

# Water Penetration Tests

## study of soil conditions affecting infiltration of water and root development of crop plants in California

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**Water penetration** of California soils is deteriorating.

Soil compaction which in former years was restricted to relatively thin plowsoles, now often extends from near the surface to a depth of 18" to 24".

This formation of compacted surface layers may in part be contributed to the increasing use of heavy farm machinery and tractors.

Many fields were examined where water penetration had been adequate, but has now become a problem. Many of these fields are irrigated three or four times as frequently as in the past, with the water held on the field much longer at each irrigation.

Infiltration rates and soil densities were determined on 24 core samples from representative fields. These examples are from a few of the many areas investigated during the past two years.

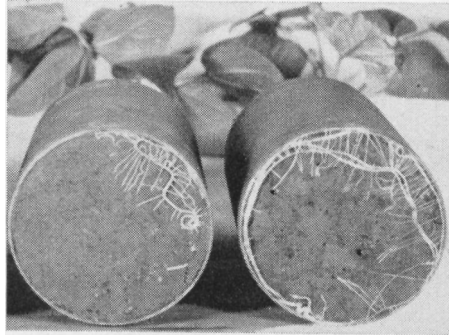
Samples one and two were taken from a potato field on Hesperia sandy loam in Kern County. The samples were obtained the spring following the potato harvest, after the soil was plowed but before planting cotton.

The first sample, taken from a depth of 8" to 15" had a soil density of 1.73 and a water infiltration rate of 0.162" per hour. The second sample, taken from a depth of 19" to 25" had a soil density of 1.62. This reduction of only 0.11 in density caused an increase in the infiltration rate of over 200%, to 0.495" per hour.

Water in this field stood in depressions and the ends of furrows for two and three days before soaking into the soil. Examination of the soil profile under the beds and furrows indicated that few potato roots penetrated more than 2" or 3" below the bottom of the furrow. The soil—having a density of 1.74 at this depth—was sufficiently compact to limit root development.

The yield of this field was about half that of adjoining fields where compaction was no problem, and there was an appreciably smaller percentage of U. S. No. 1 grade.

Samples three and four were taken from the same field in an unplanted area where farm equipment was turned repeatedly in cultivating the field. The soil was of high density and low infiltration rate to a depth of at least 14", apparently



Root development of beans in undisturbed soil samples from a field having a soil density of 1.60. The roots grow between container and the dense soil. They are flattened and four to five times as wide as they are thick. All branching of the roots is parallel to the surface of the dense soil on the sides and the bottom of container.

the result of farm machinery passing over the surface. An infiltration rate of 3" to 4" per hour is not unusual in these soils while the rate in the samples was only about 0.2" per hour.

Samples five and six were also taken from Hesperia sandy loam, but of a lighter phase. Density of this soil was as high as that of samples one, three and four, but the infiltration rates averaged 0.75" per hour, and excellent potatoes were produced. These data show that density alone is not a good criterion on soil compaction.

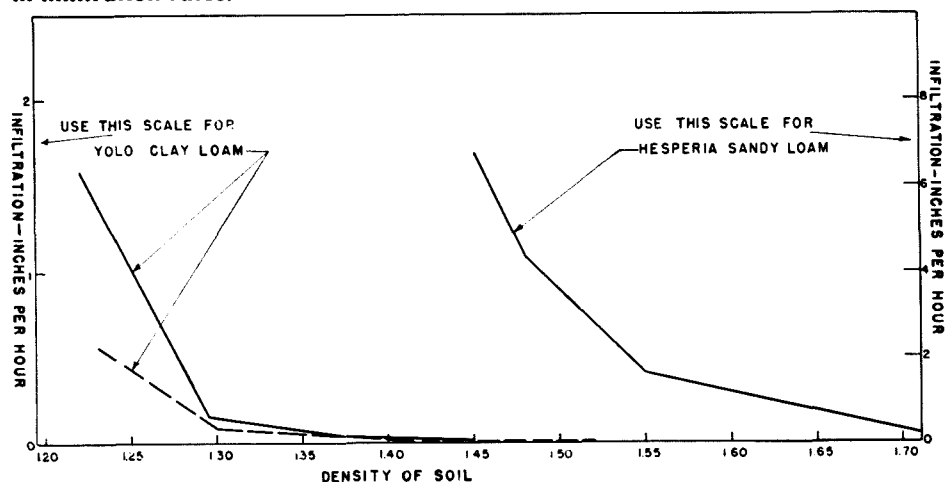
Samples seven and eight were obtained from a Kern County alfalfa field on Exeter sandy loam. Three years before, the field had been disked after a crop of potatoes, and there were dense strips between the rows of the previous crop resulting from cultivation, furrowing, and harvesting operations. The first year after the planting of the alfalfa, plants had been only 3" or 4" high on the compacted strips. Even three seasons later, the alfalfa was still much smaller on the compacted strips than on the noncompact soil, only 15" away, where the plants grew vigorously.

Infiltration rates on the compacted strips were half those of the normal producing areas.

Samples nine and 10 came from a barley field on Delano loamy sand which received one irrigation when the crop was about half grown. This field showed compacted strips 18" to 20" wide, suggesting use of a crawler type tractor. In the compact area water penetration was so poor that barley plants were nearly dead from lack of water, while the barley in the noncompact areas grew normally. The densities between the two areas differed only slightly—1.73 on the compacted strips, to 1.71 on the normal area—but infiltration rate in the noncompact areas was

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**Soil density is not a good criterion for water infiltration studies. Here, infiltration rates of laboratory-packed samples are plotted against density. At relatively low densities a small increase in density results in a large decrease in infiltration rate, while at high densities an increase in density results in only a slight decrease in infiltration rates.**



## MILK

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1% of the children one to six years old did not drink any milk. All the children from seven to 12 drank milk, as did all the girls and most of the boys from 13 to 15 years. In the 16-to-20-year group about 8% of the boys and girls in Los Angeles and 7% of the boys and 17% of the girls in Oakland did not drink milk.

Of persons 21 years and over, an average of over one third did not drink any milk. The proportion of women who did not drink milk was larger than that for men.

If those who did not drink milk during the survey period had drunk the average amounts the per capita consumption of milk as a beverage would be increased 52 quarts per year in Oakland and 42 quarts in Los Angeles.

### Other Uses

Almost 90% of the families studied used fluid milk in food preparation. From 10% to 15% of the different whole milks purchased was used in this way. The largest proportion—2% to 5%—was used in baked goods. From 1% to 3% was used for sauces, gravies, and in casserole dishes. About 1% of fluid milk was used for seasoning vegetables, and from 1% to 3% in ice creams, puddings and the like.

About two thirds of the families used 10% of the milk on cereal.

Approximately one fifth of the families used milk in their tea and coffee, thus consuming about 2% to 3% of the total milk.

Half-and-half milk seems to have almost replaced table cream. Whereas 28% of the families in Oakland and 38% in

Los Angeles bought half-and-half, only about 7% bought table cream during the week studied.

From 15% to 21% of the families used half-and-half on cereals but less than 2% used table cream. Almost 10% used half-and-half in food preparation, and less than 2% used table cream.

Slightly over one half pint of half-and-half was used on the average by Oakland families and more than three fourths pint by the Los Angeles families. The average of table cream used was only 0.06 pints.

About 45% of the half-and-half was used in tea and coffee, about 37% on cereal, and 7% in food preparation.

Whipping cream was used by more families than table cream. In Oakland the amount of whipping cream was almost twice that of table cream. Practically all of it was used in food preparation and on fruits and desserts at the table.

Evaporated milk was used by 46% of the families in Oakland and 36% of those in Los Angeles.

From 23% to 30% of the families used evaporated milk in tea and coffee; 4% to 5% on cereal at the table; 2% to 3% as a beverage; and 17% to 22% in food preparation.

About one third of the evaporated milk used was used in tea and coffee; almost one fourth in infant feeding; 7% on cereals; 6% to 9% as a beverage; 20% in food preparation; and 7% to 12% for pet food.

Only about 3% of the families used either non-fat or whole dry milk, a larger proportion using the former. Non-fat dry milk was used in food preparation, as a beverage, as pet food and, in Los Angeles, on cereal.

Cottage cheese was used by 60% to 68% of the families surveyed. Families in Oakland consumed almost three-fourths pound and those in Los Angeles, almost one pound.

About 37% of the families used cottage cheese in salads and salad dressings. Over 31% in Oakland and 45% in Los Angeles served it alone at the table. About 2% used it in food preparation.

American cheddar cheese was used in sandwiches by almost half of the families; was served at the table by nearly 20% of the families; and was used in food preparation—sauces, gravies, casserole dishes—by 20% to 25% of the families.

About 55% of the total cheddar cheese used went into sandwiches, 22% to 24% was served at the table and 20% to 23% went for food preparation.

In addition to American cheddar cheese Oakland families used an average of 0.13 pound of other hard cheese and cream and other soft cheese. The Los Angeles families used an average of 0.2 pound of these cheeses during the week. Like the cheddar cheese the most popular use was in sandwiches.

Although some cheddar cheese was used in salads and salad dressing, from two to three times as much other hard cheese and from three to four times as much cream cheese was used in this way.

About 52% of the families surveyed used butter. The average quantity used by all families surveyed was a little more than one half pound per family.

Two thirds or more of the butter was used at the table; about 8% in sandwiches; about one fourth in food preparation; and 1% to season vegetables.

Butter was used as a spread at the table by about half of the families, i.e., by nearly all who used butter in any way; to season vegetables at the table by 27% to 32% of the families; sandwiches by 21% to 28% of the families; and in food preparation by almost 42% of the families.

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## PENETRATION

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3½ times that of the compacted strips.

Samples 11 and 12 were taken from an old irrigated pasture on Cajon clay loam. Water penetration had been normal at the time of planting but compaction was caused by grazing on wet soil.

Infiltration rates were measured by determining the rate of drop of the water surface in the cylinders. These cores did not transmit any water. The condition was so severe that water grass and other water-loving weeds crowded out pasture plants.

Samples 13 to 20 were taken in San Joaquin County, and are examples of difficulties with heavier soil types. The samples were taken in tomato fields in the bottom of irrigation furrows, a level 5" or 6" below the ground surface before the beds were formed.

Samples 13 and 14 were obtained from the first foot of a dense layer of Rincon clay extending to a depth of about 22". Sample 15 was secured from the friable soil below this depth. The friable soil had an infiltration rate 7½ times that of the compacted layer.

Samples 16 to 18 came from Sorrento silty clay which had a dense layer at least 16" deep, and a very low infiltration rate. Probing and digging indicated that the layer was approximately 22" thick.

Samples 19 and 20 were taken in a Stockton clay adobe. The soil was very dense considering its heavy texture, and the infiltration rate was very low. Below the 24" depth there was an extremely heavy clay with a density of 1.68.

Excavations were made in all tomato fields and roots were examined. A heavy mass of large and small roots was found

**Milk and Cream Used on Cereals**

	Oakland	Los Angeles
Total weekly consumption	1.1 qt.	1.3 qt.
Homogenized	61.8%	52.2%
Other whole milk	22.9	30.2
Half and half	8.3	10.4
Evaporated	5.9	4.2
Other	1.1	3.0

**Milk and Cream Used in Food Preparation**

	Oakland	Los Angeles
Total weekly consumption	1.5 qt.	1.3 qt.
Homogenized	56.7%	50.7%
Other whole milk	20.2	29.2
Evaporated	12.3	10.2
Buttermilk	4.9	2.6
Other	5.9	7.3

**Milk and Cream Used in Tea and Coffee**

	Oakland	Los Angeles
Total weekly consumption	0.45 qt.	0.5 qt.
Half and half	26.7%	36.1%
Evaporated	31.5	23.2
Homogenized	23.6	24.2
Other whole milk	9.3	10.0
Table cream	4.1	3.0
Other	4.8	3.5

in the surface 8" to 10" depth, which included the cultivated layer plus the soil from the furrows. Only a few slender roots penetrated the dense layers. There was no branching in the compact zone, but considerable branching in the more friable soil below.

Samples 21 to 24 were taken from a Sudan grass field on Yolo clay loam at Davis. They indicated compaction to a depth of 18" with a resulting low infiltration rate. Sample 24, taken from below the 18" depth, was only slightly more dense than is normal for this soil.

Root development in compact Yolo clay loam was studied in 60 core samples 4" in depth. Two inches of loose sieved soil from the same location was placed on top of these cores, and beans, tomatoes, onions, sunflowers, and wheat were planted.

None of the crops had any appreciable number of roots in the compact soil, except wheat whose root diameter is smaller than that of the other plants. About 25% of the total wheat roots—by weight—grew in the compact layer.

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## OLIVE

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perature, showed 7% of the fruits frozen. A third group, warmed up very slowly in a box of insulating vermiculite, had 8% of the fruits frozen.

Maturity of the fruit has a marked effect on freezing injury, black fruit being more resistant to freezing than green fruit. This resistance apparently consists of the ability of the more mature fruit to undercool below its freezing point without ice crystals forming. However, there is little difference in the actual freezing point of olive fruits of different maturity.

To learn the effect of shaking the fruit on the incidence of freezing, a test was conducted in which the fruits were shaken at one-half hour intervals during a three-hour freezing period at 22° F. The shaking caused ice crystals to form in all fruits, with 100% of the fruits frozen, whereas only 28% of the undisturbed fruits were frozen. This would indicate that much greater freezing injury could be expected if olive fruits were shaken by winds or otherwise disturbed on the tree during a period when they were undercooled below their freezing point.

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## DONATIONS FOR AGRICULTURAL RESEARCH

Gifts to the University of California for research by the College of Agriculture  
accepted in August, 1952

### BERKELEY

Ace Pump Corp.....	1 Ace diaphragm spray pump model 77 1 shaft adapter for pulley drive 1 Ace hydraulic agitator	
	For experimental cotton spraying tests	
American Cyanamid Co.....	5 gallons technical malathion	
	For experimental work on control of greenhouse pests	
American Cyanamid Co. Lederle Laboratories Division.....	3 gms. 7-hydroxy-1-v-triazolo-(D) pyrimidine	
	For plant virus chemotherapy work	
California Farm Bureau Federation.....		\$275.00
	For research work on strawberry pests, particularly cyclamen mite	
California Fertilizer Association.....	2320* treble super phosphate	
	For demonstration plots in field, pasture, truck, and fruit crops	
California Grape & Tree Fruit League.....		\$500.00
	For study of consumer and trade preference for fresh grapes	
Chipman Chemical Company, Inc.....	1 gallon toxaphene insecticide	
	For experimental use on control of pests of ornamentals	
Colloidal Products Corp.....	3 cases (25 lbs.) DDT depositor	
	For investigations on walnut insects	
Commercial Solvents Corp.....	10 vials of Bacitracin Systemic Bacitracin 50,000 u/vial	
	For investigational use in control of respiratory infections of poultry	
Dow Chemical Co.....	5 gal. Pramerga	
	For Ladino clover mite investigations	
E. I. du Pont de Nemours & Co.....	50 lbs. 2% EPN dust 1 gal. NPD insecticide	
	For melon insect investigations and research on control of greenhouse pests	
Eston Chemicals, Inc.....	1 gal. agric. insecticide N.O.S. Malaphos 50 E	
	For greenhouse insect investigations	
Glenn County Board of Supervisors.....		\$1,500.00
	For surveying the soils of Glenn County	
McLaughlin, Gormley, King Co.....	100 lbs. 10% F 1187 dust	
	For melon insect investigations	
Frank S. Myers Estate.....		\$200,217.62
	One fourth (\$50,054.40) for establishment of "Frank and Ivy Myers Scholarship"; three fourths (\$150,163.22) for agricultural research, in particular for vegetable crops, at the discretion of the Regents	
Pacific Coast Borax Co.....	202* fertilizer borate, regular grade, coarse grind	
	For demonstrations in truck crops of boron deficiency	
Plant Products Corp.....	1 carton metaldehyde smoke generators	
	For experimental work on slug control in greenhouses	
Poultry and Egg National Board.....		\$400.00
	For program on dietary factors influencing absorption, metabolism and synthesis of cholesterol. First payment on \$1,200 grant	
Rohm & Haas Co.....	12 lbs. Q-137	
	For investigations on walnut insects	
	1 gallon Q-137 insecticide	
	For experimental use on control of pests of ornamentals	
Shell Chemical Corp.....	5 gals. Shell Dieldrex 15	
	For melon insect investigations	
Sunland Industries.....	200 lbs. experimental dusts	
	For cotton insect investigations	
U. S. Public Health Service.....		\$4,549.00
	For research on synthesis and degradation of fatty acids and other compounds by bacterial enzymes	

### DAVIS

Allied Chemical & Dye Corp. General Chemical Division.....		\$1,000.00
	For conducting flavor evaluation tests on peaches	
Alsynite Co. of America.....	305 sq. ft. of Alsynite	
	For research in plant propagation	
American Cyanamid Co.....	1,000 lbs. aero-cyanamid	
	For turf research	
American Cyanamid Co. Lederle Laboratories Division.....	1 pkg. folic acid—10 gm.	
	For poultry nutritional studies	
	4 pkg. Aurofac 2A (200 lbs.) 1 kg. crude crystalline aureomycin	
	For poultry disease studies	
California Beet Growers Association.....		\$1,000.00
	For research on sugar beets	

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