STOCKOSORB®
for Water and Soil Management in Agriculture and Horticulture
- your key to improving yield and quality
STOCKOSORB® improves water use efficiency and soil structure

The ever-expanding global demand for water, combined with the impacts of climate change, is already making water scarcity a reality in many parts of the world. While we are approaching the limit of the available clean water supply, there will be an increasing competition for water. Economically speaking, this implies a shortage as well as higher water costs.

Water and nutrients are essential for plant growth and development. Drought stress is one of the major limiting factors that affect crop and fruit growth and productivity. Plant productivity is often also limited by adverse physical and chemical soil properties, such as reduced macro-pore space, resulting in low soil aeration, low infiltration rates as well as low water retention and low cation exchange capacity. In industrial agriculture, soil compaction from heavy machinery may even aggravate the situation.

All these factors affect the biological activity of the soil, root growth, plant moisture and nutrient supply, resulting in low yield quantity and quality. Additionally, under heavy rainfall conditions, low water infiltration causes high surface runoff and amplified soil erosion. The water and nutrient holding capacity of sandy and permeable soils, in particular, are extremely limited. These soil types are characterized by excessive drainage of rain and irrigation water, as well as plant nutrients leaching below the root zone. This leads to inefficient water and fertilizer use by crops. These conditions are intensified in shallow-rooted crops or when irrigation water or irrigation systems are missing.

STOCKOSORB® description
STOCKOSORB® is a soil conditioner specially designed and developed for water and nutrient retention and release in substrates and soils. Upon contact with water, STOCKOSORB® swells quickly, creating a hydrogel by absorbing and retaining large quantities of plant available water. Fertilizer leaching can thus be reduced. During the soil drying process, both water and water-soluble nutrients are released to the plant in a uniform manner.

STOCKOSORB® components
STOCKOSORB® is a highly cross-linked water insoluble superabsorbent anionic polymer that is partially neutralized with potassium. STOCKOSORB® 500 is a copolymer containing acrylic acid, acrylamide and potassium. STOCKOSORB® 660 is a homo-polymer based on acrylic acid potassium. The latter does not contain any acrylamide. These soil conditioners are available as white, dry and solid granulate with different particle sizes and with excellent water absorption power. Different particle sizes are used for application to different soil textures.

STOCKOSORB® mode of action
After swelling to a hydrogel, STOCKOSORB® acts as a reservoir of water that is available to plants on demand. The higher water availability helps to avoid water stress during longer periods of drought. During the water release phase of the hydrogel, free pore volume will be created within the soil, offering additional space for root growth and air and water infiltration and storage. STOCKOSORB® also strongly resists soil pressure at high soil depth without losing its swelling capacity.

STOCKOSORB® improves the water retention capacity, aeration balance and structure of soils, substrates and potting mixes. Consequently, water is stored in the root zone so that water and plant nutrient losses due to deep percolation and nutrient leaching can be avoided. In this way water and nutrients are available to the plant over a longer period of time. This allows stronger and healthier plant growth also under hot and dry climate conditions and therefore increases the safety margin and yield potential in plant production. STOCKOSORB® is a technology for lasting improvement in the efficiency of water and soil management in agriculture and horticulture.
STOCKOSORB® product specific characteristics

In plant and fruit production, water availability to the roots constitutes one of the major limiting factors of plant growth and crop productivity, especially in arid and semi-arid regions, where drought is the most important biotic stress factor. Drought stress not only affects plant growth and yield quantity but also crop health and yield quality. STOCKOSORB® added to soil and growing media acts as a water reservoir for optimum crop yield, and preserves and restores soil structure.

**Application in soils, substrates or potting mixes**

- **Is a polymer with high water absorption capacity**
  - STOCKOSORB® quickly absorbs and stores tap water (1.3 mmol/l CaCO₃) equivalent to more than 180 times its own weight.

- **Has a long lasting performance also under soil pressure**
  - STOCKOSORB® performs its wetting/drying cycles over a long period of time, maintaining its very high water swelling and releasing capacity even against soil pressure.

- **Improves soil structure**
  - STOCKOSORB® creates within the soil, free pore volume offering additional space for air and water infiltration, storage and root growth.

- **Reduces surface runoff and soil erosion**
  - STOCKOSORB® reduces surface runoff by increasing soil porosity and soil permeability.
  - This achieved higher water infiltration rate will enhance the ability of the top soil to resist erosion and improve water supply to the lower soil layers.

- **Increases the plant available water of most soils and reduces fertilizer leaching into ground water**
  - STOCKOSORB® enhances plant available water (PAW) and nutrients (PAN) by absorbing and retaining water and water soluble nutrients in the root zone. Water loss due to excessive percolation and evapotranspiration, as well as nutrient loss due to fertilizer leaching can therefore be minimized.

- **Activates sustainable root growth**
  - The fast growth of the root mass to moist areas leads to an increased ability for water and nutrient uptake. STOCKOSORB® the plant will survive dry spells for a longer period of time without stress or irreversible damage.

- **Enhances crop water use efficiency and allows the reduction of the standard irrigation frequency as well as the corresponding water costs**
  - By applying STOCKOSORB®, water is stored in the macro-pore area. Water and nutrients which normally drain away are retained in the root zone and are now readily available to plants for a longer period of time so that irrigation intervals can be extended, generating substantial water cost savings.

- **Improves seedling survival and establishment as well as early plant growth**
  - STOCKOSORB® provides optimal and constant moisture conditions to the young seedling during transplanting and establishment. High survival rates followed by enhanced early growth after establishment are the result.

- **Improves yield quantity and quality**
  - STOCKOSORB® provides a continuously available water reservoir, just where the plant needs it – in the root zone. With a more consistent moisture supply, constant and balanced plant growth will be achieved so that the yield potential of soils and potting mixes can be fully exploited. In rain-fed agriculture this can lead to faster plant growth and thus faster maturity. Earlier market access ensures the best price for seasonal crops, vegetables and fruits.

- **Is non-toxic, environmentally safe and degradable**
  - STOCKOSORB® is safe for humans and the environment, is not persistent and will not pollute soil, surface and ground water. After a period of time, the polymer is susceptible to natural degradation processes in the soil by physical and microbial activities. After solubilisation and mineralization the polymer will break down into nonhazardous compounds, such as potassium salts, carbon dioxide and water. The polymer will be fully integrated into soil biosphere without any negative effects of residuals on the plants, soil and soil borne microorganisms or on groundwater.

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**Seed-coating**

STOCKOSORB® improves seedling survival and establishment as well as early plant growth

Once germination has started, seed coating with STOCKOSORB® can increase the amount of available water and oxygen, which are necessary for an efficient seed reserve mobilization into the seedling. This can create the best possible conditions during germination and crop establishment, especially when unreliable rainfall early in the season leads to drought stress.

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**Bare root-dipping**

STOCKOSORB® improves seedling survival and establishment

The transport of seedlings to the field and during transplanting is a very crucial time for bare-root transplants. Exposing the roots to direct sunlight and temperatures of 68 °F (+ 20 °C) for even 20 or 30 seconds will kill the fine root hairs that absorb water and nutrients. Root-dipping with STOCKOSORB® keeps the fine root hairs from drying out so that seedling survival and fast establishment are ensured.
**STOCKOSORB® performance parameters**

**Outstanding water absorption capacity**

Water absorption capacity of STOCKOSORB® is determined by water quality and soil types. With distilled water even higher absorption capacities can be achieved. However, this is not relevant for soil application. Thus, water holding capacity in a soil or soil substrate varies around 70–120 times its weight.

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**Absorption capacity and quick rewetting ability after drying out**

STOCKOSORB® maintains its ability to continuously absorb and release water over a period of several years. A particular feature of STOCKOSORB® is very quick rewetting ability, even after complete dehydration.

More water is stored, wilting point is delayed

After 40 days without irrigation, the sandy soil contained 1 liter (0.26 gal.) of water, whereas, the soil treated with STOCKOSORB® contained 1 liter (0.26 gal.) of water after 80 days. The soil moisture potential is kept for a longer period of time at a higher level, resulting in less drought stress for the plants. Because a sandy soil amended with 3 grams of STOCKOSORB® per liter of soil (0.4 oz./gal.) holds water twice as long as untreated soil, irrigation frequency can be reduced by up to 50%.

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**Water content in a sandy soil, 40 and 80 days after last watering**

<table>
<thead>
<tr>
<th>Liter</th>
<th>Days after last irrigation</th>
</tr>
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<tbody>
<tr>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>1</td>
<td>50</td>
</tr>
</tbody>
</table>

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**Absorption capacity of STOCKOSORB® after numerous wet/dry cycles in deionised water**

% after 50 cycles: the absorption is still 88.5%
Soil run off and erosion control

STOCKOSORB® reduces soil compaction and thereby increases the infiltration rate of water into the soil. If rainwater infiltrates the soil quickly, less water runs off and less top soil will be eroded.

<table>
<thead>
<tr>
<th>Surface water runoff</th>
<th>Soil erosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 g/m²</td>
<td>Control</td>
</tr>
<tr>
<td>5 g/m²</td>
<td>Control</td>
</tr>
<tr>
<td>10 g/m²</td>
<td>Control</td>
</tr>
<tr>
<td>15 g/m²</td>
<td>Control</td>
</tr>
<tr>
<td>20 g/m²</td>
<td>Control</td>
</tr>
</tbody>
</table>

Water losses by surface runoff at a slope of 20°: Precipitation: 30 mm/h for 20 minutes

Soil erosion on a slope of 120°: Precipitation: 30 mm/h for 20 minutes (3 g/l = 0.4 oz./gal.)

Yield and quality increase in tomato production

Tomato is a high value crop which is very sensitive to water stress. During a field trial conducted in Florida, tomato production on an untreated soil was compared with tomatoes grown in a soil where STOCKOSORB® was banded in the tomato bed at a rate of 20 lbs. per acre (22.42 kg/ha) and incorporated into the top 6 in. (15 cm) of the soil. As a result, the tomato yield was increased by 12.91%. In addition, the proportion of large and extra large size grades was substantially increased. This yield increase would have resulted in a gross margin increase of approx. $2,000 (USD) per acre (4,942 USD/ha) at an avg. tomato wholesale price of $0.51/lb. ($1.12 USD/kg) in 2008.

Yield and quality increase in potato production

In potato production, water stress can reduce dry matter accumulation especially during tuber initiation and mid-bulking. A field trial conducted in South Africa at the University of Free State in Bloemfontein with irrigation has shown that STOCKOSORB® application on a sandy loam at a rate of 26.5 lbs./acre (29.7 kg/ha) in the plant row, increased potato yield by 18.96%. The yield of large to medium marketable potatoes was increased by 24.91% (Grade 1). Similar positive effects could be achieved under rain-fed conditions.
Hydrogel injection with MTM BioLift Injector

VOGT Geo Tiller, a modified AMAZONE Rotary Cultivator equipped with a multi component dosing unit for dry granules

Mixing procedure with a concrete mixer

**STOCKOSORB® general application procedures**

The incorporation of STOCKOSORB® into the soil does not necessarily require product specific equipment. Common attachments normally used in soil tillage and planting operations may be adequate. STOCKOSORB® can be applied as a dry granule or in pre-hydrated gel form.

**Applied as dry granule alone or in combination with seed or fertilizer application**

- **Broadcast Application:** incorporate into the soil at a depth of 4–6 in. (10–15 cm) before sowing/planting or during basal fertilizer applications.
- **Banded Application:** apply in crop or plant furrows alone or blended with seed or dry bulk fertilizer by using a starter fertilizer row bander or a grain drill. (Grain drill applications can only be used in very low relative humidity environments). STOCKOSORB® 660 Powder can also be mixed with liquid starter fertilizer (see liquid fertilizer mixing guide). In addition to single-operation machines, STOCKOSORB® can also be applied with combined planters and tillage equipment (see the picture of a Rotary Cultivator below). Furthermore, STOCKOSORB® can be incorporated into the soil alone or blended with fertilizer by using starter fertilizer or side-dress application equipment.
- **Greenhouse Application:** mix into the plant media at a concentration of 1.7–5.0 lbs. per cubic yards (1–3 g/l or 3 g to 40 g) dry granules per tree or shrub transplant, depending on the species, root volume, transplant height and climate conditions. ⅔ of the recommended dosage is applied directly into the planting hole while the remaining ⅓ is mixed with the fill material. Leave a small part of untreated soil for the final soil coverage. Pack fill material firmly. Irrigate transplants until soil saturation. Individual transplanting situations and equipment will vary widely. Contact your EVONIK Sales Representative for individual use recommendations.
- **Application at Transplant:** mix with the soil extract or plant substrate. The total application rate can vary from 0.71–1.41 oz. (3 to 40 grams) dry granules per tree or shrub transplant, depending on the species, root volume, transplant height and climate conditions. ⅔ of the recommended dosage is applied directly into the planting hole while the remaining ⅓ is mixed with the fill material. Leave a small part of untreated soil for the final soil coverage. Pack fill material firmly. Irrigate transplants until soil saturation. Individual transplanting situations and equipment will vary widely. Contact your EVONIK Sales Representative for individual use recommendations.
- **Application on Established Trees-Shrubs-Vines-Ornamentals:** mix with the soil extract or plant substrate. The total application rate can vary from 0.71–1.41 oz. (3 to 40 grams) dry granules per tree or shrub transplant, depending on the species, root volume, transplant height and climate conditions. Use a single pneumatic system; the third type of lance uses a system combining a pneumatic and a hydraulic device. All three lances use the same method of operation. First, a jack hammer mechanism enables the lance to penetrate hard soils at precisely targeted depths ranging from 6–48 in. (15–120 cm) without damaging the roots. Second, the injector pulses pressurized air into the soil in order to create cracks and free space. Finally, the hydrogel is injected into the newly created space. The total application rate can vary between 2.82–14.11 oz. (80–400 g) dry granulate per plant.

**Applied in pre-hydrated form during transplanting & on established trees-shrubs-vines-ornamentals**

- **Pre-hydrated STOCKOSORB®** is made by adding STOCKOSORB® to water and stirring it slowly. You could also add the product to a water stream when filling the nurse tank. After a swelling time of approx. 30 min. (subject to water temperature), the gel is ready to be used. The recommended water mixture ratio ranges from HC 60 (2.2 lbs. STOCKOSORB® for every 16 gal. of clear water) up to HC 601 (2.2 pounds STOCKOSORB® for every 300 gal. of clear water).
- **Application on Established Trees-Shrubs-Vines-Ornamentals:** apply pre-hydrated STOCKOSORB® in the root zone with a MTM, AIRITECH or VOGT Lance-Injector. The first two types of lances use a single pneumatic system; the third type of lance uses a system combining a pneumatic and a hydraulic device. All three lances use the same method of operation. First, a jack hammer mechanism enables the lance to penetrate hard soils at precisely targeted depths ranging from 6–48 in. (15–120 cm) without damaging the roots. Second, the injector pulses pressurized air into the soil in order to create cracks and free space. Finally, the hydrogel is injected into the newly created space. The total application rate can vary between 2.82–14.11 oz. (80–400 g) dry granulate per plant.

**STOCKOSORB® product and equipment handling**

Before feeding STOCKOSORB® granules into the hopper, the equipment should be dry. During product application it is fundamental to keep moisture away from STOCKOSORB®, otherwise the dry granules will create a hydrogel. This is also true for application equipment. The hydrogel can cause plugging in any contact area. After final usage, clean out all granules from the hopper and metering devices with compressed air. For thorough cleaning, check all screens, nozzles and tubes. Store the applicator in a dry place. Store the product in a dry place until application. STOCKOSORB® is classified as a mild irritant, so wear gloves and protective eyewear during handling.

For complete handling instructions, see the product labels or consult an EVONIK Sales Representative.
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For more detailed information or to obtain more detailed technical information, please contact the Evonik office in Germany or US or contact your local representative.

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