Intercropping

Impact: Nutrient use efficiency

Reference 2

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Background and objective

Several studies have indicated that intercropping increases phosphorus use efficiency but no overarching analysis exists on the role of species traits and input levels. 1) Does cereal/legume intercropping increase P uptake, biomass, and yield as compared to sole crops? 2) How do species traits affect the complementarity for P uptake, biomass and yield in intercropping? 3) How do P input, N input and differences in growing period between species affect the effect of intercropping on P uptake, biomass and yield? 4) What is for cereals and legumes in sole crops and intercrops the relationship between P uptake and biomass or yield (internal use efficiency)?

Search strategy and selection criteria

Data on P uptake in intercropping were obtained through computer searches in Google scholar, ISI Web of Science and the China National Knowledge Infrastructure (www.cnki.net). We used the following key-words alone or in combination: intercrop*, phosphorus, and cereal* and legume*. (i) the study quantified biomass and P uptake or P concentration of sole crops and intercrops with the same management (e.g. level of fertilizer input) under field conditions; (ii) it reported the rate of N and P fertilizer; (iii) it reported the plant density in sole crops and intercrops (this information is needed to calculate the net effect).

Data and analysis

Authors performed an unweighted analysis. Relationships between response variables and explanatory variables were estimated via linear mixed effects modelling. Random effects were included to account for the possibility of correlation between data originating from the same experiment and/or publication. Authors used the anova() function to check the significance of interactions in ANOVA.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
17	Cereals and legumes	Intercropping	Monoculture	Metric: Phosphorus use efficiency (Land equivalent ratio for P uptake, LERP; Net effect for P uptake, NEP); Effect size: Sum of the fractions of the intercropped metric divided by the sole-crop metric or the difference between the observed and the expected value of the considered metrics	75%

Results

- The P fertilizer requirement was 21% lower in intercrops than in sole crops for the same yields: P uptake was substantially increased (LERP = 1.24 ± 0.04, NE = 3.67 ± 1.00 kg/ha; mean ± SE), the conversion efficiency of P uptake to biomass decreased with P uptake and was lower in intercrops than in sole crops but the conversion efficiency to yield was not affected by intercropping.
- NA
- NA
- NA
- NA

Factors influencing effect sizes

- Crop/cultivar combinations : The net effect for P uptake of systems with maize was significantly greater than 0, but the net effect for P uptake for systems without maize was not significantly greater than 0. Moreover, LERP was significantly greater in systems with legumes with a stronger ability to mobilize sparingly soluble P in the soil (faba bean and chickpea) than in systems with soybean. In terms of net effect, no significant effect of legume species was found.
- Fertiliser application : P fertilizer had a significant and positive effect on NEP (β1 = 0.03, P = 0.026) but no effect on LERP. N fertilizer had a significant and positive on NEP (β1 = 0.03, P = 0.018) but no effect on LERP.
- Sowing time : The absolute gain in P uptake (NEP) due to intercropping increased by 6.87 kg/ha per unit TND (temporal niche differentiation; β1 = 6.87, P = 0.031)

Conclusion

Cereal/legume intercropping can increase the uptake of P and hence has the potential to increase P fertilizer use efficiency in agriculture.