ESTIMATING CARBON ACCUMULATION FOR THE FORESTRY SPECIES INSTALLED ON FIELDS UNSUITABLE FOR AGRICULTURE SITUATED ON THE TULCEA HILLS

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Abstract

The researches were performed in U.P.IV Heracleea canton 26 Malcoci from O.S. Babadag and aimed carbon assimilation by the forestry species based on the afforestation composition. From the measurements of the stalks performed on the seedlings from the plantations of five years old, with the help of the alometric equations, the results have been read statistically. The conclusion is that the afforestation composition influences the amount of carbon assimilated by the forestry species which compose it.

Key words: Assimilated carbon, alometric equations

INTRODUCTION

It is well known that at night plants release carbon dioxide through the respiration process, and in the day they absorb carbon dioxide which, with the help of solar light, by photosynthesis, is transformed in organic combinations, releasing oxygen.

In the last half of century, there were released in the atmosphere very large amounts of CO_2 and methane which, through the greenhouse effect, have lead to the beginning of the global warming phenomenon.

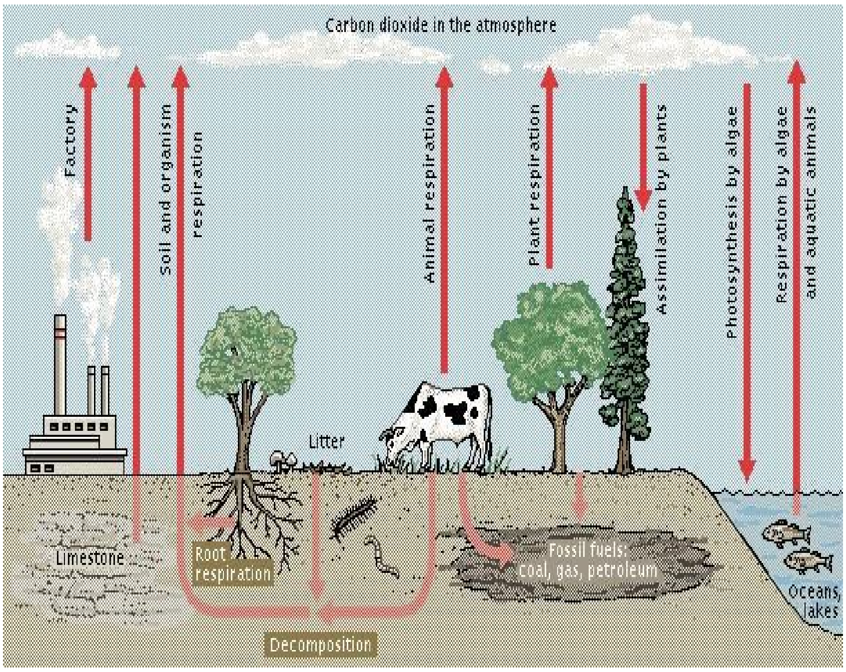

Figure 1. Carbon cycle in the nature

The purpose of the forestry vegetation installation is to assimilate and stock a certain amount of carbon dioxide in the trees and to release oxygen, thus in the forests occure both inputs and outputs of carbon. Carbon assimilation by the wooden vegetation is realised through photosynthesis and the outputs are realised through respiration.

In the case of the forestry ecosystems, the annual accumulation of dead organic residues made of leaves, branches and even full trees which die and fall on the ground forms the forestry litter or the dead carpet. This, together with the roots, the tubers, the rhizomes and the dead animals form the dead organic matter. A part of this matter will mineralise, rapidly releasing CO_2 back to atmosphere, and the other part will humify generating the humus, an organic product with a complex structure, very rich in carbon (Târziu, 2006).

MATERIAL AND METHOD

The biomass of the species is calculated with the help of the alometric equations for the forestry species which are specific to the studied area, with seedlings aged till 6 years. In the speciality literature (Blujdea, 2009), in order to ease calculations, the carbon content is estimated as being 50% of the entire dried material for biomass. As a result, the stored carbon mass is calculated to the formula:

Cm =Dried biomass x 0, 5; where:

Cm- Carbon mass stored in the biomass

This value has been calculated taking into account the main components (lignin, hemicelluloses, pectin) and secondary of the wood, the last ones having a reduced content of carbon. The carbon quantity varies after the proportion of the chemical components of the wood, as an example in cellulose ($C_6H_{10}O_5$), the carbon participation is approximate of 44,44%; the hemicelluloses ($C_5H_8O_4$) has an approximate content of 42% carbon and the lignin around 64%, (Beldeanu, 2008).

Six forestry species grouped in four afforestation compositions have been installed in the studied area on the same stationary conditions.

The purpose of this research consists in the fact that having determined the alometric equations for each species, one can calculate the carbon amount stored by the seedlings through the initial calculation of the biomass.

The emplacement of the experimental parcels has been made so that they reproduce as close as possible the specific conditions from the studied plantations.

The experimental parcels are situated in plantations realised in 2006, on flat grounds or slight slopes which were laboured on the entire surface through ploughing and harrowing (Table 1)

Table 1

The surfaces subject to analyse

Nr. crt.	U.P.	Parcel	Surface (ha)	Overall surface of the experimental parcels (mp)	The afforestation composition %
1	IV	251B	1,1	400	100%Greyish Oak
2		251E	3,47		100%Ac
3		256C	1,0		40%Gr.Ok.20%As20%Fl20%Ol
4		254E	4,13		25%Gr.Ok.50%El 25%Ol

Gr.Ok-Greyish Oak, As-Common Ash, Fl-Flowering Ash, Ol-Oleaster, Ac-Accacia, El-Elm

In order to obtain biomass for the planted species, there has been measured the diameter of the stalk, as being the independent variable. The measurement of the diameter for the forestry seedlings from the experimental parcels has been made with a calliper and the result was read in mm.

The results of the measurements had been recorded on the field sheets and centralized at the office.

For the interpretation of the results from the statistical point of view for each species and each seedling, the biomass has been calculated with the help of the alometric equations. The obtained biomass was added in every experimental parcel, thus being obtained the biomass of the seedlings at 100 mp.

RESULTS AND DISSCUSIONS

The primary results have been interpreted with the help of the alometric equations which had been elaborated by the ICAS collective under the guidance of prof. dr. ing. Blujdea V. and published in „Monitoring report from July 27, 2009" the 3rd version. The data which led to the elaboration of the alometric equations had been collected from the eastern part of the country and Tulcea district, through the plantations installed between 2002 and 2004 from Agighiol perimeter.

The alometric equations have been applied to each species from the afforestation composition. In Table 2, there are presented the afforestation compositions and the alometric equations.

Table 2

The alometric equations based on species

U.P.	u.a.	The afforestation composition	The participation proportion%	The alometric equations
IV	251B	Greyish Oak	100	$BT=1,3396 \times Dc^{1,7837}$
	251E	Oleaster	100	$BT=0,2165 \times Dc^{2,4848}$
	256C	Greyish Oak Common Ash Flowering Ash Oleaster	40 20 20 20	$BT=1,3396 \times Dc^{1,7837}$ $BT=1,0795 \times Dc^{1,8165}$ $BT=1,0795 \times Dc^{1,8165}$ $BT=11,39 \times Dc$
	254E	Greyish Oak Elm Oleaster	25 50 25	$BT=1,3396 \times Dc^{1,7837}$ $BT=1,2288 \times Dc^{1,8814}$ $BT=11,39 \times Dc$

The plantations were of maximum five years old.

For every species from the afforestation composition there has been calculated the average diameter of the stalk in mm. By introducing the average diameter in the alometric equation formula there resulted the dry biomass, in grams, of a specimen from the measured species, the dry mass of the components of the tree (root, stalk, branches, leaves).

In conclusion, for each afforestation formula, there has been obtained four different results of the existent biomass on the surface of 100mp.

Considering these results, it has been passed to *The simple analyse of the variance* in order to establish whether there are differences between the afforestation compositions regarding the quantification of carbon on young plantations.

The obtained results after the measurements were centralised and then, with the help of the alometric equations, it was calculated the biomass and based on the biomass it was determined the carbon mass. The dry biomass results obtained through the alometric equations are determined in grams.

The carbon mass used in calculations was given in kilograms.

In Table 3 there are presented the determined values for every experimental parcel, calculated as being the sum of the values calculated with the help of the alometric equations for every species and specimen.

Table 3.

The carbon mass based on the afforestation compositions

U.P.	u.a.	The variant	The afforestation composition%	The carbon mass in the experimental parcels 1-4 kg			
IV	251B	V_1	100Gr.Ok	17,45	46,63	36,01	22,31
IV	251E	V_2	100Ac	94,77	110,07	108,00	101,51
IV	256C	V_3	40%Gr.Ok20As20Fl20Ol	33,23	39,55	34,15	33,83
IV	254E	V_4	25Br.Ok.50El25Ol	11,26	9,39	9,18	9,28

Gr.Ok-Greyish Oak, As-Common Ash, Fl-Flowering Ash, Ol-Oleaster, Ac-Accacia,

El-Elm

Analysing the data from the above table one can observe that there are differences regarding the carbon quantity stored at the level of afforestation composition. This means that the species which make the afforestation composition of a plantation influences the stored carbon quantity.

For a detailed analysis on the existence of significant differences between the afforestation formula we proceed to analyze the four variants using *The Simple analyse of the variance*.

In this concern, it is determined the average carbon amount stored in the four afforestation compositions.

Table 4.

The carbon mass based on the afforestation compositions for the plantations of 5 years old

Variants	The carbon mass in the four experimental parcels Kg				N nr. of variants	Sum	Average
V1	2,54	4,8	3,60	2,23	4	13,25	33
V2	60,95	83,01	92,50	103,98	4	340,43	85,11
V3	23,65	31,27	28	29,26	4	112,17	28,04
V4	11,26	9,39	9,18	10,24	4	40,07	10,02
Total					**4**	**505,93**	

In order to analyse the data obtained with the help of the distribution of the test F (Fischer), it is verified if there are differences between the formulas. With this purpose, it is determined the experimental value of the test F, which is compared with the theoretical value F (extract from the table for the probability of admitted transgression 5%), presented in Table 5.

Table5.

The results from the analyse of the variant

The source of the variation	The sum of the squares of the deviations	The number of the degrees of freedom	The variance	F value	
				Experimental	Theoretical
Between the afforestation compositions	16.566,73	3	5522,24	63,89	F 0,05 3,41
Residual	1073,14	12	86,43		F 0,01 5,74

From the analyse of Table 5 there results that the experimental value F is bigger than the theoretical value F (Giurgiu, 1972).

This means that for the taken into account variants there are significative differences regarding the carbon amount stored at species based on the afforestation compositions. Thereby the analyzed afforestation formulas differ significantly, which is why it will be applied the t test.

With the help of the t test it will be established the signification of every difference between the averages of the afforestation composition types.

Previously, the error of the difference s_d is calculated.

Then, the *limit differences* are determined for different probabilities of transgression, thus being obtained the following results:

$DL_{5\%}$ = 14,32;

$DL_{1\%}$ = 20,08;

$DL_{0,1\%}$ = 28,38;

All the values obtained from the t test have been centralised in Table 6, where the differences between the variants represented statistically have been presented depending on the symbols. The signification of the differences is established by comparison.

Table 6

The influence of carbon storage depending on
the afforestation compositions

The afforestation composition	Average	Differences			
		II	**III**	**IV**	**I**
V_2	85,1		57,06***	75,09***	81,79***
V_3	28,04			18,02*	24,73**
V_4	10,02				6,71
V_1	3,31				

* Significant difference;** Distinct significant difference *** Very significant difference

CONCLUSIONS AND RECOMMENDATIONS

Taking into account the above mentioned, we consider some conclusions can be drawn regarding the carbon assimilation by the forestry seedlings installed according to afforestation compositions.

The species found in the afforestation compositions affect the quantity of carbon stored in a plantation.

It is recommended that the afforestation of the grounds unsuitable for agriculture to be formed not only from seedlings of greyish oak but this one to be introduced in association with other species.

REFERENCES

1. Blujdea, V., 2009 :published in „Monitoring report from July 27, 2009” the 3rd version..
2. Târziu D.,1997: Pedology and forestry resorts, Ceres Publishing House, Bucureşti;
3. Giurgiu.V., 1972 : Methods of the statistics mathematic applied in forestry, Ceres Publishing House, Bucureşti;
4. Stănescu V., Sofletea N., Popescu O., 1997: The wooden forestry flora of Romania, Ceres Publishing House, Bucureşti.
5. Nijnik, M., Bizikova, L. 2008, Responding to the Kyoto Protocol through forestry: A comparison of opportunities for several countries in Europe, Forest Policy and Economics 10, pp.257-269.
6. Abrudan I.V., Afforestation, The Publishing House of “Transilvania” University, Braşov 2006;
7. *** 2005, Amanajamentul Ocolului Silvic Babadag.
8. *** Technical guidelines regarding compositions, schemes and technologies for the regeneration of the forests and for the afforestment of the degraded grounds; (Nr.1)

9. *** Ecological forestry reconstruction on the grounds taken from the agricultural grounds on the basis of H.G.2259/2004, constituted in the Agighiol-O.S.Babadag improvement area.
10. *** Technical guidelines regarding compositions, schemes and technologies for the regeneration of the forests and for the afforestment of the degraded grounds; (Nr.1).
11. *** 2003 Cartea pădurarului.