

Severe seed yield loss in Mediterranean stone pine

Report Short Term Scientific Mission COST-STSM-FP1203-25224

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The Dry Cone Syndrome, severe cone and kernel yield loss in stone pine

The relevance of the Mediterranean stone pine, *Pinus pinea* L., for economic sustainability of Mediterranean forests is based on the value of its edible pine nut kernels. But in the last years, a severe loss of seed-per-cone yield has been reported by processing industries for stone pine cones collected in all countries: When cracking apparently sane cones, up to half of the seeds have been found to be empty or damaged. Additionally, cone pickers have reported also an unusual high percentage of aborted unripe conelets, resulting in a drastically reduction of final cone yield. The coincidence of only recent appearance of both phenomena has coined the common name **Dry Cone Syndrome**, suggesting a possible common agent causing both.

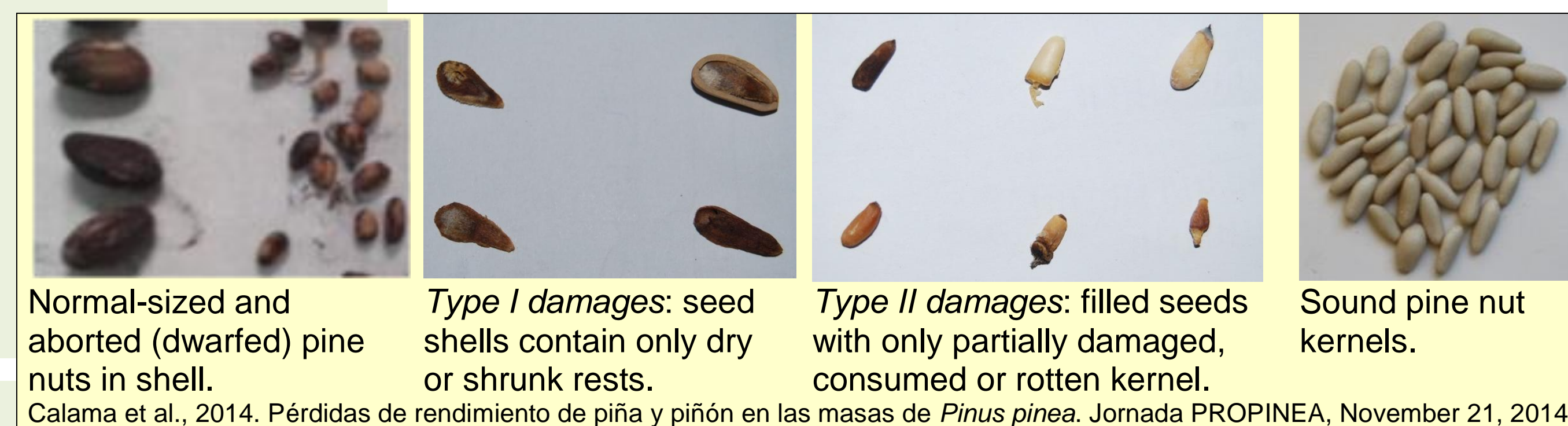
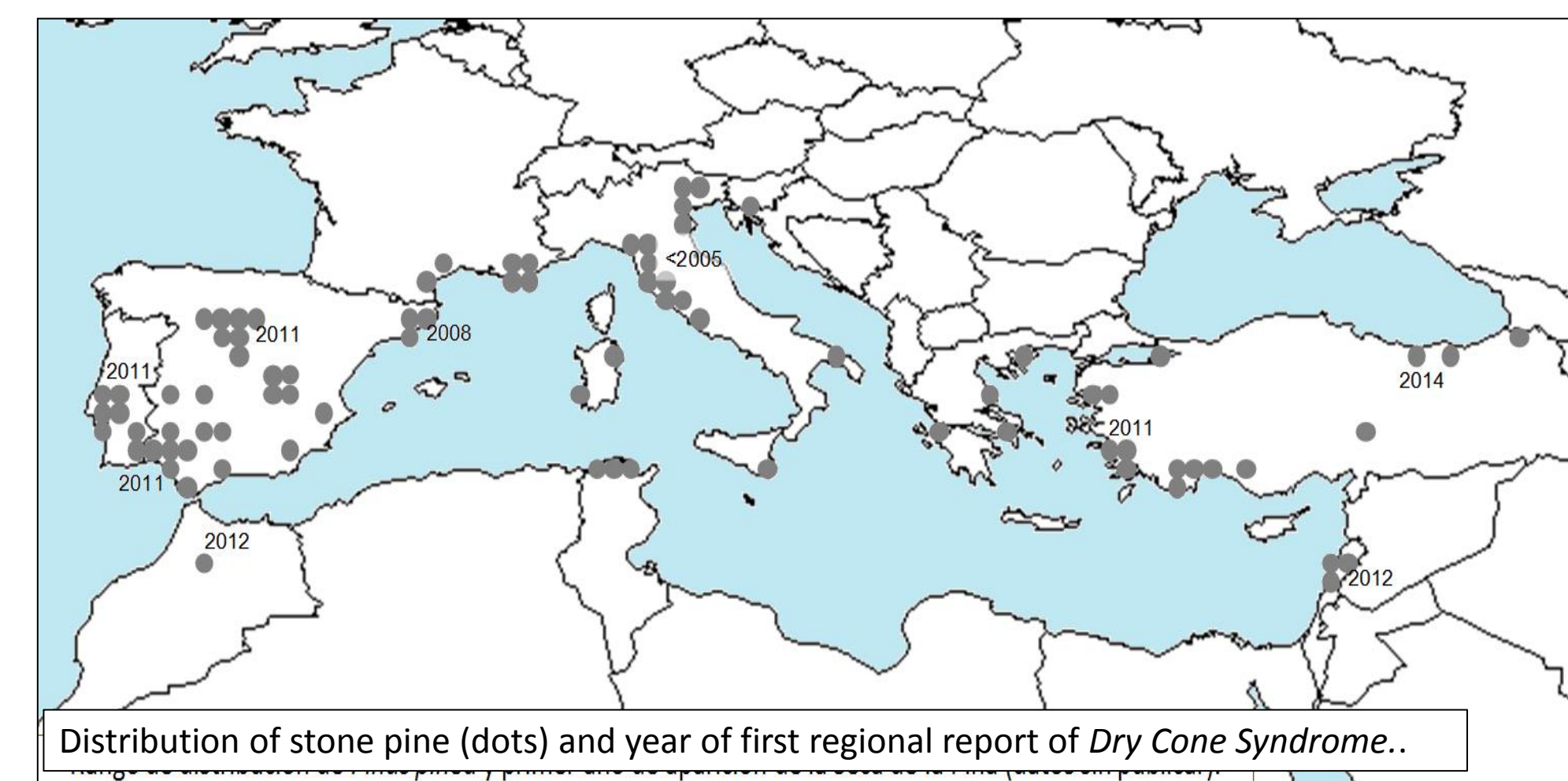
The high percentages of aborted, empty or damaged seeds found in ripe cones during post-harvest processing are a new phenomenon. Formerly, the seed-per-cone yield in this species had been considered a nearly constant ratio: about 180 kg seeds (in shell) from 1 t cones, and only 40 kg kernel.



Short Term Scientific Mission COST-STSM-FP1203-25224. In May 2015, SM spent a week in the group of **Dr. Alain Roques** at the **Forest Zoology Laboratory, INRA Orleans**. Data series of stone pine seed yield (i.e. % seed or kernel weight per cone weight) from cone processing industries in several countries were used to assess the recently arisen seed yield loss known as Dry Cone Syndrome for elucidating possible implication of the alien seed-feeding bug, *Leptoglossus occidentalis*, spread in 21st century over Europe and the Mediterranean. Dr. Roques has researched on conifer cone pests, with a recently presented PhD Thesis (Lesieur, 2014) and a more recent FP1203 STSM on seed damages by *Leptoglossus* (Farinha, 2015).

Material and Methods. During the STSM, seed per cone yield data series from cone processors in Spain, Portugal and Lebanon were discussed, as well as different interpretations and comparison of diagnostic methods for seed damages. Research on pine nuts at the home institute INIA-CIFOR has defined a scale of damage grades based on visual assessment of shelled pine nuts (see photos, Calama et al., 2014).

This typology was compared with the damages caused by known cone pests, especially by *L. occ.*, quoted as putative main biotic agent causing the DCS. The host laboratory applies x-ray assessed diagnosis for bug damages in seeds of stone pine/other species.



Results.

Some of the industries' data series for seed yield per cone were expressed in seed yield (in shell) per cone weight, others in shelled kernels per cone weight. Until the recent past, the seed-per-cone-weight ratio had been nearly constant 16-18%. In cones harvested in winter 2010/11 for the first time, some cone lots rendered less than 10% of at least "externally" sound, filled seeds (i.e. sound or only partially damaged type II). Since the following crop, the threshold of 15% seeds hasn't been reached any more, though in 2013/14 the seed output recovered to a average of 13%, after the worst year before with only 5% of seed in shell output per ton of processed cones (5%), less than the third part of a formerly normal value. Also in the series for shelled kernel, the ratio of kernel per cone weight, until 2008 quite constant 3.5-4%, has dropped to currently only 1.5-3% (fig. 1).

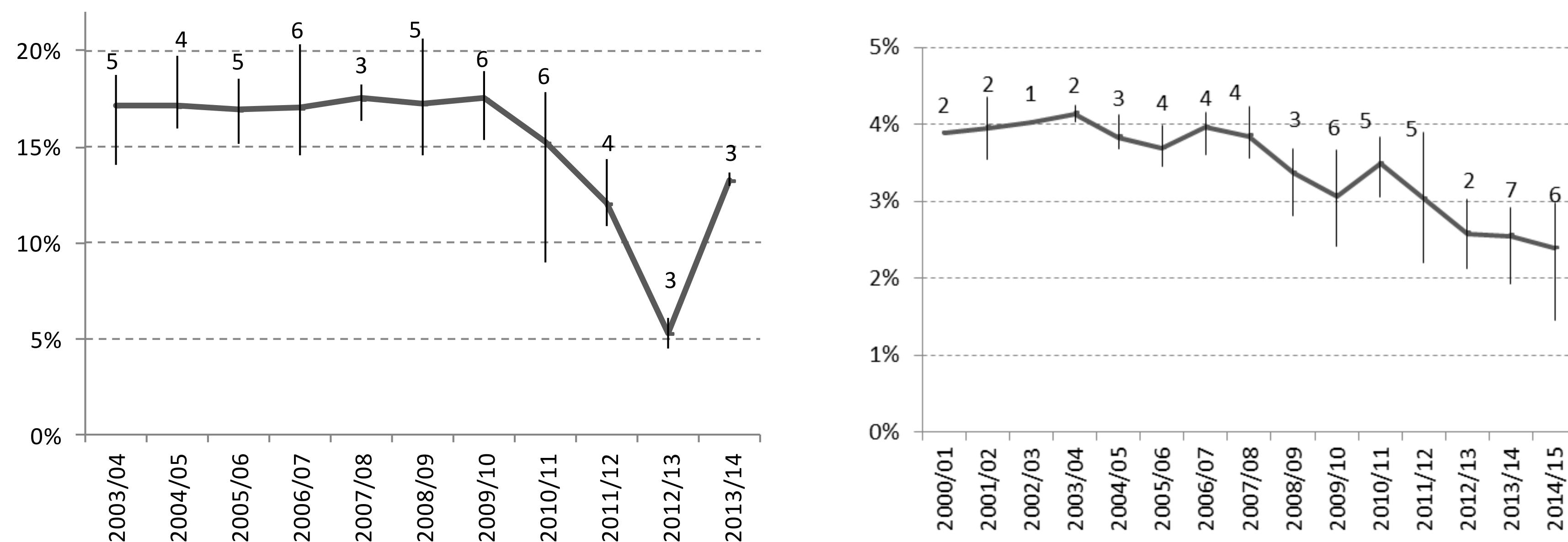


Figure 1.a. Range and mean seed yield of *Pinus pinea* cones [kg seed in shell/kg cones; n 3-6 data per year, from Castile and Andalusia (Spain)].

b. Range and mean kernel yield of *Pinus pinea* cones [kg kernel/kg cones; n = 1-6 data per year, from Spain and Portugal]

Conclusions.

The data series from cone processors confirm a **drop in the seed yield per cone weight, a new syndrome generalised since 2011**, in kernel output even some year before.

Together with the shortage of harvested cones, putatively due to conelet abortions, the economic relevance of this syndrome is overwhelming:

Though 1 ton of kernel were obtained formerly from 25 t cones, now **about 40 t cones are necessary for yielding the same output in kernels**. Due to cone prices even higher than before, profitability is jeopardised seriously and the pine nut value chain faces a very difficult situation.

All kind and grades of novel seed damages described in stone pine by processors, as well as in samples processed in INIA-CIFOR Lab (Calama et al., 2014), from aborted conelets, aborted seeds up to type 0/I/II damages are **fully compatible with damages produced directly by feeding caged *Leptoglossus occidentalis*** (ongoing research). The x-ray based assessment for these damage types, as applied by the host Laboratory for Forest Zoology at INRA Orleans, discriminates empty and even partially damaged seeds successfully from sound ones (Farinha, 2015), confirming the plain congruence of results in both methods.

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