

This experiment has established that normal healthy seedlings can be obtained by bench-pollinating redwood strobili on detached cuttings maintained in the rooting bench. The technique is not yet ready for large-scale use, but improvements in methods of pollination and subsequent culturing of the cuttings may make it more efficient, as well as much safer, than controlled crossing accomplished on the tree. Using only the most successful clone and pollination technique as an example, 18 cuttings of clone 8 bearing 64 strabili produced 15 healthy seedlings. This already is an acceptable level of success to produce small families for genetic research.

Summary

Cuttings with unopened female strobili were collected from three Coast redwood trees. The cuttings were kept under intermittent mist in a greenhouse bench. When the female strdbili became receptive, they were pollinated by various methods using pollen shed from male strobili kept in the same conditions. Additional cuttings bearing female strobili were collected shortly after pollination occurred in nature. Finally, seeds were extracted from the cones which had remained on the parent trees until mature.

Forty-six of 342 greenhouse-pollinated female strobili developed into cones, 11 of which yielded one or more viable seeds. Seventeen seeds germinated, producing 15 healthy seedlings. These were compared to seedlings obtained from tree-pollinated cones matured in the greenhouse, and from tree-pollinated cones matured on the tree. Seedlings from seeds which matured in the greenhouse were smaller than those from tree-ripened seeds. However, subsequent growth rates of the three types of seedlings were comparable.

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Results of the 25 Years' Provenance Experiment established by using 16 Scotch Pine of European and 1 of Native Provenances in Turkey

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A. Lay-out

1. General

The natural distribution of *Pinus silvestris* in Turkey generally covers the North and North West Anatolia. In this large forest region of Turkey, it occupies the high

Southern slopes of the mountains and also reaches the margin of dry inland region. In central Anatolia it occurs in regions up to 2000 meters in eastern Turkey, up to 2600 meters. The southern limit of it reaches to 38° 34' latitude

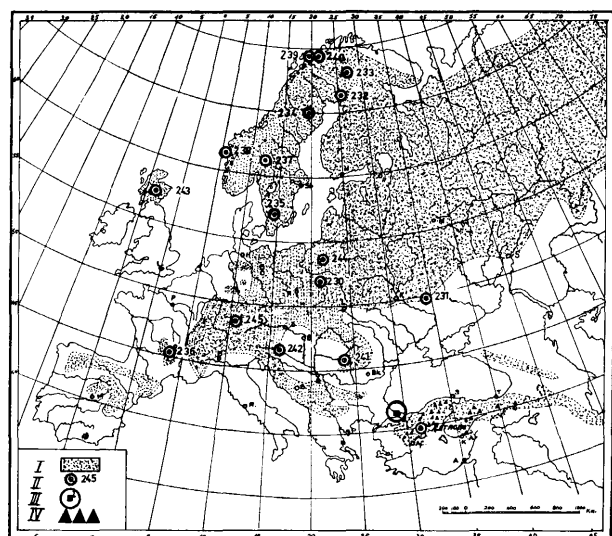


Fig. 1. — The natural distribution of *Pinus silvestris* according to DENGLER (I). — Provenances and their origin numbers (II). — Places of experiment plots (III). — Natural distribution areas of *Pinus silvestris* in Turkey according to BERNHARD and KAYACIK (IV).



Fig. 2. — A dense *Pinus silvestris* stand, composed of phenotypically good quality trees. Kizilcahamam, Altitude 1545 m. (Photo S. ÜRGENÇ).



Fig. 3. — A stand representing Çatacık provenance. Çatacık, Degirmeneyrek, altitude 1600 m. On the left: crown form; on the right: the stem forms. (Photo S. ÜRGENÇ)

(Kayseri-Pınarbaşı). This latitude is the most southern limit even in Asia (Fig. 1).

In Turkey we have different geographical races of *Pinus silvestris*. In many parts of their natural distribution area, Scotch pine forms very nice stands and individuals which are very similar to high mountain Scotch pine of Europe and Scandinavia. The Scotch pine with its narrow crown and long and smooth stems looks from long distance like spruce (Fig. 2).

2. The provenance of seeds used

Provenance experiment with *Pinus silvestris* has been laid-out in the Forestry Faculty garden in 1910. I received a small quantity of seed samples from each of the provenance through the General Secretary of International Union of Forestry Research Organizations in 1939. To these 16 pines of exotic provenance, we have added 1 of native provenance from Eskişehir (Çatacık) for sake comparison. This Çatacık provenance represents our best *Pinus silvestris* type (Fig. 3).

Table 1.

No.	Provenance country	Locality	Latitude	Longitude	Altitude m	1000 seed weight gram	Annual precipitation mm	Vegetation period months	Sender
236	France	Murat (Cantal)	45°10'	2°50'	130—120	7,351	—	—	PETRINI
230	Poland	—	51°10'	17°52'		6,648	575—620	5	PETRINI
231	Russia	Poltowa (Ukraine)	49°30'	34°30'		6,185	—	—	PETRINI
232	Finland	Rovaniemi	66°30'	27°	50	4,916	433	3	PETRINI
233	Finland	Inari	68°	27°	14	4,438	454	2	PETRINI
234	Sweden	Vindeln	65°	19°	—	4,206	—	—	PETRINI
235	Sweden	Smaland	57°	14°	—	4,726	—	—	PETRINI
237	Norway	Hedmark	61°	11°40'	200	4,965	—	—	Statens Klenganstalt, Hamar
238	Norway	Svanøy	61°29'	5°03'	50	6,110	2115	4	Klenganstalten, Vestlandets forstlige Forsøks-Station, Bergen
239	Norway	V. 150 Troms Fylke	69°30'	19°	150—250	4,705	—	—	Troms Skogselskap, Moen i Malselv.
240	Norway	W. 100 Troms Fylke	69°30'	19°	100—200	4,438	—	—	Troms Skogselskap, Moen i Malselv.
241	Romania	Talmacel 3	45°40'	24°15'	600	7,286	—	—	I G E F, Bukarest
242	Hungary	—	46°40'	16°40'	—	5,377	—	—	Sopron
243	Scotland	Ortan, Morayshire	57°05'	0°55' W	—	4,634	1990	8	Forestry commission 25 Drumsheugh, Gardens, Edinburgh 3
244	Germany	Johannisburg (Haselheide) Jg. 114, Ostpreußen	53°30'	21°40'	—	5,765	—	5	
245	Germany	Babenhausen Südwestdeutschland	48°10'	10°15'	—	5,667	—	—	
—	Turkey	Eskişehir (Çatacık) ¹⁾	39°33'	30°30'	1300—1400	10,000	—	—	
Experiment area (Istanbul-Bahçeköy)					41°10'	28°58'	110	(Meteorological dates in Table 2)	

¹⁾ According to the nearest Meteorological Station Eskişehir which its altitude is 782 meters and locality is 39°46' N. latitude, 30°31' E. longitude, in Çatacık annual average temperature is 7,8° C, average minimum temperature for January is — 1,1° C, and average maximum temperature for August is 26,2° C.

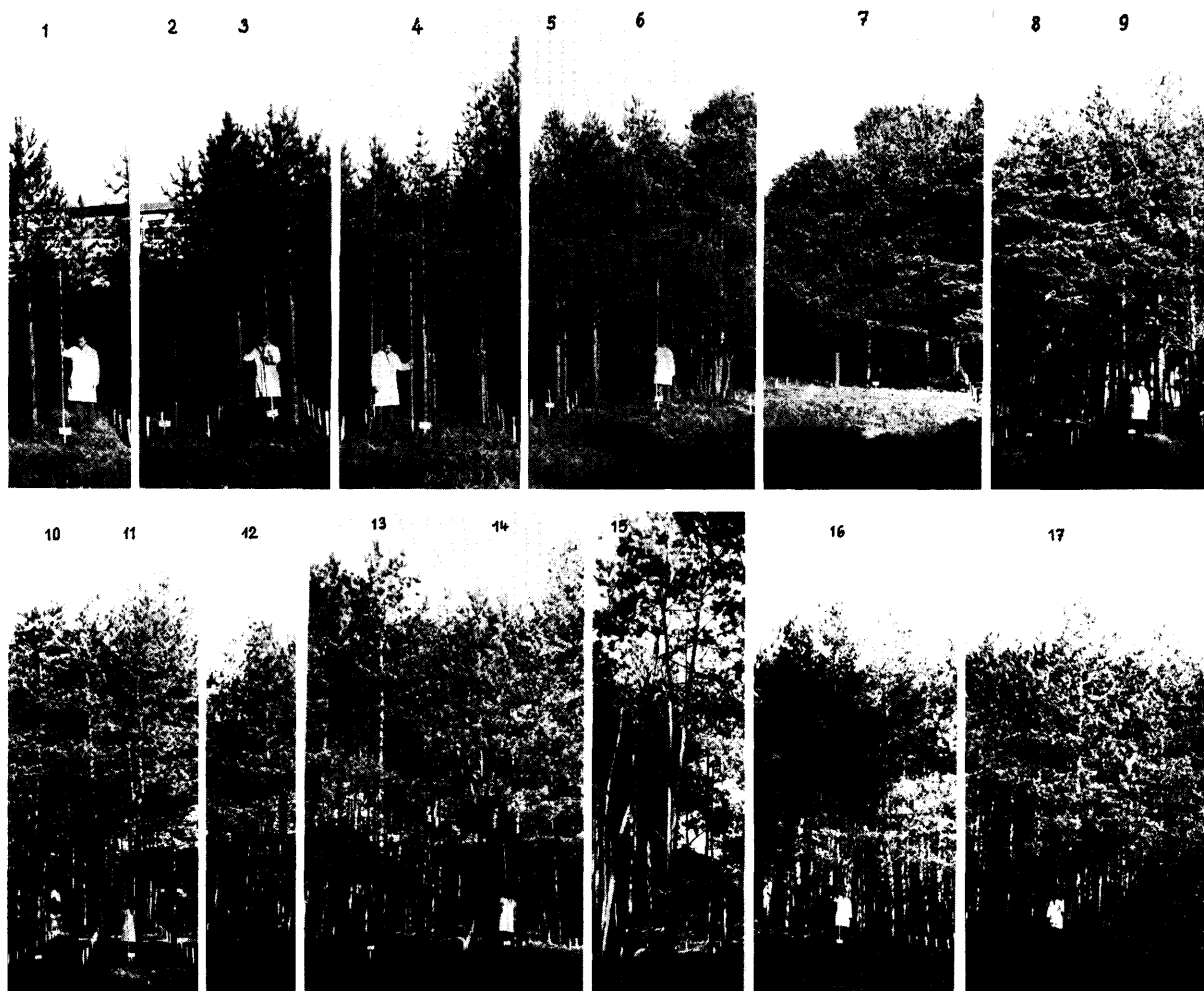


Fig. 4. — The different origins from *Pinus silvestris* provenance experiment, laid-out in the Faculty of Forestry Garden: 1. Norway 239; 2. Finland 233; 3. Norway 240; 4. Finland 232; 5. Sweden 234; 6. Norway 238; 7. Norway 237; 8. France 236; 9. Sweden 235; 10. Scotland 243; 11. Romania 241; 12. Poland 230; 13. Russia 231; 14. Germany 244; 15. Germany 245; 16. Hungary 242; 17. Turkey Çatacik. — Trees are 25 years old; rod length is 3 m.

With the help of Dr. ETTER who is technical advisor of IUFRO and making full use of ALLEGRI's and MORANDINI's publications on 1938' provenance experiments, we have obtained geographic and climatic data about the seeds of European provenance (Table 1). It is clearly seen that in this experiment research, we are able to compare far northern provenances (NO. 239, 240, 233, 232) with far southern provenances (Eskisehir, Çatacik). Other provenances in this experiment, take place between these two extreme limits. Çatacik provenance and Russian provenance are very close to the steppe region of Turkey.

3. Environment conditions of the experiment plots

The experiment has been laid-out in the garden of Forestry Faculty, Büyükdere, Istanbul. Altitude is 95 meters. There is a meteorological station which is at 200 meters from the experiment plots. Data of this meteorological station have been given in Table 2. According to these climatic data, our experiment area is generally warm, even warmer than the South-West Germany which has 10° C average annual temperature. The growing season also is quite longer than in Europe. The annual rainfall is high enough, but its distribution is not good, because of summer drought. Autumn and winter months are wet, spring and especially summer months are dry. For example, the average rainfall in August is 30.6 mm, in July 31.5 mm. Almost every

year snow remains on ground but not for a long period of time. The number of snowy days is 19 in a year. The soil is deep loam. Area is plane and soil conditions is homogeneous.

4. The lay-out, the planting stock, and the method of assessment

The sowing was made in 1940, and transplanting in 1941. Planting were made in the spring of 1943. Plots for each

Table 2. — 16 Years meteorological data of the Meteorological Station of the Faculty of Forestry

Months	Temperature C°			Precipitation mm	Relative humidity %	Number of frosty days	Number of snowy days
	Average temperature	Average minimum	Absolute minimum				
January	5,1	1,8	—15,8	158,1	85	11	5
February	4,9	1,5	—9,2	110,1	82	9	6
March	5,7	2,2	—7,8	121,9	83	8	5
April	10,0	5,8	—2,6	48,1	81	1	—
May	14,8	10,2	2,7	38,3	83	—	—
June	19,1	14,1	5,0	43,6	79	—	—
July	21,7	17,3	8,9	31,5	77	—	—
August	22,0	17,6	5,7	30,6	78	—	—
September	18,5	14,3	5,0	79,1	79	—	—
October	14,4	10,8	1,3	107,8	83	—	—
November	10,7	7,4	—7,7	121,5	84	2	1
December	7,0	3,8	—7,6	170,6	85	6	2
Annual	12,8	8,9	—15,8	1062,5	82	36	19

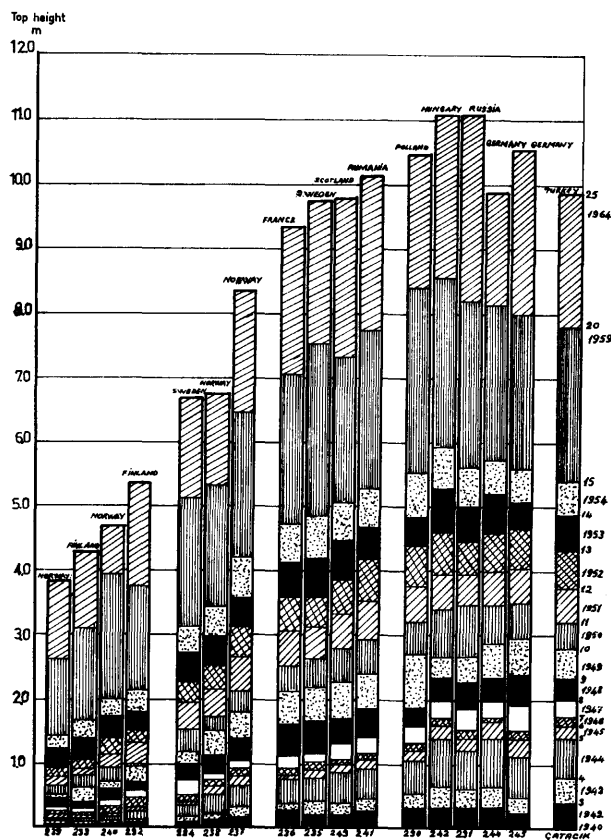


Fig. 5. — Average height growth in 25 years for different provenances.

provenance were side by side. Spacing in plantings was 1×1 meters. It has been impossible to increase the amount of planting stock, because of World War II. Total number of all planted stocks in 1943 was 1182. These planted trees have been measured every year up to this day. Yearly growth has been measured individually at the end of each growing period (late autumn). Direct method has been used to measure the length of the trees.

B. The main results

1. Growth in height

There was difference of height among trees of different origin even at the beginning. This difference has become more obvious when the trees reached their 25th years (Fig. 4). The average top height of each provenance has been shown in Figure 5 according to their age.

There are following relations between the provenances: —

1. Growth of provenances from North Scandinavia (Nos. 239, 233, 240, 232) was always smaller than those of other European provenances which belong mainly to South and East Europe.

2. In 25 years, provenances No. 242 (Hungary) and No. 231 (Russia) have shown the best height growth (11.05 meters). Other provenances follow these two provenances in this order:

No. 245 (Germany) = 10.75 meters, No. 230 Poland = 10.45 meters, No. 241 (Romania) = 10.14 meters, Turkey (Çatacik) = 9.84 meters, No. 244 (Germany) = 9.89 meters, No. 243 (Scotland) = 9.76 meters, No. 236 (Sweden) = 9.73 meters, No. 236 (France) = 9.31 meters.

3. In 25 years the smallest growth has been observed in the Norwegian provenance with 3.81 meters. Others, whose

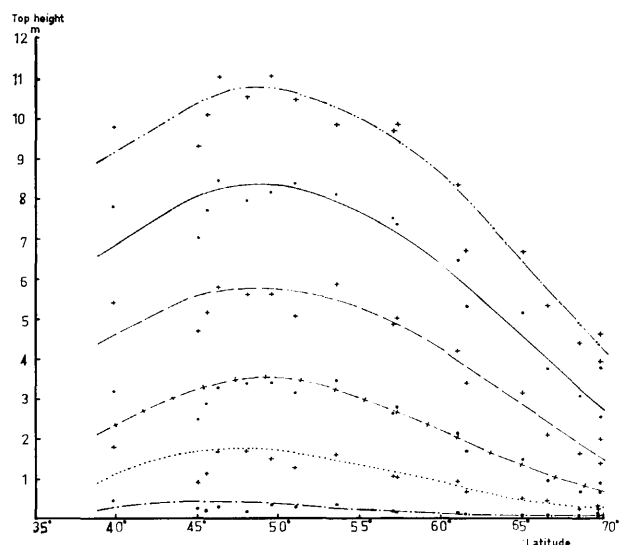


Fig. 6. — Correlations between the height growth and the latitude of different provenances.

growing is not good, are: Finland (No. 233) with 4.24 meters, Norway (No. 240) with 4.64 meters, Finland (No. 232) with 5.32 meters.

4. Difference between the best growing provenance and the worst growing provenance in their 25th year is 7.24 meters.

5. There is a correlation between the growth of provenances and the latitude of provenances (Fig. 6). The best growing provenances are from between 45–55° latitudes. Provenances from Romania, Turkey and France make exceptions in this case due to the high altitude.

2. Growth in diameter

The breast height diameters of different provenances in 1965 have been shown in table 3. Mortality during the 25 years has changed the original spacing of plantings which was the same for all provenances at the lay-out. This is why we have paid more attention to the height growth than to the diameter growth. Using the provenances, where through mortality for different reasons, the number of stems has been small, the average diameter growth is higher. For example Çatacik provenance has a large number of stems (not much mortality), so the average diameter growth is less than that of provenance No. 245 (Germany) which contains fewer stems on the experiment plot.

3. Mortality

Mortality percentage for the first 10 years period has been shown in table 4.

The mortalities occurred after this first 10 years period are the result of stand competition.

The provenances which had the worst growth have also much mortality (Finland 233 and Norway 239).

Table 3.

Origins	Breast height diameter cm	Origins	Breast height diameter cm
Turkey	11,8	Sweden	235 12,4
Hungary	242 13,1	France	236 12,9
Germany	245 16,1	Norway	237 10,4
Germany	244 12,4	Sweden	234 10,1
Russia	231 12,3	Finland	232 7,5
Poland	230 13,8	Norway	240 8,0
Romania	241 11,9	Finland	233 6,4
Scotland	243 11,7	Norway	239 7,1

Table 4.

Origins	Mortality percentage according to 1942
Turkey (Çatacik)	18,1
Germany 245	73,8
Germany 244	20,4
Russia 231	38,7
Hungary 242	30,6
Poland 230	55,9
Romania 241	17,2
Scotland 243	30,8
Sweden 235	55,2
France 236	51,5
Norway 237	64,1
Norway 238	41,2
Sweden 234	54,5
Finland 232	45,3
Norway 240	31,8
Finland 233	76,9
Norway 239	80,0

According to LANGLET and ROHMEDEK, Çatacik provenance has shown the worst result and died in the first 2 or 3 years in Sweden and Bavaria.

4. The growing period

In order to measure the growing periods of different provenances, LANGLET's method has been used. In this method needles are measured in length first on June 5 and second at the end of summer. Results have shown in table 5. It has been seen that in Northern origins needles make their almost total yearly growth up to June 5th (Table 5, Fig. 7). On the other hand according to ÜRGENÇ's assessment which depend on bud starting in the spring of 1964, Northern provenances start to grow nearly 3 weeks earlier than others.

Table 5.

Origin Number	Origins	Ratio of the needle length measured at the end of growing period to the length measured on June 5 %
245	Germany	18,66
241	Romania	21,63
	Turkey- (Çatacik)	23,3
244	Germany	23,75
242	Hungary	23,77
231	Russia	25,27
230	Poland	27,07
236	France	28,29
235	Sweden	33,6
243	Scotland	35,56
238	Norway	39,48
237	Norway	46,02
234	Sweden	66,22
240	Norway	84,12
239	Norway	87,00
232	Finland	93,00
233	Finland	100,00

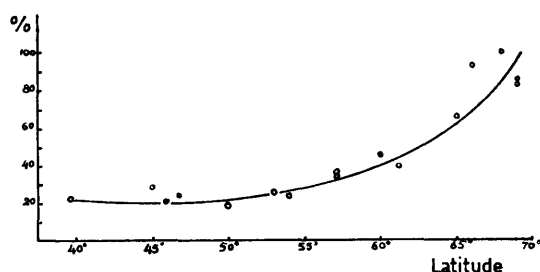


Fig. 7. — Ratio of the needle length measured at the end of growing period to the length measured on June 5.

5. Quality

Though there are some differences in stem forms and in branchness among the provenances, we are not able to pronounce ourselves clearly on the matter because of mortalities and of changes in the spaces as time went on. It seems that trees of Northern provenance have better stem form. In Çatacik provenance stems also have good forms because of high mountain origin in Turkey. In provenances of Western Germany, France, Hungary, stem forms are not so good.

6. The length of needles

The length of needles differs from origin to origin, as each provenance represents a special environment type. Table 6 and Fig. 8 show the results of measurements which were made in the 10th year and on 2400 needles.

Table 6.

Origin Number	Origins	Average needle lengths mm
232	Finland	32,9
239	Norway	30,9
233	Finland	31,5
240	Norway	33,9
234	Sweden	43,3
238	Norway	49,4
236	France	52,6
237	Norway	55,6
241	Romania	58,8
243	Scotland	63,1
	Turkey (Çatacik)	65,0
235	Sweden	64,7
244	Germany	65,1
245	Germany	73,1
231	Russia	72,2
242	Hungary	71,4
230	Poland	73,9

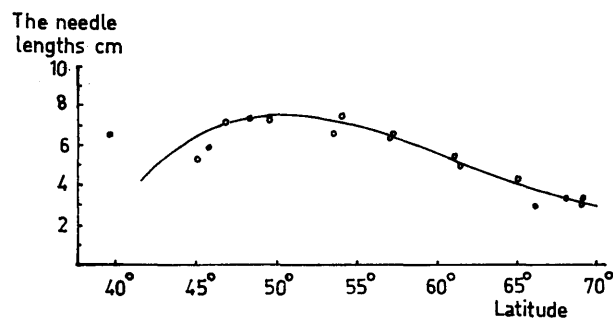


Fig. 8. — Average needle lengths according to latitude.

7. Colour changing of needles

Colour changing of needles in the winter months is clearly and usually observed in the following provenances: Norway 239, Norway 240, Finland 232, Finland 233, Sweden 234.

C. Conclusions

The main results obtained up to day can be summarized as follows:

1. There have been differences in growth among the different provenances in 25 years; the average difference in height among different origins is about 300%.
2. There is a close relation between the height growth of the provenance and the latitude of it.
3. Among provenances from the far North, growth has been the worst and the mortality very severe. In spite of this, in these provenances stem forms are satisfactory. The Çatacik provenance which represents high land steppe limit condition of Turkey is also of good quality.

Résumé

Titre de l'article: *Résultats de 25 ans de l'essai d'origine faite par les 16 exotiques et 1 indigène pins sylvestres (Pinus silvestris L.) en Turquie.* —

(1) Dans cet article, l'Auteur donne les principales conclusions de l'essai d'origine qui a été établi en 1940, dans le jardin d'exercice de la Faculté des Sciences Forestières de l'Université d'Istanbul.

(2) Pendant la durée de 25 ans, on a constaté assez grande diversité en vue de croissance à hauteur, parmi des origines de pins sylvestres et trouvé une relation comme le 300% parmi les moyennes vertes de maximum et de minimum.

(3) En général, la croissance à hauteur diminue, en fonction du grandissement de la différence entre les climas de l'endroit d'établissement et des régions d'origine. Les origines scandinaviennes les plus nordiques (Nr. 239, 233, 240 et 232) ont montré toujours une croissance faible que celle des origines de Sud et Nord Europe et des origines orientales. La corrélation entre les croissances à hauteur et le cercle de latitude des origines est tout entièrement nette dans cet essai qui a une particularité uniant les origines de 38° et 69° N latitudes. La descente rapide de courbe de hauteur vers le Nord est très frappante. Les origines croissantes les plus fortes se trouvent presque entre les latitudes de 45° et 55°.

(4) La différence de croissance à hauteur parmi les origines qui poussent bien et mal, est 7 m 24.

(5) L'énergie de croissance et la capacité d'être de certaines origines nordiques qui sont situées dans la région du climat froide sont très faibles et c'est pourquoi ses nombres de sujet ont diminué fortement. Par contre les sujets scandinaviens possèdent en général les fûts rectilignes et de bonnes qualités phénotypiques. L'origine de Çatacik (Eskisehir) étant représentative la station élevée et la région située au bord de la steppe de l'Anatolie, a une supériorité très nette et frappante.

(6) Hors de l'énergie de croissance et de la capacité d'être, on a aussi constaté quelques diversités et symptômes en vue de la période de végétation, du jaunissement hivernal et de la prématurité etc. parmi les origines.

Zusammenfassung

Titel der Arbeit: *Ein Provenienzversuch mit Kiefern (Pinus silvestris L.) verschiedener Herkunft in der Türkei.* —

(1) Die 25jährigen Hauptergebnisse eines im Jahre 1940 im Versuchsgarten der Forstwissenschaftlichen Fakultät der Universität Istanbul angelegten Provenienzversuches werden dargestellt.

(2) Die Kiefern der 16 verschiedenen Herkünfte zeigen im Alter von 25 Jahren erhebliche Wuchsunterschiede, die im Falle des Höhenwuchses bis zu 300% betragen.

(3) Die Wuchsergebnisse sind im allgemeinen um so schlechter, je mehr das Klima der Herkunft von dem des Anbauortes abweicht. Die nördlicheren skandinavischen Herkünfte (Nr. 239, 233, 240 und 232) sind stets weit hinter den süd- und nordeuropäischen und den östlichen zurückgeblieben. Zwischen der Wuchsabnahme der Kiefernher-

künfte und dem Breitengrade kommt eine deutliche Analogie zum Ausdruck, so daß die Ergebnisse im allgemeinen um so schlechter sind, je nördlicher der Herkunftsort liegt. Der starke Abfall der Kurven nach Norden hin ist sehr deutlich. Die bestwüchsigen Provenienzen liegen etwa zwischen dem 45. und 55. Breitengrad. Die türkischen, rumänischen und französischen Herkünfte nehmen dabei eine Sonderstellung ein, die höchstwahrscheinlich dadurch erklärt werden kann, daß die betreffenden Kiefern, besonders die türkische Provenienz, aus höheren Lagen stammen. Hier scheint die Höhenlage in gewissen Grenzen die südliche Lage auszugleichen.

(4) Mit 25 Jahren zeigen unter allen Herkünften die größte erreichte Höhe die ungarische (Nr. 242) und russische (Nr. 231) mit einer durchschnittlichen Scheitelhöhe von 11,05 m. Ihnen folgen mit kleinen Unterschieden der Reihe nach die deutsche Nr. 245 (10,57 m), polnische Nr. 230 (10,45 m), rumänische Nr. 241 (10,14 m), türkische (9,84 m), deutsche Nr. 244 (9,89 m), schottische Nr. 243 (9,76 m) und französische Nr. 236 (9,31 m).

(5) Mit 25 Jahren zeigt unter allen Herkünften die geringste erreichte Höhe die norwegische Herkunft Nr. 239 mit einer durchschnittlichen Scheitelhöhe von 3,81 m. Ihr folgen aufwärts mit kleinen Unterschieden der Reihe nach die finnische Nr. 233 (4,24 m), norwegische Nr. 240 (4,64 m), finnische Nr. 232 (5,32 m).

(6) Der Höhenunterschied zwischen den bestwüchsigen und schlechtwüchsigen Herkünften beträgt im 25jährigen Alter 7,24 m.

(7) Wuchsennergie und Lebensfähigkeit bei einem Teil der zum kühlen Klimagebiet gehörenden nordischen Herkünfte sind so gering, daß von ihnen im hiesigen Klima nur noch wenige Individuen vorhanden sind. Diese weisen im allgemeinen gerade Stämme und qualitativ gute Eigenschaften auf. Auch die türkische Herkunft, die aus den Hochlagen des mittelanatolischen Steppenrandgebietes stammt, ist zum großen Teil geradschaftig und zeigt eine deutliche qualitative Überlegenheit.

(8) Neben der Wuchsennergie und Lebensfähigkeit konnte auch ein unterschiedliches Verhalten im Bezug auf Vegetationsperiode, Winterfärbung, Frühreife u. a. festgestellt werden.

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