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Cooperative Extension Service
Institute of Food and Agricultural Sciences

Calculating Fertilizer Rates for Vegetable Crops Grown in Raised-Bed Cultural Systems in Florida¹

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Most people involved in agriculture recognize the term “pounds per acre (lb/A)” as a rate. This method of expressing nutrient additions to the soil in order to obtain a positive crop response is the form in which most fertilizer recommendations are made. The University of Florida, Institute of Food and Agricultural Sciences Extension fertilizer recommendations are reported in terms of lb/A. The recommended fertilizer supplements the nutrition supplied from the soil, satisfying the nutrient requirement of the crop for that specific nutrient.

This unit (lb/A) describes a weight (pounds) applied over a surface area (acre). The term was originally used to describe the process of applying an amendment over the entire surface of a field, a so-called broadcast application. The terminology is still used in modern agriculture to describe fertilizer rates. Exact placement of the fertilizer, either broadcast or band, is based upon IFAS research with each crop and is a necessary part of the fertilizer recommendation. However, confusion exists when the cropped portion of an acre is less than the complete acre; for example in production systems where a drainage ditch is used between one or more cropped polyethylene-mulched beds. In such a system, both the fertilizer and most of the root system are confined in the volume of soil forming the bed. Additional root confinement exists when subsurface irrigation is used in conjunction with the above cultural practice. When fertilizing vegetables, it is important to provide the correct concentration of fertilizer in the soil

regardless of the cultural practices such as bed spacing. The purpose of this paper is to discuss an alternate expression of fertilizer rates for several raised-bed cropping systems used in Florida.

Definitions of Terms

Real-estate acre: Farm land (land area) that occupies an area of 43,560 sq ft. This term may also be called a “gross acre” and refers to the land area including all of the cropped land plus the land used for access roads and irrigation/drainage ditches.

Cropped area: The portion of the real-estate acre used solely for crop production. Alternately, the cropped area is the land surface remaining after uncropped land, such as access roads and ditches, has been subtracted from the real-estate acre. If the entire acre is used for crop production, then the cropped area is equal to a real-estate acre. Otherwise, the cropped area is less than a real-estate acre.

Linear bed foot: A linear distance of 1 ft measured along the planting bed. This term is abbreviated as “LBF.” The total number of feet of bed in a planting system that are in the cropped area of the real-estate acre is expressed as linear bed feet per real-estate acre (LBF/A).

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Using the LBF System with IFAS Standardized Fertilizer Recommendations

The IFAS Extension Soil Testing Laboratory (ESTL) employs the IFAS Standardized Fertilizer Recommendation System, in which all recommendations are expressed in lb/A. These fertilizer rates are based on typical distances between bed centers for each crop (Table 1). Table 1 also indicates the typical number of planting rows within each bed. Conversions of fertilizer rates from lb/A to lb/100 LBF, based upon these typical bed spacings, are shown in Table 2.

Use of lb/100 LBF as a fertilizer rate assures that an appropriate rate of fertilizer is applied, regardless of the total number of LBF in the cropped area. In other words, use of lb/A to express the fertilizer rate requires an adjustment based upon actual cropped area.

In reality, the goal is to provide a specific concentration of nutrients to plant roots; that is, a specific amount of fertilizer within a certain volume of soil. This conceptual approach makes sense because most plant roots are largely confined within the volume of soil comprising the bed, especially under the polyethylene in the full-bed mulch system.

The use of Table 2: To make correct use of Table 2, the **Typical Bed Spacing** from Table 1 must be used, even if this value differs from the grower's actual bed spacing. For example, the typical bed spacing for eggplant is 6 ft, and the IFAS-recommended nitrogen fertilizer rate is 160 lb/A. Locate the column labeled "160 lb/A". Locate the row labeled "6" under **Typical Bed Spacing** (fourth row from the top). Reading across the row and down the column, the IFAS-recommended fertilizer rate, expressed in lb/100 LBF, is 2.2 lb N/100 LBF.

If the crop is tomato, the **Typical Bed Spacing** is 6 ft, and the N fertilizer recommendation is 175 lb/A. In this example, there is no column specifically for 175 lb/A. Therefore, the reader needs to read across the row for 6 ft **Typical Bed Spacing** and add together two values: 1.05 for 75 lb/A in column 6 and 1.38 for 100 lb/A in column 8 to get 2.43 lb N/100 LBF.

In the tomato example above, if the grower's actual spacing were 8 ft, the grower should still apply 2.43 lb N/100 LBF to provide adequate, but not excessive, nutrient concentration within the bed. If Table 2 were mistakenly used with an 8 ft bed spacing, the result would be 3.22 lb N/100 LBF—a rate that is 30% more fertilizer than the recommended 2.43 lb N/100 LBF and would not increase yield.

Calculating Fertilizer Rates in Selected Planting Systems

The following three examples of common planting systems used in Florida illustrate the use of Table 1 and Table 2. In each of the examples, the specified crop is tomato, and the IFAS-recommended fertilizer rate is 175 lb N/A. If the examples do not address a particular planting pattern of interest to the reader, the same procedures demonstrated here can be used to tailor results to specific cultural practices and crops.

Example 1—Ruskin Region

A typical diagram of this planting system is shown in Figure 1. Using Table 1, we find that the typical bed spacing for tomatoes in Florida is 6 ft. The alternating pattern of bed and ditch used in the Ruskin region results in good drainage control to handle excessive precipitation. However, the 12 ft spacing between bed centers results in much less land actually in production (reduced cropped area) than for the typical bed spacing of 6 ft.

Table 1. Typical bed spacings for vegetables grown in Florida

Vegetable	Typical Spacing* (ft)	Rows of Plants per bed	Vegetable	Typical Spacing* (ft)	Rows of Plants per bed
Broccoli	6	2	Muskmelon	5	1
Cabbage	6	2	Pepper	6	2
Cauliflower	6	2	Summer squash	6	2
Cucumber	6	2	Strawberry	4	2
Eggplant	6	1	Tomato	6	1
Lettuce	4	2	Watermelon	8	1

*Spacing from the center of one bed to the center of an adjacent bed.

From Table 2, using the typical bed spacing of 6 ft and the recommended fertilizer rate of 175 lb N/A, we find that 2.43 lb N/100 LBF is the recommended rate. It is important to use this fertilizer rate, even though the bed centers in this example are spaced 12 ft apart (Figure 1).

Example 2—Gadsden County Region

Figure 2 indicates that in a typical Gadsden County tomato field there are groups of six beds, each on 6 ft centers and separated by an access road approximately 12 feet wide. This repeating-pattern cropping system (including the access road) uses less than the entire real-estate acre.

The recommended fertilizer rate for this example is 2.43 lb N/100 LBF—the same rate as for example 1! The typical bed spacing of 6 ft (Table 1) and the recommended fertilizer rate of 175 lb N/A have not changed. This bed pattern uses more of the real-estate acre for crop production than does the previous example, but the cropped area is still only 70% of the real-estate acre.

Example 3—Immokalee, Naples and Palm Beach Regions

A typical planting pattern in the Immokalee, Naples and Palm Beach areas is shown in Figure 3. Because neither the typical bed spacing of 6 ft for tomatoes nor the recommended fertilizer rate of 175 lb N/A have changed, 2.43 lb N/100 LBF is still the recommended rate. The cropped area of this planting pattern is 75% of the real-estate acre.

Summary

Expression of fertilizer rates in units of lb/100 LBF results in a fertilizer rate that is independent of the total number of LBF in a real-estate acre. This method supplies nutrient concentrations in the bed at recommended levels without risking either underfertilization or overfertilization.

Table 2. Conversion of fertilizer rates in lb/A to lb/100 LBF

Typical Bed Spacing (ft)	Recommended fertilizer (N, P ₂ O ₅ , or K ₂ O)											
	----- lb/A -----											
	20	25	40	50	60	75	80	100	120	140	160	180
	Resulting fertilizer rate (N, P ₂ O ₅ , or K ₂ O)											
	----- lb/100 LBF -----											
3	0.14	0.18	0.28	0.36	0.41	0.54	0.55	0.69	0.83	0.96	1.10	1.24
4	0.18	0.23	0.37	0.46	0.55	0.69	0.73	0.92	1.10	1.29	1.47	1.65
5	0.23	0.29	0.46	0.58	0.69	0.87	0.92	1.15	1.38	1.61	1.84	2.07
6	0.28	0.35	0.55	0.70	0.83	1.05	1.10	1.38	1.65	1.93	2.20	2.48
8	0.37	0.46	0.73	0.92	1.10	1.38	1.47	1.84	2.20	2.57	2.94	3.31

This table is used correctly by (1) determining the typical bed spacing from Table 1 for the crop; (2) locating the column containing the recommended fertilizer rate in lb/A; and (3) reading down the column until reaching the row containing the typical row spacing. This rate, in lb/100 LBF, should be used even in situations where the grower's bed spacing differs from the typical bed spacing.

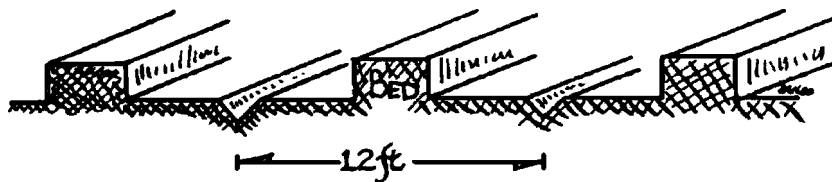


Figure 1. Single-bed-and-ditch system commonly used in the Ruskin region. The bed top is approximately 3 ft, and bed spacing is 12 ft.

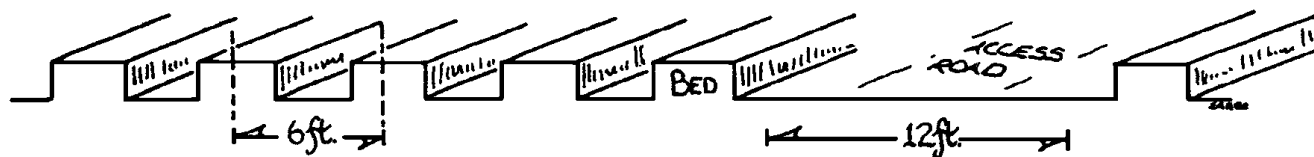


Figure 2. Planting system, which includes an access road, used in the Gadsden region. Actual width of bed top is 3 ft with a bed spacing of 6 ft.

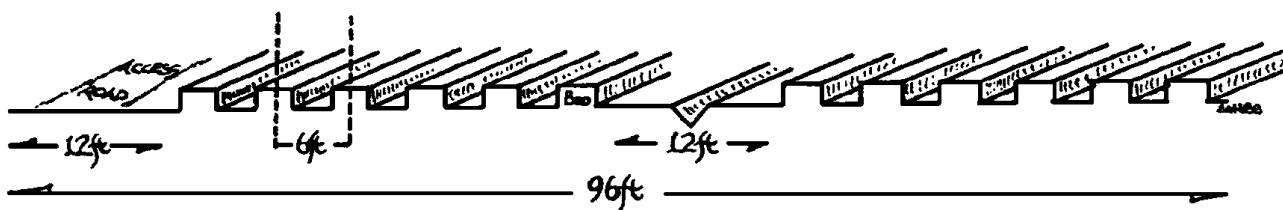


Figure 3. Planting system used in the Immokalee, Naples, and Palm Beach regions. Twelve planting beds are combined with both ditching and an access road. As before, the bed tops are approximately 3 ft, while the bed spacing is set at 6 ft.