The new poplar hybrids’ growth in the Central Black Earth region of Russia

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Abstract. The description of the following ten poplar hybrids bred in All-Russian Research Institute of Forest Genetics, Breeding and Biotechnology (originator is A P Tsarev): white poplar hybrid ‘Veduga’, black poplar hybrids ‘Vertical’ and ‘Prolog’ and intersectional poplar hybrids ‘Strojn’, ‘Arctur’, ‘Arta’, ‘Versija’, ‘Peredel’, ‘Saturija’ and ‘Erida’ have been testing in the Shekman’ experience site in the forest-steppe zone of Tambov region is presented. The roodage of 1-year-old hybrids and further its survival during 33 years of research are shown. It is noted that the dry year 2010 significantly affected the survival of plants, which resulted in its reduction in subsequent years in the whole site by almost half. The hybrids ‘Versija’, ‘Peredel’, ‘Saturija’ and ‘Erida’ have been more drought-resistant, the survival of which by the year 2015 did not fall below 70 %. The promising hybrids for massive, protective and greener planting of the region have been allocated. The best hybrids on growth energy and productivity in the region: ‘Veduga’, ‘Erida’, ‘Peredel’ and ‘Versija’, which in 25 years had average height of 20.4-23.8 m, diameter – 26.2-29.8 cm and volume of the trunk – 0.5-0.7 m³. At the age of 33 their indicators were 23-25 m, 28-32 cm and 0.55-0.8 m³ respectively.

1. Introduction

Genus Populus L. includes many fast-growing species and forms. That is the main reason to stimulate the interest in its investigate and cultivate all over the world. It consists of several sections, dozens of species, hundreds of introduction varieties, and thousands of hybrids. Some of them are capable of producing saw logs; others go for cellulose pulping and papermaking. Some of them have the ability to temporarily survive in the anaerobic conditions of the floodplains and can be used in the creation of protective plantings around the ponds; others possess decorative qualities, pollution sustainable, more intense produce oxygen and can be used in landscape gardening and recreational spaces.

Different forms and clones of poplars are used in different soil and climatic conditions, in different types of cultivation technologies and for different purposes. Since the beginning of the twentieth century various forest scientists in different countries began to conduct research on their hybridization to obtain the most suitable for various purposes genotypes and varieties.

There were known pioneer works of Professor Henry, who in 1912 crossed in England (Kew Garden) P. balsamifera L. and P. trichocarpa Torr. et Gray. He received a few seeds, planted of them
4 seedling, and thus obtain the hybrid poplar P. × generosa Henry. In further experiments he bred a number of hybrids that were common in Western Europe [1].

The following large-scale experiments were conducted by Stout and Schreiner in the USA [2], Heimburger in Canada [3], Jacometti in Italy [4], Wettstein in Germany [5] and others. The summary of poplar hybrids obtained in Western countries before the organization of the International Poplar Commission was presented by S. Pauley [6]. According to him, by the middle of the twentieth century in Western countries (without the USSR and Russia) 83 poplar hybrids were obtained. Since the FAO International Poplar Commission had been established in 1947, works on hybridization and development of new poplar varieties have been coordinated by this structure. The main results obtained all over the world in the field of poplar hybridization were presented in the generalizing editions of this organization in 1958 and 1979 [7, 8]. And in the issue by B. J. Stanton et al [9] works on the poplars’ hybridization reflected with the participation of Russia. In subsequent years, a number of promising poplar hybrids for energy purposes were obtained and tested [10-13].

It should be noted that large-scale studies on the poplars hybridization in the USSR and Russia have been undertaken since the 30s of the twentieth century. This works were conducted by A. M. Berezin [14], A. S. Yablokov [15], A. V. Alfensky [1], P. L. Bogdanov [16], P. P. Besschetnov [17].

In 1950-1955 there were bred such widely known hybrids of poplars as ‘Leningradsky’, ‘Newsky’ (Leningrad Forest Technical Academy – originator P. L. Bogdanov [16]); ‘Pioneer’, ‘Ivantevsky’, ‘Soviet pyramidal’ny’ (All-Union Research Institute of Silviculture and Forestry Mechanization – originator A. S. Yablokov [15, 18, 19]); ‘Pyramidal’ny-osokorevsky Kamshyinsk’ (All-Union Research Institute of Agro-Forest Reclamations – originator A. V. Al’bensky [1]); ‘Voronezh giant E.s.-38’ (Voronezh Forest Technical Institute – originator M. M. Veresin [20]) etc. At this time, much attention was also paid to foreign researches. As a result, a number of Euro-American poplar cultivars and new poplar hybrids have been introduced to Russia [21, 22].

In subsequent years (1971-1995) the works by A. P. Tsarev, R. P. Tsareva and V. P. Petrukhnov conducted in the Central Research Institute of Forest Genetics and Breeding, organized in 1971 in Voronezh, were devoted to issues of poplars hybridization and breeding in Russia [21, 23, 24, 25, 26]. They have received hundreds of new hybrids; some of them are currently obtained patents and copyright certificates (‘Bolide’, ‘Veduga’, ‘Steppe Lada’, ‘Breeze’ etc.) [27].

Having such a wide gene pool of poplar hybrids, there was a need to create a collection of them and testing sites in different zones and regions. The first of such collections, numbering more than 300 species, forms, clones, hybrids and varieties of poplars by domestic and foreign breeding, was created by Professor A. P. Tsarev in the period from 1972 to 1975 in the Central Chernozem forest-steppe zone in Semiluky district of Voronezh region. On its basis 80 best productivity and stability forms were selected, and using them the variety testing site – Semiluky populetum was created [21, 25, 26]. The results of the white, black, balsam poplars’ and their intersectional hybrids’ variety testing in the Central Chernozem Region were presented earlier [25, 26, 28, 29, 30]. Also on the basis of the All-Russian Research Institute of Forest Genetics, Breeding and Biotechnology in the Central Black Earth region of Voronezh region works on hybridization of poplars were actively carried out [24, 31], and currently works on hybridization of aspen are being carried out [32].

The main reasons for the need to breed and test new hybrids and varieties are the erasing of new requirements in the life of communities and in the developing economies on the one hand; and, on the other, the aging, degeneration and often the death of known clones and varieties as a result of environmental change and the emergence of new pathogens and pests. In this regard, it’s not advisable to bet on one, even the most outstanding variety, clone or hybrid.

So, back in the 70s of the last century, a hypothesis was put forward about the possibility of increasing the value of poplar plantations through the use of mixing clones (H. A. Meiden, 1974) [33]. The need to create poplar cultures with a set of clones was also pointed out by O. Lange [34], who believed that instead of one clone, populations of 30-50 clones (0.20 – 0.25 ha area for each clone) homogeneous in terms of growth, environmental sustainability and morphological similarity should be planted. Practical use of these recommendations in Germany showed that it is very difficult to choose
a set of clones and varieties that would need the same cultivation technology, so different clones are more appropriate to grow in different areas. But the need to have not one, but several promising clones and varieties in the same area, similar in economic value, but different in genetic structure is remained.

Given to attention the wide range of poplars applications in the national economy, its hybridization and breeding in our country should be carried out for different growing environments and different purposes. The most extensive studies in this direction were carried out in the Central Research Institute of Forest Genetics and Breeding on dozens of variety testing sites including the lands of Shekhman' Forestry [35].

The purpose of the research presented in this publication is to identify the most promising new poplar hybrids in survival and growth for the forest-steppe zone of the Central Black Earth region of the European Russia.

2. Methods and Materials

The variety testing site was laid in the Tambov region on the territory of the Shekhman' Forest Research Station in April 14, 1986 on the area of 1.0 ha by 10 hybrids of poplar bred by A. P. Tsarev. Coordinates: latitude 52°30'20" North, longitude 40°25'50" East. The soil is typical loamy black soil. The average annual long-term temperature is 6°C. The average annual rainfall is 516 mm [36, 37].

Planting was carried out by 1-year-old rooted clonal plants without ball with 4×4 m placement in 4 repetitions. The test introduced 6 intersectional hybrids, (‘Arctur’, ‘Arta’, ‘Versija’, ‘Erida’ ‘Peredel’ and ‘Saturija’) selected in the family No 75.41 (‘Pioneer’×P. balsamifera L.); one intersectional hybrid (‘Strojn’) selected in the family No 75.33 (P. balsamifera L.×‘POK’), two hybrids (‘Vertikal’ and ‘Prolog’) selected in the family of black poplars No 75.13 (P. deltoides Marsh.×‘POK’) and one hybrid of white poplars (‘Veduga’) selected in the family No 76.W.31 (P. alba L.×P. bolleana Lauche). Totally 605 plants were planted. Regular surveys were conducted on 480 plants (table 1). The placement of hybrids in repetitions was randomized.

3. Results and discussion

| No | The name of the hybrid | The number of the breeding family | Parents | Initially planted, examples | Survival examples % |
|----|-----------------------|----------------------------------|---------|----------------------------|-------------------|
| 1  | ‘Veduga’              | 76.W.31                          | alba×bolleana                      | 35                | 28 80 |
| 2  | ‘Vertikal’            | 75.13-32.03                      | deltoides×‘POK’                    | 55                | 46 82 |
| 3  | ‘Prolog’              | 75.13-32.05                      | deltoides×‘POK’                    | 34                | 31 91 |
| 4  | ‘Strojn’              | 75.33-11.05                      | balsamifera×‘POK’                  | 63                | 60 95 |
| 5  | ‘Arctur’              | 75.41-21.10                      | ‘Pioneer’×balsamifera              | 63                | 59 94 |
| 6  | ‘Arta’                | 75.41-25.05                      | ‘Pioneer’×balsamifera              | 62                | 60 97 |
| 7  | ‘Versija’             | 75.41-23.07                      | ‘Pioneer’×balsamifera              | 51                | 45 88 |
| 8  | ‘Peredel’             | 75.41-22.02                      | ‘Pioneer’×balsamifera              | 13                | 13 100 |
| 9  | ‘Saturija’            | 75.41-23.13                      | ‘Pioneer’×balsamifera              | 51                | 47 92 |
| 10 | ‘Erida’               | 75.41-25.04                      | ‘Pioneer’×balsamifera              | 52                | 50 96 |
|    | Total and average     |                                  | 480                               | 439              | 91   |

‘Pioneer’ is a black poplar hybrid bred by A. S. Yablokov from the crossing of P. pyramidalis Roz. × P. nigra L.

‘POK’ (‘Pyramidal’ny Osokorevy Kamysinsky’) is also a black poplar hybrid obtained by A. V. Albensky from the crossing of P. pyramidalis Roz. × P. nigra L.
The survival rate of 1-year-old plants as a whole for the Shekhman' variety testing site was 91% (table 1). Survival by the 3rd year of growth was 81% and almost did not decrease until the age of 20. In 20 years, the survival was also high, ranging from 55% (‘Veduga’) to 95% (‘Erida’).

After the intense heat and drought of 2010, when the plantation was 25 years old, the survival of poplars from 75% to 30 years decreased to 61%, and by 33 years fell to 55% with a variation from 37% to 79%. The greatest survival in 33 years was noted in intersectional hybrids ‘Erida’, ‘Saturija’, ‘Peredel’, and ‘Versija’. These hybrids can be considered the most drought-resistant. The lowest survival was noted in white and black poplar hybrids ‘Veduga’, ‘Vertical’ and ‘Arctur’. The remaining poplars were kept in an intermediate position (figure 1).

Analysis of the growth dynamics of hybrids and ranking them in height showed that the growth ranks began to be established in 3-5 years, and by the end of 7 years, they stabilized and almost completely remained for the next years of research until the last inventory conducted in 33 years.

This suggests that the assessment of growth and selection of promising forms of poplars can be carried out in 5-7 years, that confirms the conclusion made earlier by A. P. Tsarev in 1977 [38].

Previously, it was also found that the quantitative timber maturity of varietal poplars occurs in 22-27 years, i.e. on average in 25 years [25].

![Figure 1. Survival dynamics of the poplar hybrids at the Shekhman' variety testing site.](image)

Therefore, a detailed analysis of the growth of new hybrids can be carried out at the age of 25, which came on this site in 2010. The year 2010 in the region was very hot and dry and these ecological and climatic features had a significant impact on many forest species, but especially on poplars. Growth and productivity characteristics of the studied poplars at the age of 25 are presented in table 2.
Table 2. The brief description of the hybrid poplars growth at the Shekhman’ variety testing site in the age of 25 years.

| No | The name of the hybrid | Survival % | Height±s, m | Diameter±s, cm | Volume of the trunk m±s | rank |
|----|------------------------|------------|-------------|---------------|------------------------|------|
| 1  | ‘Veduga’               | 54         | 23.8±0.44   | 29.8±1.19     | 0.65±0.07              | 1    |
| 2  | ‘Vertikal’             | 67         | 21.6±0.61   | 26.0±1.33     | 0.45±0.06              | 4    |
| 3  | ‘Prolog’               | 70         | 20.8±0.52   | 24.5±1.15     | 0.38±0.07              | 8    |
| 4  | ‘Strojn’               | 80         | 21.0±0.46   | 25.0±1.09     | 0.40±0.07              | 6    |
| 5  | ‘Arctur’               | 79         | 17.7±0.63   | 23.3±1.28     | 0.29±0.06              | 9    |
| 6  | ‘Arta’                 | 90         | 20.8±0.48   | 25.0±1.38     | 0.39±0.13              | 7    |
| 7  | ‘Versija’              | 73         | 20.4±0.40   | 26.2±0.90     | 0.43±0.05              | 5    |
| 8  | ‘Peredel’              | 83         | 21.6±0.74   | 26.2±1.73     | 0.46±0.08              | 3    |
| 9  | ‘Saturija’             | 71         | 18.5±0.64   | 22.0±1.79     | 0.27±0.18              | 10   |
| 10 | ‘Erida’                | 85         | 21.4±0.57   | 26.8±1.35     | 0.47±0.10              | 2    |
| Aggregate average (control) | 75 | 5.5 | 20.7±0.19 | 25.5±0.47 | 0.42±0.04 | 5.5 |

From the data of the table 2 it can be seen that the survival of poplars at the age of 25 was high and varied mostly between 70 % and 90 %, in exception of the hybrids ‘Veduga’ and ‘Vertical’. In the top five hybrids by growth (rank 1-5) at this age there were ‘Veduga’, ‘Erida’, ‘Peredel’, ‘Vertical’ and ‘Versija’. The worst indices were in ‘Saturija’ and ‘Arctur’.

Long-term growth dynamics of tested poplars in height and diameter during the 33 years period are presented in figures 2 and 3.

![Figure 2](image-url)

**Figure 2.** Growth dynamics of the poplar hybrids at the Shekhman’ variety testing site (height, m).

As can be seen from the figure 2, the increases in the height of hybrids were observed mainly up to 25 years. After 25 years, the growth rate decreased, and by 33 years almost stopped. The addition in height from 30 to 33 years was insignificant and made 0.1-0.2 m per year. The average height of the best hybrids in 30 years ranged from 22.0 to 24.8 m and in 33 years – from 22.5 to 25.2 m.

The same trend was observed for growth in diameter (figure 3).
Figure 3. Growth dynamics of the poplar hybrids at the Shekhman' variety testing site (diameter, cm).

In the figure 4 you can see the results of statistical processing of the data on the age dynamics of the aggregate average heights with the determination of the trend line.

Figure 4. The polynomial curve of the fifth degree of the age dynamics of the aggregate average heights of the tested hybrids varieties at the Shekhman' variety testing site.
In the figure 5 you can see the results of statistical processing of the data on the age dynamics of the aggregate average diameters with the determination of the trend line.

**Figure 5.** The polynomial curve of the fifth degree of the age dynamics of the aggregate average diameters of the tested hybrids varieties at the Shekhman' variety testing site.

Growth dynamics of hybrid poplars by trunk volume is shown in figure 6.

**Figure 6.** Growth dynamics of the poplar hybrids at the Shekhman' variety testing site (trunk volume, m³).
As can be seen from the figure 6, the increase in volume of stem wood in different forms occurred in different ways. Since the first years of growth the hybrid ‘Veduga’ performed the best volume of the trunk, which in all subsequent years of observation maintained its primacy. And it did not slow down the rate of growth after 25 years.

Poplars ‘Peredel’ and ‘Erida’ were at the second and third place in the increase in volume of stem wood. The hybrids ‘Arctur’, ‘Saturija’ and ‘Prolog’ have shown the lowest indices of the trunk volume.

Table 3 and figure 7 presents the results of statistical processing of data on the age dynamics of trunk volumes with the determination of the trend line.

**Table 3.** The polinomial approximation of the poplar hybrids volumes of the trunk dynamics at the Shekhman’ variety testing site.

| No | The name of the hybrids | Polynomial trend line | The coefficient of approximation, $R^2$ |
|----|-------------------------|-----------------------|--------------------------------------|
| 1  | ‘Veduga’                | $y = 0.0002x^5 - 0.0055x^4 + 0.0418x^3 - 0.1234x^2 + 0.2317x - 0.1095$ | 0.9999 |
| 2  | ‘Peredel’               | $y = 5E-05x^5 - 0.0022x^4 + 0.0269x^3 - 0.1138x^2 + 0.2218x - 0.114$ | 0.9986 |
| 3  | ‘Erida’                 | $y = 0.0003x^5 - 0.0065x^4 + 0.0543x^3 - 0.184x^2 + 0.3021x - 0.1452$ | 0.9979 |
| 4  | ‘Versija’               | $y = 0.0003x^5 - 0.0067x^4 + 0.0603x^3 - 0.224x^2 + 0.3851x - 0.1992$ | 0.9995 |
| 5  | ‘Vertikal’              | $y = 0.0004x^5 - 0.01x^4 + 0.0868x^3 - 0.3138x^2 + 0.5996x - 0.2565$ | 0.9998 |
| 6  | ‘Strojn’                | $y = 0.0004x^5 - 0.0102x^4 + 0.0839x^3 - 0.2921x^2 + 0.4719x - 0.234$ | 0.9986 |
| 7  | ‘Arta’                  | $y = 0.0004x^5 - 0.0092x^4 + 0.0823x^3 - 0.3079x^2 + 0.5124x - 0.2625$ | 0.9991 |
| 8  | ‘Prolog’                | $y = 0.0005x^5 - 0.0119x^4 + 0.1015x^3 - 0.3667x^2 + 0.5853x - 0.295$ | 0.9995 |
| 9  | ‘Saturija’              | $y = 0.0002x^5 - 0.0044x^4 + 0.0416x^3 - 0.1621x^2 + 0.2801x - 0.142$ | 0.9994 |
| 10 | ‘Arctur’                | $y = 0.0002x^5 - 0.0062x^4 + 0.0574x^3 - 0.224x^2 + 0.3934x - 0.2077$ | 0.998 |
| Aggregate average | $y = 0.0003x^5 - 0.0074x^4 + 0.0647x^3 - 0.2348x^2 + 0.3947x - 0.1987$ | 0.9994 |
Figure 7. The polynomial curves of the fifth degree of the age dynamics of the trunk volumes of the tested hybrids varieties at the Shekhman' variety testing site.

The obtained results of statistical analysis show that the age dynamics of the heights, diameters and trunk volumes of the tested varieties are described by polynomial curves of the fifth degree with a high coefficient of approximation (at least two nines after the decimal point).

Other hybrids are known in Russia obtained by P.L. Bogdanov from crossing P. canadensis (♀) with P. balsamifera (♂) and P. suaveolens (♂), ['Nevsky' ('P. newesis' Bogd.) and ‘Leningradsky’ ('P. leningradensis' Bogd.)], according to A.K. Boytsov, A.V. Zhigunov et al., still serve as standards of productivity in the North-West of Russia [39]. In 7 years they had a height of 10-11 m, diameter – 13 cm and were quite frost-resistant. In the conditions of the Leningrad climate they are recommended both for massive (for timber materials) and for greenery landscaping plants (both clones are male) [16].

In the conditions of the Central Chernozem Region at the age of quantitative maturity (25 years) they reached a height of 23 and 25 m, diameter – 21 and 27 cm, survival – 83 % and 96 % respectively. Wood stock – 139 and 265 m³/ha which in 3 and 1.5 times lower than control (397 m³/ha). After 30 years of age P. ‘Leningradsky’ ‘ in the forest-steppe zone completely fell out, and the survival of P. ‘Nevsky’ decreased to 33 %. I.e. both of these hybrids in more southern conditions don’t withstand the lack of moisture and cannot be recommended for artificial afforestation in the Central Chernozem Region [30].

The same trend was observed with the poplar ‘Ivanteevsky’ which was characterized by rapid growth, good winter hardiness and decorative in the Moscow region [18, 19], but under the conditions of the Central Chernozem Region it was also not drought-resistant. Since the age of 10 it had one of the worst indices of growth, survival and productivity. At the age of quantitative maturity (25 years) its wood stock was 93 m³/ha, which is more than in 4 times less than control (397 m³/ha), and by the age of 35 it completely fell out of the plant [30].

Abroad of the Russian Federation Populus interspecific hybridization is the main breeding approach in programmes operating at latitudes higher than about 25–32° of the equator. First-
generation hybridization ($F^1$) is used most often as the controlled breeding strategy as it frequently results in heterosis for growth rate. Advanced-generation breeding into the second ($F^2$) interspecific generation has not been as widely reported. Although transgressive segregants are occasionally found, the mean performance of the $F^2$ generation is less than the $F^1$ and is not commonly pursued. Backcrossing is a more common approach to advanced-generation breeding and is generally used to introduce a single, highly heritable trait from a donor species to improve a recurrent species that is otherwise suitable, save a missing characteristic. In the north central region of the USA, $P. \times$ canadensis ($F^1$) hybrids are backcrossed to $P. \ deltoides$ selections to introduce the strong adventitious rooting ability of $P. \ maximowiczii$ into the recurrent $P. \ deltoides$ parent, while maintaining the latter species’ resistance to Sertoria stem canker. In China’s Jiangsu province, $P. \times$ euramericana ($P. \ deltoides \times P. \ nigra$, synonym $P. \ ×$euramericana) hybrids are backcrossed to southern provenances of $P. \ deltoides$ to exploit interspecific heterosis, while maintaining adaptation to the local photoperiod. Hybridization involving three or more species has also been pursued as an advanced generation strategy in Populus (e.g. complexes of $P. \ ×$petrowskyana $\times P. \ maximowiczii$) [9].

In Western Europe, the most common are Euro-American varieties of poplars. In 1971, at the XIV session of the FAO international poplar Commission in Bucharest, 28 varieties of poplar received international recognition and were included in the register of this organization [40]. Among them are such well-known, so-called "old varieties" of black poplars as “Bachelieri”, “Brabantica”, “Vernirubens”, “Regenerata”, “Robusta”, “Sacrau”, “Serotina” etc, which have heterosis of growth and show high productivity results not only in Western Europe, but also in the forest-steppe zone of the Russian Federation [21, 40].

In 60-70 years the list of varieties of black poplars was supplemented with new cultivars, including resistant to Marssonina populii. In Italy, the varieties “Harvard” (I-63/51), “Lux” (I-69/55), “Onda” (I-72/51) etc are selected. In Germany the varieties “Lincoln”, “Marquette”, “Peoria” were obtained; in the USA – “Stoneville”, “NE”; in Canada – “Saskatchewan”, “Walkner” etc. Among the white poplars especially in the south European and Asian countries the following varieties are common: “Roumi” in Syria and Afghanistan, “Kabudeh Schirazin”, “Kabudeh Bumi” in Iran, I-58/57 in Italy, “Racket” in Netherlands, “Ankaraq AT” in Turkey etc [8, 41, 42].

In recent years, new varieties have been obtained in Western Europe, including in Italy – “San Martino” (I-72/58), “Tripolo” (I-37/61), “Boccolari”, “Gattoni”, “Kappa Bigliona”, “Branagesi”, “Campador”; in the Netherlands – “Doskamp” (NL-925), “Flevo” (NL-923), “Spike”, “Agatha”, “Florence Biondi”; in Belgium – “Primo”, “Haver”, “Gibek”, “Goy”, “Augie”; in Germany – “Bluchig” (Baden-408), “Rintaim” (Baden-431) etc [43].

Among the balsamic poplars known varieties “Fritzi Pauley” (sp-126), “Scott Pauley” (sp-127), “Blöhm”, “Haimburger”. Stout and Schreiner (USA) obtained stable interspecific hybrids “Androscoggin”, “Geneva”, “Oxford”, “Rochester”, “Andover”, “Roxbury”, “Rumford”, “Stratsglas”, “Maine” etc [43].

All of these hybrids in the regions of their production were distinguished by the straightness of the trunk and showed good rootage and survival, rapid growth and high productivity [43]. But when attempts were made to introduce, propagate and test some of them in the USSR and in the Russian Federation, they grew well in the first years of planting but then they could not withstand harsh winters in some years and either completely fell out of plantations in the first ten years or significantly reduced their safety and growth in the future [44].

Conclusions

Thus, long-term growth and productivity indices of the new poplar hybrids bred in the All-Russian Research Institute of Forest Genetics, Breeding and Biotechnology allowed drawing the following conclusions.

The investigation gave possibilities to select promising hybrid forms, which can be recommended both for massive and for protective forest plantations of the forest-steppe zone of the European part of Russia.
The poplar hybrids ‘Veduga’, ‘Peredel’, ‘Erida’ and ‘Versija’ can be recommended for massive plantations of forest-steppe zone.

The same four above listed hybrids can be recommended for protective plantings.

The highly decorative white pyramidal poplar ‘Veduga’ with silvery leaves and cross-sectional poplar hybrid ‘Strojn’ with pyramidal crown can be recommended for landscape gardening.

In General, new hybrids obtained in the All-Russian Research Institute of Forest Genetics, Breeding and Biotechnology can increase the composition of poplars used in the research area and can be used in further poplar breeding.

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