

## THE APPRECIATION OF ALNUS GLUTINOSA STANDS QUALITY RELATED TO FOREST TYPES AND AGES

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### Abstract

Due to the interest in *Alnus glutinosa* as the plantation species has increased in Latvia during last years, a structural unit "LVM Sēklas un stādi" of State Stock Company "Latvijas Valsts Meži" (Latvia's State Forests) offers to the local market *Alnus glutinosa* bare root seedlings with an advanced root system obtained from *Alnus glutinosa* seeds grown in planting such selected seedlings in cutovers and for land reforestation theoretically will allow the land owner to increase the value of forest and the profit from its management. Practically, this prospects should be evaluated from the perspective of forest health.

Therefore, the purpose of this study were to: (1) estimate the incidence of heart colouring and stem decay in *Alnus glutinosa* stands in different forest types and ages, (2) identify and measure heart colouring area /heartwood hard rot stage area diameter and soft rot stage area diameter/ cavity diameter of the stumps, (3) evaluate the relationships between stand species composition (forest types) and *Alnus glutinosa* stands age on heart colouring/heartwood hard rot stage and soft rot stage/cavity incidence, (4) by analysing the results to work out the recommendations to improve the forest management in forest stands where *Alnus glutinosa* stands from plantations are growing.

**Keywords:** *Alnus glutinosa*, *Dryopterioso-caricosa*, *Myrtillosa*, *Myrtillosaturf.mel*, *Dryopterioso-caricosa*, *Oxalidosa*, *Myrtilloso-sphagnosa*, *Oxalidosa turf.mel*.

### I. INTRODUCTION

Stands of black alder (*Alnus glutinosa* (L.) Gaertn.) comprise 5.1% of the total forest area of Latvia. *Alnus glutinosa* typically grows on wet peatlands, usually comprising pure stands or stands mixed with *Alnus incana* (L.) Moench., *Betula* spp., *Populus tremula* L. and *Picea abies* (L.) Karst. [1], [16]. Specific characteristics of this tree species are frost and waterlogging tolerance, a strong root system that penetrates both vertically and horizontally, adaption to various soil conditions and ability to fix nitrogen in symbiotic root nodules with bacteria in the genus *Frankia* [1], [3]. The root system is adapted to very wet soils. Many strong, vertically growing, sinker roots anchor the tree on riverbanks, and they are able to penetrate deeply into wet and anaerobic soils reaching almost 5m deep [9].

Three main site types where *Alnus glutinosa* grows can be identified [5], [6] in relation to the type of water supply are:

- Marshy sites that have waterlogged subsoil throughout the year. On these, *Alnus glutinosa* forms pure stands owing to its physiological adaptations that allow it to grow in anaerobic soils.
- Riverside sites in which the soil in the rooting zone is well aerated during the growing season. On these, *Alnus glutinosa* is often mixed with species that are adapted to alluvial sites (*Alno-Padion* community).
- Plateau sites which high soil moisture contents where the stand is dominated by other species that are more competitive (*Carpinion* community).

*Alnus glutinosa* is regarded a short living tree species, starting to die out naturally at about 60 years of age under Central European conditions [18]. However, depending on the region and growth conditions, the species might reach age of 100-160 years [5]. *Alnus glutinosa* is usually attacked by a heartwood rot at the age of 50-70 years [5]. Some authors noted that *Alnus glutinosa* wood quality

declines after 60-70 years because of heartwood rot [4], [17]. According to investigations made in Bavaria [7] the beginning of the phenomenon at about age 50. According to the results of investigation [1] made in Latvia, the frequency of stem decay and heart colouring of 51-84 year old *Alnus glutinosa* stands are sequential “Table 1”.

**Table 1.** Characteristics of *Alnus Glutinosa* stem quality

| Age, years | Species composition (%)  | Forest site type      | Sampled trees, no. | Decayed stems (%) |
|------------|--|-----------------------|--------------------|-------------------|
| 51         | 100 <i>Alnus glutinosa</i>   | <i>Mercurialis</i>    | 100                | 98                |
| 74         | 80 <i>Alnus glutinosa</i> +20<br><i>Alnus incana</i>                           | <i>Filipendulosa</i>  | 100                | 82                |
| 76         | 60 <i>Alnus glutinosa</i> +30<br><i>Alnus incana</i> +10<br><i>Picea abies</i> | <i>Oxalidos turf.</i> | 150                | 53                |
| 84         | 80 <i>Alnus glutinosa</i> +20<br><i>Alnus incana</i>                           | <i>Oxalidos turf.</i> | 100                | 78                |
|            |  |                       | Average            | 75                |

According to investigations [10] the frequency of heartwood rot differs with site but diagnosis from external characteristics is unreliable.

Nowadays *Alnus glutinosa* is becoming increasingly important as a plantation species. Aside from commercial forestry, this tree species is important for riparian ecosystems and their biodiversity, providing habitats for specific wetland flora and fauna and stabilising riverbanks [1], [15].

If *Alnus glutinosa* is planted in a cutover where a heartwood rot has already been established [5], there will be no positive effect, as the young trees will become infected when their roots contact with the roots of the rotten stumps [13].

It is believed that deciduous tree in pure stands are generally resistant to *Heterobasidion* root rot. On the other hand, the results of studies performed in Lithuania show that *Bertula* stands planted in previously severely affected areas of *H. annosum* (*Pinus sylvestris*) is also infected with *H. annosum* [11]. However, it is possible that no suitable planting material has been selected in this case [8].

The vegetative method plays a very important role in the propagation of many deciduous tree species. *Alnus glutinosa* has great strain-healing abilities. A forest derived from seeds differs in many biological characteristics from a forest derived from coppice. In large forest stands, trees are often taller at the end of their lives compared to trees grown from coppice. For example, oak forests continue to grow intensively until the age of 120-150 years, live 300-400 years and reach a height of 30-40 m. Oak shoots grow intensively for 70-80 years, live for 150-200 years and reach a height of 20-30 m.

The third important difference between a large forest and a coppice is that the wood structure of a large forest is more even and correct than that of a coppice tree. Big forest trees differ much more radically from coppice trees in that the carcasses damage trees much less in stand stands than in coppice trees. In stands formed vegetatively, the stems and roots of the mother trees gradually die. Through the parts of the dying roots, the fungal filaments penetrate the coppice and develop freely in the new generation of forest.

Because of that foresters must ensure the regeneration of the forest with seeds, seedlings, not coppice [13]. The early stage of forestry is crucial for successful and sustainable forest management. One third of the reforested forest in Latvia is regenerated by planting with different kinds of tree seedlings. The success of forest regeneration by planting depends on correctly prepared soil and choice of the right

seeding material. Reforestation by *Alnus glutinosa* in Joint Stock Company “Latvia State Forests” (LVM) have been conducting by bare roots, containerized and with improved root system. The main aim in forestry is to achieve higher tree seeding establishment and promote their growth and improve fixation in soil. Practically, this projects should be evaluated from the perspective of forest health.

In order to ensure and improve the ecological stability of forests, the ability to adapt to various pathogenic microorganisms and resistance to stress factors caused by anthropogenic effects, the territory of Latvia is divided into two regions for (*Alnus glutinosa* Gaertn.) reforestation. Seedlings obtained from clone seeds in West region “Fig. 2”, “Table 4” can be planted only in West region of Latvia “Fig. 2”. The same methodology applies to East and North regions.

## II. STUDY GOAL

The goal of this study was to synthesize the existing experience and knowledge about the silviculture of *Alnus glutinosa* on suitable sites in relation to the production of high quality and valuable timber and to work out the recommendations to improve the forest management in forest stands where *Alnus glutinosa* stands from plantations are growing.

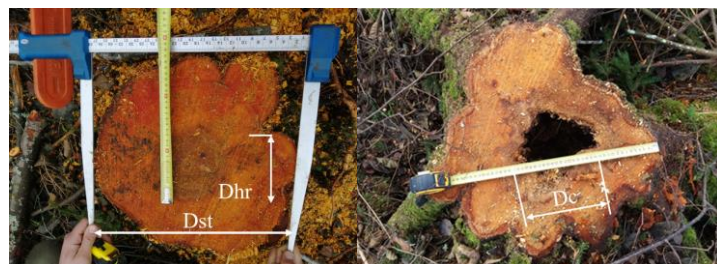
The following objectives were set to achieve the study goal:

- To identify the origin of the clones in the West region of Latvia.
- To estimate the incidence of heart colouring and stem decay in *Alnus glutinosa* stands in different forest types and ages in all regions of Latvia.
- To identify and measure the diameter of heart colouring and stem decay area.
- To evaluate the relationships between stand species composition (forest types) and *Alnus glutinosa* stands age on heart colouring/heartwood rot incidence.

## III. MATERIALS AND METHODS

### 3.1. Field Measurements.

- Sampling stumps of *Alnus glutinosa* in different forest type and age class felling areas after commercial thinning and final felling for estimating the frequency of decay and heart colouring.
- Measuring the diameters of the stumps, the diameters of heart colouring areas, and diameters of heartwood rot areas according to the scheme “Fig. 1”.



**Fig. 1.** Dst- diameter of the stump; Dhr- Heart colouring area /Heartwood hard rot stage area diameter;  
Dc –Heartwood soft rot stage area diameter/ Cavity diameter

### 3.2. Statistical Analyses.

The sequential data were collected and analysed:

- Block area-Forest block-Forest compartment; Area (ha) ; Stock nr; Average tree (m<sup>3</sup>); Stock (m<sup>3</sup>); County; Coordinates X/Y; Forest type; Age class; Age decade; Species composition; Sampled stumps (pcs.); Decayed (Heartwood soft rot/ Cavity) stems(%); Stump diameter (mm)/ Average/Median/Stdev; Heart colouring area diameter/Heartwood hard rot stage diameter (mm); Average/Median/Stdev; Heartwood soft rot stage diameter/Cavity diameter(mm) Average/Median/Stdev

#### IV. RESULTS AND DISCUSSIONS

In order to ensure and improve the ecological stability of forests, the ability to adapt to various pathogenic microorganisms and resistance to stress factors caused by anthropogenic effects, the territory of Latvia is divided into regions of origin of *Alnus glutinosa*, which must be observed in the processes of reforestation [12].

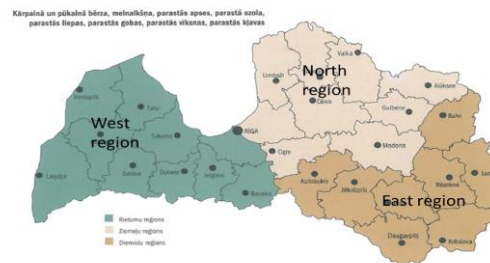


Fig. 2. Regions of origin of *Alnus glutinosa* [12]

The Latvian State Forest Research Institute “Silava” has confirmed that the identification of 50 clones (*Alnus glutinosa* Gaertn.) of Platene (West region of Latvia) seed plantations and operations has been done with molecular passporting methods that ensure the acquisition of these plants in the forest reproductive material identification to be at the stage of production, trade or use. The results of the identification are given in “Table 2”.

Table 2. Molecular passport of the clones

| Clone, no. | Sample, no. | Makers |     |     |     |      |     |      |     |      |     |     |     |     |     |     |     |     |     |
|------------|-------------|--------|-----|-----|-----|------|-----|------|-----|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|            |             | be 14  |     | be1 |     | be10 |     | be12 |     | be13 |     | be5 |     | be6 |     | be8 |     | be9 |     |
| 1          | 43          | 189    | 189 | 335 | 340 | 247  | 247 | 116  | 116 | 233  | 233 | 242 | 246 | 151 | 157 | 230 | 247 | 190 | 190 |
| 2          | 10          | 189    | 193 | 344 | 348 | 247  | 247 | 116  | 120 | 225  | 233 | 242 | 256 | 157 | 157 | 247 | 247 | 132 | 134 |
| 3          | 21          | 0      | 0   | 337 | 344 | 247  | 247 | 116  | 118 | 225  | 236 | 246 | 246 | 151 | 187 | 226 | 247 | 0   | 0   |
| 4          | 28          | 0      | 0   | 318 | 346 | 247  | 247 | 116  | 118 | 225  | 233 | 248 | 248 | 157 | 157 | 0   | 0   | 0   | 0   |

Reforestation by *Alnus glutinosa* in LVM in West region “Fig. 2” have been conducting by bare roots, containerized and with improved root system. The scheme of manufacturing of seedlings with improved root system is given “Fig. 3.”



Fig. 3. The scheme of manufacturing of seedlings with improved root system

Reforestation by *Alnus glutinosa* in LVM in West, North and East region in 2021 will be conducted according to the plan of growing seedling “Table 3.”

Table 3. Plan of growing seedling

| Plantation | Region | Plan in 2020 (pcs.) | Sown in 2020 (pcs.) | Realization plan in 2021(pcs.) |
|------------|--------|---------------------|---------------------|--------------------------------|
| Strenči    | North  | 250000              | 479830              | 180000                         |
| Podiņi     | East   | 693450              | 1729450             | 485415                         |
| Mazsili    | West   | 328300              | 328300              | 229810                         |

The origin of *Alnus glutinosa* clones for reforestation in West region were obtained in 2002. The characteristic of origin of the clones are given in “Table 4.”

Table 4. Origin of the clones

| Parameter                                  | Data   |  |  |   |   |
|--|--|--|--|---|---|
| Block area-Forest block-Forest compartment | 703-204-14   | 703-204-15   | 703-214-8  | 703-204-2   | 703-214-7   |
| Area (ha)                                  | 2.39   | 4.27   | 8.8  | 2.96  | 2.94  |
| County                                     | Dundaga  |  |  |   |   |
| Age (Age decade) years                     | 78 (8)   | 98 (10)  | 88 (9)   | 98 (10)   | 73 (8)  |
| Species composition                        | 9 <i>Alnus glutinosa</i> 1 <i>Bertula</i><br>78 + <i>F.excelsior</i><br>78 + <i>P.Abies</i> 71 | 10 <i>Alnus glutinosa</i><br>98 + <i>Bertula</i> 98<br>+ <i>P.Abies</i> 91 | 8 <i>Alnus glutinosa</i><br>2 <i>Bertula</i> 88 +<br><i>P.Abies</i> 88 | 10 <i>Alnus glutinosa</i> 98<br>+ <i>Bertula</i> 98 | 10 <i>Alnus glutinosa</i> 73<br>+ <i>Bertula</i> 91 + |
| Specie                                     | 04- <i>Bertula</i>   |  |  |   |   |
| Age (years)                                | 78   |  | 88   |   |   |
| Height (m)                                 | 26   |  | 27   |   |   |
| Diameter (cm)                              | 27   |  | 29   |   |   |
| Basal area (m <sup>2</sup> )               | 2  |  | 6  |   |   |
| Stock (m <sup>3</sup> /ha )                | 23   |  | 72   |   |   |
| Specie                                     | 06- <i>Alnus glutinosa</i>   |  |  |   |   |
| Age (years)                                | 78   |  | 88   |   |   |
| Height (m)                                 | 26   |  | 26   |   |   |
| Diameter (cm)                              | 30   |  | 31   |   |   |
| Basal area (m <sup>2</sup> )               | 25   |  | 26   |   |   |
| Stock (m <sup>3</sup> /ha )                | 309  |  | 321  |   |   |

In order to estimate the incidence of heart colouring and stem decay in *Alnus glutinosa* stands in different forest types and ages, to identify and measure the diameter of heart colouring and stem decay area and to evaluate the relationships between stand species composition (forest types) and *Alnus glutinosa* stands age on heart colouring/heartwood rot incidence, during 2020-2021, incidence of butt rot in *Alnus glutinosa* stands and the presence of fungi responsible for it were investigated.

**Table 5.** Characteristics of investigated forest site types

| Parameter  | Data   |   |  |  |  |   |   |
|--|--|---|--|--|--|---|---|
| Block area-Forest block-Forest compartment             | 503-443-46-0<br>503-443-18-0                                     | 107-421-2   | 107-443-5  | 107-438-11   | 803-307-2  | 501-119-4   | 501-110-13  |
| Area (ha)  | 0.77   | 0.8   | 1.99   | 1.75   | 4.03   | 0.85  | 0.8   |
| Stock nr.  | JD1071   | AE1828_01   | AE 1805_01   | AE 1805_01   | BS 1960_01<br>BS 1960_02   | JN 0036   |   |
| Average tree (m <sup>3</sup> )                         |  | 0.45  | 0.4  | 0.4  | 0.4  |   |   |
| Stock (m <sup>3</sup> )                                |  | 163.11  | 372.56   | 372.56   | 372.56   |   |   |
| County   | Pļaviņas   |   | Alūksne  |  | Madona   |   | Ogre  |
| Parish   | Aiviekste  |   | Liepna   |  | Vecumnieki   |   | Jugla   |
| Coordinates X/Y  |  | 708934/366266   | 708846/366207  |  |  | 549831/302173   |   |
| Forest type  | <i>Dryopteris-caricosa</i><br><i>Myrtillosa</i>                  | <i>Myrtillosa turf.mel.</i>   | <i>Dryopteris-caricosa</i>   | <i>Dryopteris-caricosa</i>   |  |   | <i>Mercurialis mel.</i><br>Overmature stand   |
| Age class  |  | Mature stand  |  |  |  |   |   |
| Age decade   | 8 (1942.)  | 9   | 8  | 8  | 9 (1931)   |   | 10  |
| Species composition                                    | 8 <i>Alnus glutinosa</i><br>1 <i>P.abies</i> 1 <i>Bertula</i> 78 | 8 <i>Bertula</i> 3 <i>Alnus glutinosa</i> 88+ <i>Pinus sylvestris</i> <i>P.tremula</i> 88 | 7 <i>Alnus glutinosa</i> 3 <i>Bertula</i> 73+ <i>P.tremula</i> 71<br><i>P.abies</i> 73 | 5 <i>Bertula</i> 4 <i>Alnus glutinosa</i> 1 <i>P.abies</i> 78+ <i>Pinus sylvestris</i> 78<br><i>P.tremula</i> 70 | 6 <i>P.abies</i> 2 <i>Alnus glutinosa</i> 1<br><i>P.tremula</i> 89 + <i>P.abies</i> 67 | 5 <i>Bertula</i> 4 <i>Alnus glutinosa</i> 1<br><i>P.tremula</i> 92+ <i>P.Abies</i> 65 | 4 <i>Bertula</i> 3 <i>Alnus glutinosa</i> 2 <i>P.Abies</i> 92+1 <i>P.tremula</i> 50 |
| Specie   | 04- <i>Bertula</i>   |   | <i>Oxalidosa</i>   |  | 08- <i>P.tremula</i>   | 04- <i>Bertula</i>  |   |
| Age (years)  | 78   |   |  |  | 89   | 92  | 92  |
| Height (m)   | 29   |   |  |  | 30   | 27  | 29  |
| Diameter (cm)  | 25   |   |  |  | 36   | 29  | 31  |
| Basal area (m <sup>2</sup> )                           | 2  |   |  |  | 9  | 11  | 11  |
| Stock (m <sup>3</sup> /ha)                             | 23   |   |  |  | 128  | 132   | 142   |
| Specie   |  |   |  | 06- <i>Alnus glutinosa</i>   |  |   |   |
| Age (years)  | 78   |   |  |  |  | 92  | 92  |
| Height (m)   | 26   |   |  |  |  | 26  | 29  |
| Diameter (cm)  | 25   |   |  |  |  | 30  | 30  |
| Basal area (m <sup>2</sup> )                           | 20   |   |  |  |  | 8   | 7   |
| Stock (m <sup>3</sup> /ha)                             | 247  |   |  |  |  | 99  | 97  |
| Sampled stumps (pcs.)                                  | 85   | 48  | 92   | 68   | 53   | 55  | 38  |
| Decayed soft rot/ cavity stems (%)                     | 75   | 88  | 48   | 55   | 82   | 88  | 87  |
| Stump diameter (mm)                                    | 342/330/79   | 394/390/73  | 330/340/58   | 340/345/75   | 340/338/44   | 375/265/64  | 372/272/58  |
| Average/Median/Stdev                                   |  |   |  |  |  |   |   |
| Heart colouring diameter*/Hard rot stage diameter (mm) | 40/40/39* // 124/110/56  | 120/126/45  | 125/115/44   | 85/90/21   | 145/152/33   | 156/165/42  | 150/158/38  |
| Average/Median/Stdev                                   |  |   |  |  |  |   |   |
| Soft rot stage diameter/Cavity diameter (mm)           | 126/100/73   | 185/185/46  | 150/146/46   | 110/110/57   | 173/167/28   | 186/190/43  | 192/188/45  |
| Average/Median/Stdev                                   |  |   |  |  |  |   |   |
| Specie   |  |   | 03- <i>P.abies</i>   |  |  | 08- <i>P.tremula</i>  |   |
| Age (years)  | 78   |   |  |  | 89   | 92  | 50  |
| Height (m)   | 27   |   |  |  | 31   | 29  | 29  |
| Diameter (cm)  | 32   |   |  |  | 36   | 36  | 35  |
| Basal area (m <sup>2</sup> )                           | 3  |   |  |  | 23   | 2   | 6   |
| Stock (m <sup>3</sup> /ha)                             | 38   |   |  |  | 325  | 28  | 83  |

| Parameter  | Data  |  |   |   |   |  |
|--|---|--|---|---|---|--|
| Block area-Forest block-Forest compartment                                 | 803-305-23  | 807-71-4   | 202-454-8   | 202-453-29  | 313-42-25   | 312-228-18   |
| Area (ha)  | 2   | 2.32   | 1.54  | 1.01  | 1.84  | 1.96   |
| Stock nr.  | AA2323  | BS 1933  | HT1840_01   | HT1906_01   | BT 2007_01  | BT 2020_01   |
| Average tree (m <sup>3</sup> )   | 0.6   | 0.44   | 0.79  | 0.6   | 0.72  | 0.1  |
| Stock (m <sup>3</sup> )  | 795.57  | 292  | 512.4   | 262.5   | 367.8   | 91.14  |
| County   | Madona  | Kārsava  | Renda   | Renda   | Svente  | Svente   |
| Coordinates X/Y  | 661455/282037   | 697466/31613   | 396397/321503   | 398896/322313   | 668075/183534   | 658119/179698  |
| Forest type  | <i>Oxalidos</i>   | <i>Myrtilloso-sphagnosa</i>  | <i>Oxalidos</i>   | <i>Myrtilloso-sphagnosa</i>   | <i>Oxalidos turf.me</i>   | <i>Dryopterioso-caricosa</i>   |
| Age class  |   |  | Mature stand  |   |   | Middle age stand   |
| Age decade   | 8 (1946)  | 8  | 8   | 9   | 9   | 3  |
| Species composition  | 8 <i>Alnus glutinosa</i><br>1 <i>P.tremula</i> 1 <i>Bertula</i> 74<br>+ <i>P.Abies</i> 56 | 6 <i>Bertula</i> 1 <i>Alnus glutinosa</i> 2<br><i>P.Sylvestris</i> 1 <i>P.Abies</i><br>74+ <i>P.Abies</i> 63 | 4 <i>Bertula</i> 4 <i>P.Abies</i> 1<br><i>P.Sylvestris</i> 1 <i>Alnus glutinosa</i> | 4 <i>Bertula</i> 2 <i>Alnus glutinosa</i> 2 <i>P.Sylvestris</i> 1<br><i>P.Abie</i> s 86 1 <i>Alnus glutinosa</i> 66 + <i>Bertula</i> 66 | 4 <i>Alnus glutinosa</i><br>2 <i>Bertula</i> 2<br><i>P.Abies</i><br>1 <i>P.tremula</i> 89 | 4 <i>Alnus glutinosa</i><br>3 <i>Bertula</i> 28<br>+ <i>P.tremula</i> 28 |
| Specie   |   |  | 04- <i>Bertula</i>  |   |   |  |
| Age (years)  | 74  | 74   | 71  | 86  |   | 28   |
| Height (m)   | 25  | 23   | 25  | 23  |   | 16   |
| Diameter (cm)  | 29  | 25   | 25  | 28  |   | 15   |
| Basal area (m <sup>2</sup> )   | 3   | 14   | 15  | 7   |   | 4  |
| Stock (m <sup>3</sup> /ha)   | 33  | 144  | 167   | 72  |   | 31   |
| Specie   |   |  | 06- <i>Alnus glutinosa</i>  |   |   |  |
| Age (years)  | 74  | 74   | 71  | 86  |   | 28   |
| Height (m)   | 26  | 21   | 21  | 23  |   | 16   |
| Diameter (cm)  | 27  | 25   | 25  | 27  |   | 18   |
| Basal area (m <sup>2</sup> )   | 30  | 2  | 6   | 4   |   | 9  |
| Stock (m <sup>3</sup> /ha)   | 371   | 20   | 60  | 44  | 120   | 71   |
| Sampled stumps (pcs.)  | 50  | 35   | 48  | 56  | 32  | 42   |
| Decayed (soft rot/ cavity) stems(%)  | 88  | 83   | 79  | 67  | 92  | 4  |
| Stump diameter (mm)/ Average/Median/Stdev                                  | 317/310/59  | 341/320/71   | 315/295/65  | 335/315/78  | 325/331/69  | 200/195/38   |
| Heart colouring diameter/Hard rot stage diameter (mm) Average/Median/Stdev | 152/160/30  | 133/140/39   | 115/135/42  | 142/155/42  |   |  |
| Soft rot stage diameter/Cavity diameter (mm)Average/Median/Stdev           | 167/160/27  | 138/145/37   | 108/120/40  | 145/150/40  | 152/149/48  |  |
| Specie   | 08- <i>P.tremula</i>  | 01- <i>P.sylvestris</i>  | 03- <i>P.abies</i>  | 01- <i>P.sylvestris</i>   |   |  |
| Age (years)  | 74  | 74   | 71  | 86  |   |  |
| Height (m)   | 26  | 26   | 24  | 26  |   |  |
| Diameter (cm)  | 44  | 27   | 28  | 32  |   |  |
| Basal area (m <sup>2</sup> )   | 5   | 6  | 10  | 6   |   |  |
| Stock (m <sup>3</sup> /ha)   | 62  | 71   | 114   | 71  |   |  |
| Specie   |   |  |   | 03- <i>P.abies</i>  |   |  |
| Age (years)  |   |  |   | 86  |   |  |
| Height (m)   |   |  |   | 23  |   |  |
| Diameter (cm)  |   |  |   | 27  |   |  |
| Basal area (m <sup>2</sup> )   |   |  |   | 6   |   |  |
| Stock (m <sup>3</sup> /ha)   |   |  |   | 66  |   |  |
| Specie   |   |  |   | 06- <i>Alnus glutinosa</i>  |   |  |
| Age (years)  |   |  |   | 66  |   |  |
| Height (m)   |   |  |   | 20  |   |  |
| Diameter (cm)  |   |  |   | 23  |   |  |
| Basal area (m <sup>2</sup> )   |   |  |   | 2   |   |  |
| Stock (m <sup>3</sup> /ha)   |   |  |   | 19  |   |  |

Surveyed were altogether 13 felling areas in Vidusdaugava, Dienvidkurzeme, Zemgale, Ziemeļlatgale, Dienvidlatgale, Austrumvidzemes Forest Districts the results of the investigation are given in “Table 5”. Characteristics data of investigated *Alnus glutinosa* stands are given in “Table 6.”

**Table 6.** Characteristics of investigated *Alnus Glutinosa* stands

| Age (Age decade), years | Species composition (%)   | Forest site type                                  | Sampled stumps, no. | Decayed stems (%) | Stump diameter Average (mm) | Soft rot stage /Cavity diameter Average (mm) |
|-------------------------|---|---|---------------------|-------------------|-----------------------------|--|
| 28 (3)                  | 4 <i>Alnus glutinosa</i> 3 <i>Bertula</i> 28 + <i>P.tremula</i> 28  | <i>Dryopterioso-caricosa</i>                      | 42                  | 4                 | 200                         |  |
| 74 (8)                  | 8 <i>Alnus glutinosa</i> 1 <i>P.tremula</i> 1 <i>Bertula</i> 74 + <i>P.Abies</i> 56   | <i>Oxalidosa</i>                                  | 50                  | 88                | 317                         | 167  |
| 74 (8)                  | 6 <i>Bertula</i> 1 <i>Alnus glutinosa</i> 2 <i>P.Sylvestris</i> 1 <i>P.Abies</i> 74 + <i>P.Abies</i> 63                             | <i>Myrtilloso-sphagnosa</i>                       | 35                  | 83                | 341                         | 138  |
| 79 (8)                  | 4 <i>Bertula</i> 4 <i>P.Abies</i> 1 <i>P.Sylvestris</i> 1 <i>Alnus glutinosa</i>  | <i>Oxalidosa</i>                                  | 48                  | 79                | 315                         | 108  |
| 78 (8)                  | 8 <i>Alnus glutinosa</i> 1 <i>P.abies</i> 1 <i>Bertula</i> 78   | <i>Dryopterioso-caricosa</i><br><i>Myrtillosa</i> | 85                  | 75                | 342                         | 126  |
| 73 (8)                  | 7 <i>Alnus glutinosa</i> 3 <i>Bertula</i> 73 + <i>P.tremula</i> 71 <i>P.abies</i> 73  | <i>Dryopterioso-caricosa</i>                      | 92                  | 48                | 330                         | 150  |
| 78 (8)                  | 5 <i>Bertula</i> 4 <i>Alnus glutinosa</i> 1 <i>P.abies</i> 78 + <i>Pinus sylvestris</i> 78 <i>P.tremula</i> 70                      | <i>Dryopterioso-caricosa</i>                      | 68                  | 55                | 340                         | 110  |
|                         |   |   | <b>Average</b>      | <b>69</b>         | <b>332</b>                  | <b>133</b>                                   |
| 86 (9)                  | 4 <i>Bertula</i> 2 <i>Alnus glutinosa</i> 2 <i>P.Sylvestris</i> 1 <i>P.Abies</i> 86 1 <i>Alnus glutinosa</i> 66 + <i>Bertula</i> 66 | <i>Myrtilloso-sphagnosa</i>                       | 56                  | 67                | 335                         | 145  |
| 89 (9)                  | 4 <i>Alnus glutinosa</i> 2 <i>Bertula</i> 2 <i>P.Abies</i> 1 <i>P.tremula</i> 89  | <i>Oxalidosa turf.mel.</i>                        | 32                  | 92                | 325                         | 152  |
| 88 (9)                  | 8 <i>Bertula</i> 3 <i>Alnus glutinosa</i> 88 + <i>Pinus sylvestris</i> <i>P.tremula</i> 88  | <i>Myrtillosa turf.mel.</i>                       | 48                  | 88                | 394                         | 185  |
| 89 (9)                  | 6 <i>P.abies</i> 2 <i>Alnus glutinosa</i> 1 <i>P.tremula</i> 89 + <i>P.abies</i> 67   | <i>Oxalidosa</i>                                  | 53                  | 82                | 340                         | 173  |
|                         |   |   | <b>Average</b>      | <b>81</b>         | <b>345</b>                  | <b>164</b>                                   |
| 92 (10)                 | 5 <i>Bertula</i> 4 <i>Alnus glutinosa</i> 1 <i>P.tremula</i> 92 + <i>P.Abies</i> 65   |   | 55                  | 88                | 375                         | 186  |
| 92 (10)                 | 4 <i>Bertula</i> 3 <i>Alnus glutinosa</i> 2 <i>P.Abies</i> 92 + <i>P.tremula</i> 50   | <i>Mercurialiosa mel.</i>                         | 38                  | 87                | 372                         | 192  |
|                         |   |   | <b>Average</b>      | <b>88</b>         | <b>373</b>                  | <b>188</b>                                   |

## V. CONCLUSIONS AND RECOMMENDATIONS

1. To ensure the quality of *Alnus glutinosa* wood, reforestation must be carried out with seeds, seedlings, not coppice.
2. In the processes of reforestation the regions of origin of *Alnus glutinosa* must be observed.
3. The main factor influencing the quality of wood is the age of the stems of *Alnus glutinosa*. The highest quality wood is up to 30-year-old stems.
4. When harvesting has been managed in stands older than 70 years, the proportion of decayed stems exceeds 69%, heartwood rot diameter reaches 133 mm at an average stump diameter of 332 mm.
5. When harvesting has been managed in stands older than 80 years, the proportion of decayed stems exceeds 81%, heartwood rot diameter reaches 164 mm at an average stump diameter of 345 mm.
6. When harvesting has been managed in stands older than 90 years, the proportion of decayed stems exceeds 88%, heartwood rot diameter reaches 188 mm at an average stump diameter of 373 mm.

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