# Collecting Rare Conifers in North Africa

*Robert G. Nicholson*

**Conifer seeds gathered on mountain peaks in Morocco may yield varieties more cold-hardy than those now in cultivation**

*As the cold came on, and as each more southern zone became fitted for the inhabitants of the north, these would take the places of the former inhabitants of the temperate regions. The latter, at the same time, would travel further and further southward, unless they were stopped by barriers, in which case they would perish. The mountains would become covered with snow and ice and their former Alpine inhabitants would descend to the plains. By the time that the cold had reached its maximum, we should have an arctic fauna and flora, covering the central parts of Europe, as far south as the Alps and Pyrenees, and even stretching into Spain.*

—*Charles Darwin*
The Origin of Species

Had the master biologist, Charles Darwin, travelled in North Africa, he might have amended his discourse on glaciation to include those lands south of the Pyrenees and Spain. For in Morocco and Algeria a number of peaks are high enough to have harbored an alpine flora that was spreading from Europe during the periods of glaciation. And upon these mountains there live today relict populations of these refugees, remnants of the same migrating temperate and alpine floras that Darwin so eloquently described.

Most people are surprised to learn that these relict populations include among their members such familiar moist-temperate genera as *Acer, Lonicera, Paeonia, Rosa, Sorbus,* and *Viburnum.* The order Coniferae is also well represented: species of *Abies, Cedrus, Juniperus,* and *Pinus* are also found in the colder areas of Morocco

In September 1982 I travelled to Morocco to collect seeds and specimens of its hardiest plants. The resulting seedlings I would test in the nurseries of the Arnold Arboretum. I collected on four peaks in the two major mountain ranges, the Atlas and the Rif. My collecting focussed on the native conifers, which are poorly represented in botanical gardens. It was important that I collect the seeds from as high an elevation as possible to ensure that the resulting seedlings would be of maximum hardiness. This meant extensive travelling and walking, since the isolated peaks stand far from the major cities and stretch high above the nearest villages.

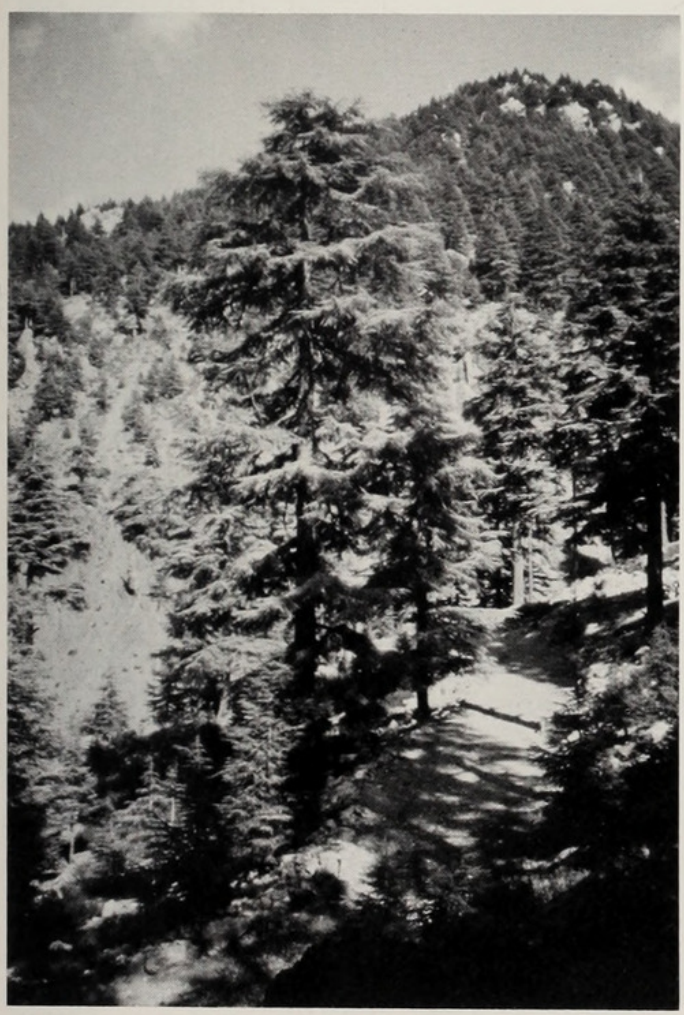
The first day's collecting was done in the Atlas Mountains, just south of Marrakech. Here, the massive Jebel Toubkal rises to 4,165 meters, making it the highest peak in northwestern Africa. It is a rocky, dry, and steep mountain that, despite its cold temperature regimen, had little to offer in the way of a temperate flora. Most woody species had tapered off by 2,300 meters, and the upper reaches of the peak offered just a few grasses, thistles, and fall-blooming crocus. *Juniperus thurifera,* the incense juniper, was plentiful in the foothills, as were two roses, *Rosa sicula* and *Rosa canina.* The latter grew among some boulders, was of fine habit, and possessed a large orange hip. Its seeds germinated readily at the Arboretum's Dana

Greenhouses and should provide some interesting hardiness testing in our nurseries.

From the Atlas region I proceeded by train to the ancient capital of Fez, a major city just south of the Rif mountain chain. Because delegates to a Pan-Arabian Summit Conference had flooded the hotels, I had to move on immediately from this exotic and quintessential Moroccan city.

### The Atlas Cedar

A five-hour bus ride along the switchbacks of the Rif Mountains brought me to the village of Ketama. It is beautifully situated in an extensive grove of *Cedrus atlantica*, the Atlas cedar. The boughs of these giants were softly bouncing in the incoming evening fog, and after the jarring bus ride their gentle beauty provided a soothing welcome. I did not know at the time that Ketama is a town noted for, and supported by, its illicit drug trade, being a distribution center for *kif*, a local cannabis product. Any Westerner is immediately assumed to be there "for business," and convincing people otherwise—"Plants?!"—can be both bothersome and amusing at times.



Cedrus atlantica *on Mount Tidiquin, near Ketama, Morocco. All photographs are the author's.*

An enterprising young Berber, Mouhammed Boudgara, rode up to me on a motorcycle before I was twelve steps off the bus. He gave me the standard greeting, "Hello my friend, you need a guide?" Knowing how useful a motorcycle would be for getting into the mountains, I struck a deal with him for the next day's collecting. Mouhammed was to be one of the lucky breaks that occur when plant-collecting in odd corners. He warned off the local toughs, helped find supplies, and eased passage through otherwise precarious areas.

The next day, after Mouhammed had proudly showed me his *kif* harvest, we left the village and sped off on motorcycles to the foothills of Mt. Tidiquin, some ten miles away. I was a passenger on the back of a second motorcycle driven by Mouhammed's cousin, a young man who seemed intent on showing his skill at high-speed driving on dirt roads. At one point we paused to take in a good view of the nearing mountain. It was a gentle, tapered cone, rising to 2,455 meters, its flanks covered with the flat blue–green color of *Cedrus atlantica.* We parked our motorcycles at a farming village in the foothills and, after my guides had renewed old acquaintances, walked upward. The gentle incline seen from five miles off was in reality quite steep, and the forest now rose a hundred feet over our heads. It was a thin forest with little undergrowth, and the *Cedrus* was the only species of any size. Full-sized specimens grew up to 120 feet in height at these lower

elevations. A crude dirt road allowed for some limited forestry.

*Cedrus atlantica* has a long history of cultivation, having been introduced into cultivation by A. Sénéclauze in 1839, while G. Manetti rendered the first description in 1844. It has long been a favorite ornamental in Europe, with about a dozen cultivars now being used. It has also found favor with French foresters, some extensive plantations of it having been established on the poorest soils of Dijon and Vaucluse.

In the northeastern United States, *Cedrus atlantica*, like *Cedrus deodara*, could hardly be called ironclad hardy. Even the variety *glauca*, which seems to be the hardiest cultivar of the Atlas cedar, tends to brown some or even to drop most of its needles in the coldest winters. I had hoped, then, by collecting seed from an area of maximum hardiness, that a hardier race of *Cedrus atlantica* could be introduced to the Boston area.

It is on Mt. Tidiquin that the Atlas cedar reaches the uppermost limit of its range and inhabits the craggy summit in a gnarled, stunted form evocative of the bristlecone pine in this country. At the summit, one side of the mountain presented a clear aspect, a rock field bare of topsoil and trees, with just a few ground-hugging plants nestled among the stones. The opposite side of the summit was a sheer cliff, a few struggling cedars locked into its side. The view from the peak gave one a stunning 360-degree panorama of the central Rif chain, a sinuous and involved series of mountains, very rugged and not unlike the mountains of central Idaho and northern California in its limited accessibility.

All of the *Cedrus* I saw in the uppermost 75 meters were barren of cones, so I assume that either the coning is erratic in the upper reaches or that the trees growing there were established from seeds blown up the mountain from the fertile plants immediately below. I busied myself collecting seeds and pressing specimens, while my guides had a *kif* break in the shade of a small cedar. As the number of different specimens was small, a complete representation of the summit flora was soon in hand. Like many mountains in Morocco, this peak showed the effects of goat herding. Many of the plants had been chewed almost to the ground, and I suspect that some species had been erased completely.

On the trip down the mountainside, I found a fine plant of *Digitalis purpurea* var. *mauretanica* and took a good amount of seed. *Rosa sicula* appeared in the understory of the cedar forest, and I collected seeds from it, too.

At the farm village, a Berber wedding was in full swing as we slipped back through the streets and alleys. A truckload of master musicians was blending the unique shrill of their olive-wood pipes with the rapid toom-toom of the skin drums, while the townspeople, dressed in their finest colors, followed these pipers through the village streets. After a quick look at the proceedings we pushed our motorcycles to the outskirts and were off.

Next morning, after farewells to my guides, I boarded an aged bus headed west. The ride's unfortunate highlight was a police roadblock and subsequent search. Searched, along with a half dozen others, I was luckily able to explain a bagful of plant material in rapid pigdin French. Another passenger, however, was found with a small chunk of *kif*. He was led away in handcuffs, while his wife could only sit silently by. The example having been set, we were allowed to pass, and an hour later I was let off on the roadside. Looking up into the foothills, I saw the starched white city of Chechaouèn.

Chechaouèn has a distinctly Iberian cast to it, a maze of narrow cobbled streets winding between the bleached walls and tiled

roofs. The feature of the city that pins itself to my memory is the distinctive blue hue applied to all the shutters and doors. Chechaouèn is a child's paradise, and young children are constantly scampering through its twisting streets.

### A Moroccan Variety of the Spanish Fir

In 1906, the botanical world was alerted to the existence in Africa of a second species of *Abies*. Only *Abies numidica*, discovered in Algeria in 1861, had previously been known. M. L. Trabut wrote of the later discovery by a Mr. Joly in "the mountains of southern Te'tuan at Chechaouèn" of a new species intermediate between the Spanish and Algerian firs. Trabut named it *Abies marocana*. However, in subsequent years, the plant was taxonomically reduced to a variety of *Abies pinsapo*, the Spanish fir. Eventually, it was brought to European botanic gardens and made its way to this hemisphere in the 1950s as seed from trees of the Arboretum des Barres in France. But there is reason to doubt the pedigree of the trees in this country, since most of the few specimens that there are seem to be hybrids, a frequent problem with seed from cultivated plants. The Arnold Arboretum has such a tree in its collection; it puzzles anyone who takes a key to it. I felt, therefore, that a fresh introduction of seed of *Abies pinsapo* var. *marocana* would guarantee authenticity and facilitate distribution of

*A view in the village of Chechaouèn.*

this rare tree.

The mountains the fir inhabits rise to 2,170 meters to the east of Chechaouèn and are uninhabited save for a few goatherds. Once the fog that obscured the top of the mountain had lifted, I could see a band of dark green covering the uppermost level of the peak. I was excited at the prospect that it was a forest of the rare fir.

The next morning I set out. The lower foothills were dry, olives, figs, and almonds being cultivated there. Following the paths made by woodcutters and goatherds was the only way to reach the upper reaches of the range, and after a few hours I was well above the city.

At around 1,300 meters the first surprise of the day's collecting occurred when I found my first plants of the Moroccan peony, *Paeonia coriacea*, a perennial species reaching to two feet. A dried flower still on its stalk suggested a floral color of deep pink or rose. Its bright-scarlet seed pods, which hold seeds of a contrasting ebony, make it a species that is easy to spot. I collected about one pound of seed from various stands on the mountain, which I have processed at the Dana Greenhouses of the Arnold Arboretum.

As I entered the colder zones of the mountain I could see ahead the unmistakable conical habit of the genus *Abies*. I also began to find additional temperate elements, such as

Abies pinsapo *var.* tazaotana, *Tazaot.*

*Juniperus communis*, the common field juniper of North America.

At about 1,400 meters I reached the lower edge of the fir population and could see the cones I had travelled so far to collect. The terrain here was steep and dry, with little or no topsoil. Large, exposed areas of loose, calcareous rock made the footing treacherous. I focussed my attention on my feet. As I scuttled upward through the forest I could see that it was largely a pure stand with specimens reaching over 30 meters in height. Some logged tree stumps had diameters of 150 centimeters. Other elements associated with a more temperate flora appeared, such as *Viburnum tinus* (laurustinus), *Sorbus aria* (the white beam), and *Crataegus monogyna* (a species of hawthorn). A maple, *Acer opalus* var. *granatense*, appeared as a low tree. Though of scraggly habit, it impressed me by its mere presence. *Cedrus atlantica* was the only other tree of size and, along with the firs, grew to the very top of Mt. Tisouka. I collected cones in the upper range. Although taken green in mid-September, they yielded hundreds of seedlings.

It is a uniquely fulfilling experience to rest on a mountain peak and to survey below you a forest of rare species. It is a sensation that might even be unique to botanical collecting, one that makes the trip down the mountain far easier than it might otherwise be.

**The Tazaotan Fir**

The following day I spent procuring pressing supplies (a task that is not as easy to do in Morocco as it is in Harvard Square) and pressing the specimens I had collected. On September 15, I travelled to the only site of the other fir known to Morocco, *Abies pinsapo* var. *tazaotana*.

This fir was first brought to the attention of the botanical world by a Spanish forester, Santiago Sanchez Cozar. In 1946 he presented a paper in which he enumerated the differences between this variety and its relatives to the south, *A. pinsapo* var. *marocana*, and east, *A. numidica*. It is a larger tree, reaching to 50 meters and forming a dense forest on the top of the massif of Tazaot. Cozar's comparisons led him to believe that he had found a new species and, on the basis of morphological characteristics he named the plant *Abies tazaotana*.

Little else has been written about the plant save for an article in 1954 by J. Pourtet and P. Turpin, in which the plant was reduced to a variety of *Abies pinsapo*. Tang Shui Liu concurs in the plant's varietal status in his recent monograph of the genus *Abies*, although his section on the Tazaotan fir contains a number of major errors. For example, the plate illustrating the fir seems to be of a branch of juvenile foliage; it gives a false impression of the shape of the needles and their placement upon the branch. The preceding plate, of *Abies pinsapo* var. *marocana*, is a much closer representation. Also, Tang's map of the variety's range places the population about 100 miles southeast of where it should be.

The stand of fir grows far from major centers of population. In a land largely devoid of timber trees, this remoteness probably saved the firs from lumbering, and certain elimination, for thousands of years.

The closest major town is Chechaouèn. From Chechaouèn one must take a bus to the junction with the road that cuts east to the Mediterranean. Transportation from the junction can be described as "catch-as-catch-can." Trucks can be flagged down and a deal struck for a ride up into the sharply steep terrain. The mountains in this part of the Rif are very rugged, and only a few roads twist along the rocky flanks of the mountainsides. The people generally are farmers, growing mainly a mixture of maize, figs, and vegetables. They are, thankfully, only too happy to

give directions. It seems to be one of the moistest areas in Morocco, as the rivers there are dependable enough for generating electricity and the creation of reservoirs.

A turn from the main road brings one down to a river gorge, where the road ends at the hillside village of Talembote. Its one main street is lined with small stores and houses, and any thoughts of an anonymous entry are quickly abandoned, as any stranger to town is an instant celebrity. The townspeople were initially reserved, mainly because Westerners have a reputation of smuggling, and because of the presence of a nosey and bored garrison of government militia.

Once the legitimacy of my purpose had been established, the townspeople arranged for a guide and donkey. After some friendly haggling in pidgin French, "*les cinquante dirhams et mon couteau ou le couteau et mon chaussures*," an arrangement was made and a 10-kilometer ride up the mountain began. From the village the dirt road gradually wound to the fir forest through zones of various Mediterranean scrub. The genera I encountered were both familiar and new. At one elevation I collected seeds from *Arbutus unedo*, a small ericaceous tree whose range stretches as far north as Ireland and whose relative, *Arbutus menziesii*, the madrone, I had encountered in British Columbia as a 100-foot tree. A beautiful heather, *Erica terminalis*, grew 2 feet high next to a small spring. An odd shrub with indumented, whitish leaves confused me, as I had never seen even the genus before. I found it to be *Cistus albidus*, a rock rose.

As we neared the higher part of the massif, a thick bank of fog began streaming in, billowing over the lower ridges like a slow-moving breaker. The fog would continue to plague us for the remainder of the day.

We rounded a curve and crossed a slight depression; finally, I could see the edge of the fir forest. As we entered the forest we passed a giant that had been struck down by lightning. My guide, warming by now to photography, insisted I pose against the weathered carcass.

I had explained to my guide that I wanted to collect cones from the uppermost region of the population, and we proceeded farther upwards into the forest as the fog continued to swirl around us. Before long we heard the dampened thud of axes working inward upon the trees. My guide felt it best that we skirt the unseen woodcutters ("They are from a different village," he explained), and we continued quietly through the fog. At this point visibility was about 15 feet, which slightly hindered collecting; locating plants by touch rarely proves productive.

The mountain flattens out at 1,700 meters, and my guide assured me that there was really no peak to speak of. The forest was primarily firs and, unlike Mt. Tisouka, there were no *Cedrus* specimens to be seen.

We staked our donkey, and as my guide broke for lunch I busied myself climbing fir trees and cutting down the cones. These were about 10 inches long, quite large for a fir, and very green, which made me fear I had travelled all these miles for naught.

I finished climbing and began gathering the cones. As I did so the woodcutters we had avoided previously emerged ghostlike through the fog, each carrying on his shoulder a 3-meter-long, handhewn beam. We exchanged a few mumbled greetings with them, and they merely continued trudging down the mountain to their village.

When breaks in the fog occurred, we could see the full dimensions of the trees, which grew as high as 50 meters with a gradual taper. This large size makes the Tazaotan fir one of the largest firs of the Mediterranean region and, with the possible exception of *Cedrus atlantica*, the largest conifer in North Africa. Given the large size of this fir and its adaptability to lime soils, there may be a

niche for it in forestry, possibly on the lime coasts of England.

There is a question as to whether the size difference between the two Moroccan firs might be the effect of local climate. The area of the Tazaotan fir has a more fertile humus soil and seemingly a higher level of moisture. Comparisons of the two plants over a period of time in botanic gardens will help to settle the question.

In addition to the *Abies*, seeds of other woody species were collected at the top of Tazaot. These are now under propagation at the Dana Greenhouses and include *Acer opalus* var. *granatense*, *Crataegus laciniata*, *Lonicera arborea*, *Berberis hispanica*, and a number of others.

### Origins of Morocco's Alpine Flora

While collecting in these Moroccan conifer forests, I had to remind myself continually that I was in Africa. How could such an atypical flora have come to rest here? What was

*The summit of Mount Tisouka.*

the genesis of these odd pockets of African conifers and how long had they existed? Upon my return to the Arnold Arboretum I sought answers for these questions.

In the *Origin of Species*, Charles Darwin provided a partial answer:

> As the warmth returned, the arctic forms would retreat northward, closely followed up in their retreat by the production of the more temperate regions. And as the snow melted from the bases of the mountains the arctic forms would seize on the cleared and thawed ground, always ascending, as the warmth increased and the snow still further disappeared, higher and higher, whilst their brethren were pursuing their northern journey. Hence when the warmth had fully returned, the same species which had lately lived together on the European and North American lowlands, would again be found in the arctic regions of the Old and New Worlds, and on many isolated mountain summits far distant from each other.

Darwin's remarks deal mainly with arctic plants and animals in Europe, but we can easily imagine the same process of regional climatic change at work farther south, in the Rif Mountains. The exodus of the Moroccan conifers to their present sites is a story that can be told only in terms of hypothesis. Fossils of *Cedrus* have been found in France (Miocene), Greece (Pliocene), and southeastern Russia (Oligocene), so we can see that a more northerly distribution existed prior to the glacial onslaught.

The lowering temperatures in the Pleistocene drove the genus farther south to its present latitudes, and even farther. *Cedrus* is believed to have grown even in the Ahaggar Massif of the central Sahara during early Pleistocene times. Since the "Ice Age" its range has shrunk to a few scattered mountain peaks, one of them being Mt. Tidiquin.

The hardiness of the Moroccan firs has never been fully determined. In the mountains where they grow, full-sized populations extend to the summits. At the lower elevations firs mingle with a warm-temperate element, but their upper limit has yet to be determined, as they simply run out of sites on which to grow. Since another variety of *Abies pinsapo*, the variety *glauca*, has grown well for some 40 years in Boston, there is real hope that its two African relatives will prove hardy also.

As with the *Cedrus*, the genesis of the *Abies* in their mountain havens can only be guessed at. The fossil record of firs in Europe extends back over 25 million years. For the genus worldwide, fossils have been found that date back 60 million years.

*Abies pinsapo* has been found in the European fossil flora from the Pliocene epoch, some 13 million years ago. This long history makes *Abies pinsapo*, along with the European species *A. cilicica* and *A. alba*, the only firs known to predate the Pleistocene epoch and the four waves of glaciation that occurred within it. *Abies pinsapo* may, then, have become established in North Africa prior to the Pleistocene glaciations.

It is more probable, though, that the temperate elements of the Moroccan flora arrived during the periods of glaciation, when the Mediterranean had receded and the gap between Europe and Africa was narrower or absent altogether. Glaciers are known to have existed at the time in the Sierra Nevada of southern Spain, the present home of *Abies pinsapo*. According to Burkhard Frenzel, during the third glacial period (the Saalian), "groves of extremely cold resistant conifers" were growing in the vicinity of Gibraltar.

During the final glaciation (the Weichselian), the Atlas Mountains of Morocco are known to have harbored glaciers of some magnitude, while the Rif area is thought to have had permanent snowfields. Again according to Frenzel, the whole of the Iberian peninsula was covered with "groves of extremely cold resistant conifers and deci-

duous trees within the prevailing steppe vegetation." It was during these final two glacial periods that North Africa probably experienced the greatest influx of plant species from Europe, and the flora of the Rif probably paralleled that of Iberia, much as it does today.

After the last glaciation, the region's climate began to warm up and dry out, driving the *Abies* to their present refuge, the highest peaks of the Rif Mountains in Morocco and the Atlas Mountains in Algeria.

These isolated populations of obscure conifers illustrate just how far south the temperate flora of Europe was driven into Africa and offer mute testimony to the fickle nature of climate.

**Epilogue**

I am happy to report excellent germination of seeds of the two Moroccan firs. Seedlings of both have survived their first winters in Boston. Three-year-old seedlings of *Abies pinsapo* var. *marocana* and of *A. pinsapo* var. *tazaotana* are available for sale, with the proceeds going toward defraying the costs of seed collection. For $15.00 the pair you may experiment with your own small piece of Africa. Write:

Robert G. Nicholson
The Dana Greenhouses
The Arnold Arboretum
Jamaica Plain, MA 02130.

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*Robert G. Nicholson, a member of the Arboretum's grounds staff, travels widely and often in search of interesting plant materials.*