Antarctica analogue test campaign preliminary result of R.U.C.O.L.A., the EDEN ISS rack-like plant production unit for microgravity applications

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Main Objectives

**EDEN ISS project (H2020 framework)**
- Advance the TRL of higher plants cultivation technologies for food production in space, aiming at future exploration missions
- Involve non space SMEs in the space sector for mutual benefit

**R.U.C.O.L.A. Unit**
- Advance the TRL of a rack-like food complement unit for microgravity applications (e.g. ISS, Cis Lunar habitat, commercial space stations, transit vehicles, etc.)

**Antarctica Test Campaign**
Use Antarctica as a space-analog test site for the following key aspects:
- Logistics (manage nominal and off-nominal activities in 9 months, without refurbishment and very limited crew, validation of remote operations)
- Microbiological environment (the contamination you bring is that you have to manage)
- Psychology (not many colored, moist, warm, green-smelling habitats around)

**Antarctica Test Facility Description**

**Neumayer Station III**
The experiment is located nearby the Neumayer Station III, owned by the German Polar Institute (Alfred Wagner Institute - AWI), located on the approximately 200 metres thick Ekstrom Ice Shelf.

**Mobile Test Facility (MTF)**
The R.U.C.O.L.A. unit developed by Thales Alenia Space is contained into a Mobile Test Facility (MTF), a controlled environment developed by the EDEN ISS consortium under the lead of the German Space Center (DLR-Bremen), placed 400m from the Neumayer Station III.

**R.U.C.O.L.A. As Built**

**R.U.C.O.L.A. Main Subsystems**

**Laboratory Test Campaign**

**Main Results**

**Light Distribution**
- White light uniformity ratio: 0.87
- Red/Blue/far red light uniformity ratio: 0.79

**Temperature and Humidity Control**
- Controlled temperature: 16-25°C ± 1.4°C
- Controlled relative humidity: 60-80% ± 4.8% (only dehumidification)

**Nutrient Delivery System Performance**
- Reservoirs replacement every 33 days
- Controlled pH: 5.0-7.0 ± 0.2
- Controlled EC: 0.0-2.5mS/cm ± 0.1mS/cm

**Seeds viability**
- In commercial germination unit: 91%
- In R.U.C.O.L.A (laboratory): 74%

**Nutrient Delivery System Performance**
- Reservoirs replacement every 10 days
- Very low air moisture and increased leak rate after transportation impacted sensibly condensate recovery capability

**Seeds viability**
- In R.U.C.O.L.A (Antarctica first batch): 34%
- Seeds were glued with agar on special tape. The extremely variable transport conditions may have impacted seeds viability.

**Antarctica Integration and Test Campaign**

**Main Highlights**
- Temperature and Humidity Control (THC)
  - Controlled temperature: 19-25°C ± 2.1°C
  - Higher than expected thermal loads during Antarctica day impacted THC performance

- Nutrient Delivery System Performance
  - Reservoirs replacement every 10 days
  - Very low air moisture and increased leak rate after transportation impacted sensibly condensate recovery capability

- Seeds viability
  - In R.U.C.O.L.A (Antarctica first batch): 34%
  - Seeds were glued with agar on special tape. The extremely variable transport conditions may have impacted seeds viability.

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