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EFFECT OF EXPOSITION ON SOIL PROPERTIES IN AN UPLAND AREA

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INTRODUCTION

Despite of a considerable number of papers concerning the effect of erosion on soils in upland areas, e.g. Ziemnicki, Mazur [1955], Ziemnicki, Repelewska-Pękalowa [1980], Dobrzański [1960], Buckman, Brady [1965], Koreleski [1975], Licznar [1985], Dymond, Hiks [1986], Norton [1986], Józefaciuk A., Józefaciuk C. [1987], Turski et al. [1987], Mazur [1988], Pałys [1989], Dębicki, Rejman [1990], Licznar et al. [1991], Klimowicz [1993], Klimowicz, Uziak [1993], Uziak, Klimowicz [1994], the problem contained in the title of this paper has not really been discussed. An attempt at estimating the effect of exposition on loess soil has been made by Klimowicz [1997]. The purpose of this paper is to study the influence of exposition on the properties of loess and loess-like soils and rendzinas in the undulating Lublin Upland.

STUDY AREA AND METHODS

The studies involved 29 slopes (Fig. 1), 16 of which are generally exposed to the north while 13 more to the south. The northern slopes are characterized with soils formed of loess and loess-like deposits. Also 8 southern slopes are covered with the soils formed from similar parents rocks, whilst the remaining 5 are located in rendzina areas. The soils of all slopes studied are agriculturally utilized. The northern slopes covered with loesses and loess-like formations are largely undulating and convex-concave, whereas the southern ones - convex and regularly inclined. The slopes with rendzinas are largely convex-concave.The basic method of field studies were crossing topographic sections supplemented by pits and so-called distribution borings. In the collected material the basic physical and chemical properties were determined by the commonly used methods in Polish laboratories. The mean values for silty soils, i.e. loess and loess-like, characterizing the basic physical and chemical properties of these soils, were calculated separately for both main expositions. In the case of rendzinas the calculation concerned

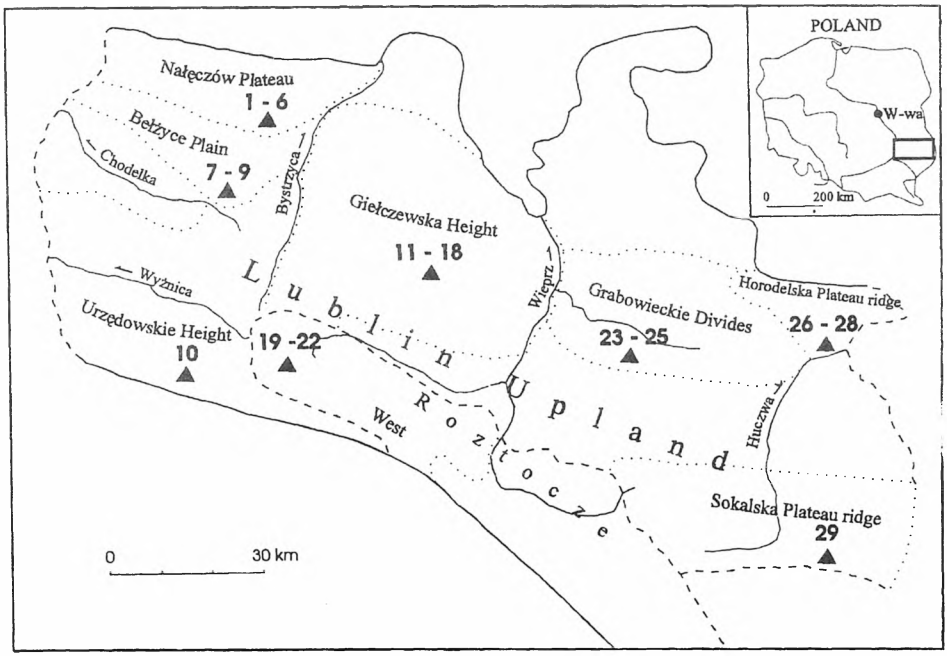

FIGURE 1. Distribution of the study objects (Nos. 1–29)

only the southern exposition due to inadequate representativeness of the material. Also extremal values are given in the Table 1.

TABLE 1. Mean and extreme values of selected physical and chemical properties of the soils studied

Study objects	Content of fractions < 0,02 mm [%]	pH (KCl)	$CaCO_3$	C	N	Available [mg/100 g]	
						P_2O_5	K_2O
				[%]			
Loess and loess-like formations:							
N-slopes	37*	5.2	–	0.89	0.09	10.8	17.6
	31–46**	4.1–7.4		0.66–1.20	0.08–0.12	2.4–24.5	2.6–64.0
S-slopes	38	5.7	–	0.82	0.09	8.6	11.3
	25–55	4.7–7.1		0.62–1.04	0.07–0.11	3.0–17.1	5.4–15.8
Rendzinas:							
S-slopes	55	7.3	3.2	1.14	0.12	8.6	21.6
	41–77	7.1–7.6	0.1–6.9	0.73–1.95	0.07–0.21	1.7–16.8	16.3–28.8

* – mean values; ** – extreme values

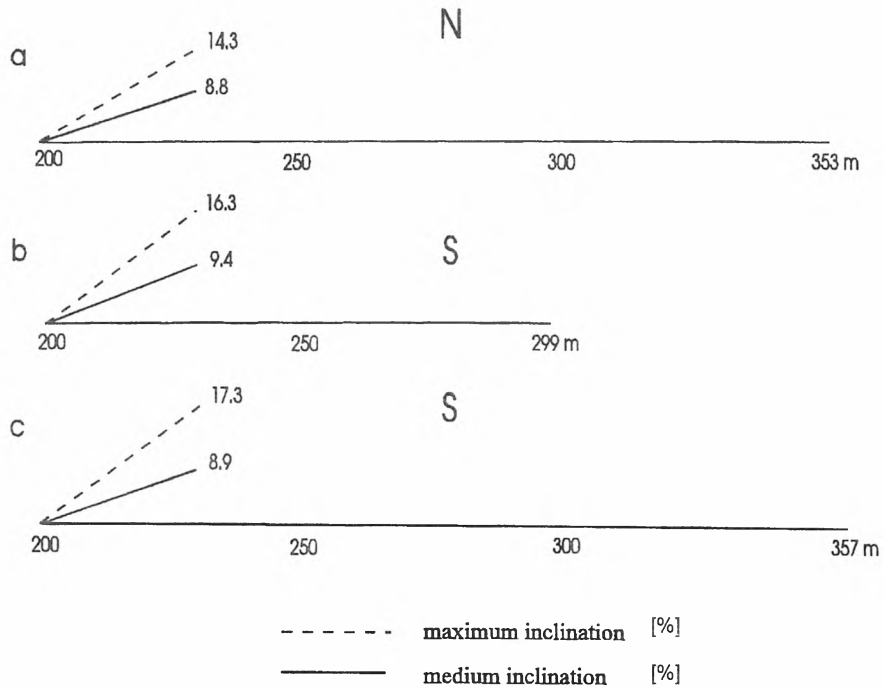

FIGURE 2. The slope length and medium and maximum inclinations (mean values): a – loess and loess-like soils (N exposition), b – loess and loess-like soils (S exposition), c – rendzinas (S exposition)

INFLUENCE OF EXPOSITION ON SOIL COVER

Exposition has a definite influence both on the character of slopes and the properties of soils covering them. The northern slopes with loess and loess-like formations are distinctly longer and sloping a little less than the southern ones. The parameters of the latter are in the case of rendzinas more approximate to those of the northern silty slopes (Fig. 2). A little different microclimatic conditions including moisture cause a bigger typological differentiation of soils on the northern slopes (Fig. 3).

The southern slopes with loess and loess-like soils are represented by only 4 soil units, of which most are brown soils with the major constituents being proper brown soils. Weakly developed soils make up 12% of the slope area. However, the northern expositions seem to favour stronger and longer moist soil conditions due to slower evaporation (weaker warming). With a small inclination of the slopes the rate of the run-off is decreased, as a result of which there is a higher quantity of water infiltrating the soil. The mentioned conditions have an effect on the processes of lessivage and acidification of soils. This is proven by a larger number of soil units, within which brown acid soils predominate in the soil cover. A considerable area is also covered by brown leached and lessive soils (Fig. 3).

The mentioned brown soils should be classified as artificial brown soils. In loess areas lessive soils predominated before forest soils changed to arable ones,

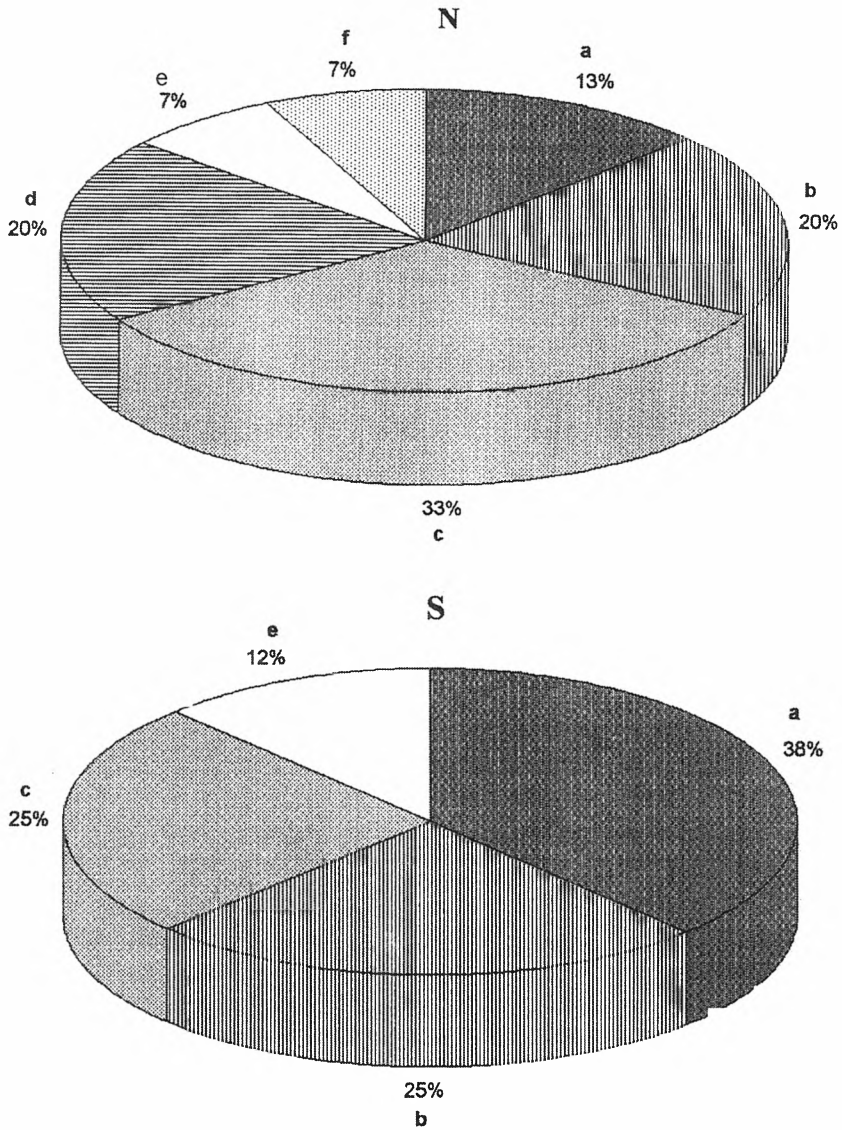

FIGURE 3. The percentage of silty soils on the slope exposed to the North (N) and South (S): a – proper brown soils (Calcaric Cambisols), b – leached brown soils, c – acid brown soils (Dystric Cambisols), d – lessive soils (Haplic Luvisols), e – weakly developed soils (Haplic Arenosols), f – initial soils (Regosols)

largely independently from land relief [Klimowicz 1993]. Deforestation caused accelerated soil erosion, especially on slopes. As a result the primary soil lessive changed, which took place at different intensification depending on many factors.

A distinctly larger differentiation in soil morphology – from lessive weakly eroded to completely eroded soils – was found rather on the northern than

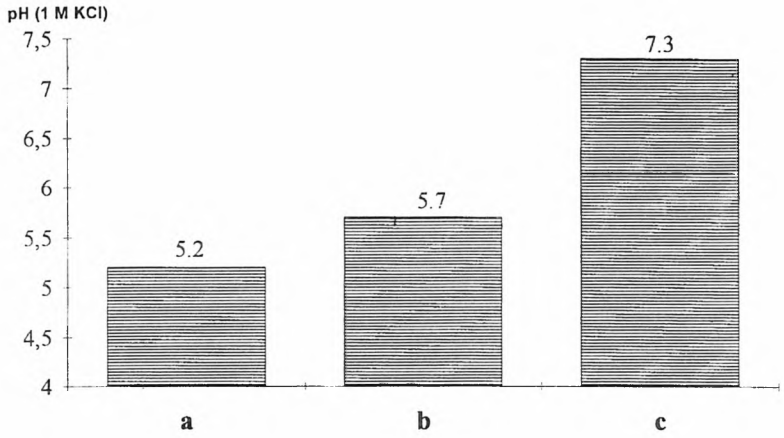

FIGURE 4. Soil reaction (mean values) – explanations as in Figure 2

southern slopes. The percentage of soil profiles with different erosion stages of the upper horizons is as follows: Ap-E- (20% of profiles), Ap-B- (33%), ApB-B- (20%) and ApB-C, ApB-Cca, Ap-C, ApCca-Cca (about 7% each).

In the profile constitution on southern slopes only 4 variations occur: Ap-ApB- (13% of profiles), Ap-B- and ApB-B- (37% each)) and ApC-Cca (13%). Most profiles representing rendzinas show the following constitution: Apca-ApCca (80%). The remaining profiles were characterized by a higher stage of erosion, i.e. ApCca-Cca.

The microrelief has a certain influence on the stage of soil erosion.

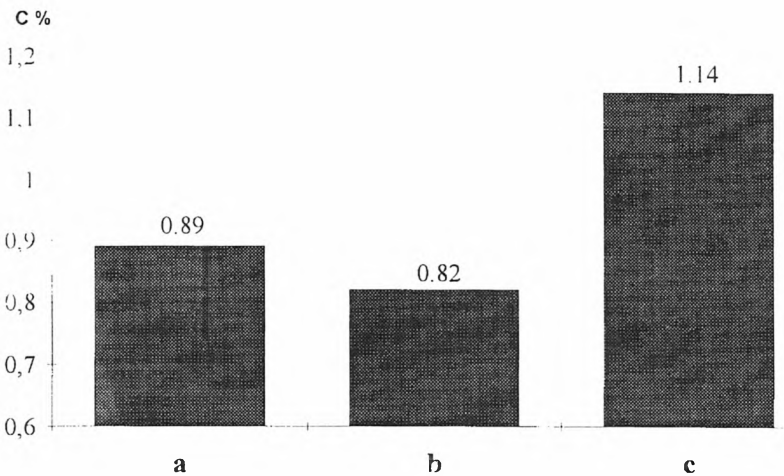

FIGURE 5. Content of organic C (mean values) – explanations as in Figure 2

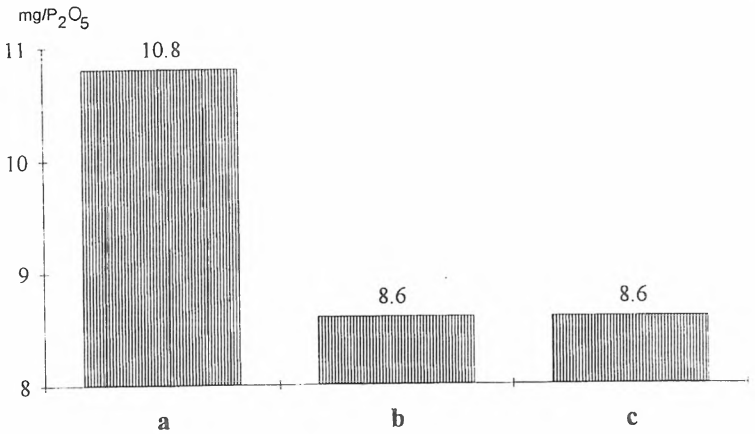

FIGURE 6. Content of available phosphorus (mean values) – explanations as in Figure 2

INFLUENCE ON THE BASIC SOIL PROPERTIES

Grain-size distribution of silty soils in both expositions is almost similar. The content of silty particles (0.1–0.02 mm) in soils of northern slopes is only about 2% (mean) higher than on the southern ones, while the latter are rather richer in fractions smaller than 0.02 mm and 0.002 mm. The granulometric composition of rendzinas is that of heavy, silty loams. A special attention is to be given a large range of the content of below 0.02 mm in the studied loess soils – almost two times higher on southern rather than northern slopes. An even higher content of the mentioned particles and also a larger difference in their content were confirmed in rendzinas (Table 1).

The silty soils are decarbonized in most profiles, especially in the upper horizons. The soils on northern slopes are acid, whilst on southern – slightly acid (pH 5.7), Figure 4, that has its effect in soil typology. As known, it has a connection with a higher moisture level of the soils on the northern slopes.

The content of organic C is generally low in silty soils – a little lower on southern slopes (due to probably faster mineralization of organic substance). Rendzinas of southern slopes are characterized by distinctly higher humification, which may indirectly result from stronger binding humus by colloidal fraction usually found in higher quantities in the mentioned soils (Fig. 5).

Distinctly more available phosphorus and potassium forms occur in soils rather on northern than southern slopes (Fig. 6 and 7). The soils of slopes exposed to the south undergo frequent freezing and thawing cycles, which, according to some authors [Buckman, Brady 1965; Gliński 1995] can be the cause of release, and then easier elution, particularly of soluble potassium forms. The content of the latter in rendzinas is distinctly higher than in silty soils, almost twice as high in the southern exposition. This should be connected with a higher humus content in rendzinas and a high content of mineral colloidal particles.

It should be added that the range of extremal values concerning chemical properties of soils is in all cases (without total nitrogen) considerably larger on the

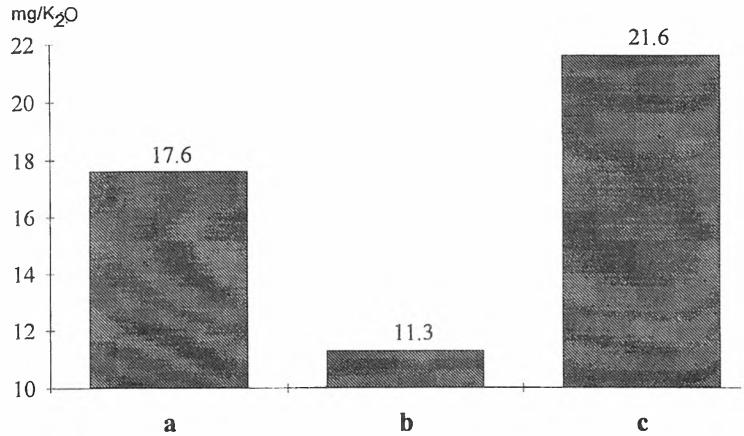

FIGURE 7. Content of available potassium (mean values) – explanations as in Figure 2)

northern than opposite slopes. It concerns especially pH as well as the soluble forms of phosphorus and potassium.

CONCLUSIONS

1. In the undulating terrain of the Lublin Upland the exposition has a distinct influence on the character of the slopes as well as on soil mosaic, especially encountered on the northern slopes.
2. A certain influence of exposition on some chemical soil properties, mainly reaction and the content of available phosphorus and potassium forms, was found.
3. The main and indirect cause of the change of soil cover character in both kinds of exposition are different in microclimatic and moistering conditions.

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WPŁYW EKSPOZYCJI NA KSZTAŁTOWANIE WŁAŚCIWOŚCI GLEBOWYCH W TERENIE WYŻYNNYM

Zakład Gleboznawstwa Uniwersytetu Marii Curie-Skłodowskiej w Lublinie

STRESZCZENIE

Celem opracowania było zbadanie wpływu wystawy na właściwości gleb lessowych i lessowatych oraz rędzin w urzeźbionym obszarze Wyżyny Lubelskiej.

Badaniami objęto łącznie 29 stoków, generalnie o dwu przeciwstawnych ekspozycjach, tj. północnej i południowej. Podstawową metodą pracy w terenie były krzyżujące się ze sobą przekroje niwelacyjno-glebowe. Stwierdzono wyraźny wpływ ekspozycji zarówno na charakter stoku, jak i zróżnicowanie typologiczne gleb (zwłaszcza eksponowanych na N) oraz ich niektóre właściwości chemiczne (głównie odczyn oraz zasobność w fosfor i potas).

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