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# Insight into Localized Fertilizer Placement in Major Cereal Crops

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**Abstract :** The current 'high input-high output' nutrient management model based on homogenous spreading over the entire soil surface remains a key challenge in China's farming systems, leading to low fertilizer use efficiency and environmental pollution. Localized placement of fertilizer (LPF) to crop root zones has been proposed as a viable approach to boost crop production while protecting environmental pollution. To assess the potential benefits of LPF on three major crops—wheat, rice, and maize—a comprehensive meta-analysis was conducted, encompassing 85 field studies published from 2002-2023. We further validated the practicability and feasibility of one-time root zone N management based on LPF for the three field crops. The meta-analysis revealed that LPF significantly increased the yields of the selected crops (13.62%) and nitrogen recovery efficiency (REN) (33.09%) while reducing cumulative nitrous oxide ($N_2O$) emission (17.37%) and ammonia ($NH_3$) volatilization (60.14%) compared to the conventional surface application (CSA). Higher grain yield and REN were achieved with an optimal fertilization depth (FD) of 5-15 cm, moderate N rates, combined NPK application, one-time deep fertilization, and coarse-textured and slightly acidic soils. Field validation experiments showed that localized one-time root zone N management without topdressing increased maize (6.2%), rice (34.6%), and wheat (2.9%) yields while saving N fertilizer (3%) and also increased the net economic benefits (23.71%) compared to CSA. A soil incubation study further proved the potential of LPF to enhance the retention and availability of mineral N in the root zone over an extended period. Thus, LPF could be an important fertilizer management strategy and should be extended to other less-developed and developing regions to win the triple benefit of food security, environmental quality, and economic gains.

**Keywords :** grain yield, LPF, $NH_3$ volatilization, $N_2O$ emission, N recovery efficiency
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