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Sentinel plantings for detecting alien, potentially damaging tree pests

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High Frequency and Diversity of Insects and Fungi in Traded Tree Seeds

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The number of introduced forest pests and the damage they cause is increasing worldwide, mainly due to the international trade in live plants. Seed trade is considered relatively safe from the phytosanitary point of view and is thus less regulated. The pests potentially carried by seeds are, however, not well documented. We assessed insects and fungi in 58 lots of traded seeds of eleven Angiosperm and Gymnosperm tree species from Europe, North America and Asia. Insects were detected by x-raying 100 randomly selected seeds per lot. Infested seeds were dissected and specimens were identified by sequencing the mtDNA COI region. The fungal community was assessed by metabarcoding, using the rDNA ITS region from a pooled sample of 100 seeds per lot. About 30% of the seed lots contained insect larvae. Larvae were found in Gymnosperm seeds from all three continents, but only in Angiosperm seeds from North America. Gymnosperm seeds contained mostly Hymenoptera, represented by three *Megastigmus* species, each specific for a certain Gymnosperm host species, whilst Angiosperm seeds contained Lepidoptera and Coleoptera species. Fungi were found in all seed lots and their diversity was much higher than insect diversity. About 76% of the 1258 Operational Taxonomic Units (OTUs) could not be assigned to a species and about 30% not even to a genus. Classified OTUs were grouped into 237 genera and 298 species. Angiosperm seed lots carried more fungal taxa than Gymnosperm seed lots. About 87% of the OTUs were unique either to Angiosperms or Gymnosperms. Moreover, 80% of the OTUs were unique to samples from one continent. The results provide evidence for the movement of insect pests and fungal pathogens previously undetected in the studied countries. The *Megastigmus* species illustrate two possible scenarios: the introductions of new pests previously unknown for a certain continent and the introductions of new genotypes of already present species, both being potentially harmful. Highly diverse fungal communities, largely composed of species unique to each of the three continents, indicate that new introductions will continue to occur and highlight the need for mitigation of the risk of introducing new pests, in particular given the large fraction of unidentified OTUs.

Keywords: Seed-borne insects and pathogens, Biological invasions, Trade, Pest Risk Analysis