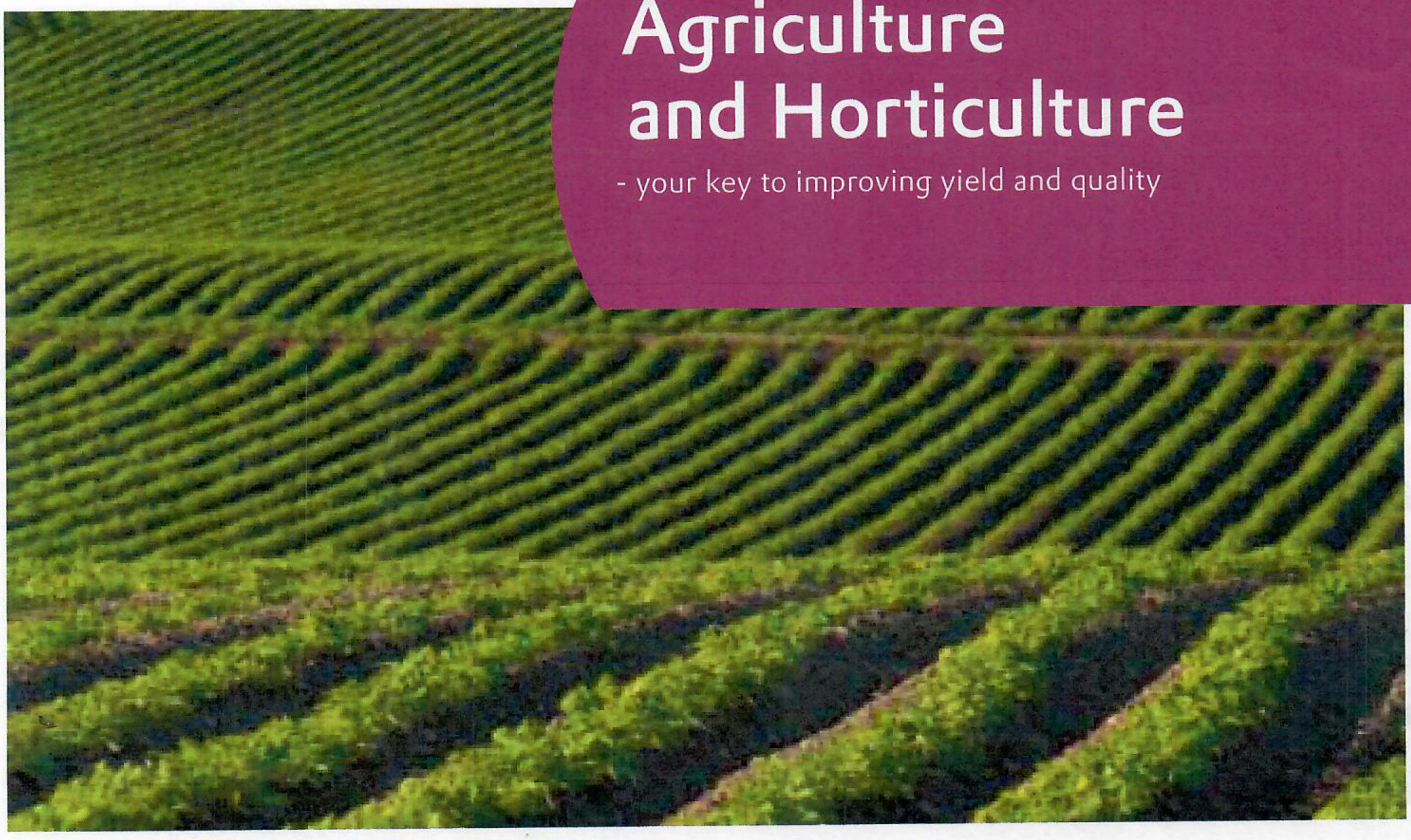
Greener Solutions Int'l
PO Box 1373
Hebron, CT 06248
860-368-7309

EVONIK INDUSTRIES

Agriculture and Horticulture

- your key to improving yield and quality



STOCKOSORB®
water + soil management

Evonik. Power to create.

... your key to optimizing yield and quality

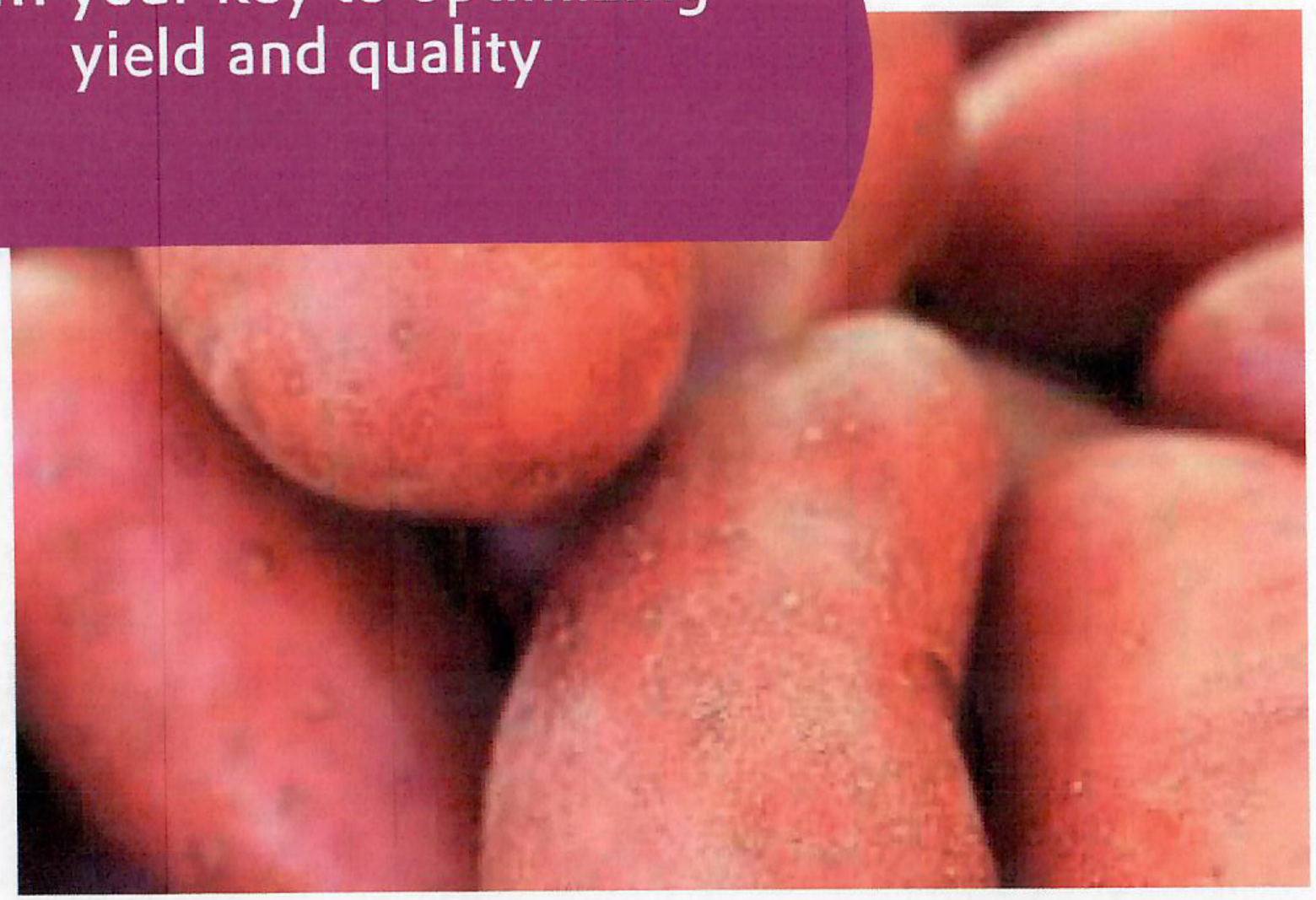


Table of Contents

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.

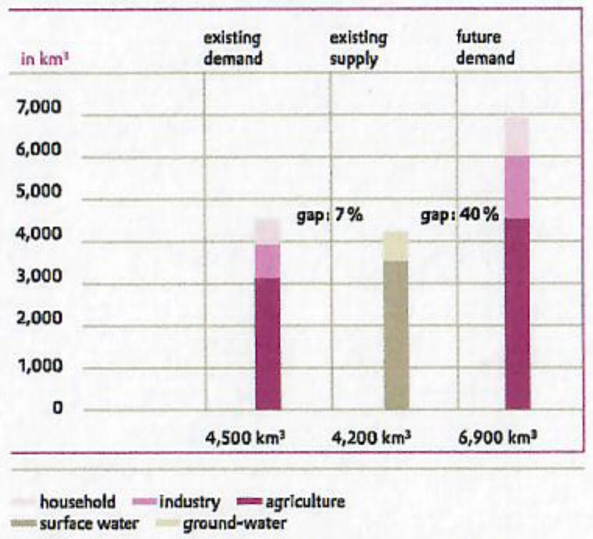
Water and nutrients are essential for plant growth and development. Drought stress is one of the major limiting factors that affect crop and fruit growth and productivity.

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.

Until 2030 a water gap of 40 % will arise



Source: Water 2030 Global Water Supply and Demand model; agricultural production based on IFPRI IMPACT-WATER base case.

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.

Aggregated global gap between existing accessible, reliable water supply[1] and 2030 water withdrawals, assuming no efficiency gains

in billion m³	Total	Agriculture	Industrial	Domestic
2010 existing water withdrawals[2]	4,500	3,100	800	600
2030 water withdrawals[3]	6,900	4,500	1,500	900
		Surface water	Ground-water	
Existing acessible, reliable, sustainable water supply[1]	4,200	3,500	700	
Water gap between 2010 water withdrawals & existing supply:	300			
Water gap:	–7 %			
Water gap between 2030 water withdrawals & existing supply:	2,700			
Total Water gap	2,700			
Water gap:	40 %			

[1] Existing supply which can be provided at 90 % reliability, based on historical hydrology and infrastructure investments scheduled through 2010; net of environmental requirements
[2] Based on the 2010 agricultural production analyses from IFPRI
[3] Based on GDP, population projection and agricultural production from IFPRI; considers no water productivity gains between 2005–2030.

Source: Water 2030 Global Water Supply and Demand model; agricultural production based on IFPRI IMPACT-WATER base case.

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 in water absorbed nutrients are released to the plant in a uniform manner.

STOCKOSORB® components

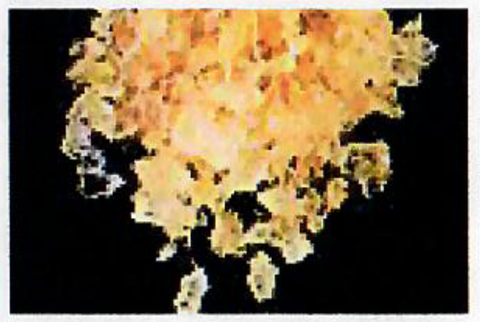
STOCKOSORB® is highly cross-linked water insoluble superabsorbent anionic polymer partially potassium neutralised. STOCKOSORB® 500 is a copolymer containing acrylic acid, acrylamide and Potassium. STOCKOSORB® 660 is a homo-polymer based on acrylic acid and Potassium. The latter does not contain any acrylamide. 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 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 releasing 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®
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.

STOCKOSORB® application in soils, substrates or potting mixes

STOCKOSORB® is a polymer with a high water absorption capacity

STOCKOSORB® quickly absorbs and stores soil water equivalent to more than 70 times its own weight. During the natural drying cycle of the soil the hydrogel will release water to the plant.

STOCKOSORB® has a long lasting performance also under soil pressure

STOCKOSORB® performs its wetting/dying cycles over a long period of time, maintaining its very high water swelling and releasing capacity – also against soil pressure.

STOCKOSORB® improves soil structure

Due to the volume reduction as water is released to the plant, the STOCKOSORB® creates within the soil, free pore volume offering additional space for air and water infiltration, storage and root growth.

STOCKOSORB® 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 of the lower soil layers.

STOCKOSORB® 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.

STOCKOSORB® activates sustainable root growth

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

STOCKOSORB® 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.

STOCKOSORB® 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.

STOCKOSORB® improves yield quantity and yield 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 yielding.
Earlier market access ensures the best price for seasonal crops, vegetables and fruits.

STOCKOSORB® 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 in the end. 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 ground water.

STOCKOSORB® seed-coating

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

Once germination has started, seed coating with STOCKOSORB® can increases 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.

STOCKOSORB® 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 hair 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. Thus, water holding capacity in a soil or soil substrate varies around 70–120 times its weight.

Absorption capacity and quick rewetting ability after drying out

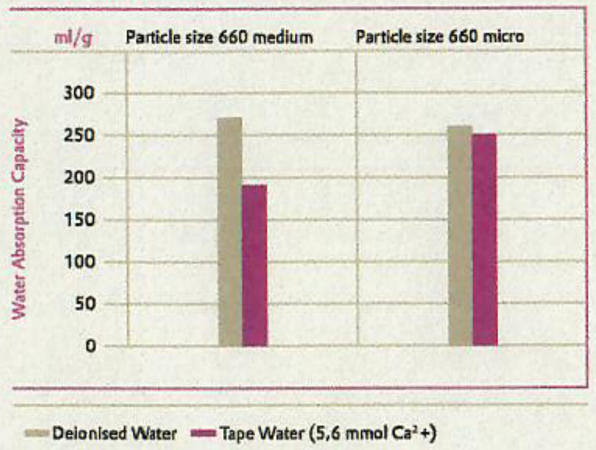
STOCKOSORB® maintains its ability to continuously absorb and release water over a period of several years. A particular feature of STOCKOSORB® is very quick rewetting ability, even after complete dehydration.

Soil run off and erosion control

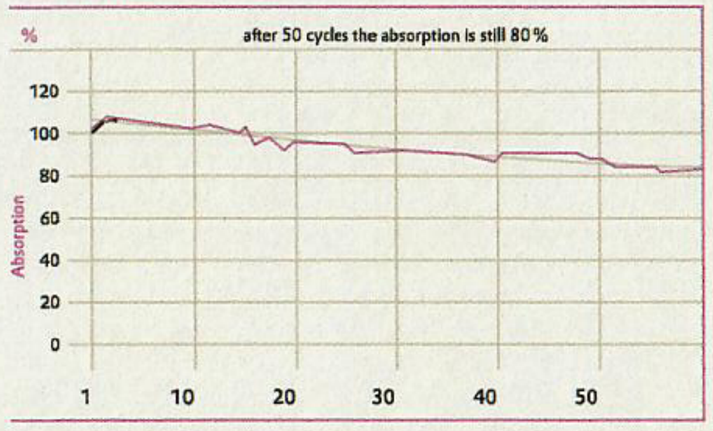
STOCKOSORB® reduces soil compaction and thereby increases the infiltration rate of water into the soil. If rainwater infiltrates the soil quickly, less water runs off and less top soil will be eroded.

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.

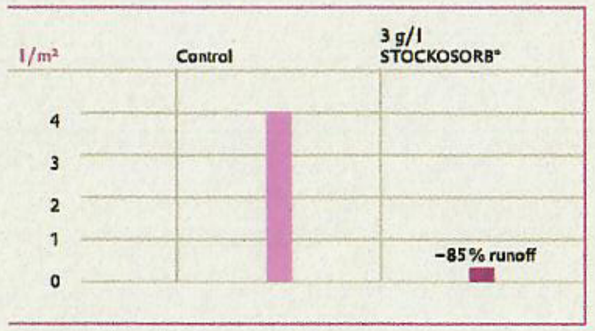
Water Absorption Capacity of STOCKOSORB® 660 with Deionised and Tape Water



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

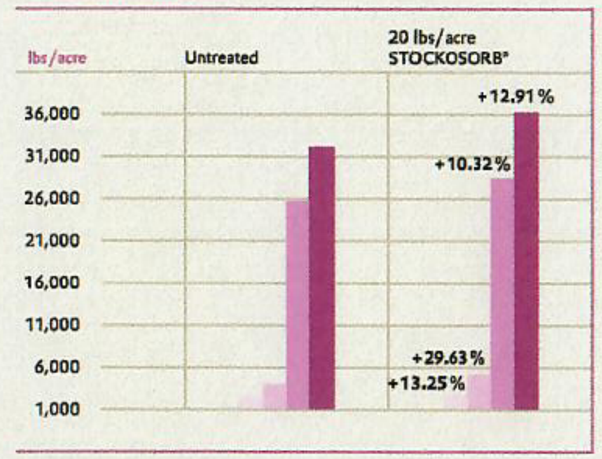


Surface water runoff

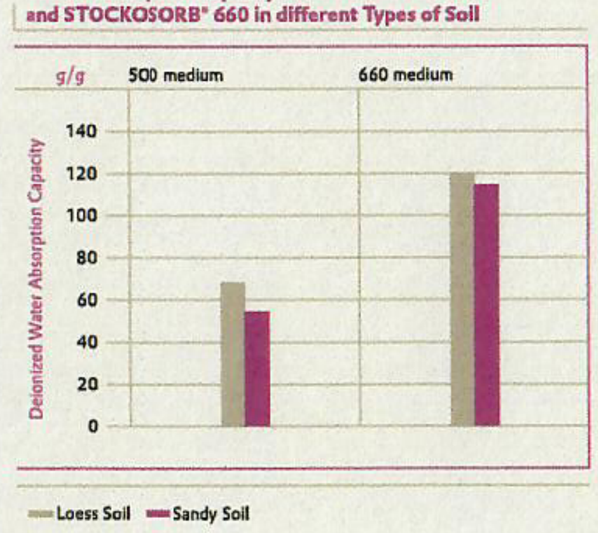


Water losses by surface runoff at a slope of 20°; Precipitation: 30 mm/h for 20 minutes

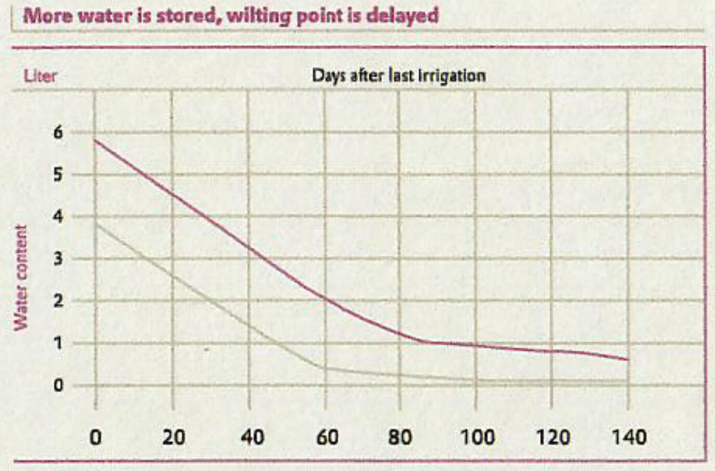
Tomato Yield Increase



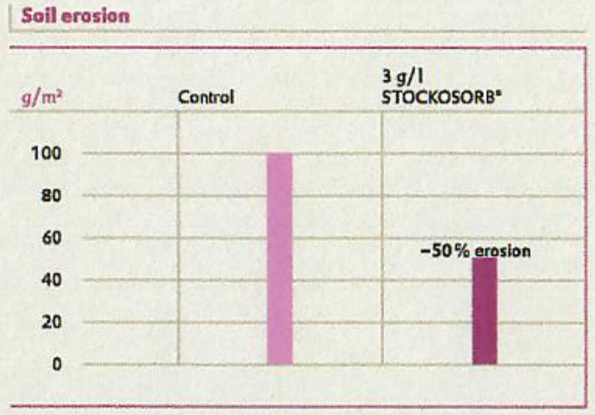
Water Absorption Capacity of STOCKOSORB® 500 and STOCKOSORB® 660 in different Types of Soil



More water is stored, wilting point is delayed

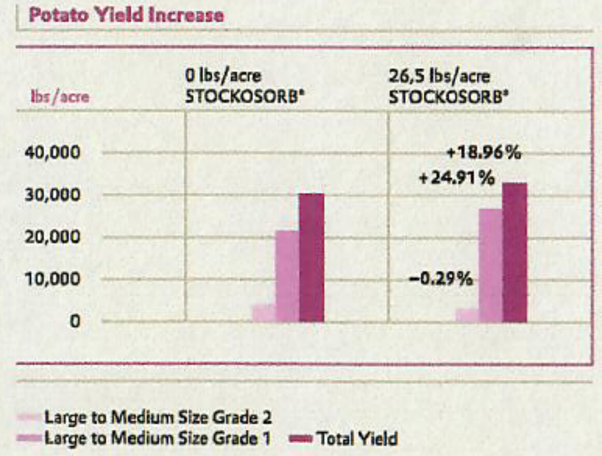


Soil erosion



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

Potato Yield Increase



After 40 days without irrigation, the sandy soil contained 1 liter **(0.2642 gal.)** of water, whereas, the soil treated with STOCKOSORB® contained 1 liter **(0.2642 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 %.

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 tomato 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.

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 con ducted in South Africa at the University of Free State in Bloemfontein under 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.

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.

STOCKOSORB® applied as dry granule alone or in combination with seed or basal fertilizer application

- STOCKOSORB® Broadcast Application: **incorporate into the soil at a depth of 4–6 in. (10–15 cm) before sowing/planting or during basal fertilizer applications. When applied alone or when blended with dry bulk fertilizer, broadcast STOCKOSORB® with a fertilizer spreader. STOCKOSORB® can also be blended with organic fertilizer using a manure spreader. After the broadcast application, STOCKOSORB® needs to be properly mixed and incorporated into the soil at a recommended minimum depth of 4–6 in. (10–15 cm).**
- STOCKOSORB® 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.
- STOCKOSORB® Greenhouse Application: **mix into the plant media at a concentration of 1.7–5.0 lbs. per cubic yards (1–3 g/l or 1-3 kg/m³) of substrate before planting. Irrigate immediately after planting all the containers until soil saturation.**
- STOCKOSORB® Application at Transplant: **mix with the soil extract or plant substrate. The total application rate can vary from 0.11–1.41 oz.** (3 to 40 grams) dry granules per tree or shrub transplant, depending on the species, root volume, transplant height and climate conditions. ⅓ of the recommended dosage is applied directly into the planting hole while the remaining ⅔ 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 agronomic technical representative for individual use recommendations.**
- STOCKOSORB® Application on Established Trees-Vines-Ornamentals: **apply** in prehydrated gel form by using the AIRITECH or MTM Lance-Injector.

Application at Transplant

AMAZONE Rotary Cultivator equipped with a multi-component VOGT dosing unit.

STOCKOSORB® applied in pre-hydrated form during transplanting & on established trees-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) **=> (1 kg STOCKOSORB for every 60 l** of clear water) up to HC300 (2.2 pounds **STOCKOSORB® for 80 gal. of clear water) => (1 kg STOCKOSORB® for every 300 l of clear water)**
- For **transplanting** use pre-hydrated STOCKOSORB®, mix with the soil extract or plant substrate. The total application rate can vary from **0.11–1.41 oz.** (3 g to 40 g) dry granules per tree or shrub transplant, depending on the species, root volume, transplant height and climate conditions.
  ⅓ of the recommended dosage is applied directly into the planting hole while the remaining ⅔ 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.
- On **established trees-shrubs-vines-ornamentals** apply pre-hydrated STOCKOSORB® in the root zone with a AIRITECH or **MTM Lance-Injector.** This type of lance uses a new technology, combining a pneumatic and a hydraulic system. First the lance, which uses a jack hammer mechanism, penetrates hard soils at precisely targeted depths ranging from **6–48 in. (15–120 cm)** without damaging the roots. In the second step, 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 treevine-ornamental.

Slurry production

Transplanting

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.