SOIL MINIMUM TILLAGE SYSTEM IMPACT UPON ARIDITY HINDERED LAND IN TELEORMAN COUNTY

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Abstract
Two land bodies in Teleorman County were characterized in order to identify aridity affected areas. The country's agricultural and edaphic potential were taken into account on one hand, and the negative consequences determined by years long application of classical technology which contributes in the long run to the enhancement of degradation processes of fine textured soils through compaction, cleaving, and waterlogging on the other. In the Traian Administration and Territorial Unit (ATU) a pronounced soils settlement process was noted due to ploughing execution at the same depth and equipment passage on the soil in inappropriate conditions. In the Mavrodin ATU the soils have a high clay content which favors soil compaction and waterproofing raising issues of air capacity. Rape crop output was 3,700 kg/ha on the Calcic Chernozem of the Traian ATU, and 3,000 kg/ha on the Mavrodin Chromic Luvisol in the same soil works system. These soils suitability for soil minimum tillage is low due to specific intrinsically characteristics. Preserving soil covered with vegetation for an as long as possible period is recommended.
Key words: soil degradation, aridization, minimum tillage

INTRODUCTION

High aridity affects approximately two third of the Country's population (64%) respectively a little over 14 million persons (INS Tempo_POP 108D, 2021), including, overall or in majority, at least 24 counties of all the development regions, including Bucharest Municipality.

The demographic dynamics of the areas affected by pronounced aridity in the last 30 years (INS Tempo_POP a 108B, 2021) highlights a population abatement in the counties affected by aridity (-3.8% of the total) slightly lower as compared to the national tendency (-4.7%) on the background of a relative constant population in urban areas (-0.8%) but emphatically decreasing in rural ones (-9.2%). The pronounced demographic decline in rural areas predominantly comes to surface in the County southern areas and Telorman County is the most affected with an almost third of the population (-30.2%) loss in the 1992-2021 period.

Drought and associated phenomena, aridization and desertification respectively, are the second big issue mankind is confronted with, next to pollution, in the last half century. These destructive phenomena spreading on global level are highlighted by climatic data which reveal an atmosphere gradual warming and a decrease of rainfall quantities which lead to drought occurrence. The area under desertification influence (the dry part of the sub-humid area) represents 7% of the Country total surface according to climatic data. Furthermore 22 counties belong to the transition sub-humid towards dry sub-humid zone which makes them a future desertification risk. Most of the land (78%) has agricultural use in these zones

out of which 62% is cultivated field. In the areas where the aridity index takes values between 0.05 and 0.65 desertification constitutes a real danger. Two fifths of dry land is framed into this category and over 20% of the globe surface.

FAO data show that the agricultural surface is estimated at 1,475 million ha; anthropically affected surface by technologies is 552 million ha to which another 10 million ha agricultural land are added affected by industrial activities in Europe which means that the total degraded surface reaches 562 million ha (38% of the agricultural surface) out of which 285 million ha is moderately degraded (Marinca et al., 2009). The following resulted based on the pedological and agro-chemical studies carried out in Teleorman County: 36,663 ha soils affected by erosion; 19,328 ha soils with waterlogging; 386 ha brackish soils; 22,933 ha acid soils; 393 ha soils polluted with brine; 87,712 ha compacted soils. Technological system enhancement and technological mistakes too led to deterioration and serious decline of different soil characteristics in conventional agriculture which determined different negative processes emphasis degrading soil as a whole and having serious direct and/or indirect consequences upon the other environment resources, biodiversity, and global climatic change at the same time (Report of the European Conservation Agriculture Federation, 1999). Removal of vegetal leftovers in areas with dry climate where intense soil working is practiced contributes to water loss from soil thus boosting drought, desertification, and implicitly desertification processes (Burtan Lavinia et al. 2016). Much attention was given to analyze the relation between climate aridity and land degradation in the last decades as well as for their contribution to desertification from the climate change perspective. The soil working system based on its protection, minimum tillage and direct sowing are largely used on broad areas in the last decades, primary for drought control through accumulation and conservation of large water quantities in soil, through fuel consumption diminution, and raising efficiency through soil works attenuation ensuring a significant profit raise (Charles, 2010; Benoit, 1989; Barriuso, 1994; Ball, 1995; Lupu, 1992; Rusu, 2004). The influence of the working system upon soil properties represent an important indicator for soil fertility conservation and agricultural system sustainability assessment (Guş, 1997; Rusu, 2001; Mark et al., 2004; Jităreanu et al., 2006; Almagro et al., 2017; Biddoccu et al., 2017; Martínez-Mena et al., 2020, 2021).

MATERIALS AND METHODS

Two land bodies of Teleorman County were characterized in order to identify fields affected by desertification. Soil profiles were made in each area previously mentioned and they were chemically, physically, and morphologically characterized according to the Guide for soil profile and environment specific conditions description on site (Munteanu I. and Florea N., Ed. Sitech, Craiova 2009). The performed analyses and determinations are conformable to the methodology and standards in effect (SRTS, 2003; MESP, vol. I-III, 1987). Turnu Măgurele meteorology station data were used for climate characterization for the meadow area and those from Alexandria for the plain area.

RESULTS AND DISCUSSION

1) The Traian administrative and land unit lays in the Teleorman County southern part in the Danube alluvial plain and in the southern Romanian Plain, in the Boianu Plain.

The climate is generally continental temperate with a relatively average annual air moisture, less harsh winters, differently distributed rainfall but all along the year, and warm summers and shorter springs.

The average temperatures take values between 10.5°C in the plain area and 11.4°C in the meadow.
The lowest annual average temperatures are registered in January (-2.6°C), February (0.1°C), and December (0°C). The highest temperatures and monthly averages are registered in July and August, with 23.3 respectively 22.3°C. The temperature sums for the March 1st – October 31st is 39.38°C, and for the April 25th – October 15th – 33.15°C. Most of the rainfall occur in the March 1st – October 31st interval, namely 378 mm. The highest rainfall quantity occurs in March, April, September, and October and the lowest in February. Rains have a pouring character with large quantities fallen in a short time. A deficit is noticed in the summer months as a consequence of high temperatures that cause strong water evaporation although there are no differences as compared to the rainfall average.
The ligneous vegetation is represented by the species: *Quercus pedunculata* (oak), *Ulmus campestris* (elm), *Robinia pseudoacacia* (acacia), *Populus nigra* (black poplar), *Salix alba* (white willow). The herbaceous vegetation is represented by weed species: *Cynodon dactylon* (Bermuda grass), *Setaria viridis* (green foxtail), *Polygonum aviculare* (common knotgrass), *and Convolvulus arvensis* (field bindweed). The *Phragmites communis* (common water reed) specie is given evidence of in the meadow and plough land. The natural vegetation encountered on the grassland is represented by: *Poa bulbosa* (bulbous bluegrass), *Andropogon ischaemum* (yellow bluestem), *Artemisia austriaca* (an absynth variety).
The soil material belongs to the Calcic Chernozem type, epicalcaric, superfine sandy loam/outer sandy loam, developed on loess and loess deposits, ploughable, with an Am-A/C-Cca type profile (SRTS 2012 and WRB-SR 2014).
Pore space and permeability are high; soil reaction is slightly acid, 6.67; humus content is low, 1.98%; total nitrogen content is average, with a 0.180% value; mobile phosphorus content is low, 12 mg/kg; potassium content is low, 114 mg/kg.
Minimum tillage is the applied agricultural technology, on a 53 ha area. Stubble ploughing and deep loosening were executed with the HORSCH TIGER 4 MT cultivator, and 150 kg/ha DAP 18:46 fertilization with the Amazone ZA-TS 4200 fertilizer distributor; 3 kg/ha DK EXPECTATION variety rape was sown with the Lemken Solitair 9 seeding machine in not irrigated land; herbicides, insecticides, and antifungals application was done with the John Deere 616 R self-propelled herbicide treatment machine. The Pantera product was used for post-emergence herbicide treatment in 1.5 l/ha dose, and 0.075 l/ha Decis expert, 0.15 kg/ha Kaiso Sorbie, 0.15 kg/ha Mospilan, and 0.2 l/ha Mavrik insecticides. Timor, Pictor Active, and Propulse antifungals were used in 1 l/ha dose each.
Harvesting was done by the John Deere S7851 cropper.
Fuel expenditure was 25 l/ha.
The rape crop yield was 3,700 kg/ha.
A strong soil compaction process was observed on the researched land due to ploughing at the same depth, equipment passing over the soil in improper conditions, chemical fertilizers application without previous agrochemical mapping.
Significant depletion of the liquid phase weight in the soils with low or no phreatic input such is the case of the research area occur in the atmospheric drought period which leads to soils physical, biological, and biochemical processes slowing or suspension in most cases so irrigation is needed.

2) The Mavrodin administrative and land unit belongs to the Gǎvanu Burdea Plain from the geo morphological point of view. It lies on the middle course of the Vedea River, north-west of Alexandria Municipality. Large meadows evolved on both banks od the Vedea River and its left tributary Pârâul Câinelui. The meadows divide here the plain into three plateaus:

the Mavrodin – Călinești field is generally flat with slight saucers and moderately hollowed valleys; the North-Nenciulești field is semblable to the eastern one; the Buzescu – Nanov plain in the south has no saucers but is fragmented by valleys which drain it.

The researched land is drained from west towards south-east by the Vedea Valley and from north to south by its tributary Pârâul Câinelui. These courses collect water from the high field during rainy periods through the dry valleys which run them in all directions. The two water courses are strongly meandering. The phreatic level in the plain is below 20 m depth and between 0.5 and 2.0 m in the meadow and especially on the Vedea River and Pârâul Câinelui left side.

The groundwater strongly and negatively influences soils development through its small depth and high mineral salts content. The rough declivitous relief opposes slope soil formation as the water washes the rock and organic matter. Waterlogging determines organic matter alteration, accented rock mineralization, and colloidal substances depth leaching which determines worsening of physical, chemical, and trophic characteristics.

The annual average temperature is 10.5°, a moderate one. The coldest month temperature is -3° an the hottest outruns 22° which shows a climate with cold harsh winters, sometimes low in snow, but long and hot summers. Absolute minimum and maximum temperatures show strong freeze possibility and also of very high temperatures during the summer, harmful for agricultural crops. Rainfall annual amount is 575 mm.

Rainfall have generally a pouring character in the summer which make part of the water form long lasting puddles on the soil surface and the soil remains compacted after evaporation or infiltration. Snow falls in December – February, rarely in march or November, but doesn't manage to form a protective layer because it is blown by the Crivetz, the most frequent wind in this area. The air relative moisture shows that atmospheric drought is observed in this area in July and august, due to lack of rainfall.

Soil cover specific for the research area is represented by Chromic Luvisol, mollic subtype, with the following formula: Am – Bt_1 – Bt_2 – Ck, with fine texture, differentiated in the profile, high clay content in the B horizons (36-180 cm) as compared to the value registered at the surface. This texture differentiation explains the pedo-genetic clay migration process through which the studied soil was formed. The fact must be mentioned that clay content outruns 33% even from the soil surface which is why this one presents the specific mechanic properties (compaction, adhesion, etc.) in the whole profile.

Total soil porosity has 45-47% values. The compactness degree is mild at 0-36 and 180-200 cm depths, becomes moderate between 36 and 180 cm depth in the Bt horizons and can be a limiting factor for soil fertility which needs to be adjusted.

Soil reaction is slightly acid and constitutes a limitation to soil fertility.

At the same time humus supply is average in the upper horizon and decreases to low in the underlying horizons. A decreasing tendency is noticed for humus content in the profile and a growing one for the reaction.

Minimum tillage is the applied agricultural technology on a 70 ha surface, soil works were done with the JOKER 8 RT combiner for the Impresion rape breed, with a 3.2 kg/ha seeding rate, in not irrigated land. Phaze wise fertilization was done with 160 kg/ha Nitrocalcar, 180 kg/ha urea, and 180 kg/ha nitrate. Sultan 50 product in 1.5 l/ha dose was used for pre-emergence weed control. For post-emergence weed control 1 l/ha Pantera and 0.25 l/ha Galera Super products were used. The insecticide products were Vantex 0.08 l/ha, Permergum 0.1 l/ha and fungicides – Caramba Turbo 1 l/ha, Cantus 0.2 kg/ha, Pictor 0.6 l/ha. Rape yield was 3,000 kg/ha.

The soils in this area have a high clay content which favors their compaction and waterproofing raising aeration issues. Deep soil loosening is recommended in these conditions on the slope direction or on the plot length. These works must be resumed each 4-5 years, even 6 when the agricultural system with remediating plants is applied. It is recommended that the soil remains covered with vegetation for as long as possible.

Soil erosion and degradation phenomena are very frequent and accented on the versants where fruit tree and vine cultures have been partially uprooted.

CONCLUSIONS

The main issues encountered on the soils of both administrative and land units are determined by the fine particle size composition with a high clay content, unevenly distributed in the soil profile, by the high compactness state and waterlogging sometimes accented by the small depth of the groundwater.

Due to these characteristics the air and moisture condition is deficient, the demand for soil loosening works is high, the soil traffic and working conditions are frequently worsened. The technological systems components for plants cultivation must adapt to these soils and contribute to improving the negative characteristics and preventing degradation processes enhancement.

These soils suitability for minimum soil works is low due to precisely their specific intrinsic characteristics. The classical technology annually applied on such soils susceptible to degradation processes by compaction and waterlogging only led to the enhancement and widening of these processes over the years and now they affect large areas. Organic carbon content increase in soil is an excellent indicator of a certain conservative agriculture practice effectiveness taking into account its well known agricultural and environmental advantages and its potential to soften climatic changes. Nevertheless more research is needed and a perfect/correct monitoring, checking, and reporting frame in order to clearly assess the organic matter gains and the way they are influenced by the other physical, chemical, and microbiological properties.

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