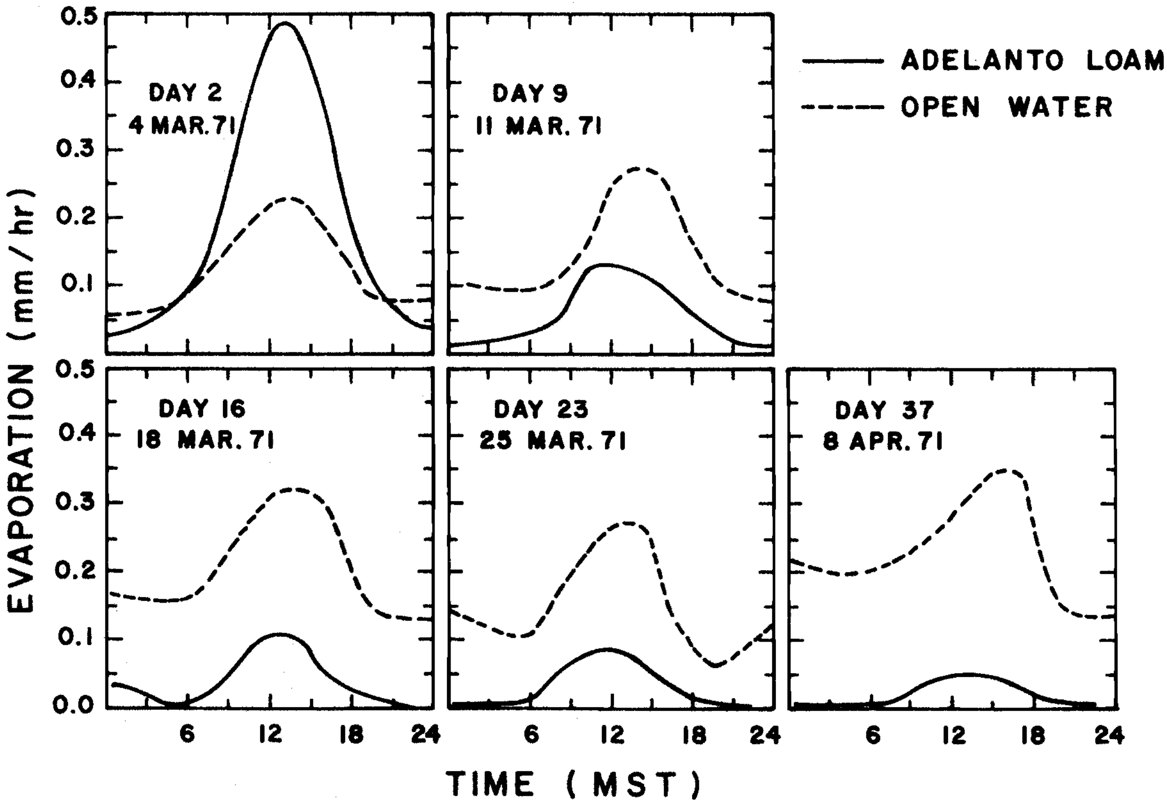

Fig. 5. Hourly evaporation from Adelanto loam and from open water versus time of day for five individual days following irrigation of the Adelanto loam.

SUMMARY

Lysimeter measurements of evaporation from bare Adelanto loam in Phoenix have been obtained during all seasons of the year. These data show that the evaporation rate on the first day of drying after irrigation is about 9 mm/day in summer and 2 mm/day in winter. By the seventh day of drying seasonal effects virtually disappear, and the evaporation rate is about 2 mm/day in both summer and winter. By 21 days it is about 0.75 mm/day in both summer and winter.

The individual drying curves were qualitatively different from the drying curves commonly obtained in the laboratory under isothermal conditions. It is suggested that the diurnal variations in temperature and other meteorological parameters have caused the difference, and data are presented which illustrate a diurnal fluctuation in evaporation rate still persisting on the 37th day after irrigation.

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BLUE-GREEN ALGAL EFFECTS ON SOME HYDROLOGIC PROCESSES AT THE SOIL SURFACE

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It has been suggested, with experimental fact, that blue-green algae have an effect on runoff, infiltration, and erosion at the soil surface by *Booth* (1940), *Fletcher and Martin* (1948), and *Osborne* (1950).

The information presented here was obtained from simulated rainfall experiments using soil plots upon which blue-green algae was grown under an artificial wetting regime (*Faust* 1970). A 30 percent clay-content soil of the Pima series and a contrasting eight percent clay-content, river bottom alluvium of the Anthony series were used. Simulated rainfall intensities of one and two inches per hour were applied for sixty minutes or until the infiltration rate became relatively constant.

The micro-vegetation was predominantly blue-green algae although some mold hyphae of undetermined genera were observed in microscopic examination of the soil crusts. On the Pima soil Scytonema hoffmanii (Vauch.) Gom. and Microcoleus vaginatus (Ag.) (Gom.) grew. Schizothrix calcicola (Ag.) Gom. developed on the Anthony soil.

After heavy watering, moisture conditions conducive to algal development were maintained for three months by covering half of six-by-twelve-feet test surfaces with an air-tight envelope of clear polyethylene plastic sheeting. Dripping condensate from the underside of the plastic sheets kept the three-by-twelve-feet areas wet.

Results of this study indicate that blue-green algal growths significantly reduced the amount of suspended soil material in runoff water originating from soil surfaces showing these growths. No statistically significant differences in response factors of settleable sediment in the runoff water, runoff-infiltration volumes, and time to the onset of surface runoff could be attributed to the presence or absence of the algae on test plot surfaces.

The bar graphs in Figure 1 show large differences in suspended sediment movement between soils, this being caused in part by the relatively larger and smaller amounts of clay material in the soils. The lower intensities of simulated rainfall produced considerably less erosion because of low kinetic energy of the drop impact which powers the disloding and saltating of fine soil particles. The micro-vegetation effect on suspended sediment reduction, while apparent on both soils for high and low intensities, is less strongly expressed on the Anthony soil.

From Table 1 we may get some statistical verification for what is to be seen in the graphs. The observed F values are marked with a double asterisk when they exceed the required F value for the one percent confidence level. The highly significant differences in sediment movement due to soil, intensity, and micro-vegetation factors are in agreement with the graphed mean values. Each mean value is of six replications of a given treatment combination. Table 2 shows mean values for each treatment combination.

In addition, the small differences in suspended sediment production on the Anthony soil due to the micro-vegetation treatment is verified by the highly significant soils-micro-vegetation interaction labeled "CA interaction" in Table

AVERAGE SUSPENDED SEDIMENT PRODUCTION RATE UNDER SIMULATED RAINFALL

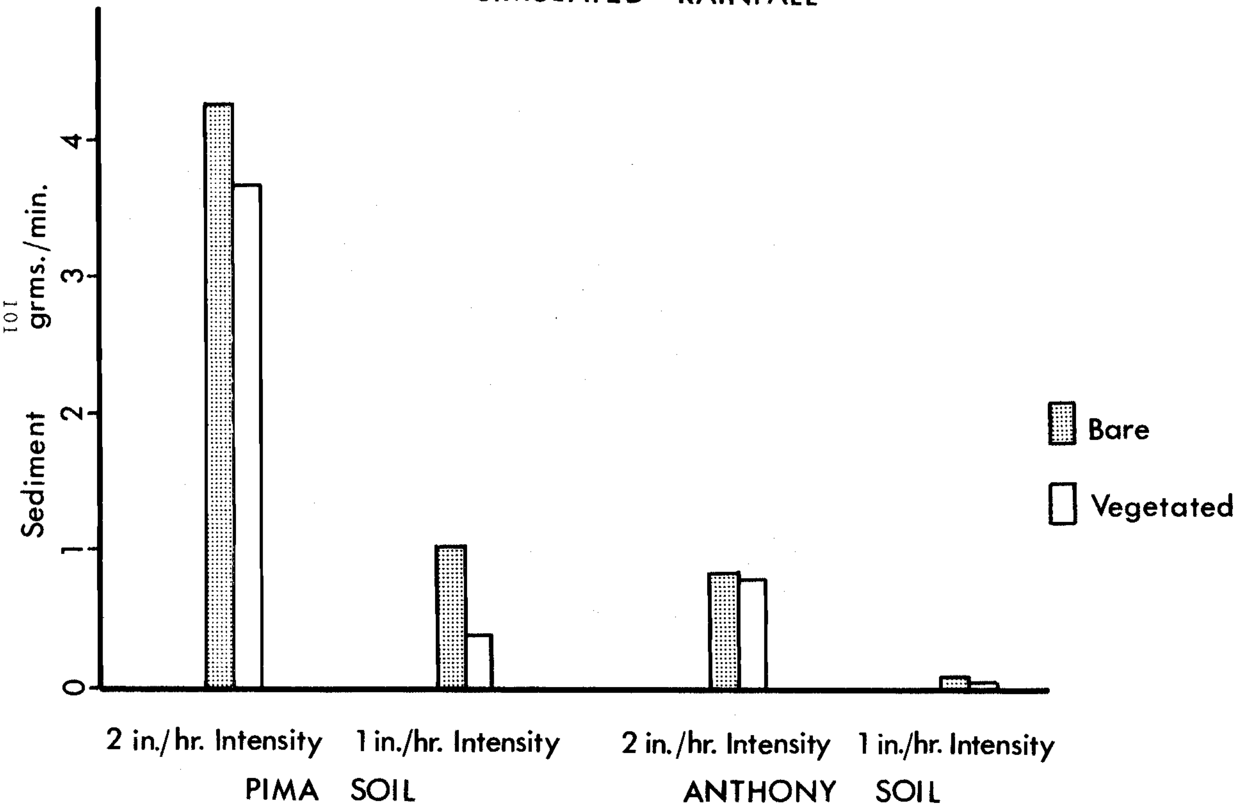

TABLE 1

MEANS OF THE RESPONSE FACTORS

Response Factor	Fixed Factors							
	Micro-Vegetated (a_1)				Bare (a_2)			
	Pima (b_2)		Anthony (b_1)		Pima (b_2)		Anthony (b_1)	
	Rainfall Intensity				Rainfall Intensity			
	High (c_2)	Low (c_1)	High (c_2)	Low (c_1)	High (c_2)	Low (c_1)	High (c_2)	Low (c_1)
	$a_1b_2c_2$	$a_1b_2c_1$	$a_1b_1c_2$	$a_1b_1c_1$	$a_2b_2c_2$	$a_2b_2c_1$	$a_2b_1c_2$	$a_2b_1c_1$
Suspended Sediment Production grams/minute	3.743	0.394	0.724	0.049	4.228	1.061	0.766	0.097

TABLE 2

ANALYSIS OF VARIANCE FOR SUSPENDED SEDIMENT PRODUCTION RATE

Source of Variation	Degrees of Freedom (df)	Sum of Squares (SS)	Mean Squares (ms)	Observed F	Required F 5%	Required F 1%
B[a]	1	45.474	45.747	255.40**	4.96	10.04
Error A	10	1.780	0.178	-	-	-
A	1	1.161	1.161	21.18**	4.96	10.04
AB Interaction	1	0.849	0.849	15.49**	4.96	10.04
Error B	10	0.548	0.055	-	-	-
C	1	46.307	46.307	385.66**	4.35	8.10
CA Interaction	1	0.026	0.026	<1	4.35	8.10
CB Interaction	1	20.052	20.052	167.00**	4.35	8.10
CAB Interaction	1	0.023	0.023	<1	4.35	8.10
Error C	20	2.401	0.120	-	-	-

[a] A is the micro-vegetation condition factor; B is the soil type factor; C is the simulated rainfall intensity factor.

1. A least significant difference (LSD) test may be used to explain the interaction. Consider the array of means of mean pairs for testing the CA interaction:

a_1b_1		a_2b_1		a_1b_2		a_2b_2
0.387		0.432		2.067		2.644
	0.045		differences		0.577	

The calculated LSD for which a real disparity in the response factor may exist due to presence or absence of micro-vegetation within soil types is 0.213. This value is not exceeded by the differences for the b_1 or Anthony soil. It is for the b_2 or Pima soil.

As indicated earlier, the Pima soil is amply provided with fine material which may become water-borne when there are no algal filaments or trichomes to form a matrix into which the fine particles may lodge. The Anthony soil is not so endowed. Too, the precision of the experiments was probably too low for detecting the small differences in suspended sediment commensurate with the supply in this soil. Examination of the surface five millimeter thickness of soil crusts did indeed show that the Anthony soil contained less micro-vegetation than the Pima soil based on total carbon and nitrogen analyses. The Anthony soil in natural situations may not be observed to harbor algal growths as heavy as the Pima soil.

The exact nature of the binding of soil particles is not within the scope of this article. Beyond the mechanical binding of soil particles, an electrostatic affinity between soil particles and algae may exist as well as a cementation between mineral particles and the cellulosic investments which enclose trichomes and filaments of the blue-green algae.

In conclusion, then, one may expect that when site conditions will support algal growths, algal-covered surfaces will not permit as much fine material to enter the overland flow as their soil counterparts which have no algal growths.

Differences in runoff and infiltration volumes, and in settleable sediment amounts could not be detected between surfaces covered with and denuded of blue-green algal growths.

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