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Pelzer, E; Hombert, N; Jeuffroy, MH; Makowski, D 2014 Meta-Analysis of the Effect of Nitrogen Fertilization on Annual Cereal-Legume Intercrop Production Agron. J. 106, 1775–1786 10.2134/agronj13.0590

### Background and objective

Numerous studies have been performed to study the effect of N fertilization on cereal–legume intercrops, and their results are sometimes conflicting. The study objective was to do a meta-analysis on cereal–legume intercrops testing the effects of N fertilization on land equivalent ration (LER; partial and total LER), yield ratio, and proportion of legume in the mixture of crop grains.

### Search strategy and selection criteria

The studies were selected from four databases: Web of Science, CAB Abstracts, Food Science and Technology Abstracts, and MEDLINE. Authors used the keywords nitrogen or N and intercrop to search the full titles of studies published from 1975 to 2012. Only the studies including experiments dealing with annual cereal–legume intercrops and investigating at least two N fertilization rates per site were retained. Moreover, studies had to present (i) grain yield data (sole crops and each species of the intercrop), (ii) intercrop and sole cereal treatments left unfertilized and fertilized at the same rate (in each study, 0 kg N ha<sup>-1</sup> and at least one N fertilization rate other than 0), and (iii) an unfertilized sole crop of the legume.

### Data and analysis

The land equivalent ratio (LER) was calculated for each experimental unit. Statistical analyses were performed with R 3.0.1 software. The R functions glm (for the fixed-effect regression models) and lme (for the mixed-effect regression models) of the nlme package were used for parameter estimation and model assessment. Models were compared on the basis of the Akaike information criterion.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
17	Cereals and legumes	Intercropping	Monoculture	Metric: Land equivalent ration (LER; partial and total LER), yield ratio, and proportion of legume in the mixture of crop grains.; Effect size: Sum of the fractions of the intercropped yields divided by the sole-crop yields	75

### Results

- Total LER and yield ratio values were generally >1, even for high N application rates. In most cases (>91% of the situations accounted for), the area of legume and cereal sole crops required to produce the same amount of grain as one unit area of the cereal–legume intercrop exceeded one unit area, and the grain yield of the intercrop was higher than the mean grain yield of the two sole crops, each cultivated on an area proportional to their relative sowing rates in the intercrop.
- The partial LER of the cereal exceeded 0.5 in 95% of the experimental units (proportion significantly >50% in the binomial test,  $p < 0.001$ ). Thus, in most cases, the yield of the cereal in intercrop situations was greater than half the yield of the sole cereal.
- The partial LER of the legume exceeded 0.5 in only 53% of the experimental units (proportion not significantly >50% in the binomial test).
- In most cases, LER(L) was lower than LER(C): the cereal had a competitive advantage over the legume for grain yield production.

### Factors influencing effect sizes

- Crop/cultivar combinations : In intercrops including C<sub>3</sub> species, the N rate seemed to have a negative effect on the LER of the legume. No clear effect was found for intercrops including C<sub>4</sub> cereals.

### Conclusion

Intercrops are more efficient than sole crops for grain yield production.