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SELECTED PHYSICAL PROPERTIES OF FALLOWED MOUNTAIN SOILS

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A b s t r a c t. The object of investigations were mountain soils derived from various parent rocks which were fallowed during five and ten years, in comparison to arable soils. The aim of the research was to characterise physical properties of the fallows and adjoining arable fields. The obtained results point to higher values of porosity, bulk density as well as content of total carbon of fallows in comparison to arable soils. On the analysed fallows far higher growth of weed with high contribution of many-year species was found.

K e y w o r d s: mountain soils, fallows, physical properties, weed infestation.

INTRODUCTION

During recent years in Poland an increasing area of fields without agricultural utilization is observed [6]. Enlargement of the area of fallows as well as their regional variation is caused by natural, economical and organisational factors [2]. Changing agricultural structure led to the fall of many farms, state farms and production cooperatives. Nowadays these fields are under control of the Agency of Agricultural Property of the State Treasury or individual persons. However in many cases, especially in the mountain areas, fields which were under agricultural use in the past, are now covered by weeds. In the fields which are not in agricultural use for about ten years or more, according to the natural succession of plants, there are more rears species. These species are normally hard to get rid of when we try to return these fields to arable utilization [1,3].

The aim of the work was to determine some physical properties of mountain fallows in comparison to arable soils on the background of changing plant cover in relation to the time of fallowing.

METHODS

The present research was carried out in the Kłodzko Valley (voivodeship of Lower Silesia) paying attention to parent rocks and time of fallowing. Objects were localised in Radków near the National Park of the Stable Mountains in the field fallowed for 10 years and in Konradów near the Bialskie Mountain in the 5-year fallow. Samples for analysis were taken from the fallow and adjoining arable field. Soil profiles were determine in the fallow. Samples were takne from the arable field from depth of 0-10 and 15-25 cm. In the material taken the following analysis were performed:

- granulometric composition by the methods of Bouyoucos with modifications by Casagrande and Prószyński,
- bulk density by the picknometric method,
- volume density using Kopecky cylinders 100 cm^3,
- total porosity was calculated on the base of bulk and volume density,
- retention properties of soils were analysed in the following way: field water retention in the range of pF 0-2.9 using sandy and sandy-kaolin blocks by Eijkelkamp,
- the maximum higroscopic water retention by the method of Nikołajew,
- on the basis of the determined maximum higroscopic water retention, moisture values corresponding to the permanent wilting point of plants were calculated (pF 4.2),
- pH in H_2O and 1 N KCl using pH-meter 340-A/SET-1 by WTW,
- amount of total carbon using CS-MAT 5500 analyser by Strohlein.

Moreover, plant species composition in the investigated fallows were prepared.

RESULTS AND DISCUSSION

The problem of fallows in Poland has become a significant issue during the last few years and is the subject of many scientific publications. Year after year the area of fallows has been increasing. In 1997 the total area of fallow was near 1 600 000 ha [2].

The area of the Lower Silesia is characterised by differentiated relief and soil cover. Many different taxonomic units can be found in this region [10]. On the basis of our investigations, mountain soils were classified as acidic brown soils derived from different parent rocks. In Konradów acidic brown soils are derived from the slope material (granite, slate), and in Radków typical acidic brown soil is derived from the slope material on the weathered red spongy [9].

The analysed soils are characterised by medium silty loam (Table 1), or light silty loam (Table 2) with different skeleton content.

Analysis of the fallow pH related to the time length of fallowing did not show

any significant influence on this parameter [5]. Even long-term fallowing following agricultural utilization did not introduce any significant changes [8]. The pH values measured in H_2O in the analysed fallows and arable fields oscillate between 4.69 and 5.05, and measured in 1 N KCl between 3.62 and 4.16. The pH value in H_2O and in KCl is strongly acidic in the upper layer (Table 3).

Similar results of the research on the total carbon content in the fallow in comparison to arable field were presented elsewhere [8]. The obtained results of analysis point to its higher contents in the analysed fallows than arable fields. Contents of total carbon in the upper layer 0-10 cm on the 5-year old fallow was 1.83%, and on the field 1.75 %. On the 10-year old fallow it reached 1.21%, and in arable field 0.94 % (Table 3).

Processes that take place in the fields which are not under agricultural utilization reflect changes of some of the analysed physical properties. Total porosity calculated on the basis of bulk and volume density in the upper layer 0-10 cm on the both fallows in Konradów and Radków was higher than on the arable soils. Contribution of individual groups of soil pores points to higher macroporosity of the fallowing soils (Fig. 1). Influence of fallowing on the changes of density and porosity was observed also on light and heavy soils; even a short-term exclusion of the field from agricultural utilization does not cause any significant decrease of the physical soil properties [5]. Similar results related to the influence of fallowing on some soil properties were described in the work by Słowińska-Jurkiewicz *et al.* [7].

With changes in the physical parameters, retention is changing as well. Particularly significant changes in the course of water desorption curves characterizing the analysed horizons was observed in the upper layer of 0-10 cm on the10-year old fallow and arable field in Radków (Fig. 2). It can be claimed that these changes are connected with strong turfing of the fallowing field.

T a b e l a 3. Selected chemical-physical and physical properties of soils

Locality	Site	Depth (cm)	pH		C %	Bulk density (Mg m^{-3})	Density (Mg m^{-3})	Porosity (%)
			H_2O	1N KCl				
Konradów	field	0-10	4.71	3.62	1.75	1.44	2.55	43.53
		15-25	4.69	3.63	1.71	1.60	2.71	40.96
	fallow	0-10	4.98	3.94	1.83	1.41	2.68	47.39
		15-25	5.05	3.92	1.73	1.51	2.80	46.07
Radków	field	0-10	5.01	4.16	0.94	1.65	2.61	36.78
		15-25	4.82	3.83	0.62	1.80	2.64	31.81
	fallow	0-10	4.73	3.75	1.21	1.31	2.64	50.38
		15-25	4.77	3.76	0.9	1.69	2.68	36.94

T a b l e 1. Granulometric composition of arable field and fallow - Konradów

Locality	Soil site	Depth (cm)	Fraction in mm, %									Sum of fraction in mm			Granulometric group
			>1.0	1.0-0.5	0.5-0,.25	0.25-0.1	0.1-0.05	0.05-0.02	0.02-0.006	0.006-0.002	<0.002	1-0.1	0.1-0.2	<0.2	
												(%)			
Konradów	field	0-10	25	16	8	7	9	20	22	12	6	31	29	40	gśp
		15-25	29	14	8	7	10	19	24	12	6	29	29	42	gśp
	fallow	0-10	21	12	9	8	10	23	22	11	5	29	33	38	gśp
		15-25	22	13	9	9	9	22	24	9	5	31	31	38	gśp
		25-34	21	9	8	6	8	30	19	9	11	23	38	39	gśp
		40-50	37	16	11	9	10	16	18	8	12	36	26	38	gśp
		60-70	50	21	17	12	11	15	9	3	12	50	26	24	glp

T a b l e 2. Granulometric composition of arable field and fallow - Radków

Locality	Soil site	Depth (cm)	Fraction in mm, %								Sum of fraction in mm			Granulometric group
			>1.0	1.0-0.5	0.5-0,.25	0.25-0.1	0.1-0.05	0.05-0.02	0.02-0.006	0.006-0.002	<0.002	1-0.1	0.1-0.2	<0.2	
												(%)			
Radków	field	0-10	15	10	12	15	20	14	15	6	8	37	34	29	glp
		15-25	21	10	12	15	20	16	12	7	8	37	36	27	glp
	fallow	0-10	19	11	12	17	20	14	12	7	7	40	34	26	glp
		15-25	16	10	12	18	19	8	17	8	8	40	27	33	glp
		25-40	11	9	10	27	21	8	9	6	10	46	29	25	glp
		50-60	15	10	11	20	25	10	11	4	9	41	35	24	glp
		80-90	0	1	3	17	17	19	16	14	13	21	36	43	gśp
		120-149	0	1	5	14	19	19	15	10	17	20	38	42	gśp

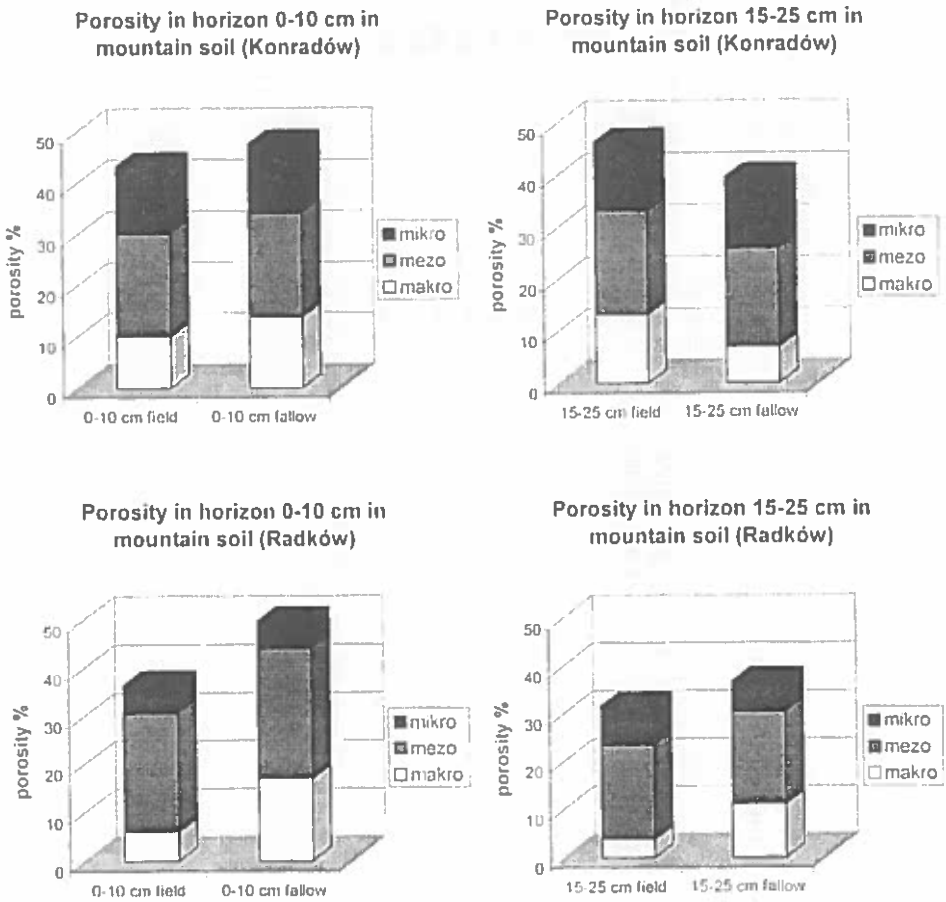

Fig. 1. Porosity of fallows and fields in mountain soil in Konradów and Radków.

T a b l e 4. Botanical characteristic of the fallow

Botanical characteristics	
five-year old fallow - Konradów	ten-year old fallow - Radków
Agropyron repens, Equisetum arvense, Cirsium arvense, Trifolium pratense, Trifolium hybridum, Crepis foetida, Sonchus arvensis, Alopecurus pratensis, Mycelis muralis, Tussilago farfara, Rumex crispus, Campanula patula, Chamaenerion angustifolium, Vicia tenuifolia	*Dactylis glomerata, Holcus lanatus, Phleum pratense, Ganphalium silvaticum, Achillea millefolium, Hypericum perforatum, Veronica chamaedrys, Cerastium arvense, Apera spica-venti, Heracleum sphondylium* and single selfsowing *Acer platanoides, Quercus robus, Betula pendula*

An important factor playing a significant role in the process of changes in plant communities on the fallowing areas, is time. Table 4 presents a list of plants on the investigated fallows. It points to a high share of many-year species. On the 5-year old fallow in Konradów the predominant species of weeds were: couch grass, horsetail, couch grass fallow [4]. On the 10-year old fallow in Radków an increasing number of grass species was observed, among others, tussock grass - abundantly present, ear grass, timothy grass - grass fallow and single self-seedlings of maple, oak and birch [4]. Numerous other experiments on the fallowing areas in the last few years confirm the increase of contribution of many-year weed species including bushes and trees [1]. Such areas require suitable prevention measures to stop the increase of weed population that should help in the future restoration of these fields for agricultural production [6].

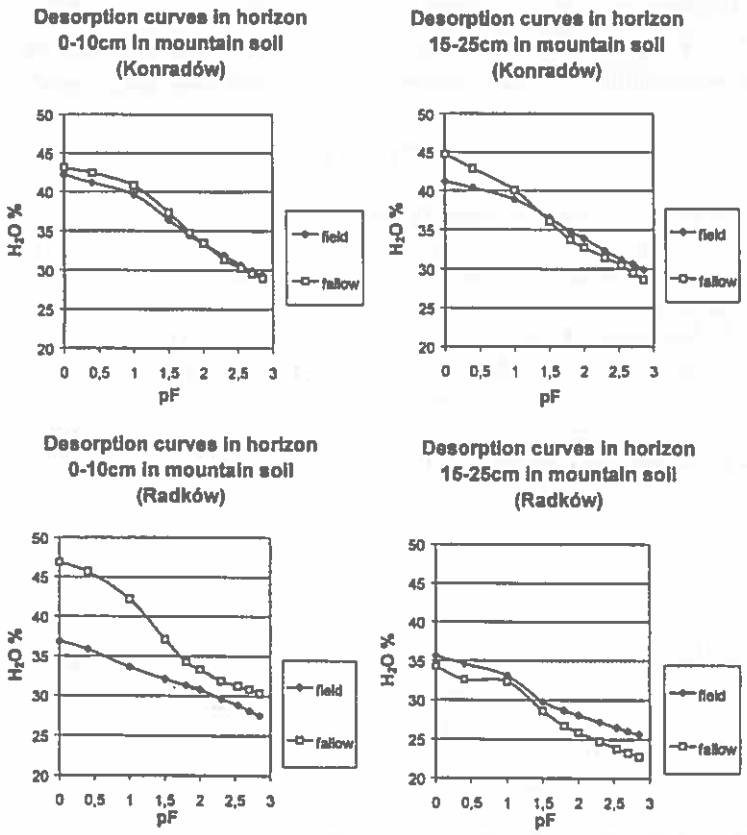

Fig. 2. Desorption curves of fallows and fields in mountain soil in Konradów and Radków.

CONCLUSIONS

1. The analysed soils have been classified as brown soils derived from different rocks (sandstone, granite). Soils with the fraction <1 mm indicate granulometric composition of light or medium silty loam with various content of fraction 1 mm.

2. The pH value of the upper layers of fallow as well as arable fields is strongly acidic and the amounts of total carbon is higher on the fallows in comparison to the arable fields.

3. Total porosity, which was calculated on the basis of bulk and volume density in the upper layers (0-10 cm) on both of the fallows, was higher in comparison to the arable fields. Content of individual pore groups indicates higher macroporosity of fallows.

4. On the basis of the plant species composition that was compiled for the analysed fallows, 23 plant species were noticed including 3 tree species. On the 5-year old fallow of Konradów, high share of *Agropyron repens*, *Equisetum arvense*, *Cirsium arvense*, *Trifolium prarense* was observed while on the 10 year-old fallow of Radków grass species were predominant: *Dactylis glomerata, Holcus lanatus, Phleum pratense* and single selfseedlings *Acer platanoides, Quercus robur*, and *Betula pendula.*

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