2 and 3, would cause water logging before 12 hours.

Sawdust mulch

Sawdust mulch was tested in the foothills of El Dorado County.

The Camino plots, in a pear orchard, consisted of cultivation (normal practice) and sawdust mulch (no cultivation).

The Placerville plots were also in a pear orchard and consisted of (1) permanent sod and (2) sawdust mulch. The sawdust mulch treatment consisted of initially applying a 6-inch layer of sawdust on the ground and replenishing as necessary. The soil type was Aiken clay loam in both orchards. Water application was by sprinkling. Evaluation was done after eight years of treatment.

Results of infiltration tests carried out in 1959 and 1960 are shown in Graph 4. The computed intake rates for the 12th-hour at Camino were: sawdust mulch—3.2 inches per hour; and clean cultivation—3.6 inches per hour. For Placerville: sawdust mulch off traffic pattern—1.2 inches per hour; sawdust mulch on traffic pattern—0.035 inch per hour; and sod on traffic pattern—0.030 inch per hour.

Results show that there was no difference between sawdust mulch and clean cultivation on or off a traffic pattern. Sawdust mulch was apparently unable to restore soil structure of a compacted zone when it was merely applied on the soil surface.

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Farmer cooperators in this study included N. Liddell and Mrs. Florence Free, Clovis; J. Wheeler, Fresno; Ch. Jacquier, Placerville; and the Michigan-California Lumber Company, Camino.