Soil & Tillage Research 168 (2017) 42–49

Contents lists available at ScienceDirect

Soil & Tillage Research

journal homepage: www.elsevier.com/locate/still

Comparison of different methods to determine wind-erodible fraction of soil with rock fragments under different tillage/management

Zhongling Guo[a], Chunping Chang[a], Rende Wang[b,*], Jifeng Li[a]

[a] College of Resource and Environment Sciences/Hebei Key Laboratory of Environmental Change and Ecological Construction, Hebei Normal University, Shijiazhang Hebei, 050024, China

[b] Institute of Geographical Sciences, Heibei Academy Sciences/Hebei Engineering Research Center for Geographic Information Application, Shijiazhaung Hebei, 050011, China

ARTICLE INFO

Article history:
Received 30 May 2016
Received in revised form 11 December 2016
Accepted 17 December 2016
Available online 27 December 2016

Keywords:
Wind-erodible fraction of soil (EF)
Flat sieve
Rotary sieve
Rock fragments
Agro-pastoral ecotone of northern China (APEC region)

ABSTRACT

Rock fragments (the coarse fraction >2 mm in soil) widely exist in the surface soils of the agro-pastoral ecotone of northern China (APEC region) where is suffering severe soil degradation induced by wind erosion. The wind-erodible fraction of soil aggregate (<0.84 mm dry soil aggregate) (EF) is an important parameter to evaluate soil management systems and estimate wind erosion. Rotary sieve is considered to be a standard device to determine EF. Flat sieves and EF estimation equation used in the Revised Wind Erosion Equation (RWEQ) are two alternatively methods to obtain EF. In this study, 74 soil samples for different soil management/tillage in a typical region of the APEC region were collected to compare rotary sieve, flat sieve and the EF estimation equation for determining EF. The results showed that (1) the EF determining from rotary sieve (EF-r) is closely related to the EF obtaining from flat sieve (EF-f) but the EF-r are generally lower than the EF-f, (2) the EF-r is significantly associated with surface soil rock fragments content for all soil management, (3) the EF-r is not related to soil textural fractions, organic matter and $CaCO_3$ content for tree windbreak, conservation and conventional tillage farmland but is related to that for grassland, (4) the EF estimation equation in the Revised Wind Erosion Equation (RWEQ) cannot be used to predict the measured EF in the APEC region.

1. Introduction

Soil degradation induced by wind erosion is a concern in arid and semiarid regions (Újvári et al., 2016; Wang et al., 2016). Soil wind erodibility is crucial for evaluating soil management systems and estimating wind erosion (Webb and Strong, 2011). Soil wind erodibility could be described by dry soil aggregate distribution, which largely governs the wind erosion process (Webb and Strong, 2011; Zou et al., 2015). In practice, some soil aggregate parameters determined from dry sieving are used to evaluate the soil susceptibility to wind erosion (Chepil, 1962; Zobeck et al., 2003). The wind-erodible fraction of soil aggregate (<0.84 mm dry soil aggregate), EF, is an important input in the Wind Erosion Equation (WEQ) (Woodruff and Siddoway, 1965), Revised Wind Erosion Equation (RWEQ) (Fryrear et al., 1998) and Wind Erosion Prediction System (WEPS) (Hagen, 1996). The EF is also widely used to access soil susceptibility to wind erosion for different land management practices in the arid and semi-arid regions (Chepil, 1954; Larney et al., 1994; Bullock et al., 2001; Hevia et al., 2007; Álvaro-Fuentes et al., 2008; Colazo and Buschiazzo, 2010).

The rotary sieve is generally considered as the standard device to determine EF for wind erosion assessment (Zobeck et al., 2003). This machine could simulate the relative resistance of the clods to breakdown by wind erosion induced mechanical forces (such as tillage or abrasion) (Chepil, 1952). Yet each cylindrical sieve of a built rotary sieve is not easy to interchange, and it is more expensive and time-consuming to construct the rotary sieve than the flat sieves (Chepil, 1962). The flexible flat sieves are considered as an alternative method for EF determination. A nest of flat sieves is cheap and user-friendly, thus many researchers utilized the flat sieves to determine the aggregate characteristic related to wind erosion evaluation (Toogood, 1978; López et al., 2001; Li et al., 2014; Wang et al., 2015).

Another method to obtain the EF is using multiple regression equation derived from intrinsic soil properties. Fryrear et al. (1994) proposed an EF estimation equation based on more than 3000 soil samples in the US. Although the EF regression equation is empirically derived from the samples of US soils, it is widely

* Corresponding author.
E-mail address: wangrende10@163.com (R. Wang).

http://dx.doi.org/10.1016/j.still.2016.12.008
0167-1987/

used in many wind erosion modeling studies for other regions (Visser et al., 2005; Youssef et al., 2012; Guo et al., 2013; Du et al., 2015; Borrelli et al., 2016).

However, compared with the standard rotary sieve, the two alternative methods have their restrictions. The EF value is inevitably affected by the frequency of motor shakers or manual

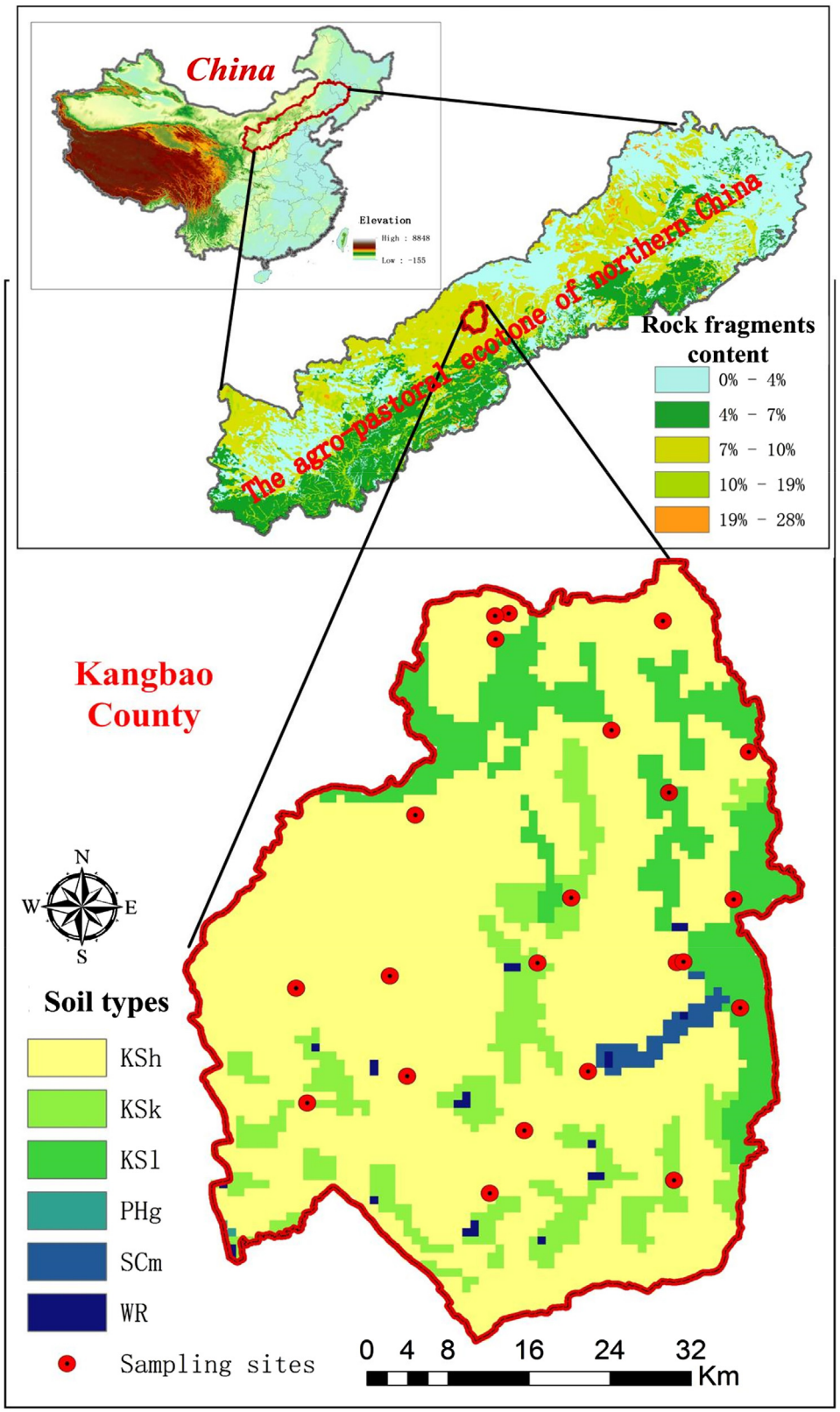

Fig. 1. Sites where soils were collected in the Kangbao county.
Note: PHg = *Gleyic Phaeozems*, SCm = *Mollic Solonchaks*, WR = *Water*, KSl = *Luvic Kastanozems*, KSh = *Haplic Kastanozems*, KSk = *Calcic Kastanozems*. The rock fragments content of surface soil and soil types distribution were based on the Harmonized World Soil Database (FAO, 2012).