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EVALUATION OF QUALITY PSEUDOGLEY SOILS BASED ON ITS WATER-AIR PROPERTIES

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Abstract

This paper provides an overview of the most important water-air soil properties (water retention capacity, permanent wilting point, plant available water capacity, soil water permeability and air capacity) in order to assess the quality of its productive properties.The study has been conducted on arable soil type pseudogley on the Agro-chemical School Dr. Djordje Radic in Kraljevo farm. The gained results of investigation showed unfavorable water-air properties, as the result of the unfavorable shape of porosity. Also, in the humic and Eg horizons, there have been determined low values of plantavailable water capacity, on the one hand, and high values of moist of permanent plants wilting, on the other hand.Unfavorable water regime of the soil is in a large extent a consequence of its low permeability of water, even in the Ah and Ahp horizon, where the ratio of water filtration is rarely higher than 30 mm/hour, whereas the individual values were less than 10 mm/hour. Extremely low permeability of soil water was in Btg horizon, which in the rainy seasons was becoming practically impermeable for water.Examined soil shows low values of absolute air capacity in Ah and Eg horizons (<10 vol. %), which does not provide sufficient aeration during periods of moderate humidity. Unfavorable water-air properties of the studied pseudogley soil require the application of appropriate pedomeliorative measures such as are: deep loosening of soil, deepening of arable horizon, breaking formed an impermeable layer, as well as the application of liming measures with humization in this soil type.

Key words: *permanent plant wilting, pseudogley, retention capacity, soil, soil-water properties, water permeability.*

Introduction

Pseudogley is the soil type, which is characterized by the alternation of wet and dry phases of moist. The cause of such a water-air regime is the presence of compacted horizon, which is impermeable or poorly permeable to water. In the case of higher rainfall, due to this provision upper soil profile becomes saturated with water, which it is stagnant and prevents normal aeration of the soil. Hence, during the dry season surface layers are very dried and deeper impermeable horizon hardens "like concrete".

Above hardly permeable horizon upper groundwater occurs, which causes anaerobic environment which produces reduced compounds toxic to plants (Caron et al., 1992; Ezeaku and Alaci, 2008). Shallower pseudogleys, where low permeability horizon lies close to the surface, quickly saturated with water in the winter and spring months. When rainfall in the sesoils during winter plant species suffer from a lack of oxygen, since all land pores are filled with water. With deeper pseudogley, the situation is better and it can be better used.

Estimation of some forms of soil water and its efficient use is related to the variability of soil physical properties and characteristics of water present, and the pronounced variability in

space and time in which it observes the air-water properties (Gao et al. 2011, Timm et al., 2011; Cajazeiraand Assis Junior, 2011).
Unfavorable soil water regime (high value permanent wilting moisture, low level of productive moisture and filtration coefficient in the soil, very low air capacity), is consequence of the occurrence of severe soil compaction, low porosity and usually unfavorable and unstable structures (Isirimah, 2004; Ezeaku and Alaci, 2008). Also, increased density of soil, prevents the filtration of water flow sufficient quantities of oxygen to the root zone, which inhibits the growth and reduces yield of the crops. Large compaction of the soil reduces aggregate stability (Caron et al., 1992) and leads to a decrease in macro porosity (Swartz et al., 2003). Therefore, the consequences of these changes are environmental degradation of land, which includes the loss of water of life, biodiversity and other plant resources (Isirimah, 2004; Ezeaku and Alaci, 2008).
Poor humic soil, with low levels of divalent alkali cations have substantially larger compressing than the very humic soils. According to Aggelides and Londra (2000) the introduction of large amounts of soil organic matter content leads to the increase in the retention of water in soil, and also to reduce its hardness.
The aim of our study was to determine the productive capacity of arable pseudogley on the most important water-air-soil properties (water retention capacity, permanent wilting humidity plants with a capacity of productive moisture, soil permeability to water and air capacity) and based on the condition of the studied trait propose the necessary pedomeliorative measures to increase the level of its productive value.

Materials and methods

Investigations were carried out on the experimental field of the Agricultural chemical school "dr Djordje Radic" on pseudogley soil in 2010/11. At the work of the stationary field experiment soil profiles are opened. From the open pits of which are previously described morphologic, soil samples were taken in the undisturbed condition. Samples were taken at three replications with Kopecki cylinders 100 cm^3 in volume from three levels, or three most important horizons of pseudogley (Ah, Eg and Btg).

Samples were taken at the same moisture content that corresponds to the field capacity. The samples in the undisturbed state analyzes were performed of water-air properties of soil, namely: water retention capacity (0.033 MPa), the method of Richards, with Pressure Plate Extractor-a; wilting humidity (1.5 MPa), the method of Richards, by Pressure-Membrane Apparatus and; plants accessible (productive moisture) was calculated from the difference between the water retention capacity and wilting humidity, filtration, variable pressure, calculated by Darcy, and air capacity has been by computed.

Results and discussion

Unfavorable water regime arable pseudogley (Table 1), it is certainly the result of a very pronounced evaporativity, which is associated with an unfavorable structure, which leads to the formation of rain after a thick crust on the soil surface and the establishment of strong capillary, with a small proportion of pore aeration.
The values of the water retention capacity values are close to the field or rain water capacity and include the maximum amount of hygroscopic, film water and capillary water in the soil. Results of analysis (Table 1) showed no significant difference in the size of the water retention capacity between Ah and Eg horizons in profile pseudogley (35.90 and 37.22 %vol.). Significantly higher values of the capacity of retention of water were found in the horizon Btg (43.50% vol.), which are of 7.60% vol. higher than in Ah and 6.28 vol%. Eg with respect to the horizon. Values close to the film-capillary capacity from 36 to 43% by volume (Ah, Eg and Btg horizon) and slightly higher Eg in relation to the Ah horizon showed that the

cultivated profiles of Kraljevo pseudogley whose water features were examined by Dugalic (1998). Also, the value of the water retention capacity and its availability in the soil affects significantly the mineralogical composition. Thus, if the land is dominated by minerals montmorillonite (crystal lattice type 2:1) (Btg horizon) value of the water retention capacity is higher than in the soil with a dominant clay mineral kaolinite group (crystal lattice ratio 1:1) (Gaiser et al. 2000).

Table 1.Water properties of arablepseudogleyof Kraljevo

Horizons	Depth (cm)	Water retention capacity, pF 2.5		Moisture permanent wilting, pF 4.2		Productive capacity of moisture, pF 2.5-4.2		Filtration coefficient
		% vol.	mm	% vol.	mm	% vol.	mm	mm/hour
Ah	0-15	35.90	53	18.90	32	16.00	25	22
Eg	15-40	37.22	92	20.60	55	14.38	38	40
Btg	60-80	43.50	86	25.00	49	19.20	35	48
	0-80		231		136		98	

Test results show extremely high levels of humidity permanent wilting in all horizons of the profiles (Table 1). Also, there are significant differences in these values between the studied horizons, especially between Ah and Btg (6.10% vol.). Significant differences between the observed water constants can be interpreted as a significant difference in clay content between the horizons, and a very pronounced differences in the structure of soil depth profiles (Rendig and Taylor, 1989; Ezeaku and Alaci, 2008). Expressed in mm water column, permanent wilting humidity of the deep zone from 0 to 80 cm (Ah, Eg and Btg horizon) is 136 mm and is noticeably greater than the moisture capacity of productive moisture (98 mm) in the same depth zone. Therefore, the results of the analysis indicate a very unfavorable physical environment (water) traits studied pseudogley. High levels of humidity permanent wilting, especially in Ah and Eg horizons which are mainly located the roots of plants, suggesting that it is necessary to take adequate pedomeliorative measures to reduce non-productive capacity of moisture in these soils. Similarly, mostly of the high moisture content of permanent wilting has been noted in the works of other authors (Stojicevic, 1961; Dugalic, 1998).

As can be seen from the data in Table 1, the productive capacity of moisture for the observed horizons (Ah, Eg, Btg), by volume or height in mm of water column, shows a lot of close losses (16.00, 14.38, 19.20). Also observed in the entire depth profile of the study (0-80 cm), the productive capacity of moisture is considerably smaller (relative to 38%) relative moist of the permanent wilting. Similar results were obtained by Dugalic (1998) by examining the properties of water from 21 profiles of forest, meadows and valleys of field pseudogley of Kraljevo.

Profile cultivated pseudogley (Table 1), the largest water filtration coefficient is significantly different. So, quite dense Ah horizon shows the lowest (22 mm/hour) coefficient of water filtration that is considered unsatisfactory. However, in the Eg and Btg horizons revealed significantly higher value of this ratio (40 and 48 mm/hour), which can be considered quite satisfactory. The appearance of much higher value of the coefficient of filtration of water in these two horizons (Eg and Btg) compared to the topsoil horizon is unusual and suggests the possibility of applying measures to undermine pedomeliorativne (loosening) the two sub-plowing horizons.

Throughput of arable land in the water, among other things dependent and application of certain cultural practices that affect the content of his large pores (pore aeration). Thus, the compaction of the surface layer there is a decrease, and wherein the dispersion to increase its permeability to water. The results presented in Table 2 show that the rate of water absorption in the horizon Ah was satisfactory (36 mm for 60 minutes), that is 0.60 mm/minute. However, the lower (Eg) during a horizon of 60 minutes pseudogley absorbed water is 25 mm, or an average of 0.42 mm/minute, which is 1:44 for times less than in the topsoil (Ah) horizon. According Sasal et al. (2006) classic treatment plot shows the positive impact of the change in total porosity, especially surface soil horizons.Also, the processing of land favorably affect the physical properties, particularly porosity, which significantly affects the change in the coefficient of filtration and increases the productive capacity of soil moisture (Lipiec et al., 2006; Lampurlanés and Cantero- Martínez, 2006; Farkas et al., 2009).

Table 2. Filtration rate in the Ah and Eg horizons profile of the pseudogley

Horizons	Current humidity	A layer of absorbed water	The duration of filtration	Mean filtration	Rating of filtration
	(%)	(mm)	(min)	(u mm/min)	
Ah	16	36	60	0.60	Satisfactory
Eg	15	25	60	0.42	Unsatisfactory

The results presented in Table 3 show the absolute size of the air capacity of the land of cultivated pseudogley.

Table 3. The air capacity in the investigated horizons of cultivated pseudogley and its level of adequate aeration of soil

Horizons	Depth (cm)	Air Capacity (% vol.)	Air Capacity Grade	Adequate aeration level
Ah	0-15	5.4	Low	Weak
Eg	15-40	4.5	Very low	Very weak
Btg	60-80	2.1	Very low	Very weak

Regarding the horizons of the studied soil air capacity ranges from 5.4 (Ah) to 2.1 (Btg). All three studied profiles show low and very low absolute values of air capacity to enable poor or very poor aeration, which is one of the most unfavorable physical characteristics of the land. Although small in all horizons, the absolute capacity of the air is considerably lower than in the horizon Btg (2.1% vol.), with respect to Eg and Ah horizons (5.4 and 4.5% vol.). Similar results were obtained by Dugalic (1998) while studied the water properties of field pseudogley in Cacak-Kraljevo basin.

Cause of the very low air capacity of the land lies primarily in poor mechanical and aggregate content of the soil, as well as a large degree of soil compaction due to improper cultivation at high or low levels of humidity. High compression of soil conditions and very poor aeration reduced water permeability, and the roots of cultivated plants. Other authors in the past have reached similar results in the past (Dugalic, 1998; Al Majou et al., 2008; Dieckowet al., 2009).

Conclusion

Based on the research results of the most important water-air features of cultivated pseudogley in Kraljevo basin in order to assess its productivity following conclusions can be drawn: Unfavorable situation porosity has a very bad water and air qualities, which is one of the most important causes of their small effective fertility. Adverse water properties of these lands are mostly a consequence of the low value of the productive capacity of moisture and high humidity values of permanent wilting plants in the Eg horizon. Productive capacity of moisture is slightly larger, and in some sections and less than permanent wilting humidity. Unfavorable water regime pseudogley land is to a significant extent and consequences of its low permeability to water, even in the Ah horizon, where the ratio of water filtration is rarely greater than 30 mm/hour. Absolute air capacity of the studied area shows low values, especially in the Btg horizon (2.1% vol.), which results in very poor aeration during periods of moderate humidity.Unfavorable water-air properties of the studied pseudogley soil require the application of appropriate pedomeliorative measures such as are: deep loosening of land, deepening of plow horizon, breaking formed an impermeable layer, as well as the application of liming measures with humization in this soil type.

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