

Effect of Treatment on the Hygroscopic Capacity of Soils.

THE fertility of a soil has long been associated with its power to absorb moisture from the air. The hygroscopic coefficient, as a soil characteristic which is connected with other physical properties of the soil, is of great interest in physical studies. The black cotton soils of Bellary are noted for their high powers of absorption. In the following note the effects of alternately heating and wetting the soil and of ignition on the hygroscopic capacity are discussed.

1. *Alternate Heating and Wetting.*—During studies on the hygroscopic capacity of soils it was found that the surface soil usually showed a lower capacity for absorption of water vapour than samples of soil taken from lower layers. An examination of the mechanical composition and other physical properties of the different layers of the profile at Hagari¹ showed that the soil is fairly uniform to a depth of three feet. The observed differences in the hygroscopic capacity of the different layers could not also be explained by the differences in the $\text{SiO}_2/\text{R}_2\text{O}_3$ ratios² for the different layers. The decrease in the hygroscopic capacity of the surface soil was naturally thought to be due to the fluctuations in the weather conditions which directly influence the top soil, which is subjected more frequently to alternate heating and wetting than the lower layers. In order to establish this, samples of black cotton soil of Hagari taken from different depths were alternately saturated with water, air dried for two days and dried in a steam oven overnight. This treatment was repeated five times. The hygroscopic capacity at 100, 99 and 75% relative humidities was studied for the treated and untreated samples under the same conditions of temperature. The vacuum desiccator method which was reported to be very satisfactory by other workers,³ was used. The following results were obtained before and after treatment for the different relative humidities (Table I).

There is a decrease in the hygroscopic capacities at each of the relative humidities at which the experiment was done. The ratio of the hygroscopic absorption at 100% R.H. to that at 75% R.H. remains practically unaltered. The results emphasise the necessity, while dealing with hygroscopic capacities of soils, for defining not only the

TABLE I.
Hygroscopic absorption.
(Period of exposure : 5 days.)

Depth	R.H.						Ratio :	
	100%		99%		75%		100/75%	
	A	B	A	B	A	B	A	B
0-6"	14.78	13.39	14.07	13.70	8.52	7.89	1.74	1.69
6-12"	15.73	13.90	15.27	14.11	9.29	8.28	1.69	1.68
12-18"	16.03	13.85	15.33	14.17	9.38	8.23	1.75	1.68

(A—before treatment; B—after treatment. The figures in this and the next table are the averages of duplicates which agreed among themselves.)

period of exposure, but the layer from which the soil sample is obtained.

2. *Ignition on Hygroscopic Moisture.*—The effect of igniting the soil in an open flame for 24 hours on the hygroscopic capacity was studied for soils obtained from different places. The ignited and unignited samples of soil were exposed to the same conditions of temperature and humidity for 24 hours. The following table contains the values for the hygroscopic coefficient (100% R.H.) for the ignited and unignited samples.

TABLE II.

Soil	Depth	Hygroscopic coefficient			
		Before ignition	After ignition	Decrease	
Black Soils	Hagari ..	0-1'	10.47	2.49	7.98
	Nandyal ..	0-1'	11.85	3.84	8.01
	Jammalamadugu	0-1'	6.68	2.23	4.45
	Ambavaram ..	0-1'	6.98	2.13	4.85
	Koilpatti ..	0-1'	15.50	4.03	11.47
	Coimbatore ..	0-6"	8.69	3.79	4.90
Red Soils	Ananthapur ..	0-4"	1.45	0.65	0.80
	Kadiri ..	0-5"	1.96	1.11	0.85
	Nandyal ..	0-1'	8.61	4.13	4.48
	Anakapalli ..	0-1'	4.47	2.31	2.16
	Koilpatti ..	0-9"	6.58	2.40	4.18

It is clear that after ignition the black soils which are 'heavy' retained from 20 to 45% of the original capacity for absorption while the red soils retained about 35 to 55% of the absorption capacity. On ignition, the hygroscopic coefficient of soils, though greatly reduced, is by no means negligible in relation to the original value. The results are in agreement with those reported by Puri, Keen and Crowther⁴ and by Alway⁵ for other types of soils.

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¹ Report of the Madras Dry Farming Scheme, Hagari, 1936-37, p. 20, of the Report of the Soil Physicist, I.C.A.R.

² Report of the Madras Dry Farming Scheme, Hagari, 1935-36, I.C.A.R., p. 34.

³ Puri, A. N., Crowther, E. W., and Keen, B. A., *Jour. Agri. Sci.*, 1925, 15, 68.

⁴ —, *loc. cit.*

⁵ Alway, F. J., *Colloid Symposium*, 1925, III, 241.

Humic Acid as a Photocatalyst in Photoammonification.

In recent years Gopala Rao and Dhar,¹ Gopala Rao,² Gopala Rao and Pandalai,³ have brought forward evidence to show that nitrification and ammonification in soils are not entirely due to the action of bacteria but can also be brought about at the surface of suitable catalysts under the influence of light. Corbet⁴ has confirmed the results of these investigators. Zobell⁵ has also shown that nitrification in sea-water cannot be due to bacterial action. By taking some solutions of ammonium salts and exposing them to sunlight with sea-water and magnesium carbonate he found that oxidation of ammonia to nitrite occurs. Fraps and Sterges⁶ have, however, expressed some doubt regarding the validity of the photo-chemical view. Sarkaria and Fazal-Uddin⁷ observed that sodium nitrite is oxidized to nitrate in the presence of zinc oxide and sunlight. Dhar and co-workers⁸ also noticed oxidation of nitrite in dilute solution when exposed to sunlight in the presence of zinc oxide or ferric oxide. Gopala Rao and Murty⁹ have investigated the photo-decomposition of nitrate to nitrite; they have found that this occurs as a reversible reaction in sunlight transmitted by glass in the presence of ferric oxide or sterilized red soil. Moreover, they have made the very interesting observation that during the photo-

dissociation of nitrate, any ammonium salt present will undergo simultaneous oxidation to nitrite.

It thus appears that many reactions hitherto ascribed to bacteria in the soil can also be brought about by sunlight with soil as a photocatalyst. In this note we are reporting the results obtained on the photo-ammonification of amino-acids in sunlight in the presence of humic acid. The humic acid employed was extracted from black garden soil with 5 per cent. sodium hydroxide solution and precipitated from the latter by the addition of warm 1:1 hydrochloric acid. 250 c.c. of M/20 solution of the appropriate amino-acid was shaken up with 0.25 gm. of humic acid and exposed to sunlight in a pyrex glass flask under strictly aseptic conditions.

The amount of ammonia formed was estimated by the Folin aeration method from time to time.

Amino acid	Amount of ammoniacal nitrogen formed in mg. per litre	
	60 hours	120 hours
Alanine	32.42	64.21
Aspartic acid	21.23	42.34
Glutamic acid	21.26	42.42

It is thus evident that humic acid can function as a catalyst in the photo-chemical decomposition of amino-acids in sunlight.

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¹ Gopala Rao, G., and Dhar, N. R., *Soil Science*, 1931, 31, 379.

² Gopala Rao, G., *ibid.*, 1934, 38, 143; *Jour. Ind. Chem. Society*, 1934, 11, 617.

³ Gopala Rao, G., and Pandalai, K. M., *Jour. Ind. Chem. Society*, 1934, 11, 623.

⁴ Corbet, A. S., *Biochem. J.*, 1934, 28, 1575; *ibid.*, 1935, 29, 1086.

⁵ Zobell, C. E., *Science*, 1933, 77, 27.

⁶ Fraps and Sterges, *Soil Science*, 1935, 39, 85.

⁷ Sarkaria and Fazal-Uddin, *Ind. Jour. Agri. Sci.*, 1933, 3, 1057.

⁸ Dhar, *et al.*, *Nature*, 1934, 10, 213; *Jour. Ind. Chem. Soc.*, 1936, 13, 180.

⁹ Gopala Rao and Murty, K. S., *Proc. Nat. Inst. Sci. (India)*, 1937, 3, 133.