

Practice PF n° 20

LOCALIZED APPLICATION OF NITROGEN AND PHOSPHATE STARTER FERTILIZERS WHEN SOWING MAIZE

Introduction

Category: Good Practice (GP)

Practice identity card

#Localized fertilizer application, maize sowing

#PF, food, oil, feed, maize, industrial, GP, France

Short description

- ➔ Localized starter fertilizer applications are already applied to 75% of maize acreage in France to enhance nutrient efficiency and minimize environmental impacts. Localized fertiliser application involves applying fertilizer directly to the roots of plants at sowing, rather than spreading it uniformly over the entire soil surface. Specialized devices, such as seed drill attachments or precision applicators, deposit nutrients precisely into the soil at a specific depth and distance from the seed. This targeted approach improves nutrient uptake efficiency, reduces fertilizer waste, and minimizes environmental losses, such as nitrogen volatilization.
- ➔ The method offers several advantages, including improved nutrient uptake efficiency, which reduces nutrient losses. Localized fertilizer can be applied via specialized devices that deposit nutrients directly into the soil. This method is particularly relevant in intensive cropping systems or areas that are sensitive to excess nitrogen and phosphate fertilizer emissions. Localized application limits volatilization losses of nitrogen and improves plant access to phosphate with its low soil mobility. By incorporating this method, farmers can improve their yields while respecting the principles of sustainability and conservation of natural resources. An application at sowing maize is necessary when the residual nitrogen in the soil is less than 60 kg/ha. A dose of 40 kg/ha is sufficient to meet the nitrogen needs of young plants with up to 10 leaves. Phosphorus deficiency affects maize between the 3-leaf and 8-10-leaf stages, a period of low root colonization that limits access to phosphorus. Phosphorus is not very mobile in the soil and stimulates root growth. Integration with precision farming tools, such as GPS-guided seeders and soil nutrient sensors, further enhances its effectiveness and applicability. Additionally, adjustments for equipment calibration and placement depth are critical to ensure the success of this method. Farmers adopting this practice should monitor residual soil nitrogen levels, adjust fertilizer placement tools accordingly, and use compatible technologies for optimal results. For wider adoption, the practice can also be adapted for other crops like cereals, potatoes, and vegetables by modifying the application technique to meet their specific nutrient requirements.

Implementation process

Which practice is considered as the standard in this region? Maize requires significant amounts of nitrogen after the 10-leaf stage to support its rapid growth and biomass accumulation. To ensure optimal nitrogen availability during this critical period, usually it is recommended to make the main nitrogen application between the 4-leaf and 10-leaf stages, with the ideal timing being around the 6-8 leaf stage. This approach maximizes nitrogen uptake efficiency while minimizing losses. Phosphorus requirements, on the other hand, are more time-sensitive and crucial during the early growth stages (3-leaf to 10-leaf). During this period, limited root development restricts phosphorus uptake from the soil. This early phosphorus availability is essential for root growth and overall plant vigor. Localized application of phosphorus at sowing is highly effective in meeting these early-stage requirements, as it places the nutrient directly within the root zone where it is most accessible to young plants.

What was the on-farm issue/challenge/opportunity that led to the implementation of the practice?

Localized fertilization using seed drill technology enables precise placement of starter fertilizers, either, in liquid or solid form, directly into the soil. Fertilizers are positioned 5 cm below the seed (9-10 cm from the surface) and 4-5 cm away from the seed line, ensuring optimal nutrient availability during early plant growth stages. Thus, this practice addresses the following key challenges: 1) Conventional surface application methods often lead to nutrient losses through volatilization and leaching, reducing efficiency and increasing costs, 2) The use of localized starter fertilizers, particularly products like DAP 18-46-0, minimizes the risk of ammonia poisoning, a common issue with earlier fertilizer formulations, 3) Precise placement ensures that nitrogen and phosphorus are readily available to young maize plants, which is critical during early development stages when root systems are still limited. Additionally, the marketing and availability of advanced fertilizer formulations like DAP18-46 played a pivotal role in facilitating this shift. These formulations, coupled with improvements in seed drill technology, have made localized fertilization both practical and efficient for farmers.

How long did it take to implement the practice and which are the measures needed to monitor:

The localized application of solid fertilizers at the sowing of maize has existed since 2008 and was commonly used since 2012-2013. Effective implementation requires farmer training on equipment calibration, regular maintenance of tools, and soil nutrient monitoring to ensure precise application. Comparing yields before and after adoption helps validate its benefits, including improved efficiency, reduced waste, and higher yields.

Logistics

- **Logistic aspects to consider:** The fertilizer spreader must be carefully calibrated and adjusted to ensure correct fertilizer positioning (typically 5 cm below and 4-5 cm to the side of the seed). Accurate placement is critical to maximize nutrient availability and prevent issues like seed damage or nutrient losses. Regular maintenance of the spreader and familiarity with its operation are also essential to avoid disruptions during sowing.
- **Other specific tools involved/included:** No
- **Additional requirements for application:** For the use of organic products (such as compost, manure, or other approved organic fertilizers) in organic farming, farmers need to verify that the equipment used for localized fertilization is suitable for handling organic materials, as these can differ in consistency and application requirements compared to synthetic fertilizers.
- **Skill/education level required:** rather high

Agronomical traits

- **Can the practice be applied to a multitude of cultivation techniques?** It can also be applied to rapeseed, cereals (spring barley, wheat), beet, potatoes, vegetables and fruit trees, by adapting the form of application (irrigation, drip). It is less relevant for conservation agriculture: the level of fertility around the seed and young plant will always be much lower than in a situation where nitrogen has been worked in, but the area around the seed is naturally enriched in phosphorus and also in biological activity (mycorrhizae) which will facilitate its absorption.
- **Targeted crop categories:** food, feed, oil, industrial
- **Influence on soil quality:** Yes: in relation to a minimum 30% reduction in fertilizer use.
- **Suitable soil types:** peaty, sandy, clay, loamy, chalky, silty
- **Expected effect on crop yield:** increase
- **Expected effect on crop yield variation:** increase
- **Expected effect on crop quality:** similar
- **Expected effect on crop quality variation:** increase
- **Which costs may increase due to the practice?** skilled labour, equipment, fuel, energy
- **Which costs may decrease due to the practice?** fertilizers, herbicides, pesticides
- **Expected long-term/indirect economic benefits of the practice:** The air and water quality through reduced nutrient runoff and decreased greenhouse gas emissions. Also, by minimizing fertilizer use and a targeted application, the practice significantly reduces the risk of eutrophication in nearby water bodies, which can lead to savings on environmental remediation costs.
- **Expected effect on the leaching of nutrients:** Decrease for nitrogen (precise application reduces nitrogen runoff and volatilization), decrease for phosphorus (targeted application ensures phosphorus is available to plants rather than being lost to leaching), none for potassium.

Administrative context

- **Does the practice qualify for subsidies?** The practice may qualify for subsidies, depending on local modalities. Subsidy eligibility is often tied to specific environmental programs, such as watershed management initiatives (drinking water production) or reinforced action zones under the Nitrates
- **Status of the legal framework that regulates the practice:** there is hardly any
- **Are there any policy barriers complicating the practice's application?** No
- **Does the practice involve the use of hazardous substances?** No
- **Is the practice supported by Eco-schemes?** In the regional action program of the Nitrates Directive: for example for spring crops, mineral fertilizers can be applied upstream and as close as possible to sowing. For autumn crops, the application of phosphate mineral fertilizer NP-NPK in rows at sow
- **Are there any gaseous emissions to be considered upon application of the practice?** Yes: Nitrous oxide
- **Greenhouse gas (GHG) reduction potential of the practice:** little or none
- **Expected effects from the practice on the time occupation of the farmer?** none
- **May the practice contribute to a better public image of agriculture?** Yes, the practice contributes to a better public image of agriculture by demonstrating environmentally responsible farming practices. By reducing eutrophication through targeted fertilizer application, it minimizes nutrient runoff into water bodies, addressing a critical environmental concern. This aligns agriculture with sustainability goals and showcases farmers as stewards of the environment, fostering greater public trust and support.

- **May the practice improve the farmer's self-image?** Yes, by adopting advanced techniques that reduce environmental impact, optimize resources, and enhance crop efficiency, farmers can take pride in their role as innovators and environmental stewards. Successfully implementing such sustainable practices can boost confidence and satisfaction in their farming operations.

Contact

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Eu member state: France

Find out more

Source of information Localized fertilizer application at sowing maize for better initial vigour
Phosphorus at seeding provides a plus

https://naserthinking.sharepoint.com/:w:/r/sites/STRATUS/_layouts/15/Doc.aspx?sourcedoc=%7BDF663F24-F74A-4BF5-88D6-DFAD6232C0E5%7D&file=2nd%20sub%20Localized%20app%20maize%20vid%C3%A9o%20AC3A.docx&action=default&mobileredirect=true

Five ways to localize fertilizer

Additional info/links:

Localized starter fertilization at sowing maize for a better initial vigour (2013, Arvalis-Institut du végétal article Perspectives Agricoles) https://www.perspectives-agricoles.com/sites/default/files/imported_files/398_1495209743650629746.pdf