SUPERGREEN®
Nanocalcium

100 % Natural CO_2 fertilizer "Made in Europe"
Suitable for use in organic farming in the European Community and in the United States

- Improves crop yields, quality and storage properties
- Accelerates growth and intensifies green coloration
- Increases resistance, growth and vitality
- Increases plant stability, frost and drought tolerance and pest resistance
- Enhances the supply of essential trace elements to the plants
- Reduces the water requirement

SUPERGREEN® - Innovation in agriculture

SUPERGREEN® natural CO_2 foliar fertilizer for outdoor use is a top-quality nanotechnological product created by High-Tech-milling-activation and micronization. Highly energized SUPERGREEN® particles, sprayed finely onto the leaf surface, are taken up directly through the stomata and converted into carbon dioxide. In this way Supergreen® can considerably increase the photosynthesis rate, since the essential factor limiting photosynthesis outdoors is the natural CO_2 content of the air. This leads to yield increases , accompanied by a reduced water requirement , since with SUPERGREEN® the plants are able to keep the stomata closed longer in case of water stress. In addition, the micronutrients also contained in the product and the trace elements that influence plant physiology, such as manganese, copper, zinc etc., increase the resistance, growth, vitality and general quality of the crop.

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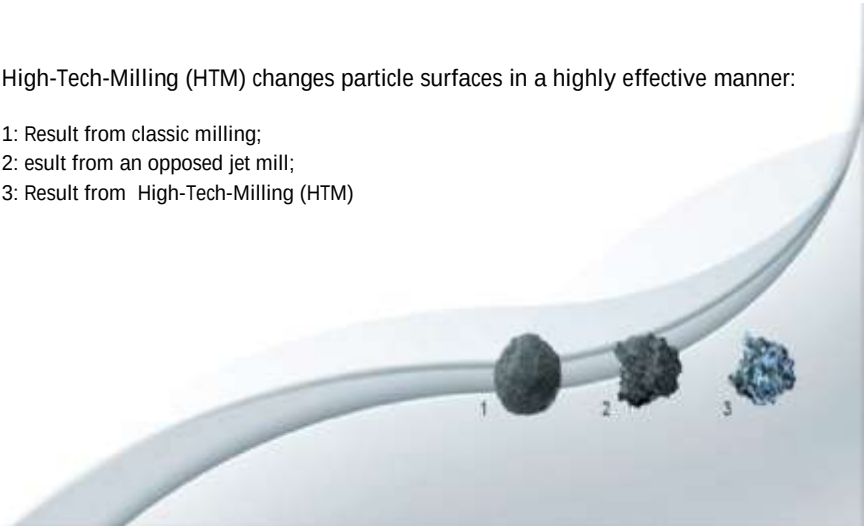
- Increases plant stability, frost and drought tolerance and pest resistance
- Enhances the supply of essential trace elements to the plants
- Reduces the water requirement
- Not suitable for plants preferring an acid soil

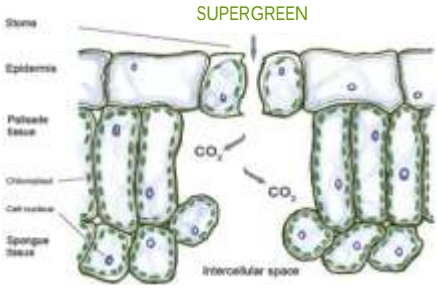
High-Tech-Milling (HTM) changes particle surfaces in a highly effective manner:

1: Result from classic milling;
2: esult from an opposed jet mill;
3: Result from High-Tech-Milling (HTM)



SUPERGREEN® - The direct effect

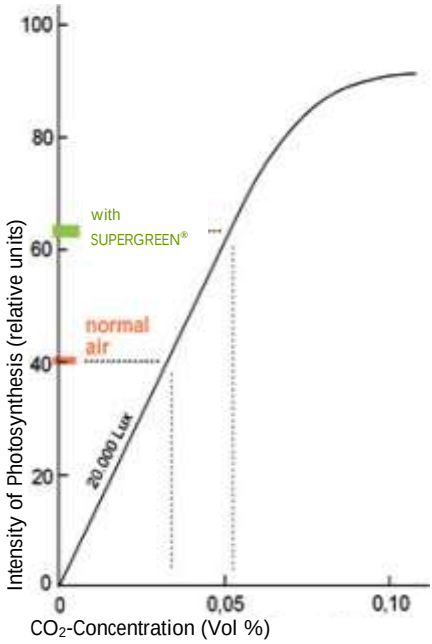
SUPERGREEN® is the first CO_2 foliar fertilizer that can be used successfully outdoors as well as under glass. It consists of calcium carbonate supplemented by numerous important micro-nutrients. Most SUPERGREEN® particles are so small (< 10 µm) that they can be absorbed directly through the stomata of the plant's foliage. Inside the leaves, the SUPERGREEN® particles break down and release CO_2 in particular, but also other substances as well. The low CO_2 content of normal air (0.04 vol.%) means that most cultivated plants fail to achieve an optimum level of photosynthesis. Assuming that temperature conditions are favorable and there is a sufficient supply of nutrients and water, the maximum level of photosynthesis is achieved at around 0.1 vol.% CO_2. The use of the SUPERGREEN® CO_2 can thus improve the photosynthesis performance. In addition, the effect is further enhanced by the micronutrients contained in SUPERGREEN®. It has long been known that CO_2 acts like a fertilizer on crops cultivated under glass, and it is being used successfully in that way with convincing results.



Crosssection of a leaf. SUPERGREEN® enters the Stoma.

Effects of improved CO_2 supply

The other ingredients contained in SUPERGREEN® are required for essential biochemical functions in plant metabolism (calcium: important in metabolism and for cell walls; magnesium: an important component of chlorophyll; manganese: cofactor of enzymes and participation in oxygen development in photosystem II; zinc: cofactor of enzymes; copper: component of enzymes and a redox catalyst; cobalt: cofactor in the symbiotic fixation of molecular nitrogen).



SUPERGREEN® Better growth - less deseases

SUPERGREEN® brings about a clear enhancement of performance of many plants, which is demonstrated in particular by more rapid growth, higher yields, and in many cases also by a lower water requirement and improved general vitality. Particularly remarkable in addition is the reduction that has repeatedly been observed in the susceptibility of plants strengthened with SUPER-GREEN® to fungal diseases (leaf rust, mildew, false mildew, fruit rot, leaf rot etc.). See the below list of direct effects on plants by doubling CO_2.

Parameter	Direct effect of doubling CO_2
Photosynthesis rate	Substantial in the case of C3 plants; C4 Plants show hardly any improvement.
Stomatal opening	Reduced with C3 and C4 plants
Water use efficiency	Increased with C3 and C4 plants
Leaf surface	Increased more with C3 plants than with C4 plants
Flowering	Accelerated with C3 and C4 plants
Maturity of plant	Earlier flowering of C3 and C4 plants
Dry mass production and yield	Substantially increased with C3 plants (up to 30 % and more), C4 plants show hardly any improvements
Differences in plant reaction	Clear differences between C3 and C4 plants. Differences between varieties possible.
Drought stress	Plants less susceptible to water stress

From: KRUPA, S.V. and KRICKERT, R.N. (1993) The Greenhouse Effect—The Impacts of Carbon Dioxide (CO2), Ultraviolet-B (UV-B) Radiation and Ozone (O3) on Vegetation (Crops). Vegetatio 104: 223-238

C3 plants

Typical representatives of this category are cultivated plants of the temperate zones such as wheat, barley, rice, soya, potatoes, lettuce, vegetables and fruit-trees. With this type of metabolism the natural CO_2 concentration is too low for optimum photosynthesis. In addition, the process called photorespiration interferes with photosynthesis. SUPER-GREEN® can thus exert its full effect.

C4 plants

Typical representatives of this category are plants cultivated in the sub-tropical or tropical zones such as millet, maize, cassava or sugarcane. All plants with this type of metabolism can photosynthesize effectively even if the CO2 concentration is low.

SUPERGREEN® Table of Contents

Calcium carbonate	79.19%
Silica	11.41%
Magnesium Carbonate	4.62%
Iron	1.31%
Alumina	0.97%
Sodium Oxide	0.55%
Sulphate	0.33%
Potassium Oxide	0.21%
Nitrogen	0.06%
Phosphate	0.01%
Manganese	0.014%
Zinc	0.005%
Copper	0.002%

SUPERGREEN® is harmless to humans and animals, not hazardous to water.

Suitable for use in organic farming according to Council Regulation (EEC) No. 2092/91 – European Community

The finer the fog the better the uptake of SUPERGREEN® by plants. Spraying in the morning until 9 AM latest and beginning afternoon from 5 PM on.

SUPERGREEN® - How it works

The most important function that takes place in plant is the **Photosynthesis**. Complicated physiochemical reactions take place in this process which are initiated by light absorption by means of the light sensitive chlorophylls in the leaves. Finally Carbon dioxide + water are converted into Carbohydrates + Oxygen.

Water exists in plant cells. Carbon dioxide is taken up from the atmosphere. The volume concentration of carbon dioxide in the atmosphere is 0.03 – 0.04 % which is far from that needed for optimum photosynthesis.

A natural stone that fulfils the requirements above

1) - must contain enough CO_2 in bond form and
2) - must be subjected to special treatment in order to set the CO_2 free in the plant.

Such natural stone is **limestone**, (Calcium, Magnesium) carbonate $(Ca,Mg)CO_3$ containing a number of minor elements (micro nutrients) important for plant physiology. The special treatment is a brandnew **High Tech Activation**.

What is that? And how can it be obtained?

Limestone is milled in High-tech- mills rotating with up to 20,000 revolutions per minute to SUPERGREEN®, a very fine powder of particle size mostly < 10µ.[1)] Most of the immense mechanical energy is converted into activation energy of the particles which manifested as:

1) Breaking of the chemical bonds between the crystal units in limestone

2) Deformation of the lattice in the upper layer of the particle as well as in further layers below.

3) Shifting of the electrostatic charges within the particle, so that the negative charges are concentrated on the surface and the positive ones inside the particle. This is the most important form of the Hi-Tech-Milling-activation (HTM).

How is CO2 set free from HTM-activated particles?

An aqueous suspension (60g-80g SUPERGREEN/20 liter) of such extreme fine powder is sprayed on the leaves. The Supergreen® particles penetrate due to their very small size through the stomata (breathing pores) into the intercellular compartment. The rest remains as thin layer on the leaf surface.

The mechanisms responsible for release CO_2 from the SUPERGREEN® are described as follows:

1) Release of CO_2 from the SUPERGREEN® in the intercellular compartment:

In the initial light reaction water is decomposed, where electrons (negative elementary charges) are taken away from water molecules converting them to oxygen and protons (positive charged hydrogen ions). The SUPERGREEN® particles dock with their negative charged surface on the cell membrane producing a negative electric potential which attracts the protons to pass the cell membrane and dock on the negative charged surface of the Carbonate groups forming intermediary carbonic acid which decomposes to CO_2 and H_2O. The equivalent amount of Ca_2+ and Mg_2+ ions partially migrate through the cell membrane and participate into the plant metabolism, partially react with water giving $(Ca,Mg)(OH)_2$ and Protons which react again with Carbonate giving CO_2 and so on.

2) Release of CO_2 from the SUPERGREEN® particles remaining on the leaves surface: At night the leaves are covered with dew water. At the same time the plants burn in darkness carbon hydrates to cover their energy need and produce $CO_2 + H_2O$. This carbon dioxide (in addition to that in the atmosphere) + H_2O (from the dew additionally to that produced) convert the carbonate in Supergreen® into hydrogencarbonate according to the thermodynamic equilibrium reaction:

$$(Ca,Mg)CO_3 + H_2O + CO_2 \leftrightarrow (Ca,Mg)(HCO_3)_2$$

The much more soluble (Ca,Mg) hydrogen carbonate particles penetrate partially through the stomata and set CO_2 free according to mechanism [2)].

During the day the temperature rises gradually and the equilibrium reaction above is shifted to the left hand side (due to evaporation of water) developing CO_2 from the hydrogen carbonate and forming (Ca,Mg) CO_3 back. In that way Supergreen® is acting as **quasi catalytic depot** supplying permanently CO_2at high concentration right at the leaves surface.

Which role does the High-Tech-activation play in mechanism[2)]?

The above equilibrium reaction is thermodynamically possible, but it needs an activation energy to take place, which is supplied from the activation energy of the SUPERGREEN® particles. The highly activated SUPERGREEN® particles change the structure of water and increase its dissociation: In pure water its dipoles normally exist as units of 9 molecules bond in tetrahedral structure by means of hydrogen bridges.

These dipoles dock with their positive hydrogen ends on the negative charged

surface of oxygen atoms in the carbonate groups of SUPERGREEN® particles. The hydrogen bonds break down due the resulted electrostatic interaction. The energy needed for that is supplied by means of energy fluctuation within the high active SUPERGREEN® particles. The electron density within the O – H bonds of the water dipoles is shifted toward the O- atoms, so that a dissociation of water molecules takes increasingly place. The H+ Ions then, dock on the negative charged carbonate groups of the SUPERGREEN® forming HCO_3- , The OH- ions react with CO_2forming HCO_3- as well. Of course the formation of HCO_3- is thermodynamically controlled by means of the equilibrium constant. However, the barrier of the formation energy is much easier overcome by means of this mechanism. The HTM-activation is acting as catalysis.

What is the effect of **SUPERGREEN®** on nitrogen fixation in plant?

The nitrogen fixation occurs primarily as nitrate reduction by means of the electrons produced in the water splitting reaction as a first step of the photosynthesis. In so far the nitrogen fixation could be regarded as dependent on the photosynthesis.

Which increase of the photosynthesis has been observed on using **SUPERGREEN®** as fertilizer?

An increase of the chlorophyll content and so of the photosynthesis by 33% has been experimentally observed when SUPERGREEN® is applied for instance on cotton (not under stress situation). In grapes (under stress situation) an increase of the maximum net assimilation rate of $CO_2$by more than factor 3 has been found. Furthermore, in general, a substantial enhancement of natural growth and so of yield increase have been obtained. The micro nutrients play sure an important role due to increase of the enzyme activities what could lead to an epigenetic effect.

Optimum effect of **SUPERGREEN®** on plants under stress situation, especially in case of minor water supply

Very probably this effect is due to the following: Normally plants react against water loss due to increasing transpiration in that they close their stomata. CO_2 uptake from the atmosphere is no more possible. First when the vapor pressure inside and outside the leaves, for instance due to dew formation, become equal, the stomata open again until the vapor pressure outside drops below that inside the leaves. Due to shortage of water and CO_2 the plant become wilt and stunted.

SUPERGREEN® Explanation of possible reasons of impact

This is counteracted by **SUPERGREEN®** as follows:

1) the stomata pores close faster due to the action of Ca_2+ ions that enhances the formation of the hormone ABA (Abscisic Acid) which transports the signal to the closing cell of the stomata. The depolarization of the membrane is probably playing also a role.

2) On closing the stomata the plant hold back the water necessary for the photosynthesis.

3) Despite closing the stomata, $CO_2$is supplied to the plant by means of SUPERGREEN® :

- A) According to mechanism 1) from inside the leaf as well as by means of penetration of the more soluble hydrogen carbonate particle at night[2)].
- B) According to mechanism 2) where the SUPERGREEN® film supplies theplants with concentrated CO_2right on the leaf surface.

4) Furthermore, enhance the micro nutrients the resistance of the plant against fungi.

1) An analysis study of the Technical University of Vienna shows, that the median size of SUPERGREEN® particles is 6 µm .

2) The stomata remain open as long as the osmotic pressure in the closing cells is higher than that in the neighboring cells of the Epidermis (constant 150 IB/in2). This value is normally reached after midnight.

SUPERGREEN® instructions for use

There are basically three different times at which SUPERGREEN® can be applied:

- at the beginning of foliation,
- at the time of flowering and
- during the period when the fruit is growing and ripening.

SUPERGREEN® may be used once or several times, (the more the better) at most every 10 - 15 days, separately or in combination with a plant protection agent. NEVER USE SUPERGREEN® in combination with a Herbicide.

Dosage: 60-80 g on 20 liter of water. Apply up to 60 Liter on 1 Rai of land (6 Rai = 1 ha). 60 gram = 3 Chinese soup spoons, 80 g = 4 spoons. It should be applied using any commercially available agricultural sprayer like Kapsack.

SPRAY FINEST FOG POSSIBLE. **Try to reach the bottomside of the leaves, there are the most stomata.**

Recommended application (DO NOT OVERDOSE):

Sugar Cane:

Between the 4th and 6th leaf and the 10 leaf stage. Then every 2 months until the plant is aged 180 days. Dose: 60-80 g on 20 l water. 60-80 liter on 1 Rai. Estimated result: Increase of BRIX of about 2 to 4 points.

Cassava:

Soak the sticks 1 night in a Supergreen solution (100 gram on 100 liter water), then plant the sticks. First application at the 10-leaf stage. You can apply Supergeeen every 4 weeks - 60 g on 20 liter of water.

Rice:

After soaking the rice seeds pour a Supergreen solution over the seeds (they are usually in bags). Then sow the seeds. First application after 21-28 days. Then every 2-3 weeks. The often the better. Keep the spraying nozzle deep so that the fog can apply to the lower side of the leaf.)

Potatoes

15 days after first foliation and again after a further 15 days. Spray in intervals of 15 days, apply 80b/20 liter, 60 liter for 1 Rai.

SUPERGREEN® Instructions for use

Maize

Between the 4th and 6th leaf and at the 10-leaf stage 60-80 g/20 l water. Then every 14 days 60-80 g/20 l water.

Salad crops & vegetables, beans, Peas

First application with the bedding out, thereafter twice more at 15 day intervals. 60g-80g/20 l of water.

Lemon, Limes, Oranges, Lemon leaves

3 - 5 applications starting 2 months before flowering. Spray until the fruits are appearing, spray these fruits as well as the leaves. Spray 80g/20 l.

Tomatoes, Cucumbers, Melons, Pumpkin

3 to 5 and more applications at intervals of 15 days, commencing with the second leaf or the bedding out. Spray 80 g/20 l water, 60 l/Rai.

Rubber Trees

Spray the surface around the stem or the Rubber tree (radius about 3 m) and spray the stem up to 4-5 m every 2 weeks with a dilution of 80g/20 l.

Fruit farming

3 - 5 or more applications starting 2 months before flowering. Spray in intervals of 15 days until the fruits are appearing, spray these fruits as well as the leaves. Spray 80g/20 l.

SUPERGREEN® makes the difference

Tests on Limes: *NO SUPERGREEN® applied.*

SUPERGREEN® 3 applications 60g/20l applied.

Tests on Hom Mali: *NO SUPER-GREEN® applied.*

SUPERGREEN® 3 applications 60g/20l applied

Tests on Pepper: NO SUPERGREEN® applied.

SUPERGREEN® 3 applications 60g/20l

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