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CULTURILE FORESTIERE EXPERIMENTALE DIN STAȚIUNEA BĂRĂGAN

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Summary

An important number of experimental forest plantations have been established at Bărăganul - the experimental basis of ICAS for steppe forest cultures - between 1947 and 1950, comprising 27 species of trees and 5 species of shrubs, and a dendrological park with 19 coniferous trees and 56 species of deciduous trees. Between 1990 and 1992, when the plantations have reached the age of 39 – 44, an integrated ecological research have been conducted in order to emphasize the ecological behaviour of wood species cultivated in climatic and soil conditions that are characteristic to the steppe region.

The experimental basis is located in the South-Eastern steppe area of Romania, in Bărăganul Ialomiței, at an latitude of 44°34' N and a longitude of 27°36' E. Its relief is a flat plain with an altitude of around 50 m (and local uneven surfaces of +/- 3-6 m). The climate is steppe moderate with an average annual temperature of 10,6° C and an average annual rainfall of 475 mm, but also with variations between 322 to 813 mm/year and a high number of droughty days per year (144) and permanent winds (236 days per year). On a loess substratum typical chernozemic and carbonatic soils have formed especially on positive relief forms, and cumulic chernozemic soils in microdepressions.

The ecological behaviour of trees and shrubs (dimensions reached, development in pure and mixed plantations, on different microrelief forms, biomass production, transpiration and water consumption) have been established on research basis emphasizing the modifications occurred in the atmosphere and soil under the influence of forest cultures (i. e. microclimatic modifications, accumulation and decomposition of litter, hydric and acidity regime of soil). The developed forest biocenosis under the circumstances of natural integration and immigration of distinct species of organisms (herbs, fungi, insects, mammals, birds) has also been studied.

The main conclusions resulted after the analysis of research materials are the following:

• Any forest plantation established even in less favourable conditions for forests such as Bărăgan steppe may open spontaneous processes for developing a forest ecosystem causing consistent modifications both in the biotic and abiotic environment by means of forming biocenotic structures that are characteristic to forests, especially to the subsystem of consumers and decomposers. The latter category is gradually constituted by successive migrations from forest neighbouring or distant environments that may be either active or passive.

• During the process of forest biocenosis formation the most mobile elements have proved to be insects and fungi which have populated in high number the steppic forest plantations, over 1200 species of insects and over 200 species of fungi identified until present, under the circumstances that superior plants characteristic to forests have a slower migration.

• The formation of consumers and decomposers subsystems has allowed the trigger of ecosystemic circuit of organic matter hindering the accumulation of undecomposed necromass (with certain exceptions for resinous plantations).

• The shrubs that have been introduced constantly in almost all tree plantations play an important role in creating and maintaining the forest environment. They have hindered the establishing of herbal species, especially weeds with high-water consumption. Generally, the water consumption of shrubs is two or three times less than that of the herbs.

• As regarding the environment modifications under the action of forest plantations the main results are:

- in comparison with bare fields, the tree plantations have a microclimate with temperatures that are lower with 1,2 – 9,2°C on the vertical profile in warm periods and a humidity that is higher with 5-6% (relative units), and an important action of wind alleviation (twice or three times stronger, increasing with the wind speed until thirteen times), and a ten or thirty times decrease in light under the massif corroborated with modifications in the radiation spectrum.

- inside the tree plantations a litter layer has formed with a value of 4-7 t/ha under deciduous trees and 10 t/ha under resinous trees, with an active decomposition for the first category and a delayed one to the second category of forest plantations; the half decomposed litter is richer in nitrogen, phosphorus and potassium than the undecomposed one.

- modifications have occurred in the soil on a lower scale, especially on the first layer of the soil (3-10 cm) by the decrease of pH with 1-1,5 units and an increase of humus, nitrogen and sodium content that evidence an intensification in the process of bio-accumulation.

- a variation of the soil reaction in the vegetation period has been noticed with an increase of pH during the dry periods and a decrease during the wet periods.

- important modifications have occurred in the humidity regime of the soil as a consequence of change in intensity and rhythm of water depletion due to the soil protection by the litter layer; a high decrease in soil humidity has occurred in June inspite the important quantity of precipitation during that period of time.

- the water reserve in soils is intensely used in the second part of the summer when may occur decreases until or under the wilting coefficient; during a great

part of growing season (3 or 4 months) the accessibility to water is inferior to a normal consumption because water is retained with a cappilary potential that is superior to the free, unrestricted absorption (higher than pF 3,6).

• The research concerning the transpiration process of wood plants and herbs have proved the following:

- 4 groups of species may be distinguished in accordance with the transpiration intensity: very high intensity at hybrid poplars, Siberian pea-tree (*Caragana arborescens*), dogwood (*Cornus sanguinea*); high intensity at Turkey oak (*Quercus cerris*), wild privet (*Ligustrum vulgare*), wild pear (*Pyrus pyraster*); moderate intensity at grey oak (*Quercus pedunculiflora*), downy oak (*Q. pubescens*), European ash (*Fraxinus excelsior*), Fraxinus pallisae, field maple (*Acer campestre*), silver birch (*Betula pendula*), European larch (*Larix decidua*), common hawthorn (*Crataegus monogyna*), common smoke-tree (*Cotinus coggygria*), prunus mahaleb (*Saint lucie cherry*); low intensity at pedunculate oak (*Quercus robur*), red oak (*Q. rubra*), narrow-leaved ash (*Fraxinus angustifolia*), black locust (*Robinia pseudacacia*), common walnut (*Juglans regia*), Tartarian maple (*Acer tataricum*), Douglas-fir (*Pseudotsuga menziesii*), Austrian pine (*Pinus nigra*), native linden species (*Tilia tomentosa, T. cordata, T. plathyphyllos*), Siberian elm (*Ulmus pumila*).

- more groups of tree species may be distinguished according to water consumption and foliar mass: megahydric species with a consumption of over 2500 kg/tree, eg. hybrid poplars, ash species, red oak (*Q. rubra*), Turkey oak (*Quercus cerris*), common walnut (*Juglans regia*); euhydric species with a consumption between 1000-2500 kg/tree, e.g. grey oak (*Quercus pedunculiflora*), downy oak (*Q. pubescens*), pedunculate oak (*Quercus robur*), linden species (*Tilia tomentosa, T. cordata, T. plathyphyllos*), elm species (*Ulmus minor, Ulmus pumila*), field maple (*Acer campestre*), silver birch (*Betula pendula*); and olygohidric species with a consumption under 1000 kg/tree, e.g. black locust (*Robinia pseudacacia*), Tartarian maple (*Acer tataricum*), and all the shrubs species.

- from the point of view of the capacity to reduce transpiration during dry periods 5 categories of species have been dinstinguished, very efficient being the Siberian elm (*Ulmus pumila*), black locust (*Robinia pseudacacia*), downy oak (*Q. pubescens*), hybrid poplars and all the shrubs.

• The research concerning biomass production has led to the following conclusions:

- the biomass per tree may vary between 21 and 398 kg, the highest individual biomass dimensions being registered at European ash (*Fraxinus excelsior*), Fraxinus pallisae and Siberian elm (*Ulmus pumila*) and the lowest at black

locust (*Robinia pseudacacia*) and linden species (*Tilia tomentosa, T. cordata, T. plathyphyllos*) developed understorey.

- the biomass of shrubs is reduced, between 6 and 12 t/ha, the foliar mass represents only 0,65 -1,6 t/ha out of it.
- the biomass of herbs species in stands without shrubs may vary between 0,4 and 1,2 t./ha
- the biomass may vary between 59 and 95 t/ha depending on composition of plantations.

• Wood production and the dimensions of trees depend on the microrelief to a great extent and this determines the available volume of water and the intensity of growth.

- in microdepressions the height of the trees is 1 - 4 meters higher and the diameter is 4 - 8 cm greater. On micro-elevations the height and the diameter are 1- 2 m and 2 - 4 cm lower than those existing under the circumstances of flat plateau. The wood volume and the average growth may vary accordingly, i.e. 3 to 5 m^3 in microdepressions, and under 2m^3/yar/ha on micro-elevations.
- in forest belts the heights, diameters, volumes and growths are relatively high in comparison with those in depressions due to a water excedent absorbed from the bare spaces located next to the belts.
- in similar conditions, the coniferous trees reach dimensions and wood productions that are higher than those of deciduous trees, but with no additional water supply (irrigations) they manifest a decline in crown density.
- the special plantations for veneer, initially irrigated, have reached higher growths than the plantations under normal water regime, with a good development of sycamore/plane tree (Platanus hybrida).
- in the dendrological collection the majority of coniferous and deciduous species have proved their capacity to adapt to the special conditions of the steppe, with a special focus on the pine species (especially *Pinus strobus* and *P. nigra*), but also on silver Douglas-fir (*Pseudotsuga menziesii* ssp. *glauca*), Turkish hazel (*Corylus colurna*), oak species (*Quercus pedunculiflora, Q. pubescens, Q. robur, Q. rubra*), native linden species (*Tilia tomentosa, T. cordata, T. plathyphyllos*), Sophora japonica, thorny locust (*Gleditsia triacanthos*) and on all the shrubs species.

• The evaluation of the ecological behaviour of wood species according to different criteria and their capacity to face the potential impact of disturbing factors have allowed a rating of species according to their capacity to adapt to the special conditions of the steppe. In the decreasing order of the capacity to adapt the species are the following (ranked from easily adaptable to at all adaptable):

- the major deciduous species: Siberian elm (*Ulmus pumila*), downy oak (*Q. pubescens*), grey oak (*Quercus pedunculiflora*), Turkey oak (*Quercus cerris)*, pedunculate oak (*Quercus robur*), black locust (*Robinia pseudacacia*), narrow-leaved ash (*Fraxinus angustifolia*), *Fraxinus pallisae*, Norway mapple (*Acer platanoides*), common walnut (Juglans regia), hybrid poplars;

- shrubs species: wild privet (*Ligustrum vulgare*), common hawthorn (*Crataegus monogyna*), common smoke-tree (*Cotinus coggygria*), Siberian pea-tree (*Caragana arborescens*), dogwood (*Cornus sanguinea*)

A special attention should be paid to the species with high risk when cultivated in steppe conditions such as maple (*Acer* sp.) (damages caused by frost or rabbits), black pine (*Pinus nigra*) and Scots pine (*Pinus sylvestris*) (damages caused by moist snow), European larch (*Larix decidua*) (frequent drying after 30 years), Turkey oak (*Quercus cerris*) and downy oak (*Q. pubescens*) (drying cause by frost during the last years and frequent frost split at younger trees), hybrid poplars (high consumption of water which can be supplied through the elimination of rival herbal species or irrigations).

• As a final remark we may conclude that in Bărăgan steppe the forest as a massif is still possible and it can be maintained until the half of a rotation period under certain circumstances:

- the groups of forests as massifs to cover only the negative relief forms (i.e. depressions),

- species with a high plasticity to the water factor should be chosen, especially those originated in the neighbouring biotypes with the steppe,

- the grassing of soil with shrubs should be avoided,

- the artificial pruning should be applied especially to shadow demanding species in order to reduce the useless water consumption.