Quality of Humus in Tropical Soils

J. FEKETE

University of Agricultural Sciences, Gödöllő, Hungary

Introduction

The quantity and quality of the humus content has an important effect on the fertility and genetic properties of the soil. This is why different humic substances are tested extensively for the purpose of characterizing soils in the temperate and tropical regions. The decomposition and humification of the organic matter shows a close relation with the vegetation, climate, hydrological correlation, dynamics and type of the soils (FEKETE, 1988; HARGITAI, 1964; MAUL, 1972). The quantity of insoluble humic material is directly proportional to the age of the soil and this phenomenon is suitable for defining its relative age. There are several methods for defining the humus quality of the soil (HARGITAI, 1964): solution in acetyl bromide (after Springer), solution in acetyl sulphate, fractional method (after Tyurin), electroscopical, X-ray, DTA and optical methods, light absorption tests in UV and IR spectra, etc.

Methods

Humus quality studies were implemented using Hargitai's two-solvent method. The humic materials were dissolved in NaF (1%) and NaOH (0.5%). The extinction of these solutions were measured with a Specol photometer in the 460, 490, 520, 550, 580, 610, 640, 670, 700 and 730 nm wavelength ranges. Using these results it was possible to calculate the stability value of the humic materials (Q) and the stability coefficient (K).

$$Q = \frac{E_{NaF}}{E_{NaOH}} \qquad K = \frac{E_{NaF}}{E_{NaOH} \cdot H}$$

E_{NaF} = extinction of the NaF solution
E_{NaOH} = extinction of the NaOH solution
H = total humus content (%) after Tyurin.

Discussion

The results are presented in Table 1. The extinction values and stability values were also illustrated graphically (Figures 1-4). The amount of humus in the different soils shows significant differences correlated with the vegetation, the climatic conditions and the quantity of decomposition. The quantity and quality also change in the different soil types (Table 1).

Table 1
Results of soil analysis

Soil		Soil type	Depth, cm	Humus %	pH H_2O	Q	K
Kenya	1a	Tropical	0 - 25	1.21	7.10	2.08	1.71
	1b	brown soil	25-75	1.87	7.18	3.87	1.67
Kenya	2a	Tropical	0 - 25	1.30	7.20	2.15	1.90
	2b	brown soil	25-50	1.86	7.05	0.56	0.33
Kenya	3	Tropical brown soil	0 - 20	1.41	7.50	2.87	2.65
Kenya	4	Ferral soil	0 - 20	1.27	5.51	0.13	0.08
Kenya	5a	Gley soil	0 - 20	1.28	6.36	0.88	0.70
	5b	(red)	20-40	1.04	6.42	0.84	0.64
South	6a	Gley soil	0 - 25	0.35	4.92	0.58	1.70
China	6b	(red)	25-50	0.30	4.71	0.38	2.36
Cuba	7	Cambisoil	0 - 15	3.81	7.05	4.96	1.09
Santa Clara	8	Gley soil	0 - 25	3.58	5.45	0.77	0.21
Mantazas	9	Ferral soil	0 - 20	2.39	6.41	0.23	0.10

The soils studied can be divided into two classes according to the quality of the humus. In the first class the average Q values are 2.08-4.96. The Kenyan soils Nos. 1, 2, 3 and Cuban No. 7 tropic siallytic soil can be included in this group. The extinction values of the NaF extract are always higher than in the case of NaOH (Figures 1-3). The stability values are relatively high and typical; first decrease, then increase with increasing wavelength. In the humic substances of these soils, more stable, bigger, Ca-saturated humates are in predominance. The emergence of these humic materials took place in neutral or slightly alkalic circumstances. This quality is typical of limey, montmorillonitic, loam soils.

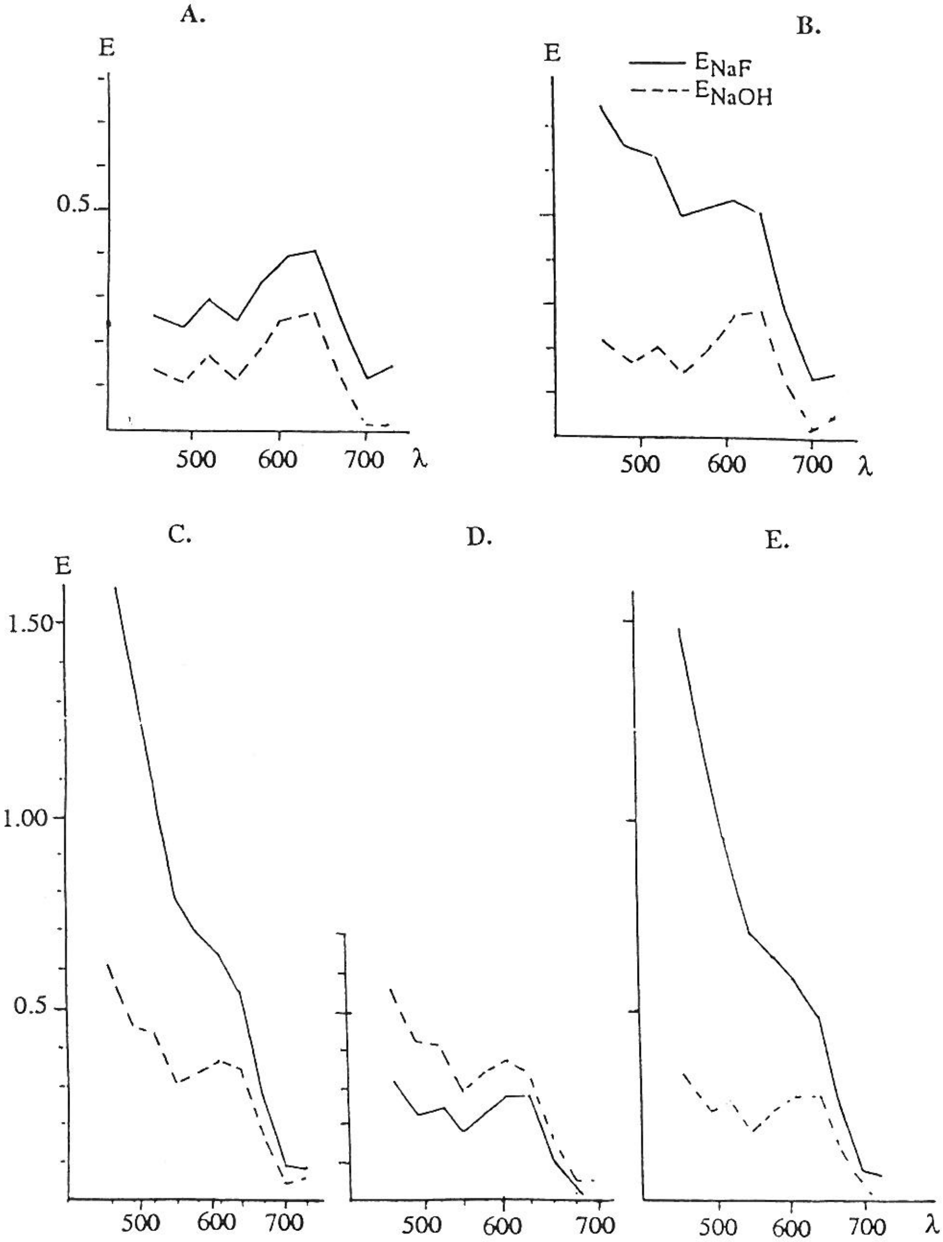

Figure 1

The extinction of NaF and NaOH extracts at different wavelengths.
A. Kenya (1a) 20-25 cm. B. Kenya (1b) 25-75 cm. C. Kenya (2a) 0-25 cm. D. Kenya (2a) 25-50 cm. E. Kenya (3) 0-20 cm

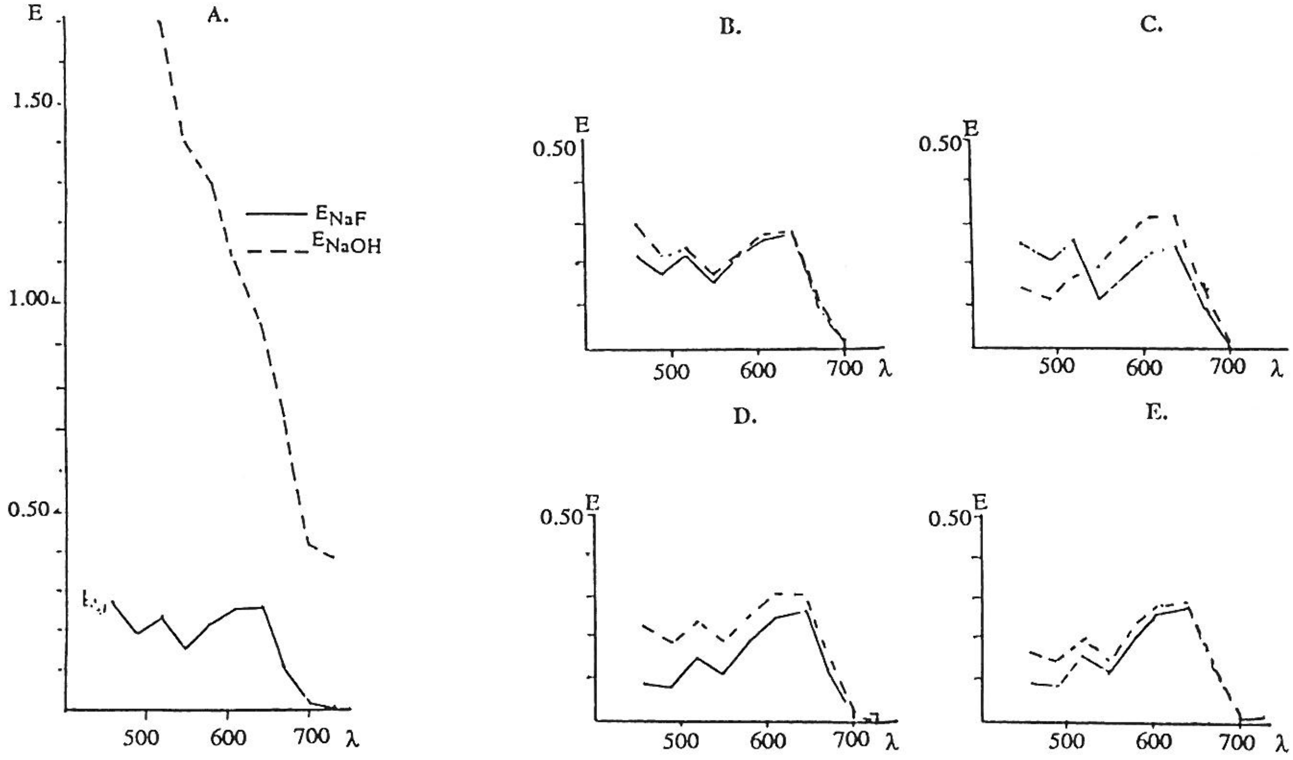

Figure 2
The extinction of NaF and NaOH extracts at different wavelengths.
A. Kenya (4) 0-20 cm. B. Kenya (5a) 0-20 cm. C. Kenya (5b) 20-470 cm.
D. South China (6a) 0-25 cm. E. South China (6b) 25-50 cm.

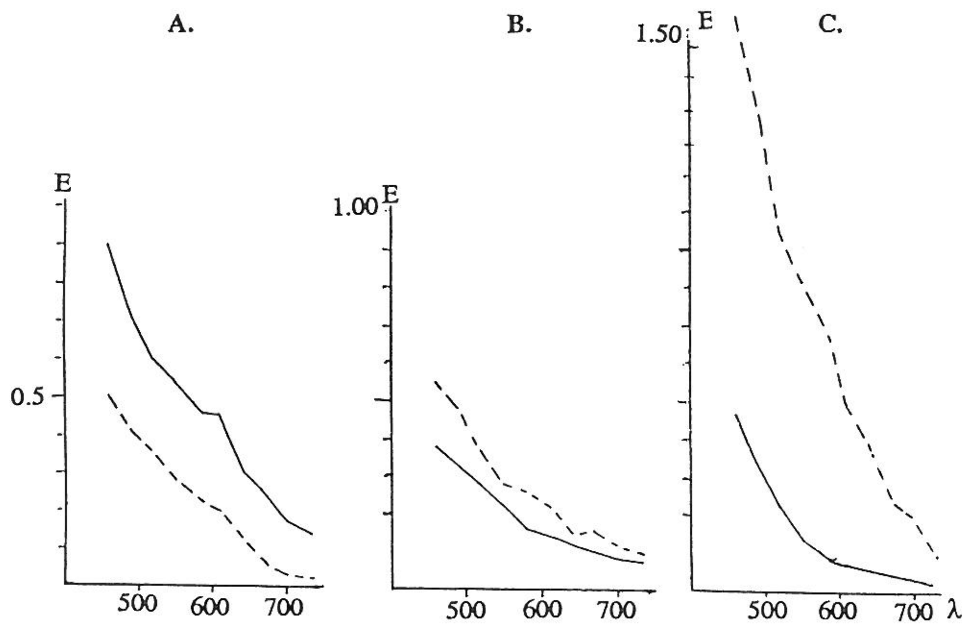

Figure 3
The extinction of NaF and NaOH extracts at different wavelengths.
A. Cuba (7) Sta. Clara (Cambisoil) 0-15 cm. B. Cuba (8) Jucaro (Gley soil) 0-25 cm.
C. Cuba (9) Matanzas (Ferral soil) 0-20 cm

In the second class the Q values are significantly lower, being less than 1. This class includes ferral soils and tropical gley soils of Kenya (4, 5), South China (6), Cuba (8, 9) (Figures 2 and 3). The extinction values of the NaOH extracts are higher than those in NaF. The humus stability numbers have a slightly decreasing or increasing rate, depending on the wavelength. These humic substances are not perfectly formed, have small molecules and are very mobile, promoting the leading. In this class two subclasses can be distinguished. The humic substances, stability numbers and stability coefficients of the Kenyan (4) and Cuban (9) ferral soils, which were formed under aerobic conditions are the smallest. The humic substances of the Kenyan (5), South Chinese (6) and Cuban (8) soils were formed by partial or constant effect and their stability numbers are between 0.5 and 0.8.

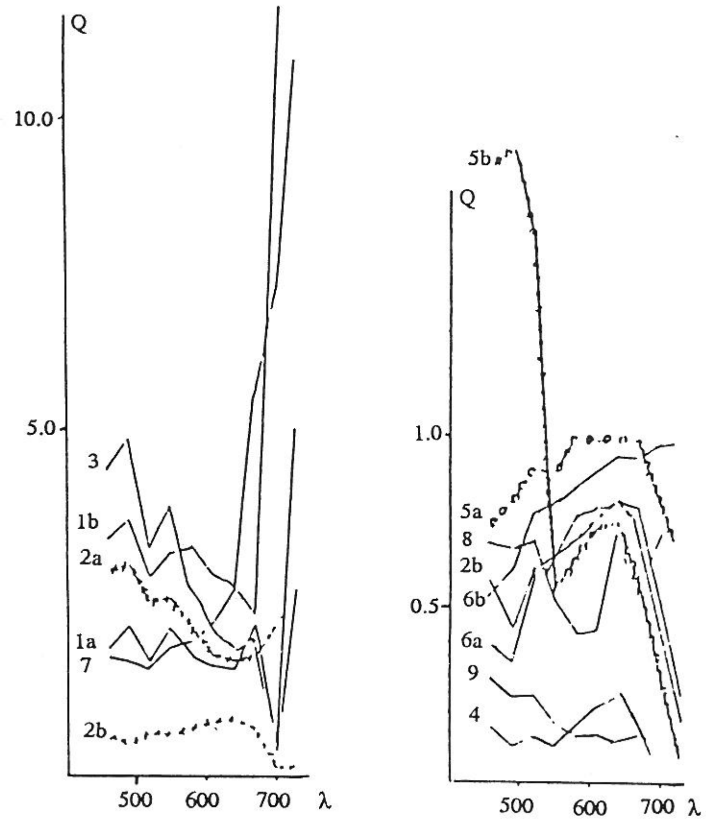

Figure 4

Changes in the different humus stability values at different wavelengths. For soils and soil types: See Table 1

Summary

It can be said that the two-solvent optical method is suitable for characterizing the genetic and nutrient-dynamic properties of tropical soils. The humus quality values are typical in the case of siallytic, ferralitic and tropical soils.

References

FEKETE, J., 1988. Tropical soils. Akadémiai Kiadó, Budapest.

HARGITAI, L., 1964. Comparing and studying the quality of humus of Middle-European soils. Kertészeti Egyetem Évkönyve.

MAUL, F., 1972. Comparing and studying the quality of humus of the main Cuban soils by optical methods. Agrártudományi Egyetem kiadványa.