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Editors:
Christopher Teh B.S.
Zin Z. Zakaria
Izham Ahmad
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Osmanu Haruna Ahmed
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Editors

C.B.S. Teh
O.H. Ahmed
C.I. Fauziah
A. Izham
Wan Noordin Wan Daud
Zin Z. Zakaria

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DYNAMICS OF SOIL AGGREGATE BREAKDOWN

C.B.S. Teh, T. Jamal and S. Nuranina
Dept. Land Management, Faculty of Agriculture, Uni. Putra Malaysia, Serdang, Selangor

INTRODUCTION

This study's objectives were to: 1) to determine the breakdown rate of different aggregate sizes from several soil types, and 2) to relate the aggregate breakdown rates with several soil properties.

MATERIALS AND METHODS

Two Ultisol soils (Bungor and Serdang) and one Oxisol soil (Munchong), were sampled randomly at soil depth 0-150 mm from several UPM farms in Serdang (3° 2' N; 101° 42' E), Malaysia. Air-dried soil samples were dry sieved into three aggregate size fractions: 3-5, 1-2 and 0.3-0.5 mm. Each aggregate size fraction was wet sieved for six time durations: 3, 6, 10, 20, 30 and 45 minutes. Every aggregate size fraction was also measured for its texture, organic carbon (C), total nitrogen (N), cation exchange capacity (CEC), and free iron oxide (Fe_2O_3).

RESULTS AND DISCUSSION

Results showed that the rate of aggregate breakdown followed a power relationship: $w \propto t^{-b}$, where w is the weight of water-stable aggregates at time t, and b is the aggregate breakdown rate (Fig. 1). Overall, large aggregates (3-5 and 1-2 mm) broke down slower as compared to the small aggregates (0.3-0.5 mm), and that Munchong soil aggregates broke down slower than the aggregates of both Serdang and Bungor soils.

The rate of aggregate breakdown also correlated strongly with N ($r=-0.780$; $p<0.013$), CEC ($r=-0.765$; $p<0.016$), clay ($r=-0.786$; $p<0.012$) and sand ($r=0.787$; $p<0.012$) (Table 1). This agreed with measurements that large aggregates tended to have greater amounts of N and clay and lesser amount of sand as compared to the small aggregates. The soil with the highest amount of N and clay (and the least sand) was Munchong, followed by Serdang then Bungor. The insignificant correlation at the 5% level between C and aggregate breakdown rate could be due to the fact that it is the constituents of organic matter rather than the total organic matter per se that is responsible for stabilising aggregates (Tisdall and Oades, 1982).

The main implications of this study are: 1) smaller aggregates are more susceptible to erosion by water due to their relatively lower amounts of essential stabilising agents, and 2) aggregates become increasingly more difficult to breakdown with time, meaning that soils of most susceptible to water during the initial periods of erosion.

ACKNOWLEDGMENTS

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REFERENCES

Tisdall, J.M. and Oades, J.M., 1982. Organic matter and water stable aggregates in soils. J. Soil Sci., 33: 141-163.

Table 1. Aggregate properties

Aggregate size (mm)	Soil series	N %	Fe_2O_3 ppm	CEC ppm	C %	clay %	silt %	sand %	rate
3-5	Bungor	0.14	12.43	5.63	2.57	32.28	5.71	61.70	0.265
1-2		0.14	8.80	5.68	3.05	30.02	2.81	67.13	0.129
0.3-0.5		0.12	9.08	4.98	2.61	22.14	2.09	75.74	0.220
3-5	Munchong	0.25	31.95	6.80	3.09	76.96	6.65	16.34	0.121
1-2		0.26	32.33	6.91	3.35	74.17	8.41	17.38	0.033
0.3-0.5		0.27	31.10	6.89	3.39	69.63	7.37	22.98	0.184
3-5	Serdang	0.15	33.42	6.40	2.72	32.22	10.09	57.65	0.148
1-2		0.16	35.73	5.69	2.61	28.82	9.39	61.75	0.105
0.3-0.5		0.08	38.67	5.43	0.68	28.01	4.15	67.83	0.197

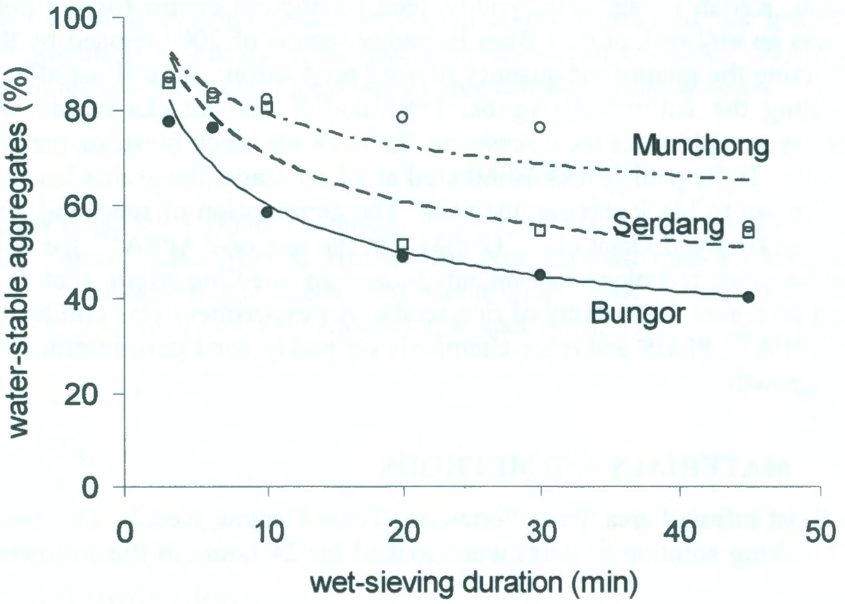

Fig. 1. The breakdown of aggregates (0.3-0.5 mm) with time for the three type of soil series. The breakdown of aggregates followed a power relationship.