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HS899

Optimum Fertilization Management for Vegetable Crops Grown in Florida in the BMP Era[1]

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This publication is one of a series entitled Fertilizer and Irrigation Management in the BMP Era. This series is divided into nine principles described in the Introduction Chapter (HOS-897). This publication is part of Principle 2, "Soil Test and Follow the Recommendations." BMP implementation requires a global approach to production management. However, for presentation purposes, each aspect of vegetable production is described in a separate publication.

Vegetable fertility programs are complex in nature, resulting from the interaction of many factors. One important factor is fertilizer cost, which is a large portion of the total crop production expense (15 to 20%). Growers should refrain from applying unneeded nutrients which contributes to farming inefficiency and can also lead to water resource contamination. Careful use of fertilizers will save money and reduce environmental impacts.

The crop nutrient requirement (CNR) for a crop is determined from field experiments that test the yield response to levels of added fertilizer. Current N, P, and K recommendations for vegetables in Florida are supported by more than 40 years of research and on-farm trials.

Working Definition

Optimum fertilization management is the judicious application of fertilizers to meet the crop nutrient requirement without starving the crop nor adding excessive nutrients.

Fertilization Rates – Things to Do

- Refer to the section on Linear Bed Feet and follow these recommendations.
- Know the crop nutrient requirement (CNR) for N and target this amount for total crop N fertilization.
- Set realistic yield goals. Some growers believe that N fertilization is the key to greater yields and, therefore, set yield goals at unrealistic and rarely achieved levels. Once optimum N-fertilization programs, determined by research, have been set, then weather and market conditions usually determine the fluctuations in marketable yield from year to year.
- Calibrate fertilizer applicators accurately and make adjustments to the equipment so that the correct amount of fertilizer is applied in the

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correct position in the root zone or production bed, nearest the root system.

General Pre-plant Fertilizer Application – Things to Do

- Place P in the root zone. Banding is generally considered to provide for more efficient utilization of P by plants than broadcasting.
- Manage N carefully since N is mobile in sandy soils. Under non-mulched systems, split applications of the mobile nutrients must be used to reduce losses to leaching. Up to one-half of the N may be applied to the soil at planting or shortly after that time.
- Use a calibrated soil test to determine P fertilizer needs.

Pre-plant Fertilizer Placement with Plastic Mulch When Using Subsurface Irrigation, Not Using Drip Tubing – Things to Do

Incorporate all P and micronutrients in the bed when using sub-surface irrigation. Apply 10 to 20% (but not more) of the N and K with the P. The remaining N and K should be placed in narrow bands on the bed shoulders, the number of which depend on the crop and number of rows per bed. These bands should be placed in shallow (2- to 2 1/2-inch-deep) grooves. This placement requires that adequate bed moisture be maintained by subsurface irrigation so that capillarity is not broken. Otherwise, fertilizer will not move to the root zone.

Pre-plant Fertilizer Placement When Using Drip Tubing – Things to Do

- Incorporate all P, micronutrients, and 20 to 40% of the N and K in the bed.
- Apply no more than 20% of the N and K in the bed when using sub-surface irrigation to keep beds moist.
- Place fertilizer in the bed in a way that it will be least likely to leach, either from rain coming through the holes in the plastic or from water applied with the drip irrigation tubing. This means that fertilizer applied in bands should be applied to the area of the bed outside of the tubing placement. The band should not be placed on the surface between the tubing and the row because irrigation water from the tubing would have a tendency to move the fertilizer salts toward the plant where soluble salt injury could occur.
- Apply the remaining 60 to 80% of the N and K in increments through the cropping season via the drip irrigation system.

Bare-Ground Fertilization – Things to Do

- Use split applications of the nutrients to reduce losses to leaching.
- Apply up to one-half of the N and K at planting or shortly after planting.
- Apply the remaining fertilizer in one or two applications during the early part of the growing season. Splitting the fertilizer applications also will help reduce the potential for soluble salt damage to the plants.

Drip Irrigation/Fertigation During the Growing Season - Things to Do

- The frequency of injection (once a day, once every two days or once a week) depends on system design constraints, on soil type, availability of labor, and on grower preference. Injecting fertilizer more frequently, such as once a day, would reduce the chances that nutrients are leached from the beds during a heavy rainstorm or excessive irrigation compared to injecting larger amounts on a less frequent basis. If the chances for leaching losses are extremely low, then injection once per week would be satisfactory. It is extremely important that the nutrients applied in any irrigation event are not subject to leaching either during that same irrigation event or by subsequent irrigation events. This is why knowledge of the crop root zone is important for optimum fertilizer management. It is very important to monitor the application of water and to realize that fertilizer application is linked to water application.

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- When some N and K is applied pre-plant in a fertigation program, fertilizer injections do not need to begin immediately after planting, rather they can begin one or two weeks after planting. Application rates are determined by crop growth and resulting nutrient demand. Demand early in the season is small and thus rates of application are small. As the crop grows, nutrient demand increases rapidly. Schedules of N and K application have been developed for most vegetables produced with drip irrigation in Florida. For information, consult IFAS "Vegetable Production Guide for Florida."

Fertigation Through the Sprinkler System During the Growing Season – Things to Do

- Fertigate through the sprinkler system on crops with close row spacing such as leafy greens or corn, rather than on crops with wide row spacings such as watermelon.
- Start fertigation after the root system has advanced into the soil below the inter-row to intercept nutrients.
- Schedule application of N or K with the growth rate of the crop.

Operation and Maintenance

- Always store nitrogen-based fertilizers separately in a concrete building with a metal or other type of flame-resistant roof away from solvents, fuels and pesticides. Many fertilizers are oxidants and can accelerate a fire.
- Always store fertilizer in an area that is protected from rainfall in order to prevent contamination of nearby ground and surface water sources.
- Load fertilizer into application equipment away from wells or other surface waters.
- Properly calibrate fertilizer application equipment.

Other Considerations

- Under some situations, variable injection rates may not be needed and the injection program can be simplified. For example, on finer-textured soils or where the irrigation management is very efficient (no leaching), then the seasonal amount of N and K_2O can be applied in equal amounts rather than changing the rate of injection as the crop grows.
- The frequency of injection, even up to once per week, is not as important as achieving a correct rate of application of nutrients to the crop during a specified period of time. With computer control of drip irrigation systems, some growers find it easy to inject more frequently such as once every day.
- In some production systems where soils are relatively high in organic matter, micronutrients, P, and K, it is possible to grow successful crops with no in-bed fertilizer (i.e. all nitrogen fertilizer applied through the drip-irrigation system). This is particularly attractive for areas in the state where growers experience soluble salt problems in the soils. Reducing the amount of dry fertilizer applied in the bed may reduce soluble salt injury to young seedlings or transplants.
- Excess moisture can result in fertilizer leaching. Fertilizer and water management programs are linked. Highest fertilizer efficiency is achieved only with close attention to water management. Under either system (overhead or sub-surface irrigation system), fertilizing with drip irrigation or with a liquid fertilizer injection wheel might be a suitable alternative to the placement of all N and K in or on the bed prior to mulching.

Additional Readings

Soil and Fertilizer Management for Vegetable Production in Florida, HS711, Fla. Coop. Ext. Ser., IFAS, Univ. of Fla. http://edis.ifas.ufl.edu/CV101

Phosphorus Management for Vegetable Production in Florida, HS715, Fla. Coop. Ext. Ser., IFAS, Univ. of Fla. http://edis.ifas.ufl.edu/HS105

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Fertilizer Application and Management for Micro (drip)-irrigated Vegetables in Florida, Circ. 1181, Fla. Coop. Ext. Ser., IFAS, Univ. of Fla. http://edis.ifas.ufl.edu/CV141

For current nutrient recommendations for row crops, see “Vegetable Production Guide for Florida”, SP170, Fla. Coop. Ext. Ser., IFAS, Univ. of Fa. http://edis.ifas.ufl.edu/TOPIC_GUIDE_Vegetable_Production_Guide_for_Florida