FARMING PRACTICE
INTERCROPPING

IMPACT: PLANT NUTRIENT UPTAKE

Reference 4

Li, CJ; Hoffland, E; Kuyper, TW; Yu, Y; Zhang, CC; Li, HG; Zhang, FS; van der Werf, W 2020 Syndromes of production in intercropping impact yield gains Nat. Plants 6, 653–660 10.1038/s41477-020-0680-9

Background and objective

Intercropping, the simultaneous production of multiple crops on the same field, provides opportunities for the sustainable intensification of agriculture if it can provide a greater yield per unit land and fertilizer than sole crops. Authors performed a global meta-analysis to quantify the effect of intercropping on the yield gain, exploring the effects of crop species combinations, temporal and spatial arrangements, and fertilizer input.

Search strategy and selection criteria

The dataset was built by combining a database built by Yu et al. (Yu, Y., Stomph, T.-J., Makowski, D. & van der Werf, W. Temporal niche differentiation increases the land equivalent ratio of annual intercrops: a meta-analysis. Field Crops Res. 184, 133–144. 2015) and a database built by Li et al. (Li, C. J. et al. Yield gain, complementarity and competitive dominance in intercropping in China: a meta-analysis of drivers of yield gain using additive partitioning. Eur. J. Agron. 113, 125987. 2020) From the original database of Yu et al., all the data records of grain-producing intercrops (such as cereals, legumes and oilseed crops) that provided data on species densities were extracted (539 records). We removed the duplicate data records (9 publications and 31 data records) in the two datasets. All intercrops in the resulting database were grain-producing intercrops.

Data and analysis

Linear regression with mixed-effects models (function lme in R package nlme) was used for the analyses. Authors used the publication and the experiment within publications as random effects to account for differences among the studies (publications) and the experiments (sites × years) within studies. A variance model (function varIdent in R package nlme) was used to account for the heterogeneity of variance between intercrops with and without maize. The associations between the yield gain (NE) of intercrops and the variables were further visualized with principal component analysis, using the vegan package in R.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
132	Multiple crops	Intercropping	Monoculture	Metric: Nitrogen fertilizer equivalent ratio (NFER) and phosphorus fertilizer equivalent ratio (PFER); Effect size: Sum of the fractions of the intercropped fertilizer input divided by the sole-crop fertilizer input	81.25

Results

- The sole crops used 19–33% more N fertilizer than the intercrops.
- Intercrops save P fertilizer compared with sole crops both for intercrops with maize (1.36 ± 0.03) and intercrops without maize (1.19 ± 0.04).

Factors influencing effect sizes

- Crop/cultivar combinations : Intercrops with maize save more N and P fertilizer compared with sole crops than do intercrops without maize.

Conclusion

Intercropping saves nitrogen and phosphorus fertilizer compared with sole crop, offering opportunities for the sustainable intensification of both high- and low-input agriculture.