



Variety Screening for Design/Desired Traits

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Professor, Dept of Agronomy
Kasetsart University, Kamphaeng Saen

Desirable traits are available from:

- 1. Commercial cultivars (except the gene is patented)**
- 2. Breeding lines from breeding programs**
- 3. Native varieties**
- 4. Wild varieties**
- 5. Related species/genera**

Commercial cultivars and breeding lines

Advantage

- Genes of desired traits can be used directly

Disadvantage

- Must be aware of essentially derived regulation
- Usually lack in genes conferring resistance to diseases and insects due to early evolution

Native varieties

Advantage

- Sources of desirable genes for disease and insect resistance due to long co-evolution between plants and pests

Disadvantage

- Usually associated with low yield

Wild and related species

Advantage

- Novel genes not available in commercial varieties

Disadvantage

- Include undesirable genes (genetic drag or genetic load), thus used as gene sources in genetic transformation rather than direct use



Desired traits in plants

Common desirable traits

- Taste, appearance and nutritional quality
- Natural fiber
- Fast growing trees
- Significant medicinal values in vegetables and herbs as health or nutraceutical foods for health benefits

Energy and fiber are novel traits

Production of new plants

Traits related to nutritions

Demand

Variety of Protective Components in Fruits and Vegetables

Color of Wellness



Phytochemicals

Allicin

Sulfaforaphanes

Beta Carotene

Anthocyanins

Lycopene



**Eat Your Colors Every Day
To Stay Healthy & Fit**

Special vegetables needs recipes



NUTRITION FACTS

Serving size: 100g

Amount per serving

Calories: 25

Calories from Fat 0

	% Daily Value*
Total Fat: 0g	0%
Saturated Fat: 0g	0%
Trans Fat: 0g	
Cholesterol: 0mg	0%
Sodium: 0mg	0%
Total Carbohydrate: 5g	2%
Dietary Fiber: 2g	0%
Sugars: 5g	
Protein: 1g	

Vitamin A: 10%

Calcium: 0%

Vitamin C: 30%

Iron: 2%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

NUTRITION FACTS

Serving size: 185g

Amount per serving

Calories: 50

Calories from Fat 3.5

	% Daily Value*
Total Fat: 0.4g	1%
Saturated Fat: 0.1g	2%
Trans Fat: 0g	
Cholesterol: 0mg	0%
Sodium: 4mg	0%
Total Carbohydrate: 12g	4%
Dietary Fiber: 2g	7%
Sugars: 6g	
Protein: 2g	

Vitamin A: 7%

Calcium: 2%

Vitamin C: 569%

Iron: 5%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Source: www.sunsetproduce.com

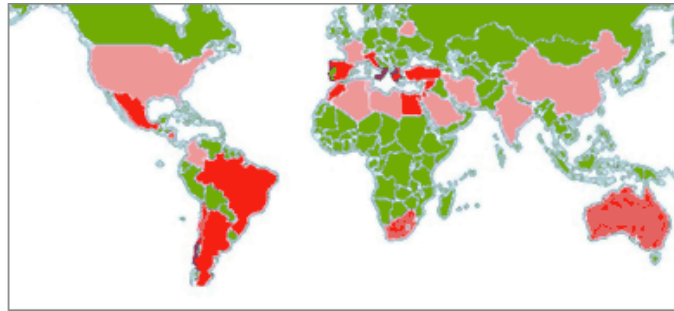
Vegetables as health snacks






Source: 1) www.agrisemen.com 2) www.sunsetproduce.com 3) www.cooksgarden.com, 4) www.burpee.com

5) www2.warwick.ac.uk/services/foodanddrink/food 6) www.vitaminis.nl

BonTom improves design traits for customers



Market Share	
	50% - 100%
	20% - 50%
	5% - 20%

- **provides seed companies with leading tomato varieties for their seed brands.**
- **Tomato varieties developed by BonTom**
 - produced by American, European, South American and Israeli seed companies
 - exported to many countries worldwide.
- **Greenhouse Tomato Varieties –**
 - Market Share Over \$50 million worth of BonTom seeds
 - >5,000 kg annually are sold by seed companies worldwide.

Breeding Trials

conduct scores of many trials taking place on-site in
**customers' fields in Israel, Turkey , Spain, France ,
Holland as well as in Mexico.**



Breeding Projects - Future directions:

- Development of varieties **rich in anti-oxidative agents**
- Improving **flavor** of high-yielding tomato varieties
- Breeding **heat-tolerant greenhouse** tomatoes
- Development of tomato **rootstocks for grafting**
- Breeding indeterminate hybrids **large, high quality,**
Roma-shaped fruit with **long shelf-life**
- Breeding of **disease-resistant** cultivars
adapted to specific regions
- Breeding of **cherry** tomatoes
- Breeding of **cluster tomatoes** with
tasty fruits of different sizes ,
shapes and colors.



Tomato nutrition and innovation



Minimato

Nirit Seeds
Israel



Summer Sun

“\$350,000 /kg”

Hazera Genetics &
Hebrew Univ.
Israel



Intense™ tomato

Nunhems Netherlands BV



Ramapo

Rutgers Univ., USA



Tomaraisin

Tomaisins Int. LTD, Israel



Tomaberry

Tokita seed Japan



Sun Black, Italy



Purple tomatoes

John Inn Center, UK

Salt Tolerant Tomato

■experimental varieties
currently undergoing field
trials in target locations
worldwide...

Evogene and Zeraim
Gedera...Israel

Summer Sun tomato



**Most expensive seed \$
350,000/kg; fruits \$25/kg**

**Honey sweet, high in beta
carotene**

**Bred by Hazera Genetics and
Faculty of Agriculture, Hebrew
University, Israel**

Tomaberry...

Bred by Tokita Company, Japan





Tomaisins: Lycopene from Israel ?

- Rich in anti-oxidants
- 20 times more lycopene than a regular tomato
 - 10 raisins (= 20 g.) contains 1/3 of Lycopene daily recommended intake
- Include Beta-Carotene, Provitamin A, as found in carrot
- 50 raisins (= 100 g.) contains 75% of the daily recommended intake of Vitamin E for an adult

- EP1211926 - METHOD FOR BREEDING TOMATOES HAVING REDUCED WATER CONTENT AND PRODUCT OF THE METHOD
 - U.S. Pat. No. 7,119,261 B1 Oct. 10, 2006
 - U.S. Pat. App. No. 2010/0095393

Ramapo old US native cultivar



Coming back for backyard garden. Improved by Rutgers New Jersey Agricultural Experiment Station since 1968.

www.njfarmfresh.rutgers.edu/documents/Ramapoorderform.pdf



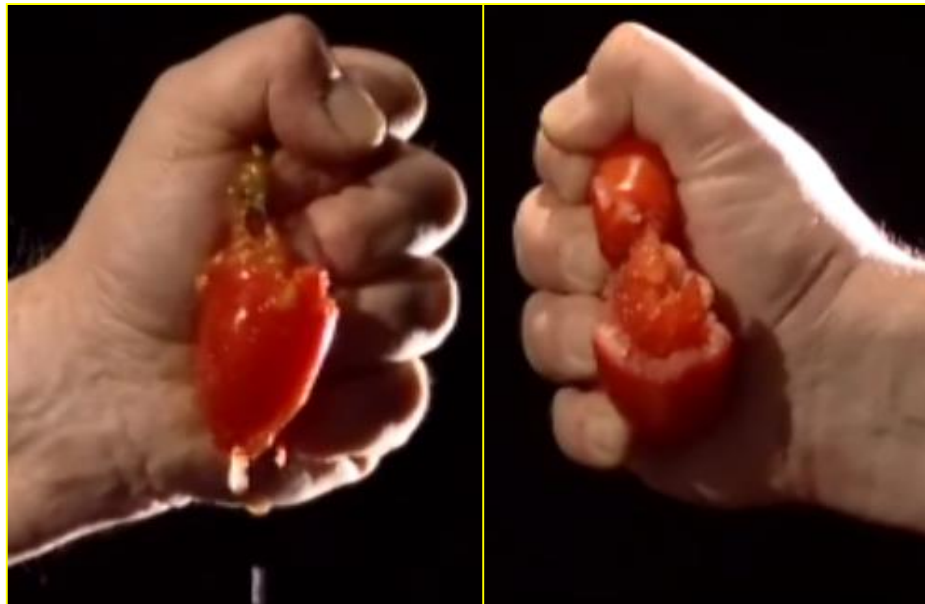
- Caption: **Purple, high anthocyanin** tomatoes and red wild-type tomatoes.
- Credit: John Innes Centre, Norwich Bio Science Institutes, UK.
- Usage Restrictions: None
- Related news release: *Fried **purple tomatoes***
- Scientists have expressed **genes from snapdragon** in tomatoes to grow purple tomatoes high in health-protecting anthocyanins.....



Nunhems Intense™ tomato

Beef tomato with full, firm flesh...for salads & the fresh-cut sector.

- very dense structure
- no juice is lost when the fruit is cut



Innovative new product

Minimato... *a “fool proof” and the world’s first interactive tomato plant*

“breakthrough”, “educational”, “innovative”, “decorative”,
“convenient” and “superbly packaged”



“A new dwarf cherry tomato plant specially prepared and packaged for **harvesting in the home**, provide up to 2 months of decoration ...35 cm., 40-50 fruits”



Nirit Seeds LTD, Israel. www.minimato.com

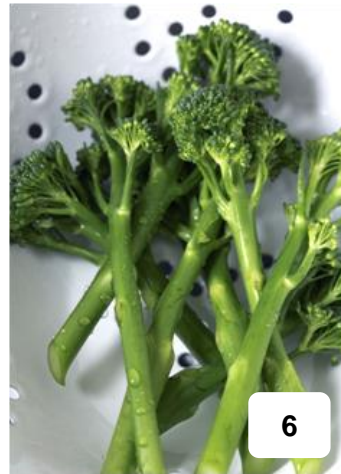
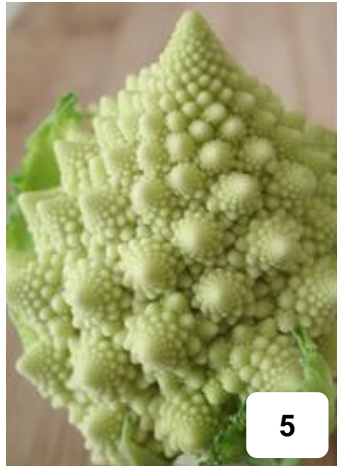


Kaye Innovation Awards
Hybrid Peppers Developed at Hebrew University
Achieve Worldwide Sales Success...
\$9.5 mil. In 2005



Source: 1. http://www.innovations-report.com/html/reports/agricultural_sciences/report-66243.htm
 2. <http://www.usna.usda.gov/Research/BlackPearl.html>
 3. <http://www.ars.usda.gov/is/AR/archive/sep06/veg0906.htm>





Cauliflower, cabbage and broccoli were improved into different colors

[w](#)

Source: 1. <http://www.westcoastseeds.com/productdetail/Vegetables/Cauliflower/> 2. <http://www.jungleseeds.com/SeedShop/Vegetables.htm>
 3. <http://www.agrisemen.com> 4. <http://corvallis.craigslist.org/grd/936881318.html> 5. <http://www.almostachef.com/2008/04/romanesco-cauliflower>
 6. <http://www.tenderstem.co.uk/photography1.htm> 7. <http://www.elsoms.com/PDFs/32-40.pdf>

Vegetables with nutraceutical traits



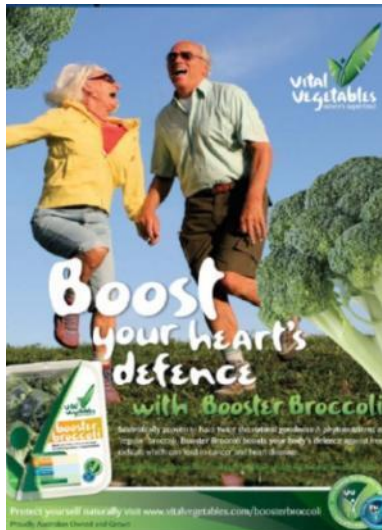
VitalVegetables

"nurtured by nature, certified by science"

A multi million dollar world class research project developed by Australian and New Zealand scientists.

Brand Promise

To revolutionize the ideal of natural prevention and holistic wellness by providing deliciously tasting, wholesome natural vegetables which have been scientifically proven to contain **twice the phytonutrient** goodness of basic varieties



Vitalimeter Phytonutrient Potency Index		
PHENOLICS PH	normal broccoli	
	booster broccoli	
CAROTENOIDS CA	normal broccoli	
	booster broccoli	
GLUCOSINOLATES GS	normal broccoli	
	booster broccoli	

Source: Adapted from Vital Vegetables-project website (August 15, 2010)

BROCCO SPROUTS®

Powered by **sgs**, the Long Lasting Antioxidant



5 Hrs.

Ordinary antioxidants only last for hours

One Serving



One Ounce

sgs™

Protects for Days!

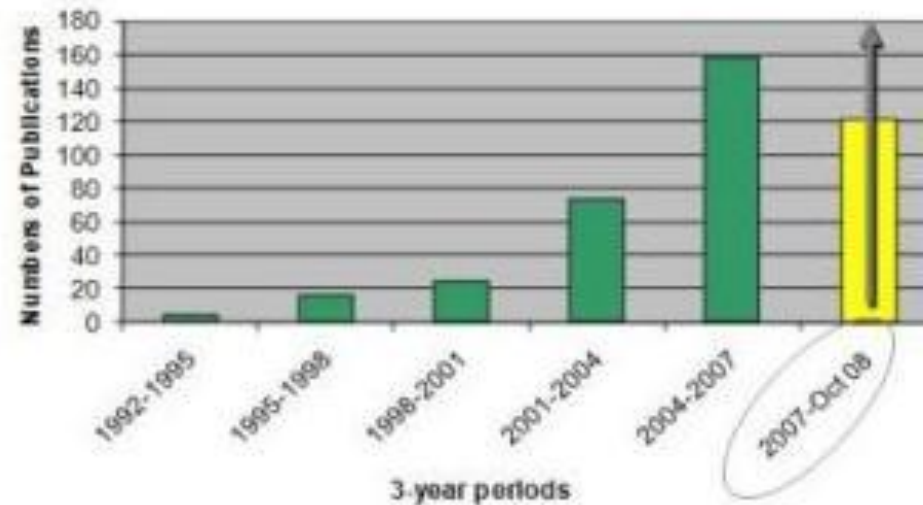
Day 1

Day 2

Day 3

<http://brassicatea.com/content/view/10/1/>

ANNUAL PubMed 'Sulforaphane' CITATIONS

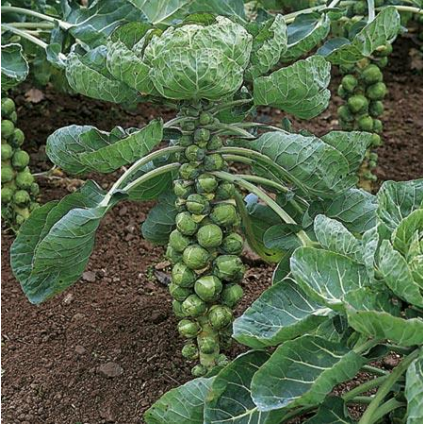


<http://www.enduracell.com/links>

Since the initial 1992 discovery of sulforaphane glucosinolate in broccoli, scientific studies on **SGS** have increased 10-fold world-wide.

Tozer Seeds' Flower Sprout

Tozer Seeds has launched the Flower Sprout, which is the size of a sprout but is open rather than closed and has a mild kale flavor.





http://www.cals.wisc.edu/media/news/02_00/carrot_pigment.html



<http://www.vic.edu/main>



<http://www.theproducehunter.com/productdisplay.asp?ID=2384>



<http://www.theproducehunter.com/productdisplay.asp?ID=5521>



<http://www.homedepot.ca/wcsstore/HomeDepotCanada/images/HDBuyingGuides/mckenzie/en/CV130122.jpg>





Ayamurasaki



Japan Orange- and Purple-Colored Sweetpotato Juice.



China Fried Vegetable Chips
SF-020



Source: Dr. M. Isabel Vales Potato Genetics and Breeding



Small tomato "apérillables " from France can be consumed as snack without peeling. Just put in a microwave oven for 3 minutes.



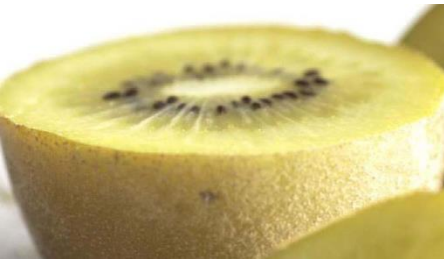
Red Flesh Apple

HortResearch fruit cultivars

The Horticulture and Food Research Institute of New Zealand



***“Innovation & Differentiation
Taste, Convenience & Health”***



Zespri™ Gold Kiwifruit (Hort16A)



Kiwiberry (Hortgem Tahi)



Feijoa (Apollo Star)



Crisp white fleshed peach (Coconut Ice)



Blueberry (Reka)



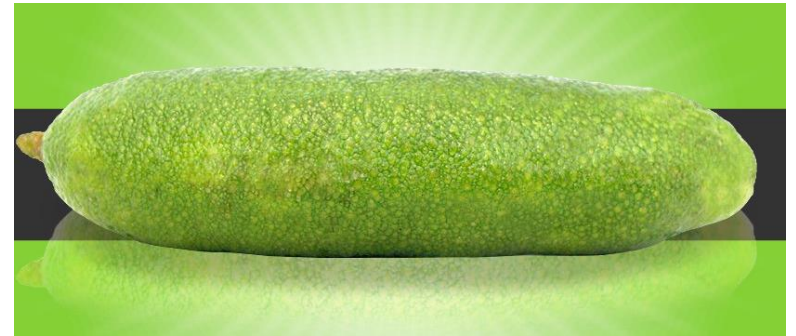
Blackcurrant (Blackadder)



Boysenberry (Riwaka Choice)



Tamarillo (Sweeten)



FRUIT LOGISTICA
Innovation Award
2011

fingerlimes[®]

limeburst[®]

Citrus Caviar

A fingerlime cut in half, revealing a dense cluster of small, clear, gelatinous caviar pearls inside. Some pearls have spilled out onto the surface below.

Product of Australia

Limeburst Fingerlimes, native to the Australian rain forest

From Dream to Reality: superior in taste, color and texture



85 varieties



Limeburst® pink



Limeburst® green



Limeburst® opaque



Limeburst® yellow



Limeburst® burgandy

- the same shape and size of an adult finger
- a distinctive autumnal or rainforest aroma
- the skin can be green, black, yellow or red
- the color of the pulp is variety dependant
opaque to pink, lime green to yellow and red to vibrant burgundy
- bite into the pulp the vesicles burst in your mouth, releasing its unique tangy lime flavor
- gender specific





Keygene: The Netherlands research company highest ranking agri-business company in European Biotech SME Award 2010



- The **only “agri-company”** in the top five finalists of the first ever Most Innovative European Biotech SME Award.
- The unique international position as developer of molecular breeding solutions to produce more efficient food, feed, fuel, fiber, flower and fun crops with a lower environmental footprint.
- has four strategic customers: Enza Zaden, Rijk Zwaan, Vilmorin & Cie, & Takii
- aim is to develop novel enabling technologies and applications to support companies and institutes that carry out fundamental or applied genetic/genomic research or that seek to enhance the quality of their product through the improvement of the genetic material used in their industrial processes.



Services & Technologies

- prefers to work with breeding companies in partnerships, either for long-term molecular support of the breeding programs of the partner or in co-development programs with the aim to introduce novel traits into the market.
- developed a large number of enabling technologies that comprise the [three technology platforms](#):
 - [Lead Discovery & Validation](#)
 - [Accelerated Molecular Breeding](#)
 - [Molecular Mutagenesis](#)

The standard applications and enabling technologies

- **Sequencing Services** - 454 and Solexa
- **Whole Genome Profiling (WGP)** - Physical map construction
- **KeyTrack™** Automated phenotyping, **Whole Genome Sequencing**, - Genome sequence assembly
- **Genetic consultancy** - - Bioinformatics solutions
- **CRoPS®** - HTP SNP discovery, - Molecular Genetic Solutions,
- Genetic fingerprinting
- **KeyPoint™** - Mutation Screening - Allele mining
- **SNPWave®** - Multiplex SNP detection
- **AFLP®** - Genetic fingerprinting, - Gene expression

High Tech Equipment

- ◆ Roche 454 GS-FLX

- 400,000 reads 400 nt per run



- ◆ Illumina Genome Analyzer 1G

- 40,000,000 reads 35 bp per run



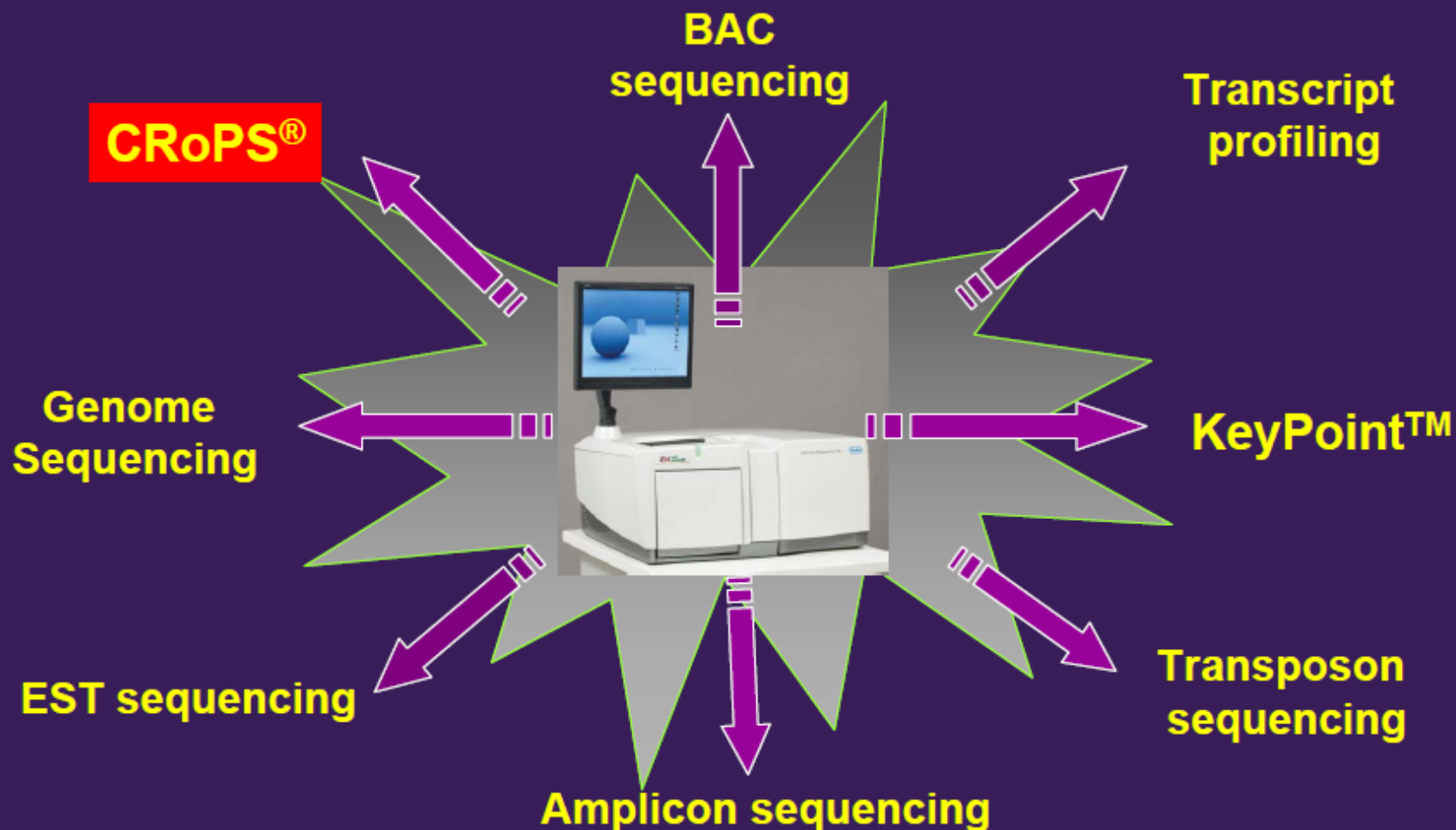
- ◆ LemnaTec Scanalyzer

- High throughput phenotyping equipment



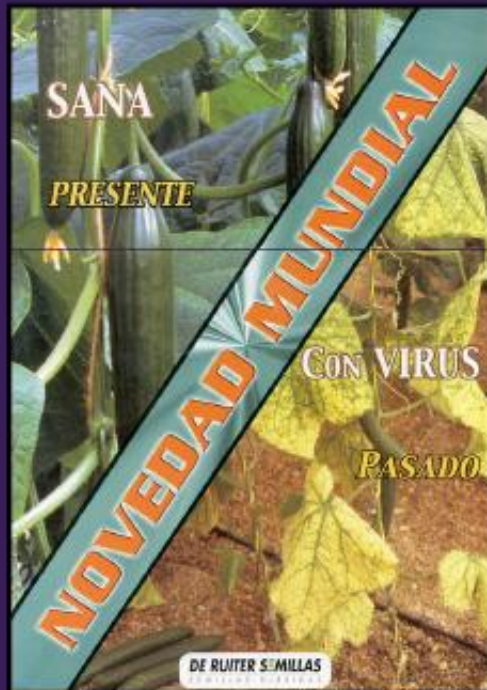
Filling up the cucumber genomics tool box

Overview GS FLX applications



Marker Assisted Breeding: commercial products

CYSD Virus
Resistance cucumber



brown aphid
resistant lettuce



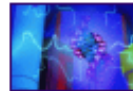
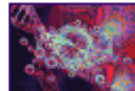
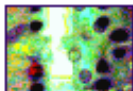
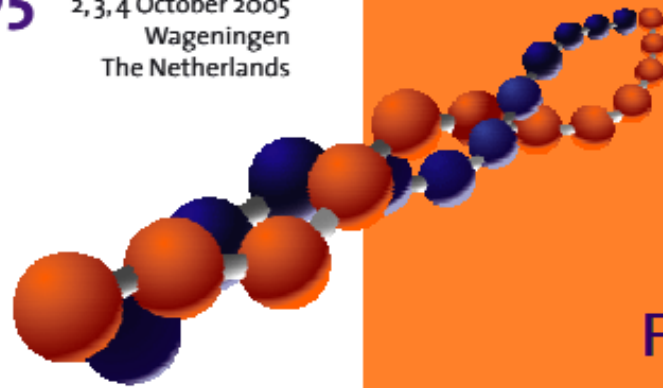
stacking
resistances



Genomics in Business

2005

2,3,4 October 2005
Wageningen
The Netherlands



Applied Bioinformatics



From Genomic Data to Improved Traits

Rodrigo Yelin

Director of Computational Genomics
EVOGENE LTD



Evogene's Trait Development Pipeline



Trait Improvement Projects

- Tomato Aroma and Taste
- Nitrogen use efficiency
- Cotton fiber quality & yield
- Abiotic Stress Tolerance (drought & salinity)

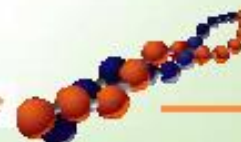


Gene Validation in Commercial Processing Tomato (M82)

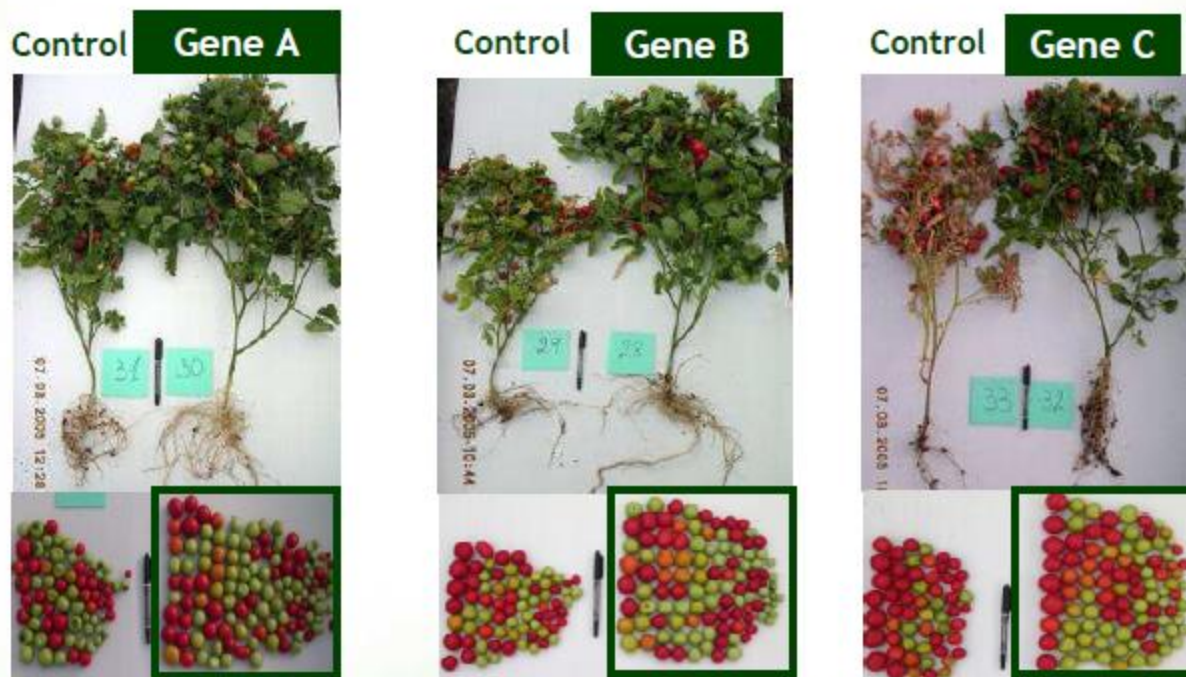
Control plants
Irrigated with saline water



Plants expressing Gene A
Irrigated with saline water



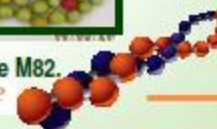
Gene Validation in Commercial Processing Tomato (M82)



Backcross of transgenic Microtom expressing the candidate genes with commercial processing tomato line M82.

Plants were grown in the presence of 180 mM NaCl.

Enhance the value

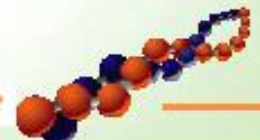


Gene Validation in Commercial Processing Tomato (M82)

Transgenic Plants Yield at least as well as the control plants under Normal conditions

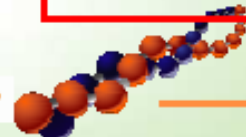
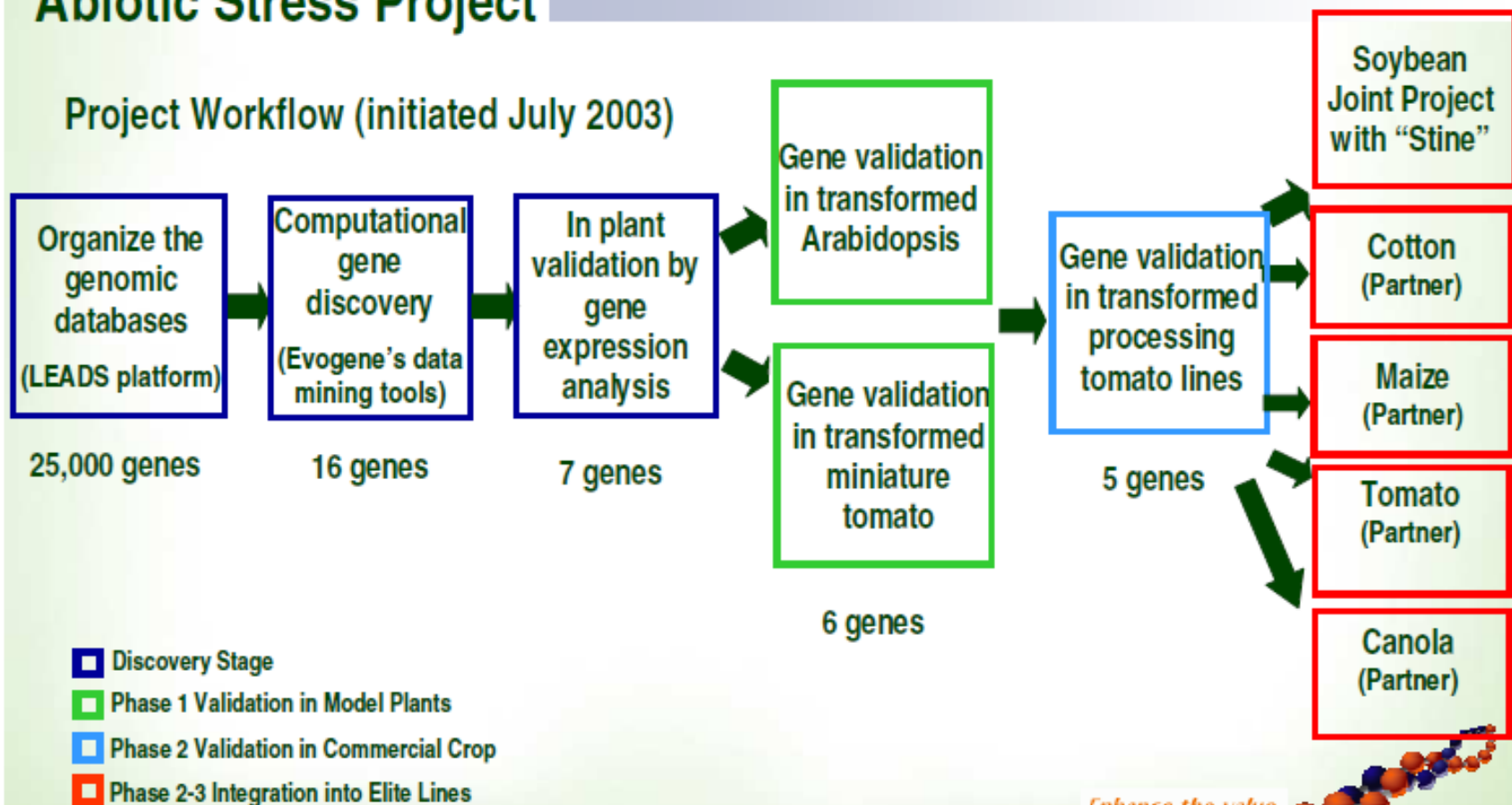
BIOMASS

Backcross of
Gene A in M82
line grown
under normal
conditions
(Fresh Water)



Abiotic Stress Project

Project Workflow (initiated July 2003)



Netherlands to China

Land with incredible possibilities"

Dutch horticulturalists take stock of Chinese horticulture

China want to achieve **in 5 years**, what we have achieved in the last **30 years**. A very large demonstration project has been built in the province of Sichuan in the town of Beichuan. This demoproject also has a new knowledge centre, in which young Chinese people can learn about agriculture.





Bell Peppers/Paprika



Broccoli



Carrot



Cauliflower



Cherry Tomato



Chinese Cabbage



Baby Corn



Bamboo Shoot



Bell Peppers/Paprika



Broccoli



Carrot



Cauliflower



Chinese Radish



Choi Sum



Cucumber



Eggplant



Hot Peppers



Iceberg Lettuce



Celery



Corn



Green Beans



Mix Vegetables



Mukimame



Mushroom



Loquat



Mandarin



Melon



Onion



Potato



Pumpkin



Okra



Pea Pods



Spinach



Strawberry



Sugar Snaps



Water Chestnuts



Sugar Snaps



Summer Squash



Sweet Corn



Sweet Potato



Watermelon



Welsh Onion



Huangshan R&D Center



Good vegetables in Africa



Ms. Emily Kiema from Kyome Fresh Business Development department





InterVeg Exports Ltd



InterVeg Exports Ltd



InterVeg Exports Ltd



InterVeg Exports Ltd

Germinating seeds are health foods



12



36



48



0



72



120



0



12



72

120



Traits from new plants

Salicornia Crop Field **Sun, seawater and deserts**

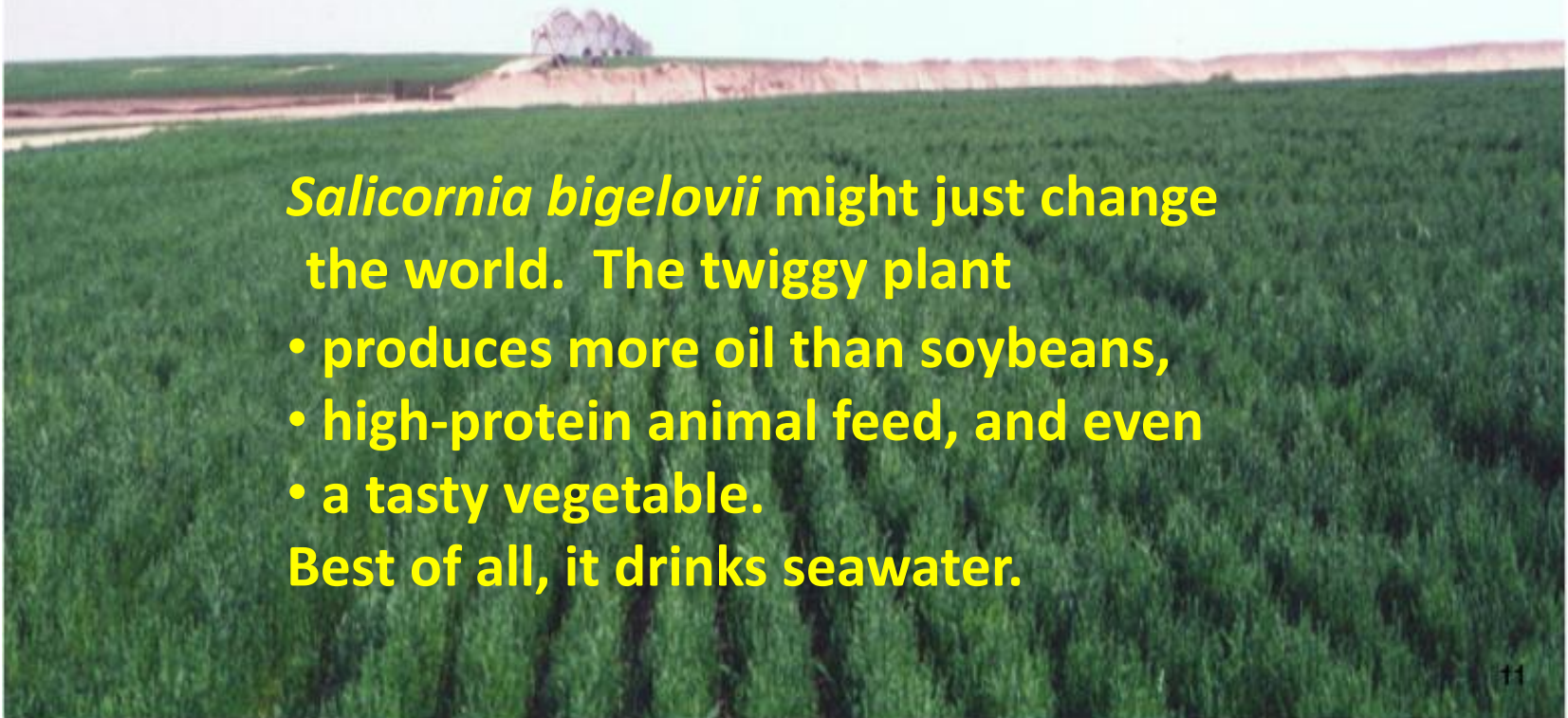
"Salicornia is a very promising crop, really, it is the hope of the world."

Known in parts of the world as Sea Asparagus and Samphire

Salicornia bigelovii might just change
the world. The twiggy plant

- produces more oil than soybeans,
- high-protein animal feed, and even
- a tasty vegetable.

Best of all, it drinks seawater.



Irrigating Crops with Seawater

As the world's population grows and freshwater stores become more precious, researchers are looking to the sea for the water to irrigate selected crops

by Edward P. Glenn, J. Jed Brown and James W. O'Leary

Earth may be the Ocean Planet, but most terrestrial creatures—including humans—depend for food on plants irrigated by freshwater from rainfall, rivers, lakes, springs and streams. None of the top five plants eaten by people—wheat, corn, rice, potatoes and soybeans—can tolerate salt: expose them to seawater, and they droop, shrivel and die within days.

One of the most urgent global problems is finding enough water and land to support the world's food needs. The United Nations Food and Agriculture Organization estimates that an additional 200 million hectares (494.2 million acres) of new cropland—an area the size of Arizona, New Mexico, Utah, Colorado, Idaho, Wyoming and Montana



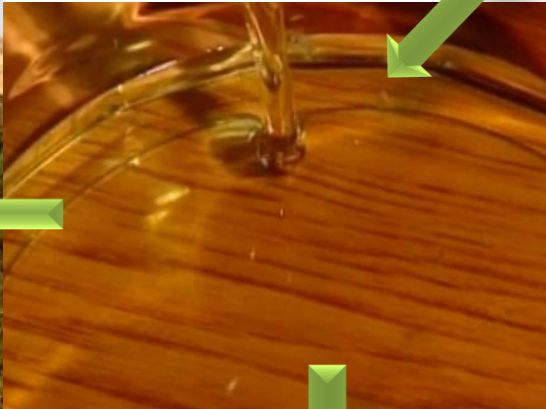
[Dr Carl Hodges](#)

an atmospheric physicist, has developed a way to farm a salt-loving plant, salicornia, for food and biofuel.

**feed the world,
fuel our vehicles and
slow global warming.**

GLASSWORT SPECIES (here, *Salicornia bigelovii*) usually grow in coastal marshes. Because of their ability to flourish in saltwater, glasswort plants are the most promising crop to be grown so far using seawater irrigation along coastal deserts. They can be eaten by livestock, and their seeds yield a nutty-tasting oil.





National Aeronautics and Space Administration



**JAL 30 Jan 2009
[42;8;trace] %
biojet (Camelina)**



X

National Aeronautics and Space Administration



**Air New Zealand
30 Dec 2008
50% biojet
(Jatropha)**



X

www.nasa.gov



7 Jan 2009 Continental 47.5;2.5 % biojet



www.nasa.gov

National Aeronautics and Space Administration



**Virgin Atlantic
24 Feb 2008
20% biojet
(coconut oils)**



www.nasa.gov

Oil-bearing seeds



CHENOPODIACEAE
Salicornia bigelovii
(DWARF SALTWORT)



1. Edible vegetable oil
2. Biofuel
3. Cosmetic oil

<http://www.hazmac.biz/070917/070917SalicorniaBigelovii.html>

<http://www.photoarchive.saudiaramcoworld.com/SlideDetail.aspx?mode=search&keyword=ND94&id=36898>



1. Vegetable tips when harvest green: Sea Asparagus



<http://www.flickr.com/photos/islandvittles/4612408809/sizes/o/in/photostream/>

<http://www.papawow.com/blog/sea-beans.html>

caputmundicibus.com

<http://www.flickr.com/photos/niamheen/845431958/in/photostream/>

Traits required for chamber production

Plant Cellar



The size of the prototype is roughly a small refrigerator, and it has multiple light-emitting diode bulbs (LED) inside. This system can grow vegetables faster than traditional outdoor farming, and it takes only 35-40 days from seeding to harvest.

<http://www.imf-wb.2012tokyo.mof.go.jp/en/cool/garden/kodawaru/plant.html>
<http://innoplex.org/eng/blog/2012/08/05/vertical-hydroponics-in-japanese-homeplace>



University of Arizona, Environmental Research Laboratory
supported by a grant from The Seawater Foundation , October 7, 2005
Salicornia Research



■ MINI-VEGEPLANT 130



Specifications

* For reference purposes only

Model	MINI-VEGEPLANT 130
Power supply	100V, 12A
No. of shelves	3
No. of plant pots	72 (12 plants x 6 pots)
Yield (No. of plants)	90 to 130 per month
Light source	Fluorescent lights 9 (with reflector) + LED grow-light source
Light source control	Manual or timer
Nutrient medium control	Controls EC and pH with an automatic control unit
No. of cooling units	1
Water temperature range	18 to 25°C
Operating temperature and humidity	Temperature: 20 to 40°C Humidity: 50 to 85%RH (without condensation)
Storage temperature and humidity	Temperature: 20 to 40°C Humidity: 50 to 85%RH (without condensation)
Dimensions (WxDxH) mm	1300 x 700 x 1900
Weight	Base unit: approx. 152kg. During full operation: approx. 255kg
Accessories	Instruction Manual

■ Optional LED lighting

Natural light LED type



Red/White LED type



Red/Blue LED type



* Custom lighting also available upon request.



NOTES

- * Please read the "Instruction Manual" thoroughly before use for correct and safe operation.
- * Specifications and design might change without notice for the purpose of product improvement.

Fairy Plant Technology Inc.

3F CCS Asset Bldg.
491-1 Nakadenita-cho, Minamachi-8gashiwa,
Daitoku-dai, Konogyo-ku, Kyoto 600-0012, JAPAN
Phone: +81-75-441-7772 Fax: +81-75-441-7774
Website: <http://www.fairy-pt.com>

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Created as of November 2010. 0000-01-001-MVP



Vegetable Cultivation Unit

MINI-VEGEPLANT



Fairy Plant Technology Inc.

The plants grow in water using "**NASA-tested**" aeroponic technology. grow five times faster.

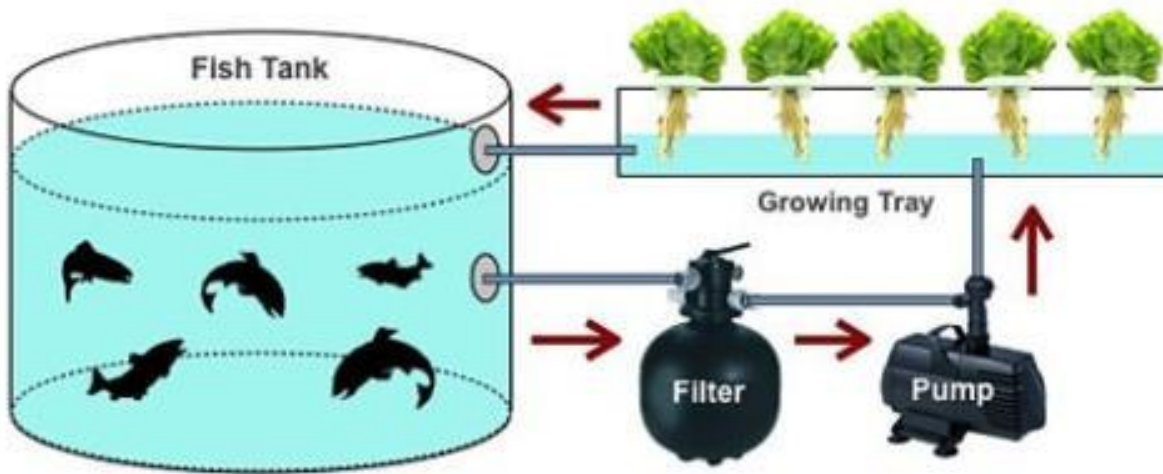


The AeroGarden Family...

guaranteed
to grow



Aquaponics: fish and vegetables



www.cityscapefarms.com/soillessfarming/



James Rakocy, Donald Bailey, Charlie Shultz and Jason Danaher. 2010. The Status of Aquaponics 2010



Portable Farms™ Aquaponics Systems



Commercial 10,000 sq ft Portable Farms Aquaponics System in Botswana, Africa

<http://portablefarm.com>



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Source: 1. Rocoky, J. Update on Tilapia and Vegetable. Production in the UVI Aquaponic. System 2..www.flickr.com/ photos/ 9304424@N02/3898457715 3.www.sunshinecoastaquaponics.com.au/ 4.www.ansarisustainableliving.com/CSLUK/index.htm 5. http://portablefarm.com 6. www.aquaculture hub.org/photo/my-aquaponics-equipment/prev?context=user 7. www.synergyfish.com/wp-content/uploads/2010/04/tote-aquaponic-0012.jpg 8..www.aquaponics.org.uk 9.. www.youtube.com/watch?feature=endscreen&NR=1&v=GshsHYMdNvw 10. http://backyardaquaponics.com/systems.html





Thai herbs with medicinal traits





Q & A

