

IMPACT: CROP YIELD

Reference 9

Nkebiwe, PM; Weinmann, M; Bar-Tal, A; Muller, T 2016 Fertilizer placement to improve crop nutrient acquisition and yield: A review and meta-analysis *Field Crops Research* 196, 389-401 10.1016/j.fcr.2016.07.018

Background and objective

In agricultural soils, plant-available nitrogen (N) and phosphorous (P) may be inadequate for crop production although total N and P concentrations are high. Therefore, N and/or P fertilizer is commonly applied to field soil by broadcast, even though broadcast does not ensure that a considerable proportion of applied fertilizer is available at the right time and place for optimal root uptake. Fertilizer placement in soil, which refers to precise application of specific fertilizer formulations close to seeds or plant roots to ensure high nutrient availability, may be a more effective alternative to broadcast application. The objectives of this paper are: 1) to summarize current techniques for fertilizer placement in soil and to identify fertilizers that are suitable for subsurface placement; and 2) to quantify the relative effects of fertilizer placement to fertilizer broadcast on crop nutrient acquisition and yield.

Search strategy and selection criteria

The authors used published peer-reviewed articles and reviews obtained through recognized literature databases like Scopus and EBSCO EDS-global index as well as free scientific publication servers like Google Scholar. In our comprehensive literature search, we initially employed the following keywords and their combinations: fertilizer application methods, fertilizer application techniques, fertilizer placement, nutrient placement, localized fertilizer, localized nutrient supply, soil fertilizer depot, nitrogen placement, phosphorous placement, potassium placement, manure placement, slurry placement, field soil, field crops. These searches yielded more specific keywords and technical terms that were subsequently used particularly in literature search. Priority was given to scientific papers published from recent years till 2000 before older publications were considered. Studies included in the meta-analysis fulfilled the following conditions: 1) Published in an international peer-reviewed journal. Two exceptions were made specific to the fertilizer placement technique termed CULTAN (Sommer, 2005): a Ph.D. Thesis and a publication in a national agricultural research center journal. 2) Performed under field conditions. 3) Contained at least one fertilizer placement treatment (Treatment) and one fertilizer broadcast (or broadcast/incorporation) treatment (Control). 4) Applied the same or comparable fertilizer types and application rates for Treatments and Control.

Data and analysis

The procedure for the weighted random effects model analysis consisted of: (1.) Running a fixed effects model to produce summary statistics (mean effect size and total heterogeneity). (2.) Using the resulting summary statistics to estimate a pooled variance. (3.) Using the pooled variance to calculate random effects-weights for each individual study, which were then used in further calculations.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
40	Maize, Soybean, Turnip rape, Winter wheat	Liquid and Solid manure deep placement	Broadcast distribution of liquid manure	Metric: Crop yield; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	87.5

Results

- Irrespective of placement depth, there was no relative placement effect on yield for Solid manure (7.9%, CI95% -0.1 to 14.6, n = 6).
- Relative placement effect on yield of liquid manure was significantly positive (11.6%, CI95% 5.9-18.3, n = 24).
- NULL
- NULL
- NULL

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

Manure placement effect on yield was non-significant for solid manure, while significantly positive for liquid manure.