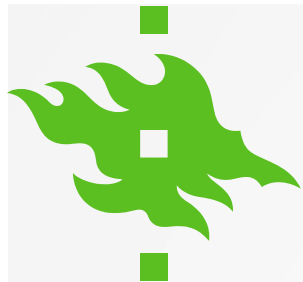




BIOSUODATUSRAKENTEILLA PUHTAAMPAA HULEVETTÄ?

Kirsi Kuoppamäki, FT, dosentti
Helsingin yliopisto
Bio- ja ympäristötieteellinen tiedekunta
LAHTI

Espoo, Merituulentie 6.8.2018

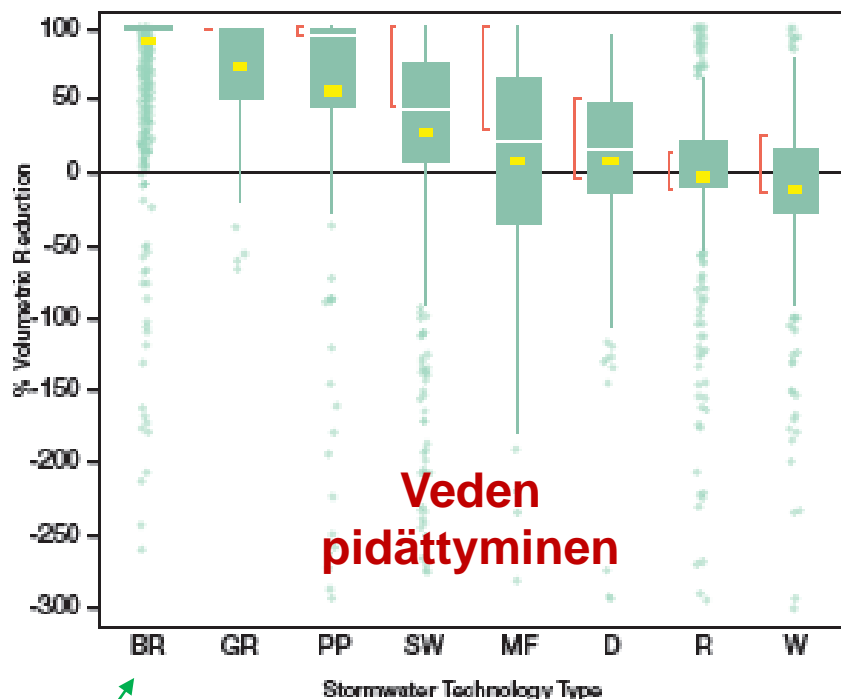


MONENLAISIA HULERATKAISUJA

BIOSUODATUSRAKENTEET, VIHERKATOT, OJAPAINANTEET, SADEVESIPUUTARHAT, KOSTEIKOT, LÄPÄISEVÄ ASFALTTI...

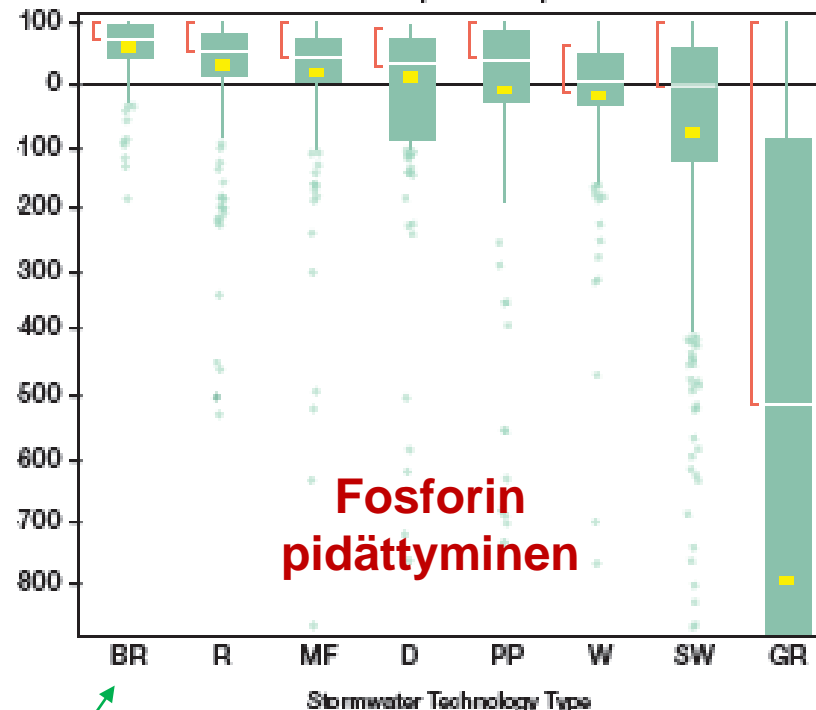
MÄÄRÄLLINEN HALLINTA

All Observations % Volumetric Reduction



LAADULLINEN HALLINTA

Total Phosphorus Capture



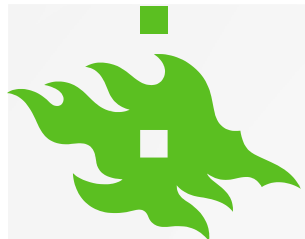
BR - Bioretention:	90.3%
GR - Green Roof:	73.2%
PP - Porous Pavement:	57.5%
SW - Swale:	27.4%
MF - Media Filter:	8.34%
D - Detention Pond:	7.51%
R - Retention Pond:	-2.42%
W - Wetland:	-11.3%

BR - Bioretention:	58.5%
R - Retention Pond:	32.0%
MF - Media Filter:	17.3%
D - Detention Pond:	12.7%
PP - Porous Pavement:	-9.25%
W - Wetland:	-19.9%
SW - Swale:	-76.3%
GR - Green Roof:	-791%

biosuodatus

biosuodatus

Driscoll et al. 2015. Green infrastructure: lessons from science and practice. A publication of the Science Policy Exchange.

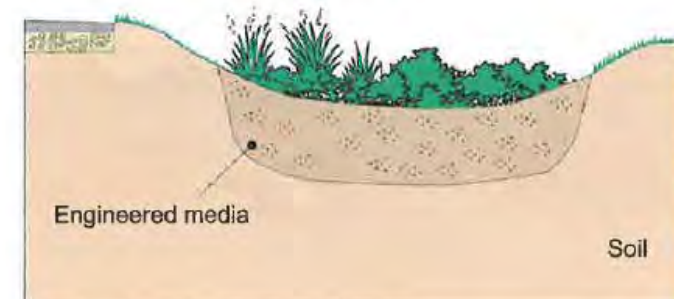


BIOSUODATUS

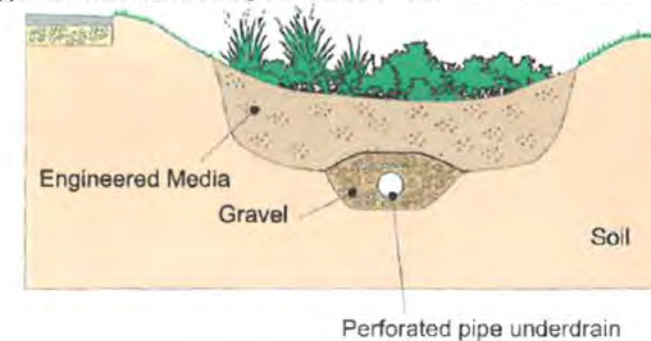
Jennifer Feinstein & Paul Hanley
University of Melbourne, Australia
<https://phys.org/news/2017-11-stormwater-home-veggie-raingarden.html>



Entä kuinka se tehdään !?
“engineered media”?

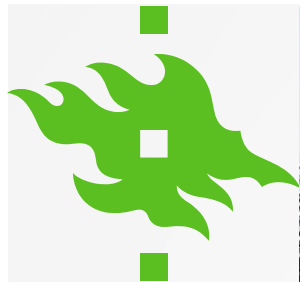


4.14 Typical bioinfiltration (rain garden) cross section



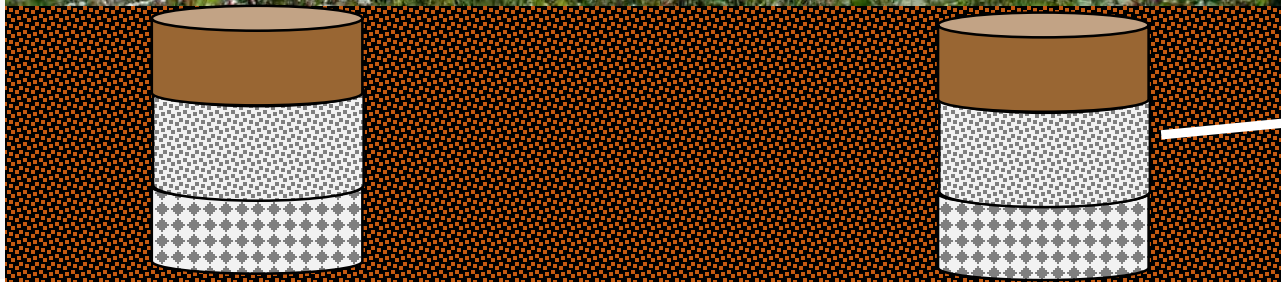
4.15 Typical bioinfiltration system cross section

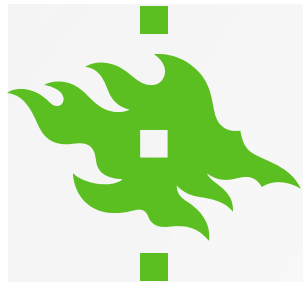
Erickson et al. 2013. Optimizing stormwater treatment practices. A handbook of assessment and maintenance. Springer



BIOSUODATUSTUTKIMUSTA KENTTÄLYSIMETREILLÄ

Tutkimusasema Lahdessa





BIOSUODATUS

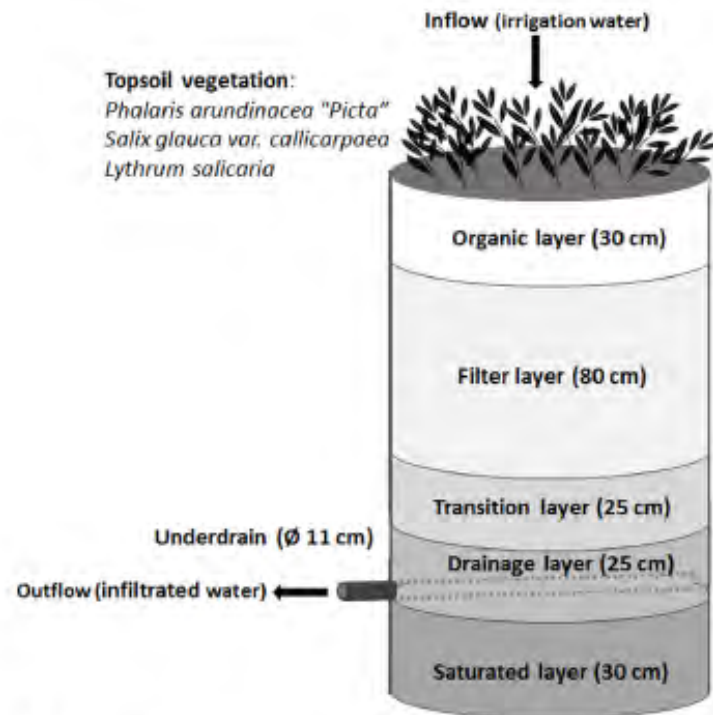


Fig. 2. Schematic presentation of the soil layers (depth in cm) in a vegetated biofiltration system constructed in a lysimeter. Organic layer - a mixture of 50% peat and compost and 50% sand (0-2 mm), filter layer - sand (0-2 mm), transition layer - gravel (2-6 mm), drainage layer - gravel (8-16 mm), saturated layer - gravel (16-32 mm). Organic layer: pH 7.0, P 9.1 mg/L, Ca 1400 mg/L, K 80 mg/L, Mg 200 mg/L, bulk density 1.26 kg/L. Infiltration water samples were taken from the underdrain.

Hulevedestä pidättyi lysimetreihin:

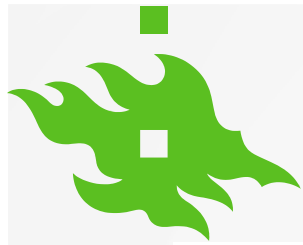
- lähes 100 % fosforista
- 0-47 % typestä
- 82-96% kuparista ja sinkistä
- 70-90% alumiinista

Valtanen et al. 2017; Ecol. Eng. 100: 89-98

Suodatusmateriaalina perinteinen pesty hiekka (0-2 mm)



Lysimetrlaitos "Soilia", Lahti



SUODATUS- MATERIAALIT?

- Luontoarvojen, viihtyvyyden ja ekosysteemipalvelujen kannalta neitseellisten sora- ja hiekkavarojen käyttöä tulee pyrkiä korvaamaan kierrätetyillä maa-aineksilla. Samalla maa-ainesten kierron riskit ympäristölle ja terveydelle tulee tiedostaa.
- Kuntien tulisi toimillaan edesauttaa maa-ainesten kierrätystä, koordinoita maamassojen liikkumista eri infrahankkeiden välillä ja perustaa maa-aineksen kierrätysterminaleja.

Puheenvuoroja Ympäristötiedon foorumin tilaisuudesta 10/2016

Puheenvuoroja Ympäristötiedon foorumin tilaisuudesta 10/2016

www.ymparistotiedonfoorumi.fi/wp-content/uploads/2016/12/YTF_10_2016.pdf

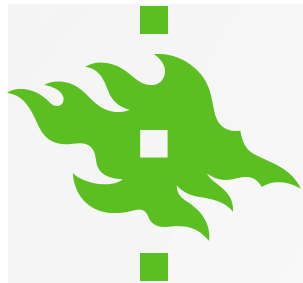
Jos perinteinen
suodatushiekkä ei ole
kestävä ratkaisu niin
mitä tilalle?

Malttia soraharjujen hävitysvimmaan

Maailmanmatkaaja Merja Åkerlind ihastelee suunvuorossaan Suomen luonnon erikoispiirteitä kuten jylihiä kallioita ja muhevia jäkälämättäitä. Hän on myös huolissaan siitä, miten luonnonvarat ja maa-ainekset hupenevat esimerkiksi rakentamisen tarpeisiin.

Suunvuorot 12.10.2011 klo 16:42 | päivitetty 20.4.2012 klo 08:45





HULEVEDEN HALLINTAA KIERTOTALOUDEN HENGESSÄ?

- neitseellisten sora- ja hiekkavarojen käyttöä pyrittävä korvaamaan kierrätetyillä maa-aineksilla
- riskit ympäristölle tulee tiedostaa

Biohiili...?

POLLUTION WRANGLER

Biochar's start may have been in agriculture, but researchers are now looking at other applications. Biochar can bind to heavy metals in soil, which helps to keep them from reaching plants or entering water supplies. That has attracted the notice of the US Environmental Protection Agency, other agencies, and companies seeking to reclaim land formerly used in mining. At the Hope Mine near Aspen, Colorado, biochar added in 2010 helped to neutralize the impacts of decades-old mine refuse by immobilizing the metals and increasing the amount of water held on the slope — thereby reducing the opportunity for contaminated water to become run-off. It also helped to spur plant growth on the formerly barren hillside, according to the Aspen Center for Environmental Studies.

Biochar is also showing promise in cleaning up polluted water, perhaps as a much cheaper replacement for activated charcoal, which is used at sites ranging from treatment plants to areas that are heavily contaminated with toxic chemicals. Biochar particles have a relatively large surface area, which expands even further in water, providing a vast number of sites for contaminants to bind to, says Charles Pittman, a retired chemist at Mississippi State University in Starkville. He says that this type of pollution remediation may be particularly beneficial in countries that lack full water-treatment systems. It could also help to remove antibiotics or chemical wastes, which are difficult to strip out with conventional water treatments.

NEWS FEATURE



Biochar — a soil additive made by heating biological material — is catching attention as a means to improve crop growth and clean up contaminated water.

STATE-OF-THE-ART SOIL

A charcoal-rich product called biochar could boost agricultural yields and control pollution. Scientists are putting the trendy substance to the test.

BY RACHEL CERNANSKY

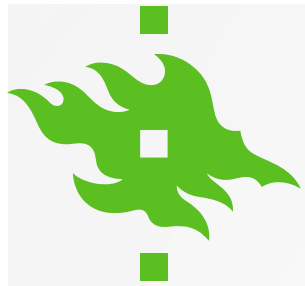
For more than 150 years, the Brooklyn Navy Yard constructed vessels that helped to stop the slave trade from Africa, lay the first undersea telegraph cable and end the Second World War. Now, this sprawling industrial facility in New York City is filled with artists, architects, producers of artisanal moonshine and people growing organic vegetables. On a drizzly day in autumn, Ben Flanner tends a sea of red and green lettuce on a 6,000-square-metre rooftop farm.

The soil beneath the plants looks ordinary, but Flanner grabs a handful and holds it up for inspection. Amid the brown clods of dirt are small black particles — remnants of charcoal fragments that were mixed into the soil two years ago. Flanner thinks that this carbon-rich material, known as biochar, has helped the crops to thrive, possibly even

increasing their yield, and he hopes for more impressive results over the next few years.

Across the United States, sales of this long-lasting soil additive have surged over the past few years, tripling annually since 2008, according to some estimates. The Biochar Company in Berwyn, Pennsylvania — which supplied Flanner's Brooklyn farm — sells it both wholesale and direct to consumers, through outlets including Amazon and some Whole Foods stores. And countries ranging from China to Sweden are using biochar on agricultural fields and city lawns.

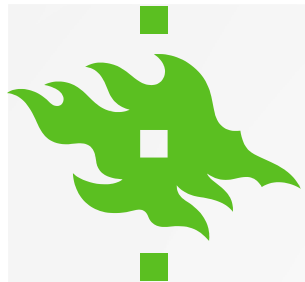
Proponents see big potential for the soil enhancer, which is produced by heating biological material — such as husks and other agricultural waste — in a low-oxygen chamber. Biochar can be made as a by-product of biofuel generation, so some companies are hoping to cash in on both products



KIERRÄTYSMATERIAALEJA

Tiilimurska...?

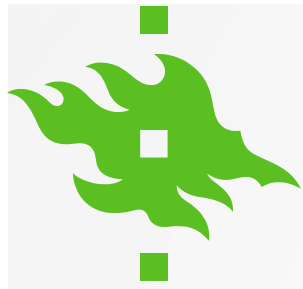




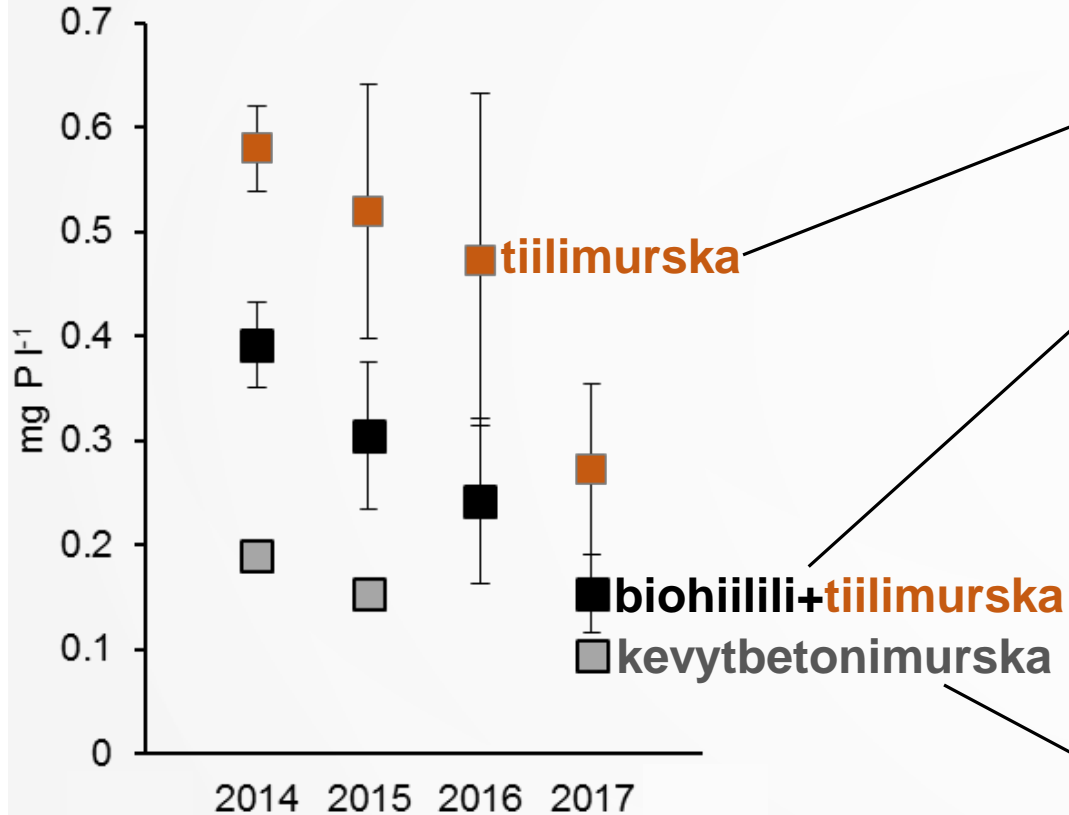
KIERRÄTYSMATERIAALEJA: TEOLLISUUDEN SIVUVIRTATUOTTEITA?

Betoni...?





FOSFORIN HUUHTOUTUMINEN VIHERKATOILTA



Kuoppamäki et al. (osin julkaisematon aineisto)



Uudenmaan liitto
Nylands förbund



KONEEN SÄÄTIÖ

Bio- ja ympäristötieteellinen tiedekunta

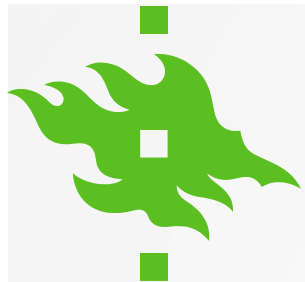
HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI



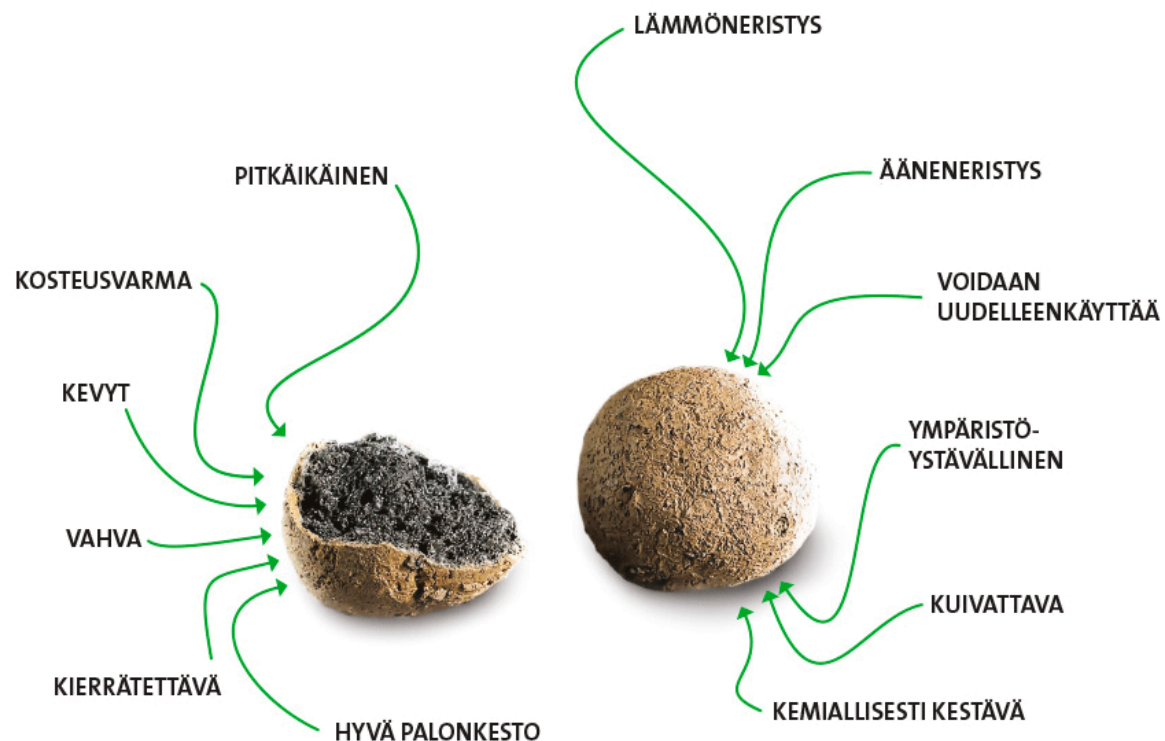
Lahti



Hollola

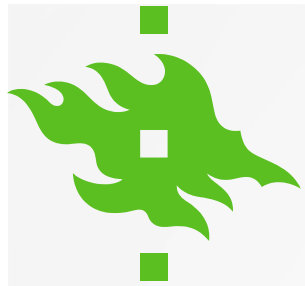


MUITA MAHD. MATERIAALEJA?



www.leca.fi

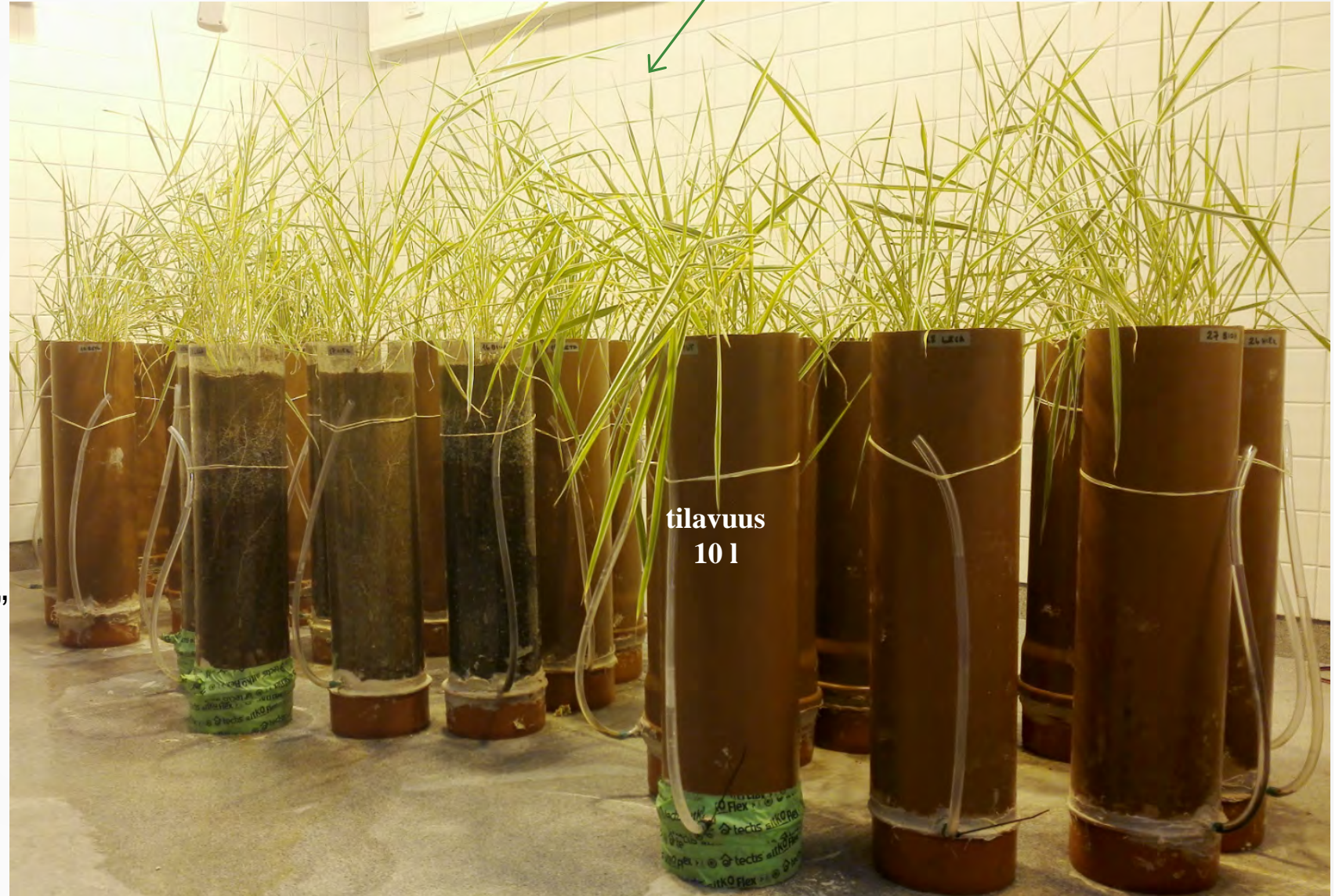
Leca-sora...?

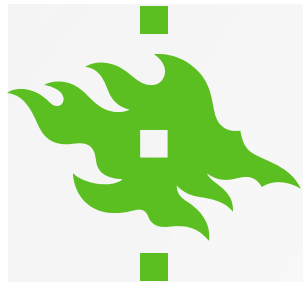


BIOSUODATUSKOE HUHTIKUUSTA HEINÄKUUHUN 2018

- Leca-murske "Leca"
- Leca-murske + biohiili "Leca+b"
- Filtralite P® "Filt"
- Betonimurske "Beto"
- Suodatushiekka "Hiek"

viiruhelmi *Phalaris arundinacea picta*

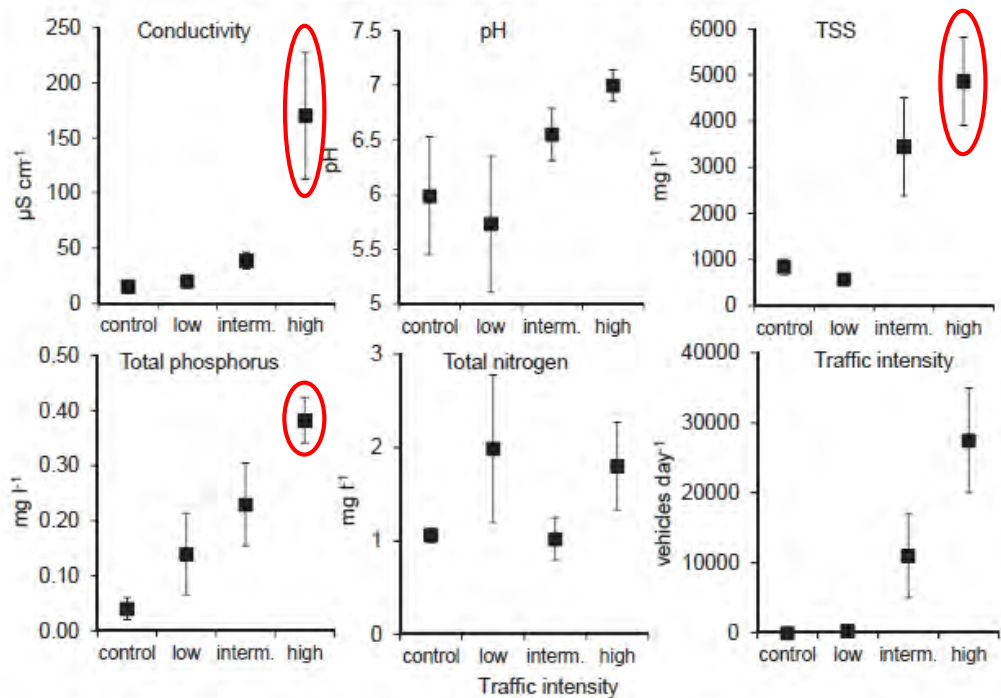




HULEVESI LUMENA LIIKENNEALUEELTA

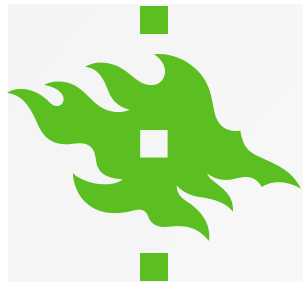
60

K. Kuoppamäki et al. / Environmental Pollution 195 (2014) 56–63



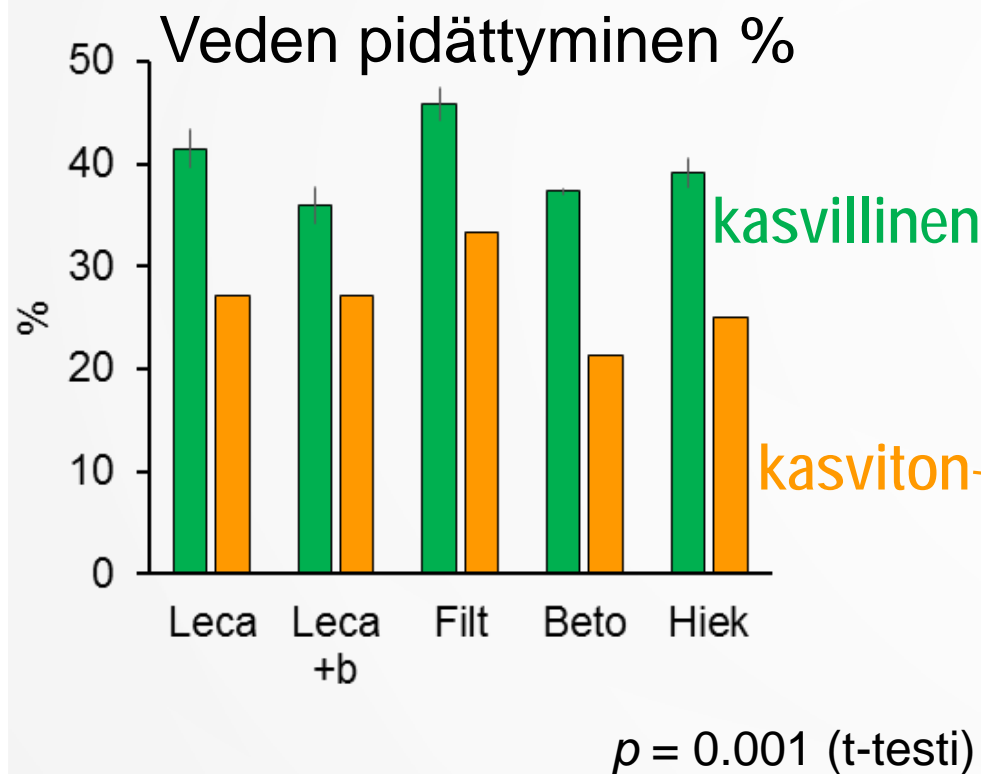
Lahti, Mytjääisten risteys 5.4.2018

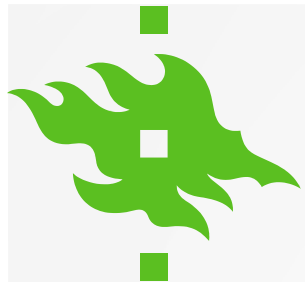
→
Liikennemäärä kasvaa



KASVEILLA KESKEINEN MERKITYS VEDEN PIDÄTTYMISESSÄ JA IMEYTYMISESSÄ

paitsi vettyneessä maassa kasvien vaikutus pidättymiseen oli olematon



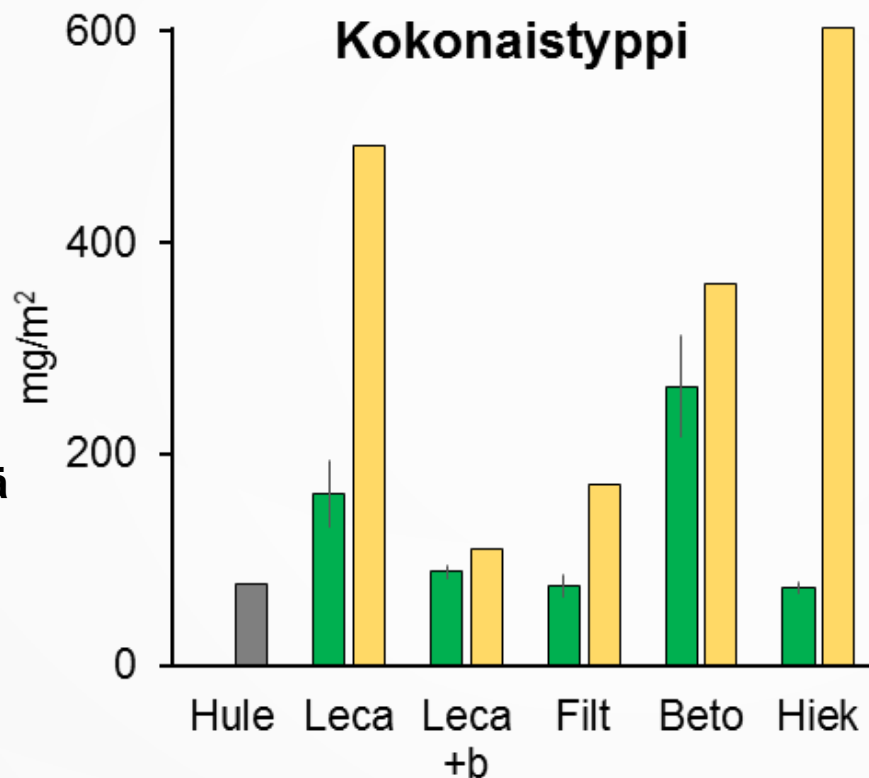


KASVIT VÄHENSIVÄT MYÖS TYPEN HUUHTOUTUMISTA

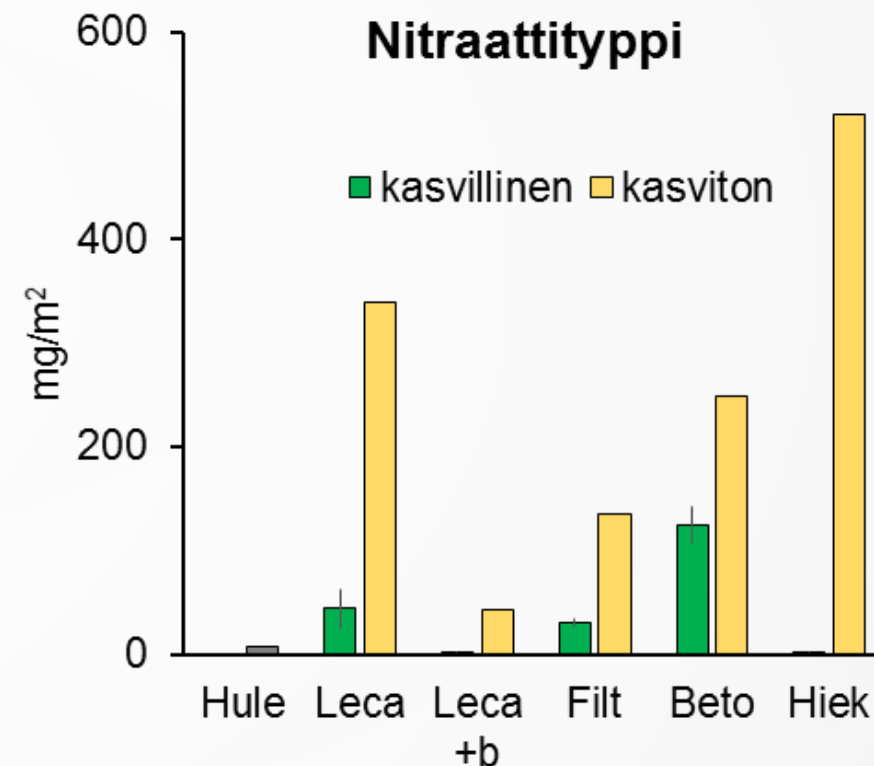
Suodatusrakenteista itsestään huuhtoutui typpeä

- Ei ollenkaan tavaton tulos

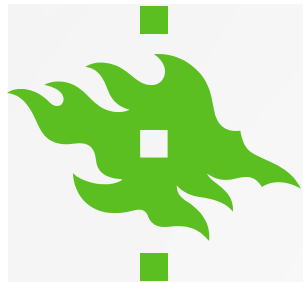
(Hatt ym. 2009, Valtanen ym. 2016, Shrestha ym. 2018)



$p = 0.028$ (t-testi)



$p = 0.016$ (t-testi)

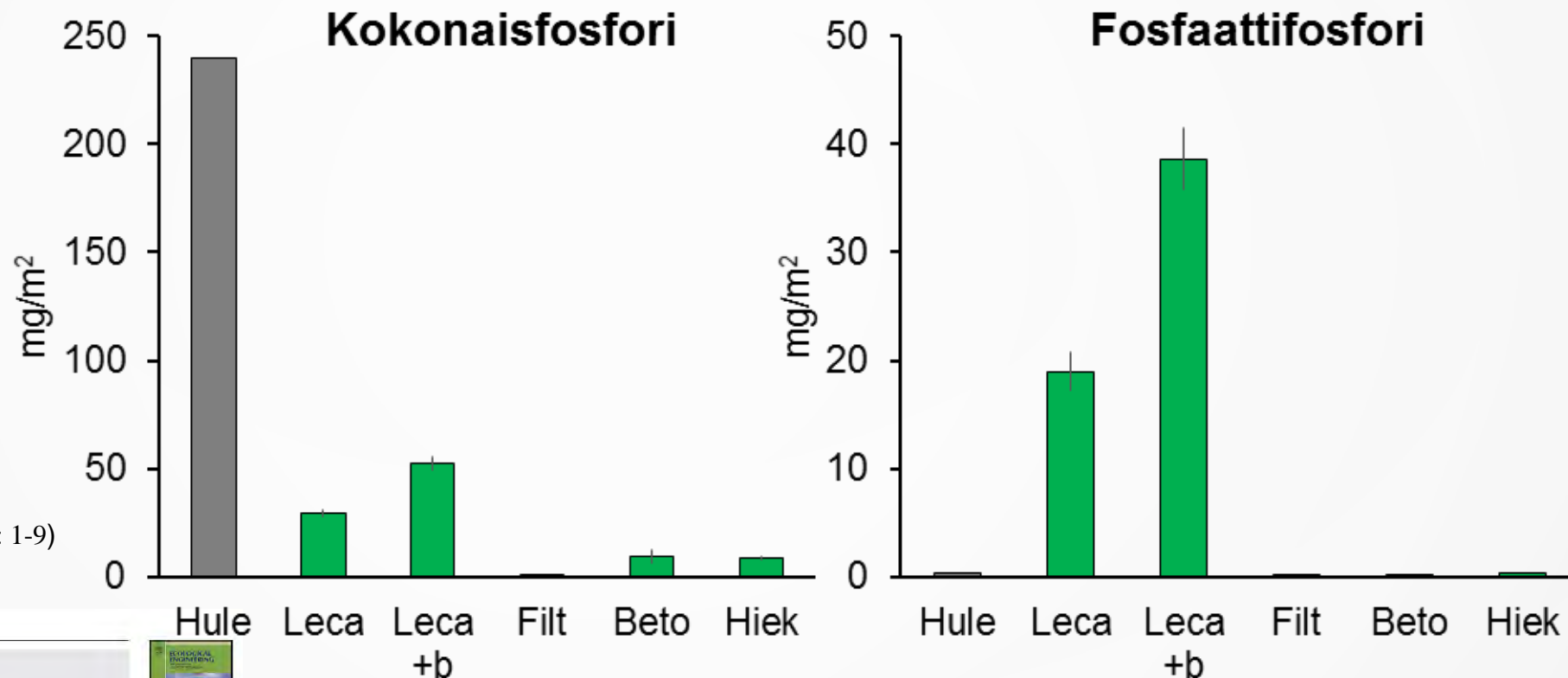


HULEVEDESSÄ KIINTOAINEESEEN SITOUTUNEENA PALJON FOSFORIA, JOKA PIDÄTTYI HYVIN

Biohiilestä huuhtoutui fosfaattia

Huom! Biohiilissä on eroja.

(Kuoppamäki ym. 2016; Ecol. Eng. 88: 1-9)



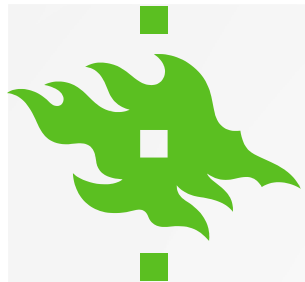
Ecological Engineering 88 (2016) 1–9

Contents lists available at ScienceDirect

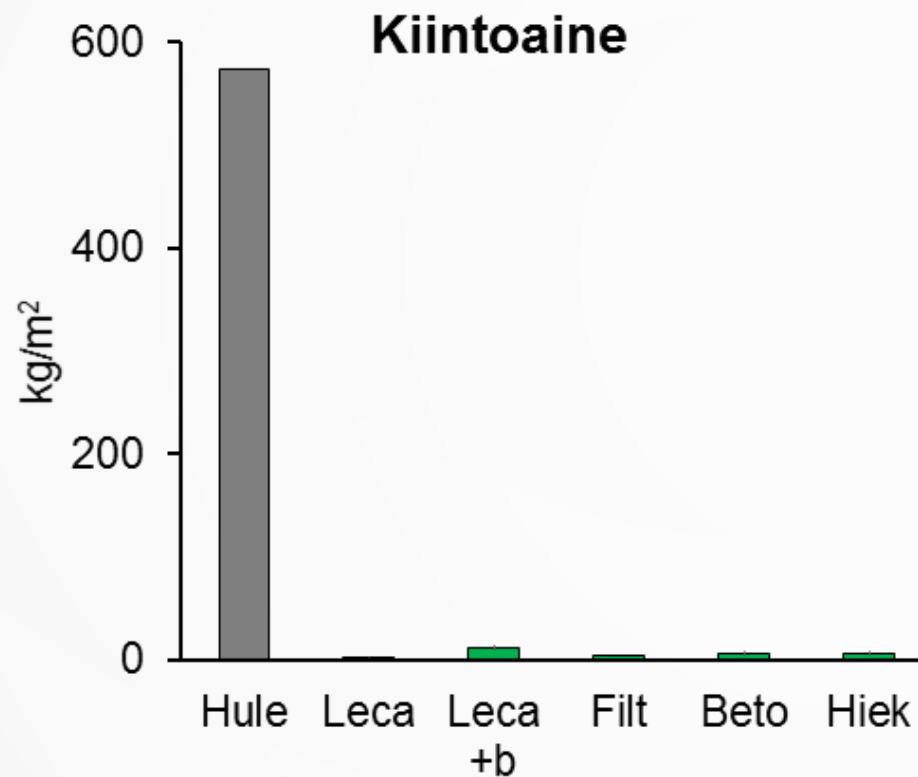
Ecological Engineering

journal homepage: www.elsevier.com/locate/ecoleng

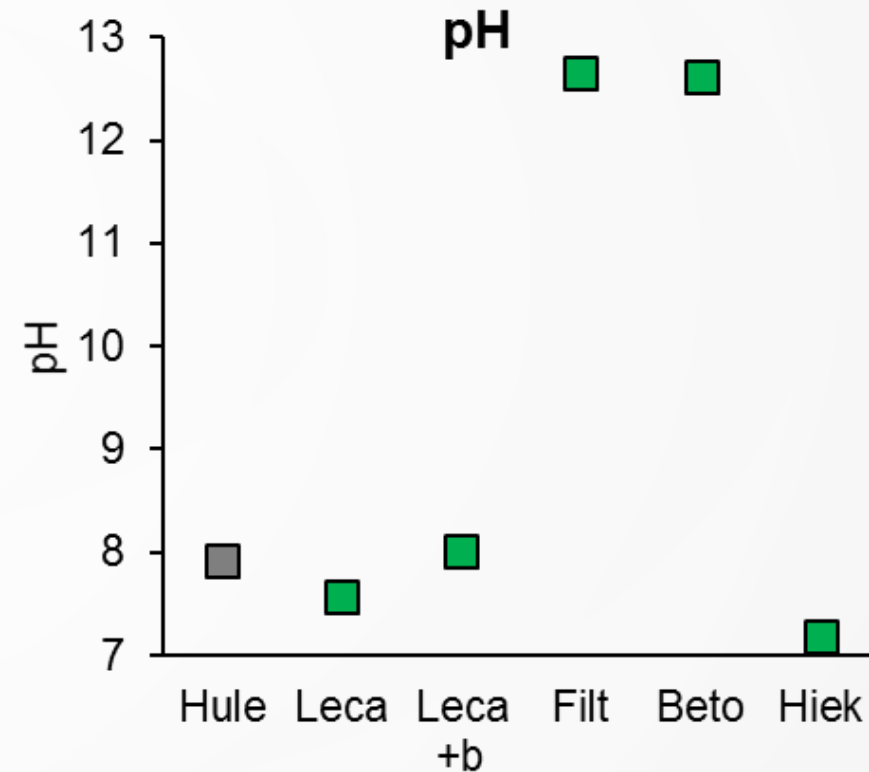


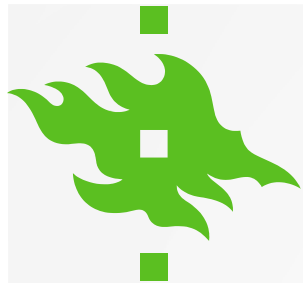


HULEVEDESSÄ PALJON KIINTOAINETTA JOKA PIDÄTTY Y ERINOMAISESTI

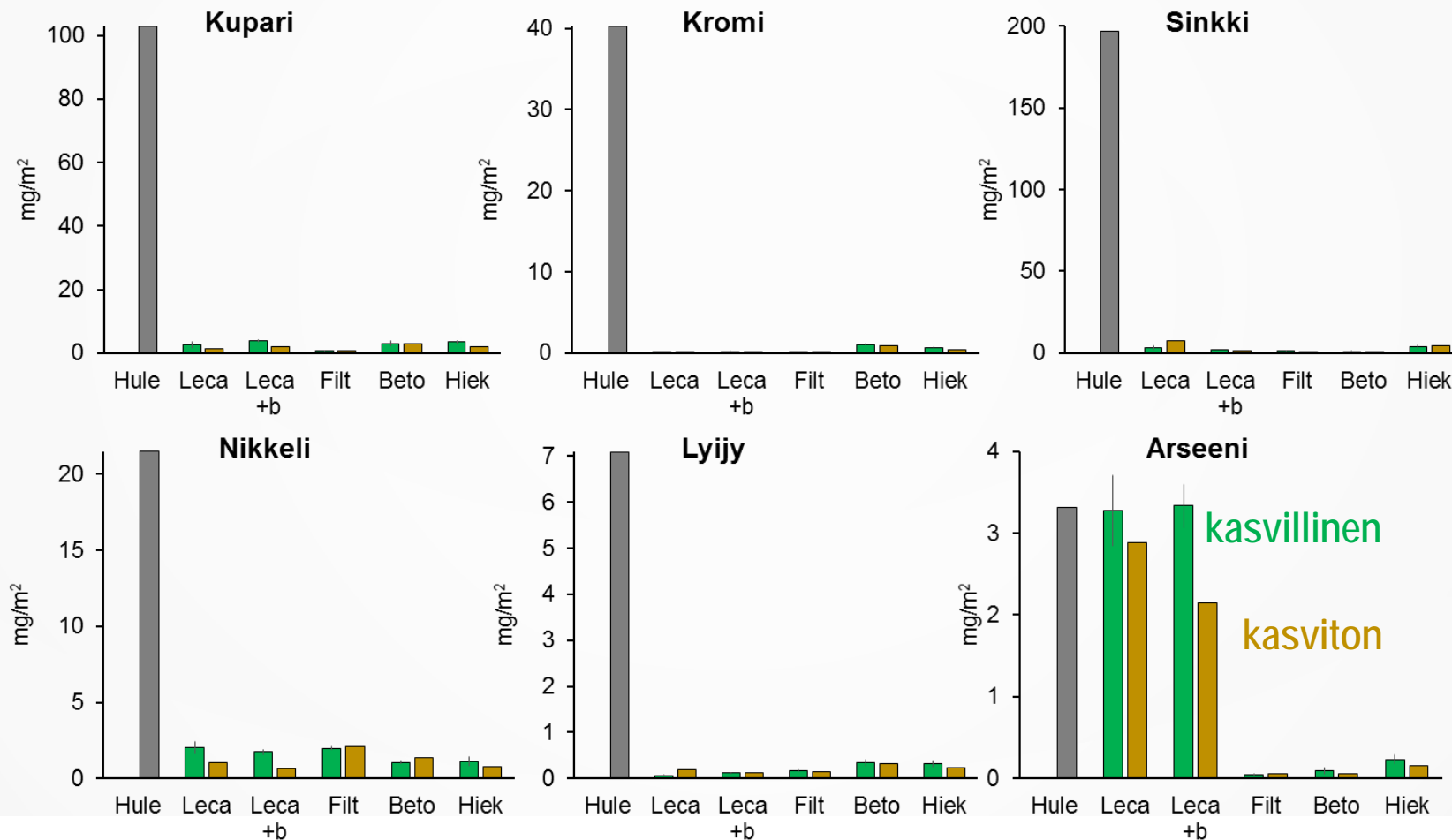


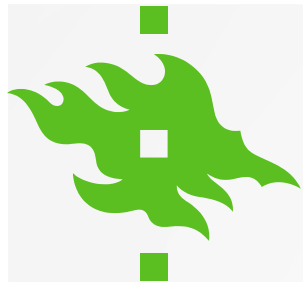
pH SELITTÄÄ FOSFAATIN PIDÄTTYMISTÄ



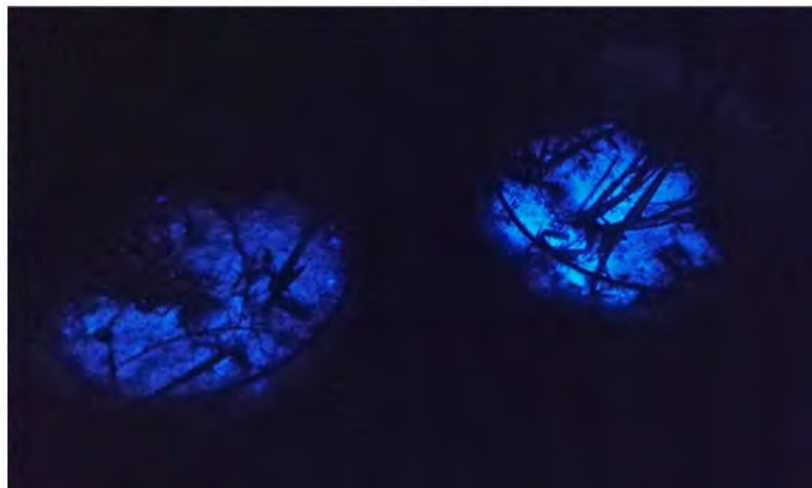


KOKONAISMETALLIT PIDÄTTYIVÄT PÄÄSÄÄNTÖISESTI ERINOMAISESTI HULEVEDESSÄ METALLIT SITOUTUNEET KIINTOAINEESEEN



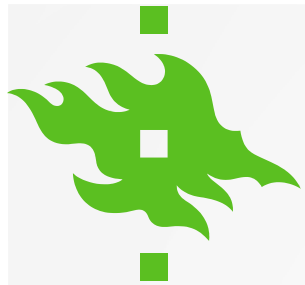


MIKROMUOVI PIDÄTTYI ERINOMAISESTI

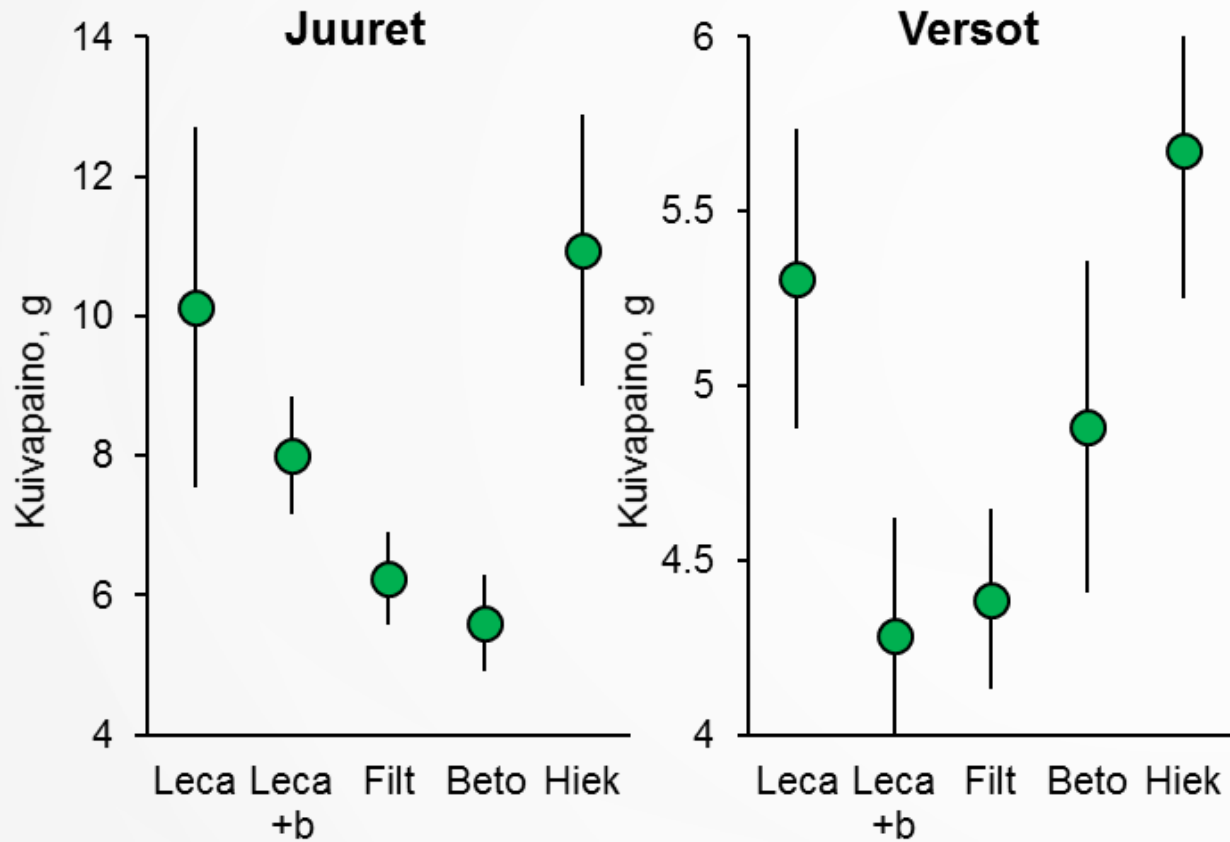


MIKROMUOVIA LAHDEN VESIJÄRVELTÄ KESÄLLÄ 2018 OTETUISSA PLANKTONNÄYTTEISSÄ





VIIRUHELPI KASVATTI JUURET KAIKKIIN MUIHIN MATERIAALEIHIN PAITSI FILTRALITEEN JA BETONIMURSKAAN





BIOSUODATUSRAKENTEILLA VOI SYNTYÄ PUHTAAMPAA HULEVETTÄ

- Mutta materiaalien välillä on suuria eroja eikä yksikään ole ylitse muiden (paitsi perinteinen pesty suodatushiekkä, neitseellinen luonnonvara)
- Suodatusmateriaaleista itsestään voi huuhtoutua ravinteita ja metalleja
- Yksi biosuodatusrakenne tahi yksittäinen rakenneratkaisu ei riitä
- Huleveden laadullinen ja määrällinen hallinta on kokonaisuus

HULEVEDEN HALLINTAJUNA STORMWATER TREATMENT TRAIN



Urban Ecosystems

helsinki.fi/urbanecosystems

Viides ulottuvuus – viherkatot osaksi kaupunkia

helsinki.fi/fifth-dimension