

## NEXT GENERATION APPLICATION TECHNOLOGY

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### ABSTRACT / INTRODUCTION

New technologies and new applications of new and existing technologies continue to be integrated into equipment for the application of crop production inputs including fertilizer, pesticides and seed. GPS assisted steering now allows “hands off” steering of self-propelled applicators and tractors. Results include better application accuracy, improved machine efficiency and less operator fatigue. Variable rate liquid systems are available to compete with and/or compliment widely adopted multiple bin dry fertilizer application systems. Commercially available, active light source sensors (Ntech) now can control nitrogen application around the clock. The technology is currently available as an after market installation on most liquid applicators, self-propelled or pull type. Algorithms are available for wheat and are being developed for other crops including cotton, corn and potatoes. Rules and regulations continue to be implemented for the application of biosolids including animal and municipal sources. New self-propelled applicators can apply biosolids at constant or variable rates based on nutrient requirement maps. New injection and incorporation attachments can maintain crop residue on the soil surface to meet conservation compliance crop residue management plans for erosion control. Other attachments allow “undisturbed” application in sod forming crops. Records of application are automatically logged during application.

### APPLICATIONS

#### Auto-Guide (assisted steering)

Auto-Guide (AGCO) and AutoTrak (John Deere) are two of several assisted steering solutions for tractors and self-propelled applicators. Once a driving line is established the operator simply turns the applicator around and points the machine at about a 30-degree angle to the previous pass, and lets go of the steering. The guidance system takes over steering until it is time to turn the machine around (Fig.1). Operators are reporting less fatigue after a long day and the reduction of overlap is allowing machines to cover more acres in the same time.

Figure 1. TerraGator equipped with Auto-Guide applying fertilizer.

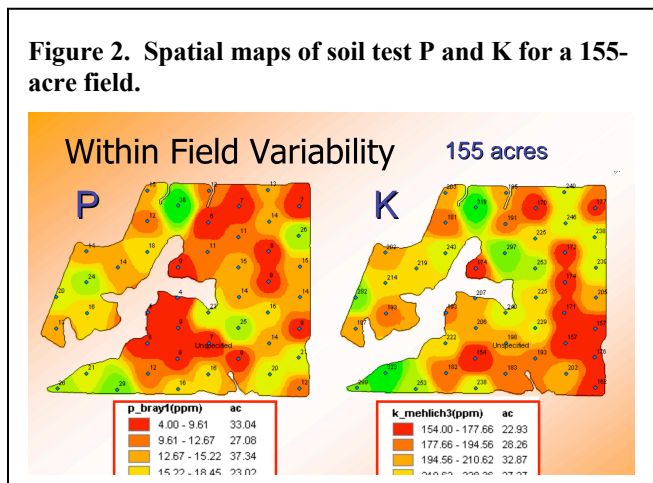


With the new application has come some “marketing” created confusion over absolute and relative accuracy. Pass-to-pass accuracy (relative or dynamic accuracy) refers to the precision of application relative to the previous swath. This may be suitable for ag applications where you do not need to come back to the same pass in subsequent days. This might be adequate for fertilizer spreading. However if you are doing strip till and then coming back to plant on the strips at a later date, then you need to be making your buying decision on absolute (static) accuracy. Planting followed by combine harvesting is another application requiring good static accuracy. All systems will appear to be more precise when accuracy is expressed on a pass-to-pass basis.

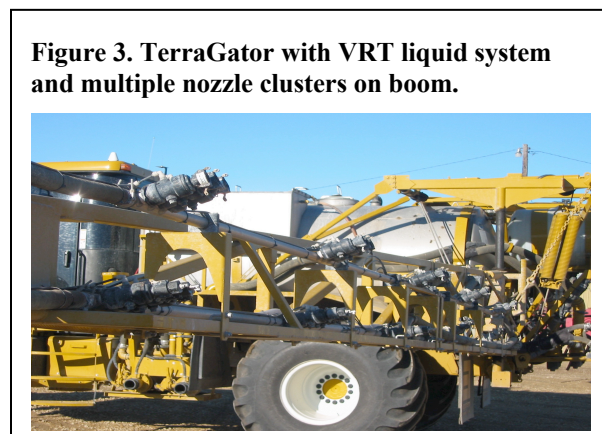
Accuracy is a function of the differential correction signal. AGCO offers 5 differential solutions with its Auto-Guide system including: WAAS – 25 cm dynamic; OminStar VBS – 20 cm dynamic; OminStar HP – 5 cm dynamic; local base – 5 cm dynamic and local base – 2 cm dynamic.

### Variable Rate Liquid Fertilizer Applicator

Systematic soil sampling has shown that most farm fields have varying levels of plant available nutrients. Not only do the soil test levels vary, but also the patterns of variability are often different for differing nutrients (Fig. 2). The application of a single rate of a fertilizer (single product or blended) will result in over- or under-application for a substantial part of a field. Dry fertilizer dealers have responded by purchasing multiple bin dry fertilizer application systems. Liquid dealers were at somewhat of a disadvantage for a multiple product solution.



A technology application developed in the 1990’s that was ahead of its time was Ag-Chem’s multiple product variable rate liquid system. The system (Fig. 3) consists of a tank split into two compartments, with separate plumbing and nozzles on the boom for each compartment. Each nozzle location on the boom consists of 3 nozzles that are controlled by a FALCON controller reading rates from product application maps. The controller reads a rate and then turns on/off one or more nozzles automatically to accomplish a continuous variable rate application. Dribble



banding kits are available for controlled placement. This particular system includes a 3rd tank on top (Fig. 4) for pesticides or micronutrients.

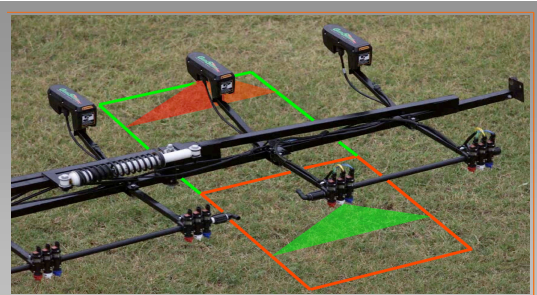
While this system is not a standard offering, Ag-Chem will build the system. With the increased interest in precision application and nutrient use efficiency, a VRT liquid system may provide a competitive advantage for liquid fertilizer dealers. Ag-Chem also continues to build single tank (product) VRT liquid systems as a standard option.

### Sensor Based Control for Nitrogen Application

On-the-go variable rate, sensor controlled nitrogen application was made commercial by Norsk Hydro in the late 1990's and made a brief appearance in the U.S. This technology application does work and is primarily used in Germany today. Limited field-testing in the U.S., proprietary algorithms and field applications limited to sunny days during midday may have contributed to the technology not being rapidly adopted in North America.

In contrast to the passive sensors requiring the sun's energy, Ntech has developed a sensor technology that has its own LED energy source (GreenSeeker) Fig.5. This allows day or nighttime sensor controlled nitrogen application. Oklahoma State University researchers have developed algorithms for wheat that use the sensor readings to determine N sufficiency wheat plants (relative index) and to predict yield. Oklahoma State and University of Nebraska researchers are working on corn algorithms. Other researchers are working crops including cotton and potatoes. The GreenSeeker sensor is commercially available as a single sensor unit for experimentation and as a fully functional after market fitted system on pull type and self-propelled fertilizer applicators. Example implementations are shown in Fig. 6 & 7.

**Figure 5. GreenSeeker sensor controlling variable rate nitrogen application on a sprayer.**



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**Figure 6. TerraGator with GreenSeeker mounted in combination with the standard system.**



**Figure 7. Spra-Coupe with GreenSeeker system.**



## Biosolids Nutrient Management Systems

Rules and regulations continue to be implemented governing the application of biosolids including animal and municipal sources. New self-propelled applicators have been built to apply biosolids at constant or variable rates based on nutrient requirement maps. Metering is accomplished with a positive displacement pump. High flotation ensures minimal compaction and high horsepower creates efficiency (Fig.8). Operators can now load from a stationary reservoir without leaving the comfort of the cab (Fig.9). The loading process takes 3.5 minutes. Two machines running together in a field can consistently apply 50,000 gal/hr, and have been documented at 60,000 gal/hr. A variety of incorporation attachments are available to meet customer needs including deep primary tillage, leave crop residue for soil erosion control (Fig.10), apply in heavy residue or apply into sod (Fig.11). In addition, application records are automatically created. These systems add creditability to the proper utilization of biosolids and create new business opportunities.

**Figure 8. High flotation applicator with positive displacement pump.**



**Figure 9. Load 4500 gal in 3.5 minutes from a field side reservoir without leaving the cab.**



**Figure 11. Inject biosolids directly into sod.**

