

Plant Nutrition Part IV

The Four Rs of Nutrient Management

Many of us are familiar with the four Rs of waste management – Reduce, Reuse, Repurpose, Recycle. And hopefully, many of you are familiar with the three Rs of landscaping – Right plant, Right place, Right season. So now I'd like to tell you about

the four Rs of nutrient stewardship.

4R Nutrient Stewardship is an innovative approach for fertilizer best management practices adopted by the world's fertilizer industry. This approach considers

economic, social, and environmental dimensions of nutrient management and is essential to sustainability of agricultural systems. While it has been mostly talked about and applied with field production by large scale farmers, the concepts are equally applicable and valuable for small scale farming as well as home gardens and landscapes. The four Rs are: Right source, Right rate, Right time, Right place.

Right Source: The core scientific principles that define right source for a specific set of conditions are the following.

Supply nutrients in plant-available forms. Ensure the nutrient applied is plant-available or is in a form that converts into a plant-available form in the soil in a timely manner.

Suit soil physical and chemical properties. For example, nitrate is too easily lost from flooded soils, and urea on the surface of alkaline soils

loses ammonia too easily.

Recognize synergisms among nutrient elements and sources. For instance, nitrogen can increase availability of applied phosphorus. Applied phosphorus can reduce availability of

zinc. Fertilizers complement manures.

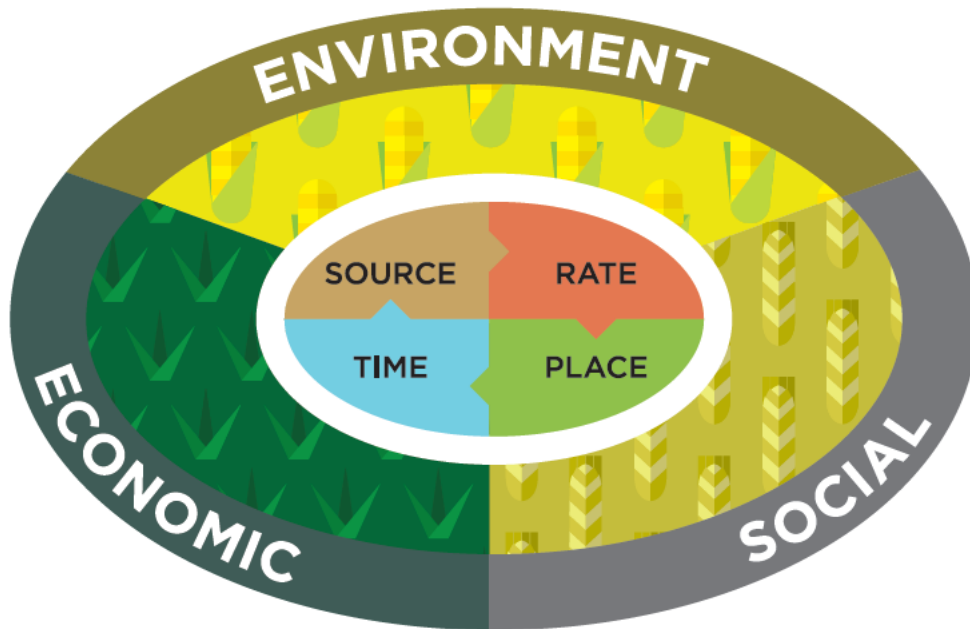
Recognize blend compatibility. Avoid combinations that attract moisture when mixed and match granule sizes when blending.

Recognize benefits and sensitivities to

associated elements. Most nutrients have an accompanying ion that may be beneficial, neutral or detrimental to the crop. For example, the chloride in muriate of potash can benefit corn, but also increases salt risk and may be detrimental to some fruits. Some sources of P fertilizer may contain plant-available Ca and S, and small amounts of Mg and micronutrients.

Control effects of non-nutritive elements. For example, natural deposits of some phosphate rock contain non-nutritive trace elements. The level of addition of these elements should be kept within acceptable thresholds.

Select the correct source of nutrient for your soil ensuring a balanced supply of essential plant nutrients including granular or liquid fertilizers or manures.



Right Rate: The core scientific principles that define right rate for a specific set of conditions are the following.

Assess plant nutrient demand. During a plant's growth cycle, nutrient demand both in quantity and quality fluctuates. Applying the right rate means you are giving the plant the amount and combination of nutrients it needs for optimum performance at that particular growth stage.

Use methods to assess soil nutrient supply. This will include soil analysis to tell you what nutrients are in the soil and their availability. It can also include plant tissue analysis to tell what nutrient is the limiting factor to plant development at that particular time. Perform annual soil testing.

Assess all available nutrient sources. If you're planning to use soil amendments, take into account how much nutrient they will be providing. If you use surface water, there may be low levels of nutrients in the water.

Some loss is unavoidable, so to meet plant demand, the amount of loss must be considered. For instance, if there is substantial rain after applying fertilizer, a large percentage of the nitrogen you applied may leach out of the root zone. In this case, an additional application of nitrogen may be warranted.

For nutrients unlikely to be retained in the soil (think nitrogen), the most economic rate of application is where the last unit of nutrient applied is equal to the amount of nutrient the plant will take up during that growth stage. For nutrients retained in the soil, their value to future crops should be considered.

Calibrate application equipment to accurately deliver target rates.

Right Time: The core scientific principles that define right time for a specific set of conditions are the following.

Assess timing of plant uptake. Nutrients should be applied to match the seasonal crop nutrient

demand, which depends on planting date, plant growth characteristics, sensitivity to deficiencies at particular growth stages, etc.

Assess dynamics of soil nutrient supply.

Mineralization of soil organic matter supplies a large quantity of some nutrients, but if the crop's uptake need precedes its release, deficiencies may limit productivity.

Recognize dynamics of soil nutrient loss. For example, leaching losses tend to be more frequent in the spring and fall.

Evaluate growing/gardening logistics. For example, multiple applications of nutrients may or may not be reasonably feasible. Nutrient applications should not be onerous or interrupt normal gardening activities.

Right Place: Right place means positioning needed nutrient supplies strategically so that a plant has access to them. Proper placement allows a plant to develop properly and realize its potential yield, given the environmental conditions in which it grows.

Consider where plant roots are growing. Nutrients need to be placed where they can be taken up by growing roots when needed.

Consider soil chemical reactions. Concentrating soil-retained nutrients like P in bands or smaller soil volumes can improve availability.

Suit the goals of the growing system. Subsurface placement techniques can help conserve nutrients and water.

Manage spatial variability. Assess soil differences within the growing area in crop grown, soil nutrient content, and vulnerability to nutrient loss.

The benefits of implementing 4R nutrient management can include:

Reducing inputs and input costs – saves you money.

Better crop/plant quality – all your plants grow better.

Improved yields or plant health – more veggies on the table.

Reduced erosion and nutrient leaching – reduce surface and groundwater contamination.

Summary

The 4R nutrient management approach can be summed up as:

Right Source refers to the nutrients a fertilizer is composed of. The fertilizer you use should always suit both the plant's and the soil's physical and chemical properties. Soil sampling is a great way to understand your soil's and plant's needs.

Right Rate indicates the correct amount of fertilizer. An imbalance in fertilizer nutrients can affect soil health, plant yields, or both. Underapplication reduces yields by not providing the correct amount of nutrients to the soil and to the plant. Overapplication can cause negative environmental effects and even alter the health of the soil in such a way that reduces plant growth.

Right Time means applying fertilizer when your plants are most receptive to it. The proper timing of fertilizer applications helps to promote maximum plant nutrient uptake, which reduces the loss of nutrients to the environment and nutrient runoff, especially of nitrogen fertilizers.

Right Place is simply applying fertilizer in a way that ensures it is accessible to your plants. Fertilizer is completely useless if a plant is unable to access it; therefore, it should always be positioned for optimal plant use.

Selected References

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