

Glossary of Site-Specific Nutrient Management Terms¹

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Introduction

Nutrient management is a critical topic in agriculture, especially in Florida. Optimum nutrient management varies among and within crop fields due to differences in environmental conditions and management systems. Making nutrient management recommendations more specific to different fields and their specific needs and conditions can help balance crop production goals with environmental protection and recent state legislation. In 2022, Florida Senate Bill (SB) 1000 charged UF/IFAS with analyzing and assessing the use of site-specific nutrient management for various crops and developing recommendations for how to implement site-specific nutrient management. Throughout this document, we will refer to site-specific nutrient management as SSNM, although we have tried to limit other abbreviations and acronyms as much as possible in order for the glossary to be a helpful guide for farmers and consulting agronomists.

Some UF/IFAS nutrient management recommendations are already site-specific, including potato recommendations that vary nitrogen (N) requirements based on yield goal ranges, corn recommendations that vary N rates based on seeding rate, and cabbage nutrient recommendations based

on plant population. These new recommendations represent a portion of the significant effort UF/IFAS researchers have invested in SSNM research. More recommendations will be released over the coming years on other crops based on additional sets of site conditions.

Recommendations for implementing SSNM on farms are more complex and detailed than previous nutrient management recommendations because location and characteristics of a farm site may be required, and communicating these recommendations requires nuance. Also, SSNM recommendations sometimes refer to emerging technologies that farmers or agronomists may be unfamiliar with. This glossary provides clear, unified definitions for terms and is intended to help aid communication with nutrient management professionals across the state, especially when sharing new SSNM recommendations. This glossary should help lessen confusion on how the listed terms are defined and interpreted, thereby helping to improve communication within and across disciplines.

Note that portions of some definitions are in bold throughout the glossary. Those portions in bold are “impact statements” of sorts and are intended to provide context

1. This document is SS-AGR-490, a publication of the Department of Agronomy, UF/IFAS Extension. Original publication date April 2025. Visit the EDIS website at <https://edis.ifas.ufl.edu> for the currently supported version of this publication. © 2025 UF/IFAS. This publication is licensed under CC BY-NC-ND 4.0.

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about how a word relates to nutrient management or other words in the glossary.

Glossary Development Process

The first step in the glossary development process was generating a relevant word list. Our team worked with UF/IFAS Department of Agronomy undergraduate and graduate students to review all Florida Department of Agriculture and Consumer Services (FDACS) Best Management Practice (BMP) manuals and develop a list of words that were unclear or full of jargon. We followed a similar review process to identify words in two USDA reports about precision agriculture, plus the UF/IFAS request for proposals statement for the SSNM block grant.

After identifying terms, a team of four nutrient management Extension and research professionals located existing definitions for each word using FDACS and federal government reports. We reviewed those definitions for consistency and edited all definitions for brevity and clarity. These initial edited definitions became the first draft of our SSNM glossary.

Focus groups were used to generate feedback on the glossary draft. Attendees were asked to review the word list and suggest other words that would be helpful additions. Attendees also reviewed a subset of the definitions to determine if they were complete and useful. Focus group participants included Extension agents and specialists from Florida and Georgia, as well as Florida regional and state agency employees.

Focus group feedback emphasized that a glossary would help promote consistent language usage across Florida, so that everyone can “speak the same language across agencies.” Participants also emphasized the importance of consistent language usage to reduce misunderstandings, because confusion about new recommendations can reduce farmers’ trust in university and government staff.

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Crop Management

BANDING

Banding is an input management strategy that applies fertilizers or other products in narrow swaths (typically 1–4 inches wide, although sometimes as wide as 10 inches) on or below the soil surface, generally next to or below a planted row, instead of applying products evenly across the whole field (broadcast). **Banding is a term that encompasses many nutrient placements, including but not limited to side-dressing, in-furrow, or 2x2 placements (Bartnick et al. 2005).**

COVER CROP

Cover cropping is a cultural practice to improve soil health by protecting the soil surface until the next primary crop is planted. Unlike “cash” crops, they are not grown for the purpose of selling for profit and are instead managed to provide environmental benefits or improve conditions for future crops. **Certain cover crops may also be used to “scavenge” or trap some excess nutrients left in the soil after the primary crop is harvested (Bartnick et al. 2005).**

ORGANIC PRODUCTION

USDA certified organic foods are grown and processed according to federal guidelines addressing, among many factors, soil quality, animal management practices, pest and weed control, and additive use. Organic producers rely on federally approved, naturally occurring substances and physical, mechanical, or biologically based farming methods to the fullest extent possible. **Certified organic production requires the use of nutrient sources that are approved for organic systems (McEnvoy 2012).**

SCOUTING

Scouting involves manual or unmanned aerial vehicle (UAV)-based monitoring of nutrient deficiency or toxicity symptoms, environmental stress, and pest presence and development throughout the growing season. **Observing plant conditions regularly can improve in-season nutrient and pest management decisions (FDACS 2011).**

SEQUESTERING AGENTS

Sequestering agents are chemical compounds used to tie up undesirable ions, keep them in solution, and reduce their effects. **Sequestering agents prevent harmful ions from being taken up by plants (FDACS 2012).**

SYMPTOMS

Symptoms are visual evidence of nutrient deficiency, nutrient toxicity, pests, or disease in plant leaves or other tissues. **Prolonged symptoms indicate management practices or environmental conditions that can result in reduced plant growth and yield (USDA 2011).**

Environment

BUFFER STRIPS (FILTER STRIPS)

Buffer strips, sometimes referred to as vegetated-buffer zones, are narrow strips of perennial grasses or other plants that border cropland and are typically located between croplands and wetlands, ponds, or streams. Some buffer strips are purely voluntary, whereas others are created to comply with state or federal conservation programs. **Buffer**

strips help reduce erosion at the edges of fields by reducing the speed of water on the soil surface and can filter agrichemicals out of soil water before they move off-site (FDACS 2011).

CALCAREOUS SOILS

This is a general term for a soil containing sufficient calcium carbonate to effervesce, or bubble, noticeably when treated with cold, dilute (0.1 M) HCl. In the US, there is no minimum amount of calcium carbonate required for soils to be considered calcareous, although the Food and Agriculture Organization of the United Nations only designates soils with 15% or greater calcium carbonate content as calcareous. **Not all soils with a pH > 7 are calcareous, although most calcareous soils have a high pH (Ditzler 2017).**

CONFINING LAYERS

A confining layer is a body of material such as dense clays or organic matter with little room between particles for liquid to flow through. Material that slows down the flow is called a semi-confining layer, while material that stops any flow from passing through is a confining layer. **Confining layers can impact nutrient movement throughout a soil profile (FDACS 2011).**

CONSOLIDATED SOILS

Consolidated soils have very low pore volumes, whereas loosely consolidated soils have greater than 50% pore volume. Soil density and particle size contribute to the degree of consolidation. **Higher consolidation/lower soil porosity decreases infiltration and percolation, which may be detrimental to plant growth and may increase runoff (Bartnick et al. 2005).**

FIELD CAPACITY

Field capacity is the amount of soil water remaining in soil after the free water has drained through the profile. **Nutrient leaching is greater when soil water exceeds field capacity (FDACS 2012).**

HIGHLY PERMEABLE/WELL-DRAINED SOILS

Highly permeable/well-drained soils are soil series, or types of soils, that drain water quickly, **making them vulnerable to nutrient leaching (FDACS 2012).**

KARST TOPOGRAPHY

Karst topography occurs when the dissolving of soluble bedrock like limestone has created sinkholes, caves, springs, or other characteristic landscape features. **Karst topography allows for the rapid movement of surface soil water**

to underground water sources (US National Park Service 2022).

SOIL ELECTRICAL CONDUCTIVITY (EC)

Soil electrical conductivity measures the ability of soil water to carry an electrical current or charge, and it is proportional to electrolytes in the water-filled pores of soils generally expressed in deciSiemens per meter (dS/m). Dissolved fertilizers form cations (Ca^{2+} , Mg^{2+} , K^+ , Na^+ , and NH_4^+) and anions (SO_4^{2-} , Cl^- , NO_3^- , and HCO_3^-) that are able to carry electrical charges and conduct the electrical current, thereby increasing soil EC. **In agriculture, EC has been used principally as a measure of soil water salinity and may be an indication of nutrient concentration in non-saline soils (USDA NRCS 2011).**

SPOIL

Spoil refers to the soil material obtained from excavating an area to construct such works as canals/ditches and/or ponds. **This material is typically used to build berms and/or dikes along or in the vicinity of the excavation site and could contain nutrients or pollutants (FDACS 2012).**

TURBIDITY

Turbidity is reduced water clarity from a buildup of suspended sediments in the water column. **Sediment movement in water occurs when eroded soils are washed into surface waters and is most commonly associated with erosion of unprotected soils (FDACS 2011).**

UNCOATED SANDS

Uncoated sands are sand particles that lack clay mineral or organic matter coating. **Soils with uncoated sand particles have poor water and nutrient holding capacities (FDACS 2012).**

Programs and Policies

4R NUTRIENT STEWARDSHIP

A framework of nutrient management practices that defines the right source, right rate, right time, and right place to apply fertilizers to produce not only the most economical outcome in a given crop but also to provide desirable social and environmental benefits essential to sustainable agriculture (Bryla 2011).

5R NUTRIENT STEWARDSHIP

The 5R framework is a modification of the 4R Nutrient Stewardship framework that integrates the “5th R” of right irrigation management, in addition to the right source, rate, time, and place (Dixon and Liu 2020).

BEST MANAGEMENT PRACTICE (BMP)

Best management practices are a practice or combination of practices based on research, field-testing, and expert review, found to be the most effective and practicable on-location means for improving water quality in agricultural and urban discharges while factoring in economic and technological considerations. **While FDACS utilizes BMP programs for Basin Management Action Plan (BMAP) areas, not all best management practices are regulatory in nature. Adoption of BMPs for nutrients should increase plant productivity, increase profitability, maintain or improve soil fertility and productivity, and avoid damage to the environment (FDACS 2012).**

BASIN MANAGEMENT ACTION PLAN (BMAP)

The Florida Department of Environmental Protection (FDEP) may develop and adopt Basin Management Action Plans (BMAPs), which contain the activities that affected interests will undertake to reduce point and nonpoint source pollutant loadings. **In watersheds with adopted BMAPs, and in some other areas, agricultural producers either must implement FDACS-adopted BMPs or conduct water quality monitoring prescribed by FDEP or the water management district (FDACS 2011).**

IMPLEMENTATION VERIFICATION

The Florida Department of Agriculture and Consumer Services (FDACS) Office of Agricultural Water Policy (OAWP) has established implementation verification (IV) to assist producers in preparing FDACS-sponsored cost-share application packages. Based on a Florida state law passed in July 2020, FDACS is required to make IV site visits on agricultural properties enrolled in the BMP program every two years. **Landowners and producers applying nutrients to their properties must retain application records, and FDACS must inspect the records related to nitrogen and phosphorous during IV site visits (FDACS OAWP 2020).**

TOTAL MAXIMUM DAILY LOAD (TMDL)

A TMDL is a calculation of the maximum amount of a pollutant allowed to enter a waterbody daily so that the waterbody will meet and continue to meet water quality standards for that particular pollutant. **A TMDL can be used to determine a pollutant reduction target (US EPA 2015).**

Precision Crop Management DIGITAL AGRICULTURE (DA)

Digital agriculture is the diffusion (i.e., spread and adoption) of information technologies, mobile devices, and

predictive analytics to enhance the collection, exchange, and analysis of information within the agricultural sector. **The agricultural digitalization process increases use of precision agriculture technologies; promotes data-sharing among farmers, data aggregators, and input companies; and increases data-driven decision making for day-to-day management of farm operations (McFadden et al. 2023).**

LAYBY

Late postemergence herbicides and sometimes fertilizers are applied at or near the time of the last cultivation (“layby”). **The word *layby* is typically used to describe pesticide applications, and the word *side-dress* is typically used to describe nutrient applications, although both words describe similar placements of inputs and are sometimes used interchangeably (USDA Animal and Plant Health Inspection Service 1996).**

PRECISION AGRICULTURE (PA)

Precision agriculture represents a broad term for emerging technologies in crop production. Variable rate technologies for fertilizer application, irrigation, and planting are one category of precision agriculture technology. Other technologies that differentiate management based on variation in the environment but do not vary the rate of inputs, such as active downforce on planters, can also be considered precision agriculture. **The goal of precision agriculture is to increase efficiency of farming operations, maintain or increase crop production levels, and lessen off-site impacts of crop inputs (Schimmelpfennig 2016).**

PRECISION IRRIGATION

Precision irrigation practices apply water using smart scheduling tools, and can include variable rate irrigation, proximal or remote sensing data, and other technologies. **The goal of precision irrigation is to improve water use efficiency and reduce nutrient losses from fields. At its most sophisticated level, it allows irrigation events to be adjusted in real time for location, frequency, and duration, based on soil properties, crop water demand, and weather conditions (FDACS 2011).**

PRECISION SOIL SAMPLING

Precision soil sampling is a management strategy where high-density soil samples are collected using grid or zone sampling schemes. Each soil sample in a precision soil sampling operation typically represents an area of 10 acres or less, sometimes as small as half an acre. Densities of 2–2.5 acres are most common. **Most precision soil sampling is used to assess fertility status of soils, and soil sampling is**

the basis for most phosphorous and potassium fertilizer rate recommendations (McFadden et al. 2023).

PROFITABILITY MAPS

Profitability maps incorporate yield maps, crop prices, input maps, and input costs to visually display which field areas produce high or lower profits. **These maps can be used to determine which field areas have input prices that consistently exceed revenue, and are useful for estimating whole-farm profitability under different management scenarios** (Massey et al. 2008).

PROXIMAL SENSING

Proximal sensing is the use of sensors or machines within a field or growing environment in proximity to plants or related features to measure characteristics of a plant or environment. **One common example of proximal sensing is soil moisture sensors, which are used for precision irrigation management** (Texas A&M University 2025).

REMOTE SENSING

Remote sensing is the use of satellites, manned/unmanned aircrafts, or ground-based structures to generate data about Earth's surface, including crop canopy and soil surface conditions. **Imagery and other remotely sensed data are an important input for precision agriculture operations, such as management zone delineation or variable rate prescription writing** (Huang et al. 2018).

SIDE-DRESSING

Side-dressing is a banded application near the roots of a growing crop. **An example of side-dress application is applying granular or liquid nitrogen fertilizer to one side of the planted row during the growing season** (USDA 2019).

SITE-SPECIFIC NUTRIENT MANAGEMENT (SSNM)

Site-specific nutrient management is a management framework that can improve nutrient use efficiency by distributing nutrients based on spatial variation in yield potential, soil characteristics, crop management systems, or other spatially variable factors that influence soil nutrient availability and crop nutrient demand. **SSNM can include aspects of 4R/5R Nutrient Stewardship and precision agriculture, all of which aim to balance the needs of optimal crop production with lower environmental risks** (Richards et al. 2015).

SOIL MAPS

Soil mapping is used to identify soils and their properties. Soil maps are available online from the USDA National Resources Conservation Service (NRCS). These maps illustrate the limits of specific soil series within fields. Information on soil series depth, water holding capacity, drainage, and runoff characteristics is generally provided for land use management. **In agricultural land management, soil mapping is used as a decision tool to determine the suitability of specific soils for particular crops** (McFadden et al. 2023).

SPATIAL VARIABILITY

Spatial variability is the measure of dissimilarity or difference in soil and environmental properties across a field. **After identifying the underlying causes and extent of variation, some sources of spatial variability can be managed through precision agriculture technologies** (Kitchen and Clay 2018).

SMART IRRIGATION

Smart irrigation technology estimates crop water use from weather data and soil moisture to schedule irrigation quantity and timing, **with the goal of optimizing water use while minimizing leaching** (Gotcher et al. 2014).

UNMANNED AERIAL VEHICLES (UAVS)

Unmanned aerial vehicles, or drones, are machines that fly over fields. They are typically equipped with location tracking and camera technology. UAVs fly at lower heights than planes, which can be useful for high-resolution imagery and product applications. **UAVs can geo-reference vast stretches of farmland, which can aid farmers' decision making (e.g., helping to identify land features or vegetation patterns that are more easily visible from above)** (McFadden et al. 2023).

VARIABLE RATE TECHNOLOGIES (VRT)

VRT is used to adjust the rate of farm inputs within a production area, using variable rate transmissions on planters, fertilizer applicators, or other farming equipment, typically with GPS systems to change application rates based on the equipment's location within a field. **This technology enables greater control of important variable inputs, possibly leading to more efficient applications without a loss of yields and potentially lowering total production costs** (McFadden et al. 2023).

YIELD MAPS

Yield maps are typically created from yield monitor data and are a visual representation of spatial variation in yield within individual fields or whole farms. Most yield maps have observations every 5–20 feet along the path of travel for a combine or other harvesting equipment. **Yield maps are used to visualize spatial and temporal changes in yield, which inform many farm management decisions such as writing variable rate fertilizer prescriptions** (McFadden et al. 2023).

YIELD MONITOR

Yield monitors measure crop weight or flow through a harvester to estimate yield within production areas. Combined with geolocation data, the information from yield monitors is used to create maps that allow for the interpretation of spatial variation in crop yield. **When properly calibrated, yield monitors can generate accurate information that can be used to aid current and future decision making** (McFadden et al. 2023).

MANAGEMENT ZONE

Management zones are determined based on differences in nutrient availability or crop nutrient need in addition to other data such as previous years' yield data, field use history, digitized scouting reports, soil, and survey information. **Initial delineations of nutrient management zones can be determined using any one or a combination of the following methods: multispectral satellite imagery or aerial ortho-photography, grid soil sampling, electro-conductivity (EC) monitoring, or land-based optical sensing** (USDA 2010).

Nutrient Sources

BIOSOLIDS

Solid or semisolid residue generated during the treatment of wastewater in a municipal/domestic wastewater treatment facility. **Biosolids are typically used as a macronutrient source, but some can contain high levels of micronutrients. Although heavy metal concentrations are regulated in biosolids, some biosolids may contain potential pollutants. Some fertilizer blends contain biosolids as filler and/or a source of micronutrients** (FDACS 2012).

CHELATING AGENTS

A chemical compound that holds onto ions to keep the ion in soil water solutions, improving the ion's availability for nutrient uptake by plants. **Chelating agents are commonly**

used for iron or other micronutrient fertilizers, especially in high pH environments (Liu et al. 2012).

CONTROLLED-RELEASE FERTILIZER (CRF)

Fertilizers that are formulated so that their nutrient release is synchronized to meet changing crop nutrient requirements, typically by coating or encapsulating the nutrient source with inorganic or organic materials that control the rate, pattern, and duration of plant nutrient release. **Release is delayed after application and generally controlled by temperature and soil water availability so that CRFs provide the plant with available nutrients over a longer duration compared to other soluble nutrient sources** (Liu et al. 2014).

GUARANTEED ANALYSIS

Guaranteed analysis is the minimum percentage of primary or secondary plant macronutrients or micronutrients, or both, claimed by the manufacturer according to state law. **Typically, guaranteed analyses are included on fertilizer labels using the N-P₂O₅-K₂O format** (California Code — Food and Agricultural Code 2023).

SLOW-RELEASE FERTILIZER (SRF)

Fertilizers that change form by chemical, pH, or biological interactions, typically changing from a plant-unavailable form to a plant-available form. **Nutrients in SRFs become plant-available over a longer period than immediate release fertilizers. The risk of leaching at the time of application is lower for SRF sources compared to soluble mineral fertilizers** (Liu et al. 2014).

SOIL AMENDMENTS

Soil amendments are materials that typically are added to soil to enhance plant growth. **These include fertilizers, compost, sludge, manure, microbes, additives, and others or combinations thereof** (USDA Animal and Plant Health Inspection Service 2023).

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