

Effect of peat on the soil physical properties

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Abstract Peat is a common soil amendment. We investigated differences in chemical properties among peat products and their effects on soil physical properties. The results showed that: (1) There were significant differences on the chemical properties of peats, such as organic matter, humic acid and CEC. (2) The physical properties of sand will be obviously influenced by adding peats. When sand was mixed with peat, the percolation rate, bulk density and air-porosity decreased. On the other hand, the total porosity, capillary porosity and water retention were increased. The more peats and the finer peats are, the more obvious influence on soil physical properties is.

Introduction Peat is a common amendment used on Green construction. The rapid development of China Golf Industry requires a better understanding of the degree to which different peat products alter important soil physical properties. Here we compare chemical properties of six peat products and their effects on soil physical properties with the aim that this information will improve our ability to select the most appropriate materials for rootzone amendment on Greens.

Materials and methods Five peat products were collected in China, signed as local products (LP), the other one was from Germany (GP). The particle size distribution of sand met the USGA recommendation. The pH, organic matter (OM), humic acid (HA) and cation exchangeable capacity (CEC) of peat were measured. The sand-peat mixture was analyzed for physical properties according to ASTM standards.

Results and discussion The properties of six peat products were shown in Table 1. There was lower pH for GP and LP No. 1, 2, 3. Significant differences were observed among peat samples in OM, HA and CEC. For the five LPs, No. 1, 2, 3 have better quality than No. 4, 5. The GP and LP No. 3 were chosen to be mixed with sand for the testing of physical properties (Table 2). Compared to sand, there were significant differences in percolation rate and bulk density of two sand-peat mixtures. With the amount of peat increased, percolation rate, bulk density and air-filled porosity significantly decreased, but water retention, total porosity and capillary porosity increased significantly. There was significant different performance between two peats, which was caused by the difference of chemical properties (Table 1).

Table 1 The chemical properties of different peats.

Samples	pH	OM(%)	HA (%)	CEC (cmol/kg)
GP	4.93e*	96.0a	58.3a	125a
LP No. 1	5.20c	73.5b	44.9b	73.2b
LP No. 2	5.10c	61.0c	40.2b	64.4c
LP No. 3	4.58d	45.5d	30.9c	53.6d
LP No. 4	6.81b	37.7e	15.0d	25.9e
LP No. 5	7.60a	18.1f	19.2d	31.8e

* Note: Different letters in the same row indicate significantly difference at $p < 0.05$.

The physical properties of sand-peat mixture were influenced by the size of peat (Table 3). With the particle size of peat became smaller, the percolation rate and air-filled porosity decreased significantly, but water retention and capillary porosity increased obviously.

Table 2 Effect of different peats on the physical properties of sand-peat mixture.

Items	Sand	Sand mixed with GP		Sand mixed with LP No. 3	
		8:2	7:3	8:2	7:3
Percolation Rate (cm/h)	40.2a*	19.7c	16.5c	36.1a	26.7b
Bulk Density (g/cm ³)	1.62a	1.46b	1.36d	1.41c	1.30e
Water Retention (%)	5.63e	11.7d	16.1b	12.6c	18.6a
Total Porosity (%)	40.6e	45.0d	48.5b	47.0c	51.1a
Capillary Porosity (%)	9.13d	17.1c	22.0b	17.8c	24.2a
Air-filled Porosity (%)	31.4a	27.9c	26.4d	29.2b	26.9cd

* Note: Different letters in the same line indicate significantly difference at $p < 0.05$.

Table 3 Effect of different size of LP No. 3 on the physical properties of sand-peat mixture.

Items	Sand	Sand-Peat (4mm) mixture		Sand-Peat (0.5mm) mixture	
		8:2	7:3	8:2	7:3
Percolation Rate (cm/h)	40.2a*	19.7b	16.5b	7.79c	5.23c
Bulk Density (g/cm ³)	1.62a	1.46c	1.36e	1.49b	1.42d
Water Retention (%)	5.63d	11.7c	16.1b	16.1b	19.0a
Total Porosity (%)	40.6c	45.0b	48.4a	44.4b	45.3b
Capillary Porosity (%)	9.13e	17.1d	22.0c	24.0b	26.9a
Air-filled Porosity (%)	31.4a	27.9b	26.4c	20.4d	18.4e

* Note: Different letters in the same line indicate significantly difference at $p < 0.05$.