FARMING PRACTICE INTERCROPPING

IMPACT: CROP YIELD

Reference 17

Raseduzzaman, M; Jensen, ES 2017 Does intercropping enhance yield stability in arable crop production ? A meta-analysis Eur. J. Agron. 91, 25–33 10.1016/j.eja.2017.09.009

Background and objective

The adverse effects of climate change are significantly decreasing yield levels and yield stability over time in current monocropping systems. Intercropping (IC), i.e. growing more than one species simultaneously in the same field, often increases resource use efficiency and agricultural productivity compared with growing the component crops solely and can enhance yield stability This meta-analysis analysed yield stability in intercrops compared with the respective sole crops, focusing on the effect of intercrop components (e.g. cereal-grain legume, non-cereal-grain legume), experimental patterns (e.g. experiment over years, experiment over locations), IC design (e.g. additive and replacement) and climatic zone (e.g. tropical, subtropical, and temperate).

Search strategy and selection criteria

An extensive search of peer-reviewed literature was conducted in Web of Science™ databases on 5 January 2016 and in Scopus on 11 January 2016. The initial search term was 'intercrop' OR 'mixed crop' OR 'mixed cultivation' OR 'crop mixture' in the title, for papers published between 1980 and 2016, and then the yielded literatures were subsequently refined by search term 'Grain yield'. The search yielded 2513 publications in Web of Science™ and 586 publications in Scopus. An additional literature search was conducted in Google Scholar using the search term 'intercrop' OR 'mixed crop' AND 'grain yield' in the 'anywhere in the article' option, sorted by relevance to get more relevant articles at the beginning. The first 1000 articles in Google Scholar search were considered for further action, assuming that the more relevant articles would be among these. Authors' initial selection criterion was whether the experiment was conducted for a minimum of three years (temporal variability) or at a minimum of three locations (spatial variability) or for at least two years at two locations. Articles ideally had to have grain yield data for each experimental year and location. Articles presenting the mean value of grain yield for different years or locations, instead of mentioning yield data for all experimental years or locations, were not considered in the meta-analysis, unless the mean values were presented together with the standard deviation (SD) or coefficient of variation (CV) for grain yield. Experiments containing different cultivars of the same species at different locations or years were also excluded from the analysis.

Data and analysis

Data were analysed by a non-parametric method using the Friedman test. Nonparametric yield stability measures are distribution-free and are not affected by outliers, unlike parametric estimates. The regression analysis between grain yield level and CV was performed using a scatter plot approach. The probability (P) value for each regression line was obtained by analysis of variance. All statistical analysis was performed using Minitab 17 statistical software.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
33	Multiple crops	Intercropping	Monoculture	Metric: Yield stability (Coefficient of variation - %CV); Effect size: Coefficient of variation	56.25

Results

- Analyses showed significantly ($P \leq 0.001$) higher yield stability (lower % CV) in intercropping compared with sole cropping of cereals or legumes.
- In non-cereal grain legume systems, intercropping showed higher stability than the respective sole crops, but the difference was not significant.
- Compared with temporal variability, in terms of spatial variability both sole crops and IC had lower yield stability (higher CV value) in the same cropping system.

Factors influencing effect sizes

- Crop spatial arrangement : Also intercropping in replacement design gave more stable yields than IC in an additive design.
- Crop/cultivar combinations : Compared with the respective cereal and legume sole crops, intecropping in the cereal-grain legume systems gave higher yield stability than intecropping in the non-cereal-grain legume systems.

Conclusion

Increasing crop diversification through intercropping of cereals and grain legumes can enhance yield stability and food security, making an important contribution to eco-functional, ecological or sustainable intensification of global food production.