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Leading soil conditioning technology

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# TEST REPORT

## 1. Contact information

**Client:** *Lesy Slovenskej republiky (Forests of the Slovak Republic), OZ SEMENOLES Liptovský Hrádok, ŠS Šarišské Michaľany*
**Country:** *Slovakia*
**Contact person:** *Mrs. Ing. Sušková Miriam PhD, Head Production Manager*
*Mr. Ing. Ivan Varchol, head of ŠS Šarišské Michaľany*

## 2. Plants

- Sessile Oak (*Quercus petraea*) and Beech (*Fagus sylvatica*)
  ☑ Seeds
  ☐ Seedlings
  ☐ Trees

Plant seeds were sown using the following system:

| Tree species | Type of planting tray | Number of cells per planting tray | Cell volume in ml |
|---|---|---|---|
| **Beech** | QP 35T | 35 | 200 |
| **Beech** | Planter V300/53 MAX-40 | 53 | 300 |
| **Sessile Oak** | Q35 | 35 | 200 |
| **Sessile Oak** | Planter V300/53 MAX-40 | 53 | 300 |

## 3. Substrate

- Ready-to-use sowing substrate supplied in big bags with a volume of 6m$^3$ each (20,000 to 30,000 pcs/bag) was used to fill planters for subsequent sowing. Sowing substrate composition:
  - Fraction: 4-20 mm;
  - Dry mass: 35-45 %;
  - pH (1:5): 4-5 (STN EN 13037 method);
  - EC conductivity (1:5): 0.15-0.25 mS/cm (STN EN 13038 method);
  - EC conductivity (1:5) of the basic raw substrate: 0.02-0.06 mS/cm (STN EN 13038 method);
  - Dry mass organic substances: >93 % gravimetric method;

## 4. Trial objectives

- Increase yield or reduce plant mortality from sowing to distribution of the seedlings to clients
- Improve quality of seedlings for sale
- Make the plant water supply system more effective
- Improve effectivity of fertilisation in cultivation of container plants

## 5. Trial description

- Test duration: ***April to October 2017***

- Sowing substrate preparation:
  *The purchased substrate in 6m³ bags was mechanically scarified and subsequently manually and evenly mixed with the TerraCottem® Universal soil conditioner at a rate of 1.5 kg TCU/m³ and 3.0 kg TCU/m³ of substrate, under professional supervision. Subsequently, the planters of different volumes were mechanically filled with the sowing substrate containing TCU.*
  *The total amount of substrate used: approximately* ***66 m³****.*
  *The total amount of TCU soil conditioner used:* ***107,08 kg.***

- Sowing of seeds:
  *The filled planters were continuously and manually sown with oak and beech seeds as described in this graph:*

| Tree species | Type of planting tray | Number of cells per planting tray | Cell volume in ml | Number of cells with 1.5kg TCU /m³ of substrate (in pcs) | Number of cells with 3 kg TCU/m³ of substrate (in pcs) | Total number of cells with TCU in pcs | |
|---|---|---|---|---|---|---|---|
| **Beech** | QP 35T | 35 | 200 | 10,000 | 5,000 | 15,000 | **253,634** |
| **Beech** | Planter V300/53 MAX-40 | 53 | 300 | 4,000 | 4,000 | 8,000 | |
| **Sessile Oak** | Q35 | 35 | 200 | 150,000 | 50,000 | 200,000 | |
| **Sessile Oak** | Planter V300/53 MAX-40 | 53 | 300 | 15,317 | 15,317 | 30,634 | |

The above monitored groups of planting trays were duly designated and placed in three identical greenhouses with an automated irrigation for the entire duration of the trial i.e. April to October 2017 .

- **Greenhouse 1** with individual irrigation mode
  *Oak without TCU:* *20,500 pcs*
  *Oak with 1.5 kg TCU:* *24,100 pcs*
  *Oak with 3.0 kg TCU:* *48,100 pcs*
  Total: 92,700 pcs

- **Greenhouse 2** with individual irrigation mode
  Oak *with 1.5 kg TCU:* *70,600 pcs*
  *Beech with 1.5 kg TCU:* *7,000 pcs*
  Oak *with 3.0 kg TCU:* *8,608 pcs*
  *Beech with 3.0 kg TCU:* *4,500 pcs*
  Total: 90,708 pcs

- **Greenhouse 3** with individual irrigation mode
  Oak *with 1.5 kg TCU:* *70,600 pcs*
  *Beech with 1.5 kg TCU:* *7,000 pcs*
  Oak *with 3.0 kg TCU:* *8,608 pcs*
  *Beech with 3.0 kg TCU:* *4,500 pcs*
  Total: 90,708 pcs

- **Greenhouse 4** with normal irrigation mode, identical to the previous period

*Beech without TCU:* *80,500 pcs*

## 6. Trial results of the substrate with 1.5 and 3.0 kg TCU /m³:

a.) Plant yield (or mortality of seeds and plants from sowing to distribution):

| | | Yield - average | | |
|---|---|---|---|---|
| **Tree species** | **Type of packaging** | **Past achieved value %** | **Yield 2017 %** | **Average improvement by** |
| **Beech** | QP 35T | 55 - 60 | **64.99** | **13 %** |
| **Beech** | Planter V300/53 MAX-40 | 55 - 60 | **74.20** | **29 %** |
| **Sessile Oak** | Q35 | 30 - 40 | **60.57** | **73 %** |
| **Sessile Oak** | Planter V300/53 MAX-40 | 30 - 40 | **70.04** | **100 %** |

b.) Quality of seedlings produced – average height above ground:

| | | Average height above ground | | |
|---|---|---|---|---|
| **Tree species** | **Type of packaging** | **Past achieved value** | **Value achieved 2017** | **Average improvement by** |
| **Beech** | QP 35T | 20 cm + | **35 cm +** | **75 %** |
| **Beech** | Planter V300/53 MAX-40 | 20 cm + | **35 cm +** | **75 %** |
| **Sessile Oak** | Q35 | 15 cm + | **35 cm +** | **133 %** |
| **Sessile Oak** | Planter V300/53 MAX-40 | 15 cm + | **35 cm +** | **133 %** |

c.) Quality of seedlings produced – average thickness at root collar:

| | | Average thickness at root collar | | |
|---|---|---|---|---|
| **Tree species** | **Type of packaging** | **Past achieved value** | **Value achieved 2017** | **Average improvement by** |
| **Beech** | QP 35T | 4 mm + | **5 mm +** | **25 %** |
| **Beech** | Planter V300/53 MAX-40 | 4 mm + | **5 mm +** | **25 %** |
| **Sessile Oak** | Q35 | 4 mm + | **6 mm +** | **50 %** |
| **Sessile Oak** | Planter V300/53 MAX-40 | 4 mm + | **6 mm +** | **50 %** |

d.) Quality of seedlings produced – stem taper:

*The seedlings of the planting trays with TCU had a better stem quality – stems were less "tapering", i.e. stem has a more even thickness in its entire length.*

e.) Water supply – irrigation:

*Despite exceptionally long-lasting high temperatures in 2017, the trays with the seedlings treated with the TCU soil conditioner had a reduction of **50%** in costs of irrigation water compared to the previous years. Consequently, there was a reduction of labour costs related to irrigation.*
*The remarkable benefit in terms of water and labour savings was due to the fact that the seedlings situated at the exposed areas (i.e. at the edges of the operating corridors) were not additionally irrigated in comparison to previous seasons.*

f.) Additional fertilisation of plants:

*It was not necessary to apply any additional fertilisation to any seedlings which substrate was treated with TCU at a rate of 1.5 kg/m$^3$ or 3.0 kg/m$^3$, during their entire stay at the nursery.*

## 7. Conclusion:

The trial fulfilled all objectives set by the planting stock producer before its commencement. The expected effect was observed not only in savings in water, labour and energy, but mainly in the quality and quantity of the planting stock produced. All plants treated with TCU were healthier, stronger and with a better developed root system.

The TCU had a particularly positive effect on the yield of the Sessile oak seeds, but subsequently also on the seedlings themselves. This was reflected in the number of seedlings produced, their growth and overall quality.

Furthermore, it has been noted that the mixture of hydroabsorbants contained in the TCU-formula has - through an even and proper soaking of the substrate - ensured a supply of water to the plants, even during extremely hot days.

TCU´s own fertiliser composition and the synergy with the other components ensured adequate and balanced nutrition for the seedlings from sowing to distribution without further regular fertilisation.

In the comparison of the two rates of TCU (1.5 and 3.0 kg TCU per m$^3$ of substrate) in this trial, the rate of 1.5 kg / m$^3$ substrate proved to be the most effective. At this rate *TerraCottem® Universal* has achieved the optimum effect in terms of positive impact on plants and costs.

The general conclusion regarding the above-mentioned trial is that the use of TCU in ŠS Šarišské Michaľany:

- increased seedling production
- improved seedling quality
- reduced costs of cultivation.

The use of *TerraCottem® Universal* soil conditioner in the current conditions of the forest nursery has in this case proven to be economical, safe and noticeable. The aforesaid product facilitates an increase of seedling production and improves their quality. This is an important fact that will affect the seedling production system for use in forestry not only in ŠS Šarišské Michaľany, but probably also for several other producers. Additionally, in times of global warming and increased demands on seedling quality by customers, the producers have to seek other options to improve their products. From this overall perspective the *TerraCottem® Universal* soil conditioner definitely has an important role to play.

*The report was prepared by:*
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*Supporting documents to the report and professional supervision arranged by:*
**Ing. Ivan Varchol**, Head of *ŠS Šarišské Michaľany*

23 December 2017

***Annex: - Photographs documenting the evolution of the trial***

26.4.2017
Weighing the TerraCottem® Universal rates


26.4.2017
Adding TerraCottem® Universal to the substrate

26.4.2017
Preparation work prior to mixing TerraCottem® Universal with the substrate

26.4.2017
Mixing

26.4.2017
Mixing

26.4.2017
Control and visual inspection of the amount of TerraCottem® Universal hydroabsorbants in a sample

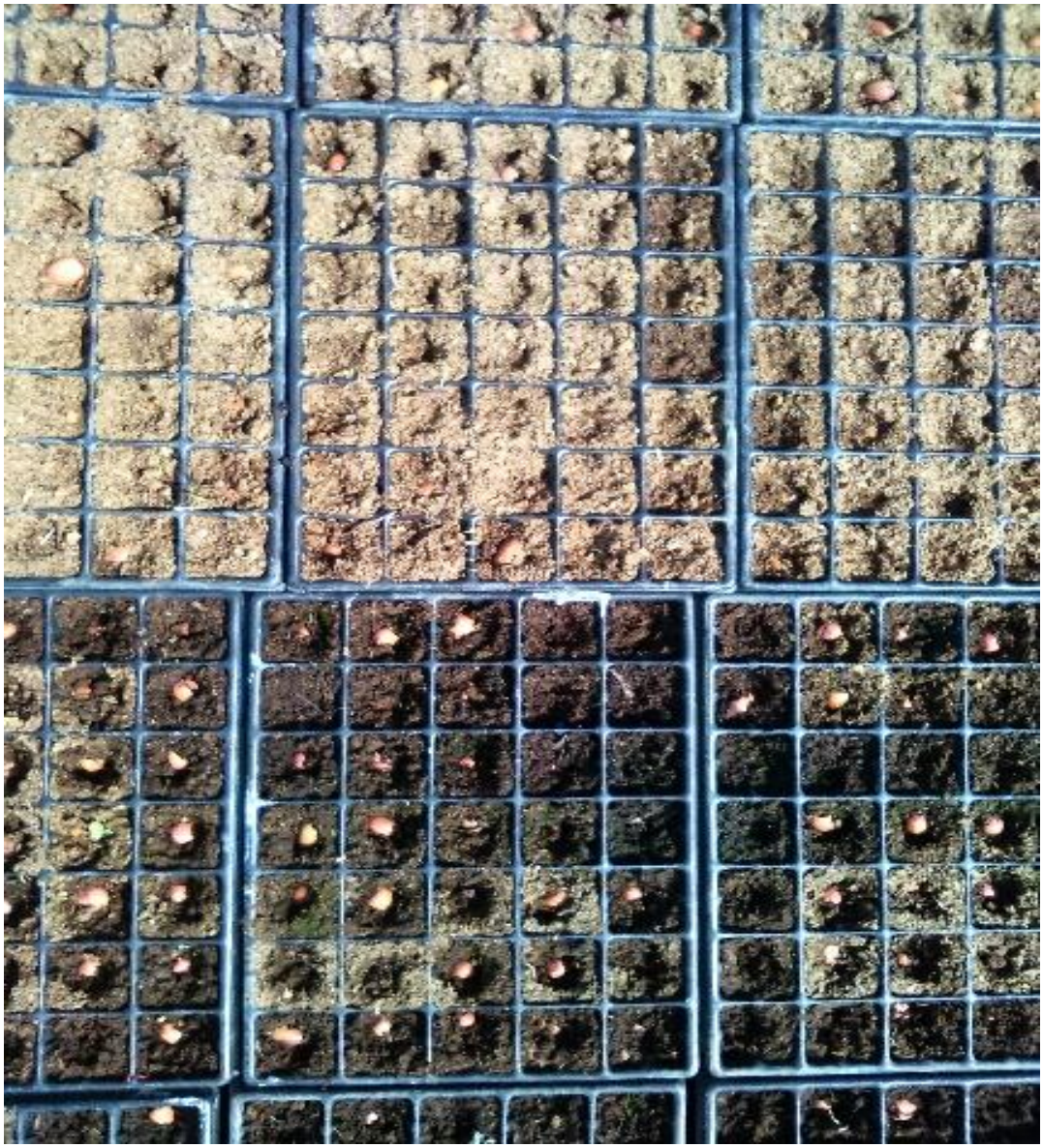
26.4.2017
Filling the planting trays with the mixture of substrate and TerraCottem® Universal

26.4.2017
Sown planting trays with TerraCottem® Universal recently placed in the greenhouses

Visual comparison of sown, identical planters in terms of their ability to preserve water at the same irrigation frequency:

1.) above **without** TerraCottem® Universal

2.) below **with** TerraCottem® Universal



19.6.2017


19.6.2017

9.8.2017


9.8.2017

Sessile oak root system growing through the TerraCottem® polymers *(in a cell)*

15.11.2017
Seedlings in planting trays relocated from greenhouses to exterior

Ing. Ivan Varchol, Head of ŠS Šarišské Michaľany, checks the quality of winter oak seedlings before distribution