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DYNAMICS OF SOIL MOISTURE UNDER THE MAIN FIELD CROPS (WHEAT, MAIZE, SUNFLOWER, PASTURE) ON A CLAY-LOAM SOIL IN THE SOUTH-WEST OF ROMANIA

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Abstract

The water consumption of plants is influenced by species, variety, vegetation periods, the degree of root development and intensified by the type of soil and the type of practical agricultural work. This paper presents the evolution soil moisture in 2022 year, depending on the technology applied to wheat, corn, sunflower and pasture crops. Analysing the evolution of soil moisture, under the 4 crops, during the agricultural year, it was possible to observe differences in soil moisture between the applied technologies and, of course, also between crops. For the analysed area, respectively on a clay loam soil, the utilization of the water from the precipitation is better achieved in the conditions of the preparation of the germinal bed by plowing.

Key words*: soil moisture, tillage, precipitation.*

INTRODUCTION

Soil moisture (SM) is a parameter that in agricultural technology should be very well known and tracked.

Globally there has been since 2009, the International Soil Moisture Network (ISMN) which was initiated to serve as a centralized facility of soil moisture (SM) data available worldwide (Dorigo et al., 2021). The ISMN gathers SM measurements collected by a multitude of organizations, harmonizes them across international scientific units, and stores them in a database. Users can freely retrieve data from this database through an online web portal (https://ismn.earth/en/) (Dorigo et al., 2021).

At national level, there is the Romanian Soil Moisture Network (RSMN), managed by the Romanian National Meteorological Administration, consisting of 19 stations homogeneously distributed throughout Romania, for 13 stations the data are also available in the ISMN database. The network aims to create a framework for the assessment of current and future soil surface moisture products (0-0.05m) obtained through satellite monitoring (Ortenzi et al., 2024). However, there is limited coverage due to the high variability of SM, it is difficult to obtain estimates of soil moisture over large areas, as well as missing data for certain demarcated areas.

SM directly or indirectly influences a series of actions/processes on soil and plants (Ortenzi et al., 2024; Wang et al., 2019), such as: erosion (wind, water, harvesting, landslides), soil biodiversity (Babaeian et al., 2019), soil compaction, soil salinization, soil contamination, soil nutrients, soil pH (Calistru et al., 2024) carbon content (Trugman et al., 2018), desertification, soil degradation, drought (Gu et al., 2019), flooding, evapotranspiration, crop yields (Babaeian et al., 2019), Plant health, applied agrotechnics (Partal & Oltenacu, 2022), production costs (Maleknia et al., 2023), etc.

The movement of water in the soil determines how nutrients reach the disposition of the roots both in a tilled soil and in a soil covered by natural grasslands (Bălan et al., 2024 a, b). The movement of water from the surface of the soil, of excess water (free water), when the soil moisture is above the value of the field capacity has a negative influence, in addition to the phenomenon of erosion and leaching and there are constant changes in terms of morphological and physical properties, hydro-physical, chemical and biological factors, compared to soils not affected by this phenomenon (Bălan et al., 2024b; Popescu et al., 2024).

Due to the importance and extensive use of SM information, Numerous measurement and monitoring capabilities have been developed in recent years (electromagnetic sensors, tensiometer, reflectometry, cosmic ray neutron, gamma ray, neutron probe, remote sensing,) From one-point measurement to global determinations (Babaeian et al., 2019). The number of SM networks continues to grow, but most of these networks have evolved without international standardization and thus present challenges for validating the correct estimation of SM (Caldwell et al., 2022)

In general, gravimetric measurements and electromagnetic (EM) sensor arrays are considered to be the most reliable means for the direct and accurate determination of SM moisture in the soil profile (Babaeian et al., 2019).

Soil moisture, or soil water content (SWC), can be determined using electromagnetic sensors buried in the ground, which infer SWC from an electromagnetic response. This signal can vary considerably depending on the texture and mineralogy of the soil, the salinity of the soil or the electrical conductivity and temperature of the soil; Each of these can have different impacts depending on the sensor technology, in addition, poor ground contact and sensor degradation can affect the quality of these readings over time (Caldwell et al., 2022).

The soil retains water in a mixture, called the soil solution, through the action of surface tension that attracts water molecules to soil particles.

The moisture content of the soil is influenced by several factors: the hydraulic properties of the soil, the types of soil texture, the slope, surface infiltration and runoff, and mainly the evolution of the climate (Maleknia et al., 2023).

A main feature of the soil that influences the water regime is water permeability, in soils with good water permeability, water infiltrates and can be kept by the soil at a great depth (loam soils), while soils with low water permeability (clay soils) the soil is soaked with water, puddles appear on the surface, creating anaerobic conditions (Grumeza, 2005).

In recent years, the evolution of the climate is very varied, so that the summer months become drier, rainfall is uneven, and extreme weather causes large production losses. At the Romanian level, Ontel et al. (2021) determined through a series of indices (soil moisture anomaly, soil water index, standardized precipitation index, land surface temperature anomaly, normalized difference vegetation index anomaly) the following years as dry: 2007, 2011-2012 excessively dry, and the years 2009, 2019 and 2020 as dry years. Data demonstrate a recurrence period of 3 events at 10 years.

For the period 2000-2013, throughout the country, and thus in the studied area, S-V Romanian Plain, there were five years of extreme drought and three years of excessive rains (Constantin et al., 2015).

Most studies and research on ensuring the water needs for field crops show that the most important role is played by rainfall. Thus, the researches carried out by Popescu (2001) in the period 1996-1998, by Pandrea (2012) in 2008-2010 with irrigated wheat, corn and sunflower crops showed that rainwater is the major source of water supply from soil and plants, ranging from 50% to over 90%. It is clear that in order to use rainwater effectively, appropriate technologies must be applied that lead to better soil water retention, plant water supply and minimal evaporation.

MATERIALS AND METHODS

The research and determinations carried out in this work aim to follow the dynamics of soil moisture. The determinations were made in 2022 on 6 variants for the following field crops: wheat, corn, sunflower and natural pasture.

The working method consisted of determining the soil water content (SWC) by the gravimetric method. Soil samples were taken from a depth of 20 cm during the vegetation period (Table 2). Gravimetric water content is measured by weighing a soil sample, drying the sample to remove the water, then weighing the dried soil.

As outlined above, this method is the safest for determining soil moisture (SM).

The soil belongs to the Chernisols class, the vermic Chernozem type, characterized by:

- loam-clay texture (34-36% clay);
- humus content is small 2.5-3%;
- soil pH 6.2-6.7;

- total porosity 50-52% at start 0-40 cm;
- wilting coefficient (WC) in layer 0-20 is 11.4-12.9%, and in layer 0-80 it is 12.8-13.5% (100-135 mm);
- field capacity (FC) falls in the middle class with a value of 23.1-24.5%, in the 0-20 cm layer, and in the 0-80 cm layer it is 23.1-23.4% (230-260 mm);
- total water capacity is 29.3%;
- bulk density is 1.26-1.31 (g/cm^3).

For the interpretation of the resulting humidity data, field capacity (FC), permanent wilting (WC) and minimum ceiling at 1/2 (MC) were also determined in advance. SWC data has also been converted to mm.

The working methods presented were made for the following variants (crops and agricultural technologies):

a.1) Wheat (Wht.1): – The preparation of the seedbed was carried out with a disc harrow (10-15 cm), the cultivated area was 49 ha, the previous crop was sunflower. The preparation of the seedbed consisted of 3 passes with the disc harrow, one immediately after harvesting (August 22, 2021), and the others during the autumn before sowing. Before the last processing with the disc, the basic fertilization was carried out. Sowing was carried out on October 10-12, 2021 at a depth of 4-5 cm. The harvest was done at a humidity of 13% of the grains, between July 12-15, 2022 obtaining an average yield of 6280 kg/ha.

a.2) Wheat (Wht.2): – ploughed at a depth of 22-25 cm plus two shredding and leveling works of the soil, the cultivated area was 55 ha. The predecessor plant was rapeseed. Between June 21-34, 2021, the entire surface was ploughed at a depth of 22-25, and immediately afterwards a disc harrow pass was made. On October 7, 2021, basic fertilization was carried out, followed by soil tillage with a combiner, and sowing was done between October 10-12, 2021. The harvest was done at a humidity of 14% of the grains, between July 12-15, 2022 with a yield of 6740 kg/ha.

b.1) Maize (Mz.1): – plowing at 30 cm depth plus seedbed cultivators, the cultivated area was 41 ha. The plowing was done at a depth of 30 cm between November 18-22, 2021. The previous harvest was sunflower. Spring seedbed preparation consisted of two passes with seedbed growers from April 3 to 5, 2022. The signing started between April 13-15, 2022 with a density of 60000 plants/ha, at 70 cm between the rows and at 7-8 cm depth. There was no weed infestation because herbicide was carried out both pre-emergent and in vegetation. On May 12, a mechanical sweep was made. The harvest was done between September 15-16, 2022, obtaining a yield of 4410 kg/ha corn grains with 15% moisture.

b.2) Maize (Mz.2): – plowing at 20-25 cm plus disc harrow, the cultivated area was 44 ha. The previous harvest was wheat, and immediately after its harvest, a ploughing was made at 20-25 cm between July 18-22, 2021. The preparation of the seedbed consisted of a disc harrow processing on 1-2 March 2022 and then a processing on 4-5 April 2022. Sowing was carried out between April 13-15, 2022 with a density of 60000 plants/ha, at 70 cm between the rows and 7-8 cm deep. There was no weed infestation because herbicide was carried out both pre-emergent and in vegetation. No more soil tillage was carried out during the vegetation period. The harvest was carried out mechanically between September 15-16, 2022 with a yield of 4850 kg/ha at 15.5% humidity.

c) Sunflower (Sfl.): – plowing at 24-27 cm plus disk harrow, the cropped surface was of 45 ha. The previous crop was wheat. The plowing was performed at 24-27 cm between 18-22 July 2021. The seedbed preparation was performed by disk harrow tillage at 1-5 march 2022 and then, at 28 march there was made tillage by disk harrow. Sowing was performed at 4-6 April 2022 with a density of 58,000 plants/ha, at 70 cm between rows and 4-5 cm depth. There was no weed infestation because herbicide was carried out both pre-emergent and in vegetation. No more soil tillage was carried out during the vegetation period. The harvesting started at 5 September 2022, at 9% moisture of sunflower kernels with an yield of 2740 kg/ha.

d) Natural pasture (Np) – farmed by grazing with animals, cattle and sheep.

In order to analyze soil moisture data, it is necessary to know the climatic data, especially rainfall and temperature. In this case, the climatic data of the 2021-2022 agricultural year from the ARDS-Caracal weather station, Olt County, were used.

In addition, the rainfall recorded in the agricultural year 2021-2022 was corrected with that recorded in the field.

With the help of these data, an improved Walter-Lieth climate diagram (Walter et al., 1960) was made. This chart provides a generalized representation of temperature and precipitation values for the time of year. The temperature and precipitation scales are fixed in the chart in a ratio of 1:2 and 1:3, making it easy to compare different periods.

RESULTS AND DISCUSSIONS

The land where the determinations were made is located in the Oltenia Plain, in the western part of the Romanian Plain and belongs to a farm in the south of Olt County, in the southwestern region of Romania.

The dominant relief is flat, on certain areas with low slopes of 2-5%, the altitude is 58 m, the groundwater is found at 3-5 m, and from a hydrological point of view the land belongs to the hydrographic basin of the Olt River, with influences from the Danube itself. The land is located on the first terrace of the Danube River, on the left side, about 20 km away.

The hydrological regime of the soil depends on a number of external factors, climate, relief, groundwater intake. Among these factors, the climate has a special role. Climate acts on SM both positively through precipitation and negatively through evaporation and transpiration, along with the other climatic elements: light, heat/temperature, solar radiation, wind.

From the meteorological data of the southern area of Olt County (Table 1) it can be seen that the average annual temperature is 10.61ºC. The lowest temperature is recorded in January (-3.0ºC), and the highest is recorded in July (22.7ºC) and August (21.9ºC). From the determination of the multiannual average values, it can be seen that the extreme values recorded both negative and positive values.

The average annual temperature was 12.43ºC (Table 1), so there was a pronounced warming compared to the multiannual average of 1.99ºC. Except for October, March and April, all other months of the 2021-2022 agricultural year had temperatures above the multiannual averages, even the winter months. It can be seen that this winter the average temperatures did not reach negative values.

Table 1. The average temperatures and rainfall during 2021-2022 agricultural year

	Months												
	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	Annual average
Temperature (ºC)													
2021–2022	10,18	7,32	2,57	1,96	4,13	4,48	11,11	18,17	23,03	25,42	24,8	18	12,60
Multiannual	11,3	4,9	-0,5	-3,0	-0,6	4,8	11,2	16,6	20,5	22,7	21,9	17,6	10,61
Deviation	-1,12	2,42	3,07	4,96	4,73	-0,32	-0,09	1,57	2,53	2,72	2,90	0,40	1,99
Rainfall (mm)													
2021 - 2022	101,4	28,0	60,8	19,2	4,8	13,2	77,8	44,6	14,2	30	50,2	55,4	499,60
Multiannual	40.4	40.3	39.4	33.3	30.4	34.9	43.6	64.9	67.0	52.9	50.7	39.6	537,4
Deviation	61,00	-12,30	21,40	-14,10	-25,60	-21,70	34,20	-20,30	-52,80	-22,90	-0,50	15,80	-37,80

The rainfall data (Table 1) for the agricultural year 2021-2022 are spatio-temporally fluctuating and unevenly distributed, thus values between 4.8 mm (February 2022) and 101.4 mm (October 2021) were recorded. During the vegetation period (2022), rainfall ranged from 14.2 mm in June to 77.8 mm in April, 44.6 mm in May, 30 mm in July, 50.2 mm in August and 55.4 mm in September. All summer months record values below the multi-annual average, with a significant deficit for certain months (June).

The total amount of precipitation in the agricultural year 2021-2022 is lower than the sum of the multiannual average (499.60 mm compared to 537.4 mm-My.a), there is a deficit of 37.8 mm (Table 1, Figure 1).

The distribution of precipitation during the vegetation period was much smaller compared to the multiannual average (Table 1).

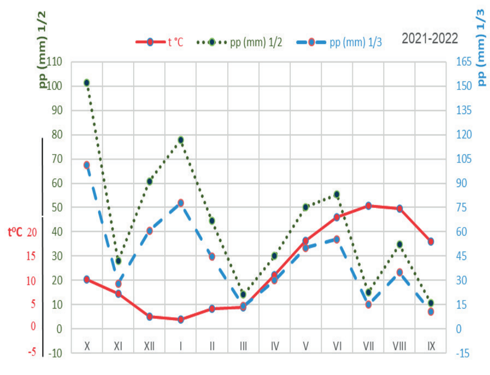

Figure 1. Climate diagram for 2021-2022 agricultural year

The climate data recorded in this case are also confirmed by other researchers, who note the same trend of increasing temperature and uneven distribution of precipitation.

In a long-term study of the evolution of the weather in Romania (temperature over 122 years, and precipitation over 146 years) it was shown that the average temperature over the entire agricultural year, but also during the vegetation period, increased from 10.3°C in 1897-1898 and reaching 12.7°C, and precipitation tends to decrease values, especially during the vegetation period (Șumuleac L. et al., 2020).

In case of an increase in average temperatures by 2ºC, the water requirement for corn will be 61% above the current requirement, and in the case of a temperature increase of 5ºC, the water requirement will be 74% above the current requirement, in an irrigated system (Nițu A. et al., 2023).

By translating these climatic data into Walter-Lieth charts (Figure 1), it is possible to identify periods of the year with excess moisture or moisture deficit. Thus, as can be seen, it can be seen that the more significant rainfall in the autumn of 2021 ensured a high level of humidity, and the summer period of 2022 is dry.

In most previous years, plants suffered from a lack of water in the soil, but 2021 was a rainy year, with rainfall reaching 711.6 mm compared to the multiannual average of 537.4 mm (Cioboata M. et al., 2024).

At first glance, this rainfall could be sufficient for crops, especially wheat, in terms of ensuring the initial water supply.

In the studied area, for the depth of 20 cm, the field capacity (FC) is 23.4% (59.9 mm), the wilting coefficient (WC) is 12.9% (33.02 mm), and the minimum ceiling (MC) calculated at 1/2 of the active humidity range is 18.15% (46.46 mm).

The evolution of soil moisture (SM) is dependent on the amount of precipitation. Soil samples were taken for the 4 crops analyzed from April 12, 2022 to September 15.

Figure 2 shows the SM dynamics for the 2 technological variants of the wheat crop Wht.1 (DH), Wht.2 (Pl,dh). In April, the SM level for both variants is above the MC (minimum ceiling), in May when wheat has the highest water consumption, the SM drops below MC, but does not reach the WC. The rainfall recorded at the end of May determined the recovery of MS, right at the beginning of June, before harvesting, when the wheat was towards maturity. The SM was higher in the Wht.2 (Pl,dh) variant, on all three months of wheat vegetation, but continued after harvesting. On the analyzed soil, the preparation of the seedbed by ploughing plus disc harrow favored the storage of water in the soil.

Figure 2. Soil moisture dynamics in winter wheat crop (mm) and after harvest

In the maize crop, for both variants, Mz.1 (Pl30) and Mz.2 (Pl25) SM decreases from sowing to harvest, the same trend for sunflower (Figure 3).

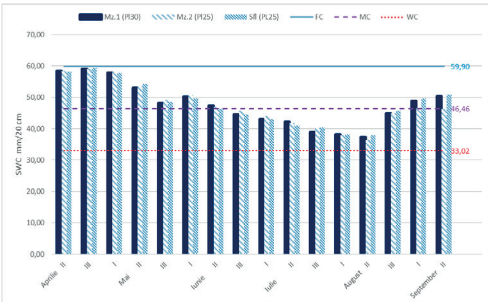

Figure 3. Soil moisture dynamics in maize and sunflower crops (mm)

In April, when both crops were established, rainfall was also recorded, and the SM at a depth of 20 cm was very close to the FC, 58-59 mm. The SM in May for both crops has values above the MC, starting with the last decade of June, the SM value decreases below the MC, and in mid-August the SM approaches the WC value. Both cultures Mz.1 (Pl30), Mz.2 (Pl25) and Sfl. (Pl25) have an SM of 36-37 mm, and the WC is 33.02 mm. The rainfall recorded in the second half of August determines the recovery of SM.

As for the dynamics of soil moisture (SM) on pasture, it can be seen that it depends on both precipitation and air temperatures.

The highest SM values were recorded in April, May and the first half of June, when they are above the MC (Figure 4). The next period is characterized by a very low SM level on grasslands, until the last determination SM was below MC. This is also due to high air temperatures.

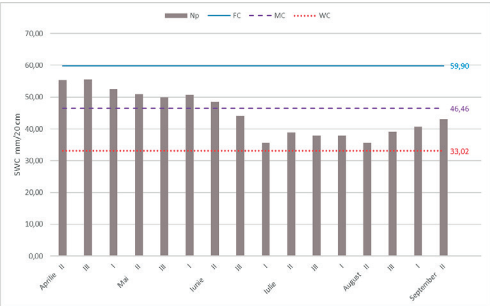

Figure 4. Dynamics of soil moisture with pasture (mm)

The analysis of SM dynamics (Table 2 and Figure 5) for the four researched crops and 6 variants for determining soil moisture, during 2022 presents the following aspects:

- at the beginning of the vegetation period, when the first determination was made, on 12.04.2022, it can be seen that the soil water reserve is high for all 6 soil samples, being sufficient and normal for this period;
- at the first determination of SM, the highest values are for corn and sunflower soils (22.7-22.8%), wheat soils have 20.8-21.4%;
- at the next determination, on 22.04.2022, there are significant differences between crops. Wheat has the lowest soil moisture (19.4% and 19.8%) compared to the other crops: corn - 23.1%, sunflower 23.2%, meadow 21.7%;
- the SM determinations in May are between 17.2-22.6%, the wheat variants have the lowest values, and for Wht.1 (DH) and Wht.2 (Pl,dh) the SM of the second decade and the third decade of May is below the MC (in wheat the wilting phenomenon is observed). In the third decade of May, all variants have SM very close to MC (18.8-19.5%);
- the low SM values in May are due to the lack of precipitation, between May 1 and May 26 only 8.4 mm was recorded, on May 27-28 there were 35.2 mm of precipitation, which influenced the subsequent SM values;
- in June there are only 14.2 mm of precipitation, which led to a decrease in SM for all variants. In the first and second decade of June, the SM is between 18.0-19.8%, being very close to the MC (18.15%), in the last decade the SM for all variants is below the MC, the values being between 16.2-17.9%;
- the SM values in July are definitely the most influenced by climatic factors. The total rainfall this month was 30 mm, with a maximum of 13.6 mm on July 26. SM, the average air temperature recorded the highest values (25.42^{0}C). In this month, the SM for all variants is below the value of the minimum ceiling (MC) of 18.15%, the SM is between 13.9-17.2%. Np has the lowest SM values, close to permanent wilting (12.9%);
- in August the SM remains below the MC, values between 13.9-17.9% are determined, except for the harvested wheat soils, where the SM is 18.2-18.4% in the third decade of August, a value influenced by 21.2 mm rainfall on August 22 and probably by the plant residues on the soil surface;
- the latest determinations of the SM indicate slight increases close to the MC, even above, values influenced by the rainfall at the end of August and in the first decade of September (38.8 mm). In the soils of Np, the SM values remain below the MC.

From the analysis of the "crop plant" factor, it can be seen that there are differences between them. SM varies between crops depending on the vegetation stage. This being a certain thing. According to previous research, water consumption (ET) is different. Thus, for the research area, Nistor A. et al. (2017) determined a water consumption, for the crops followed in this work, in the soil layer 0-75 cm, as follows (m^3/ha/day): for wheat 29 April, 41 May, for corn 18 in April, 26 in May, 39 in June, 59 in July, 42 in August, 24 in September, and for sunflowers 16 in April, 35 in May, 56 in June, 58 in July and 26 in August.

Table 2. Evolution of soil moisture (SM) during the vegetation period, sampling data, researched variants

	April		May			June			Juli			August			September	
Decad (sampling of day)	II (12)	III (22)	I (3)	II (13)	III (23)	I (2)	II (12)	III (23)	I (4)	II (14)	III (25)	I (5)	II (16)	III (26)	I (5)	II (14)
Wht.1(DH)	20.8	19.4	18.8	17.9	17.2	18.8	18.0	16.2	16.1	15.3	15.3	15.1	15.1	18.2	20.1	19.7
Wht.2 (Pl,dh)	21.4	19.8	19.2	18.1	17.6	19.0	18.8	17.1	16.6	16.1	15.7	15.6	15.1	18.4	20.3	19.9
Mz.1 (Pl30)	22.8	23.1	22.6	20.7	18.8	19.6	18.5	17.4	16.8	16.5	15.2	14.9	14.6	17.5	19.1	19.7
Mz.2 (Pl25)	22.8	23.1	22.7	20.9	19.2	19.8	18.4	17.9	17.2	16.3	15.7	14.8	14.2	17.5	18.2	18.1
Sfl (PL25)	22.7	23.2	22.6	21.2	19.0	19.4	18.1	17.4	16.8	16.0	15.8	14.9	14.8	17.9	19.4	19.9
Np	21.6	21.7	20.5	19.9	19.5	19.8	18.9	17.2	13.9	15.2	14.8	14.8	13.9	15.3	15.9	16.8
FC = 23.40% = 599.04 m^3/ha = 59.9 mm, WC = 12.90% = 330.24 m^3/ha = 33.02 mm, MC = 18.15% = 464.64 m^3/ha = 46.46 mm																
Wht.1 (DH) – wheat/ disc harrow; Wht.2 (Pl,dh) – wheat/ploughing + disc harrow; Mz.1 (Pl30) – maize/ploughing at 30 cm; Mz.2 (Pl25) – maize/ploughing at 25 cm; Sfl (PL25) – sunflower/ploughing at 25 cm; Np – natural grassland.																

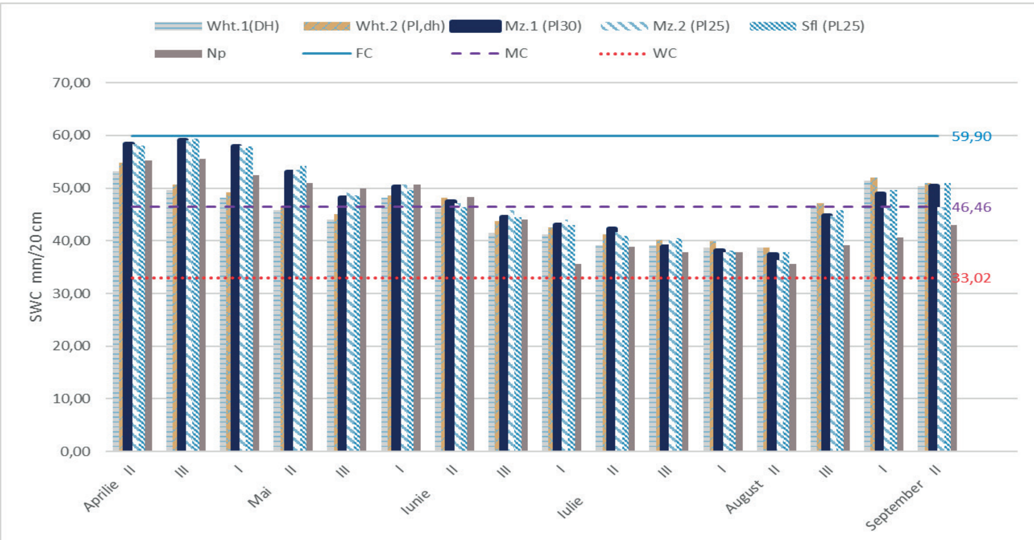

Figure 5. Centralized soil moisture dynamics

Also from the point of view of crops, it is worth analysing the fact that in June after the wheat harvest, the SM was higher in the plots (variants) covered by vegetation, respectively corn and sunflower, compared to plots on which there was wheat and Np.

From the analysis of the influence of cultivation technology on the evolution of soil moisture (SM) it is found (Table 2):

- for the wheat variants Wht.1 (DH), Wht.2 (Pl,dh) it can be observed that the variant Wht.2 (Pl,dh) where the seedbed preparation was carried out by ploughing with the pulse plough with disc harrow passes, SM has higher values compared to Wht.1 (DH) where the seedbed preparation was carried out only by disc harrow passages;
- at the first determinations of SM, at the beginning of vegetation, the lowest values were for the Wht.1(DH) variant (20.8%) and for Np (uncultivated land) (21.6%);
- the determinations after the wheat harvest indicate higher values also for plot Wht.2 (Pl,dh), compared to plot Wht.1 (Pl,DH);

- the tillage of the Mz.1 (Pl30), Mz.2 (Pl25) maize variants differs in that at Mz.1 (Pl30) the surface soil is better shredded, due to the use of seedbed cultivators, compared to the other variant where the disc harrow was used;
- for the Mz.1 (Pl30), Mz.2 (Pl25) maize variants, the SM values are very close, slightly higher at Mz.2 (Pl25);
- the sunflower variant Sfl (PL25) where the tillage was ploughed plus the disc harrow records SM values close to the corn varieties, with small differences during the vegetation period;
- the natural grassland variant (Np) registers the lowest SM values;
- in the Np variant, the lowest value (13.9%) of SM close to the WC value (12.9%) was determined;
- from the comparisons of SM between Np and the other variants where the soil was tilled, the conclusion can be drawn that the tillage of the soil on the surface can prevent evaporation.

CONCLUSIONS

From the aspects presented during the work, several conclusions and interpretations can be drawn, as well as perspectives for carrying out other research.
The most relevant conclusions are summarized.
The year 2022 in which the research was carried out was a dry year, recording rainfall below the multiannual average (-37.8 mm), with extremely hot summer months and very low rainfall in quantity. The average annual temperature was 12.6ºC, 1.99ºC above the multiannual average.
The level of precipitation directly influences the evolution of soil moisture, both during vegetation and before the vegetation season.
The accumulation of precipitation in autumn and winter can influence the soil moisture (SM) in the vegetation period. This explains the fact that the variants where the soil was ploughed, the storage of water in the soil was favoured, and the result was by determining higher values of SM as well as higher productions.
The vegetation development of crops causes a higher water consumption, but they also have a role in mitigating the evaporation of water from the soil surface, through shading, soil cover.
Soil tillage most of the time causes the loss of water from the soil, but there are situations when a good infiltration of water into the soil is subsequently found, Or situations when the soil is shredded very finely and the infiltration slows down.
It should be noted that the physical properties of the soil, the agricultural equipment used, the time of execution of agricultural works influence the infiltration and maintenance of water in the soil in the short and long term.
From soil moisture data, as well as yield results, we can conclude that the best option was soil preparation by ploughing.
Determination of SM at the surface does not provide clear information on the water consumption of crops

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