RESEARCH ON 5724 TURKEY OAK-SESSIL OAK WITH COMMON HORNBEAM MIXED STAND WITH *GLECHOMA-GEUM* (REGIONAL VARIANT WITH STAGNANT LUVOSOL OF A NEW TYPE) WITHIN THE SEGMENT OF LANDSCAPE SITUATED ON LOW WESTERN HILLS OF TINCA FOREST DISTRICT

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RESEARCH ARTICLE

Abstract

Forest typology evolved from the necessity of differentiating management measures of the forests according to composition, structure, productivity, features of the stands, i.e. after their eco-systemic features (Doniță et al., 1990). In this type of forest ecosystem the nucleus of constant species consists of: Quercus polycarpa, Q. cerris, Crataegus monogyna, Rubus hirtus, Ligustrum vulgare, Geum urbanum, Glechoma hirsuta, Stellaria holostea, Galium schultesii, Ajuga reptans, Geranium robertianum, Stachys sylvatica, Mycelis muralis, Euphorbia amygdaloides, Lapsana communis, Veronica officinalis, V. Chamaedrys, Festuca heterophylla, Poa nemoralis, Melica uniflora

Keywords: forest ecosystems, geographical segment landscape, ecological landscape environment, sustainable forestry

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INTRODUCTION

The Low Hills, situated in the southwestern part of the study area, have average altitudes of 200-300 m, have reduced vertical fragmentation, with flat or slightly curved interfluves, elongated slopes and mid values inclinations. The valleys are rare, the clay deposits conditioning the formation of heavy soils, and on slopes the clay-loam deposits, with alternation of sand and gravel deposits, conditioning the formation of normal hydric soils.

The relief is fragmented by valleys, the slopes being the main relief form, but also extended plateaus. On slopes, the sedimentary formations of sand, loam, clay, gravel, caused the formation of basic stagnic luvisols, at most mid basic, with a well-balanced hydric regime and on few areas eutricambosoils, more fertile and with a well-balanced hydric regime.

The aim of the study was to establish the main forest ecosystem type within Tinca Forest District and to establish the state of these ecosystems in order to find the best management solution for a sustainable use, preserving and conserving the optimum biodiversity of the forest. The aim of the research was also the scientific fundamentation, very useful both in forest management and in applied forestry, in order to find the best management solutions for a sustainable use. The soil indicators herbaceous and shrub layer consists of: *Festuca drymeja, Carex pilosa, Asperula-Asarum-Stellaria.* These types characterize stationary low-hill ecosystems where there are also soils with higher trophic levels, with balanced hydric regime, due to richer precipitation and permeable soils. Also, in the western low hills we meet: *Genista-Glechoma-Geum* type*.* This characterizes the ecosystems on moderately acid - weakly acid soils, with more a medium trophicity and with a quasi-balanced water hydric regime.

MATERIAL AND METHOD

The locations of the research are the forests administrated by Tinca Forest District; the study has started in 2021 and continued in 2022.

The forest ecosystems were analyzed according to **location** within the study area; **the features of the ecosystem type**: surface area, geographical parameters (average altitude, altitude range); relief forms: types, inclination of the slopes, slope exposition, lithology, soil types and subtypes, ecological limitative factors); the description of the stands, the

description of the herbaceous layer; the **correspondence with**: types of forests, types of stations, plant associations, types of habitat, **present state of the stands and management measures (particularities)**: main features, distribution according to age classes, the source of main elements, natural regeneration, productivity classes, management measures, variability and succession tendency (forms of type, successional tendencies and forest facies).

The description of the forest ecosystem was made based on collected field data. In order to analyze the collected data were used different softwares, such as Excel, ArcGis.

After determining the types, they were mapped by researching all the planning units and classifying them into types, considering the composition of the trees, the type of grass-subshrub layer, the type of humus (Moțiu and co., 2011; Moțiu and co., 2012). The delimitation method of the forest ecosystems had as base some typological schemes made for the study area (for ex forest corps) (Moțiu and co., 2011; Moțiu and co., 2012). The landscaping units with non-native species cultures were classified into types based on the type of resort.

RESULTS AND DISCUSSIONS

TYPE OF ECOSYSTEM: 5724 Turkey oak-Sessil oak with common hornbeam mixed stand, high and medium productive on typical and stagnant luvosols, oligo-mesobasic, hydric quasi-balanced with *Glechoma-Geum* (regional variant with stagnant luvosol of a new type of ecosystem)

Subtypes:

57241 highly productive subtype

57242 mid productive subtype.

Dispersion: this type of forest ecosystem is distributed in the low hills within: U.P.II - Trup Coltău - Şirinca; U.P.III - Trup Pădurea Gorunului, Trup Gânţei; U.P.IV - Trup Tinca - Topile, Trup Cărănzel, Trup Dumbrava, Trup Valea Mare, Trup Holod - Hodiş, Trup Cărăndeni, Trup Bicăcel, Trup Miheleu - Topile; U.P.V - Trup Hodişel, Trup Măgura.

Characteristics of the type of ecosystem within the researched area:

a. Surface: 3357 ha.

b. Forest sites:

- average altitude 225 m (altitude variation 150-300 m);

- relief: by shape - middle and lower slope, less often upper slope and plateau; by slope: moderate and strong slopes, flat terrain; after the exhibition - mostly shady or partly sunny slopes, rarely sunny;

- type of rock: sandy clays alternating with clays, sands, gravels

- types and subtypes of soil: Typical and stagnant Luvosoil, rarely Eutricambosols;

- limiting ecological factors: soils with higher compactness in the Btw horizon, the decrease in soil moisture in the second part of summer, especially on sunny slopes, celery soil at low consistencies.

c. Compositions of the stands: in the dominant floor of *Quercus petraea ssp. polycarpa,* rarely and *Quercus petraea ssp. dalechampii, Quercus cerris,* in varying proportions, more rarely *Quercus robur, Quercus frainetto, Prunus avium, Acer pseudoplatanus;* in the dominated floor it is met *Carpinus betulus* on 10-60% of the surface, *Sorbus torminalis, Acer campestre, Acer tataricum. Quercus frainetto* achieves the facies proportion in some situations.

d. Compositions of the sub-stands: *Crataegus monogyna, Rubus hirtus, Ligustrum vulgare; Cornus mas, Rubus caesius and Rosa canina* it may occur with reduced frequency. Shrubs are generally variably developed and spread unevenly, in the portions with less hornbeam, covering 5% - 30% of the surface. *Carpinus betulus* it is also present in the subtree level, covering 5% - 50% of the surface, in some situations *Acer tataricum, Acer campestre* and *Quercus cerris* can still be found.

The subtree is variably developed, covering 10% - 50% of the surface, depending on the degree of illumination.

e. Composition of the herbaceous layer: *Geum urbanum, Glechoma hirsuta, Stellaria holostea, Galium schultesii, Ajuga reptans, Geranium robertianum, Stachys sylvatica, Mycelis muralis, Euphorbia amygdaloides, Lapsana communis, Veronica officinalis, V. chamaedrys, Festuca heterophylla, Poa nemoralis, Hieracium umbellatum, Carex sylvatica, C. divulsa, Melica uniflora, Dactylis polygama, Potentilla micrantha, Lychnis coronaria, Lysimachia nummularia, L. vulgaris, Juncus effusus, Viola reichenbachiana.* In some surfaces with more clayey soils, the presence of the *Carex pilosa,* marks the middle productive subtype.

Among the sub-shrub species can be found *Chamaecytisus hirsutus* and *Cytisus nigricans*.

Among the lianas they can be found *Hedera helix* and *Tamus communis*.

The grassy layer is developed unevenly, in patches, with variable coverage of 10% - 50% of the surface, depending on the degree of illumination.

Figure 1: **Turkey oak-Sessil oak with common hornbeam mixed stand with Glechoma-Geum in u.a. 94E, U.P.IV Topile area, (photo - P.T. Moțiu)**

Correspondence with:

- **Forest types[2]: 7115** - Sessile oak - Quercus cerris of superior productivity(s); **7511** – hill Șleao- Quercus cerris with Sessile oak (m) (situations without Tilia);

- **Resort types[3]: 6.3.1.1.** – Hilly oak (Sessile oak, Quercus cerris **±** Quercus frainetto) Pm, luvosols, including whitish luvosols (**± hypostagnic**) medium edaphic, with mesoxerophyte grasses; **6.3.1.2.** - Quercus frainetto (Quercus petraea, Quercus petraea - elms, hilly elm with Sessile oak **± Quercus cerris, Quercus frainetto)** Ps, luvosols (**± hypostagnic**), highly edaphic, with mesoxerophytic grasses and elements of mull flora;

- **Vegetable associations[4]:** *Quercetum petraea - cerris* Soó 57 (mostly);

- **Type of habitat[5]: R4132** - Pannonian-Balkan sessile oak forests (*Quercus petraea*) and Oak (*Quercus cerris*) (beech) (*Fagus sylvatica*) with *Melittis melissophyllum.*

The current state of stands and management measures (peculiarities):

f. The structure of the stands: Figure 2 shows the distribution of the number of trees by diameters, and Figure 3 shows the vertical and horizontal structure of a representative arboretum, inventoried in u.a.94E, U.P.IV. Composition of the tree: 3Go 3Ce 3Ca 1Fa, 95 years old, number of trees per hectare: gorun - 60, cer - 24, hornbeam - 200, beech - 28.

g. Distribution according to age intervals: 0-5 years old - 1%; 6-10 years old - 13%; 11-20 years old - 11%; 21-40 years old - 23%; 41-80 years old - 50%; over 80 years old - 6%.

h. The source of the main elements of the stand: sessile oak - natural sowing 25%, shoots 58%, plantation 17%; turkey oak - natural sowing 28%, shoots 66%; common hornbeam - natural sowing 25%, shoots 75%; common beech - natural sowing 100%.

[2]Forest types are cited from N. Doniță et al., 2005.
[3]Resort types are cited from F. Dănescu, C. Costăchescu, Elena Mihăil, 2010.
[4]Vegetal associations are cited from N. Doniță et al., 1990, and the types of new ecosystems, after V. Sanda, A. Popescu, D. I. Stanciu, 2001.
[5]The habitat types are cited from N. Doniță et al., 2005.

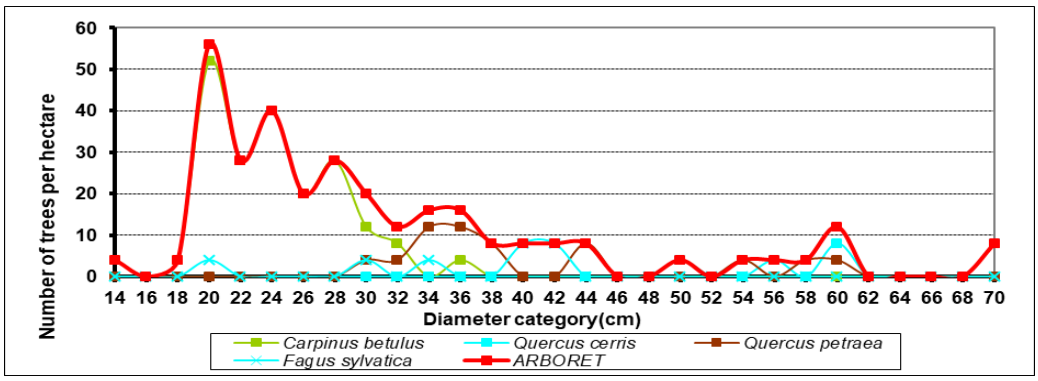
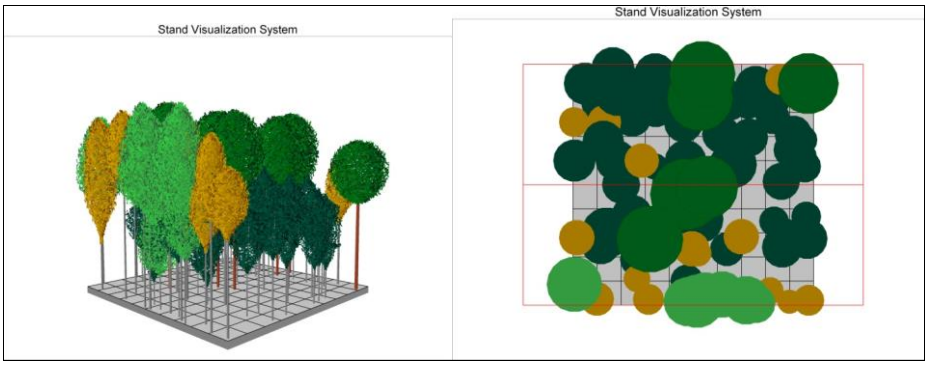


Figure 2: **The distribution of tree numbers per hectar in stand, according to diameter categories and species in u.a. 94E, U.P.IV Topile area**



Legend:

Quercus petraea *Quercus cerris* *Carpinus betulus* *Fagus sylvatica*

Figure 3: **The diagram of vertical structure (left) and plan projection of the canopy (right) for test plot of 1250 sqm, using SVS software, 3.36 version, in u.a. 94E, U.P.IV Topile area**

i. Production classes of the main species of the stand: Go cl III/II; Ce cl III/II; Ca cl III/IV; Ca cl II.

j. Natural regeneration through seeding: active especially in case of Quercus cerris, but also in case of Quercus petraea and Fagus sylvatica, weak in case of Quercus robur, good in case of Acer campestre, Sorbus aucuparia, Prunus avium.

k. Indicated composition: 6Go 2Ce(St,Gâ) 2Ca,Sr,Ju,Ar,Pă.

l. Management measures on age intervals: 0-5 years - uncovering natural regenerations and/or plantations especially of species of the genus *Rubus*, complementing the regenerations with sessile oak plantations to increase the proportion of this species and with mixed species if needed; 6-10 years – removal of oaks, removal of Eurasian aspen and of goat willow; 11-20 years - proportioning the mixture, through cleanings, keeping enough species of the mixture in addition to the oak; 21-40 years - choosing the trees of the future (come from the seed) and applying the first combined thinning around these trees; 41-80 years - continuing the combined thinning, proportioning the mixture to achieve the target composition; over 80 years - combined low-intensity thinning, if necessary, applying hygiene cuts and helping the natural regeneration of the main species by cutting the hornbeam sublevel and the too dense subtree.

m. Other management measures: the conversion of stands originating from shoots, either through natural regeneration, to fruiting, or through restoration; replacement of hornbeam and of stands with non-native species, stationary not indicated, with trees of native species.

n. Variability and successional trends (forms of type, successional tendencies and forest facies): within this type of forest ecosystem, the natural tendency is to eliminate sessile oak by the turkey oak and hornbeam, in

high quality resorts, with Eutricambosol soil (especially in the lower third of the slopes) producing the natural succession towards the type of ecosystem **7214** - Turkey oak with common hornbeam stand with *Arum-Brachypodium*. On sunny or partially sunny slopes, we find the transition form to the type **5524** - Turkey oak-Sessile oak with common hornbeam mixed stand with *Asperula-Asarum-Stellaria*, and on shaded slopes we meet the form of transition to the type **5225** - Sessile oak with common hornbeam stand with *Carex pilosa*. On flat places we find the form of transition to the form of a plateau with sessile oak within the type **7135** - Turkey oak stand with *Genista-Festuca heterophylla*. **Silvofacies**: with sycamore, Norway maple, cherry and wild service tree (mix in bouquets or groups with coverage up to 40% in the composition of the stand); with manna ash, with black alder - near the valleys, where the seasonal conditions are favorable for these species, they achieve the 2nd class of production.

o. Observations: In favorable conditions (with Eutricambosol soils), on high-quality resorts, hornbeam achieves the 2nd class of production.

Lower productivity on soils with a compacted B horizon (marked by the presence of the Carex pilosa species); the tendency of partial or total derivation through the elimination of sessile oak and replacement with hornbeam.

It is the stagnant luvosol regional variant of a new ecosystem type.

CONCLUSIONS

Knowing the physical-geographical conditions of the territory in which researches were carried out, are important for knowing the ecological complex of factors and determinants of the forest ecosystem biotope (forestry resort) (Chiriţă et al., 1964; Chiriţă et al., 1977). Therefore, it is evident that the regional variants of forest ecosystem types arise due to the influence of regional variants of climate and soil – pedogenetic sub-layers.

Regarding the regional particularities of ecosystem type

The regional variant of the turkey oak-sessile oak ecosystem type with hornbeam with Glechoma-Geum, is given by the formation on soils with greater compactness in the Btw horizon. Another characteristic of the soil types and subtypes is the decrease in soil moisture in the second part of the summer, especially on sunny slopes, resulting in soil compaction at reduced stand densities.

The higher the proportion of hornbeam in the stand, the better the seasonal conditions, the type of ecosystem evolving, obtaining higher productivity.

Silvicultural recommendation

Keeping hornbeam regeneration under control, within the application of silvicultural treatments, to achieve the succession of stands in good conditions, with optimal compositions for the type of forest ecosystem. Treatments with repeated cuts and regeneration under the massif are recommended, and more precisely, the treatment of progressive cuts through which the mixture can be better proportioned in favoring the sessile oak instead of turkey oak. Preparatory cuts are mandatory to extract badly shaped hornbeam specimens with defects, especially those originating from shoots; thus avoiding the transmission of their genetic characteristics in the future tree, improving the gene pool of the hornbeam population and at the same time, maintaining the desired proportion of hornbeam.

This priority of this period is to establish types of forests ecosystems on small geographic units, at the level of landscapes, the typology having thus a strong regional feature.

We tried, as the research of this paper to establish ecosystem-based forest type principal existing in a territory smaller but representative low western hill within Tinca Forest District, to state the current status of types and propose appropriate management measures this state and designed to bring a type similar to the natural state.

Regarding forestry measures by type of forest culture have revealed that there were concerns relating to differentiating normal types but not the present state of the as result of more or less proper management methods. Forester practitioner is forced to differentiate on the basis of this action and the current state of forest types that manage them

REFERENCES

Beldie Al., Chiriţă C., 1967, *Flora indicatoare din pădurile noastre*. Editura Agro-silvică, Bucureşti.

Ciocârlan, V., 2000, *Flora ilustrată a României*. Editura Ceres, București.

Chiriţă C., Tufescu V., Beldie Al., Ceucă G., Haring P., Stănescu V., Toma G., Tomescu Aurora, Vlad I., 1964, *Fundamentele naturalistice şi metodologice ale tipologiei şi cartării staţionale forestiere*. Editura Academiei, Bucureşti.

Chiriţă C., Vlad I., Păunescu C., Pătrăşcoiu N., Roşu C., Iancu I., 1977, *Staţiuni forestiere*. Editura Academiei R.S.R., Bucureşti, p. 518.

Cristea, V., Gafta, D., Pedrotti, F. 2004, *Fitosociologie*, Editura Universitară Clujeană, ClujNapoca.

Dănescu F., Costăchescu C., Drăgan Dorina, 2010, *Corelarea Sistemului român de clasificare a solurilor cu (SRCS, 1980) cu Sistemul român de taxonomie a solurilor (SRTS, 2003)*. Editura Silvică, București p. 80.

Dănescu F., Costăchescu C., Mihăilă Elena, 2010, *Sistematica stațiunilor forestiere*. Editura Silvică, București, p. 253.

Doniţă N., 2004, *Tipologia forestieră integrată şi sarcini de viitor ale tipologiei forestiere în România*. Revista Pădurilor, No. 2/2004.

Doniță N., Chiriță C., Stănescu V. et al., 1990, *Tipuri de ecosisteme forestiere din România*, C.M.D.P.A., I.C.A.S., București.

Doniţă N., Popescu A., Păucă-Comănescu Mihaela, Mihăilescu Simona, Biriş I., 2005, *Habitatele din România*. Editura Tehnică Silvică, Bucureşti.

Doniţă N., Borlea F., Turcu D., 2006, *Cultura pădurilor*. Editura Eurobit, Timişoara, p. 367.

Florescu I., Nicolescu N., 1996, *Silvicultura, Vol. I, Studiul pădurii*. Editura Lux Libris, Braşov, p. 210.

Florea, N., Munteanu, I., 2003, *Sistemul român de taxonomie a solurilor (SRTS)*. Editura Esfalia, București.

Florescu I., Nicolescu N., 1998, *Silvicultura, Vol. II, Silvotehnica*, Editura Universităţii Transilvania din Braşov, p. 194.

Giurgiu V., 2004, *Probleme actuale ale tipologiei forestiere Româneşti*. Revista Pădurilor, No. 2/2004.

Mc.Gaughey, Robert J., 1999, *Stand Vizualisation System (SVS vers. 3.36)*. USDA Forest Service, Pacific Northwest Research Station.

Moţiu P.T., 2004, *Caracteristici dendrometrice ale unor specii alohtone cultivate în O.S. Tinca, Jud. Bihor*. Analele Universităţii din Oradea, Fascicula Silvicultură, pp. 135-144.

Motiu P.T., Bartha Sz., 2006, *Progresive clear-strip felling simplified in total regeneration stand*, The 4thInternatinal Symposium „Natural resources and sustainable development". Annals of the University of Oradea, Forestry Fascicula. University of Oradea Printing House, pp. 407-410.

Moțiu, P.T., 2011, *Typological research of forest ecosystems from Crișul Negru Plain and Hills of Tăşad*. EdituraUniversităţii din Oradea, pg. 580 -588.

Moțiu P.T., 2011. *Contributions to sustainable management measures, based on the type of forests from Crișul Negru Plain and Hills of Tăşad*. EdituraUniversităţii din Oradea, pg. 589 - 598.

Moțiu P.T., Bucur L., Nistor S., 2011, *Contribution to the typological substantiation of the forestry using gis tools in Crișul Negru plain and Tășadului Hills*. Annals of the University of Oradea, Forestry Fascicula, University of Oradea Printing House, pp. 572-579.

Moțiu P.T., Bucur L., Nistor S., 2012, *Researches on types of forest ecosystems in the Crisul Negru Low Plain*. Annals of the University of Oradea, Forestry Fascicula, University of Oradea Printing House, pp. 516-529.

Moțiu P.T., Bucur L., Nistor S., 2012, *The methodology of elaboration researches regarding typology studies and typological mapping of forest ecosystems in Crisul Negru Plain and Tasadului Hills.* Annals of the University of Oradea, Forestry Fascicula, University of Oradea Printing House, pp. 507-516.

Moțiu P.T., Bucur L., Nistor S., 2013, *Research on 5225 forest ecosystem type sessil oak with common hornbeam with Carex pilosa within the segment of landscape situated on low hills of Tinca forest district.* EdituraUniversităţii din Oradea, p. 453 - 462.

Motiu P. T., Bucur L., Nistor S., 2013, *Research on 7214 forest ecosystem type turkey oak with common hornbeam with Arum-Brachypodium within the segment of landscape situated on high plain of Tinca forest district.* EdituraUniversităţii din Oradea, p. 463 - 472.

Motiu P. T., 2014, *Research of the Main Types of Forest Ecosystems on the West Crişana Low Hills.* Editura Universităţii din Oradea, p. 503 - 508.

Motiu P. T., 2015, *Research of the Main Types of Forest Ecosystems on the West Crişana Piedmont Plain.* Editura Universităţii din Oradea, p. 325 - 332.

Motiu P. T., 2016, *The importance of knowing geology and geomorphology of a territory regarding typological research on geographical landscape segments*. Editura Universităţii din Oradea, p. 437 - 444.

Motiu P. T., 2017. *Research on 4236 forest ecosystem type european beech stand with Festuca drymeja within the segment of landscape situated on low western hills of Tinca forest district.* Editura Universităţii din Oradea, p. 203 - 210.

Motiu P. T., 2018. *Research on 5535 forest ecosystem type sessil oak-turkey oak-hungarian oak mixed stand with Genista-Festuca heterophylla (regional version on stagnic luvosoles) within the segment of landscape situated on low western hills of Tinca forest district.* Editura Universităţii din Oradea, p. 135 - 144.

Motiu P. T., 2019. *Research on 7135 forest ecosystem type turkey oak with Genista - Festuca heterophylla (regional version with common oak - sessil oak - hungarian oak mixed stand) within the segment of landscape situated on high plain of Tinca forest district.* Editura Universităţii din Oradea, p. 147 -156.

Motiu P. T., 2020. *Research on 4636 forest ecosystem type sessil oak-european beech mixed stand with Festuca drimeja (regional version with common hornbean and turkey oak) within the segment of landscape situated on low western hills of Tinca forest district.* Editura Universităţii din Oradea, p. 181 - 190.

Motiu P. T., 2021. *Research on 6833 forest ecosystem type common oak-turkey oak mixed stand with Agrostis-Carex brizoides (regional version of a new type of ecosystem) within the segment of landscape situated on hight western plain of Tinca forest district.* Editura Universităţii din Oradea, p. 195 - 202.

Paşcovschi S., Leandru V., 1958, *Tipuri de pădure din R.P.R.*, Editura Agro-Silvică, Bucureşti.

Paşcovschi S., Avram C., Constantinescu N., Petrescu L., Popa G., 1964, *Complexe de măsuri silvotehnice pentru tipuri de pădure din Republica Populară Română*. Editura Agro-Silvică, București.

Târziu D.R., 2006, *Pedologie și stațiuni forestiere*. Editura Silvodel, Brașov.

Târziu D., Spârchez G., Dincă L., 2004, *Solurile României*. Editura „Pentru viață".

* * *, 1999, *Amenajamentul O. S. Tinca - Studiul general*. Bucureşti.

* * *, 2004, *La typologie des stations forestières. Inventaire Forstier National*.

* * *, 2007, *Amenajamentul O. S. Tinca - Studiul general*. Bucureşti.