FARMING PRACTICE
LANDSCAPE FEATURES

IMPACT: CROP YIELD

Reference 25

Rivest, D; Paquette, A; Moreno, G; Messier, C 2013 A meta-analysis reveals mostly neutral influence of scattered trees on pasture yield along with some contrasted effects depending on functional groups and rainfall conditions AGRICULTURE ECOSYSTEMS AND ENVIRONMENT, 165, 74-79. 10.1016/j.agee.2012.12.010

Background and objective

Scattered trees occurring throughout farmland matrix are prominent features of many human-dominated landscapes around the world, especially in livestock grazing systems. They are keystone structures that may play important roles in maintaining ecosystem functions, services, and farmland biodiversity. The authors addressed the following key questions: 1) What is the overall effect of scattered trees on pasture yield across different biomes and species? 2) Does the effect of scattered trees on pasture yield differ between different tree functional groups? 3) Does decreasing annual rainfall influence the effects of scattered trees on pasture yield? 4) Are the latter interactions mitigated among tree functional groups?

Search strategy and selection criteria

The literature published between 1989 and 2011 was investigated using the following electronic databases: CAB Abstracts, Biological Abstract, Scopus and Google Scholar. Titles, abstracts and keywords were searched using these keywords: "agroforestry parkland" ,"dehesa", "grassland production", "grazed woodlands", "herbaceous production", "montado", "paddock trees", "pasture understory", "pasture yield", "savanna", "scattered tree", "silvopastoral system", "tree-grass". 1) Field studies where herbaceous aboveground biomass (expressed per unit area) was measured directly beneath the canopy of scattered mature trees (density typically ranged from 15 to 50 trees ha−1) and in an appropriate control (away from tree crowns in open areas); 2) Data collection was limited to experimental plots that included exclusively an unimproved herbaceous layer (i.e. unfertilized, non-irrigated, not sown with genetically improved varieties) to avoid possible confounding effects of agricultural inputs with that of tree environment.

Data and analysis

The statistical analyses were performed using the MAD and metaphor libraries in the R software environment (version 2.14.1). First, a simple random effects model was used to test the overall effect of trees on pasture yields. A mixed-effects model was then performed by including tree functional group and annual precipitation as moderators. Significant differences between groups were explored using contrasts. A mixed-effects models was built for each group including precipitation as a moderator.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
27	Pasture land	Scattered trees	No scattered trees	Metric: Crop yield; Effect size: Hedge g (standardized difference) comparing the considered metrics between intervention and control	75

Results

- Overall, tree overstorey had a neutral effect on total herbaceous aboveground biomass, with a non-significant (n = 73, Z = −1.268, P = 0.205) mean effect size of −0.39 and 95% CI ranging from −1.00 to 0.21.
- The overall heterogeneity of effect sizes was large (Q = 1283.39, d.f. = 72, P < 0.0001), indicating that the individual effect sizes in our data did not estimate a common population mean and that other experimental treatments or moderators may have influenced results.
- The effect size was negative and significant for Eucalyptus (g = −2.49 ± 1.97, P = 0.0135), positive and near-significant for N2-fixing (g = 1.73 ± 1.91, P = 0.076), and near zero and non-significant for deciduous (g = 0.16 ± 0.61, P = 0.838) and evergreen oak (g = −0.37 ± 1.66, P = 0.666).
- Annual precipitation had no significant effect on effect size across all tree functional groups when these were taken together (QM = 0.30, d.f. = 1, P = 0.584).

Factors influencing effect sizes

- Tree functional group : The tree functional groups had a significant effect on effect sizes (P < 0.0001).

Conclusion

The sign and magnitude of scattered tree effects on pasture yield did vary among tree functional groups and according to precipitation levels. This study suggests that, as drought pressure increases abiotic stress, tree facilitation by N2-fixing trees, and competition by Eucalyptus, will become the more common interactions between scattered trees and pasture.