RESEARCH REGARDING THE INFLUENCE OF THE WORK METHOD ON THE SOIL MOISTURE AND THE WATER RESOURCE IN THE FORESTRY NURSERY OF IARAC

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Abstract

The present research has as a purpose the determination of the optimal work methods of the soil used in forestry nurseries and which are meant to obtain high quality saplings by maintaining a possibly large quantity of water in the soil. The research was carried out in the Iarac forestry nursery in the O.S. Iuliu Moldovan during 2005-2009, on an alluvial soil - the vertical-gleiying subtype. The experiment is multi-factorial – the A X B type. The placement of the sample markets was carried out according to the "divided parcels method" in two repetitions, and the surface of the parcel was 80 m^2.
Soil moisture is an important characteristic for the development of the saplings in the forestry nurseries. It suffers big variances in time according to various factors, among which: water interception from rain, outflow, infiltration, retention, capillary ascension etc. A larger quantity of soil moisture can be also obtained through its mobilization by different means of mechanic work.
Thus, this research presents the results obtained after the working of the soil through different methods on the physical properties (moisture and water resource), determined at the beginning of the vegetation season and at its middle for the scarified and non-scarified soil. The work method of the soil adjusts the main hydro-physical properties for the determination of the soil fertility in order to assure the productive consumption of the saplings and the avoidance of the loss through evaporation.
The usefulness of the present research consists in the research data collected, determined, analyzed and valorised in order to offer a pertinent study material which could indeed be used by specialists in envisaging the process of obtaining saplings in forestry nurseries and the choice of optimal tillage systems of the soil.

Key words: technical work, soil moisture, water resource

The soil is the environment of the growth and development of the saplings, because in it and through it there are the nutritive elements and the activity of the micro-organisms in the context of a normal thermo-aero-hydro regime. It can be penetrated by the roots of the plants, it is stirred, it contains water, air and living matter (flora and fauna) and it represents the necessary support for the growth and development of the saplings.

The characteristic of the soil as a growth and development environment for the plans is given by a series of properties (texture, structure, porosity, compaction, reaction, humus content and nutritive elements), expressed globally through the notion of fertility (Boja N. 2008).

The water determines the solubility, the transport and the assimilation of the mineral substances towards the saplings; the water is a soil component which ensures permanently the exchange of nutritive substances between the soil and the saplings. In addition, it confers other properties of the soil linked to its work method.

In the present, the water constitutes a vital problem for the growth and development of the saplings in the forestry nurseries, situation which imposes itself to be studied from all perspectives.

The works of the soil encompass technological processes with a general character, through which they can assure the favourable conditions for the accumulation of possibly larger quantities of water. The simplest information about the water in the soil can be taken by knowing its water quantity.

Knowing the soil humidity is important for the orientation of the water resource in the soil at the disposal of the plants, for the determination of the optimal moment of execution of the soil works and the ratio of watering (Ţopa D., 2007).

As the water consumption of the saplings is concerned, it is necessary to know the existent quantity of water in the soil, this constituting the water resource of the soil and it is expressed in m3/ha or in t/ha (Popescu I., 1984).

Soil moisture is an important characteristic for the development of the saplings in the forestry

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nurseries. It suffers big variances in time according to various factors, among which: water interception from rain, outflow, infiltration, retention, capillary ascension etc. A larger quantity of soil moisture can be also obtained through its mobilization by different means of mechanic work, but this aspect will derive after the processing of the soil in a classical and minimal tillage system.

The tillage system of the soil influences the processes linked to the movement of the water in the soil according to the intensity of the stirring and work method, which influence as well: interception, outflow, infiltration, capillary ascension or on the contrary the water loss in the soil (Rusu T., 2007).

By applying different work methods, the regime of the ecological factors in the soil are adjusted positively, which is finally felt in the fertility state of that soil.

The water resource is another physical indicator which reflects the water quantity stored on a certain surface, on its values depending a lot the further development of the saplings.

A recent concern of the research is the agro-physical foundation of the technological systems, the choice of the tillage system which has to take into consideration the type of soil, climate, relief and plant. The specialty literature emphasizes the importance and the place of the soil works, the technological systems in general, the modifications of the physical, chemical and biological state of the soil under their influence.

Our research takes into consideration the influence of the tillage system of the soil on some physical properties like moisture and water reserve, during 2005-2009 in the forestry nursery of Iarac.

MATERIAL AND METHOD

The research was carried out in the Iarac forestry nursery in O.S. Iuliu Moldovan during 2005-2009, on an alluvial soil (vertical-gleyed soil). The experiment is multi-factorial – the A X B type. The placement of the sample markets was carried out according to the "divided parcels method" in two repetitions, and the surface of the parcel was 80 m^2.

The factors considered:

Factor A Deep soil loosening:

- a_1 ploughed;
- a_2 scarified.

Factor B Soil work:

- b_1 plow + disc harrow 2X;
- b_2 disc harrow;
- b_3 grower;
- b_4 paraplow;
- b_5 rotary harrow.

This paper presents the results obtained after the soil processing through different methods on the physical properties (moisture and water resource), determined at the beginning of the vegetation season and at its middle for the scarified and non-scarified soil.

The work method of the soil adjusts the main hydro-physical properties for the determination of the soil fertility in order to assure the productive consumption of the saplings and the avoidance of the loss through evaporation.

This way, it could be determined the momentary moisture of the soil and the water resource accumulated during the period of vegetation. These hydro-physical properties are influenced by the type of soil work and are important both for the soil quality and for the saplings.

For the calculation of the water resource in the soil, both the soil moisture and the apparent density were determined at two moments: at the beginning of the vegetation season and at its middle. The soil moisture for the water was determined 10 out of 10 up to the 30cm/depth for each experimental variant.

RESULTS AND DISCUSSIONS

When choosing the work method of the soil, one needs to take into consideration not only the immediate ingredients, but also those on the long term, which assure the productivity and profitability, but they must be ecological and to preserve the soil and water resources.

The state of soil moisture modifies permanently according to the quantity of rain, the intensity of evaporation, the water consumption towards the saplings, the technical works carried out. The determination of the soil moisture has a high practical significance and one which is one of the most spread analyses of the soil in research and production.

The five-year research was characterized by a quite different pluviometer regime as it can be shown in Table 1 and this is why we considered taking into consideration the quantity of fallen rain in the analyzed interval.

In order to observe the influence of the work method on the moisture and water resource in the Iarac nursery, six determinations were made for the two physical indicators of the soil in steps from 10 to ten 10 up to 30 cm depth, for each experimented variant, in Tables 2 and 3 being given their average.

Table 1

Atmospheric rainfall-annual quantities (mm)

Meteorological station	2005	2006	2007	2008	2009
Arad (Iarac nursery)	732.2	582.7	695.5	560.7	592.6

Table 2

The soil moisture (%), according to the work method, year 2009

Deep breaking	Soil tillage	Depth, cm	Beginning of the vegetation season	Middle of the vegetation season
Witness sample		0-10	18.91	22.04
		10-20	17.14	22.18
		20-30	16.27	20.20
Soil ploughing	Plow + disc harrow 2X	0-10	25.37	26.38
		10-20	23.43	24.44
		20-30	21.86	22.87
	Disc harrow	0-10	22.81	24.79
		10-20	20.62	22.60
		20-30	20.01	21.99
	Grower	0-10	20.41	22.39
		10-20	19.34	21.32
		20-30	18.12	20.10
	Paraplow	0-10	16.60	18.58
		10-20	16.02	18.00
		20-30	13.93	15.91
	Rotary harrow	0-10	15.30	17.28
		10-20	15.93	17.91
		20-30	17.86	19.84
Soil scarifier	Plow + disc harrow 2X	0-10	27.37	27.75
		10-20	23.86	25.28
		20-30	25.43	26.85
	Disc harrow	0-10	23.70	25.12
		10-20	26.43	27.85
		20-30	23.51	24.93
	Grower	0-10	23.55	24.97
		10-20	21.62	23.04
		20-30	20.43	21.85
	Paraplow	0-10	23.13	24.55
		10-20	21.22	22.64
		20-30	20.05	21.47
	Rotary harrow	0-10	22.52	23.94
		10-20	20.15	21.57
		20-30	19.54	20.96

In order to analyze the variance of the two physical indicators, after each technical work, it became essential to compare them with the initial state of the un-dislocated soil, called henceforth witness sample.

In order to establish the co-relational dependence between the indicator and the sampling depth, through the analysis of the carriage, two equations were used as it follows: a linear one and a second degree polynomial.

The element of statistical nature which determined the choice of the corresponding curve was the coefficient of determination R^2. In all cases, the coefficient of determination for the second degree polynomial was lesser than that corresponding for the right line.

For each correlational dependence in the series of the five technical works carried out we tested two regression equations and the chosen one was that whose determination coefficient R^2 had the highest value. In the case in which the dependence between variables resulted as being linear, we also established the size of the simple correlation coefficient - r. Finally, we retained only four correlational dependences (fig.1 … fig.4), thus only those for which the influence of the independent variable represented more than 50% of the total influences on the dependent variable.

The correlational dependence between the soil moisture, U% (dependent variable) and the soil works, Ls (independent variable), emphasized that in the entire series of the influential factors on the resulting characteristic, the soil works are relevant

about 60%. The shape of the link is linear, of equation:

1. Ploughed soil (fig. 1)

- Beginning of the vegetation season: $U = -0.6743L_s + 24.568$, $R^2 = 0.828$ and $r=0.91$ (1)
- Middle of the vegetation season: $U = -0.6119L_s + 25.855$, $R^2 = 0.8035$ and $r=0.89$ (2)

2. Scarified soil (fig. 2)

- Beginning of the vegetation season: $U=-0.449L_s + 26.426$, $R^2 =0.7159$ and $r=0.85$ (3)
- Middle of the vegetation season: $U = -0.449L_s + 27.846$ $R^2 = 0.7159$ and $r=0.85$ (4)

The mechanical processing of the soil through traditional and modern methods is currently put under question due to the high energy consumption and the continuous degradation of the arable horizon through erosion and excessive compaction (Boja, N. 2010).

The soil processing in the classical tillage system leads to an excessive break-up through repeated interventions, leaving it without vegetal remains through the reversal of the clods in the ploughing process, thus being strongly eroded under the action of the water and wind (Boja N. 2010). Worldwide, there is the tendency to replace the classical tillage system of the soil, through the extension of the minimum work system, method recommended both from the point of view of the preservation of the soil and for the reduction of energy consumption (Boja N. 2009).

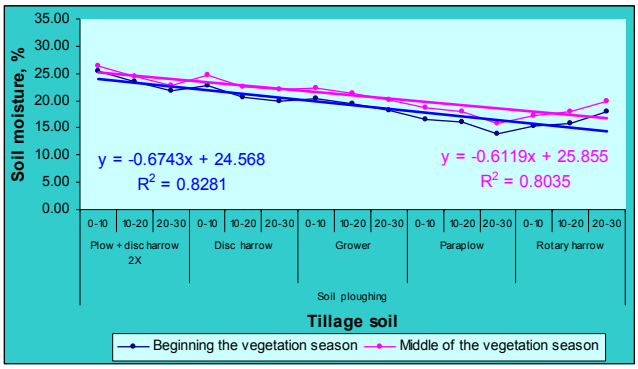

Figure 1 **The variance of the soil moisture according to the works of the ploughed soil**

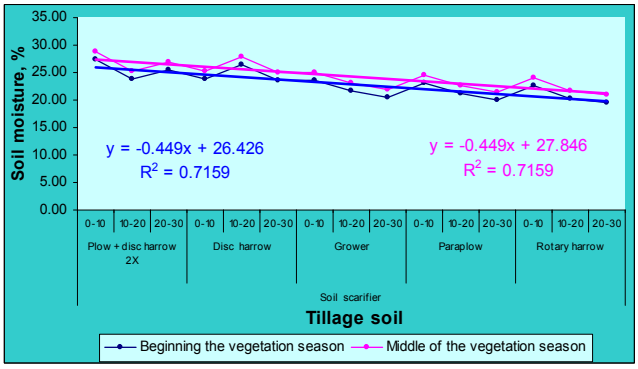

Figure 2 **The variance of the soil moisture of the soil according to the works of the scarified soil**

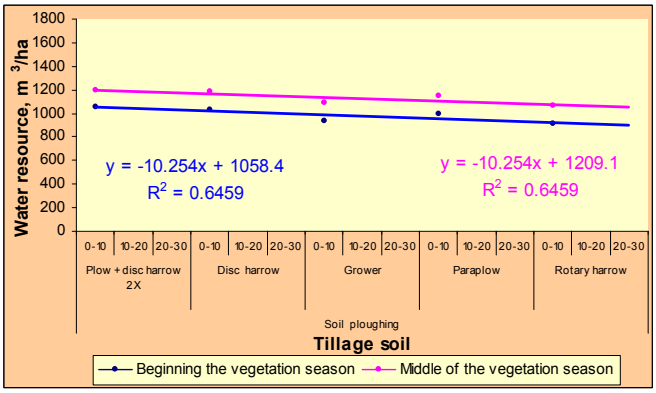

Figure 3 **The variance of the water resource according to the works of the ploughed soil**

Table 3

The water resource (m^3/ha), according to the work method, year 2009

Deep breaking	Soil tillage	Depth, cm	Beginning of the vegetation season	Middle of the vegetation season	Beginning of the vegetation season	Middle of the vegetation season
Witness sample		0-10	176.05	183.75	956.76	1047.98
		10-20	331.61	367.56		
		20-30	449.10	496.67		
Soil ploughing	Plow + disc harrow 2X	0-10	197.47	247.71	1050.87	1201.59
		10-20	323.04	373.28		
		20-30	530.36	580.60		
	Disc harrow	0-10	170.43	220.67	1034.28	1185.00
		10-20	369.73	419.97		
		20-30	494.12	544.36		
	Grower	0-10	166.01	216.25	933.70	1084.42
		10-20	316.20	366.44		
		20-30	451.49	501.73		
	Paraplow	0-10	132.43	182.67	1000.28	1151.00
		10-20	325.63	375.87		
		20-30	542.22	592.46		
	Rotary harrow	0-10	135.84	186.08	914.06	1064.78
		10-20	292.57	342.81		
		20-30	485.65	535.89		
Soil scarifier	Plow + disc harrow 2X	0-10	164.23	244.47	1122.09	1362.81
		10-20	292.65	372.89		
		20-30	665.21	745.45		
	Disc harrow	0-10	183.50	263.74	1120.55	1361.27
		10-20	323.92	404.16		
		20-30	613.13	693.37		
	Grower	0-10	160.63	240.87	1300.59	1541.31
		10-20	428.13	508.37		
		20-30	711.83	792.07		
	Paraplow	0-10	158.34	238.58	1282.16	1522.88
		10-20	421.96	502.20		
		20-30	701.86	782.10		
	Rotary harrow	0-10	194.21	274.45	1421.45	1603.17
		10-20	456.48	536.72		
		20-30	770.76	792.00		

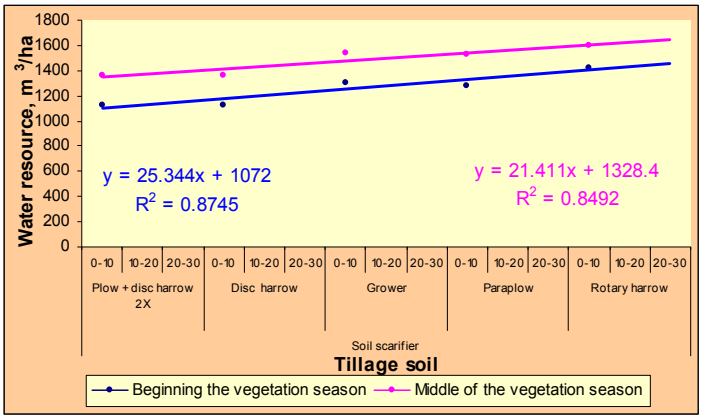

Figure 4 **The variance of the water resource of the soil according to the works of the scarified soil**

The correlational connections between water resource Ra m^3/ha, (dependent variable) and the soil works L_s (independent variable), have a linear shape of equation:

1. Ploughed soil (fig. 3):

- Beginning of the vegetation season: $U = -10.254L_s + 1058.4$, $R^2 = 0.6459$ and $r=0.80$ (5).

- Middle of the vegetation season: $U = - 10.254L_s + 1209.1$, $R^2 = 0.6459$ and $r=0.80$ (6).

2. Scarified soil (fig. 4):

- Beginning of the vegetation season: $U = 25.344L_s + 1072$, $R^2 = 0.8745$ and $r=0.93$ (7).
- Middle of the vegetation season: $U = 21.411L_s + 1328.4$ $R^2 = 0.8492$ and $r=0.92$ (8).

As a conclusion, we may infer that the soil works have a direct influence on the soil moisture and the water resource, determining the increase or decrease of these physical indicators according to the type of work.

CONCLUSIONS

After analyzing the soil moisture and the water resource observed during the soil processing by different methods, we can draw the following conclusions:

1. The analysis of the data collected shows that the highest value of soil moisture at a 30 cm-depth was obtained at the ploughed variance in the interval 0-10 cm, using the plough and the rotary harrow, while the lowest value was registered in the interval 20-30 cm when the soil processing was made with a paraplow.

2. At the scarified variance the highest value of soil moisture at a 30 cm-depth was obtained in the interval 10-20 cm using a disc harrow, while the lowest value was registered in the interval 20-30 cm when the soil processing was made with a rotary harrow.

3. The total quantity of water stored at a certain surface, expressed by means of water resource has maximal values for the ploughed variance when the plough and the disc harrow are used (1201,59 m^3/ha) and minimal values when the rotary harrow is used (914,09 m^3/ha).

4. At the scarified variance the highest value of the water resource is registered when the soil is processed with a rotary harrow (1603.17 m^3/ha) and the minimal values when the disc harrow is used (1120.55 m^3/ha).

5. In conclusion, it is important to keep in mind that the soil works have a direct impact on the moisture and water resource, determining the variance of these indicators at different levels of depth, frequently in a decreasing order from surface to depth, taking into consideration the quantity of rain fallen during the period analyzed, but also the depth at which the soil is dislocated.

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