Ash-sycamore secondary forests: a new chance for the Italian Alpine region?

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Abstract - Ash-sycamore secondary forest is an important forest type that it is increasingly spreading in northern Italy. Nowadays, these forests are not managed with high forest system as they are left in natural evolution and subsequently managed with coppice system without improvement in timber quality. Remarkable potentiality and strong dynamism of these new spontaneous forests, able to colonize in short time fertile lands once used by agricultural activities, have been underlined in many sites. Research activities have shown interesting results in terms of high quality timber production by applying the target tree system. This management approach permits to improve the timber quality concentrating forest practices and production on a restricted number of trees (70-150 per hectare). This practice allows a considerable cost reduction and a good growth improvement. First thinning has to be realized at about 15-20 years when the dominant trees have average dbh of 9-12 cm, height of 12 –16 m., and crowns deep enough and able to react to thinning and to maintain diameter growth about 1 cm.

Remarkable socio-economic difficulties, land propriety fragmentation, lack of tradition and knowledge in high stand broadleaved forest management, hamper strongly the application of this method. In order to make the best use of Ash-sycamore secondary forest is therefore necessary to undertake actions focused on land properties association, forest owners training and financial support.

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Introduction

In the last decades Sycamore-lime forests and Ash forests have reached a notable territorial importance in Northern Italy. According to National Forests and Forest Carbon Sinks Inventory - IFNC- (MIPAF 2007), these forests occupy a surface of 153.904 hectares, mainly concentrated in Northern Italy 88% (Table 1). A large part of these stands are secondary forests (Del Favero *et al.* 1998, AA.VV. 2002) and have colonized former agricultural lands and pastures. The forest surface growth in Italy in the last 50 years, at the annual rate of 15.000 hectares per year (Piussi 2006), has been driven by secondary successions and sycamore-lime forests and ash forests have played an important role in the Prealps.

Italian research activities.

In the last twenty years the research activity in Italy has been aimed to understand many factors characterizing the forest ecology and dynamism, carbon sequestration capacity and growth yield models of unmanaged stands along with silvicultural practices and timber characteristics, with the following results:

- *Secondary successions dynamism in former agricultural lands and pastures* .

Ash and sycamore have similar ecological needs and can be considered as post-pioneer species (Bernetti 1998) able to colonize directly fertile and fresh former agricultural and pasture land.

Their considerable seed production and easy dispersal produce a rapid colonization strongly influenced by the presence of seed bearer trees, often planted for fodder alongside the fields (Bargioni and Zanzi Sulli 1998). Their regeneration is characterized by a complete cover of soil achieved by successive waves of seed dispersal that in 3-10 years are able to prevent the growing of other tree species. In general, the dominance of ash or sycamore depends on the proximity of the seed bearer tree, even if land type orientation has been observed in Piedmont, where sycamore often tends to colonize abandoned agricultural lands while ash pastures (Pividori Bertolotto 2003).

The stand density is high when colonization is fast and direct (near 20.000 plants per hectare in 7 years old stands), being lower when succession takes place trough a shrubs stage (hazel particularly) (Pelleri *et al* 2003).

- *Carbon sequestration, wood production and growth models in unmanaged stands.*

The carbon storage capacity of these stands has been estimated in Friuli and valued near 1.18 Mg C Ha^{-1} y^{-1} (Alberti *et al* 2008). The carbon is stored in particular in the woody biomass while a progressive decrease with the age of the stand has been found in the soil in comparison to adjacent open fields.

Research carried out in Veneto Prealps (Pelleri *et al* 2008[a]) on 25 plots of different age (7 to 60 yr.) have defined the growth models of ash-sycamore unmanaged stands underlining their high

productivity. In particular, dendrometric volume in 60 years old stands, reaches about 400 m^3 ha^{-1}, while the medium volume increment reaches its maximum at 28 years (12 m^3ha^{-1}). Analysing the trend of dbh, height and crown insertion of dominant trees with the age it is possible to have important information to be used in thinning scheduling. As shown in Figure 1, the best timing for the first thinning, is between 15-20 years when dominant trees have average dbh of 9-12 cm, height of 12-16 m and crown insertion of 8-10 m high. Conversely, late thinnings favour the presence of knots and defects in larger portions of the stems and small crowns not able to react promptly.

- *Silvicultural practices to improve good quality timber production.*

Thinning trials had been carried out in ash-sycamore unmanaged stands of Canzo Lombardy (Pividori 2002) and in Recoaro Terme Veneto (Pelleri Fontana 2003, 2004; Giulietti *et al* 2008). In these stands, characterized by different development stages, both first and second thinning have been realized, testing either traditional silvicultural approach (stand forestry) or single tree oriented forestry (target tree system), with the following results:

Thicket stage (up to 10 years) - Thinning trials have proved the ineffectiveness of thinning from below. Using this system the stocking densities has been reduced of 50% without modifying substantially the competition among the biggest trees. Only after two years a limited degree of mortality has been observed among potential dominant trees. In the unthinned plot (control) a stronger tree mortality has been observed due, mainly, to the death of dominated trees with similar results in terms of stocking density and growth of potential dominant trees. As a results, at this stage thinning from below have to be avoided being expensive and unsuccessful.

Pole stage (15-20 years)- The best timing to carry out first thinning has been found in the thicket-pole and young pole stages. The differentiation in social classes is evident, dominant trees are stables with 5-6 m from ground branch-free stems, crowns able to react promptly to thinnings. In these stage only the target tree system has been tested. This type of silviculture is oriented to improve single trees leaving as much as possible undisturbed the remaining part of the stand. The selection criteria for the target tree are: dominant or pre-dominant position within the stand, strong vigour, stems without defects, deep and well shaped crowns, uniform distribution.

In the thinning trials different densities have been tested (from 150-400 target tree per hectare). Around any target tree 2-3 competitors have been felled. The results, obtained after 10 years, have shown the necessity to select, both in relation to the economic and silvicultural point of view, a restricted number of target trees (70-150 per hectare). With higher densities costs are duplicated since additional interventions must be made in order to reduce the competition among the target trees themselves (Spiecker 2006).

To give an example, in a 14 years stand a density of 400 target trees per hectare has been chosen and among them the best 100 plants have been marked. After only 4 years an additional thinning

has been necessary and half of the target trees has been felled (Figure 2). The diametrical increment of the best 100 plants, the other target trees and the 100 best dominant plant in the control plot differs significantly (Figure 3).

In order to have a further cost reduction the technique of girdling can be implemented since it allows heavy thinnings without decreasing the stand stability. (Schütz 2006).

High forest stage (>25 years) - In older stands a different approach has been chosen, oriented to improve the stand in the whole. A first thinning from below, followed by a second mixed thinning, allows progressively the stand structure and stability.

In a 30 years stand placed in Veneto Prealps, a little reaction to thinning has been found compared with the unthinned control plot and the younger plots. Low diametrical increments lead to an elongation of rotation in order to reach marketable dimension.

Especially for ash stands this could be an hazard as the older is the plant the more frequent is the presence of black heart in the log.

As a general recommendation, the spacing among target trees must be set considering the different ecology in terms of light demand of ash and sycamore. German experiences suggest a final distance of 12,6 metres for ash and 9,8 for sycamore (AA.VV.).

- *Ash wood characterization.*

Wood properties have been analysed in two pure ash stands of 37 and 60 years old in Recoaro T. Prealps of Veneto and Canzo in Prealps of Lombardy. Mechanical and physical parameters have been analysed altogether in 25 trees coming from secondary forest in Recoaro T. (Pelleri et al 2008[b]) and 9 trees from Canzo (Table 2). The values of volume mass resulted coherent with the data checked in bibliography for natural forest and lower than ones for artificial plantations of narrow-leaved ash. Timber with black hearth has resulted heavier and more nervous in comparison with timber without this chromatic alteration. The frequency of this defect is high (50%) in the sixty years old stands, while black hearth is absent in the younger ones.

- **Actual management**

Nowadays, these stands are left in natural evolution and managed like coppices to satisfy the fire wood owner's needs. Strong socio-economic difficulties influence the possibility to pass towards different types of management able to give value good quality timber. Land property fragmentation, lack of interest among the owners for new management practices and absence of market allocation impede the improvement and diversification of ash and sycamore stand management.

- **How to operate to improve good quality timber production ?**

It is necessary to organise different incentive forms to solve the socio-economic difficulties, in particular it is necessary to operate at different levels:

- to favour an associated management of forests;
- to support the training of forest technicians, forest workers and owners;
- to finance the realization of first thinnings that are often a real cost for the owners;
- to form a local market of broadleaves good quality timber by ensuring a significant amount of timber to be sold to local factories and diffusing the knowledge of grading timber criteria.
- To reduce the costs of cultural practices focusing on a restricted number of target trees.

Depending on different territorial contests, it is advisable to suggest different modality of management:

1. target tree system in favourable ecological and socio economic conditions, with public proprieties or in large private proprieties (single or associated).
2. coppice with standard system in less favourable ecological and socio economic conditions.

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Table 1- Sycamore –Linden and Ash forest surfaces INFC 2007

Region	Sycamore –Linden and Ash forests ha	%
Northern of Italy	128.730	84%
Central Italy	16.936	11%
Southern Italy	8.238	5%
Total Italy	153.904	100%

Table 2 – Main technological characteristics
Recoaro Terme (plot1 38 years,10 trees - plot2 60 years, 25 trees)
Canzo (plot3 25 years, 9 trees

	Recoaro Terme. Veneto			
	MV_{eq} (kg/m^3)	DB (kg/m^3)	Bvol (%)	Btang/Brad (%)
Average	735	578	16,9	2,1
Standard Deviation	0,065	0,043	2,878	0,436
Minimum value	544	443	9,5	1,0
Maximum value	931	741	25,5	4,8
	Canzo Lombardy			
Average	751	604	15.1	2.03

Standard Deviation	0.043	0.033	2.6	
Minimum value	659	536	8.8	
Maximum value	880	711	22.8	
References	720* - 880**		19,1**	2,8**

* Giordano, G., Tecnologia del legno UTET

** Berti S., Brunetti M., Macchioni N. 1999 from artificial plantations of narrow-leaved ash

Figure 1 – Relations between age, dbh, height and crown insertion of dominant trees.

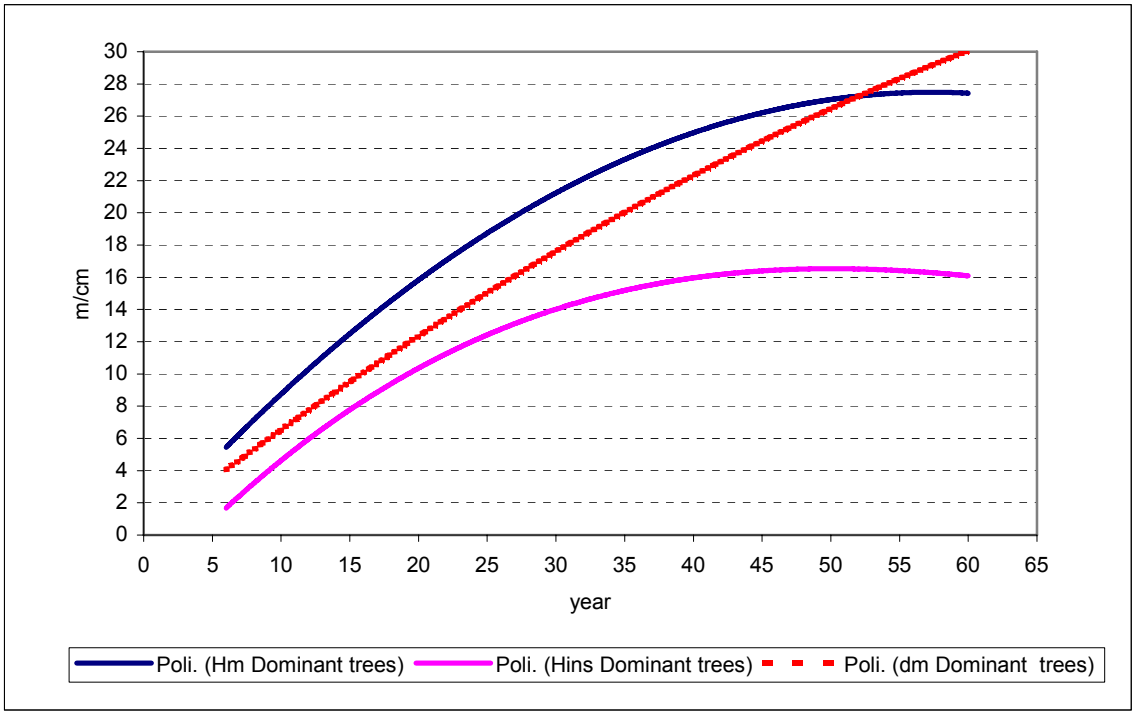

Figure 2 – Covole: stand structure before and after second thinning.

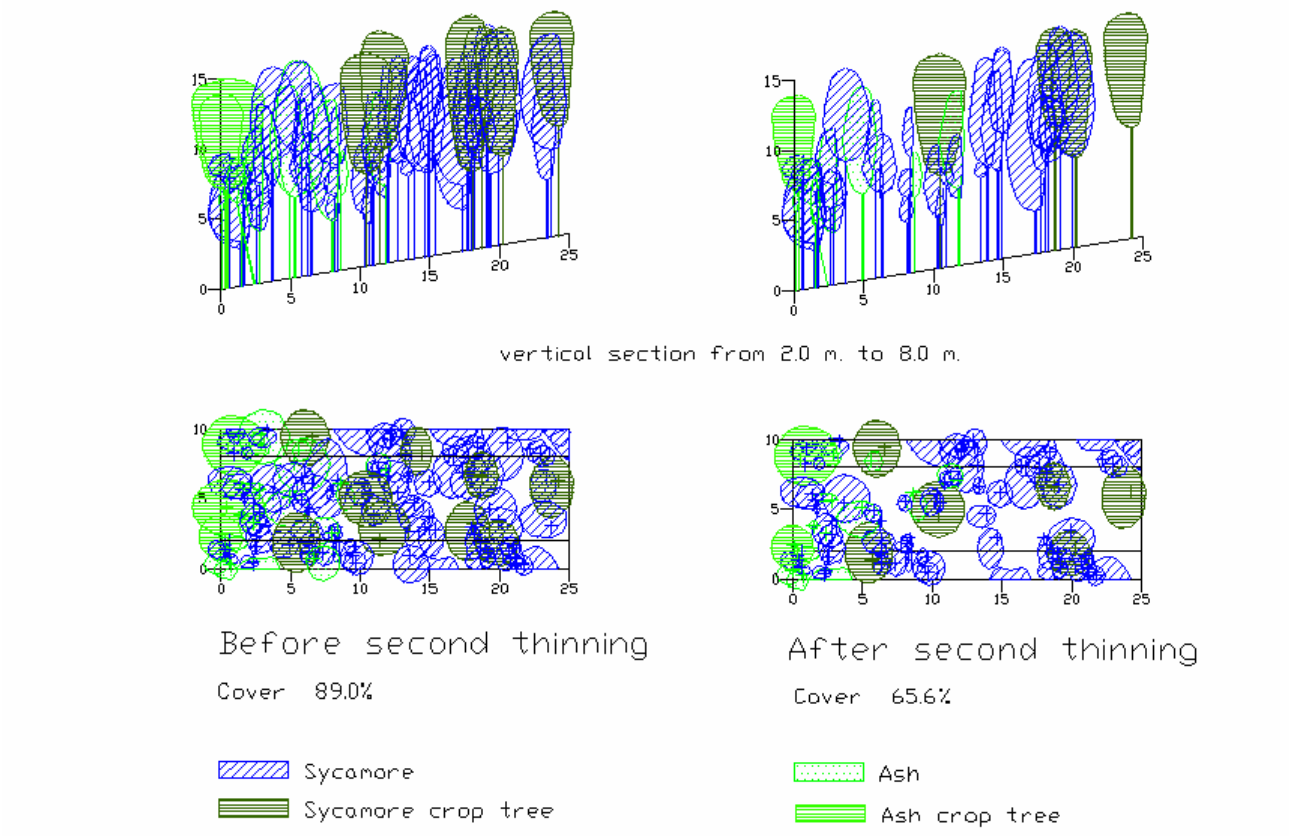

Figure 3 - Crop trees dbh increments.