

# Fertilizer Technology Update (draft)

Yuncong Li

Fertilizer technology is changing unceasingly every decade and development of new fertilizer technology is often driven by fertilizer price, labor cost and regulations. These changes include inventing new fertilizers and improving application methods. I divided fertilizer technology into 7 groups: 1) dry granular fertilizers, 2) fertigation, 3) foliar fertilizers, 4) controlled/slow release fertilizers, 5) organic fertilizers/soil organic amendments, 6) mycorrhizae/microbial fertilizers, and 7) magical/mysterious products. In the following sections, each of these groups will be discussed briefly in terms of their development and potential impact on crop production.

## **Dry granular fertilizers:**

Dry granular fertilizer is still and will continue to be a major fertilizer source for crop production. It is relatively cheap and always available from fertilizer distributors. Most of dry granular fertilizers are blended regionally and shipped to distributors. Most large-scale growers have their own machinery for fertilizer application, while small-scale growers always get help from fertilizer distributors. Most growers have relatively more knowledge of this group of fertilizers than of any others. The technology of blending has not changed much for long time. The changes of dry granular fertilizer technology are mainly on 1) specific fertilizer for specific crops and 2) application technology. Special fertilizer such as "palm special", "lawn special", "tomato special", "HLB special", "zero-phosphorus", etc. will become progressively more available to growers. Blending controlled release fertilizers into regular dry granular fertilizers will also become more and more popular. These special fertilizers are manufactured or mixed with distinct nutritional formulas to meet specific needs of the crop. However, variation between fields and between varieties should be considered also when selecting a special fertilizer. Another set of adjustments in the use of dry granular fertilizer involves application timing and rates. Precision technology will greatly improve fertilizer application method.

## **Fertigation:**

Fertigation is the application of liquid fertilizer through an irrigation system. The technology was developed in the 1970s and its adoption continues unabated to the present. Almost all tomato growers in Miami-Dade County use fertigation. Fertigation also has been used for other vegetable crops such as squash, eggplant, cucumber, etc. Our survey revealed that about 53% tropical fruit growers are using either fertigation or soil drenches in their groves. Various innovations in fertigation equipment are being developed and marketed to growers. Research information is also more available through traditional publications and internet access. The advancement and progressive adoption of fertigation technology is certain to improve fertilizer use efficiency, overcome micronutrient deficiencies and reduce leaching of nutrients into groundwater. The improvement of fertigation often follows advancement of irrigation (moisture sensors, GPS technology, etc.) for better delivery in quantity and timing.

## **Foliar fertilizers:**

Foliar fertilizer technology came into use early in last century, but did not become common practice until the 1980s. This slow adoption was caused by the scarcity of fertilizer sources and appropriate application equipment. The application of foliar fertilizers is the quickest way to deliver nutrients to the tissues and organs of the crop. However, the plant leaf is structured in such a way that it naturally resists ready and reliable penetration of fertilizer salts. This is particularly true of N, P, and K. Research in Florida clearly shows that foliar application of N, P, and K does not result in consistent yield increases. Indeed some recent work has documented severe yield reductions with foliar nutrient sprays. On the other hand foliar application of micronutrients can be beneficial to correct certain nutrient deficiencies. However, a micronutrient formulation should be applied only when a specific deficiency has been clearly diagnosed. Our research group recently developed foliar formula with NPK plus amino acid which was produced in our laboratory. It shows significant improvement of plant growth compared to NPK alone.

### **Controlled release fertilizers:**

Controlled-release fertilizers (CRFs) are often called slow-release fertilizers (SRFs) or timed-release fertilizers. However, the terms CRF and SRF should not be used interchangeably. The Association of American Plant Food Control Officials defines CRFs as fertilizers that contain a plant nutrient in a form in which the plant uptake is delayed after application, or that provide a longer duration of nutrient availability compared to other quick-release fertilizers, such as urea. The main difference between CRF and SRF is that in CRF (usually coated fertilizer), the factors affecting the rate, pattern, and duration of release are well known and controllable, whereas in SRF, they are not well controlled. At soil temperatures under 25°C, a CRF must meet three criteria: (1) less than 15% of the CRF nutrients should be released in 24 hours, (2) less than 75% should be released in 28 days, and (3) at least 75% should be released by the stated release time (40–360 days). Widely used CRFs include Nutricote®, Osmocote®, and Polyon®. Controlled release fertilizer technology was developed in the 1960s, but became commercially available only in late 1970s and early 1980s. Price and availability of such formulations still restrict their use in traditional crop production. The quality of fertilizer is also of major concern. However, the development of new technologies for controlling nutrient release will lead to improvement in prices and quality of slow release fertilizer formulations.

### **Soil organic amendments and organic fertilizers:**

Soil organic amendments usually consist of animal manures, cover crops, or composts. In many instances animal manures are the best source of organic matter. Indeed since the beginning of agriculture, animal manures have been used effectively for crop production. Animal manures supply significant quantities of essential plant nutrients and increase soil organic matter. However, availability, transportation costs, and regulations limit widespread use of animal wastes in crop production in Miami-Dade County. Cover crops, commonly referred as green manure, are also important soil organic amendments for sandy or gravelly soils in this area. Cover crops are used to improve soil physical properties, increase soil organic carbon, conserve soil water, reduce surface runoff, and recycle nutrients during the heavy summer rains. Composts have been increasing in popularity as soil organic amendments. Research has demonstrated that compost can serve as a soil amendment to increase organic matter, improve microbial activities in soils, provide nutrients, and ultimately improve plant growth and yield. However, composts

are produced from various organic wastes and consequently, environmental concerns are always an issue in compost utilization.

Most of commercial organic fertilizers are byproducts of livestock, fish, food, and other processing industries. Prices of these products are often more expensive than mineral fertilizers if the calculation is based on unit nutrient because of high production cost (drying, granulating, bagging, etc.). Availability and quality of organic fertilizers are also a concern. There are more and more organic fertilizers available on the market. However, effectiveness of these organic fertilizers is often not evaluated adequately and scientifically.

### **Mycorrhizae/microbial fertilizers/biofertilizers:**

Mycorrhizae are certain soil fungi which form symbiotic associations with plant roots. These beneficial symbioses are ubiquitous in nature and almost all vascular plant species have some form of mycorrhizal association. Mycorrhizae were discovered in 1840, but were not studied extensively until the 1990s. Most research focused on the potential of mycorrhizal fungi to improve crop yields and to reduce the use of fertilizers. An experiment conducted in the Tropical Research and Education Center, University of Florida indicated that lychee plantlets derived from air-layers and inoculated with mycorrhizal fungi grow and develop much more rapidly than those which are not exposed to these beneficial symbionts. Many other scientists have reported significant functions of mycorrhizal fungi in crop production. However, such promising research results have not led to significant commercial utilization of mycorrhizae. Nevertheless, mycorrhizae are likely to play a very important role for crop nutrient management in the future.

Some of microorganisms have ability to fix nitrogen and/or solubilizing phosphorus, potassium and micronutrients. Incorporating these beneficial microorganisms could improve nutrient availability and enhance crop growth. However, there is no commercial product which could show reliable and consistent effect. It is almost impossible to find and isolate bacteria or fungus universally survival and multiplying in various soil conditions. Except nitrogen fixing bacteria, all other microorganisms can only increase solubility of existing nutrients in soils and cannot generate nutrients.

### **Magical/mysterious products:**

There are many magical/mysterious products, derisively known as “snake oils”, marketed by various companies or individuals. These products are often referred to as biostimulants, soil supplements, soil conditioners, natural fertilizers, soil additives or growth activators. So far, few of them have demonstrated significant impact on crop production. Some of them have either no effects or negative effects on crop growth. Others are said to reveal their beneficial effects only under certain conditions of plant stress. However, we hope someday some products from this group will make significant contributions to crop nutrient management.