Table 3. Sweet corn yield results when fertilization was based on Mehlich-1 soil test results, grower fertilizer application, and additional phosphorus, site 1a, Zellwood, FL, 1992.

Treatment	Rate (lb/A) N	P	K	Average ear Wt. (g)	Width (cm)	Length (cm)	Yield (crates/A)
Mehlich-1	0	0	0	234 b[z]	4.2 a	17.7 b	138 bc
0.5 × Grower P	0	12	0	230 b	4.2 a	17.5 b	123 c
Grower P	0	24	0	283 a	4.3 a	18.3 a	176 b
Grower	35	24	209	283 a	4.3 a	18.8 a	233 a
Liquid P	6	9	0	256 ab	4.2 a	18.3 a	173 b

[z]Mean separation in columns by Duncan's multiple range test, 5% level.

Table 4. Sweet corn yield results when fertilization was based on Mehlich-1 soil test results, grower fertilizer application, and additional phosphorus, site 2, Zellwood, FL, 1992.

Treatment	Rate (lb/acre) N	P	K	Average ear Wt. (g)	Width (cm)	Length (cm)	Yield (crates/A)
Mehlich-1	0	0	0	307 a[z]	4.4 a	18.7 a	276 a
0.5 × Grower P	0	16	0	303 a	4.4 a	18.4 a	249 a
Grower P	0	32	0	343 a	4.4 a	18.3 a	279 a
Grower	24	32	239	314 a	4.4 a	18.4 a	270 a
Liquid P	6	9	0	329 a	4.4 a	18.4 a	243 a

[z]Mean separation in columns by Duncan's multiple range test, 5% level.

including increased use of calibrated soil testing and following P recommendations more closely. The amount of P fertilizer applied to vegetable crops in the Lake Apopka basin has been reduced by 55% in the last two years (unpublished survey data, 1993).

Table 5. Sweet corn yield results when fertilization was based on Mehlich-1 soil test results, grower fertilizer application, and additional P, site 1c, Zellwood, FL, 1992.

Treatment	Rate (lb/A) N	P	K	Average ear Wt. (g)	Width (cm)	Length (cm)	Yield (crates/A)
Control	0	0	100	313 b[z]	4.6 ab	20.0 a	239 a
1	0	33	100	372 a	4.6 ab	19.8 a	258 a
2	0	66	100	386 a	4.5 b	20.0 a	225 a
3	0	98	100	390 a	4.7 a	19.8 a	235 a
Grower	80	79	100	368 ab	4.6 ab	19.6 a	242 a
Liquid P	20	26	100	363 ab	4.6 ab	20.1 a	285 a

[z]Mean separation in columns by Duncan's multiple range test, 5% level.

Literature Cited

Conrow, R. C. 1989. Draft SWIM Plan for Lake Apopka. St. Johns River Water Mgt. District.

Freie, R. L. and H. V. Young, Jr. 1993. Fla. Agri. Stat. Service, Vegetable Summary 1991-1992. Fla. Dept. Agri. and Consumer Services, Orlando, FL.

Hochmuth, G. J. and E. A. Hanlon. 1989. Commercial vegetable crops nutrient requirements. Univ. of Fla., Cooperative Ext. Service Cir. 806.

Hochmuth, G. J., D. Maynard, C. Vavrina, and E. A. Hanlon. 1991. Plant tissue analysis for vegetable crops in Florida. Univ. of Fla., Cooperative Ext. Service, Gainesville, FL. SS-VEC-42.

Neal, C. A., E. A. Hanlon, S. Crnko, and J. M. White. 1992. Extension soil fertility efforts in the Lake Apopka HUA Project. Agronomy Abstr. p. 28.

Sanchez, C. A. 1990. Soil testing and fertilization recommendations for crop production on organic soils in Florida. Univ. of Fla., Agr. Expt. Sta. Bull. 876.

Proc. Fla. State Hort. Soc. 106:201-202. 1993.

AN OPINION ON THE GRADIENT CONCEPT OF NUTRITION

C. M. Geraldson
1111 99th St. NW
Bradenton, FL 34309

Blake Whisenant
P.O. Box 207
Parrish, FL 34219

Introduction

In the authors opinion the rhizosphere, which can be described as a "black box" that is a dynamic mix of soil borne and applied nutrients is nutritionally undefinable. Darrah (1993) states that "conventionally, nutrient response curves or models include every aspect of plant function, climate, soil types, etc., into a soil-plant-season specific description of yield variation with fertilizer application and therefore have no predictive ability beyond a statistical interpretation based on field trials." This is an empirical description (trial and error) of how plant yield varies with nutrient application. The question is—why not go beyond the trial and error procedure—provide a nutritionally predictable system by defining and stabilizing the ionic composition contained in the "black box."

The Gradient Concept

The Intensity and Balance (I&B) procedure (Geraldson, 1967) was developed to define the ionic composition (concentration and ratios) in the soil solution. The gradient concept (Geraldson, 1962, 1970) was designed to stabilize the ionic composition and thus provide a nutritional predictability that could be held accountable. The stability of the gradient is provided by synchronizing the nutrient/water input with removal. A constant source of water and a separate and constant source of soluble N-K, covered by a full-bed mulch are the basic components of the gradient-mulch system (Geraldson, 1962, 1970, 1990). The concept as a commercial procedure has been most successful using a constant water table with a banded source of soluble N-K at the soil bed surface. The use of fumigants enhanced the potential of the gradient concept by reducing weed competition and soil borne pests and in experimental plots, yields were increased 400 to 500% using a trellis supported non-determinate tomato cultivar (Geraldson, 1970); commercial yields were more than doubled using stake supported determinate cultivars (Van Sickle et al., 1992). It must be emphasized that in-bed N-K or fertigated N-K moves with the water required for transpiration and thus can weaken or destroy the gradient. To be predictable the gradient must be the source of N-K. Nutritionally this is most important when the crop nutrient/water requirement is at a maximum.

Alternatives

In the early 1970's (Geraldson, 1973) in an effort to expand the use of the gradient concept, microirrigation rather than a water table was evaluated as a constant source of water. With a point source of water at the surface and a banded surface N-K source, the lateral gradient provided an experimentally feasible system.

In more recent times, because of potential water restrictions, microirrigation has been evaluated as a component in the production system. In-bed N-K and fertigated N-K have been included as nutritional components and thus as a nutritionally conventional system is unpredictable—previously described as a "black box."

Some commercial growers are utilizing an intermittent-point source of water (microirrigation) at the plant row with a banded parallel source of N-K within a wettable distance from the plant row to provide a lateral gradient. This procedure has been satisfactory but even with precise management it can become nutritionally vulnerable.

Most recently in an effort to provide a globally sustainable production system, a containerized gradient concept is being evaluated and has been most successful with a built-in water table. The water would be that required for transpiration and to maintain a gradient path from the surface to the root; pollution due to nutrient leaching would be minimized or eliminated; productivity based on a minimal unit cost has been projected as equivalent to and has the potential to advance beyond the conventional trial and error procedure. A hydroponic solution is designed also to provide an optimal nutritional environment but does not have a synchronized nutrient/water component and thus the stability is vulnerable and dependent on precise management. In contrast, the nutrient/water input of a functional gradient system is controlled by plant removal rather than the variances of management.

Commercial growers as well as home gardeners using the gradient concept (mulched or containerized) could grow a wide range of horticulture crops requiring only periodic additions of water to maintain the concept. Nutritionally the gradient concept is a paradigm shift and is fought with great vigor by the proponents of conventional procedure because it destroys the former investment. However because of the potential, it is suggested that to nutritionally advance productivity beyond the trial and error procedure, it is necessary to nutritionally optimize the contents of the "black box."

Literature Cited

Darrah, P. R. 1993. The rhizosphere and plant nutrition: a quantitative approach. Plant Nutrition. Kluwer Academic Publishers. 3-22.

Geraldson, C. M. 1962. Growing tomatoes and cucumbers with high analysis fertilizers and plastic mulch. Proc. Fla. State Hort. 75:252-260.

Geraldson, C. M. 1967. Evaluation of the Nutrient Intensity and Balance System of soil testing. Soil and Crop Sci. Soc. of Fla. 27:59-67.

Geraldson, C. M. 1970. Precise nutrient gradients—a component of optimal production. Soil Sci. and Plant Analysis 1:317-331.

Geraldson, C. M. 1973. Nutritional studies utilizing a constant micro-source of moisture. Proc. of the Tropical Region Am. Soc. Hort. Sci. 17:355-362.

Geraldson, C. M. 1990. Conceptual evaluation of intensive production system. Plant Nutrititon, Kluwer Academic Publishers. p. 539-544.

Van Sickle, J., D. Cantliffe, D. Belibasis, G. Thompson, and D. Oebker. 1992. Competition with Mexico and potential impact from free trade. Proc. Fla. Tom. Inst., Sept. 1992:2-40.

Proc. Fla. State Hort. Soc. 106:202-204. 1993.

WATER USE AND NITROGEN BALANCE FOR SUBIRRIGATED FRESH-MARKET BELL PEPPER PRODUCTION

C. D. Stanley and G. A Clark
Gulf Coast Research and Education Center
IFAS, University of Florida
Bradenton, FL 34203

Additional index words. nitrate, nutrient leaching, water table management.

Abstract. **Self-contained drainage lysimeters located in field plots were used to determine water use and N balance for bell peppers (*Capsicum annuum* L.) grown in the 1992 fall production season. Each lysimeter unit, automatically irrigated by maintaining a water table at 20 inches below the soil surface, contained eight plants spaced at a density equivalent to 14,500 plants per acre and fertilized at an N rate of 300 lb/acre. Weekly determinations of water use and nitrate-N concentration of the water table were taken. Determinations of total-N uptake through plant tissue (foliage and fruit) and residual N in the soil and water at the end of the growing season were used to develop an N budget. Results showed that plant uptake accounted for 51.9% of the applied N, where as 15.1% remained in the soil solution below the root zone, and 10% remained in the upper soil profile. Approximately 23% of the applied N was unaccounted for, indicating a possibility that denitrification occurred. Seasonal crop water use was determined to be approximately 4.4 inches (plant use and soil evaporation), not including water needed for field preparation, transplant establishment, crop protection, or system inefficiencies. Crop coefficients were developed using adjusted pan evaporation for reference evapotranspiration and ranged from 0.4 to 1.28 depending on stage of growth.**

Florida Agricultural Experiment Station Journal Series No. N-00864.