THEME [ENV.2012.6.3-1]
Innovative resource efficient technologies, processes and services

ZEPHYR project – Deliverable D7.3

Proceedings of Workshop1

Funding scheme: **Collaborative Project**

Project Acronym: **ZEPHYR**

Project Coordinator: **TUSCIA UNIVERSITY**

Proposal full title: **Zero-impact innovative technology in forest plant production**

Grant Agreement n°: **308313**

Authors: **Elisabetta Margheriti**

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Date: **January 2014**

Project start: October 2012 **Duration: 36 Months**

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1. Introduction

This deliverable presents the proceedings of the first workshop co-organised by the Zephyr project: inside an international multiple event. The workshop was held with a delay respect to the schedule, due to the decision to have the first project workshop in an international multiple event in November 2013, instead of a stand-alone event on September 2013 .

The UNESCO Italian Committee launched the week “Education for Sustainable Development” from 18 to 24 November 2013; Veltha and Vivai Torsanlorenzo, partners in the DEBPAL project, decided to organize during such a week a series of events related to DEBPAL2 and further EU projects and applied for the UNESCO sponsorship.

The aim was to have a series of international events (all related to biodiversity conservation and sustainable development) concentrated in the five days of the UNESCO week and allow an actual exchange of experiences and point of view between partners of 3 different EU funded projects coming from 11 different EU Countries and several stakeholders.

Conferma di inserimento dell'iniziativa nel Programma Nazionale della
Settimana UNESCO di Educazione allo Sviluppo Sostenibile 2013

Con la presente siamo lieti di confermare, con le specificazioni che seguono, l'inserimento della Vostra iniziativa nel Programma della *Settimana UNESCO di Educazione allo Sviluppo Sostenibile* (18-24 novembre 2013), promossa e patrocinata dalla *Commissione Nazionale Italiana per l'UNESCO* e dedicata quest'anno al tema ***I Paesaggi della Bellezza: dalla valorizzazione alla creatività.***

Si inviano in allegato i loghi, che dovranno essere utilizzati congiuntamente, l'uno accanto all'altro, unitamente alla dicitura "Questa iniziativa/materiale è stata/o realizzata/o per la "*Settimana UNESCO di Educazione allo Sviluppo Sostenibile 2013*". Si ricorda che i loghi UNESCO e Settimana DESS non possono in nessun caso essere accostati a "brand" commerciali.

Sul sito *www.unesco.it* è possibile scaricare la locandina 2013 utilizzabile per promuovere l'iniziativa e la *Settimana*. La locandina potrà essere utilizzata da tutti coloro che partecipano alla *Settimana*. Si potrà unire la locandina (loghi inclusi) ai propri poster/flyer/avvisi/calendari relativi alla specifica iniziativa organizzata.

Si ricorda che il materiale prodotto dalla Commissione UNESCO (loghi e locandina) potrà essere utilizzato solo con riferimento alle specifiche iniziative che si svolgono nel periodo 18-24 novembre 2013 e che sono state inserite da questa Commissione nel programma della *Settimana*. Qualsiasi utilizzo improprio o inerente a attività diverse o realizzate in periodi diversi è vietato e potrà essere penalmente perseguito. In via eccezionale, laddove si tratti di materiale che, pur essendo specificamente realizzato per l'evento inquadrato nella *Settimana*, dovesse trovare una qualche residua diffusione in periodi successivi (per es: atti di convegno), è necessario che anche nel materiale diffuso i due loghi siano sempre preceduti dalla dicitura "Questo materiale è stato realizzato per la Settimana UNESCO di Educazione allo Sviluppo Sostenibile 2013".

Ringraziando per l'impegno e la collaborazione assicurata alla campagna UNESCO per l'Educazione allo Sviluppo Sostenibile, inviamo i nostri migliori saluti e auguri di successo per le iniziative.

Buona *Settimana 2013* a tutti!

* * *
Commissione Nazionale Italiana per l'UNESCO

Fig. 1 Approval of the events by the UNESCO Committee

This initiative achieved the UNESCO sponsorship as shown in fig. 1 (*no money or kinds: only the insertion of the event in their list and the authorization for using their logos*) and was successfully held during the period from 19th to 23rd November 2013 with both public and restricted (only on invitation) events, as for the programmes in fig. 2 and 3.

The participation at the multiple event was a unique occasion to disseminate the ZEPHYR project to international and Italian stakeholder through the participation at other workshops, as well as through the general project presentation of Thursday 21

Organizzazione delle Nazioni Unite per l'Educazione, la Scienza e la Cultura

Commissione Nazionale Italiana per l' UNESCO

PAESAGGIO, BELLEZZA E CREATIVITA' PER LA SETTIMANA UNESCO DI EDUCAZIONE ALLO SVILUPPO SOSTENIBILE 2013
(18-24 novembre 2013)

Questa iniziativa è stata/o realizzata per la "*Settimana UNESCO di Educazione allo Sviluppo Sostenibile 2013*

International events organised for the week 18 – 24 November by the International no profit Association Veltha ivzw

Vivai Torsanlorenzo - Via Campo di Carne n° 51 - 00040, Tor San Lorenzo - Ardea (Roma)

PUBLIC EVENTS

Tuesday 19/11	Wednesday 20/11	Thursday 21/11	Friday 22/11	Saturday23/11
h 10,00	h 10,00-16,00	h 09,00	h 10,00	h10,00
WORKSHOP "From Research to Business" Organised within the EU FP7 Project **DEBPAL** *"Reinforcing Capacity Building for Defending Biodiversity in the Palestinian Territories"*	Open day Guided tours in the nursery "Vivai Torsanlorenzo" (reservation requested)	Presentation of the EU FP7 project **ZEPHYR** *"Zero impact innovative technology for forest plant production"*	Workshop Organised within the EU LIFE project **Verenike** *"Use of innovative practices and new technology in the production of wide variety and high quality forestry seedlings in order to enhance regeneration success and increase biodiversity"*	International workshop organized by Torsanlorenzo Prize Palestinian Biodiversity Photo contest

Fig. 2 List of the public events approved by the UNESCO Committee

Tuesday 19/11	Wednesday 20/11	Thursday 21/11	Friday 22/11	Saturday23/11
h 10,00	h 09,30	h 09,00	h 09,00 Project meeting ZEPHYR (only project partners)	h10,00
WORKSHOP “From Research to Business” Organised within the EU FP7 Project DEBPAL h 13,00 Lunch	Visit to a Naturalistic area (only Debpal partners) h 13,00 Lunch Break	Presentation of the EU FP7 project ZEPHYR h11,00 Project meeting ZEPHYR (only Zephyr partners) h 11,30 Visit to the Botanic Garden in Rome (only Verenike and Debpal partners) h 13,00 Lunch Break (only Zephyr partners)	h10,00 Workshop “ Organised within the EU LIFE project Verenike h 13,00 Lunch Break	Torsanlorenzo Prize Palestinian Biodiversity Photo contest h 13,00 LUNCH
h. 14,30 Brokerage event between researchers and stakeholders h 20,00 DEBPAL project dinner	h 16,00 Project meeting DEBPAL (only project partners) h 20,00 Social dinner offered by VIVAI TORSANLORENZO	h 15,00 Project meeting ZEPHYR (only project partners) h 20,00 Zephyr project dinner	h 14,00Project meeting Zephyr (only project partners) h 20,00 VERENIKE project dinner	

Fig. 3 Full list of events (public and restricted)

2. Workshop "From Research to Business"

This workshop was focused to:

- Transfer of best practices on how to transform the results of biodiversity conservation research into business opportunities
- Working on a real business plan proposal raised by Palestinian Researchers and stakeholders
- Face to face contacts with other EU researchers and Italian industries working in a field related to biodiversity conservation

As for the following programme:

Day 1-WORKSHOP
"From Research to Business"
Organised within the EU FP7 Project DEBPAL
Reinforcing Capacity Building for Defending Biodiversity in the Palestinian Territories
Tuesday 19/11
Programme

h 10,00 Opening Speech – Mrs. Elisabetta Margheriti- Vivai Torsanlorenzo- Promoter of the event
h 10,10 Zakariya Salawdeh - Assistant Deputy Minister, Ministry of Agriculture Palestine
h10,20 Dr. Abdel Kareem - Al –Quds University
h10,30 Dr. Mutaz Ali Kutub - Al –Quds University -Coordinator of DEBPAL project
h10,50 Prof. Bartolomeo Schirone – Tuscia University –
h11,05 Dr. Husam Taleeb - Director of Forestry Department , Ministry of Agriculture Palestine
h11,15 COFFEE BREAK
h11,45 Dr. Khaled M. S. Sawalha - Al –Quds University – Business opportunities related to the biodiversity conservation
h12,00 Prof. Maurizio Sorice – University of Rome "Sapienza"
h12,15 Introduction to the Palestinian PhD Students scientific activities
Prof. Andrea Petroselli, Tuscia University
Dott. Federico Vessella, Tuscia University
h12,40 Ms. Iman Al Hirsh PhD student at Tuscia University (within Debpal project)
h12,45 Ms. Nisreen Alqadi PhD student at Tuscia University (within Debpal project)
h13,00 LUNCH
h14,30 Brokerage events with Italian universities and companies

- 14,40-Dr. Abdel Kareem Abdu Sharif Al –Quds University -brief introduction
- 14,50 Dr. Fuad S. Q. Al-Rimawi Al –Quds University – brief introduction
- 15,00 Dr. Jehad S.Q. Abadi Al –Quds University – brief introduction
- 15,10 Mr. Maher Ismail (Palestinian businessman) brief introduction
- 15,20 Italian company Ecocosmesi (Cosmetics production)
- 15, 30 Italian company Pragma (Cosmetic and medicinal plants production production)

h 15,40 face to face meetings
h18,00 End of the brokerage event
h20,00 project dinner

Fig. 4 Dr. *Abdel Kareem Abdu Sharif*

Dean of Faculty of Science and Technology

Al – Quds University

Fig. 5 Dr. *Mutaz Qutob - Al – Quds University*

Coordinator of the Debpal2 Project

Fig. 6 Prof.Bartolomeo Schirone - Tuscia University

Coordinator of the Zephyr project

3. Cross- Fertilisation with other EU- Funded Projects

Since all the events took place in the same premise of Vivai Torsanlorenzo, including lunchs and dinners, the partners of the different EU projects had a noticeable occasion to sharing coffee breaks and meals in the same place: this led to a relevant number of informal discussions about Common interests and possible future cooperation

Fig.7 Dinner with the project partners of 3 Different EU funded projects

The following programme of the presentations of Zephyr project towards an international public gives an idea about the number of the established relationships and their relevance.

Day 3 – 21/11/2013 - Presentation of the EU FP7 project ZEPHYR

Zero-impact innovative technology in forest plant production

Thursday 21/11

h09,00 I Introduction– Prof. Schirone –Tuscia University-Coordinator

h09,10 Status of the project , challenges and next steps – Carlo Polidori – Veltha

Presentation of some project partners: their main activities and their role in the project

H09,200	azorina	*SME– Portugal Project in Furnas Water Basin and how the project Zephyr is useful for such project.*
h09,30	SWEDISH ICT ACREO	*Research Institute - Sweden*
h09,40	Fraunhofer IFAM	*Fraunhofer Institute for Manufacturing Technology and Advanced Materials - Germany*
h09,50		*Insubria University – Faculty of Forest sciences - Italy*
h10,00	Valoya	*SME – Special LED lamps for growing vegetables in greenhouses - Finland*
h10,10	DALARNA UNIVERSITY	*University – Faculty of Forest sciences - Sweden*
h10,20	Fo.met Art.	*SME - Special mechanic devices - Italy*
h10,30	robosoft	*SME –robotic devices - France*
h10,40	exergy	*SME – energy green solutions UK*
h10,50	advanticsys	*SME –Wireless network and control systems -Spain*

h11,00 COFFEE break and networking with the other projects: multi-disciplinary approach to business opportunities

h11,30 departure for the visit at the Botanic Garden in Rome (Only Debpal and Verenike partners)

Fig.8 Participation at the Verenike workshop

Day 4 – 22/11/2013 -

WORKSHOP

Organised within the EU LIFE Project **Verenike**

"Use of innovative practices and new technology in the production of wide variety and high quality forestry seedlings in order to enhance regeneration success and increase biodiversity"

10:00-10:10 Information about LIFE projects (posters, newsletters, leaflets)
10:10-10:20 Welcome addresses by **Elisabetta Margheriti** - Torsanlorenzo Gruppo Florovivaistico
10:20-10:40 **Kalliopi Radoglou** (Professor, D.U.Th): Enhancing biodiversity in reforestation, from theory to practice, the contribution of VERENIKE .
10:40-11:00 **Georgia Viglaki and Stefanos Giannakos (**DAMT-DRCM**)**: Seed Collection, The significant part of the seedlings production
11.00-11:20 **Gabriel Spyroglou** (FRI, ELGO-DEMETER): Seed testing, the base for a good germination protocol and production of high quality plants

11:20-11:40 **Stavros Karaisaridis and Alexis Anastasiou (**DAMT-DRCM & DAMT-DCSFA(*)) Experimental sites: preparation - planting - monitoring.
11:40-13:00 Networking with Debpal2 project (*"Reinforcing Capacity Building for Defending Biodiversity in the Palestinian Territories")* and discussion on participants' inputs.
h13,00 Lunch and networking
h20,00 Project dinner and networking

- (*)Decentralized Administration of Macedonia & Thrace- Directorate for Reforestation in Central Macedonia (DAMT-DRCM), Greece (GR);

Fig.9 Zephyr partners discuss their speeches

3 List of presentations

D1 – Unitus- Marras

D2 – Robosoft - Carrell

D3 – Dalarna - Mattsson

D4 – DUTH - Smirnakou

D5 – Valoya - Korkalainen

D6 – Unitus-Vessella

D7 – Cometart - Menta

D8 – Al-Quds University - Abbadi

Project co-financed by the European Commission- DG Research & innovation, through the 7th Framework Programme

ZEPHYR

Zero-impact innovative technology in forest plant production

Ongoing work and future perspectives

T. Marras

ZEPHYR

Project aim: to introduce an innovative technology built on pre-cultivation of forest regeneration materials in a zero-impact and cost-friendly production unit (a mobile and totally automatized growth chamber).

Main problem: to find the best growth conditions for each cultivated species (similar to the natural conditions of the specific distributional area).

Ongoing work: many forest species are cultivated under different conditions of light, humidity, temperature and type of soil in order to define the best growth protocols.

Limits of this project phase: some biologically relevant factors, characteristic of hypogeal and epigeous environment, are not considered

Let us briefly analyse these factors….

1° FACTOR: PHOTOPERIOD

In the growth chambers plants are cultivated according to protocols selected in literature for each species (values of humidity, temperature and photoperiod optimal for indoor growth).

INDOOR PHOTOPERIOD = OUTDOOR PHOTOPERIOD?

YES: plant is ready for the transplant in the greenhouse or in the nursery.
NO: it would be better to adapt the plant to the outdoor photoperiod for a while.

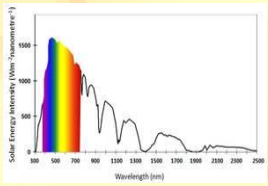
BIOLOGICAL RHYTHM OF RESERVE STARCH DEGRADATION DURING THE NIGHT

2° FACTOR: SUNLIGHT AND MOONLIGHT

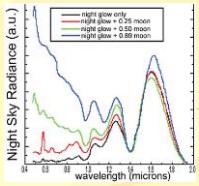
The best light spectrum for indoor plant growth has to resemble SUNLIGHT, with a combination of wavelengths able to sustain biological processes as photosynthesis, radicles extension, increase in leaves area or biomass…

LIGHT OFF = DARKNESS
INDOOR DARKNESS ≠ OUTDOOR DARKNESS

In a natural environment, plants are not generally exposed to full darkness but to moonlight from twilight to dawn.



sunlight



moonlight

Different from sunlight and independent from clouds.

Its wavelengths go deep into the soil, influencing germination.

SUN, MOON AND BIOLOGICAL CYCLES

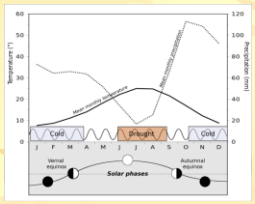
Forest trees show cyclic variations in the growth and on the phenology (e.i. diametric growth, flowering cycles…), difficult to remove even if the organism is transferred in an artificial, isolated environment.

Period	Name
< 20 hours	Ultradian
20 ± 4 h	Circadian
24 ± 2 h	Dian
> 28 h	Infradian
7 ± 3 days	Circaseptan
14 ± 3 days	Circadiseptan
21 ± 3 days	Circavigintan
30 ± 5 days	Circatrigintan
12 ± 2 months	Circannual
> 2 years	Poliennal

These rhythms are classified on the basis of the length of their cycle

Their origin is linked to past and present motions and rhythms of astral activity which affect plants directly or undirectly (via climatic oscillations).

Some biorhythms of plants correspond to the armonic series of 22-11.5-5.6 and 16-8-4 years of solar activity.



Sun and moon cycles influence plant life

PLANTS AND MOON CYCLES

Farmers have programmed agricultural activities according to moon cycles for a long time.

Nowadays, the interest of scientists in this topic is increasing, so it would be useful to collect some information about farm tradition (sowing time, harvesting time…) in different countries.

DEBPAL project may provide some information about Palestinian tradition.

The moon influences plant biorhythms through

- GRAVITATIONAL PHENOMENA
- LIGHT

POPULAR TRADITION IN THE SERVICE OF ZEPHYR PROJECT

Popular knowledge about the influence of moon cycles on plant life may give some advices to improve Zephyr project:

To introduce a lamp able to simulate the night light (sweet light)

To synchronize the sowing with the start of a moon cycle (each moon cycle lasts 28 days -> 13 moon cycles per year). The popular tradition says "to sown seeds 2-5 days before full moon".

To do a transplant when the moon is crescent, possibly after the twilight (moon light makes the change of position less traumatic for the organism)

3° FACTOR: COMMUNICATION BETWEEN PLANTS

Plants have been considered for a long time as isolated, unsensible creatures, not able to communicate.

They have more then 5 senses:
1.Sense of smell
2.Taste
3.Touch
4.Sight
5.Hearing
6.Additional senses:
e.i. perception of soil humidity, grav
CO2, chemical compounds

Above ground
wavelengths 100-500 Hz (including human voice)
Molecules into the wind

Below ground
Communication between root tips (via molecules, vibrations or magnetic fields)
Contacts between mycelia of symbiotic fungi
Root breaking cells

4° FACTOR: SENSE OF «FAMILY»

A plant is able to recognize other plants born from its own seeds or from its own «mother plant» so as plants belonging to other «mother plants» or other species.

It can decide to limit its own growth in order to leave space for the growth of its «relatives»

The number of plants growing into the same tray has to be established according to each species behaviour

It can produce some signals limiting the germination or growth of other plants

In the case of co-cultivation of different species in the growth chamber, it is important not to choose competitors

ZEPHYR

WP3: Growth protocols and biological validation

Preliminary results at the end of the first year of work

T. Marras – M.R. Ortolani

STUDIED SPECIES:

- *Punica granatum* L. (pomegranate)
- *Prunus avium* L. (wild cherry)
- *Taxus baccata* L. (common yew)
- *Abies alba* Mill. (silver fir)
- *Corylus avellana* L. (common hazel

INDOOR GROWTH CONDITIONS:

- Relative Humidity: 60 ±10%
- Room Temperature: 22 ± 2°C
- Light sources: Valoya Lamps (AP673L, AP67b, NS1, G2, AP67t)
  OSRAM FLUORA-T8
- Photoperiod: 12 L 12 D
- Tray type: quickpot Herkuplast QPD 104 VW
- Substrate: Jiffy soil (*P. granatum* and *M. communis*);
  DAFNE soil (*P. avium* and *T. baccata*)

GROWTH CYCLE SCHEME

Seeds collection

Seeds storage

Germination pre-treaments

Germination of seeds

About 30 days of indoor growth

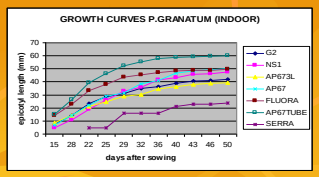
Morphometric, microscopic, biochemical, ecophysiological analysis

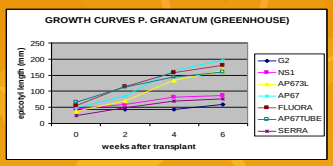
Transfer of plants in greenhouse for 1 month

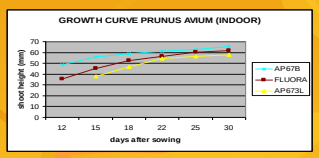
Growth curves

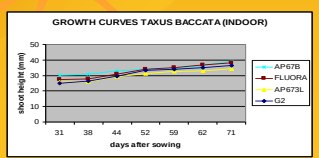
INDOOR

IN GREENHOUSE



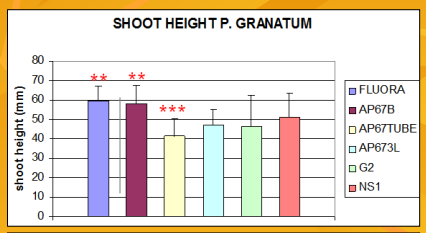


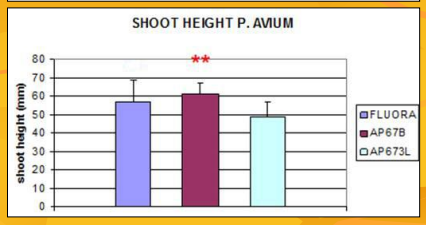




SPECIES NOT YET TRANSFERRED INTO THE GREENHOUSE

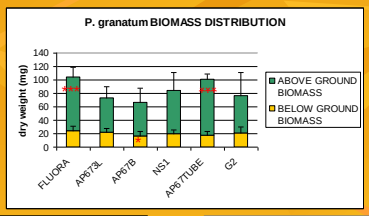
MORPHOMETRIC PARAMETERS: shoot height

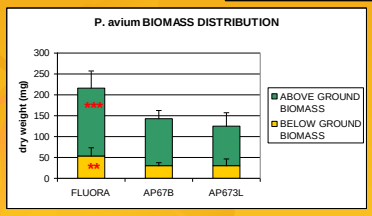


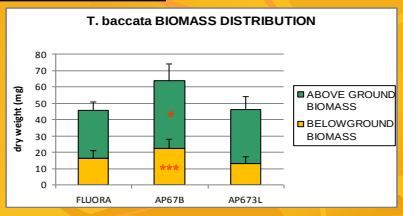


Legend of statystical analysis (crossed t-test):
* P. value < 0.5
** P-value < 0.01
*** P-value < 0.001

MORPHOMETRIC PARAMETERS: above ground biomass (dry weight of leaves and stem) vs below ground biomass (dry weight of roots)







Legend of statystical analysis (crossed t-test):
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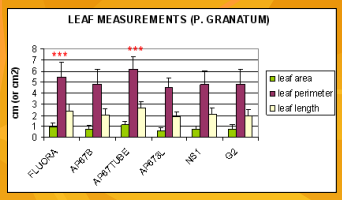
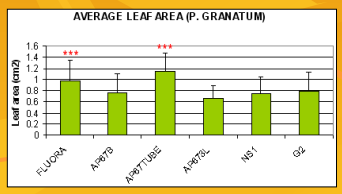
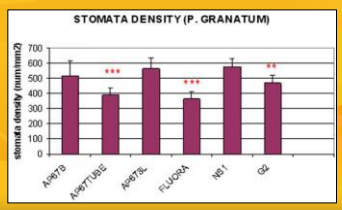
LEAF ANALYSIS

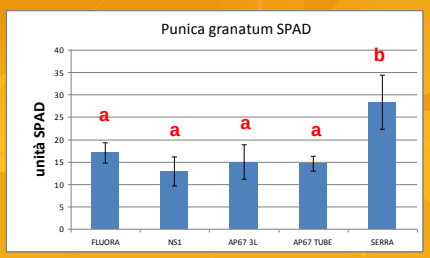


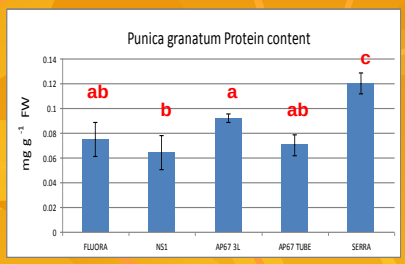


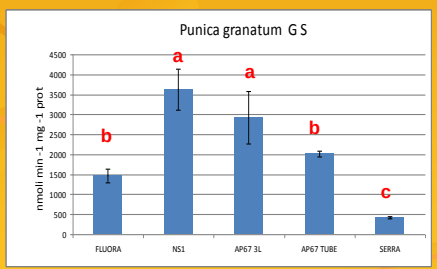


Legend of statystical analysis (crossed t-test):
- * P. value < 0.5
- ** P-value < 0.01
- *** P-value < 0.001

BIOCHEMICAL ANALYSIS







Other analysis are still in progress:
- NR (nitrate reductase)
- Lipid peroxidation
- Chlorophyll a, b and carotenoids content

Turkey-Kramer Multiple Comparisons Test


Thank you for your attention

www.du.se

Dalarna University
- main activities and role in the Zephyr project

Settimana UNESCO di educazione allo Sviluppo Sostenibile 2013

November 2013

SEVENTH FRAMEWORK PROGRAMME

ZEPHYR

HÖGSKOLAN DALARNA

www.du.se

Dalarna University

Founded in 1977, Dalarna University has experienced rapid growth and today is the place of study of some 16 000 students and 800 employees. Dalarna University comprises two campuses: Campus Falun and Campus Borlänge. It is nationally recognized for its web-based courses and New Generation Learning (NGL) program.

SEVENTH FRAMEWORK PROGRAMME

ZEPHYR

HÖGSKOLAN DALARNA

Energy, Forests and Built Environments

The basis of this research profile is forestry, engineering and natural sciences focusing on:

- sustainable forest management,
- sustainable energy systems,
- and sustainable buildings.

There are also important research in social science to understand the processes in the conversion to a sustainable society.

SEVENTH FRAMEWORK PROGRAMME ZEPHYR HÖGSKOLAN DALARNA

Role in the Zephyr Project

- Test of different LED lamps spectra for the cultivation of important tree species in Sweden.
- Analysis and optimization of the energy requirements of the incubator.
- Support in designing and planning the Photovoltaic system.

SEVENTH FRAMEWORK PROGRAMME ZEPHYR HÖGSKOLAN DALARNA

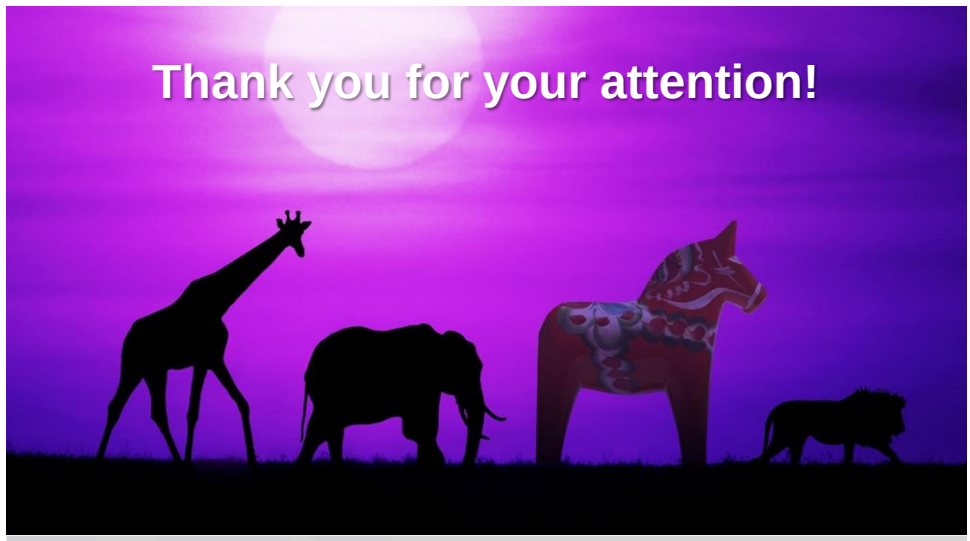
Main Activities

Biological Area

- Pre-cultivation test of Scots Pine and Norway Spruce under LED lights
- Assessment of seedling quality during long term cold storage
- Seedling performance after transplanting to open land

Energy area

- Simulations for different system sizes and climates
- Support finding suitable configurations
- Monitoring and evaluation of the energy supply system



Democritus University of Thrace

ZEPHYR

Testing LED spectrum in the cultivation of tree seedlings

Prof. Kalliopi Radoglou
Msc. Sonia Smirnakou

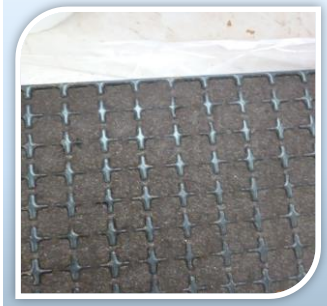
Democritus University of Thrace

ZEPHYR

OBJECTIVES

- Study LED lights with continuous light spectrum & Fluorescent spectrum (FL) on seedling growth
- Select the most efficient LED lights for optimum seedling quality growth.
- Determine species effect.
- Determine field performance (RGP)

MATERIALS AND METHODS
MINI-PLUG SIZE – GROWTH CHAMBER



- **QPD 104 VW** (tray dimension 310x530; cell size 38.5 mm; plant centre 43/43 mm; depth 50 mm; volume 50 cc; 510 plant/m²)
- ***(QuickPot ®, Herkuplast-Kubern GmbH, Ering, Germany)***
- Soil substrate: stabilized medium (SM)
- ph: 3.7-4.3 rich in Br
- ***(Preforma PP01, Jiffy Products International AS, Stange, Norway).***

MATERIAL AND METHODS
STUDIED SPECIES – GROWTH CHAMBER

ZEPHYR

- ***Arbutus unedo* L.& *Myrtus communis* L.**
- (7 weeks duration)
- parallel with ***Abies borisii-regis* Mattf.**
- (5 weeks duration)

- ***Platanus orientalis* L.& *Myrtus communis* L.**
- parellel with ***Picea abies* Karst. & *Pinus sylvestris* L.**
- (5 weeks duration)

Democritus University of Thrace

MATERIAL AND METHODS
ID SPECIES – GROWTH CHAMBER

ZEPHYR

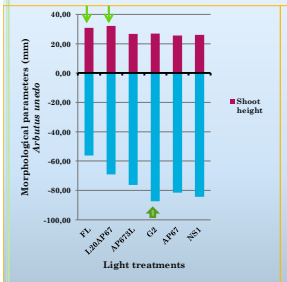
***Arbutus unedo* L.** seedlings under AP67

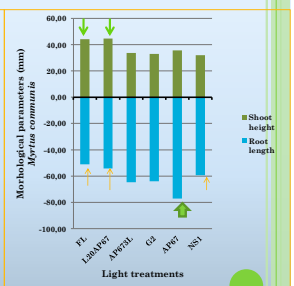
***Myrtus communis* L.** seedlings under AP673L

***Abies borisii-regis* Mattf.** seedlings under NS1

RESULTS
SHOOT HEIGHT & ROOT LENGTH

ZEPHYR

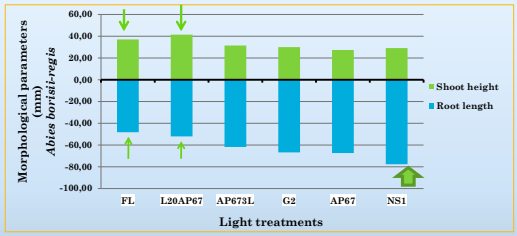




LTS
T HEIGHT & ROOT LENGTH

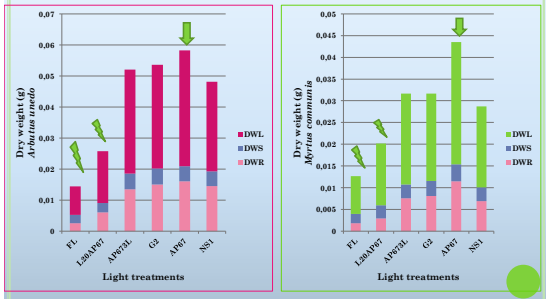
- **Arbutus unedo**
  - **No significant** differences found between the **light treatments** for the **Shoot height**. Considering the **highest** average value was found under the **L20AP67** (32.12 mm) and the **FL** (30.89 mm) and the **lowest** under the **AP67** (25.68 mm).
  - LEDs **G2** (87.46 mm), **NS1** (84.45 mm), **AP67** (81.62 mm) & **AP673L** (76.22 mm) induced **significantly longer roots** contrast to **FL** (56.28 mm). Further **G2** light differed significantly from **L20AP67** (69.11 mm).
- **Myrtus communis**
  - Under **L20AP67** (44.67 mm) & **FL** (44.12 mm) lights **significantly higher** seedlings were found **contrast** to LEDs **NS1**(32.06 mm), **G2** (32.92 mm), **AP673L** (33.71 mm) and **AP67** (35.56 mm).
  - **Significantly longer** roots were found under the **AP67** (77.02 mm) compared to **FL** (51.19 mm), **L20AP67** (54.14 mm) & **NS1** (59.43 mm).

RESULTS
SHOOT HEIGHT & ROOT LENGTH



- **Significant taller** seedlings were found under the **L20AP67**(41.48 mm) & **FL** (37 mm) lights compared to AP67 (27.19 mm), NS1 (28.90 mm), G2 (29.84 mm) & AP673L (31.28 mm).
- **NS1** radiation induced **significantly longer roots** compared to **FL** (48.34 mm) & **L20AP67** (52.10 mm).

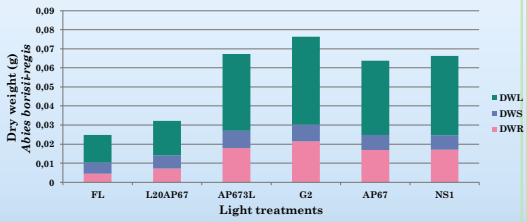
RESULTS
DRY WEIGHTS



RESULTS
SHOOT HEIGHT & ROOT LENGTH

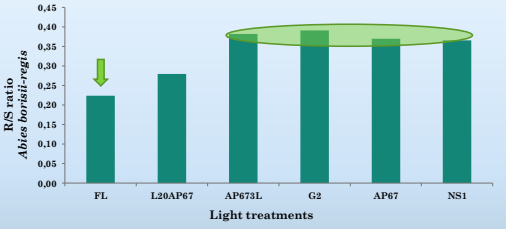
Arbutus unedo	Myrtus communis
LEDs irradiation (**AP67, G2, AP673L, NS1**) induced a **significant increase** of dry weight matter (**DWL, DWS, DWR**) compared to **FL** & **L20AP67**.	**DWL: FL significant lower** compared to **AP67, G2, AP673L, NS1.** Further **AP67 differed** also **significantly** with **L20AP67.**
Especially for the **DWR**, FL light shown also significant difference with the **L20AP67**.	**DWS: FL significant lower ONLY** compared to **AP67.**
*Greater results under the **AP67** light.*	**DWR: FL & L20AP67 significant lower** than **AP67, G2, AP673L, NS1**
	Further among LEDs, **AP67 differed** also **significantly** with **NS1, AP673L & G2.**
	*Greater results under the **AP67** light.*

RESULTS
DRY WEIGHTS



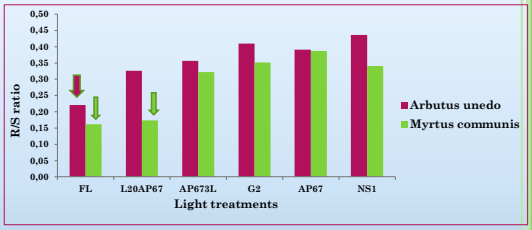
- **DWL**: **FL** & **L20AP67** significantly **lower** than **G2, NS1, AP673L** & **AP67**
- **DWS: FL significant lower ONLY** compared to **AP673L** & **G2**
- **DWR: FL** & **L20AP67** significantly **lower** than **G2, AP673L, NS1,** & **AP67**
- *Greater results under the **G2** & **AP673L** light.*

RESULTS
ROOT-TO-SHOOT RATIO



- **R/S ratio** obtained found **significantly lower** under **FL** than **G2, AP673L, AP67** & **NS1**

RESULTS
ROOT-TO-SHOOT RATIO



- ***Arbutus unedo***: R/S ratio obtained found **significantly lower** under **FL** than **NS1, G2, AP67 & AP673L**
- ***Myrtus communis*: FL & L20AP67** significantly **lower** than **AP67, G2, NS1 & AP673L**

MATERIAL AND METHODS
STUDIED SPECIES – GROWTH CHAMBER

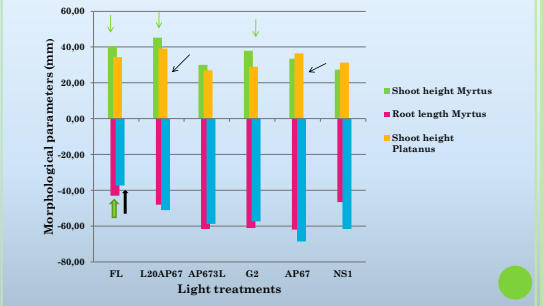
Platanus orientalis L. under G2

Myrtus communis L. under L20AP67

Picea abies Karst. under **AP67**

Pinus sylvestris L. under **NS1**

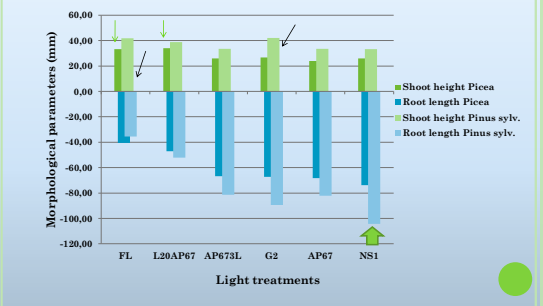
RESULTS
SHOOT HEIGHT & ROOT LENGTH



RESULTS
SHOOT HEIGHT & ROOT LENGTH

Myrtus communis L.	*Platanus orientalis* L.
Shoot height:	**Shoot height**:
✓ **L20AP67** light induced significantly **taller** seedlings than **NS1, AP673L & AP67**	✓ **L20AP67** light induced significantly **taller** seedlings than **G2 & AP673L**
✓ Further **FL also** induced significantly **taller** seedlings than **NS1, AP673L**	✓ Further **AP67** induced significantly **taller** seedlings than **AP673L**
✓ **Also G2** induced significantly **taller** seedlings than **NS1**	**Root length:**
Root length:	✓ **Significantly longer roots** obtained under the **AP67, NS1, AP673L & G2** compared to **FL**
Significantly longer roots obtained under the **AP67 & AP673L** lights than the **FL.**	

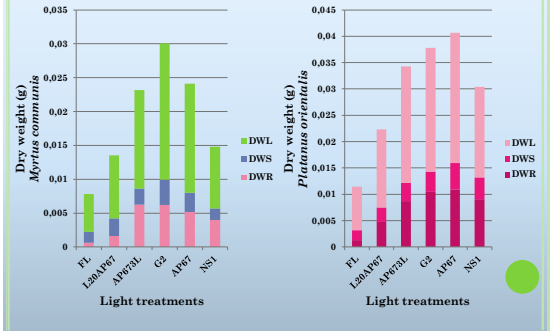
RESULTS
SHOOT HEIGHT & ROOT LENGTH



RESULTS
SHOOT HEIGHT & ROOT LENGTH

Picea abies Karst.	*Pinus sylvestris* L.
Shoot height:	**Shoot height**:
➢ **L20AP67 & FL** light induced significantly **taller** seedlings than **AP67 but**	➢ **G2** light induced significantly **taller** seedlings than **NS1, AP673L & AP67**
Root length:	➢ **Also FL** shown **significantly taller** seedlings compared **to NS1**
➢ **Significantly longer roots** obtained under the **NS1, AP67, G2 & AP673L** compared to **FL & L20AP67**	**Root length:**
	Significantly longer roots obtained under the **NS1, G2, AP67 & AP673L** compared to **FL & L20AP67**
	Further NS1 differed **significantly** with the **AP673L &AP67**

RESULTS
DRY WEIGHTS



RESULTS
DRY WEIGHTS

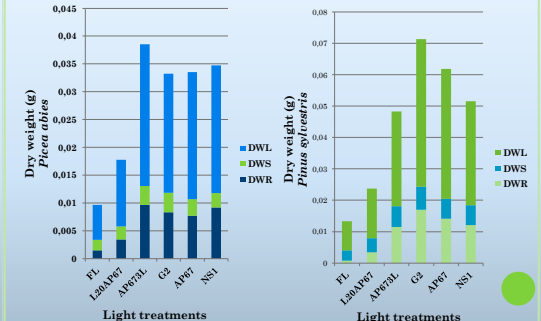
Myrtus communis L.

- **DWL: significant lower** under **FL** than under the **G2, AP67** & **AP673L**
- **L20AP67** also had **significantly lower** value than the **G2** light
- Further **G2 & AP67** shown **significantly higher** than the **NS1**
- **DWS: significantly higher** value found under **G2** compared to **FL** & **NS1**
- **DWR: AP673L, G2 & AP67** induced **significantly higher** values than the **FL & L20AP67**

Platanus orientalis L.

- **DWL: significant lower** under **FL** than under the **AP67, G2, AP673L & NS1**
- **L20AP67** also had **significantly lower** value than **AP67, G2 & AP673L**
- Further **AP67** shown **significantly higher** value than the **NS1**
- **DWS: significant lower** under **FL** than under the **AP67, NS1, G2** & **AP673L**
- Further **AP67** shown **significantly higher** value than the **L20AP67** & **AP673L**
- **DWR:AP67, G2, NS1 & AP673L** induced **significantly higher** values than the **FL & L20AP67**

RESULTS
DRY WEIGHTS



RESULTS
DRY WEIGHTS

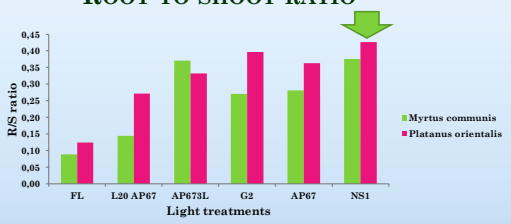
Picea abies Karst.

- **DWL: significant lower** under **FL & L20AP67** than under the **AP673L , NS1, AP67** & **G2**
- **DWS: significant lower** under **FL ONLY compared to G2**
- **DWR: significant lower** under **FL & L20AP67** than under the **AP673L , NS1, G2 & AP67**

Pinus sylvestris L.

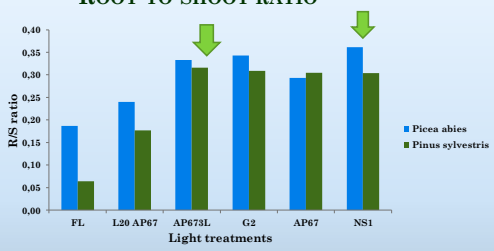
- **DWL: significant lower** under **FL & L20AP67** than under the **G2, AP67, NS1** & **AP673L**
- Further **G2 & AP67 lights differed** also **significantly** with the **AP673L & NS1**
- **DWS: significant lower** under **FL & L20AP67** than under the **G2, AP67, AP673L & NS1**
- **DWR: significant lower** under **FL & L20AP67** than under the **G2, AP67, NS1 & AP673L**
- Further **G2 & AP67 lights differed** also **significantly** with the **AP673L & NS1**

RESULTS
ROOT-TO-SHOOT RATIO



- ***Myrtus communis*** : R/S ratio obtained found **significantly lower** under **FL** & **L20AP67** than **NS1, AP673L G2, AP67 G2**
- ***Platanus orientalis*: FL** significantly **lower** than all the lights. **NS1, G2, AP67** & **AP673**
- **Further: NS1&G2 significantly higher** ratio than the **L20AP67**

RESULTS
ROOT-TO-SHOOT RATIO



- ***Picea abies***: R/S ratio obtained found **significantly lower** under **FL** than **NS1, G2 & AP673L**
- **Further: NS1 showed significantly higher** ratio than the **L20AP67**
- ***Pinus sylvestris***: R/S ratio obtained found **significantly lower** under **FL & L20AP67** than **AP673L, G2, AP67** & **NS1**

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CONCLUSIONS
SHOOT HEIGHT& ROOT LENGTH

- Generally **taller** seedlings obtained cultivated under the **L20AP67 & FL** lights
- Some **exceptions**: **G2** light (*Myrtus-P.sylvestris*)
- **Broad-leaved** species are **benefited more** for the **root development** under LED illumination of the **AP67** (*Myrtus-Platanus*) & the **G2** (*Arbutus*)
- While **coniferous** species under the **NS1** (*A. borisii-regis- Picea abies-P. sylvestris*)

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CONCLUSIONS
DRY WEIGHT MATTER

- Generally **lower dry mass** of **leaves, shoots & roots for all the tested species** was found under the **FL & L20 AP67** light treatments.
- More specifically for each of them:
- ***Arbutus***: total **dry weight** seemed to be benefited more under the **AP67** radiation.
- ***Myrtus*** (1) (*7 weeks)*: total **dry weight** seemed to be benefited more under the **AP67** radiation.
- *(DWR: AP67 differed sig. with other LEDs (NS1 & AP673L)*
- ***Myrtus*** (2) (5 weeks): total **dry weight** seemed to be benefited more under the **G2** radiation.
- *(DWL & DWS: G2 differed sig. with other LEDs (NS1)*

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CONCLUSIONS
DRY WEIGHT MATTER

- ***A.borisii-regis***: total **dry weight** seemed to be benefited more under the **G2** & **AP673L** light qualities.
- ***Platanus***: total **dry weight** seemed to be benefited more under the **AP67** radiation.
- *(DWL& DWS respectively: AP67 differed sig. with other LEDs (NS1 & AP673L)*
- ***Picea***: total **dry weight** seemed to be benefited more under the **AP673L** & **G2** radiation.
- ***P.sylvestris:*** total **dry weight** seemed to be benefited more under the **G2** & **AP67** lights
- *(DWL& DWS* **G2** & **AP67** *differed sig. with other LEDs (NS1 & AP673L)*

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CONCLUSIONS
ROOT/SHOOT RATIO

- Generally seedlings grown under the **FL & L20AP67** lights obtained lower allocation to the roots……than the rest of the LEDs….
- ***Arbutus***: greater root allocation obtained under the NS1 light quality
- ***Myrtus 7 weeks***: greater root allocation under the **AP67**
- **Myrtus 5 weeks:** greater root allocation under **NS1**
- ***A. borisii-regis***: greater root allocation under the **G2 & AP673L**
- ***Platanus*: NS1 & G2**
- ***Picea*: NS1, G2, AP673L**
- ***P.sylvestris*: AP673L, G2**

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CONCLUSIONS
NEW LIGTS AP673L & NS1

- **AP673L better predicted the DWR of *A. borisii-regis* & *Picea abies***
- **NS1 better predicted the R/S ratio of *Arbutus unedo*, *Platanus orientalis* & *Picea abies***

THANK YOU FOR YOUR ATTENTION

Valoya

Professional Grow Lights

Ate Korkalainen, Technology Director

About Valoya

- ✓ Valoya is a Finnish company with 14 professionals in Finland, Netherlands, UK, Japan and Singapore
- ✓ We have deep knowledge in horticulture, photobiology and semiconductors.
- ✓ We focus on horticultural lighting only, and offer patented wide spectrum LED lights for greenhouse roof lighting, growth chambers, inter-lighting, hydroponic conveyors and multilayer systems.
- ✓ Early experiments with red/blue LEDs showed that we need to develop our own LED technology based on what plants need instead of using existing LED components that you can buy from the market.
- ✓ We do extensive research together with customers, universities and in-house experiments.

Choosing the best spectrum

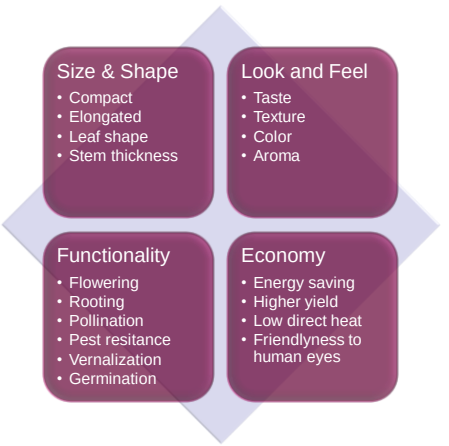
- ✓ What is the goal for plant growing?
  - Biomass, flowering, compactness, vernalization, taste, aroma, etc.
  - Preparation for outdoors or simulating the sun?
- ✓ What do you optimize?
  - Energy savings / low heat generation
  - Quick growth
  - Quality improvement
- ✓ Limitations
  - Space (make high number of plants in small area)
  - Budget
  - No sun
  - Multiple plant varieties (compromizes needed)

Choose a spectrum and fixture, which in addition to the light energy also gives plants the right information to reach the goals.

Narrow bandwidth LEDs and traditional (HPS, MH, FL) do not contain sufficient/right information for most growing applications.

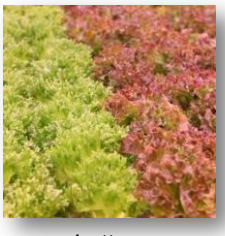
Nor does copies of the sun (Plasma).

Optimizing growth with the right light



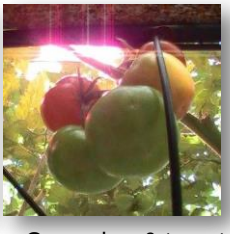
Promotes flowering and biomass growth	AP67
Promotes biomass growth on leafy greens	AP673
Vernalization and root formation	G2
Compactness for flowers and microgreens	NS2
Warm white growth light for architectural use	Architectural

We have knowledge of light for a wide range of plants

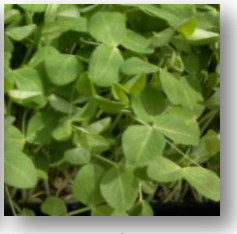


Lettuce

Leafy greens



Cucumber & tomato



Herbs

Flowers

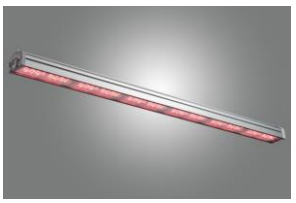
Tree seedlings

Citrus trees

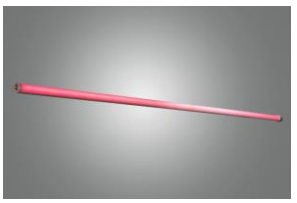
Wheat & barley

Valoya product portfolio

R-series



B-series



L-series

	R150	R300	B50	B100	B200	L20
Spectrum	AP67, AP673, NS2, G2, Architectural white					AP67, AP673, G2
Recommended application	General roof lighting, growth rooms		Conveyors, multilayer, moving lights, interlighting			Growth chambers, multilayer
Recommended distance from plants	1 - 2,5 m	1 - 4 m	0,5 - 1,5 m			0,1 -0,5 m
Ambient operating temperature	0 - 35° C					
Expected light intensity decay	Max 10% light intensity decay after 35000 hours. Typical usage 50000 hours.					
Power consumption (total)	138 W	276 W	55 W	102 W	192 W	22 W
Ingress protection rating	IP55	IP55	IP65	IP65	IP65	IP20
Dimensions, mm (lenght, width, height)	340 x 400 x 167	340 x 400 x 167	600 x 74 x 65	1200 x 74 x 65	1800 x 74 x 65	*T8, 120 & 150 cm*
Weight including power unit	14,5 kg	7,1 kg	4,0 kg	6,1 kg	8,2 kg	0,5 kg
Power input	AC 220 - 240 Vac. 50 - 60 Hz					G13 cap
ROHS compliance	Yes					

Some case examples: Leafy greens, tree seedlings

WS Bentley ,UK

Customer wanted to ensure excellent quality pea shoots year round in an energy efficient way by using moving Valoya B-series lights

- ✓ Better quality especially in winter
- ✓ Excellent taste and texture
- ✓ Very low energy consumption

Holmen skog, Sweden

Cultivation of tree seedlings in layers in order to save space and energy while preserving high quality.

- ✓ High quality plants in no-sunlight conditions
- ✓ Energy savings compared to TL tubes
- ✓ Less heat and cooling required

Some case examples: Cucumber, Strawberry

Cucumber inter-lighting, Finland

Customer wanted to explore potential energy savings by using Valoya B-series inter-lighting instead of HPS.

- ✓ Same yield with 36% energy saving
- ✓ Good quality cucumbers
- ✓ Even light distribution compared to HPS

University of Helsinki, Finland

Customer wanted to grow strawberry in no-sunlight conditions in order to do year round research.

- ✓ Flowering 1½ week earlier than with HPS
- ✓ Considerable better plant quality
- ✓ Very good light for visual quality control (pleasant for the human eye)

Valoyas role in Zephyr project

- ✓ Provide best possible Valoya patented wide spectra for the project needs
  - ✓ decisions based on project partner tests and Valoya knowledge database
- ✓ Provide energy efficient Valoya luminaires for the project needs with the selected spectra
  - ✓ based on Valoya current products, new innovative sulutions will be developed during the project
    - ✓ off-grid solutions
    - ✓ intelligent control of luminaires

APPROACHES TO NICHE-BASED MODELLING – THEORY AND PRACTICE

Federico Vessella – University of Tuscia (Italy)

Vivai Torsanlorenzo (RM) – November 19th 2013

1. Why model species ranges?
2. What is Ecological Niche Modeling (ENM)?
3. Distribution datasets
4. Variables and their selection
5. Models and their selection
6. Examples

WHY MODEL SPECIES RANGES?

We need to know where species occur, why they occur and where they do:

- ✓ We want to predict where a particular species occurs.
- ✓ We want to know more about organism-environment relationships

Page 3

USED IN RESPONSE TO

- ✓ Increase rates of habitat, and species loss
- ✓ Incomplete (spatial and temporal) distribution info for a large number of taxa
- ✓ Existing distribution data collected in an ad hoc fashion.
- ✓ Given the rate of species loss, it is unlikely that we will get the distribution data that we need in time if we rely on conventional survey techniques.

Page 4

WHAT IS ECOLOGICAL NICHE MODELING (ENM)?

- The idea is that known occurrences of species across landscapes can be related to digital raster GIS coverages summarizing environmental variation across those landscapes to develop a quantitative picture of the ecologic distribution of the species.

- ENM characterizes the distribution of the species in a space defined by environmental parameters, which are precisely those that govern the species' geographic distribution under Grinnell's definition of ecological niches.

Page 5

SPECIES DISTRIBUTION DATASETS

- **Museum/Herbarium data**
- **Survey Atlas data**
- **Expert Atlas e.g. Plants of Middle-East**
- **Field data**
- **Presence / Absence data**
- **Georeference accuracy e.g. GPS**
- **Taxonomy affects numbers**
- **Taxonomic updates of older museum data**

Data sources and their typical scales	Locality Type	1-1000m	1-5km	1-15 minutes	0.25- 1 degree	1-5 degree
Museum Specimens	Presence	⟷	⟷	⟷	⟷	⟷
Herbaria Specimens	Presence	⟷	⟷	⟷	⟷	⟷
Expert Atlas	Presence/Absence			⟷	⟷	
Survey Atlas	Presence/Absence		⟷	⟷	⟷	
Fieldwork	Presence/Absence	⟷	⟷			

Page 6

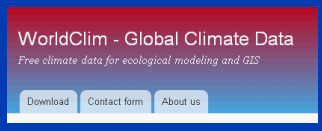
SPECIFICS: VARIABLE SELECTION

	Direct	Indirect
Definition	Variables with biological relationship with study species	Variables that correlate with study species because of correlation with series of intermediate direct factors rather than direct relationship
Example	Climate, nesting sites, soil nutrients (plants), interacting species, site isolation	Elevation, soil, topography, geology, soil nutrients (animals)
Strength	Model structure easily interpreted in biological meaningful terms. Direct biological relationship should generalize better to new areas, and be more effective for climate change modeling than indirect predictors. Provides more info for conservation management	Data sets widely available in GIS Low cost, ease of collection Can be effective predictors, ie elevation in mountainous areas Encompasses a range of correlated variables so should: result in parsimonious models if variable selection applied, recording fewer variables
Weakness	Variables require greater effort to record Data sets may need to be estimated for large spatial extents (using indirect variables reducing overall accuracy	Correlation with direct variables tend to be location specific Limited interpretation – biological meaning inferred, resulting in increased uncertainty

Page 7

VARIABLES AND THEIR SELECTION

CLIMATIC DATASET



www.worldclim.org

- Bioclimatic variables, e.g.
- Temeperature (min, max, mean)
- Precipitation
- Seasonality
- Diurnal range

FUTURE CONDITION (2050-2100)

http://cmip-pcmdi.llnl.gov/cmip5/

PAST CONDITION (120 ka up to 1850)

http://pmip2.lsce.ipsl.fr/

Page 8

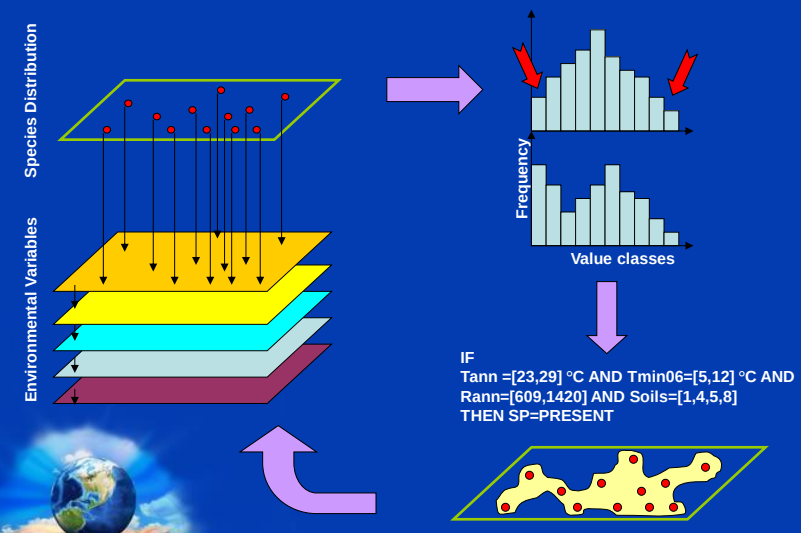
HOW DO WE CHOOSE A MODEL TYPE?

DIFFERENT TYPES OF MODELS

- ✓ BioClimatic envelope e.g. Bioclim
- ✓ Ordinary Regression e.g. incl. in Arc-SDM
- ✓ Generalised additive models (GAM) e.g. GRASP
- ✓ Generalised linear models (GLM) e.g. incl. in Biomod
- ✓ Ordination (e.g. CCA) e.g. ENFA
- ✓ Classification and regression trees (CART) e.g. incl. in Biomod
- ✓ Genetic Algorithm e.g. GARP
- ✓ Artificial neural networks e.g. SPECIES
- ✓ Bayesian e.g. WinBUGS
- ✓ Maximum Entropy e.g. MaxEnt
- ✓ Support Vector Machine (SVM)

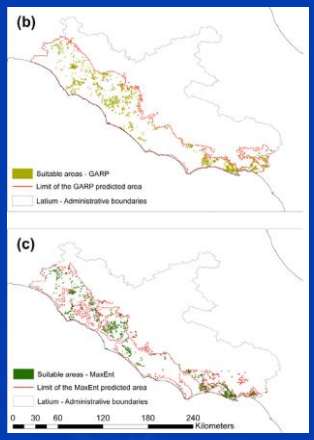
Page 9

MODELS AND THEIR SELECTION - BIOCLIMATIC ENVELOPE



Page 10

EXAMPLES



Contents lists available at SciVerse ScienceDirect
Forest Ecology and Management
journal homepage: www.elsevier.com/locate/foreco

Predicting potential distribution of *Quercus suber* in Italy based on ecological niche models: Conservation insights and reforestation involvements

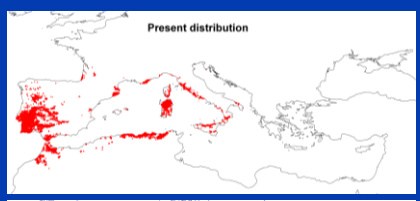
Federico Vessella *, Bartolomeo Schirone
Dipartimento Ambiente, Foreste, Natura ed Energia (DAFNE), Università degli Studi della Tuscia, 01100 Viterbo, Italy

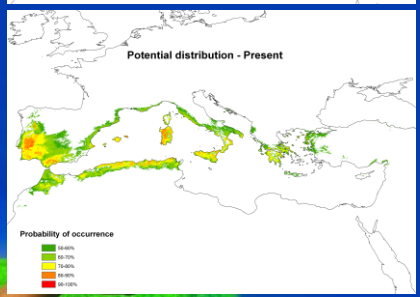
Log-scale surface range (hectares)	Corine land cover class	GARP		MaxEnt	
		N	Hectares (%)	*N*	Hectares (%)
0–1	243	29	11	68	22
	244	3	1	21	7
	3211	18	6	46	17
	3232	15	5	78	28
Sub-total (%)		*65 (1.4)*	*23 (0.00002)*	*213 (4.9)*	*74 (0.01)*
1–10	243	74	370	174	856
	244	16	90	71	332
	3211	49	259	123	514
	3232	49	294	248	1224
Sub-total (%)		*188 (3.9)*	*1013 (0.1)*	*616 (14.2)*	*2826 (0.5)*
10–100	243	1090	54,828	888	39,972
	244	169	8890	235	10,910
	3211	591	29,179	392	16,743
	3232	792	38,109	767	31,929
Sub-total (%)		*2642 (55.4)*	*131006 (15.3)*	*2282 (52.6)*	*99,554 (17.0)*
100–1000	243	793	215550	434	114165
	244	129	32,883	136	37,898
	3211	355	91,260	185	49,285
	3232	470	125121	387	104725
Sub-total (%)		*1747 (36.6)*	*464814 (54.3)*	*1142 (26.3)*	*306073 (52.4)*
1000–10,000	243	58	113851	32	60,051
	244	11	28,389	12	28,805
	3211	20	32,488	13	21,129
	3232	40	84,423	30	65,502
Sub-total (%)		*129 (2.7)*	*259151 (30.3)*	*87 (2.0)*	*175487 (30.0)*
Total		4771	856007	4340	584014

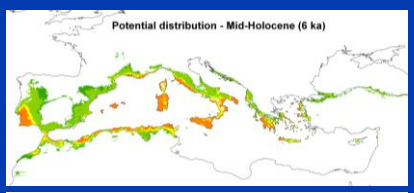
Page 11

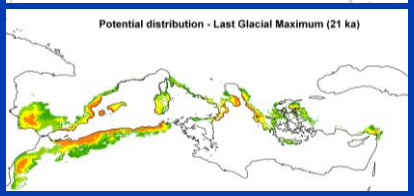
EXAMPLES

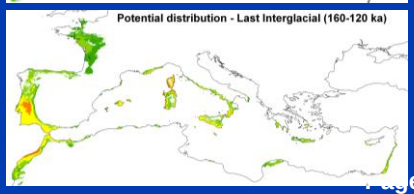
ENM application to retrieve past occurrence of *Quercus suber* in the Mediterranean Basin





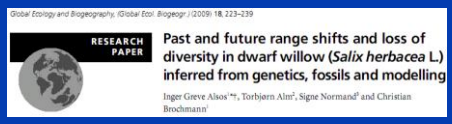






Page 12

FURTHER EXAMPLES FROM LITERATURE


Global Ecology and Biogeography, (Global Ecol. Biogeogr.) (2009) 18, 223–239

RESEARCH PAPER

Past and future range shifts and loss of diversity in dwarf willow (*Salix herbacea* L.) inferred from genetics, fossils and modelling

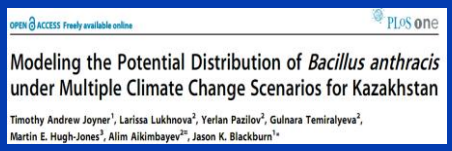
Inger Greve Alsos[1*†], Torbjørn Alm[2], Signe Normand[3] and Christian Brochmann[1]


Ecology and Evolution

Open Access

Predicting the impacts of climate change on the distribution of threatened forest-restricted birds in Madagascar

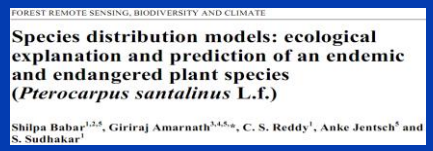
Rado H. Andriamasimanana[1] & Alison Cameron[2]


OPEN ACCESS Freely available online

PLoS one

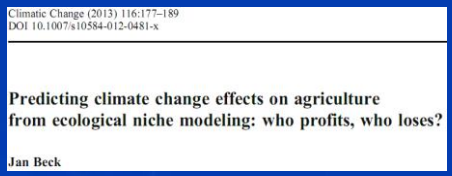
Modeling the Potential Distribution of *Bacillus anthracis* under Multiple Climate Change Scenarios for Kazakhstan

Timothy Andrew Joyner[1], Larissa Lukhnova[2], Yerlan Pazilov[2], Gulnara Temiralyeva[2], Martin E. Hugh-Jones[3], Alim Aikimbayev[2¤], Jason K. Blackburn[1]*


FOREST REMOTE SENSING, BIODIVERSITY AND CLIMATE

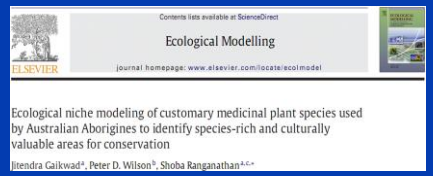
Species distribution models: ecological explanation and prediction of an endemic and endangered plant species (*Pterocarpus santalinus* L.f.)

Shilpa Babar[1,2,5], Giriraj Amarnath[3,4,5]*, C. S. Reddy[1], Anke Jentsch[5] and S. Sudhakar[1]


Climatic Change (2013) 116:177–189
DOI 10.1007/s10584-012-0481-x

Predicting climate change effects on agriculture from ecological niche modeling: who profits, who loses?

Jan Beck


Contents lists available at ScienceDirect

Ecological Modelling

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

ELSEVIER

Ecological niche modeling of customary medicinal plant species used by Australian Aborigines to identify species-rich and culturally valuable areas for conservation

Jitendra Gaikwad[a], Peter D. Wilson[b], Shoba Ranganathan[a,c,*]

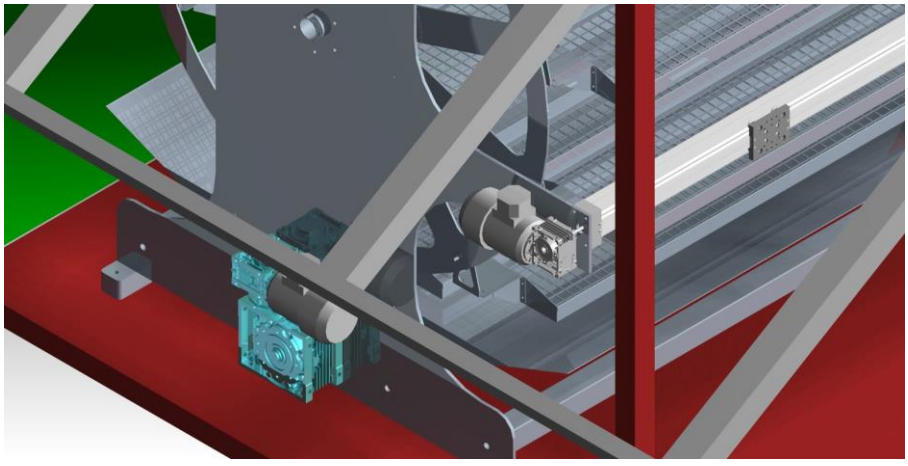

Ecological Applications, 20(2), 2010, pp. 311–326
© 2010 by the Ecological Society of America

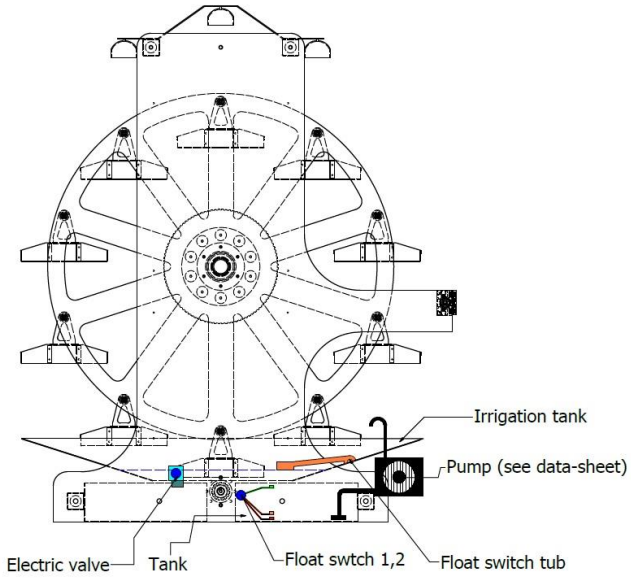
Combining local- and large-scale models to predict the distributions of invasive plant species

Chad C. Jones,[1,3] Steven A. Acker,[2] and Charles B. Halpern[1]

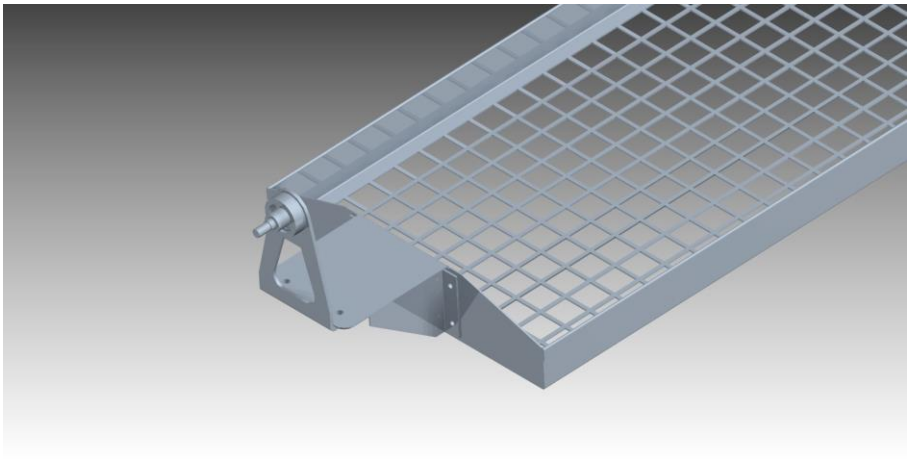
THANK YOU FOR YOUR KIND ATTENTION

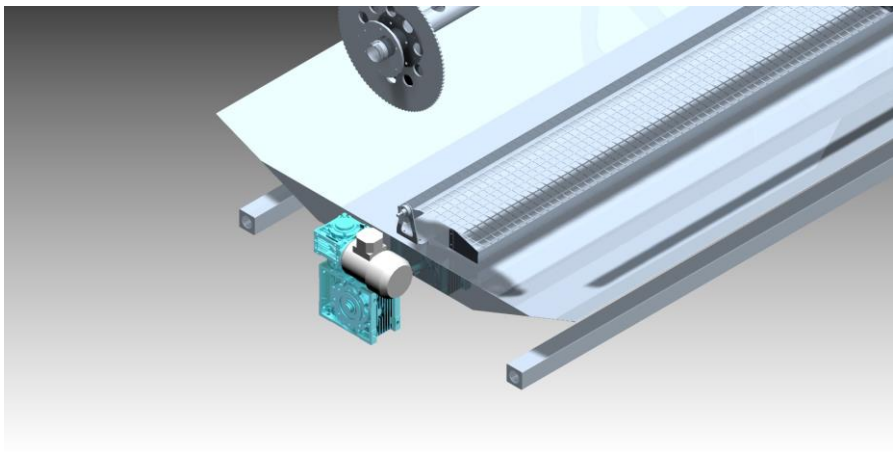
WP 4 – Development of the mechanical components

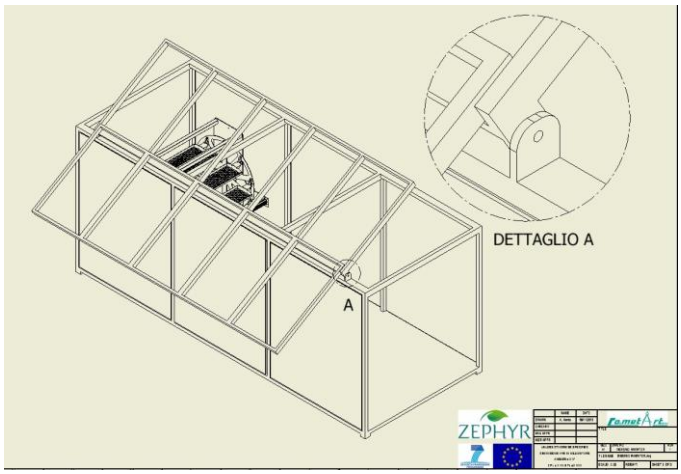




Andrea Menta - C/o CoMetArt sas di Adriano and Stefano Menta & C.



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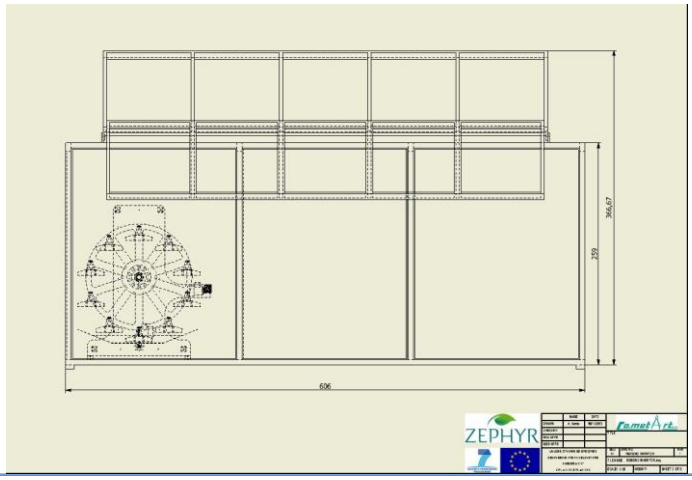
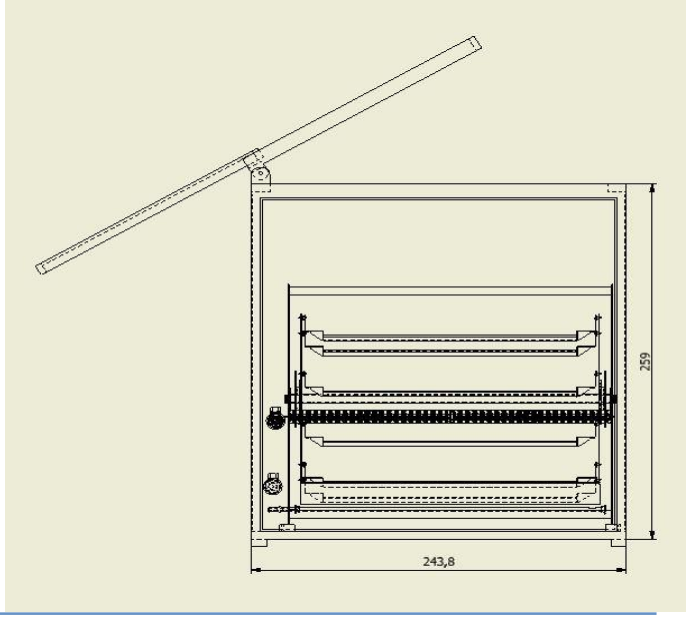
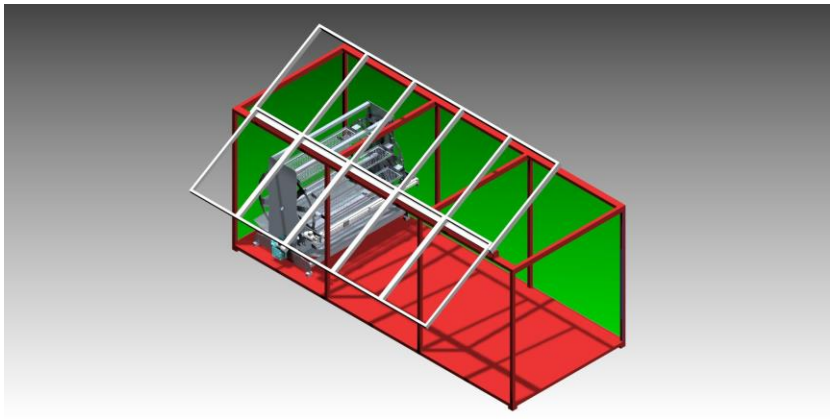

366,67
259
606


259
243,8



College of Science and Technology

Department of Biology

Oil production from neglected oil crops in Palestine

Safflower , Sesame, wild mustard under low input organic conditions

Jehad Abbadi

20th November, 2013

College of Science & Technology

Department of Biology

From Biodiversity to Business

By

Dr. Jehad Abbadi

Introduction

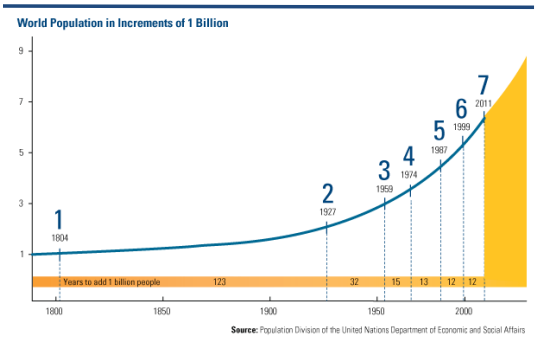
- Agricultural research has traditionally focused on staple species.
- Scientists have given little attention to minor (or underutilized or neglected) crops.
- Such crops generally failed to attract significant research funding.
- Unlike most staples, many of these neglected species are adapted to various marginal growing conditions.

Introduction

- Humanity relies on a diverse range of cultivated species (at least 6000) for a variety of purposes.
- few staple crops produce the majority of the food supply
- the important contribution of many minor species should not be underestimated.

Introduction

Problem: Human population explosion



Introduction

- Many crops considered neglected at a global level are staples at a national or regional level
- they contribute considerably to food supply in certain periods or are important for a nutritionally well-balanced diet.

Introduction
Reduction in average yield

Table 2. Average Yield of Important Food Crops (t ha^{-1})[a]

		America					World	
Crop	Africa	North/ Central	South	Asia	Europe	Oceania	Average	Recorded Maximum Potential
Wheat	1.65	2.46	2.22	2.39	3.09	2.15	2.47	14.50
Barley	1.33	3.17	1.78	1.53	2.77	1.94	2.33	11.40
Maize	1.71	6.50	2.61	3.73	4.87	5.96	3.79	22.20
Rice	2.21	5.83	3.11	3.80	5.17	6.59	3.73	—
Sorghum	0.86	3.79	3.02	1.18	3.47	2.38	1.46	21.50
Soybean	0.65	2.53	2.17	1.33	1.72	2.28	2.08	5.60
Common bean	0.71	0.92	0.62	0.62	1.11	0.71	0.68	—
Potato	12.07	34.41	12.59	14.42	16.18	28.79	15.47	95.00

[a] Baligar and Fageria, (1997) and FAO, 1997 year book.

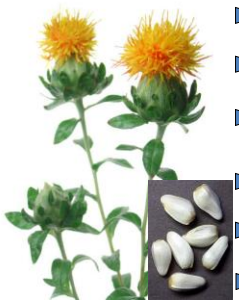
8

Introduction
The Need of New Resources

- **Acidic soils** occupy 4 billion ha of the ice-free land area in the world.
- **Salt affected** soils in the world is about 950 million ha.
- Many agricultural soils of the World are **deficient** in one or more of essential **nutrients**.

7

Introduction
Safflower's Description



- ***Carthamus tinctorius* L.**
- **Compositae family**
- **Highly branched 30- 150 cm height.**
- **Middle-East Origin**
- **two tonnes seeds/ ha.**
- **35 to 40% edible oil.**

Introduction
Increased food production could be achieved by:

- Expanding land **area under cultivation**
- Increasing **yields per unit area**
- **Selecting low input alternative** species (requirements and **NUE**)

Introduction
Safflower's Origin

- The **cultivated** specie *Carthamus tinctorius*
- The **parental** species are *C. oxyacanthus* and *C. Persicus*
- the **progenitor** of these two species is the wild specie ***Carthamus palaestinus*** restricted to the Palestinian desert and western Iraq.

Introduction
Safflower's Description

Introduction
Safflower's history

- It is one of humanity's **oldest crops**
- has been grown in **Egypt** in 2000 BC.
- Its cultivation was reported in **Baghdad** (c. 1000 BC) and in Arabia (1562 BC)
- was expanded in **Europe** in the fifth and sixth centuries through the western expansion of the Arabs.

Introduction
Safflower's description

- characterized by a **strong taproot**
- able it to thrive in **dry climates**
- can access and **utilize nutrients** from below the root zone of cereal crops.

Introduction
Safflower's history

- Safflower **oil** has been produced commercially and for export for about **50 years**
  - first as an oil source for the **paint industry**
  - now as **edible** oil for **cooking**, margarine and salad oil in over **60 countries**

Introduction
Safflower's history

- was grown for its **flowers**, which were used in making **dyes** for **clothing and food**
- nowadays grown mainly for its **oil** and **silage**.

Introduction
Safflower's oil

- The oil of some cultivars is high in **linoleic acid** (75%) of total fatty acids, higher than sunflower, corn, soybean, cottonseed, peanut or olive oils.
- Other varieties are high in **oleic acid** (75 to 80%)

Introduction
Safflower's production

- over **half** is produced in **India**
- the production in the **USA**, **Mexico**, **Ethiopia**, **Argentina** and **Australia** comprises most of the remainder.

Introduction
Safflower's oil

- Other safflower varieties are high in **mono unsaturated oleic acid** (75 to 80%)
- may serve as **heat-stable**, **cooking** oil used to fry potato chips and French fries.

Introduction
Safflower's oil

- Safflower oil high in **polyunsaturated** fatty acids is used as **salad** oils and soft **margarines**
- help to decrease blood **cholesterol** and related **heart** and circulatory problems
- marketed as "**high quality**" edible oil.

Introduction
Safflower's oil quality

- safflower oil contains a total of **92% unsaturated fatty** acids compared to **89% for sunflower** and **86% for olive oil**.

Introduction
Safflower's oil

Fatty acid		Corn oil	Soybean oil	Sunflower oil	Safflower oil	Linola oil
Palmitic acid	16:0	11%	11%	7%	7%	6%
Stearic acid	18:0	2%	4%	5%	2%	4%
Total saturated		~13%	~15%	~13%	~9%	~10%
Oleic acid	18:1w9	29%	23%	20%	13%	16%
Linoleic acid	18:2w6	57%	54%	66%	78%	72%
Linolenic acid	18:3w3	1%	7.6%	0.1%	-	2%
Total unsaturated		~86%	~84%	~86%	~90%	~90%
Linoleic acid as % of total unsat.		~65%	~64%	~77%	~86%	~80%

Introduction
Safflower cultivation

- has a wide adaptation from **45°S to 60°N**
- can be cultivated in **Mediterranean** climate as well as in regions with a **temperate** climate.
- large-scale commercial cropping is practiced between **30° and 45° N**.

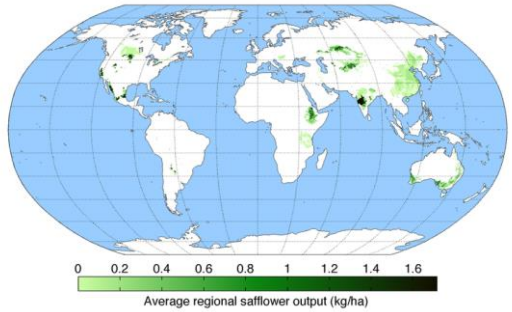
Introduction
Safflower's oil quality

- Safflower oil contains moderate levels of saturated fatty acids (aprox. 10%), compared with higher contents in sunflower (aprox. 12%), and soybean (aprox. 16%), but lower contents in canola (aprox. 6%).

Introduction
Safflower cultivation

- grows on a **wide range of soils**
- most economical production is achieved on fairly **deep, well-drained, somewhat sandy loam** of neutral reaction.
- production under excessive moisture and high **humidity** conditions is seriously stifled by **diseases**.

Introduction
Safflower cultivation



Introduction
Safflower cultivation

safflower may have a certain **production potential under Palestinian conditions** as it was originated from the Palestinian desert, particularly **under low input farming conditions**

Introduction
Safflower cultivation

- Therefore, the success of safflower introduction into new areas will largely **depend on**:
  - ❑ **disease resistance**
  - ❑ **improvement** in **yield** and **oil content**
- **its cultivation in Palestine could be promising.**

Published Work

1

Plant Soil
DOI 10.1007/s11104-008-9569-5

REGULAR ARTICLE

Effects of nitrogen supply on growth, yield and yield components of safflower and sunflower

Jehad Abbadi · Jóska Gerendás · Burkhard Sattelmacher

2

Journal of Plant Nutrition, 32: 929–945, 2009

ISSN: 0190-4167 print / 1532-4087 online
DOI: 10.1080/01904160902870705

Taylor & Francis

Nitrogen Use Efficiency of Safflower as Compared to Sunflower

Jehad Abbadi and Jóska Gerendás

Introduction
Safflower cultivation

- therefore the **objective** of this proposed study is:
- ❑ **Collect safflower landraces** from Palestinian areas
- ❑ find **suitable cultivars by evaluating the oil yield** of collected accessions, varieties, under low input organic farming conditions in the Palestinian areas.

Published Work

5

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EFFECTS OF PHOSPHORUS SUPPLY ON GROWTH, YIELD, AND YIELD COMPONENTS OF SAFFLOWER AND SUNFLOWER

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Published Work

3

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Effects of potassium supply on growth and yield of safflower as compared to sunflower§

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J. Plant Nutr. Soil Sci. 2008, *171*, 431–439 **DOI:** 10.1002/jpln.200720218 431

4 **Potassium efficiency of safflower (*Carthamus tinctorius* L.) and sunflower (*Helianthus annuus* L.)§**

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Published Work

7

Journal of Plant Nutrition

Phosphorus Use Efficiency of Safflower (Carthamus tinctorius L.) and Sunflower (Helianthus annuus L.)

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Published Work

6

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DAVID PUBLISHING

Phosphorus Use Efficiency of Safflower (*Carthamus tinctorius* L.) and Sunflower (*Helianthus annuus* L.) Studied in Nutrient Solution

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Published Work

9 Characterizing and modeling the mechanisms of K uptake efficiency of safflower and sunflower using two types of soils

10 Characterizing the mechanisms of P uptake efficiency of safflower and sunflower using two types of soils

Published Work

8

Journal of Agricultural Science and Technology A 2 (2012) 1307-1321
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DAVID PUBLISHING

Potential for Safflower Cultivation under Temperate Conditions

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Mustard Production

Distribution:

- West Europe, Sweden, Canada, Northern regions of the USA, Near East to India.
- Potentially in temperate region

Mustard

Mustard Production

Mustard Production

- **Type of soil:**
  - Prefers calcareous loamy soil with a uniform water supply.
- **Yield:**
  - 2-3 t/ha Seed
  - 25-35 t/ha green matter

White Mustard (*Sinabis alba*) uses

- **Green matter:**
  - animal feed
  - compost
  - 15% dry mass
  - 2-3% protein
  - 5-8% carbohydrate
  - 1.5-3% crude fiber
- **Seeds**:
  - spices
  - 30%oil
  - 1.5-2.5% sinalbin

White Mustard (*Sinabis alba*) uses

Mustard Oil

Black mustard (*Brassica nigra*)

Brown mustard (*Brassica juncea*)

white mustard (*Brassica hirta*)

Mustard Oil

- Has a distinctive **pungent** taste, characteristic of all mustard family
- Traditionally preferred oil for **cooking**.
- **30%** of the mustard seeds.

Mustard Oil

- Like canola (rapeseed), have high levels of **omega-3** (6–11%)
- Are a common, cheap, mass-produced source of **vegetarian omega-3 fatty acids**.
- Flax (linseed) oil has 55% plant-based omega-3 but is uncommon as a table or cooking oil.
- Soybean oil has 6% omega-3 but contains over 50% omega-6, the fatty acid that competes with the omega-3 function.

Mustard Oil

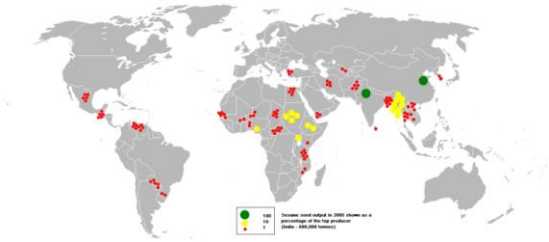
- The pungent flavour of is due to Allyl isothiocyanate.
- About **60% monounsaturated** fatty acids (42% erucic acid (see hidden) and 12% oleic acid)
- About **21% polyunsaturated** fats (**6% the omega-3 alpha-linolenic** acid and 15% the omega-6 linoleic acid)
- About 12% saturated fats.

Sesame

Mustard Oil

- Is often used as a body oil for **massage**,
  - Is thought to reduce skin dryness
  - Improve blood circulation, muscular development and skin texture
- Is thought to be **antibacterial**
- protection against **cardiovascular** diseases.
- May even **repel insects**.

Sesame



Sesame

- Sesame seed is considered to be one of the **oldest oilseed crops** known to humanity.
- Sesame has **many species**, and most are wild.
- Most wild species of the genus *Sesamum* are native to **sub-Saharan Africa**.
- *Sesame Indicum* the **cultivated type, originated in India**.
- Adapted to many soil types.

Sesame Oil

- Initiation of **flowering** is sensitive to **photoperiod** and to sesame variety.
- The **photoperiod** has positive impact on **oil content**
- **Oil content is inversely** proportional to **protein** content.

Sesame Production

- Has the ability to grow in **areas** that do **not support the growth of other crops**.
- It needs **little farming support**
- it grows in: **drought** conditions, in **high heat**, with **residual moisture**, or even when **rains fail** or when rains are excessive.
- Could be grown by **subsistence farmers at the edge of deserts, where no other crops grow**.
- Sesame has been called a **survivor crop**.

Production and trade

- The most productive sesame seed farms in the world were in the European Union with an average yield of 5.5 metric tonnes per hectare in 2010
- Italy reported the best nationwide average yield of 7.2 metric tonnes per hectare.

Sesame Production and trade

- **Global** harvest about **3.84 million tonnes** of seeds in 2010.
- **Largest** producer in 2010 was **Burma**
- **Top three** producers, **Burma**, **India**, and **China**, accounted for 50 percent of global production.
- Global **average yield** of seeds was **0.49 tonnes/ h** in 2010.

Sesame Oil Nutrition and health treatments

- Sesame seeds have been a source of **food** and **oil**.
- Sesame has one of the **highest oil content** of any seed, some varietals exceeding **50%** oil content compared to soybean's 20 percent.

Production and trade

- There is a large **yield gap** between major sesame seed producers, because of:
  - **knowledge** gap
  - poor crop **management** practices
  - use of **technology**.

Sesame Oil Nutrition and health treatments

- Oil from the seed is used in **cooking**, as **salad** oils and **margarine**
- Oil contains about:
  - **47% oleic**
  - **39% linoleic acid**.

Sesame Oil Nutrition and health treatments

- Sesame oil is one of the most **stable vegetable oils**, with **long shelf life**, because of the high level of **natural antioxidants:**
  - **sesamin**
  - **Sesamolin**
  - **sesamol**.

Sesame Oil Nutrition and health treatments

- Flour
- has good **effective carbohydrates**
- contains **water-soluble antioxidants** (sesaminol glucosides) that provide added shelf-life to many products.

Sesame Oil Nutrition and health treatments

- Sesame oil, like sunflower seed oil, is **rich in Omega 6 fatty acids**
- Sesame oil **lacks Omega 3 fatty acids**.
- Sesame seed is **rich in protein**, at 25% by weight.
- The **flour** that remains after oil extraction contains **35 to 50% protein**