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SIDASS project
Part 4. Wind erodibility of cultivated soils in north-east Hungary

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Abstract

In the last two decades dry climatic conditions become frequent in Hungary, especially in the lowland area. Under dry conditions the danger of wind erosion increases especially in the sand areas when plant coverage is incomplete or missing in spring and autumn. According to field observations the wind erosion can be significant not only on sandy but on loamy soils, as well.

The present work – in SIDASS project of the European Community (CT15-CT98-0106) – aimed at characterizing wind erodibility of soils differing in texture at the cultivated agricultural area in the Northeast part of Hungary. Soils of the test area were grouped into three categories. Soil groups were characterized beyond their soil properties by the critical starting wind velocity, parameters of the vertical wind profile functions above the soil surface and quantity of the eroded soil determined in wind tunnel experiments. After determining the wind erosion parameters the potential wind erosion of the soils was estimated for the study area of Hungary. Surface roughness and wind speed of the critical starting velocity of wind erosion were estimated. The estimation is considered potential since soils assumed dry and without plant cover. Estimation showed that about 10% of the studied agricultural area is endangered by strong, and about 15% is by medium level wind erosion. The no and less susceptible wind erosion area covers about 75% of the county's agricultural area.

Keywords: Wind erosion; Wind tunnel; Soil surface properties; Grain-size; Erodibility

1. Introduction

One of the task of the "SIDASS: a spatially distributed simulation model predicting the dynamics

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of agro-physical soil state within Eastern and Western European Countries for the selection of management practices to prevent soil erosion'' research program was to estimate the soil loss due to wind erosion. The work done on this respect in the SIDASS project is in this paper. Systematic and regular studies of wind erosion began about 50 years ago. Bagnold started the wind tunnel experiments on blown sandy soils. He published his new results in the early 1940s (Bagnold, 1941). Later other authors published further results in this subject (Chepil, 1945; Zingg, 1951, 1953; Williams, 1964).

In Hungary Borsy started to apply wind tunnel at the Debrecen University and carried out field experiments on sand areas of Hungary (Bodolay, 1965, 1966; Borsy, 1972, 1974).

In the last 20 years there is a decreasing trend in the annual amount of precipitation in Hungary. Parallel to that the irregularity in the time distribution of rainfall is also increasing. As a consequence of the above drying climatic conditions danger of wind erosion increases. The possibility of wind erosion is higher especially in the light texture sand areas when plant coverage is incomplete or missing after soil cultivation and before plant emergence in the Spring and Autumn. According to our field observations the wind erosion in the Lowland area of Hungary can be significant not only on the light texture sandy soils but on finer texture loamy soils, as well. In the last decade, our studies were intensified for wind erodibility of different texture and soil categories of Hungary (Lóki, 2000; Lóki and Szabó, 1997a,b, 1998).

The present work aims at characterizing the wind erodibility of different texture soils covering cultivated agricultural areas of three landscape units in the Northeast part of Hungary. Beside soil characteristics the critical starting velocity, the parameters of the vertical wind profile function above the soil surface and the amount of eroded soil quantity were determined in wind tunnel experiments. After determining the wind erosion parameters and properties of the most frequent soil categories in the Northeast part of Hungary the potential wind erosion was estimated for the area.

2. Materials and methods

Soil samples were collected from the top 20 cm of 10 cultivated agricultural fields representing three different soil texture groups (coarse sandy soils: Arenosols, loamy soils formed on loess material: Chernozems, and clay-loam soils with saltic phase: Solonetz).

Soil sample code, soil name and geographical coordinates are listed in Table 1.

The differential particle-size distribution curves of soil samples are shown in Fig. 1a–c. The number of particle-size fractions is more of that is used in the standard soil scientific practice. Geographers determine additional sand particle-size fractions and characterize soil texture with using the differential particle-size distribution curve (Jakucs, 1967). For determining the particle-size distribution of soil samples the geographical method was used since it is more useful for wind erosion purposes.

The 10 frequent agricultural soils of the Northeast part of Hungary represent three – Arenosols, Chernozems and Solonetz – groups of soils.

Table 1
Code, soil name and GPS coordinates of the sample sites

No.	Code	Soil name	Latitude, ϕ	Longitude, λ
1	0627/1	Luvic Arenosols, ARl	47°31′37.54″	21°45′36.48″
2	0627/2	Gleyic Arenosols, ARg	47°31′34.80″	21°51′57.88″
3	0627/3	Gleyic Chernozem, CHg	47°22′58.80″	21°51′05.77″
4	0627/4	Gleyic Arenosols, ARg	47°25′35.36″	21°42′21.44″
5	0627/5	Haplic Arenosols, ARh	47°27′12.73″	21°42′10.29″
6	0627/6	Calcic Chernozem, CHk	47°35′15.77″	21°34′40.72″
7	0627/7	Calcic Chernozem, CHk	47°36′45.23″	21°33′29.12″
8	0627/8	Haplic Chernozem (CHh) with saltic phase	47°37′47.73″	21°21′54.49″
9	0705/9	Gleyic Solonetz, SNg	47°33′36.48″	21°18′19.91″
10	0705/10	Mollic Solonetz, SNm	47°33′35.48″	21°18′24.89″