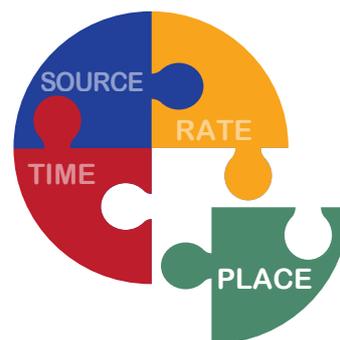


4

4R NUTRIENT STEWARDSHIP GUIDEBOOK

LEARNING MODULES
FOR EXTENSION AGENTS

MODULE 4 RIGHT PLACE



RIGHT PLACE:

ADDING NUTRIENTS
TO THE SOIL AT A PLACE
WHERE CROPS CAN
EASILY ACCESS THEM.





1. SCIENTIFIC PRINCIPLES BEHIND RIGHT PLACE

Applying nutrients at the right place means adding nutrients to the soil at a place where the crops can easily access them. Proper placement of nutrients allows a plant to develop properly and attain its potential yield, based on the environmental conditions in which it is grown. Right place depends on many factors that include the type of crop, tillage practices, plant spacing, crop growth stage, cropping systems (e.g., crop rotation or intercropping), and weather variability.

To determine the right placement of nutrients, the following scientific principles should be considered:

- Consider source, rate and time of application.
- Consider where plant roots are growing.
- Consider mobility of nutrients in the soil.
- Suit the goals of the tillage system.
- Manage spatial variability.

1.1 Consider source, rate, and time of nutrient application

➤ **Consider the source of nutrients:** The nutrient source selected has an implication on the right placement method. Different forms of fertilizer may be best suited for specific fertilizer placement methods. For example, in irrigated rice cropping systems, urea super granules are best suited for deep placement, while the conventional granular form of urea fertilizer is best suited for application through broadcasting.

➤ **Consider the rate of nutrient application:** Where large quantities of fertilizer are available, fertilizer application through

broadcasting can be conducted. On the other hand, where only small quantities of fertilizers are available, application through banding or spot application is best suited.

➤ **Consider the time of application:** The time of nutrient application with respect to crop growth has an influence on the right placement. For example, during basal fertilizer application for maize at planting, fertilizer should be applied in the planting hole where seeds shall be planted, while during top-dressing application, fertilizer should be applied by making small holes close to the plant.

1.2 Consider where plant roots are growing

For efficient uptake, nutrients need to be placed where they can easily be taken up by growing roots when required.

Different plant species have different root growth patterns, and this has an effect on their individual abilities to access nutrients in various parts of the soil.

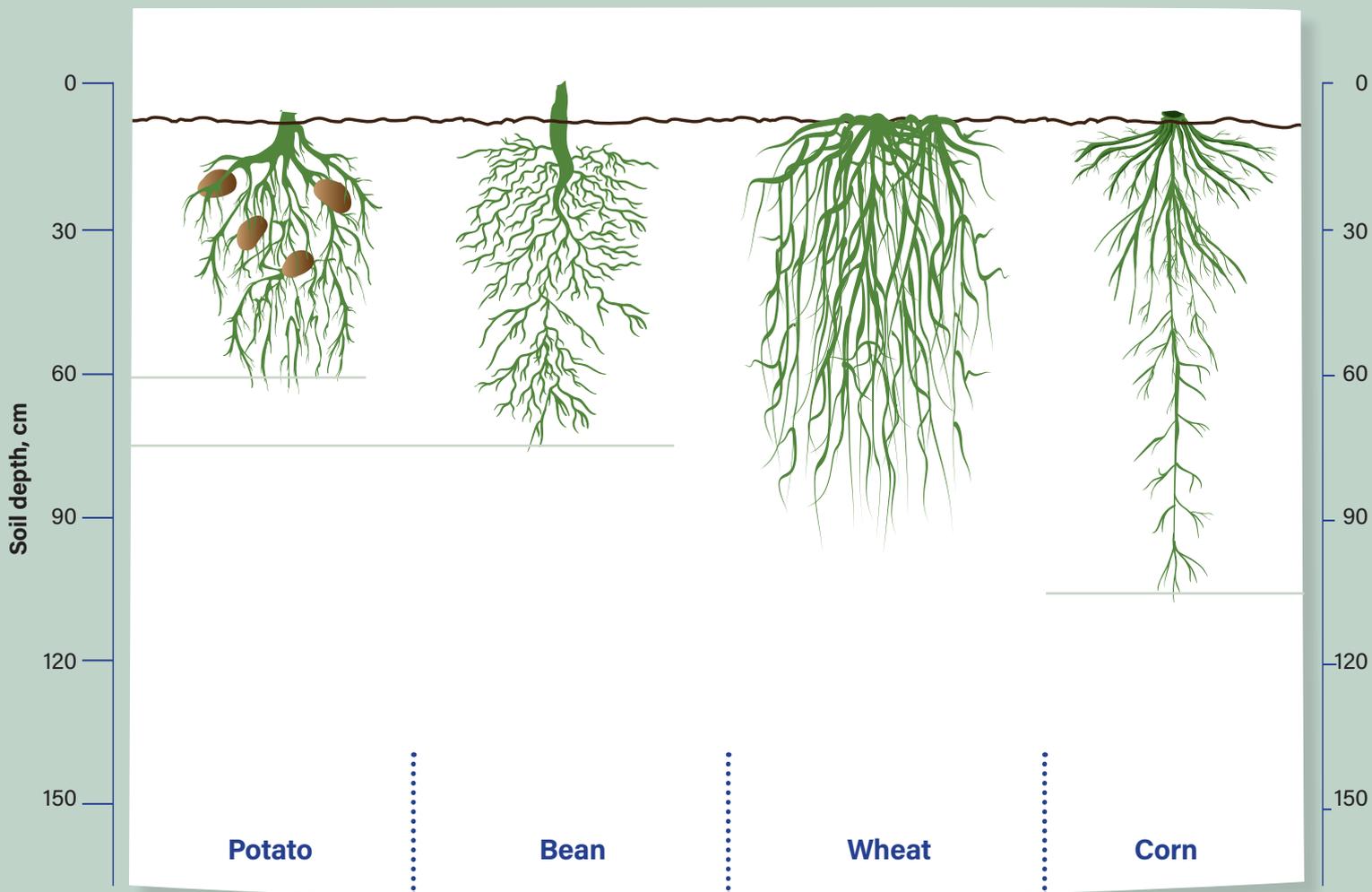


Figure 1. Rooting characteristics of different crop types.

1.3 Consider mobility of nutrients in the soil

Fertilizer placement should consider the mobility in the soil of nutrients supplied. Nutrients that have low mobility such as

phosphorus should be concentrated in bands or holes close to the plants so as to improve availability.

1.4 Suit the tillage system under practice

Selected fertilizer placement methods should suit the tillage system under practice. For example, in conservation tillage systems that involve minimal or no tillage, special equipment is often used to apply fertilizer under the soil while maintaining crop residue cover so as to conserve nutrients and water.

Fertilizer placement methods that require covering of applied fertilizer with soil may therefore not be suitable for conservation tillage systems.

1.5 Managing spatial variability

Fertilizer placement should also aim at managing differences in soil fertility within or between fields in a farm.

Fields within smallholder farms in Africa often have large differences in soil fertility levels. These differences are often due to factors such as distance from the homestead which results in for example more frequent applications of organic resources to fields closer to the homestead compared to those further away. Overtime, such differences in applications of organic resources often result in substantial differences in soil fertility levels between fields in the same farm.

Knowledge of differences in soil fertility within a farm can therefore help to guide decisions on where to prioritize fertilizer applications. For example, fertilizer application can be prioritized to parts of the field with low fertility so as to manage spatial variability.

Where limited quantities of fertilizer are available, fertilizer application can be prioritized to higher fertility fields that are expected to give a better yield response to fertilizer application, hence better returns on fertilizer use.



Differences in maize growth within a field which suggest spatial differences in soil fertility.



2. FERTILIZER PLACEMENT METHODS

Fertilizer placement methods best suited for specific crops and cropping systems are mainly influenced by the planting density and the rooting system of a particular plant. There are four main methods for placement of fertilizer:

1. Broadcasting
2. Banding
3. Spot application
4. Deep placement

2.1 Broadcasting

Fertilizer placement through broadcasting involves the uniform application of fertilizer across the surface of the field. Broadcasting aims at applying nutrients to the entire soil surface in a uniform manner.

Fertilizer placement by broadcasting is used when there is need to increase the fertility level of the entire plough layer. In such cases, basal fertilizers are broadcast and incorporated into the soil through tilling or ploughing-in.

Broadcasting is also suitable for fertilizer application to crops grown at a high planting density such as rice, wheat, and teff.

Fertilizer application through broadcasting can be conducted by hand or using fertilizer application equipment. Whether the fertilizer is broadcast by hand or with fertilizer spreading equipment, the spreading should be as uniform as possible.

Fertilizer application through broadcasting is easy to implement with low labour requirements.



Application of urea fertilizer through broadcasting during top-dressing in a teff field.

2.2 Banding

Banding involves the placement of fertilizer in bands or furrows at a depth of about 5 to 8 cm below the soil surface.

Placement through banding is mainly used when fertilizer placement near the planting rows is required.

Banding is preferably used for crops planted in rows, where there are relatively large spaces between rows, but relatively small spaces between plants as is common for beans, soybeans, lentils, and groundnut.

Banding is an effective fertilizer placement method on P-fixing soils.

Banding is also an effective placement method when the amounts of fertilizer available are too small to be broadcast on soils with a low fertility level.

To ensure uniform distribution of banded fertilizer, the amount of fertilizer to be placed in each row should be determined in advance and measured out in an appropriate container.

The fertilizer applied in each band should be placed under, or beside the seed, and covered with soil. Direct contact between seed or the germinating plant should be avoided, especially when fertilizers containing ammonium are used, as this may cause scorching of seeds or young plants.



Placement of basal fertilizer through banding in planting furrows.



Soybean seeds sown in a furrow beside banded basal fertilizer.

2.3 Spot application

Spot application involves the placement of small amounts of fertilizer close to each planting hole at planting, or close to each plant during the growing season.

Spot application is suitable for crops grown at wide spacing such as maize.

Spot application is the most effective method of fertilizer placement when very low rates of fertilizer are used.

To ensure uniform distribution of fertilizer during spot application, small dollop cups

of different sizes that are calibrated to achieve various application rates should be used to apply fertilizer. Where dollop cups are not available, farmers can use small containers (such as bottle tops) to apply equal quantities of fertilizer per planting hole or planting station.

Fertilizer applied through spot application should be immediately covered with some soil to avoid losses of nutrients.



Spot application of basal fertilizer using a dollop cup.



Spot application of top dressed fertilizer in a maize field using a dollop cup.

2.4 Deep placement

Deep placement involves application of large fertilizer granules 5 to 10 cm into the soil by hand or using specially designed applicators.

Urea fertilizers can be compressed into large granules that are suitable for application through deep placement.

Deep placement is an effective method for N fertilizer application in paddy rice. Fertilizer application through deep

placement is relatively expensive compared to other placement methods due to the higher cost of compressed fertilizer granules, and the high labour demand, plus specialized equipment required.



Farmer holding compressed urea granules and a urea granules applicator in a paddy rice field.



Deep placement application of compressed urea granules in a paddy rice field.

Module 4: Right Place Quiz

- Which of the following is among the core scientific principles that define right place for nutrients application?
 - Bury nutrients deeply in the soil
 - Mix nutrients throughout the whole soil volume
 - Consider where plant roots are growing
 - Incorporate nutrients using primary tillage
- The nutrient placement method that most uniformly distributes nutrients throughout the soil volume is
 - Spot application
 - Banding
 - Broadcasting
 - Deep placement
- Which fertilizer placement method is best suited for legume crops such as beans and groundnut?
 - Deep placement
 - Broadcasting
 - Spot application
 - Banding
- Which of the following fertilizer placement options is best suited for application of fertilizer P to a maize crop?
 - 5 cm beside and 5 cm below the seed
 - In direct contact with the seed
 - Directly below the seed
 - Broadcast and thoroughly incorporated
- Which of the following crops is not suited for fertilizer application through banding?
 - Lentils
 - Wheat
 - Soybean
 - Groundnut
- Which fertilizer placement method is best suited for maize?
 - Deep placement
 - Broadcasting
 - Spot application
 - Banding
- Which of the following is incorrect about fertilizer application by spot application?
 - Most effective method when low very low rates of fertilizer are used
 - Suitable for crops grown at wide spacing
 - Most labour efficient method
 - Spot applied fertilizer should be covered with some soil
- Which of the following is not a key consideration when deciding on right placement of fertilizer?
 - Suit the tillage system
 - Consider the target yield
 - Manage spatial variability
 - Consider mobility of nutrients in the soil
- For low fertility soils, low rates of band applied nutrients can help to
 - Increase the use efficiency of the applied fertilizer nutrient
 - Increase the fertilized soil volume as nutrients diffuse outwards
 - Meet the total nutritional demands of the crop
 - Fertilize a large volume of soil to attain maximum yield
- What is the right order of the 4R rights of fertilizer management?
 - Right rate, right source, right time, right place
 - Right source, right rate, right place, right time
 - Right source, right time, right place, right rate
 - Right source, right rate, right time, right place

For the answers, take the on-line quiz at:

<https://www.apni.net/courses/4rs-for-extension-agents/>

ABOUT **The 4R Solutions Project**



www.4rsolutions.org

The 4R Solutions Project is funded by Global Affairs Canada to improve the livelihoods of 80,000 smallholder farmers in Ethiopia, Ghana and Senegal by improving agricultural productivity and farm income through incorporation of 4R Nutrient Stewardship into local farming practices. 4R Nutrient Stewardship supports best management of plant nutrients based on four key practices: Right Source, Right Rate, Right Time, and Right Place.

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