

nanotern

SMART SUBSOIL WATER RESERVOIR

PRODUCT & TECHNOLOGY DOSSIER · SUPERABSORBENT POLYMER TECHNOLOGY

NANOTERN®

Smart subsoil water reservoir

Three product lines, two application routes. **Technology, patent family, product range, doses and field results in a single file.**

1,800 ×
water-holding capacity relative to dry weight

~50 days
slow release in the root zone per refill

up to 50%
saving in irrigation water

3 families
patent families protecting Nanotern directly · 6 publications

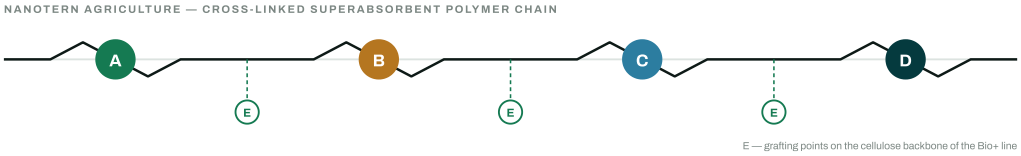
SCOPE

Nanotern Agriculture · Nanotern Bio+ Agriculture · Nanotern Landscape — granular (subsoil) and Aqua (liquid) forms

What is Nanotern? A water reservoir that works in the root zone

Nanotern is a cross-linked, three-dimensional polymer network that holds water **physically**. When the dry granule meets irrigation water or rainfall it swells, taking in water together with the nutrients dissolved in it; as the soil dries it returns that water to the root through an osmotic pressure difference, and refills at the next wetting. Superabsorbent polymers have existed for decades; what separates Nanotern is a chemistry **engineered for soil**.

POLYMER STRUCTURE & FUNCTIONAL MONOMER DESIGN — Four functional monomer groups — each group carries one job



MONOMER A · IONIC · K^+ SALT

Ultra swelling & rapid water uptake

Rapidly attracts water and drives high swelling capacity — the group that fills the reservoir.

up to 1,800×
dry-weight absorption

MONOMER B · MECHANICAL STRENGTH

Water retention & durability

Protects the gel structure under soil pressure and extends retention time through the charge cycle.

Soil-pressure resistant
gel structure that holds form

MONOMER C · SALINITY TOLERANCE

Salt-stress resistance

Protects swelling capacity in saline soils; retention performance is held under ionic load.

Retention held
works alongside fertilizer solutions

MONOMER D · CROSSLINKER

Flexibility & maximum loading

Builds the elastic 3D cross-linked network that enables maximum water absorption without rupture.

Flexible 3D network
repeated swell–release cycling

NANOTERN BIO+ — THE SAME CHAINS, ON A RENEWABLE CELLULOSE BACKBONE

The same functional chains, grafted onto a bio-based macromonomer backbone defined as **Monomer E**. Once the product has done its work it biodegrades through microbial activity in the very soil it served — leaving no persistent residue and no microplastic pathway.

The combination is the invention: absorption · stability · salinity tolerance · slow release.

3 PATENT FAMILIES · 6 PUBLICATIONS

WHERE DOES THE PATENTED TECHNOLOGY COME FROM? — University–industry collaboration, produced in its own plant

Academic foundation

Nanotern was developed in collaboration with **Sabancı University** and **SUNUM** — the Sabancı University Nanotechnology Research and Application Center, one of Türkiye's four National Research Infrastructures.

R&D campus

R&D is carried out on the **Sabancı University** and **SUNUM** infrastructure; formulation development and soil testing take place there.

Company office

The ANT Systems office is located in the Incubation Centre of the **TÜBİTAK Technology Development Zone** (Gebze / Kocaeli).

Manufacturing

Granular and liquid lines run in parallel at ANT Systems' own facility in the **Chemists' Organised Industrial Zone (KOSB), Tuzla / Istanbul**. The product is manufactured at industrial scale, in-house.

Intellectual property

The product family is protected by TR, PCT and US publications. Registrations and publication numbers are listed on page 4 of this dossier.



1,800×, in the hand. A single hydrated granule.



The phases, side by side. Dry granule, hydrated gel, the network between.

SECTION 02 · HOW IT WORKS

Granular and liquid, two application routes for one technology

The granule is a reservoir placed in the root zone that **works for one season**: the swollen particles slowly release water for up to 50 days, then refill at the next irrigation. Aqua is an **in-season intervention** delivered through the existing irrigation line: it does not form individually swelling particles but establishes a moisture-retention system distributed throughout the soil structure.

THE LIFE CYCLE — Apply — absorb — store — release and absorb again

01 APPLY
The granule is mixed into the soil; Aqua is carried by irrigation water.

→ **02 ABSORB**
On contact with water the network swells and takes up dissolved fertilizer.

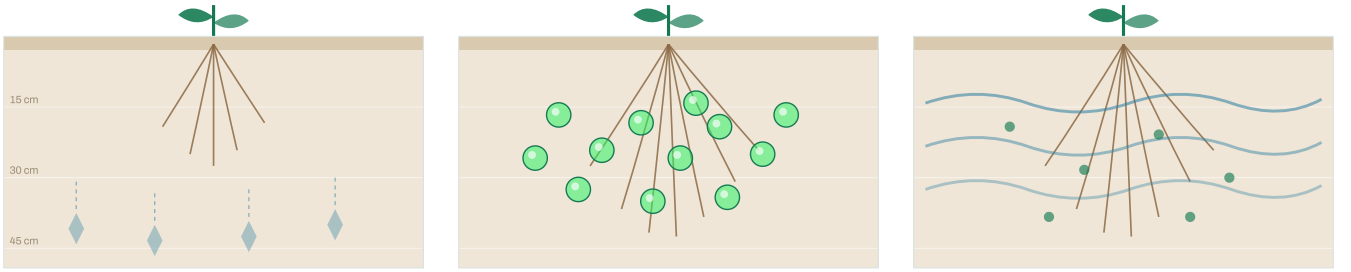
→ **03 STORE**
A stable moisture reservoir forms in the root zone.

→ **04 RELEASE**
As the soil dries, water moves to the root via osmotic pressure difference.

It refills at the next wetting — the cycle repeats all season

1,800× SWELLING CAPACITY · ONE APPLICATION · ALL SEASON

ROOT-ZONE CROSS-SECTION — Untreated soil · granular reservoir · Aqua film



UNTREATED
Water percolates below the root zone; evaporation and deep-drainage losses are high.

GRANULAR — SUBSOIL RESERVOIR
Discrete water stores at placement depth; the root takes them back.

AQUA — DISTRIBUTED MOISTURE FILM
A thin, flexible film in pores and near-surface zone; crusting and cracking are reduced

GRANULAR · SUBSOIL

Placement. Into the planting hole, into a band opened around the tree, or mixed into the soil in the field (2–5 kg/da).

Working life. The swollen particles slowly release water for up to 50 days; one application works for one season.

Particle size. Ø 0–2 mm with microgranular fertilizer · Ø 2–8 mm with standard fertilizer · coarse cut for large plants.

With fertilizer. Holds dissolved fertilizer along with the water; cuts leaching on high-infiltration soils.

AQUA · THROUGH THE IRRIGATION LINE

Delivery. Drip, sprinkler, surface irrigation or spraying onto the root zone.

Effect. Increases water viscosity, slowing its movement in light-textured soils.

Structure. Forms a thin, flexible film within soil pores and fills micro-pores.

Equipment. Works with existing irrigation infrastructure; no extra equipment or labour required.

ENGINEERED TOLERANCES — Built for the conditions soil actually imposes

−60/+70 °C
Service range of the dry polymer. In gel form the product swells and holds water between 4 and 60 °C.

pH neutral
Neither acidifies nor alkalises the root zone; compatible with fertigation programmes.

Salt tolerant
Keeps its charge–discharge function under ionic load, where commodity acrylic SAPs collapse.

Holds form
Swells and releases under soil pressure at placement depth without losing structure.

The Nanotern patent family — registered, not asserted

The table below shows the registrations that protect the Nanotern product family **directly**: three patent families, six publications, three jurisdictions (TR · PCT · US). Every publication number can be verified on Espacenet.

A biodegradable superabsorbent polymer

NANOTERN BIO+

A bio-based superabsorbent polymer with a cellulose backbone, produced from renewable feedstock, and its method of manufacture. The protection basis of the Bio+ Agriculture granule and Bio+ Agriculture Aqua products.

PUBLICATION NUMBER	JURISDICTION	APPLICATION	FAMILY / SCOPE
TR2024009195A1	TR	2024	Biyobozunur Bir Süper Emici Polimer
WO2026019394A1	PCT	PCT/TR2025/050627	A biodegradable superabsorbent polymer

Polymer matrix based superabsorbent material

NANOTERN AGRICULTURE · LANDSCAPE

A polymer-matrix based superabsorbent material; the core technology of the Nanotern Agriculture and Nanotern Landscape granular products. Protected by TR, PCT and US publications.

PUBLICATION NUMBER	JURISDICTION	APPLICATION	FAMILY / SCOPE
TR202002652A2	TR	TR2020/02652	Polimer Matrisli Süper Emici Bir Malzeme
WO2021167577A1	PCT	PCT/TR2021/050162	Polymer matrix based superabsorbent material
US2023114465A1	US	US 17/801281	Polymer matrix based superabsorbent material

A foliar fertilizer mixture

NANOTERN AQUA NUTRI

A fertilizer mixture for foliar application; covers the nutrient-carrying and foliar-application properties of the liquid line.

PUBLICATION NUMBER	JURISDICTION	APPLICATION	FAMILY / SCOPE
WO2026111684A1	PCT	PCT/TR2025/051134	A foliar fertilizer mixture

VERIFIABILITY — The publication number on every row can be queried independently. The difference between saying a technology is patented and giving its number is this table.

Links in the table resolve to the corresponding publication records on Espacenet (worldwide.espacenet.com). The portfolio also contains applications not yet published; only published records are listed in this dossier.



The hydrated network in the root zone. Photographed under greenhouse conditions — water is held in gel form and the root takes it back.

SECTION 04 · PRODUCT FAMILY

Three lines, two forms, one technology

Nanotern is organised around three application domains — **Agriculture**, **Bio+ Agriculture** and **Landscape** — and each line is offered both as a subsoil granule and as Aqua, applied through irrigation water.



GRANULAR · SUBSOIL

Nanotern Agriculture

A high-performance cross-linked superabsorbent polymer based on potassium salt, designed with four functional monomer groups.

APPLICATION AREAS

New seedling and sapling plantings · orchards and vegetable areas · field crops



GRANULAR · SUBSOIL

Nanotern Bio+ Agriculture

A bio-based, biodegradable hybrid superabsorbent polymer with a cellulose backbone, produced from renewable feedstock.

APPLICATION AREAS

Regenerative and organic farming · seedling and sapling nurseries · greenhouses



GRANULAR · SUBSOIL

Nanotern Landscape

A subsoil water reservoir for turf, flowers and landscape plants; developed against water restriction in urban green space.

APPLICATION AREAS

Sports fields · parks and gardens · potted plants · urban greening



LIQUID · VIA IRRIGATION WATER

Nanotern Agriculture Aqua

An acrylate terpolymer water solution; a liquid soil-improvement technology applied through existing irrigation infrastructure.

APPLICATION AREAS

Already-planted areas · drip irrigation and fertigation · foliar application



LIQUID · VIA IRRIGATION WATER

Nanotern Bio+ Agriculture Aqua

A bio-based liquid superabsorbent polymer produced from renewable feedstock, for residue-free applications.

APPLICATION AREAS

Organic and regenerative production · greenhouse and nursery · in-season intervention



LIQUID · VIA IRRIGATION WATER

Nanotern Landscape Aqua

A liquid soil moisturizer for turf and landscape plants; supports uniform distribution of water in the soil.

APPLICATION AREAS

Turf areas · parks and median strips · automated irrigation systems

PRODUCT CODES AND PACKAGING — The complete commercial product list

PRODUCT	PACK SIZES
GRANULAR — SUBSOIL APPLICATION	
NANOTERN AGRICULTURE	4 kg · 15 kg
NANOTERN BIO+ AGRICULTURE	500 g · 2 kg · 4 kg · 15 kg
NANOTERN LANDSCAPE	500 g · 2 kg · 4 kg · 15 kg

PRODUCT	PACK SIZES
AQUA — APPLIED WITH IRRIGATION WATER	
NANOTERN AGRICULTURE AQUA	1 L · 5 L · 20 L
NANOTERN BIO+ AGRICULTURE AQUA	1 L · 5 L · 20 L
NANOTERN LANDSCAPE AQUA	1 L · 5 L · 20 L

Granular packshots show the 15 kg bag and Aqua packshots the 5 L container.



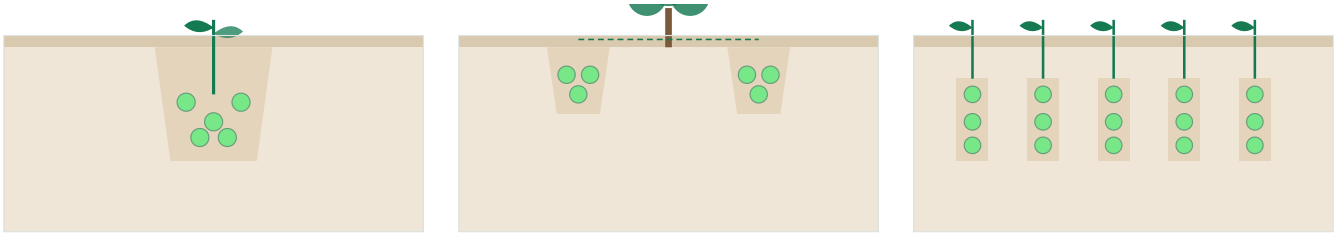
Field deployment, Senegal. Granular and Aqua products used together in the field — Tassette Demonstration Farm.

SECTION 05 · APPLICATION & DOSAGE

How it is applied, and at what dose

The granule is placed once, **in the root zone**; Aqua is repeated through the season, mixed into irrigation water. Used together, the granule builds the season's reservoir while Aqua feeds near-surface moisture through stress periods.

GRANULAR APPLICATION METHOD — Granule : soil ≈ 1 : 5 — blended at placement



SEEDLING / SAPLING PLANTING
Applied into the hole, mixed with soil, edges closed and watered.

MATURE TREE
A band or trench is opened at the canopy line, the product placed and covered.

FIELD / OPEN AREA
The soil is hoed, the product mixed in, levelled and irrigated.

RECOMMENDED GRANULAR DOSES — By plant size

SEEDLING	SAPLING	MATURE TREE	FIELD / OPEN AREA
3–5 g	**50–100** g	**100–200** g	**2–5** kg/da
per plant, into the planting hole	per sapling, into the root zone	per tree, into the canopy-line band	mixed into the soil before sowing

AQUA APPLICATION METHOD — 1 L of product : 1,000 L of irrigation water

1 — PREPARE
Mix 1 L of product into 1,000 L of water in the tank.

2 — DISPERSE
Stir until fully dispersed; shake the container well.

3 — DOSE
Feed it in during the middle of the irrigation cycle.

4 — FLUSH
Complete the final 30 minutes with water only.

Dosage	1 L of product / 1,000 L (1 tonne) of irrigation water
Frequency	6–8 applications per season, 10–15 days apart
Monthly dose	1–2 L/da per month (1 da = 1,000 m² = 0.1 ha)
Application methods	Drip · sprinkler · surface irrigation · root-zone / foliar spraying
Critical stages	Hot periods, flowering, grain filling and fruit set
Pack coverage	1 L ≈ 0.5–1 da · 5 L ≈ 2.5–5 da · 20 L ≈ 10–20 da

Used together. In the Senegal field trial, plots treated with Aqua alone returned a 10% yield increase, while plots treated with granule and Aqua together returned 40%. The granule builds the season's reservoir; Aqua feeds it and protects near-surface moisture.

STORAGE — Keep away from moisture; store in a cool, dry place away from sunlight. Ensure the packaging is sealed tightly.

Results from the field — with measurement and observation records

The four trials below are documented by sensor measurement, laboratory analysis or an official harvest record. The summary strip at the foot of the page shows field references across geographies and crops.



SENEGAL · THIÈS

Silage maize — 6 hectares

Tassette Demonstration Farm · 6 parcels, paired control · Dose: solid 3–4 kg/da, liquid 1 L/tonne

40%
yield increase where Agri + Aqua were used together

50%
saving in irrigation water

10%
yield increase on plots treated with Aqua alone

30%
increase in farm profitability



TÜRKİYE · MANİSA

Cherry — 104 days of uninterrupted measurement

Regina – Nimba · drip irrigation · 50 g/seedling, 125–250 g/tree · Nanotern Agriculture + Aqua

2.3×
increase in sap flow

2.7×
rise in EC — nutrient transport

15%
more water reserve

42,504 L
total irrigation recorded



TÜRKİYE · NİĞDE

Apple — on a saline and arid plot

Drip irrigation · 250–300 g/tree · Nanotern Agriculture + Aqua · only 5–7 L of water per week

12.5%
increase in potassium uptake

Mg · Ca
fertilizer uptake also rose

Roots
marked improvement in root development (grower record)

Harvest
awaiting harvest period



TÜRKİYE · TEKİRDAĞ

Grape — tolerance to drought stress

Barbare Vineyards · applied 13 April 2026 · monitored 24 June – 17 July 2026 · leaf water potential (bar)

39%
better water status than control on the pre-dawn average

47.6%
highest pre-dawn improvement (7 July)

3.6 / 5.0
bar — Nanotern / control, pre-dawn, 17 July

Season
monitoring continues

DOCUMENTED FIELD REFERENCES — 2024–2025 · five crops, five geographies

01	02	03	04	05
Grape — Peru	**Tomato — Denizli**	**Sunflower — Muş, rain-fed**	**Walnut & almond — irrigated**	**Cherry — Niğde**
40%	**40%**	**9%**	**30%**	**50%**
water saving	increase in root development	yield increase	yield increase	less irrigation

SECTION 07 · TECHNICAL SUMMARY

Technical data, analyses and safety

The values below are taken from the product technical data sheets (TDS). Analyses were carried out by independent laboratories and universities.

GRANULAR — CHEMICAL & PHYSICAL PROPERTIES — Nanotern and Nanotern Bio+ formulations

PROPERTY	NANOTERN AGRICULTURE · LANDSCAPE	NANOTERN BIO+ AGRICULTURE
General appearance	Amber granules	Amber granules
Particle size	0–2 mm · 2–8 mm	0–2 mm · 2–8 mm
Moisture content	3 ± 4%	3 ± 4%
Max water absorbency	up to 1,800× [1]	up to 1,000×
Water slow-release duration	50 days [1]	40–50 days
Service temperature	(–60) – (+70) °C	(–60) – (+70) °C
Melting point	200 °C	200 °C
Decomposition temperature	255 °C	225 °C
Storage modulus	1.2 GPa	1.2 GPa
Density	1.2–1.4 g/cc	1.2 g/cc
pH	Not measurable [2]	Not measurable [2]
Molecular weight	1,200 kDa [3]	—

[1] Highest values possible. The water's pH, lime and mineral level and hardness affect swelling and water-retention performance.
[2] pH cannot be measured as the product swells in water.
[3] Weight-average molecular weight of the non-cross-linked polymer, measured by GPC.

AQUA — COMPOSITION & PHYSICAL PROPERTIES — Nanotern and Nanotern Bio+ liquid formulations

PROPERTY	NANOTERN AGRICULTURE · LANDSCAPE AQUA	NANOTERN BIO+ AGRICULTURE AQUA
Product type	Acrylate terpolymer – water solution, potassium salt	Cellulose – acrylate terpolymer, bio-based
Water	≤ 88%	≥ 86%
Polymer content	≥ 12%	14% (solid content)
General appearance	Yellow viscous liquid	Yellow viscous liquid
pH	7 – 7.5	7.0 – 7.5
Viscosity	1,500–2,000 mPa·s	1,250–1,500 mPa·s
Service temperature	(+5) – (+70) °C	(+5) – (+70) °C
Solubility	Dispersible in water	Fully dispersible in water
Dosage	1 kg / 1 tonne of irrigation water	1 kg / 1 tonne of irrigation water
Packaging	1 L · 5 L · 20 L	1 L · 5 L · 20 L

Nanotern is not a fertilizer. It holds fertilizer in the root zone; it does not supply nutrients, does not cause toxicity or nutrient deficiency, and does not shift soil pH.

INDEPENDENT ANALYSES — Heavy metals, fertilizer content, plant toxicity and ecosystem safety

Heavy metals — ICP-OES · Sabancı University

Pb <0.5 · Cd <0.1 · Hg <0.05 · As <0.3 mg/kg — all values below EU limits. Reference: EU 2019/1009.

Fertilizer content · CIITA · Veracruz

Nitrate 200 ppm · potassium 5,500 ppm · sodium 290 ppm · calcium 0 ppm — well below the concentrations found in agricultural fertilizers.

Plant toxicity · Istanbul University

At 0.5% and 0.3% concentrations, germination and early development in three species showed no difference from the control (wheat 100% · maize 80% · lentil 95%).

Entomopathogenic nematodes · ADÜ · 28.07.2025

Steinernema and Heterorhabditis species were reported to remain viable for 2 months, with no toxicity observed.

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nanotern
SMART SUBSOIL WATER RESERVOIR

"Cultivating Tomorrow Through Nanotechnology."