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THE POWER OF TREES

Ecofit™

Selecting Species for Success

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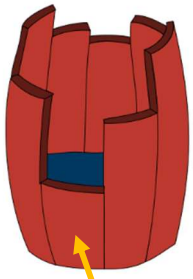
Ecofit Takes the Guesswork Out of Tree Growing Success

Justus von Liebig's widely recognized "Law of the Minimum" principle suggests that agriculture crop yield is proportionate to the amount of the most limiting essential nutrient.

A barrel with staves of unequal lengths illustrates von Liebig's point. Plant growth and health *are not controlled by the total amount* of nutrients available – rather, plant growth and health *are controlled by the scarcest* nutrients available.



Scarcest nutrient limits capacity

Von Liebig was right, and the barrel is different for every plant, including trees. Each plant has different requirements – whether it be light, temperature, moisture, essential nutrients, soil structure, atmospheric conditions, etc. These are all referred to as abiotic (non-biological) conditions because they do not consider the living things around the trees.

With Ecofit biotechnology, trees can be chosen to better fit the current or projected environment.

Critical decisions

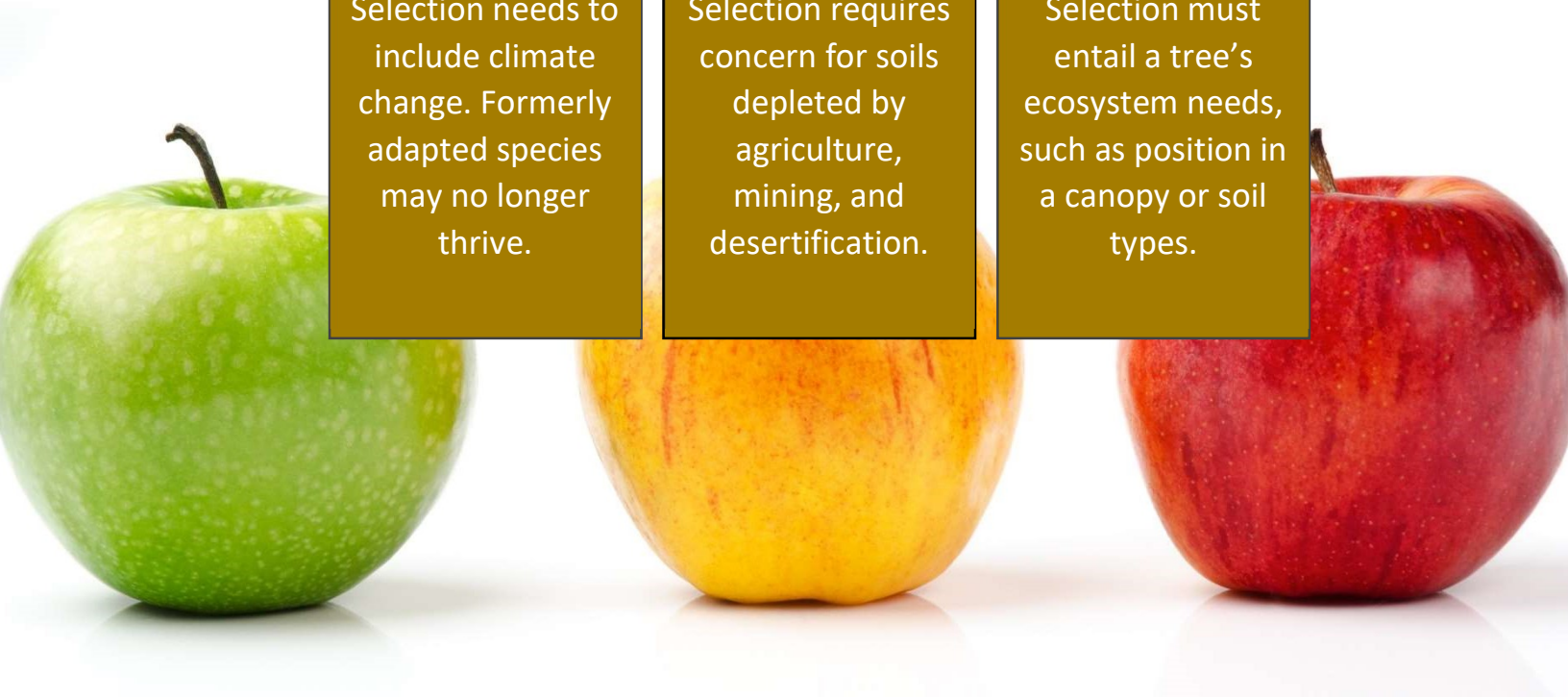
Central to every tree growing project is choosing the best species, whether for restoring local habitats, timber, agriculture, or carbon sequestration. For example, a thriving apple tree fruits better than one that is struggling or dies. This applies to every aspect of a tree, like the production of fruit, timber, carbon, etc. The critical win is to not have trees fail, and even a 10% improvement in biological performance would translate into success for the project.

Without Ecofit, selecting the right trees is exceedingly difficult.

Selection needs to include climate change. Formerly adapted species may no longer thrive.

Selection requires concern for soils depleted by agriculture, mining, and desertification.

Selection must entail a tree's ecosystem needs, such as position in a canopy or soil types.



Inadequate solution #1: Existing studies, reports, and data

Except for handfuls of commonly planted timber species, minimal data on most tree' abiotic factors are available. The state of current data is as follows:

Due to climate change, trees are failing globally. Simply replanting the same species may also fail. Reestablishing entire ecosystems requires consideration of additional factors, often requiring a staged approach.

1. Not quantitative. Studies may say a tree is 'more tolerant to saline' or 'resists frost'. But how saline? How cold? How shady? Clay vs. silt? How acidic? Etc.

2. Few factors known. Several abiotic factors limit the opportunity of plants. As the Law of the Minimum implies, all factors need attention or the plant risks failure. For instance, you may know the plant tolerates salinity, but you may not know it does not tolerate shade and therefore fail on that count.

3. Limited relevance for current conditions. Some data is available for a specific place but lack accounting for shifts caused by climate change, land use, and local varieties.

4. Limited usefulness to reestablish ecosystems. Critical data for local species is lacking, which in a rain forest may run into the hundreds. What can grow there now? What pioneer species are needed at the start?

Existing data can provide local insights but cannot predict long-term, reliable results.

Inadequate solution #2: Local trials

Since existing data is inadequate, tree growers often run trials. Using data and local knowledge to identify candidate species, they are planted in a nursery on-site. Typically, after a three-year period, planting begins with the best performing trees. This is unreliable because:

- Reforestation spans multiple soil types and microclimates unrepresented in a nursery.
- Trials are too short to be predictive as trees likely change after the seedling stage.
- They are not predictive of changing conditions or for generations of trees.
- There is no accounting for light/shade requirements.
- Trials are too slow and expensive given the urgency of climate change.

Neither existing data nor planting trials provide reliably predictive results.
As the scale of investment rises, so does the demand for risk mitigation.
Ecofit is the only biotechnology predicting species success.

Ecofit biotechnology

Ecofit testing includes both the local ecosystem and the trees to find a fit between them. Using biopsies of trees, soil tests, and climate data, Ecofit provides quantitative measures of a specific species suitability for a specific set of local conditions.

Reliably predicting environmental fit improves the risk profile of a project *and increases performance.* (A better suited apple tree not only is more likely to survive, but it also produces more fruit.) Although biological and other factors still exist, healthy trees can cope and recover better from stresses.

The biopsies of trees are not unlike those of humans. For example, a single blood test can deliver test results across hundreds of chemical measurements. Cholesterol,[1] can indicate a risk of heart disease. The study of cholesterol began in the 1600's and has continued to the present. Research took off in the 1950s and in the 1970s drug therapies made it a big business. There have been 11 Nobel Prizes on this subject.

Similarly, biopsies of trees can measure numerous chemical components. Which matter and what do the specific numbers mean? Like cholesterol, when are the LDL or HDL measures bad or good? Just being able to measure does not equal being able to interpret. Ecofit testing builds upon global research to interpret known chemical indicators and find others that were previously unknown.

Ecofit biotechnology focuses on quantifying a narrow set of chemical indicators indicating a tree's capacity to succeed under various abiotic conditions. Some conditions require no measurement. For example, continuous sub-freezing temperatures is a condition where no trees grow. But how cold can a specific tree tolerate for part of the year?

The Ecofit limiting factors are interrelated (see graphic). In other words, they impact each other. For example: climate influences which trees will thrive, and trees help stabilize the local climate.

Ecofit biotech is part of an industry working to improve the productivity of forestry, agriculture, and other plantings. These efforts are used to improve the returns on investments made in natural capital. Its considerations and applications are far-reaching.

[1] P. Kuijpers, "History in medicine: the story of cholesterol, lipids and cardiology", Vol. 19, N° 9 - 13 Jan 2021

Process for Ecofit testing

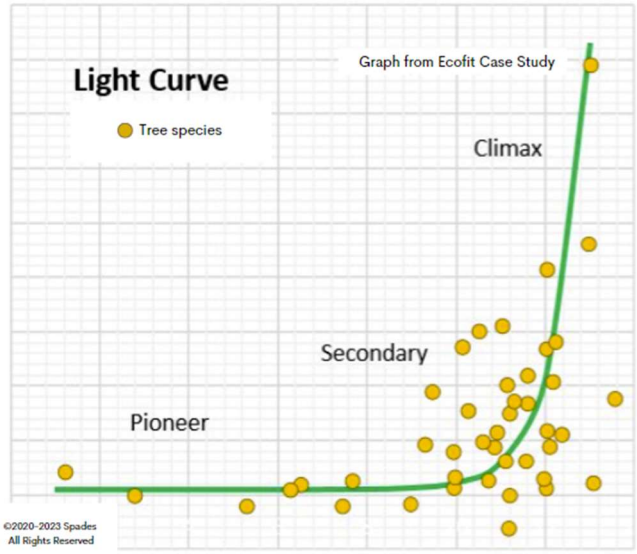
Maps of the area are provided to the testing team. The maps divide the area to be reforested by local microclimates, and within those areas any special conditions, like depleted soil, are identified.

The maps show Spades' Terrazone™ restoration zones, and the proposed species for those areas.

The following activities are completed for each distinct zone, microclimate, and condition:

1. **Collect:** assemble background data, survey site, and gather samples.
2. **Test:** conduct testing in the lab.
3. **Interpret:** use scientific evidence predictive software and algorithms.
4. **Advise:** assess the project plan against field testing.

In forests, "pioneer" trees at the top seek sunlight. In the middle, are "secondary" trees that require filtered light. At the bottom are 'climax' trees that prefer shade. When regrowing a forest, the pioneers must come first, providing shade other trees need. If adjacent to an existing forest, diversity might naturally regenerate after that.



Mapped on the curve are 40 trees tested from three sites in an Asian country. Ecofit points to which few trees should be selected as pioneers based on light conditions. Other Ecofit tests verify the ability of these pioneers to thrive in other conditions.

From this data, and others, a regrowing plan can be quantitatively evaluated. This process can be applied to multiple projects, including requirements for fruit and nuts and sustainable timber, by identifying trees that will likely have superior performance.

Proven biotechnology with a growing future

Ecofit has been laboratory tested across over 400 species in 30 ecosystems globally – from deserts to tropical rain forests to dry savannahs and highlands (see map below). There are quantitative and direct correlations between local abiotic conditions and the trees test results. Results correspond across ecosystems, aligning with tests conducted.

Trees have significant genetic diversity within each species. Selection needs to account for locally adapted varieties. For example, though all one species, 7,500 varieties of apples have diverse requirements. Therefore, each ecosystem cluster of trees must be tested to verify its suitability.

Growing Opportunity

Climate change has also put much of agriculture in peril. For example, wine regions around the world are struggling. In Napa Valley, California, there is concern that Cabernet Sauvignon will not be able to thrive there in 30 years. It is half of their production. Can any of the over 700 varieties of cabernet thrive? There is currently no clear answer.

Early trials of Ecofit biotechnology on other plants point to the possibility of revolutionizing agriculture in every field, like wineries. This includes both legumes and grasses, such as wheat, rice, and corn. Much more research is needed to verify these solutions.

Ecofit biotechnology is protected as trade secrets, necessary to attract investment to expand further research and scale up the technology globally.

Recipe for a forest

Except for humans, trees impact the climate more than any other type of living thing. When trees flourish, so does the planet. Mitigating climate change is dependent upon successfully reforesting the world. This requires an unambiguous knowledge of the links between trees and ecosystems. Only Ecofit achieves this clarity, cutting time required, reducing costs, and upping performance:

- **Different trees are selected**, making sure they have a natural and beneficial relationship among changing conditions in microclimates, depleted soils, and desertification.
- **The cultivation is different.** Pioneer and subsequent species are identified and planted in correct order. Trees are supported to cover starting soil or water conditions.
- **Greater returns achieved.** Trees more than survive, they thrive with resilience, supplying more fruit, timber, and carbon. Plus, they literally lay the groundwork for natural regeneration – so nature provides part of the regrowing, reducing needed investment.

Spades' Terrazone landscape design planning tool delivers the social and development fit for rural land use. Topodox™ site monitoring software provides comprehensive support for forest development, and monitoring and standards track project status and result from planning through 50 years.

Every tree project needs Ecofit to help assure results. There is no other option. Period.