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Ecology and silvicultural management of coppice forests in Europe

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COST Action FP1301
Innovative management and multifunctional utilization of traditional coppice forests - an answer to future ecological, economic and social challenges in the European forestry sector (*Eurocoppice*)
Florence-Italy, 26 February 2014

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Overview

- Introduction
- Coppice species and ecology of coppices
- Rotation of coppices
- Growth and yield of different coppice forests
- Over-mature coppice stands and possibilities to revitalize them
- What about coppice forest management in the future?

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Introduction

Over 16% (about 23 million ha) of the productive forests of Europe are managed as coppices:

- low coppice
- high coppice (pollarding)
- coppice with standards
- short rotation coppice SRC
- coppice selection

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Low coppice stand (Photo N. Frank, HU)

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Coppice with standards stands

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High coppice (pollarding)

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Introduction

Coppice forests are located mainly in the (central), southern and south-eastern parts of our continent:

- France (6.8 million ha)
- Italy (3.3 million ha)
- Spain (over 3 million ha)
- Greece (1.6 million ha)
- Turkey (5.7 million ha)
- Bulgaria (1.8 million ha)
- Serbia and Montenegro (1.4 million ha)
- Bosnia and Herzegovina (0.84 million ha)
- Republic of Macedonia (0.56 million ha)
- Hungary (0.5 million ha)
- Croatia (0.54 million ha)
- Albania (0.4 million ha)
- Romania (0.25 million ha)

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Last decades: **low focus on coppices** (many of them were either abandoned/neglected, undergoing natural succession, or converted/transformed into high forests) due to socio-economic changes.

Recently: **much more attention** was paid to them in Europe due to (a) the increasing demand for biomass for energy production as well as (b) increasing revenues from firewood.

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a. *Species* and e*cology* of coppices (i.e., water, nutrient balance, light requirements, ability of resprouting).

b. Rotation of coppices.

c. Growth and *yield* of different types of coppice forests.

d. Existence of *over-aged* coppice forests and possibilities to revitalize them.

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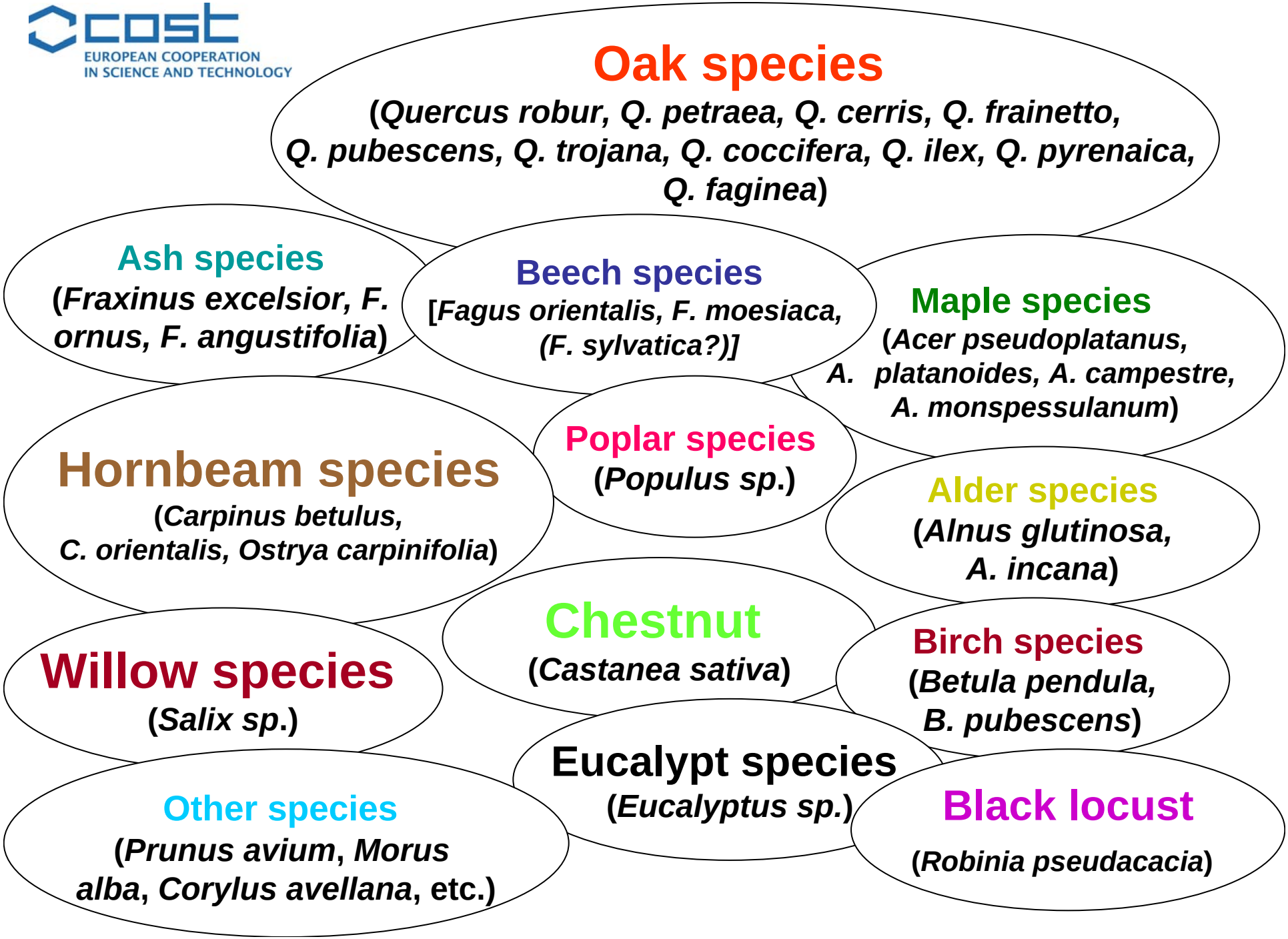

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Quercus petraea coppice (Photo H.B. Özel - TR)

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Quercus ilex coppice (Photo T. Dubravac - HR)

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Fagus orientalis coppice (Photo H.B. Özel - TR)

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Castanea sativa coppice

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Carpinus betulus coppice (Photo N. Frank, HU)

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Tilia sp. coppice

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Prunus avium trees treated as coppice

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Robinia pseudacacia coppice

Alnus glutinosa coppice (Photo N. Frank – HU)

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Salix alba coppices

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Ecological requirements

i. Water

- from *low* (e.g. southern oaks *Quercus pubescens*, *Q. coccifera*, *Q. ilex*, etc.) to *high* (i.e., willows, poplars, alders)

ii. Nutrients

- from *poor* soils (southern oaks) to *rich* soils (ash, sycamore, etc.)

iii. Light

- from *light-demanding* (e.g. oaks, willows, poplars, alders, etc.) to *shade-tolerant* (i.e., *Fagus* sp., hornbeam, field maple, etc.)

iv. Potential of re-sprouting

- depends on:

1. **Species**: all broadleaved trees species produce stump shoots = can be treated in coppice (exceptions (?): *Fagus sylvatica*, *Betula pendula*)

2. **Age**:

- *high and long-lasting potential* (up to minimum 40 years): oaks (e.g., *Q. petraea, Q. robur, Q. cerris, Q. frainetto, Q. pubescens, Quercus ilex*, *Q. coccifera*, *Q. faginea,* etc.), *Castanea sativa*, *Tilia* sp., *Acer campestre*, *Salix* sp., *Populus* sp., *Carpinus* sp., *Ulmus* sp., *Alnus glutinosa*, etc.

- *high potential only in youth* (up to 20-25 years ?): *Fagus sylvatica*, *Betula pendula*, *Acer* sp., *Fraxinus* sp., *Robinia pseudacacia*, *Populus tremula*

3. **Site conditions**:

- *high* on fertile and well water-supplied soils
- climate factors (i.e., summer droughts, early or late frosts, cold springs) can reduce or even annulate the production of shoots

Rotation of coppices (1)

a. **Low coppice**

- depends on:

i. ***Species***

- *minimum*: 1 (max. 2) year (rods for basket weaving - willows *S. viminalis*, *S. x americana*, *S. triandra*, *S. alba*, *S. purpurea*), based on *economics* (profitability)

- *maximum* (majority of species): 15-25 years, based on *ecological* reasons (potential of re-sprouting); some exceptions: *Q. robur* and *Q. petraea* (30-35 years), *Castanea sativa* (maximum 30 years), *Robinia pseudacacia* (30-35 years).

Important exceptions (examples):

a. Republic of Macedonia: oaks (*Q. petraea*, *Q. cerris*, *Q. frainetto*, *Q. pubescens*): 50 years; *Fagus moesiaca*: 50 years

b. Croatia: oaks (*Q. pubescens*, *Q. ilex*, *Q. petraea)*: 80 years; European beech (*Fagus sylvatica*): 80 years

Rotation of coppices (2)

a. **Low coppice**

ii. ***Production target (wood assortment)***

a. Oaks (*Q. petraea*, *Q. robur*): 12-15 years (even 20) for bark peel (tannin) up to 30 (35) years (industrial wood, firewood)

b. *Castanea sativa*: (10) 12-15 (20) years on average; can range from 3-5 years (small wood products) to 25-30 years (barrel production, furniture, parquetry, firewood)

c. *Robinia pseudacacia*: from 10 years (vine sticks) to 25-30 (35) years (parquetry, furniture)

iii. ***Site conditions***

- higher on best sites: from 20-25 years (poor sites) up to 30-35 years (rich sites) in case of *Robinia pseudacacia* coppices of Hungary and Romania

Rotation of coppices (3)

b. Pollarding

- *minimum* 1 year: *Morus alba* (sticks used for producing tobacco and pepper seedlings – Republic of Macedonia)
- *maximum* 15-20 (even 30) years (*Morus alba*, *Salix alba* for firewood)

c. Short rotation coppice

- willows: between 2-5 years
- poplars: 2-4 (7?) years
- *Robinia pseudacacia*: 2-4 years

1-year old mulberry sticks used for the production of tobacco and pepper seedlings (photo P. Trajkov - MK)

Mulberry plantation used for the production of firewood (photo P.Trajkov - MK)

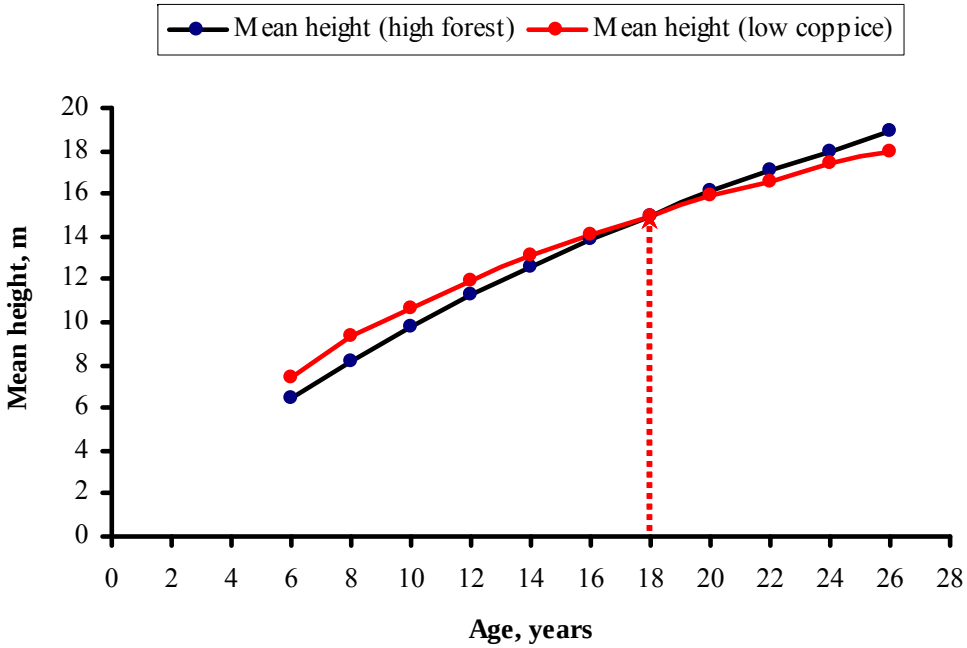
Growth and yield

Coppice trees and stands:

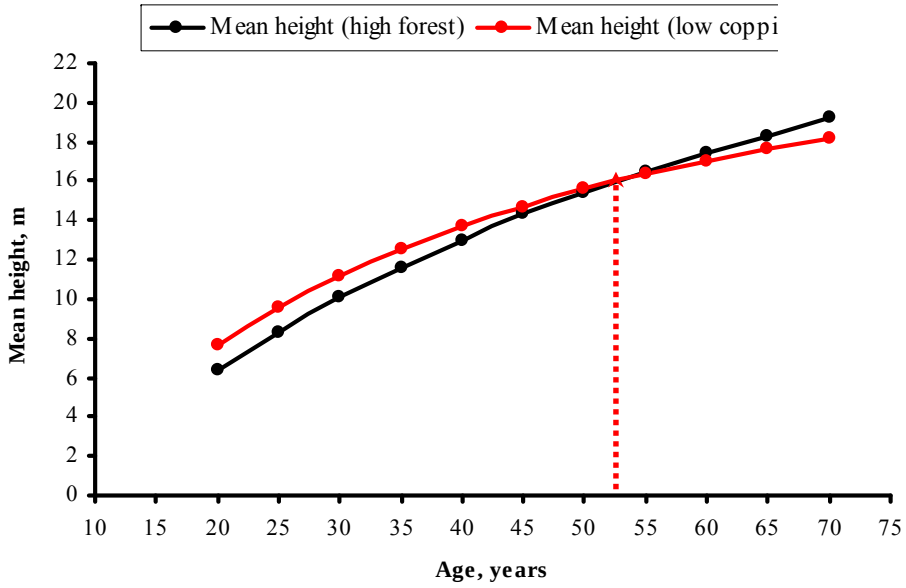
- very quick early height and volume increment.

- from a certain age (quite early, depending on species...), their height and volume increment remain lower than that of high forest stands.

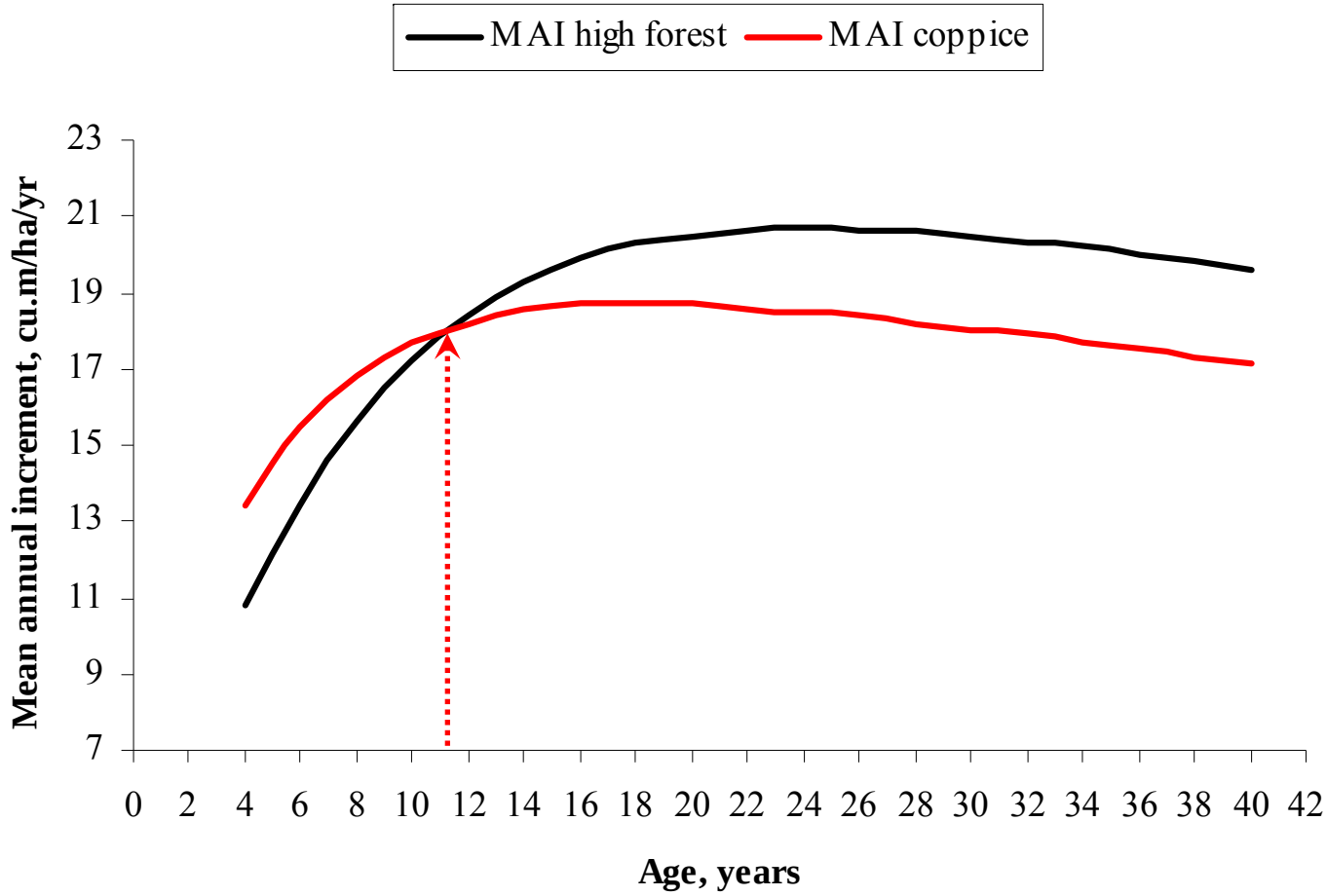
Evolution of mean height of stands treated as high forest or low coppice in Romania (yield class III) (from Giurgiu and Drăghiciu, 2004)



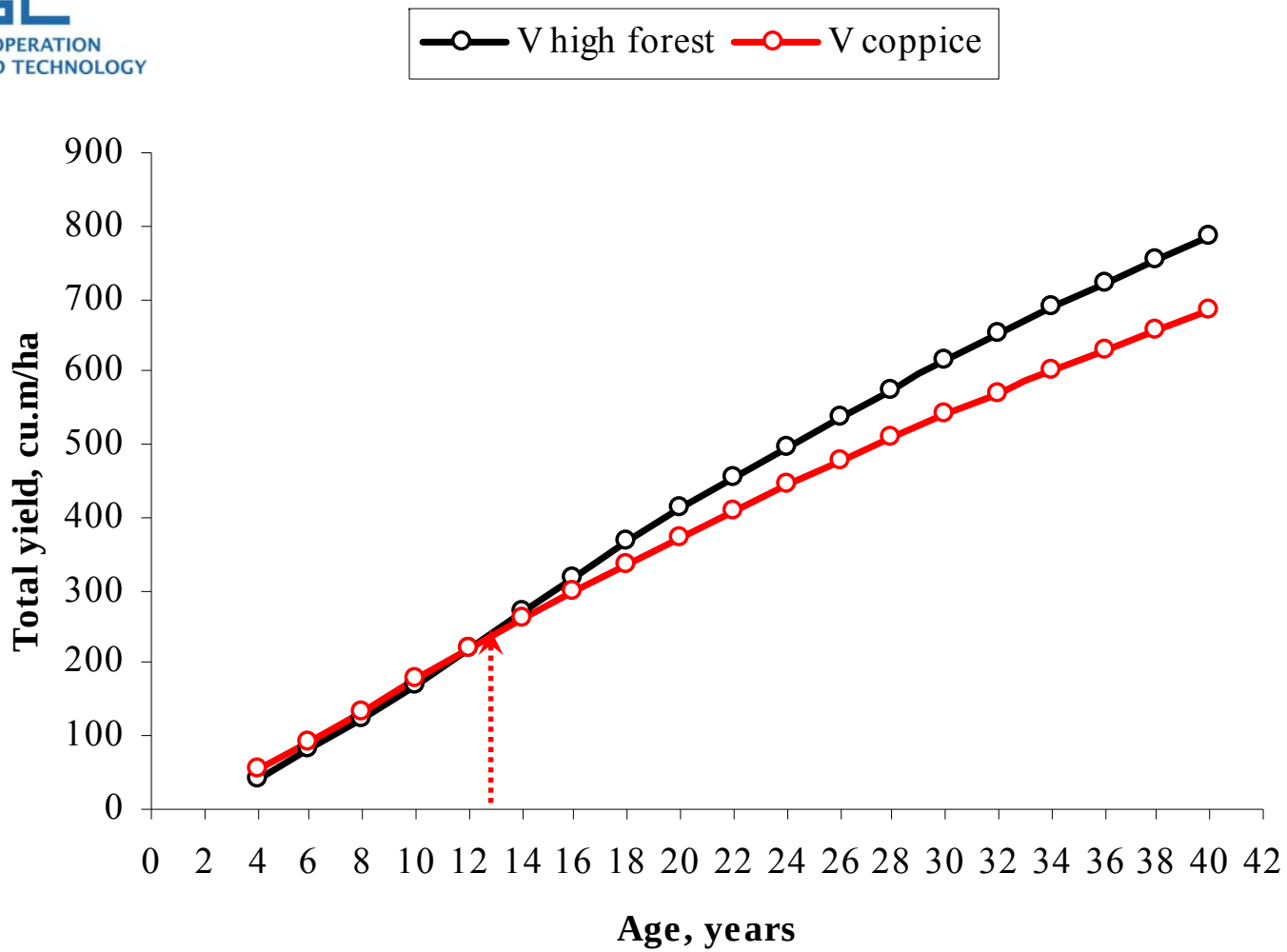
Black locust (*Robinia pseudacacia*)



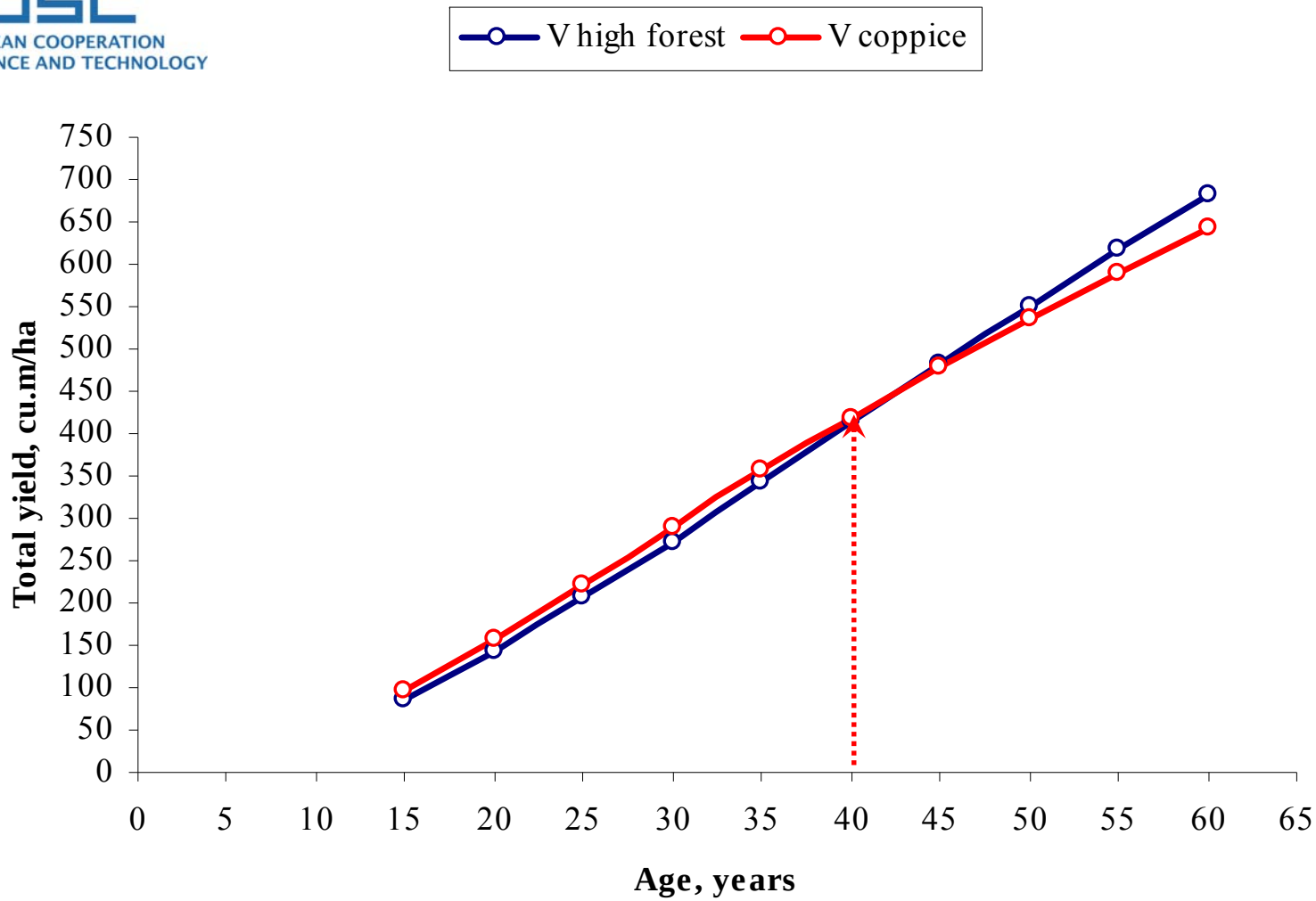
Sessile oak (*Quercus petraea*)



Evolution of mean annual increment of total yield in black locust stands of yield class I (coppice and high forest)
(in Giurgiu and Drăghiciu, 2004)

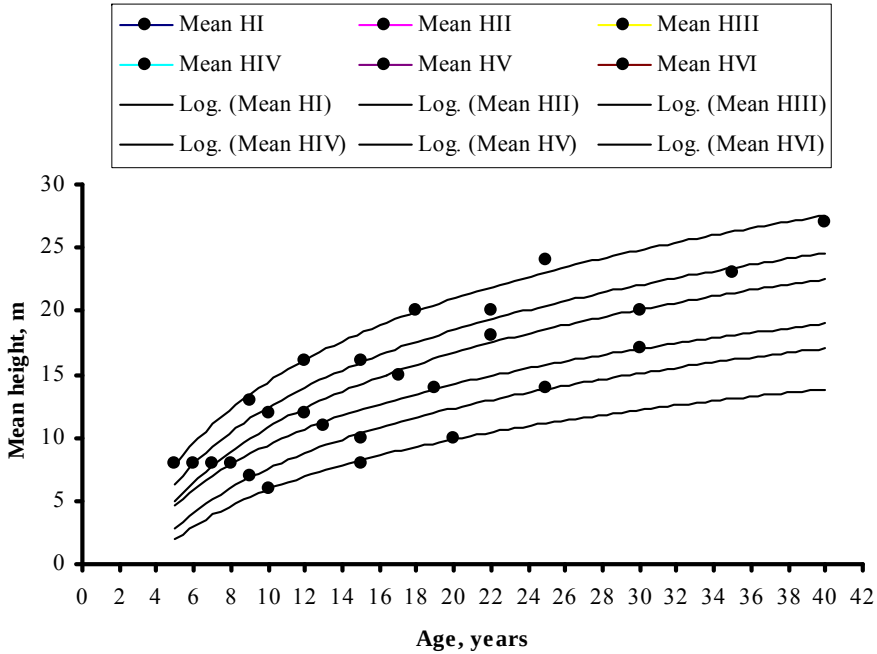


Comparison between total yield of black locust coppice stand and high forest stand (yield class I) (from Giurgiu and Drăghiciu, 2004)

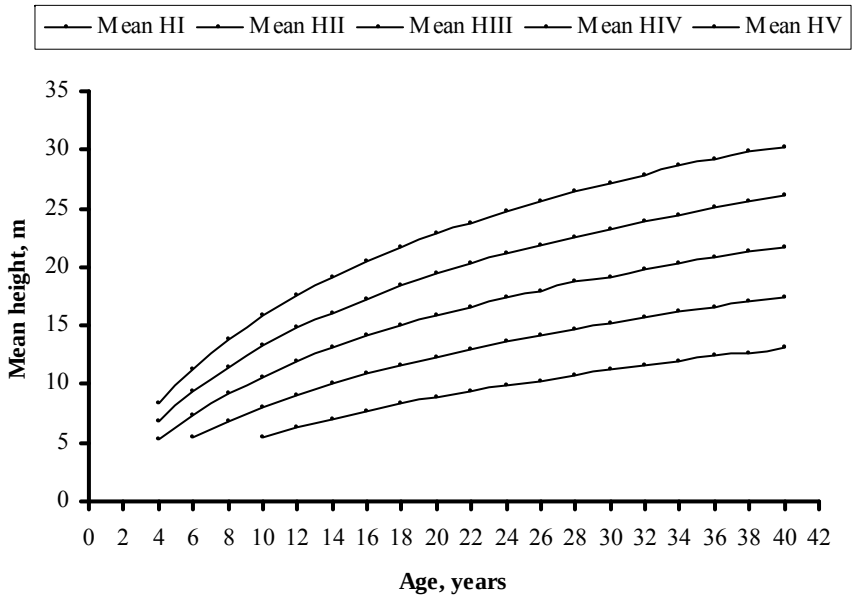


Comparison between total yield of sessile oak coppice stand (red) and high forest stand (blue) (yield class I) (from Giurgiu and Drăghiciu, 2004)

Yield class graphs for black locust (*Robinia pseudacacia*)



Hungary (Redei et al., 2010)



Romania (Giurgiu and Drăghiciu, 2004)

Coppice growth

a. **Low coppice**

Very variable, depending on species, region, site conditions:

- *minimum*: less than 1 cu.m/ha/yr
- *maximum*: 12-15 (20) cu.m/ha/yr
- highly productive tree species: *Populus* sp., *Eucalyptus* sp., *Robinia pseudacacia*, *Castanea sativa*

b. **Short rotation coppice**

Very variable, depending on species (e.g. willow, poplar, black locust), clone, site conditions, region:

- from 5-6 t DM/ha/yr to over 20 t DM/ha/yr (on average 10-15 t DM/ha/yr).

Coppice yield

Republic of Macedonia:

- growing stock: 46 cu.m/ha (*Quercus* sp. stands), 109 cu.m/ha (*Fagus moesiaca* stands)

Hungary

- average volume/ha (all *Robinia pseudacacia* stands) = 125 cu.m/ha
- average volume of *Robinia pseudacacia* stands at 30 years of age: 80-280 cu.m/ha, depending on yield class

Portugal

- *Quercus pyrenaica*: 50-140 cu.m/ha (rotation 15-30 years); *Q. robur* = 60-140 cu.m/ha (rotation 15-30 years); *Castanea sativa*: 100-185 cu.m/ha (rotation 8-30 years); *Eucalyptus globulus*: 120-250 cu.m/ha (rotation 10-12 years); *Quercus faginea*: 40 t DM/ha (rotation 10-20 years)

Croatia

- growing stock (nation-wide): 93 cu.m/ha

Over-mature coppice stands

- are found in many parts of Europe and **exist** for different reasons:

1. Legal recommendation of conversion (by „ageing”) of coppices into high forests.

2. Some coppices are located in protected areas (= no interventions...).

3. There is an increased interest to promote biodiversity.

What can be done to „revitalize” such stands?

= one important issue for WG2 members to discuss and solve!

What's next in coppice forest management?

Obviously, climate change, energy needs and aggrade awareness of other services have lead to a new interest and recognition of coppice forests' management.

» Measures that should be taken in the future:

- **LEAVE** coppice stands without any treatment, for biotope values

- **PRESERVE** them for the diversity of species and communities

- **CONVERT** them into high forests, either by *transformation* (when the state of stump and tree species composition are good enough) or by *conversion* (clear cutting + planting, if transformation is not possible, because of poor condition of stumps or inadequate species composition)

- **MANAGE** them to fully utilize the site production potential (case of coppice with standards: their potential to provide both fuelwood and valuable timber is not fully explored)

- **PERFORM** new research works on clones, establishment and cultural practices of SRC

- **THINK** how **new production forms** of coppice forests can be designed to produce biomass for energy and also enhance biodiversity, landscape diversity and cultural values

And many others to be proposed by WG2 members!

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(Photo N. Frank - HU)

Thank you for your attention!