SHEPROS®
Safety, Health & Environment Product Solutions

Non-Toxic
Environment Friendly

Increase Yield
Reduce Watering
Reduce Fertilizing

Nanogel Soil Activator



SHEPROS Sdn. Bhd.

Understanding the Properties of Soils

Soils

Soil can be described in many different ways, such as heavy, light, sandy, clay, loam, poor or good. Scientists typically describe soils according to its:

- Color
- Compaction
- Moisture content
- Organic content
- pH
- Profile
- Structure
- Temperature, and
- Texture

Although each of these factors is important, three factors (texture, organic content and pH) are more important than the others. Regardless, we will provide a brief overview of all nine factors below.

Color

Soil color can provide information about organic matter in the soil, drainage, biotic activity, and fertility. The chart below can give you some insight into the condition of your soil just from its appearance. To identify the color of your soil, you should take a garden spade or shovel, and dig a shallow hole, at least 3" - 4" deep, and gauge the color (you should do this quickly before the sun can dry it out).

Condition	**Color**		
	Dark	**Moderately Dark**	**Light**
Organic Matter	High	Medium	Low
Erosion Factor	Low	Medium	High
Aeration	High	Medium	Low
Nitrogen Availability	High	Medium	Low
Fertility	High	Medium	Low

Compaction

To be healthy, a soil needs to be able to breath and water needs to be able to move through it reasonably easily. Compacted soils don't allow much air to circulate to the root zone and water (rainfall or irrigation) tends to just run-off. This increases erosion and strips away vegetation and topsoil. A normal, loosely compacted soil helps to absorb and retain water, releasing it slowly, and allows the root zone of plants to "breath". These soils are generally more productive, since plants can grow much more readily. Dense, highly compacted soils typically have less plant growth, which increases runoff.

Sand is the largest particle in the soil. When you rub it, it feels rough. This is because it has sharp edges. Sand doesn't hold many nutrients or water. Silt is a soil particle whose size is between sand and clay. Silt feels smooth and powdery. When wet it feels smooth but not sticky.

Clay is the smallest soil particle. Clay is smooth when dry and sticky, or plastic when wet. Soils high in clay content are called heavy soils. Clay can hold a lot of nutrients, and some kinds can hold quite a bit of water, but the structure of clay doesn't let air and water move through it well. Most of the water in a clay soil is so tightly bound to the clay particles that plants can't get it loose.

Moisture

The amount if moisture found in soil varies greatly with the type of soil, climate and the amount of humus (organic material) in that soil. The types of organisms that can survive in your soil is largely determined by the amount of water available to them, since water acts as a means of nutrient transport and is necessary for cell survival.

Organic Content

The organic content of soil greatly influences the plant, animal and microorganism populations in that soil. Decomposing organic material provides many necessary nutrients to soil inhabitants. Without fresh additions of organic matter from time to time, the soil becomes deficient in some nutrients and soil populations decrease.

Soil pH

Most people think that rainwater has a pH of 7, so it comes as something of a shock when they learn that rainwater (if its not polluted) has a normal pH of about 6 - 6.5, which is slightly acidic. This is due to dissolved carbon dioxide from the air, which reacts with water to form a dilute acid (carbonic acid), much like the carbon dioxide in soda. It should then come as no surprise that most plants grow their best at around the same pH. However, some plants, such as rhododendron, camellias, azaleas, blueberries, ferns, spruce, pines, firs, and red cedar prefer soil that is more acidic, with a pH of 4.0 to 5.0. Other plants, such as beech, mock orange, asparagus and sagebrush tolerate soils with a pH 7.0 to 8.0. Above a pH 8.5, the soil is too alkaline for most plants, while if the soil pH is below 3.5 it will be too acid.

Soil Profile

Many soils have three major layers or horizons, top soil, subsoil and parent material. Depending on where you sample, the top zone may be comprised of actively growing plants and dead plant materials.

The top soil is typically darker colored and usually has more organic matter, higher biotic activity, abundant roots, and commonly lower in nutrients than underlying layers. The first inch of top soil may be lighter in color because many of the nutrients may have been leached out by water, and organic material may have been partially oxidized by sunlight and heat. The soil immediately below the first inch is usually somewhat darker, has many roots, moderate organic matter, and provides most of the nutrients for the plants. The next major layer is the subsoil. This layer is typically 1 to 2 feet below the surface and is characterized by a lighter color with much fewer, larger roots. The subsurface layer generally has less clay than the topsoil. The third layer, which may not be observable, is the parent material. This consists of unconsolidated, slightly weathered rocky materials from which soil develops. It is characterized by limited biotic activity and very few roots.

Soil Structure

Soil structure tells how the soil affects the movement of water, air and root penetration into the soil. The geometric shapes of the soil determine how it is put together. Typical soil structures can be described as below:

- ***Blocky***
  The blocks of soil are large, with the same number of cracks going horizontal as vertical.

- ***Granular***
  The blocks of soil are small, with the same number of cracks going horizontal as vertical.

- ***Columns***
  The blocks of soil and related cracks are generally longer in the vertical direction than in the horizontal

- ***Plate-like***
  The blocks of soil and related cracks are generally longer in the horizontal direction than in the vertical.

To determine the structure of your soil, carefully break apart each layer and match its characteristics with the appropriate structural type shown below.

STRUCTURAL TYPE	WATER PENETRATION	DRAINAGE	AERATION
Blocky	Good	Moderate	Moderate
Granular	Good	Best	Best
Columns	Good	Good	Good
Plate-like	Moderate	Moderate	Moderate

Soil Temperature

Soil temperature has a significant role in helping to determine the rate of plant growth, and whether a plant will even survive. It changes more slowly than the air temperature, so there is a lag time between the extremes of air temperatures and soil temperatures. The temperature in the soil changes greatly with depth. Table below can be used as a soil temperature general guideline for agriculture.

Soil Temperature	Conditions During Growing Season
Less than 40°F (4°C)	No growth, bacteria and fungi are not very active
40°F to 65°F (4°C to 18°C)	Some growth
65°F to 70°F (18°C to 21°C)	Fastest growth
70°F to 85°F (21°C to 29°C)	Some growth
Above 85°F (29°C)	No growth

Soil Texture

Sandy soil absorbs more than two inches of water per hour. It is very porous, with large spaces between soil particles. Little water is retained and the sandy soil dries out quickly. Loam soil absorbs from 0.25 inches to 2 inches per hour. The soil is loose and porous and holds water quite well. Clay soil absorbs less than 0.25 inches of water per hour. Clay soil is dense with few air spaces between particles and holds water so tightly that little water is available for plants.

Characteristics of Different Soil Textures

It can be argued that no two soils are ever exactly alike. Although this is true, it is useful to group soils into categories according to United States Department of Agriculture.

- ***Sand***
  Soil material that contains 85% or more sand; the percentage of silt plus 1.5 times the percentage of clay does not exceed 15.

- ***Loamy sand***
  Soil material that contains between 70 and 91% sand and the percentage of silt plus 1.5 times the percentage of clay is 15 or more; and the percentage of silt plus twice the percentage of clay is less than 30.

- ***Sandy loam***
  Soil material that contains 7 to 20% clay, more than 52% sand, and the percentage of silt plus twice the percentage of clays is 30 or more, or less than 7% clay, less than 50% silt, and more than 43% sand.

- ***Sandy clay loam***
  Soil material that contains 20 to 35% clay, less than 28% silt, and 45% or more sand.

- ***Sandy clay***
  Soil material that contain 35% or more clay and 45% or more sand.

- ***Loam***
  Soil material that contains 7 to 27% clay, 28 to 50% silt, and less than 52% sand.

- ***Silt loam***
  Soil material that contains 50% or more silt and 12 to 27% clay, or 50 to 80% silt and less than 12% clay.

- ***Clay loam***
  Soil material that contains 27 to 40% clay and less than 20% sand.

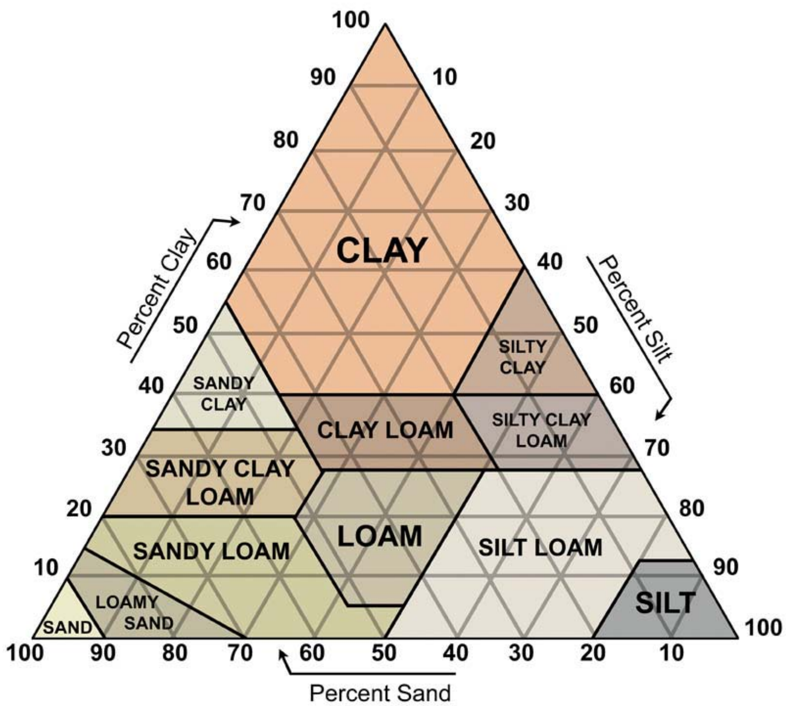
- ***Silt***
  Soil material that contains 80% or more silt and less than 12% clay.

- ***Silt clay loam***
  Soil material that contain 27 to 40% clay and less than 20% sand.

- ***Silty clay***
  Soil material that contains 40% or more clay and 40% or more silt.

- ***Clay***
  Soil material that contains 40% or more clay, less than 45% sand, and less than 40% silt.

- ***Heavy clay***
  Soil material that contains more than 60% clay.



Soil texture triangle

The Importance of Cation Exchange Capacity in Soil

What is Cation Exchange Capacity (CEC)?

Cation exchange capacity is defined as the ability to which a soil can attract, retain, and exchange cation elements. Cation exchange capacity determines a soil's ability to retain positively charged plant nutrients, such as $NH4^{+}$, K^{+}, $Ca2^{+}$, Mg^{2+}, and Na^{+}. As CEC increases for a soil, it is able to retain more of these plant nutrients and reduces the potential for leaching. It is reported in millequivalents per 100 grams of soil (meq/100g).

In order for a plant to absorb fertilizers, the fertilizers must be dissolved with water. When fertilizers are dissolved, the nutrients will be in a form called "ions". This simply means that they have electrical charges. As an example is potassium chloride (KCl) fertilizer, when it dissolves it becomes two ions; one of potassium (K^{+}) and one of chloride (Cl^{-}). The +ve and -ve signs with the K and the Cl indicate the type of electrical charges associated with these ions. In this example, the potassium has a plus charge and is called a "cation". The chloride has a negative charge is called an "anion". Since, in soil chemistry "opposites attract" and "likes repel", nutrients in the ionic form can be attracted to any opposite charges present in soil.

Some important elements with a positive electrical charge in their plant-available form include potassium (K^+), ammonium (NH_4^+), magnesium (Mg^{2+}), calcium (Ca^{2+}), zinc (Zn^+), manganese (Mn^{2+}), iron (Fe^{2+}), copper (Cu^+) and hydrogen (H^+). While hydrogen is not a nutrient, it affects the degree of acidity (pH) of the soil, so it is also important.

Some other nutrients have a negative electrical charge in their plant-available form. These are called anions and include nitrate (NO_3^-), phosphate ($H_2PO_4^-$ and HPO_4^{2-}), sulfate (SO_4^-), borate (BO_3^-), and molybdate (MoO_4^{2-}). Phosphates are unique among the negatively charged anions, in that they are not mobile in the soil. This is because they are highly reactive, and nearly all of them will combine with other elements or compounds in the soil, other than clay and organic matter. The resulting compounds are not soluble, thus they precipitate out of soil solution. In this state, they are unavailable to plants, and form the phosphorus "reserve" in the soil.

Cation Exchange Capacity (CEC) in Soils

Soil particles and organic matter have negative charges on their surfaces. Mineral cations can adsorb to the negative surface charges of the inorganic and organic soil particles. Once adsorbed, these minerals are not easily lost when the soil is leached by water and they also provide a nutrient reserve available to plant roots. These minerals can then be replaced or exchanged by other cations (i.e., cation exchange) CEC is highly dependent upon soil texture and organic matter content. In general, the more clay and organic matter in the soil, the higher the CEC. Clay content is important because these small particles have a high ration of surface area to volume.

Examples of CEC values for different soil textures are as follows:

Texture	**CEC (meq/100g soil)**
Sand	1-5
Sandy Loam	2-15
Silt Loam	10-25
Clay Loam/ Silty Clay Loam	15-35
Clay	25-60
Organic Soils	50-100

In general, the CEC of most soils increases with an increase in soil pH. Two factors determine the relative proportions of the different cations adsorbed by clays. First, cations are not held equally tight by the soil colloids. When the cations are present in equivalent amounts, the order of strength of adsorption is $Al^{3+} > Ca^{2+} > Mg^{2+} > K^+ = NH_4^+ > Na^+$. Second, the relative concentrations of the cations in soil solution help determine the degree of adsorption. Very acid soils will have high concentrations of H^+ and Al^{3+}. In neutral to moderately alkaline soils, Ca^{2+} and Mg^{2+} dominate. Poorly drained arid soils may adsorb Na in very high quantities.

Examples of Soil Textures


ORGANIC


SAND


SANDY LOAM


SILT LOAM


CLAY


CLAY LOAM

Base Saturation

The proportion of CEC satisfied by basic cations (Ca, Mg, K, and Na) is termed percentage base saturation (BS%). This property is inversely related to soil acidity. As the BS% increases, the pH increases. High base saturation is preferred but not essential for tree fruit production. The availability of nutrient cations such as Ca, Mg, and K to plants increases with increasing BS%.

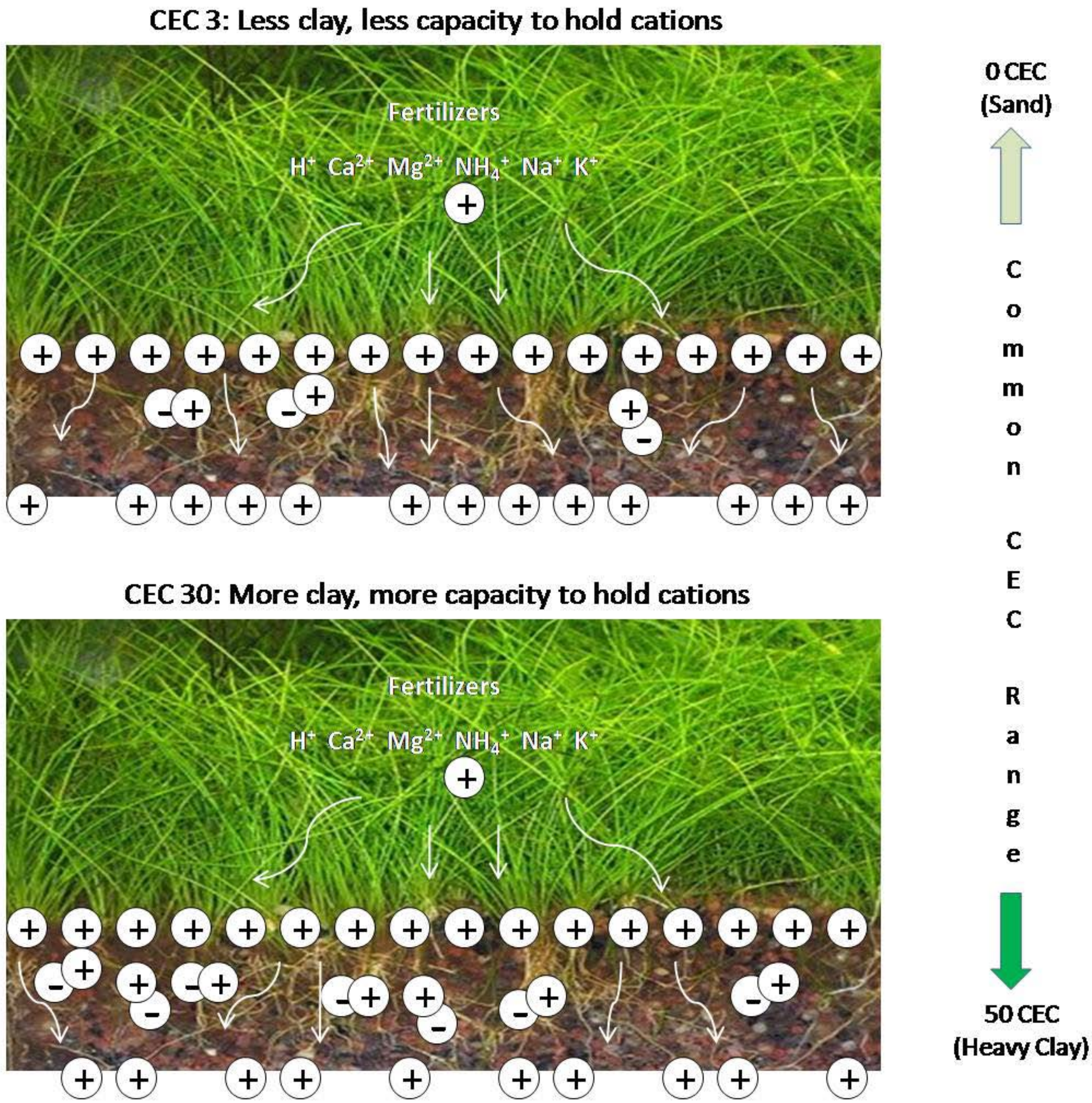
Base saturation is usually close to 100% in arid region soils. Base saturation below 100% indicates that part of the CEC is occupied by hydrogen and/or aluminum ions. Base saturation above 100% indicates that soluble salts or lime may be present, or that there is a procedural problem with the analysis.

CEC and Availability of Nutrients

Exchangeable cations, as mentioned above, may become available to plants. Plant roots also possess cation exchange capacity. Hydrogen ions from the root hairs and microorganisms may replace nutrient cations from the exchange complex on soil colloids. The nutrient cations are then released into the soil solution where they can be taken up by the adsorptive surfaces of roots and soil organisms. They may however, be lost from the system by drainage water.

Additionally, high levels of one nutrient may influence uptake of another (antagonistic relationship). For example, K uptake by plants is limited by high levels of Ca in some soils. High levels of K can in turn, limit Mg uptake even if Mg levels in soil are high.

A SCHEMATIC LOOK AT CATION EXCHANGE



SOILS DESCRIPTION OF COMMON CEC RANGE	
Soils with Higher CEC Reading (CEC 11-50)	**Soils with Lower CEC Reading (CEC 1-10)**
• Higher clay content in soil. • Greater capacity of holding nutrients. • Higher water holding capacity. • Higher lime requirement to correct pH of soil.	• Lower clay content in soil. • Lesser capacity of holding nutrients. • Lesser water holding capacity. • Lesser lime requirement to correct pH of soil.

NANOGEL SOIL ACTIVATOR (NSA)

Nanogel Soil Activator is a highly effective means for activization of the agrophysical and agrochemical processes in the soils. It contains a wide range of natural minerals that improve the ion exchange in the air, water, soil and plants. It activates agrophysical and agrochemical processes in the soils in an environmentally safe manner.

Nanogel Soil Activator's soil conditioning technology is defined as an effective soil conditioner consisting of a mixture various components from different groups all assisting the plant growth processes in a synergetic way. This technology is more effectively than any single polymer or fertilizer product, to significantly increase the capability of soils and growing media to retain and provide water and nutrients, to improve plant and root growth, and to reduce the amount of water necessary to create high-quality plants and turf.

What is wrong with Common Chemical Fertilizer?

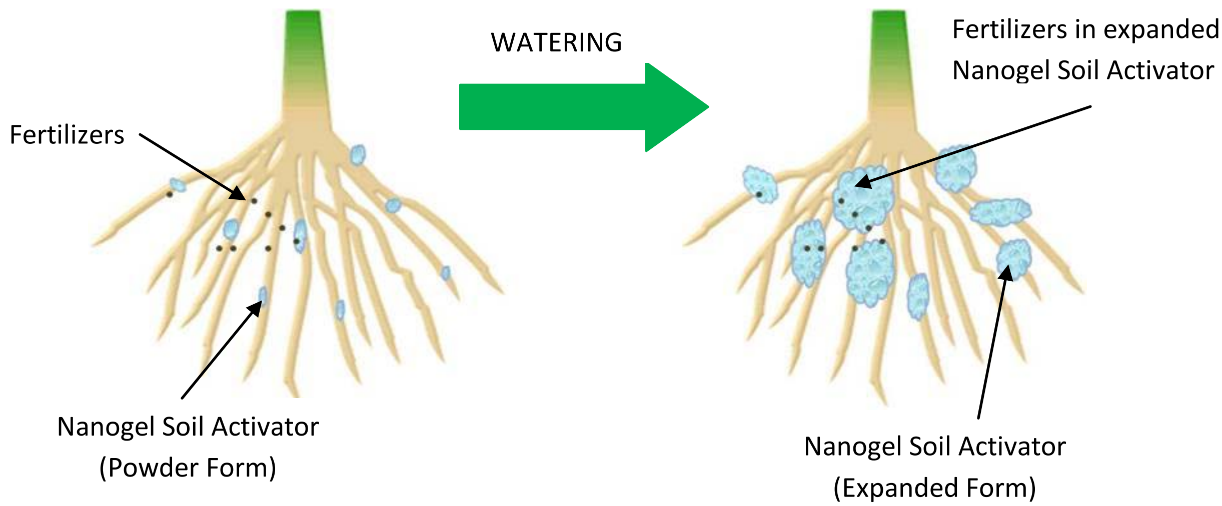
1. 40% of fertilizer nutrients loss due to leaching and high temperature.
2. It does not improve soil condition (pH), aeration, irrigation and crop's immunity.
3. Minimal or no Micro Nutrients.

Advantages of Nanogel Soil Activator for Acidic Soils

1. Improves the efficiency and value of chemical fertilizer up to 50%.
2. Reduces watering and save water up to 50%.
3. Stimulates growth of plants, flowers and agricultural products and extend their life spans.
4. Reduce acidity and balances the pH level of soils.
5. Break water clusters for easy absorption.
6. Powerful soil enhancer. Improves soil fertility and its microbiological activity.
7. Promotes hormonal and antioxidant activity, plants nutrient uptake.
8. Stimulates root and plant growth, accelerates seed germination.
9. Increases mass of fruits and plants, improves decorative properties of floral cultures.
10. Reduces soil salinization and migratory mobility of contaminants in the ionic form and their movement to ground waters and a zone of moisture evaporation.
11. Reduces dependence on chemical applications and fertilizer requirements.
12. Raises plants resistance to disease, heat and frost damage.
13. Does not contain pathogenic microflora, seeds of weeds and genetically modified organisms.
14. Has no limitation on use in soil management and agriculture.
15. Can be combined with all type of chemical fertilizer.
16. Reduces loss of chemical fertilizer nutrients by rain or high temperature.
17. Retains nutrients for use by plants.
18. High cation exchange capacity (CEC).
19. Increases crop's immunity towards crops diseases.

20. Improves long term soil quality.
21. Absorbs and holds potentially harmful or toxic substances.
22. Suitable for all kinds of crops.
23. Reduces the chance of root burning from excess ammonia.
24. Improves ammonia retention and reduces nitrogen losses.
25. Increased aggregate stability.
26. Resistance to soil compaction.
27. Resistance to soil erosion.
28. Reduction of greenhouse gases by soil C sequestration.

Water and Nutrients Retention

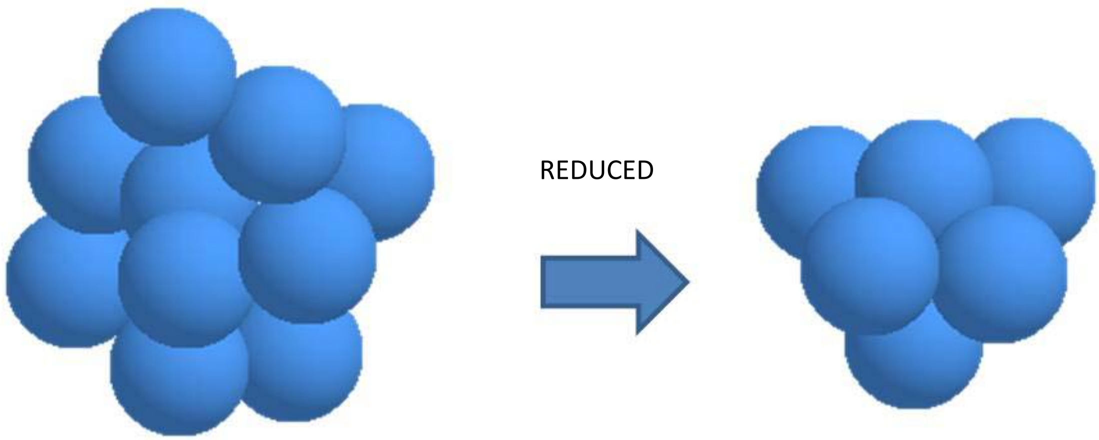


1. *Nanogel Soil Activator works at root level. It has to be mixed with the soil.*

2. *Nanogel Soil Activator is activated by watering the plant. The expanded Nanogel Soil Activator absorbs the water and fertilizers. The growth activators encourage root hair growth. These root hairs grow inside the expanded Nanogel Soil Activator and absorb the required amount of water and nutrients.*

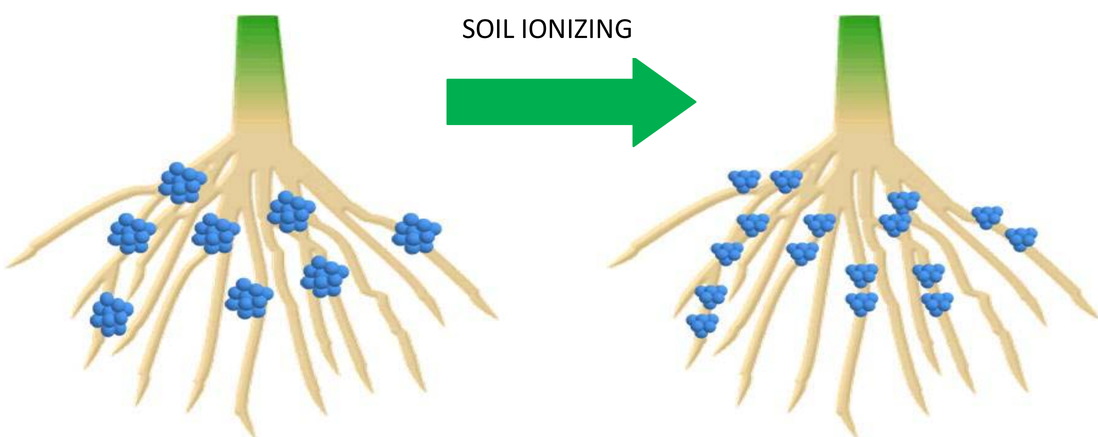
Breaking Water Clusters

Through Nanogel Soil Activator's ionizing technology, water not only gains an excess amount of electrons (e-), but the cluster of H_2O can be reduced in size from about 10 to 13 molecules per cluster to 5 to 6 molecules per cluster.



10 to 13 molecules per cluster

5 to 6 molecules per cluster

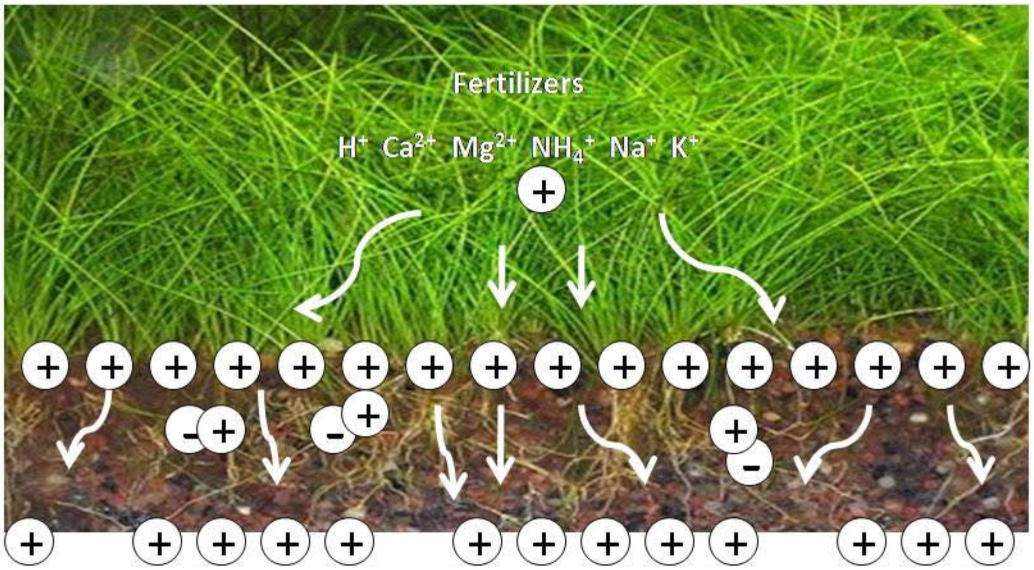


1. *Water clusters exposed and trapped in expanded Nano Soil Activator will be broken into smaller water clusters for easy and better absorption.*

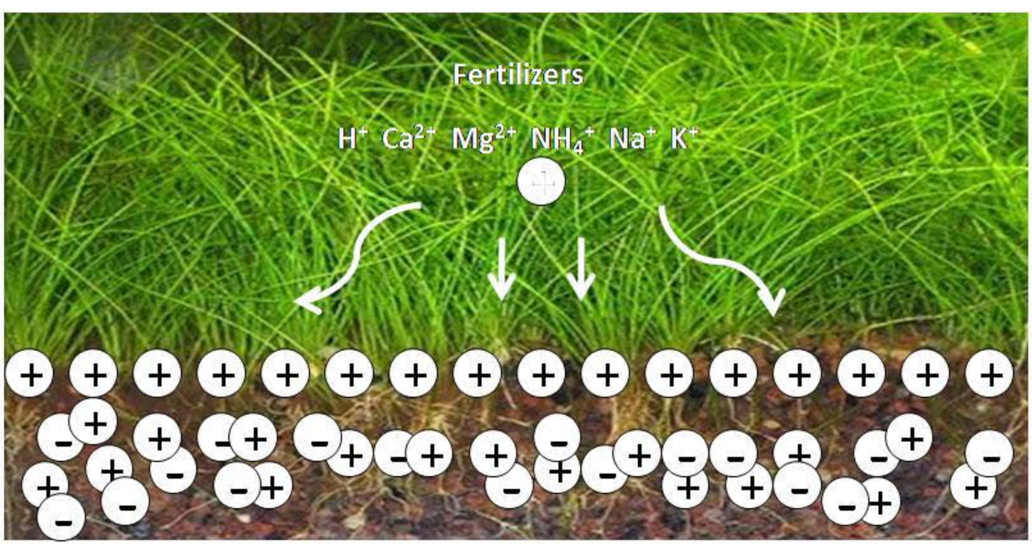
2. *Smaller water clusters stimulates root and plant growth, accelerates seed germination. It also improves soil fertility and its microbiological activity.*

Increase Cation Exchange Capacity (CEC)

BEFORE: *Sandy loam soil with low Cation Exchange Capacity.*



APPLICATION OF NANO SOIL ACTIVATOR IN SOIL



AFTER: *Sandy loam soil's CEC will increase tremendously resulting in big saving of fertilizers. It reduces the chance of root burning from excess ammonia.*

It also reduces soil salinization and migratory mobility of contaminants in the ionic form and their movement to ground waters and a zone of moisture evaporation.

Nanogel Soil Activator in Powder and Expanded Form

Powder

Expanded form

Application Rates

Plant Hole Size (cm x cm x cm)	Plant Hole Volume (liter)	Nanogel Soil Activator Volume (gram)
10 x 10 x 10	1	1.2
20 x 20 x 20	12	14.4
30 x 30 x 30	27	32.4
40 x 40 x 40	64	76.8
50 x 50 x 50	125	150
60 x 60 x 60	216	259.2
70 x 70 x 70	343	411.6
80 x 80 x 80	512	614.4
90 x 90 x 90	729	874.8
100 x 100 x 100	1,000	1,200
150 x 150 x 150	3,370	4,044
200 x 200 x 200	8,000	9,600
250 x 250 x 250	15,625	18,750
300 x 300 x 300	27,000	32,400

Application Methods

Transplanting a tree: Six Important Steps

Step 1: *Dig a hole of two times of the diameter of the root ball. Keep a small amount of soil for later use in step 5.*

Step 2: *Add Nanogel Soil Activator (NSA) to soil taken from the hole and mix well at the recommended rate.*

Step 3: *Fill ¼ of the hole with NSA-soil mixture. Place the tree in the middle of the hole in straight position.*

Step 4: *Fill with rest of NSA-soil mixture slightly higher than the top of the root ball.*

Step 5: *Apply the soil set apart earlier as a mulch layer, creating a concave shape to trap available water.*

Step 6: *Water the mulch layer thoroughly until the concave shape overflow with water.*

Soil Preparation with Nanogel Soil Activator

Flat Condition: *Lawn*

Apply NSA to surface at recommended rate with a fertilizer spreader or mix off-site with growing medium and apply this to surface.

Slopes Condition: *Lawn*

Apply NSA to surface at recommended rate with manual sprinkling or mix off-site with growing medium and apply this to surface.

Raised Beds: *Flowers, vegetables or shrubs*

Mix into the root zone to a depth of 20 cm (8 in.) with a rotovator, rotary hoe or rototiller, across the length and width of the area.

Slope Condition: *Flowers, vegetables or shrubs*

Use a hoe to incorporate the product into the soil at a depth of 20 cm (8 in.).

Nano Soil Activator

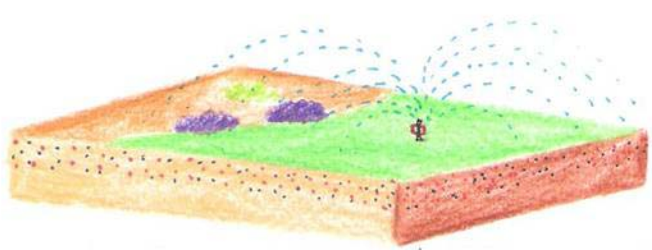
Planting or Seedling

Step 1:

Soil preparation for planting or seedling.

Step 2:

Planting or seedling.



Step 3:

Water thoroughly.

Nanogel Soil Activator

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