

# **Black locust-dominated coppice forests and continental sand dunes, a happy symbiosis in the Valea lui Mihai-Carei Plain (NW of Romania)**

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# Overview

## Introduction

**Valea lui Mihai-Carei Plain: landforms and soils, climate, forest vegetation, black locust as main tree species**

## Case studies

## Conclusions

# Introduction

**Wind erosion** = a serious environmental problem/common phenomenon occurring mostly in flat, bare areas; dry, sandy soils; or anywhere the soil is loose, dry, and finely granulated. It causes soil loss, dryness and deterioration of soil structure, nutrient and productivity losses and air pollution.

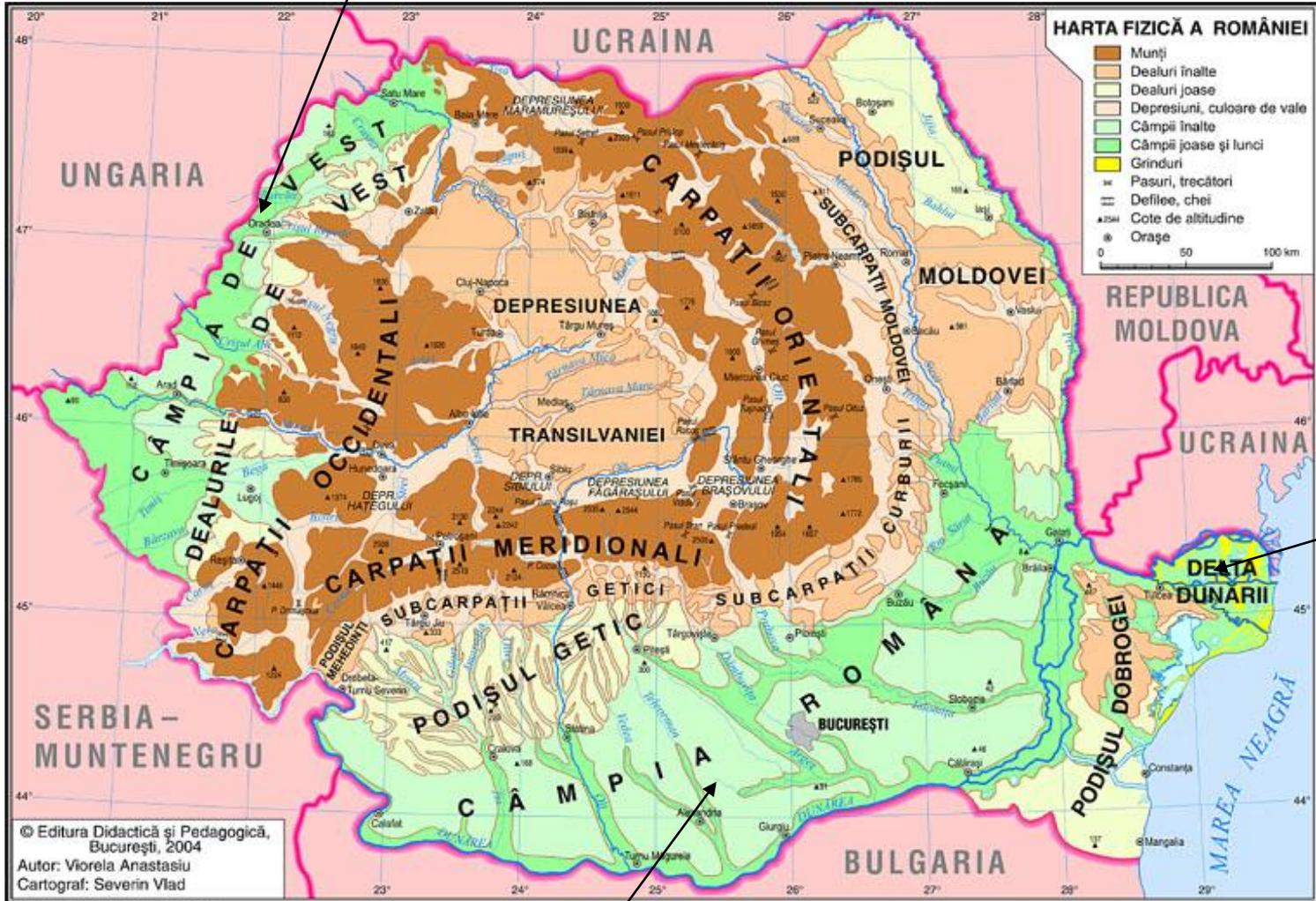
In general, the **wind erosion control** is carried out for (i) reducing wind-speed at ground level, and (ii) increasing soil cohesion, thus improving soil resistance to wind. *The most efficient solution to reduce the wind-speed is to increase the plant cover by planting blocks of forest, hedges and wind-breaks.*

In case of **sand dunes**, the point of their fixation/stabilization: to eliminate the source of sand and to keep the dunes in place.

# Romania

- sand dunes (and sandy soils) are an important component of landscape, covering about 560,000 ha, of which over 80% (about 460,000 ha) are located in the Romanian Plain (south of RO).

Western Plain



Danube Delta

Romanian Plain

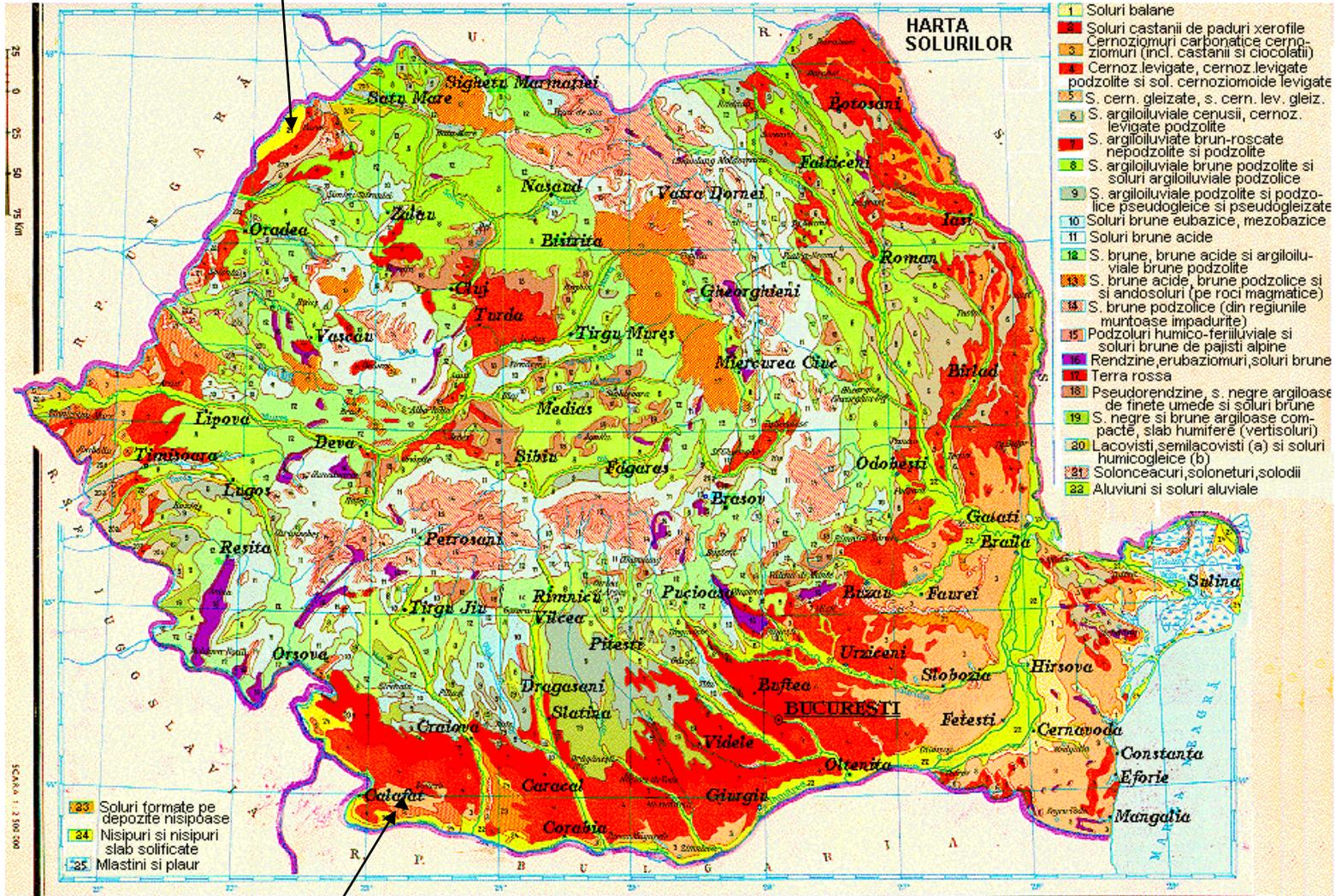
Continental sand dunes of Oltenia (S-SW of the country, about 351,000 ha) = the largest block of sands and sandy soils. The first plantations of black locust (*Robinia pseudoacacia*) in the area, in order to prevent further movement of continental sand dunes (a process started in 1830-1850 - about 200-250 m/yr), were established at Băilești (Stirbei Estate) in 1852.

Other important areas of sands and sandy soils in Romania:

- **Câmpia de Vest (Câmpia Tisei - Western Plain)**
- Câmpia Tecuciului (Tecuci Plain)
- Delta Dunării (Danube Delta), etc.

In the **Valea lui Mihai-Carei Plain**, part of the Western Plain, located along the Hungarian-Romanian border, sands and sandy soils cover over 26,000 ha - the area with its specific features will be the main focus of this presentation.

## Valea lui Mihai-Carei Plain



Continental sand dunes of Oltenia

# Valea lui Mihai-Carei Plain

## Landforms and Soils

a. **Landforms:** *continental sand dunes*, of river and wind origin, formed in the Holocene epoch, with a SW-NE and NW-SE orientation and an elevation ranging between 140 and 160 m.

Two types of dunes:

- **main:** 5-15 m height, 1-1.5 km length, 100-350 m width; distance between main dunes: 500-3,000 m.
- **secondary:** 1-6 m height, 100-1000 m length; distance between secondary dunes: 100-500 m.

## **b. Soils** = *psamosoils*:

- very deep but poor: **low fertility** and nutrient content (N, P, and K).
- soil texture: light (85-90% sand, mostly fine).
- pH: moderately acid to neutral (between 5 and 7).
- the maximum fraction of humus: 1% in the upper 25 cm of soil.

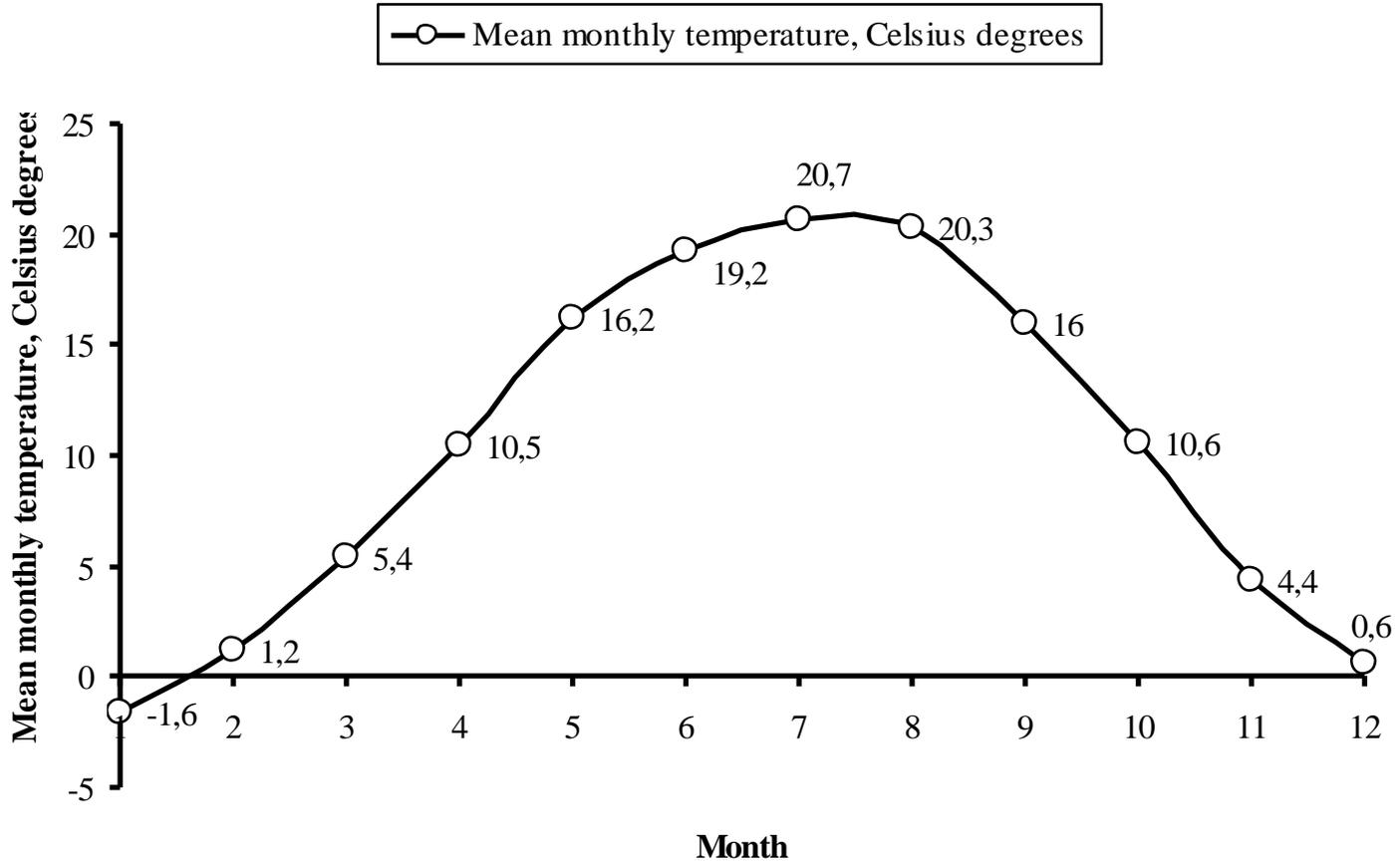
Specific to these soils: presence of a hard, cemented and poorly drained *ortstein horizon*, formed as a result of illuviation of aluminium, iron, manganese, and humus compounds from the overlying shallow O horizon. This horizon halts the water infiltration so plays a very important role in the growth and development of woody plants; water is kept within the ortstein during the most dry summer periods, when the sand gets very warm at the surface (up to 60-70 degrees Celsius) as well as quite deep below.



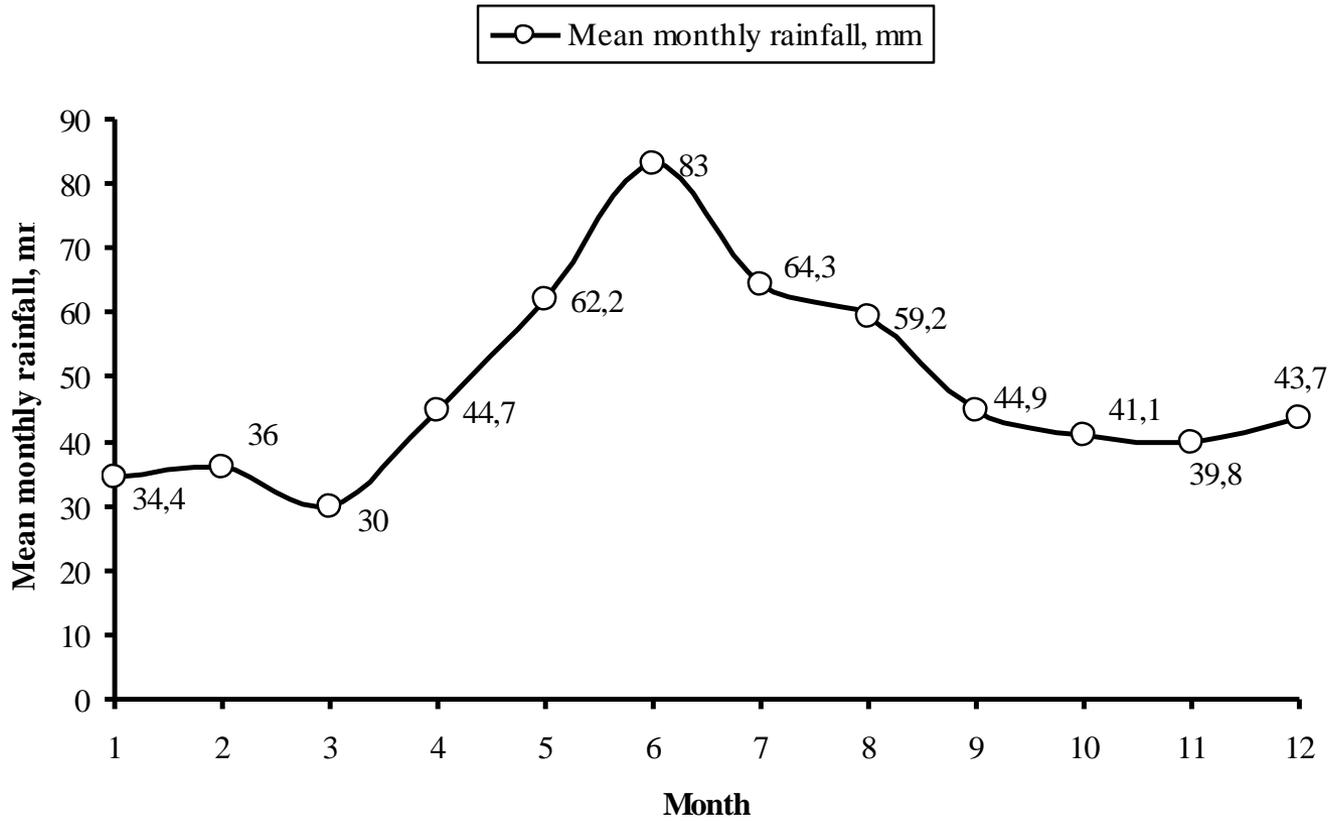
**Natural regeneration by seed of black locust, as a result of very high summer temperatures forcing the breakage of seed tegument**

## Climate

- *temperate-continental (C.f.b.x. type according to Köppen).*
- mean annual temperature: **10.3 C degrees**; max. July-August, min. December-January.
- mean annual rainfall: **573.3 mm** (but in the last two years down to ca. 350 mm...); max. June-July, min. January-March.
- potential mean annual evapotranspiration: **ca. 600 mm.**
- frost-free season: **270 days**
- annual aridity index: **28.2** = *transition zone between the plain forest zone and the forest steppe zone.*
- maximum wind speed: **4.0 m/s** (South) = no damages to forest vegetation.



**Mean monthly temperature - Săcueni-Bihor Weather Station**



**Mean monthly rainfall, Sacueni-Bihor Weather Station**

# Forest vegetation

## a. History

- **1892-1900: first** black locust plantations - 200 ha, 2 x 2 m spacing
- 1905-1909: 14.56 ha plantation of Scots pine (*Pinus sylvestris*) and 2.55 ha of black pine (*Pinus nigra var. austriaca*), both 2 x 1 m or 1.5 x 1 m
- 1905: 0.60 ha plantation of pin oak (*Quercus palustris*)-black cherry (*Prunus serotina*), 1.5 x 1.5 m
- 1905: 2.79 ha plantation of pedunculate oak (*Quercus robur*)-northern red oak (*Quercus rubra*), 1.5 x 1.5 m
- **1933-1940: 790 ha** planted by important local forest owners and communities, on low-fertility sites for agricultural uses
- **1946-1959: 1,958 ha** planted by the state (low-fertility agricultural land)
- **1960-1980: 450 ha** planted by the state (low-fertility agricultural land)

## b. Nowadays

- Forest vegetation covers ca. 12% of overall area of Valea lui Mihai-Carei Plain, of which **black locust** is the main species (cover over 80% of total area).
- Other species: black cherry, Canadian poplars (*Populus x euramericana*), oaks (e.g., pedunculate, red, pin), pines (black, Scots), mulberry (*Morus alba*), etc.



**Pure Canadian poplar culture**



**Mixed Canadian poplar-black locust stand**



**Plantations of northern red oak (left) and northern red oak-pedunculate oak (down)**



## Black locust

- Introduced on (i) low-fertility agricultural lands or (iii) for replacing low-productive tree species such as pedunculate oak, small-leaved linden, field maple, and field elm, in order to prevent wind erosion and sand dune movement as well as produce firewood.
- Subsequently treated **only** as *low coppice*, with a rotation of 20-30 years depending on yield class.
- The best results in terms of both sand dune fixation and wood production = in the last 40-50 years, since using mixtures with black cherry, an invasive tree species able to compete with black locust above- and belowground and forming a dense understorey after regenerating from seed, stump sprouts and root suckers.

# Case-studies

**a. Sub-compartment 52A%: pure natural regeneration (*by root suckers*) of black locust, 2-year old, following low coppice cut (winter 2013) and removal of stumps. Two plots of 25 sq.m (5 x 5 m) each.**

|                             |                | Overall       | Plot 1      | Plot 2      |
|-----------------------------|----------------|---------------|-------------|-------------|
| <b>Number of trees/ha</b>   |                | <b>17,000</b> | 12,000      | 22,000      |
| <b>Basal area (sq.m/ha)</b> |                | <b>0.7314</b> | 0.5324      | 0.9304      |
| <b>Diameter (cm)</b>        | <b>Mean</b>    | <b>0.68</b>   | <b>0.69</b> | <b>0.67</b> |
|                             | <b>Maximum</b> | <b>1.51</b>   | 1.44        | 1.51        |
|                             | <b>Minimum</b> | <b>0.28</b>   | 0.30        | 0,28        |
| <b>Height (m)</b>           | <b>Mean</b>    | <b>1.58</b>   | <b>1.62</b> | <b>1.55</b> |
|                             | <b>Maximum</b> | <b>2.64</b>   | 2.57        | 2.64        |
|                             | <b>Minimum</b> | <b>0.50</b>   | 0.60        | 0.50        |



**b. Sub-compartment 52A%: pure black locust exploitable stand (32-year old), regenerated by *root suckers*. Three plots of 500 sq.m (25 x 20 m) each.**

|                                                        |                | <b>Overall</b> | Plot1  | Plot2  | Plot3  |
|--------------------------------------------------------|----------------|----------------|--------|--------|--------|
| <b>Number of trees/ha</b>                              |                | <b>347</b>     | 280    | 340    | 420    |
| <b>Basal area (m<sup>2</sup>/ha)</b>                   |                | <b>19.191</b>  | 17.916 | 21.482 | 18.174 |
| <b>Diameter (cm)</b>                                   | <b>Mean</b>    | <b>25.92</b>   | 28.23  | 27.61  | 23.01  |
|                                                        | <b>Maximum</b> | <b>40.60</b>   | 39.90  | 40.60  | 29.60  |
|                                                        | <b>Minimum</b> | <b>15.30</b>   | 23.80  | 19.00  | 15.30  |
| <b>Height (m)</b>                                      | <b>Mean</b>    | <b>20.38</b>   | 21.91  | 22.18  | 17.92  |
|                                                        | <b>Maximum</b> | <b>27.50</b>   | 26.00  | 27.50  | 22.00  |
|                                                        | <b>Minimum</b> | <b>12.00</b>   | 14.75  | 12.50  | 12.00  |
| <b>Stability index (h/d) *100</b>                      | <b>Mean</b>    | <b>80</b>      | 78     | 82     | 79     |
|                                                        | <b>Maximum</b> | <b>116</b>     | 102    | 110    | 116    |
|                                                        | <b>Minimum</b> | <b>58</b>      | 60     | 58     | 66     |
| <b>Volume (m<sup>3</sup>/ha)</b>                       |                | <b>183</b>     | 176    | 222    | 151    |
| <b>Mean annual volume increment (m<sup>3</sup>/ha)</b> |                | <b>5.72</b>    | 5.50   | 6.94   | 4.73   |



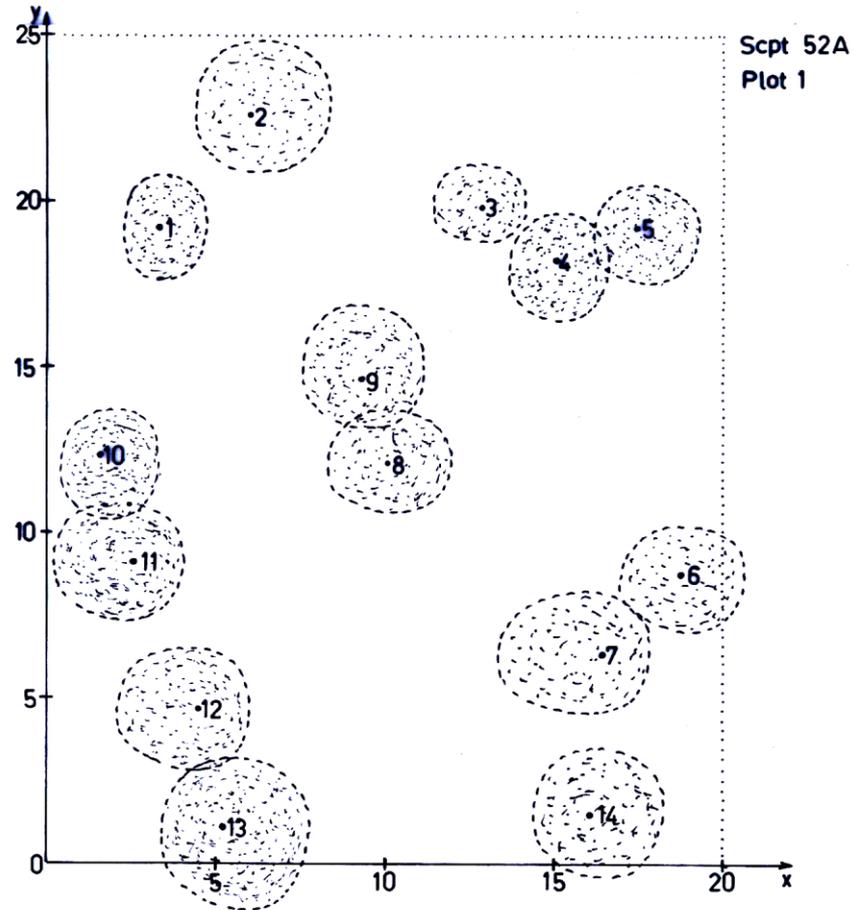
**Plot 1 (left) and  
plot 2 (down)**



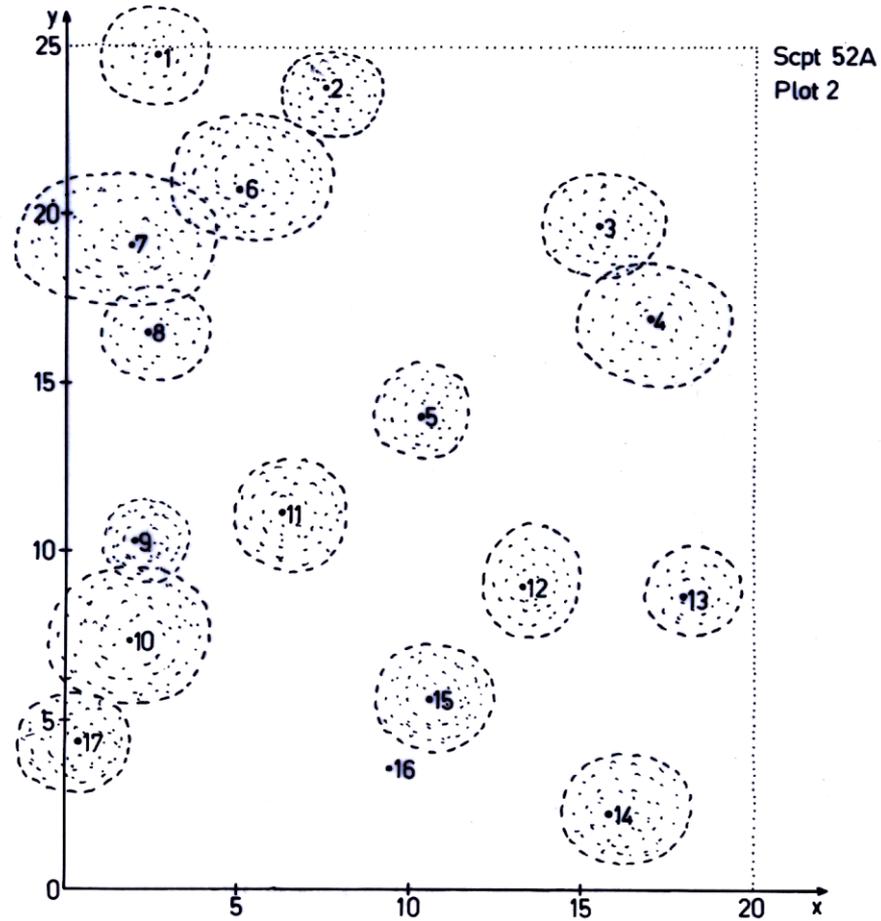


**Plot 3**

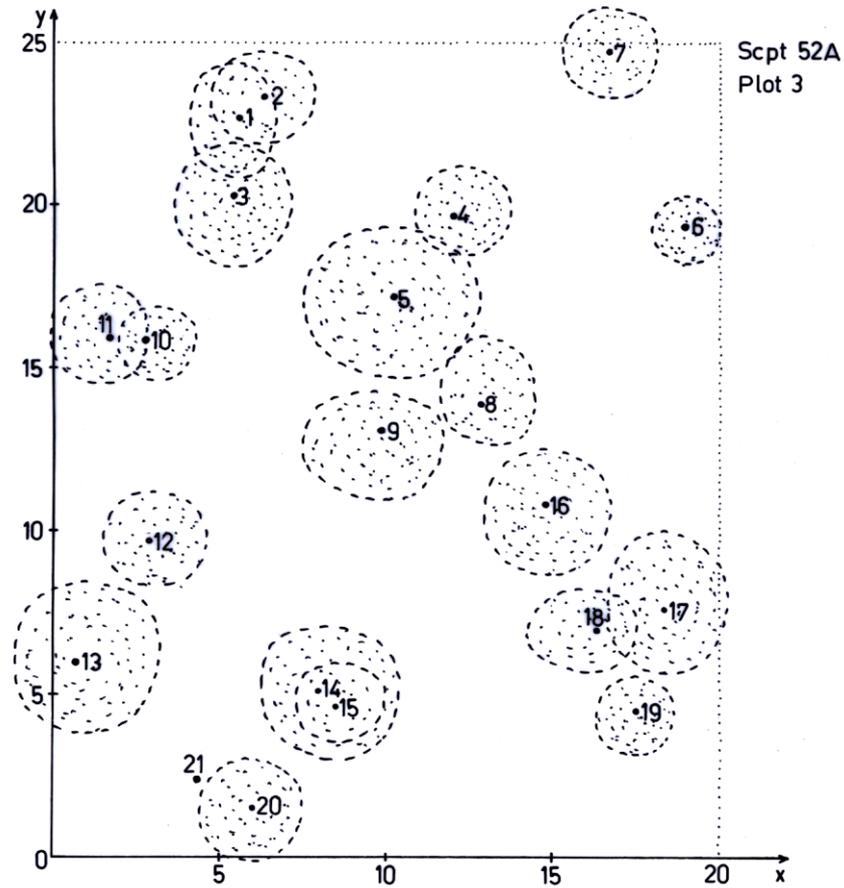




**Horizontal projection of trees in plot 1**



**Horizontal projection of trees in plot 2**



**Horizontal projection of trees in plot 3**

a. **Pure and young black locust stands** (max. 10-12 years old): closed canopy, **poor** herbal layer.



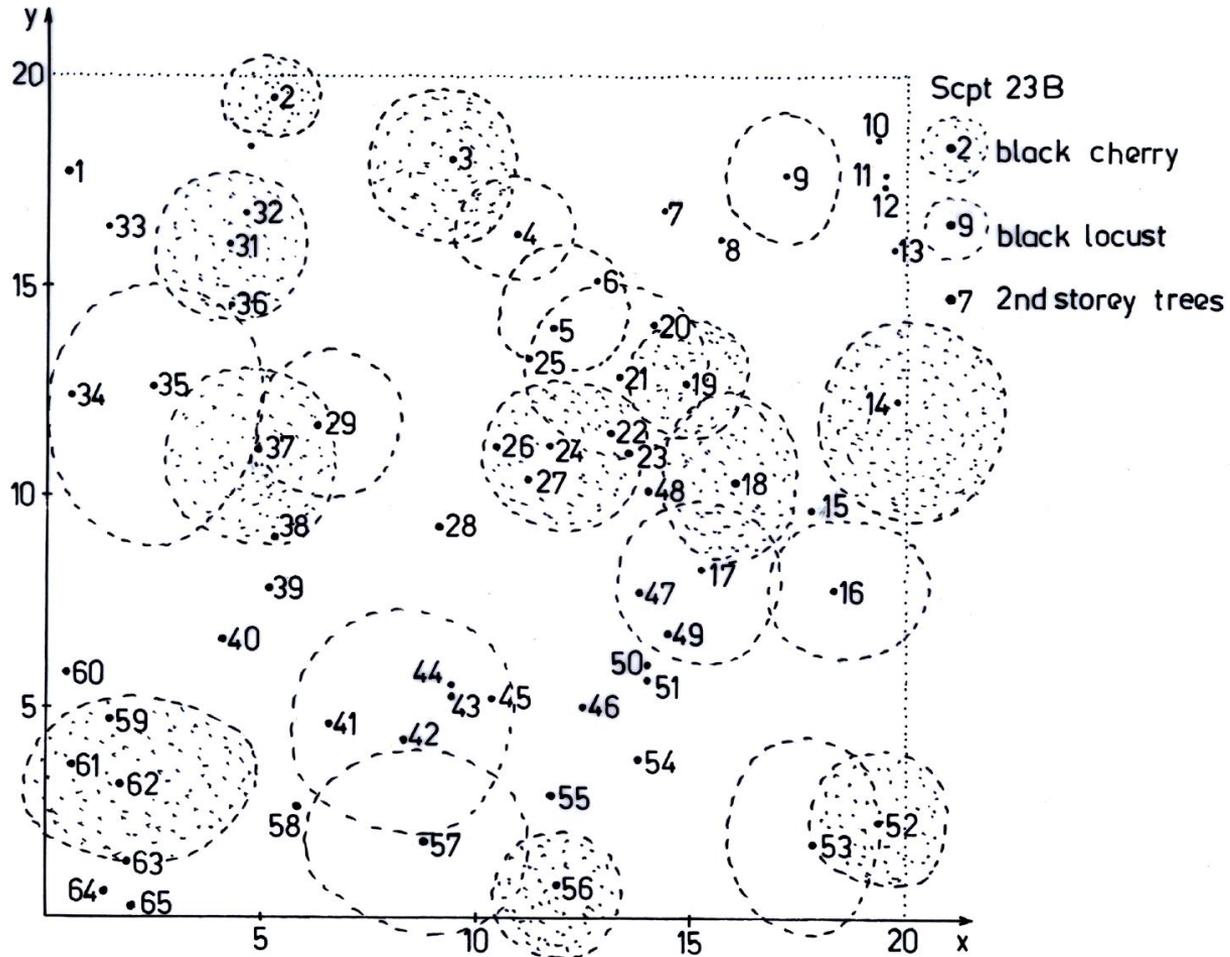
b. **Pure and older black locust stands:** open canopy, **very rich and dense** herbal layer.



**c. Sub-compartment 23B: mixture black cherry-black locust, 53 years old (rotation age 60 years). One plot of 400 sq.m (20 x 20 m).**

- Two-storied stand, with black locust and black cherry in the upper storey and black cherry in the lower one.





**Horizontal projection of trees in plot 1, scpt. 23B**

|                                                   |         | Total          | Tree species      |              |            |                   |              |
|---------------------------------------------------|---------|----------------|-------------------|--------------|------------|-------------------|--------------|
|                                                   |         |                | Black cherry (BC) |              |            | Black locust (BL) |              |
|                                                   |         |                | Upper storey      | Lower storey | Dead trees | Upper storey      | Lower storey |
| Number of trees/ha                                |         | <b>1,625</b>   | 275               | 750          | 175        | 275               | 150          |
| Basal area (m <sup>2</sup> /ha)                   |         | <b>32.2680</b> | 9.4025            | 3.1050       | 4.1025     | 15.0900           | 0.6625       |
| Diameter (cm)                                     | Mean    |                | 19.92             | 7.06         | 14.89      | 25.50             | 7.47         |
|                                                   | Maximum |                | <b>31.90</b>      | 14.90        | 27.50      | <b>35.70</b>      | 8.70         |
|                                                   | Minimum |                | 11.10             | 4.00         | 8.70       | 14.70             | 6.50         |
| Height (m)                                        | Mean    |                | 17.77             | 7.35         | 11.54      | 23.16             | 10.10        |
|                                                   | Maximum |                | <b>23.00</b>      | 13.75        | 17.50      | <b>26.75</b>      | 12.50        |
|                                                   | Minimum |                | 13.00             | 3.70         | 7.00       | 20.50             | 6.50         |
| Stability index (h/d) *100                        | Mean    |                | 94                | 107          | 88         | 96                | 133          |
|                                                   | Maximum |                | 117               | 170          | 109        | 139               | 149          |
|                                                   | Minimum |                | 72                | 60           | 76         | 69                | 120          |
| Volume (m <sup>3</sup> /ha)                       |         | <b>283</b>     | 84                | 14           | 22         | 160               | 3            |
| Mean annual volume increment (m <sup>3</sup> /ha) |         | <b>5.34</b>    | 1.58              | 0.26         | 0.42       | 3.01              | 0.07         |



- Very poor herbal layer but rich natural regeneration by seed of black cherry.



## Some other important issues in relation to black locust

- **High need/demand** for firewood (local population); increasing price, up to 70 euro/cu.m beginning of 2016.
- **Good market and high price** for sawlogs (up to 80 euro/cu.m), for domestic and international market (e.g., Hungary, Austria, Italy, Germany).



**Black locust sawlogs**

# Some conclusions

- Difficult area in ecological terms (e.g., climate, soils, etc.).
- Long-term (over a century...) commitment in using **black locust** as the main forest tree species, mostly on top and along dunes = *the only species able to fully and successfully withstand the harsh ecological conditions and have positive results in (i) wind erosion control and (ii) production of wood for different uses.*
- Best results (e.g., soil protection, wood production) in mixed black locust-black cherry stands.

# Thanks for your attention!

