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Functional traits associated with multiple abiotic stress tolerance strategies in woody plants of the Northern Hemisphere

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Climate change is altering abiotic stress regimes, and thus woody plants performance, at every scale. Functional traits have become a staple for understanding species' resistance to abiotic stressors. However, we still miss consensus on the set of traits defining general woody plant adaptations to tolerate multiple abiotic stresses. We used a dataset of 779 woody species from the Northern Hemisphere to link the key traits defining the global spectrum of plant form and function (GSPFF) with two dimensions summarizing tolerance syndromes to drought, shade, cold and waterlogging. We evaluated these trait-tolerance relationships using generalized additive models at the plant functional type level (PFT, deciduous and evergreen angiosperms, and evergreen gymnosperms). Drought-tolerant angiosperms showed greater specific stem density and seed mass (SSD-SM), and lower specific leaf area and leaf nitrogen content (SLA-LN), compared to the cold/waterlogging tolerant species. Shade-tolerant angiosperms displayed greater SSD-SM and lower SLA-LN compared to intolerant angiosperms. For evergreen gymnosperms, the shade-drought trade-off was the key tolerance strategic axis of differentiation in trait variations. Independently of PFT, specialized tolerance strategies towards considered stressors were associated with different positioning in the GSPFF, and thus to contrasting trait combinations, marking the existence of pervasive functional constraints over polytolerance in woody plants. However, the trait combinations underlying different stress tolerance strategies mostly differed between angiosperms and gymnosperms, suggesting contrasting trait-tolerance relationships only at a broad taxonomic level.