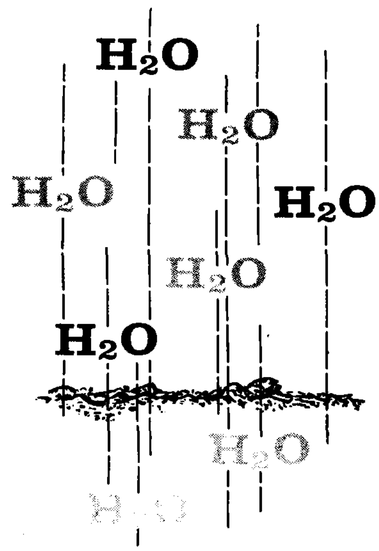
Effect of Wetting Agents on Irrigation of Water Repellent Soils



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The beneficial effects of using a wetting agent to increase the infiltration rate while irrigating highly water-repellent soils are variable, depending upon the amount of water, dryness of soil and possibly the product used, according to field tests in San Bernardino County.

WETTING AGENTS can be used to increase infiltration rates into hydrophobic (water repellent) soils. A field test was conducted on a soil classified as Tujunga stony sandy loam, which was found to be extremely hydrophobic, to learn more about the effectiveness of wetting agents. The area is located near Fontana. The land had been farmed in small grain crops years ago and then was used as a hog ranch, but it has been idle for about eight years.

The test plots were 10-foot-square basins with soil borders. Two wetting agents (designated as products A and P) were used in the study at dilutions of 1 part wetting agent to 650, 1300, 2000, and 4000 parts of water. Water was pumped from a water truck into each basin to a depth of four inches. As the water was being applied to the basin, enough wetting agent was added to the flow stream to produce the desired dilution. Each treatment was replicated three times and six basins were used as checks and received only water.

The water level was checked periodically on marked stakes which were installed in each basin. The initial test was conducted in May. The plots were allowed to dry for more than two months and then untreated water was added to each basin and the infiltration rate checked.

TABLE 1. EFFECT OF WETTING AGENTS ON INFILTRATION RATES

Product	Dilution	Time for 4-inch infiltration		Percent decrease in infiltration time compared to check	
		1st run	2nd run*	1st run	2nd run
Water	......	150	89	..	..
A	1 to 650	123	73	18	18
A	1 to 1300	107	65	29	27
A	1 to 2000	137	67	9	25
A	1 to 4000	137	77	9	14
P	1 to 650	88	52	41	42
P	1 to 1300	98	55	35	38
P	1 to 2000	107	69	29	28
P	1 to 4000	120	69	20	28

* Water was run on each plot. Values are for basins which had received the indicated treatment.

Infiltration rates of water in nonwettable soils as compared with typical curve for wettable soil.

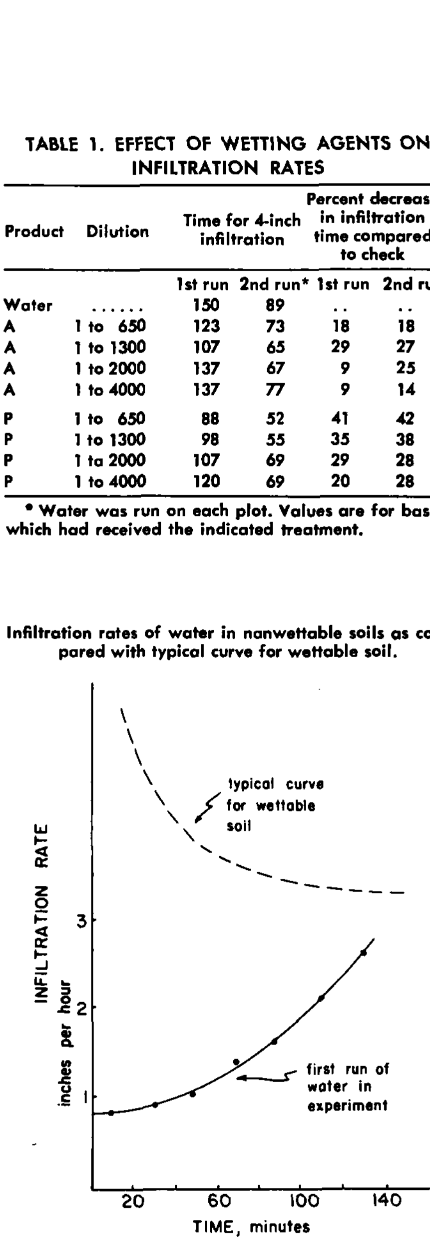

Table 1 shows the time necessary for four inches of water or solution to penetrate and the percentage of decrease in time for infiltration of wetting agent solution basins, as compared to the check plots. On the first run, all wetting agent solutions infiltrated more rapidly than water. Product P showed increasing benefits as the concentration was increased. The second most concentrated solution of product A provided the shortest time for infiltration for that product.

When water was applied during the second test, infiltration was more rapid in each of the treated plots as compared to untreated. Infiltration was more rapid on the second run perhaps because of increased soil moisture. Previous observations have indicated that a hydrophobic soil is less water repellent after once being wet, even though it becomes dry again.

The percentage of decrease in time for four inches of water to penetrate the treated plots, as compared to those untreated, was about the same as when wetting agent solutions were used in the initial test.

Infiltration rate at various times after water application follows a different pattern for nonwettable soil as compared to wettable soils, according to laboratory studies. The infiltration rate, plotted as a function of time, as well as a curve which is generally accepted as representing infiltration rates with time is presented in the graph. It is usually expected that infiltration rates will start high, and then decrease rather rapidly with time, and level out at a fairly constant rate. The infiltration rate on the plots studied was comparatively slow at the beginning, then increased with time after water application. It is assumed that the curve would have leveled off if the experiment had been extended by applying more water.

The information presented in the graph suggests that the relative beneficial effects of using a wetting agent may depend upon the quantity of water being applied. Since the infiltration rate increases with time, it would appear that beneficial effects of a wetting agent would decrease as the time of water application increased. Observation of the data presented in the second table shows this assumption to be true.

The percentage decrease in time for various quantities of water to infiltrate into the treated basins as compared to the untreated is recorded in the second table. The greatest decrease in infiltration time for all treatments was obtained with the use of one-half inch of water and the effectiveness decreased progressively as greater quantities of water were allowed to infiltrate.

While product A did not appear to be as good as product P when compared on four-inch intake, it was as good and possibly better when compared on a one-half-inch intake. Product A, for one-half-inch intake, was more effective at the highest concentration, and decreased in effectiveness as the concentration decreased. This "expected" behavior did not occur for product A when larger quantities of water were allowed to infiltrate.

These data suggest one wetting agent on the market may be superior for one problem or soil type, whereas another product may be superior for another set of conditions. More detailed investigations on the physical-chemical interactions between the wetting agent molecule, soil particle surface, and water are necessary to select a product best suited for the particular case. It would then be necessary to know the molecular structure of each commercial product so that the proper selection could be made.

TABLE 2. PERCENT DECREASE IN INFILTRATION TIME COMPARED TO CHECK

Treatment		Inches of water infiltrated				
Product	Dilution	½	1	2	3	4
		%	%	%	%	%
A	1 to 650	77	65	42	30	18
	1 to 1300	68	56	44	34	27
	1 to 2000	62	50	40	37	25
	1 to 4000	46	35	31	25	14
P	1 to 650	68	65	60	54	42
	1 to 1300	64	62	56	50	38
	1 to 2000	58	50	44	37	28
	1 to 4000	48	41	37	32	28

Water management

Aside from the application of wetting agents, information contained in the diagram provides clues toward better water management on nonwettable soils. Because a soil becomes more water repellent as it becomes drier, it is important that nonwettable soils should not be allowed to become dry before irrigation. "Double bumping" (applying water to cover the field and then stopping the application until several hours later), presently in use in some areas of the state, would appear to be a good practice on hydrophobic soils since the initial application could penetrate during the low infiltration-rate period. When the actual irrigation water is applied, the infiltration rates should be higher.

It should be stated that the results reported here were based only on tests of a very hydrophobic soil which was very dry before the test. The actual percentage of decrease in infiltration time created by wetting agent treatments cannot be assumed to apply to all systems. Conditions under which wetting agents are most likely to be beneficial are on water-repellent soils, when small amounts of water are added each time, and on sloping land, where the water will run off, if not immediately absorbed by the soil.

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Basins used to test water infiltration rates on water repellent soils as affected by wetting agents.