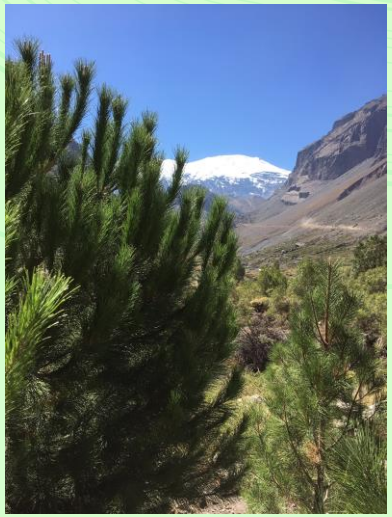
PINEA SPOT CONGRESS

LISBON 2023

21 TO 23 NOVEMBER

# Pinus pinea pine nut yield depends on cone weight and seed health

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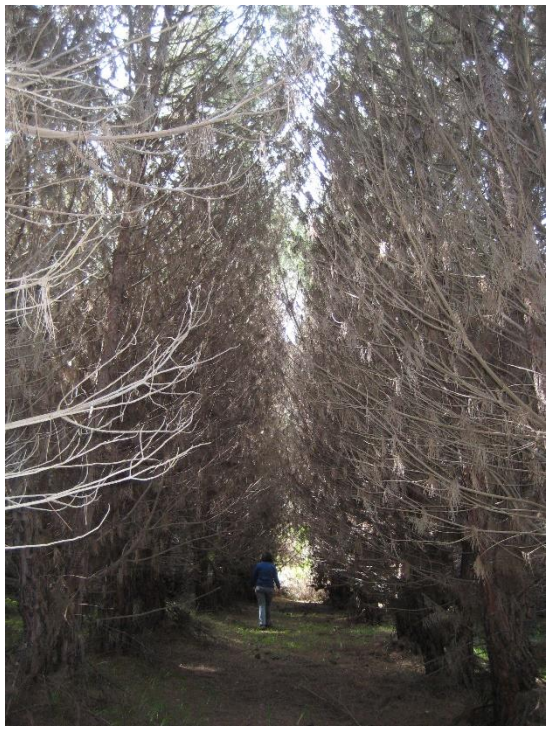
# Introduction

- *Pinus pinea* is appreciated for its highly demanded and expensive pine nuts.
- Given the market opportunities, stone pine cropping is being developed in non-native countries like Argentina, Australia, New Zealand and Chile.
- In Chile, the species grows well and bears high cone production, being considered an emergent crop, with over 4,500 ha of plantations established in the last years.
- Efforts are being made to maximize pine nut production, which is particularly important given the small fraction of cone weight that corresponds to pine nuts.
- However, cone to pine nut yield, an important crop feature, is decreasing worldwide.

# Adult Plantations

Capitán Pastene


Tanumé



Peñuelas

Toconey

Cáhuil

# New Plantations in Chile






# Goal

**Objective**: to compare the number of damaged seeds and PY among different stone pine cone weights across a wide range of spatial-temporal variability in Chile.

**Hypothesis:** heavier cones would have a higher PY and a lower percentage of damaged seeds than lighter cones.

# Methods

- To monitor cone weight, seed and pine nut morphometry, and pine nut yield over time (10-years) (2010-2020), a MET study involving seven plantations across Chile was set up.
- Hierarchical random sampling to select 10 trees per plantation.
- One healthy 3-year-old cone was harvested from each selected tree, totaling 560 cones.
- All seeds and pine nuts were measured and weighed, and seed and pine nut damage were evaluated.

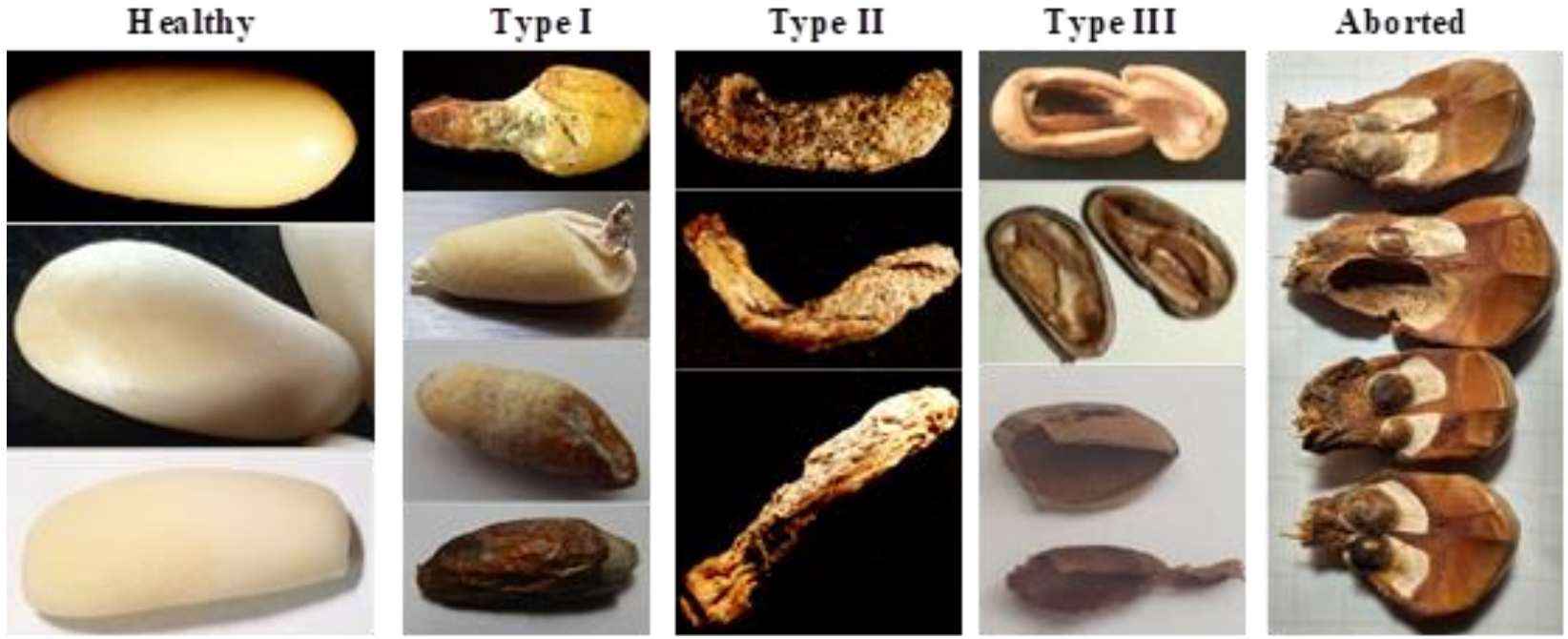
# Methods

| Traits | Abbreviation | Unit | Measurement procedures |
|---|---|---|---|
| Cone weight | CW | g | 3-year-old cones were weighed in a Mettler (Toledo, Spain) AJ150 † |
| Cone length | CL | mm | Measured with a digital caliper |
| Cone diameter | CD | mm | Measured with a digital caliper in the largest section |
| Seeds per cone | SN | # | All seeds were extracted from each cone and counted |
| Seed weight | SW | g | Each seed per cone was weighed in a Mettler (Toledo, Spain) AJ150 †† |
| Seed length | SL | mm | Measured with a digital caliper †† |
| Seed diameter | SD | mm | Measured with a digital caliper in the largest section †† |
| Seed yield | SY | % | $SY = ((SN \times SW)/CW) \times 100$ |
| Seed to pine nut yield | SPY | % | $SPY = ((PN \times PW)/total\ seed\ weight\ per\ cone) \times 100$ |
| Pine nuts per cone | PN | # | All healthy pine nuts from each cone were counted |
| Pine nut weight | PW | g | Each pine nut was weighed in a Mettler (Toledo, Spain) AJ150 ††† |
| Pine nut length | PL | mm | Measured with a digital caliper †††† |
| Pine nut diameter | PD | mm | Measured with a digital caliper in the largest section † |
| Pine nut yield | PY | % | $PY = ((PN \times PW)/CW) \times 100$ |
| Empty/Damaged seeds | DS | % | $DS = ((SN \times PN)/SN) \times 100$ |

# Methods

Types of damages quantified:

- Healthy kernel, tegument and embryo
- Type I: partially damaged kernel, variable damage of embryo.
- Type II: embryo shrunken/dry with no endosperm.
- Type III: empty shells, no embryo or endosperm.



# Methods

- Two contrasting categories of cone weight (heavy/light) were identified.
- Cone to pine nut yield and other traits were calculated and compared between categories using a mixed linear model.
- Regression trees were used to explain PY variability.
- Statistical analyses were performed using the InfoStat software and its interface with R (www.r-project.org).

# Results

- Cone weight in Chile was higher than in the species' native range (474 g on average).
- Seed and pine nut number per cone, size and weight were significantly higher in the heavy category than in the light one.
- Pine nut yield increased by 11.9%.
- Percentage of damaged seeds was lower (9% vs 15.9%, respectively).

| Variable | Heavy cones (> 503 g) | Light cones (< 393 g) | Variation (%) |
|---|---|---|---|
| CW | 594.9±5.7 a | 338.0±4.7 b | 76.0 |
| CL | 152.8±19.5 a | 131.3±20.3 a | |
| CD | 116.2±16.0 a | 103.3±17.2 a | |
| SN | 124.8±3.4 a | 89.1±3.6 b | 40.1 |
| SW | 0.96±0.02 a | 0.76±0.02 b | 26.3 |
| SL | 18.8±0.5 a | 16.6±0.6 b | 13.3 |
| SD | 9.2±0.3 a | 8.4±0.3 b | 9.5 |
| SY | 19.8±0.6 a | 18.7±0.6 b | 5.9 |
| PN | 112.9±3.4 a | 76.1±3.7 b | 48.4 |
| PW | 0.22±0.01 a | 0.18±0.01 b | 22.2 |
| PL | 13.8±0.4 a | 12.2±0.5 b | 13.1 |
| PD | 5.0±0.3 a | 4.8±0.3 b | 4.2 |
| SPY | 20.9±0.8 a | 20.3±0.9 a | |
| PY | 4.05±0.17 a | 3.62±0.18 b | 11.9 |
| DS | 9.0±1.6 b | 15.9±2.0 a | -43.4 |

# Conclusions

- PY depends on seed and pine nut morphometry and seed health.
- Heavy cones have a higher number of pine nuts, a lower percentage of damaged seeds, and a higher PY than light cones.
- Management practices, such as fertilization and irrigation, could be used to boost production of heavy cones, thereby increasing PY.
- These recommendations may be useful from an economic perspective.

# New studies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