

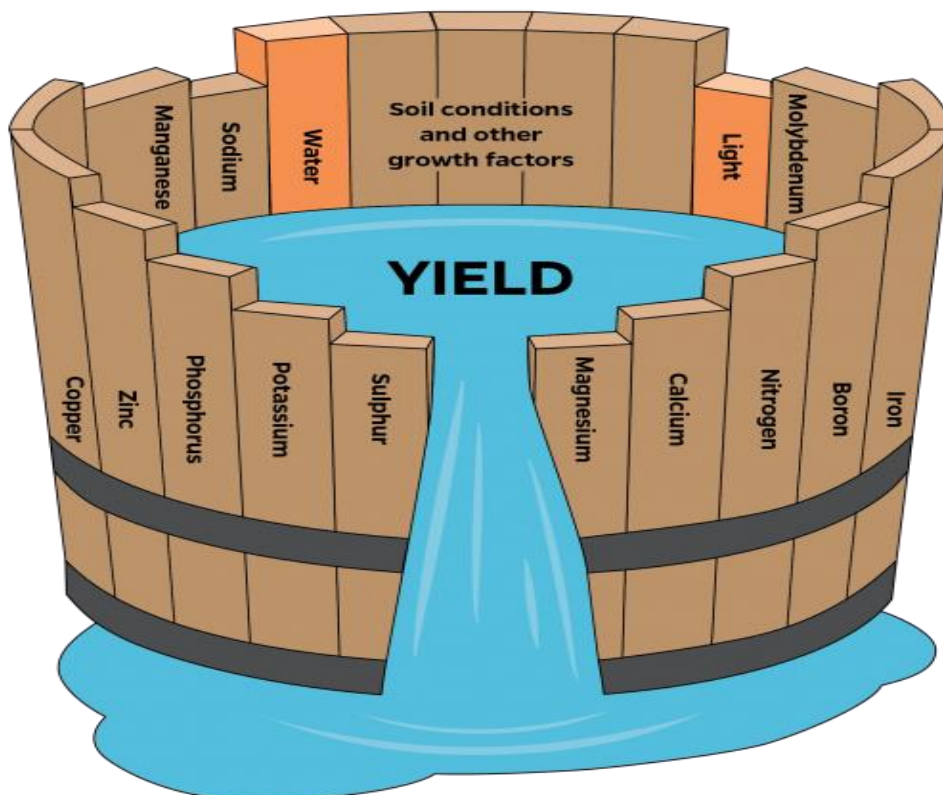
---

## Limiting factors & tolerance levels

### Liebig's law of minimum (1840)

The Law of the Minimum, made famous by German scientist *Justus von Liebig (1803-1873)*. Plants need many different nutrients, so-called essential nutritious elements, to grow healthily. If only one of these elements is deficient, plant growth will be inhibited, even if all the other essential nutrients are available in abundance.

This is also true for all other resources such as light and temperatures for the plant species. ((Necessary substances that are available in small quantities and approach the thresholds of the organism's need will be limiting factors))



## How It Works ?

### 1-Factor interaction

Example / Crustaceans need calcium to build their crust, but calcium cannot be considered as a determining factor because it can be replaced by Strantium to build crust .

### 2- The law only works in stable conditions

For example, suppose in a lake that light, phosphorus, nitrogen and other factors exist in large quantities and that the determining factor is carbon dioxide, and that productivity is in balance with the amount of carbon dioxide,

Suppose a storm added carbon dioxide, the situation here is not stable and productivity depends on the concentration of all factors .

## Shelford's Law of tolerance

Shelford in 1911. The success of an organism is determined not only by the minimum environmental resources but also by the upper limits and that any organism lives in the range between the minimum and maximum .

Under the law of tolerance, some basic principles in ecology are :

- 1- Organisms may have a wide range of tolerances for certain factors and a narrow range for other factors
- 2- There are many terms used in the field of ecology, the prefix Steno means narrow range and Eury means a wide range

When we describe the heat and salinity we say :

Eurythermal	a wide range of temperatures
Stenothermal	a narrow range of temperatures
Euryhaline	a wide range of salinity
Stenohaline	a narrow range of salinity

3. Organisms that have a wide tolerance to all environmental conditions are widespread.

4- The effects of environmental factors interfere with each other, for example, orchid flower need light to grow but, we can only find in the shade because of the high temperature in bright areas that the flower cannot bear.

5 - The reproduction period is critical and the tolerance limits for reproductive individuals (seeds, eggs, embryos, larvae, etc.) are narrower than the tolerance limits for parents.

Example: Adults blue carp and many marine animals can tolerate salt water, which contains a high proportion of chlorine but larvae cannot live in this water, so this species cannot reproduce in this water

Some types of limiting factors:

