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AGE DYNAMICS OF GROWTH SEPARATE FAMILIES OF A HYBRID-SEED PLANTATION PINES ORDINARY IN VARIOUS FOREST GROWTH AREAS

In this work the age dynamics of families growth of hybrid-seed plantations of *Pinussylvestris* in test cultures of different ages, created in Nemansko-Predpolessky and Berezinsko-Predpolessky forest growing areas is studied. It is established that the seed-bearing breed of hybrid-seed plantations of *Pinussylvestris* is characterized by the intensive height growth and preserves the inherent high growth energy over a period of 10-year tests. At present the breed-population of *Pinussylvestris* Negorelskaja is put on the State register of plants kinds by the state institution «State inspectorate on testing and protection of plants kinds» of the Ministry of agriculture and provisions of the Republic of Belarus.

Introduction. One of the main techniques of productivity improvement of artificial pine plantations is studying and selection of local populations, their involvement in forest-seed and forest-growth production to increase dramatically the trees growth [1].

In addition to selection of highly productive populations, the present development stage of forest breeding seed farming of the Republic of Belarus provides the usage of high-quality seeds with valuable hereditary properties [2].

The purpose of the given work is the analysis of the families age growth dynamics of the hybrid-seed plantation of *Pinus sylvestris* in the test cultures created in Nemansko-Predpolessky and Berezinsko-Predpolessky forest growing areas of Belarus.

Main part. Growth peculiarities studies of *Pinussylvestris* hybrid breed were done in the test cultures of Negorelsky experimental forestry station and Ivievsky forestry enterprise (Nemansko-Predpolessky forest growing area), Starobinsky forestry enterprise (Berezinsko-Predpolessky forest growing area). The conducted researches on growth peculiarities studies of seed breed of hybrid-seed plantation of *Pinus sylvestris* on the plot of test cultures created in 2004 in the Negoreloye forestry (sq. 72, site 1) of Negoreloye experimental forestry station, testify that some families during 10-year tests period are characterized by high growth indices (Table 1).

The analysis of the families age growth dynamics over the last three years on the plot of test 10-year-old cultures created in Negorelsky forestry experimental station (Nemansko-Predpolessky forest growing area), shows that the leading height position from year to year occupy families 3–5 (ranks 2, 1, 1), 2–2 (ranks 1, 2, 2), 1–3 (ranks 3, 3, 3), 2–6 (ranks 5, 5, 4) and 10–5 (ranks 4, 4, 7).

Among the families under test there are breeds which on the initial growth stage occupied a medial

rank position on height, and to 10-year-old age improved the given parameter. Families 4–1 (ranks 6, 6, 5) and 3–3 (ranks 7, 6, 6) belong to this group. There are also families in the test groups backward in height throughout the whole tests period. The breeds 4–12 (ranks 12, 12, 12), 5–1 (ranks 13, 13, 13) and 6–7 (ranks 14, 14, 14) are in this group.

Growth peculiarities of the *Pinus sylvestris* seed breed were also studied in the test cultures created in 2008 in sq. 19, site 36 of Starobinsky forestry enterprise (Berezinsko-Predpolessky forest growing area). In total 20 families of the hybrid-seed plantation (Table 2) were put to test. To compare the growth indices they planted the families grown from seeds of forest-seed plantations of the first order of Kalinkovichsky forestry enterprise (control 1) and of Starobinsky forestry enterprise (control 2) as controls. The conducted researches showed that the families under test in the same conditions are characterized by different growth.

So, the family 7–3 (ranks 1 and 1) is characterized by the highest height rank, the remaining breeds have considerable height difference of ranks at the age of 5–6 years, so, there is no stabilization of families rank position on height at this age.

On the plot of test cultures in sq. 94, site 14 of Ivievsky experimental forestry of Ivievsky forestry enterprise, situated on the territory of Nemansko-Predpolessky forest growing area, nine seed breeds of the hybrid-seed plantation of *Pinus sylvestris* of Negorelsky experimental forestry station were put to test (Table 3).

The *Pinus sylvestris* seed breeds grown from the seeds of industrial selection are taken as the control on the plot of test cultures.

The growth studying results of hybrid breeds of *Pinus sylvestris* showed that the breed under test at the age of 1–2 years also had different rank position on height. The best growth indices in the first years of life have families 4–7 (ranks 2 and 2), 1–5 (ranks 3 and 1).

Table 1

**Growth indices of seed breeds of the hybrid-seed plantation of *Pinussylvestris*
in the test cultures of Nemansko-Prepolessky forest growing area**

Family	Age, years	Indices, cm			Rank on height	Family	Age, years	Indices, cm			Rank on height
		height min-max	height growth min-max	diameter min-max				height min-max	height growth min-max	diameter min-max	
1-3	8	336.5 ± 8.8 271-402	76.0 ± 3.6 35-100	4.9 ± 0.1 2.9-6.5	3	3-5	8	361.0 ± 7.5 300-440	79.0 ± 1.7 65-90	5.9 ± 0.1 3.8-8.5	2
	9	412.5 ± 10.0 340-480	77.5 ± 5.0 60-90	5.8 ± 0.2 3.9-7.1	3		9	447.5 ± 10.0 390-495	85.0 ± 5.0 70-95	6.5 ± 0.2 4.8-8.7	1
	10	490.0 ± 12.5 425-530	79.5 ± 7.0 70-95	6.9 ± 0.3 4.9-8.2	3		10	525.5 ± 15.0 460-565	80.0 ± 7.0 60-90	7.6 ± 0.2 5.7-9.2	1
1-6	8	311.5 ± 7.3 271-389	73.4 ± 1.6 63-92	4.2 ± 0.1 3.0-5.2	11	4-1	8	329.5 ± 5.9 270-380	73.0 ± 2.9 55-95	5.4 ± 0.1 2.5-8.2	6
	9	387.5 ± 10.0 345-475	75.0 ± 5.0 55-85	5.0 ± 0.2 3.8-6.1	11		9	405.0 ± 10.0 345-440	75.0 ± 5.0 55-90	6.3 ± 0.2 3.7-8.9	6
	10	465.5 ± 15.5 415-550	78.0 ± 7.5 60-90	6.1 ± 0.2 4.9-7.2	9		10	482.5 ± 12.0 420-535	72.0 ± 6.0 50-85	7.4 ± 0.2 4.9-9.3	5
1-8	8	321.5 ± 9.0 245-415	69.0 ± 2.7 40-95	4.5 ± 0.1 2.6-7.0	8	4-12	8	310.5 ± 4.6 280-350	67.0 ± 1.8 55-85	5.3 ± 0.1 4.0-6.7	12
	9	389.0 ± 10.0 290-490	67.5 ± 5.0 45-90	5.3 ± 0.2 3.9-6.8	10		9	377.5 ± 7.5 320-415	65.0 ± 5.0 50-80	6.1 ± 0.2 4.9-7.6	12
	10	470.0 ± 15.0 395-535	74.5 ± 8.0 55-90	6.2 ± 0.2 4.8-7.9	8		10	445.5 ± 10.0 395-505	68.0 ± 7.0 45-80	7.1 ± 0.2 6.0-8.3	12
2-2	8	367.5 ± 5.1 315-390	81.0 ± 1.9 70-90	5.8 ± 0.1 4.5-7.0	1	5-1	8	293.3 ± 8.8 220-345	61.1 ± 2.8 40-80	3.9 ± 0.1 1.3-5.5	13
	9	445.0 ± 10.0 395-470	80.0 ± 5.0 65-90	6.7 ± 0.2 5.4-7.8	2		9	360.0 ± 10.0 285-405	65.0 ± 5.0 45-85	5.0 ± 0.2 3.8-6.3	13
	10	520.0 ± 15.0 470-550	78.0 ± 6.0 60-90	7.8 ± 0.2 6.5-9.0	2		10	435.5 ± 12.0 370-485	69.0 ± 7.0 55-80	6.2 ± 0.2 4.9-7.5	13
2-6	8	334.5 ± 5.2 270-360	77.0 ± 2.5 60-90	4.9 ± 0.1 2.8-7.3	5	6-7	8	292.0 ± 6.8 240-340	62.5 ± 2.5 45-80	3.9 ± 0.1 2.4-5.5	14
	9	410.0 ± 10.0 340-445	75.0 ± 5.0 65-85	5.8 ± 0.2 4.5-8.0	5		9	355.0 ± 10.0 300-395	65.0 ± 5.0 50-85	4.8 ± 0.2 3.3-6.2	14
	10	485.0 ± 15.0 400-545	77.0 ± 9.0 55-90	7.0 ± 0.2 5.5-9.3	4		10	425.0 ± 12.0 370-4960	67.0 ± 7.0 55-80	5.9 ± 0.2 4.6-7.4	14
2-7	8	320.5 ± 6.5 270-390	67.1 ± 3.1 50-95	4.6 ± 0.1 3.0-5.8	9	7-8	8	317.5 ± 6.8 235-380	72.6 ± 2.5 60-90	4.7 ± 0.1 2.0-7.3	10
	9	392.5 ± 10.0 335-455	70.0 ± 5.0 55-90	5.5 ± 0.2 3.9-6.6	8		9	390.0 ± 10.0 315-445	75.0 ± 5.0 65-95	5.6 ± 0.2 3.1-8.0	9
	10	465.5 ± 12.0 400-515	74.0 ± 8.0 60-95	6.8 ± 0.2 5.0-7.9	10		10	460.0 ± 12.0 385-495	72.0 ± 7.0 60-90	6.8 ± 0.2 4.3-8.7	11
3-3	8	326.5 ± 6.1 285-380	72.5 ± 2.4 50-90	4.6 ± 0.1 2.6-6.4	7	10-5	8	336.0 ± 6.8 290-400	69.5 ± 3.5 35-90	5.1 ± 0.1 3.6-6.4	4
	9	402.5 ± 12.5 365-450	75.0 ± 5.0 60-90	5.5 ± 0.2 3.5-7.3	7		9	410.0 ± 10.0 360-465	75.0 ± 5.0 55-85	6.0 ± 0.2 4.5-7.2	4
	10	480.5 ± 15.0 425-545	78.0 ± 7.0 55-90	6.8 ± 0.2 4.9-8.7	6		10	480.0 ± 12.0 440-525	75.0 ± 7.5 50-80	7.1 ± 0.2 5.7-8.5	7

Table 2

**Growth indices of seed breeds of the hybrid-seed plantation of *Pinussylvestris*
in the test cultures of Berezinsko-Predpolessky forest growing area**

Family	Indices, cm			Rank	Family	Indices, cm			Rank
	<u>height</u> min-max	<u>diameter</u> min-max	<u>needles length</u> min-max			<u>height</u> min-max	<u>diameter</u> min-max	<u>needles length</u> min-max	
3-6	<u>136.9 ± 2.8</u> 110-160	<u>3.1 ± 0.1</u> 2.3-4.6	<u>7.6 ± 0.2</u> 6.0-10.0	11	8-5	<u>119.1 ± 2.1</u> 102-148	<u>3.3 ± 0.1</u> 2.5-4.4	<u>8.4 ± 0.2</u> 6.0-11.0	19
	<u>174.3 ± 4.0</u> 130-218	<u>1.6 ± 0.1</u> 0.7-2.4	<u>7.3 ± 0.1</u> 7.0-8.0	21		<u>181.4 ± 3.0</u> 147-216	<u>1.5 ± 0.1</u> 1.0-2.1	<u>7.2 ± 0.2</u> 5.0-9.0	19
6-3	<u>141.5 ± 2.3</u> 116-160	<u>3.2 ± 0.1</u> 2.0-3.9	<u>7.4 ± 0.2</u> 5.0-9.0	10	12-3	<u>128.1 ± 1.8</u> 109-145	<u>2.6 ± 0.1</u> 2.0-3.3	<u>7.7 ± 0.1</u> 6.0-9.0	14
	<u>204.0 ± 2.2</u> 186-229	<u>2.2 ± 0.1</u> 1.6-3.0	<u>7.0 ± 0.1</u> 6.0-8.0	8		<u>188.8 ± 4.5</u> 137-228	<u>1.6 ± 0.1</u> 0.7-2.1	<u>7.0 ± 0.1</u> 6.0-8.0	18
6-7	<u>122.6 ± 3.9</u> 90-159	<u>2.7 ± 0.1</u> 1.6-3.6	<u>6.9 ± 0.1</u> 6.0-8.0	17	12-9	<u>124.1 ± 5.5</u> 90-210	<u>2.9 ± 0.1</u> 1.8-3.6	<u>7.9 ± 0.2</u> 6.0-10.0	16
	<u>214.6 ± 1.1</u> 204-227	<u>2.1 ± 0.1</u> 1.7-2.4	<u>6.9 ± 0.1</u> 6.0-8.0	4		<u>122.3 ± 3.6</u> 90-162	<u>2.7 ± 0.1</u> 1.6-3.4	<u>7.1 ± 0.1</u> 6.0-8.0	22
7-3	<u>157.0 ± 3.6</u> 112-195	<u>2.5 ± 0.1</u> 2.4-4.2	<u>8.3 ± 0.2</u> 6.0-10.0	1	12-10	<u>122.3 ± 3.6</u> 90-162	<u>2.7 ± 0.1</u> 1.6-3.4	<u>7.1 ± 0.1</u> 6.0-8.0	18
	<u>220.1 ± 6.4</u> 174-320	<u>2.0 ± 0.1</u> 1.2-3.6	<u>7.5 ± 0.1</u> 6.0-8.0	1		<u>205.6 ± 2.6</u> 170-233	<u>1.9 ± 0.3</u> 1.5-2.1	<u>7.8 ± 0.2</u> 7.0-10.0	6
7-4	<u>144.8 ± 1.3</u> 130-158	<u>3.3 ± 0.1</u> 2.7-4.0	<u>8.1 ± 0.2</u> 7.0-9.0	7	13-1	<u>146.1 ± 2.0</u> 130-166	<u>3.2 ± 0.1</u> 2.8-4.0	<u>7.2 ± 0.1</u> 6.0-8.0	5
	<u>219.3 ± 3.7</u> 193-278	<u>2.1 ± 0.1</u> 1.7-3.1	<u>8.0 ± 0.1</u> 7.0-10.0	3		<u>193.6 ± 4.0</u> 143-242	<u>1.8 ± 0.1</u> 1.1-2.5	<u>7.5 ± 0.1</u> 6.0-8.0	13
7-5	<u>151.5 ± 4.1</u> 111-205	<u>3.2 ± 0.1</u> 2.3-4.0	<u>7.8 ± 0.2</u> 6.0-10.0	2	13-2	<u>114.5 ± 1.7</u> 99-132	<u>2.9 ± 0.1</u> 1.8-3.8	<u>7.9 ± 0.1</u> 6.5-9.0	22
	<u>202.6 ± 3.2</u> 167-237	<u>1.9 ± 0.1</u> 1.4-2.2	<u>7.5 ± 0.1</u> 6.0-8.0	9		<u>192.0 ± 2.8</u> 165-227	<u>2.0 ± 0.1</u> 1.6-2.5	<u>7.3 ± 0.1</u> 7.0-8.0	17
7-6	<u>148.1 ± 3.1</u> 113-173	<u>3.1 ± 0.1</u> 2.0-3.7	<u>8.1 ± 0.2</u> 7.0-11.0	4	13-3	<u>128.6 ± 3.1</u> 95-170	<u>2.9 ± 0.1</u> 2.1-3.6	<u>6.4 ± 0.1</u> 5.0-7.5	13
	<u>207.1 ± 2.8</u> 184-233	<u>2.0 ± 0.1</u> 1.6-2.4	<u>7.1 ± 0.1</u> 5.0-8.0	5		<u>192.4 ± 3.8</u> 154-245	<u>1.9 ± 0.1</u> 1.1-3.1	<u>6.8 ± 0.1</u> 5.0-8.0	16.
7-7	<u>117.9 ± 2.1</u> 96-142	<u>2.3 ± 0.1</u> 1.7-2.8	<u>6.8 ± 0.3</u> 5.0-11.0	20	13-4	<u>134.4 ± 2.6</u> 101-160	<u>3.1 ± 0.1</u> 2.3-3.6	<u>8.0 ± 0.2</u> 7.0-10.0	12
	<u>202.3 ± 5.1</u> 132-243	<u>1.7 ± 0.1</u> 0.7-2.4	<u>7.0 ± 0.1</u> 6.0-8.0	10		<u>193.1 ± 5.3</u> 136-237	<u>1.8 ± 0.1</u> 0.6-2.7	<u>7.0 ± 0.1</u> 6.0-8.0	15
7-8	<u>128.0 ± 2.7</u> 103-155	<u>2.8 ± 0.1</u> 2.5-3.4	<u>8.1 ± 0.1</u> 7.5-10.0	15	13-9	<u>146.0 ± 3.2</u> 111-188	<u>3.6 ± 0.1</u> 3.0-4.1	<u>7.3 ± 0.2</u> 5.0-8.5	6
	<u>200.1 ± 3.4</u> 170-231	<u>2.0 ± 0.1</u> 1.4-2.7	<u>6.9 ± 0.1</u> 6.0-8.0	11		<u>204.9 ± 5.8</u> 143-285	<u>1.9 ± 0.1</u> 0.9-3.6	<u>6.9 ± 0.1</u> 6.0-8.0	7
7-9	<u>149.0 ± 3.6</u> 119-190	<u>3.5 ± 0.1</u> 2.6-5.1	<u>7.9 ± 0.1</u> 7.0-9.0	3	Control 1	<u>117.3 ± 2.5</u> 99-159	<u>2.6 ± 0.1</u> 1.4-4.0	<u>7.2 ± 0.2</u> 5.0-9.0	21
	<u>193.4 ± 2.9</u> 152-208	<u>1.7 ± 0.1</u> 0.9-2.2	<u>6.7 ± 0.1</u> 5.0-8.0	14		<u>219.6 ± 4.8</u> 184-270	<u>2.2 ± 0.1</u> 1.5-3.4	<u>7.9 ± 0.1</u> 7.0-9.0	2
7-10	<u>143.8 ± 3.1</u> 106-174	<u>3.0 ± 0.1</u> 2.2-3.6	<u>7.3 ± 0.1</u> 6.0-8.0	8	Control 2	<u>142.0 ± 2.2</u> 120-175	<u>3.2 ± 0.1</u> 2.0-4.0	<u>6.8 ± 0.1</u> 6.0-8.0	9
	<u>178.1 ± 4.7</u> 137-237	<u>1.4 ± 0.1</u> 0.7-2.2	<u>7.3 ± 0.1</u> 6.0-8.0	20		<u>199.7 ± 3.3</u> 167-250	<u>1.8 ± 0.1</u> 1.0-3.0	<u>7.2 ± 0.1</u> 6.0-8.0	12

Note. The *Pinussylvestris* seed breed grown from the seeds of forest-seed plantations of the first generation of Kalinkovichsky forestry enterprise (control 1) and Starobinsky forestry enterprise (control 2) is taken as the control variant (control 1 and control 2) to compare the growth indices.

Table 3

Growth indices of seed breeds of the hybrid-seed plantation of *Pinus sylvestris* in the test cultures of Nemansko-Predpolessky forest growing area

Family	Age, years	Indices, cm			Rank	Family	Age, years	Indices, cm			Rank
		height	root collar diameter	needles length				height	root collar diameter	needles length	
1-5	1	13.0 ± 0.3	0.4 ± 0.1	8.0 ± 0.1	3	10-3	1	9.2 ± 0.1	0.4 ± 0.1	9.0 ± 0.1	7
	2	33.5 ± 0.8	0.5 ± 0.1	6.4 ± 0.3	1		2	29.1 ± 0.2	0.5 ± 0.1	9.0 ± 0.1	4
1-7	1	10.1 ± 0.2	0.3 ± 0.1	7.2 ± 0.1	5	10-8	1	8.7 ± 0.1	0.4 ± 0.1	9.1 ± 0.1	8
	2	31.6 ± 0.6	0.6 ± 0.1	7.3 ± 0.1	3		2	20.6 ± 0.9	0.5 ± 0.1	7.4 ± 0.3	10
4-7	1	15.1 ± 0.2	0.5 ± 0.1	9.2 ± 0.1	2	11-1	1	9.6 ± 0.1	0.4 ± 0.1	8.9 ± 0.1	6
	2	32.8 ± 0.7	0.8 ± 0.1	9.5 ± 0.2	2		2	28.7 ± 0.7	0.5 ± 0.1	7.6 ± 0.2	5
5-1	1	11.0 ± 0.2	0.4 ± 0.1	8.2 ± 0.1	4	11-2	1	8.1 ± 0.2	0.4 ± 0.1	7.2 ± 0.1	9
	2	22.2 ± 0.9	0.5 ± 0.1	6.4 ± 0.3	9		2	27.3 ± 0.2	0.4 ± 0.1	7.0 ± 0.1	7
5-7	1	17.1 ± 0.3	0.5 ± 0.1	8.2 ± 0.1	1	Control	1	7.2 ± 0.2	0.4 ± 0.1	6.5 ± 0.1	10
	2	27.7 ± 0.9	0.7 ± 0.1	6.6 ± 0.2	6		2	23.9 ± 0.8	0.5 ± 0.1	8.0 ± 0.2	8

Note. The seed breeds grown from the seeds of industrial selection are taken as the control.

Family 5-7 which had rank 1 on height during the first year, lowered essentially its rank position during the second year (rank 6).

It should be noted that almost all families under test grow better than the control grown from the seeds of industrial selection.

Conclusion. On the basis of the conducted researches on studying of the families age growth dynamics of the hybrid-seed plantation of *Pinus sylvestris* of Negoreloye forestry experimental station it is possible to conclude that the final rank position stabilization of the hybrid breed in the test cultures have not come yet. Up to the age of 5-6 years the families ranks differ essentially on height in the cultures, and that indicates the escalation of intraspecific competition for growth conditions. Many researchers come to the analogous conclusions [3-6]. There is a considerable leveling of the families rank positions on years; however, there is no final stabilization by the age of 10.

In consideration of this fact, from now on it is necessary to continue the studies of growth peculiarities of *Pinus sylvestris* families in the test cultures.

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