

## EXPANDED FIELD TESTING & COMMERCIAL DEVELOPMENT OF SYMMETRY FUMIGANT APPLICATION TECHNOLOGY.

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The application of chemical fumigants to soil has inherent challenges among which include rate accuracy, product placement, worker safety, and minimization of off-gassing. These aspects are even more important when applying increasingly lower fumigant rates with the use of high barrier plastics, and with new products that are active at very low soil concentrations. This technology is being developed to improve these and other application issues and to provide commercial applicators with safe and accurate equipment to continue to use chemical fumigants into the future.

The Symmetry® applicator is an invention (Arysta Life Sciences patent No. US 2002/148396 A1) that makes rapidly pulsed injections of fumigants into sub-soil with precise electronically controlled delivery and distribution. This technology was introduced at the 2006 MBO conference and described in detail with regard to the concept and construction of prototype devices used in field testing. Since this time, several machines have been assembled in both Florida and California that target both raised bed and broadcast shank application methods. This report discusses some recent evaluation of the Symmetry concept and equipment designs for their suitability across larger geographic areas, and to determine the feasibility of placing Symmetry equipped machines with commercial applicators in the primary fumigant usage regions.

Symmetry® technology is legally described as: “A method for fumigating soil, comprising injecting a discrete, predetermined amount of the fumigant into the soil at a plurality of predetermined points in the soil, the fumigant volatilizing from each of the points where it is introduced and diffusing into surrounding soil to form a plurality of diffusion patterns in the soil”

Since this early description, we now refer to the application pattern of fumigant with Symmetry as a Multiple Point Source (MPS) deposition along a sub soil channel, the center of which is the orifice of the injector at the base of the soil shank. The soil depth for this injection usually ranges from 8-10 in. (15-20 cm) and occurs at 12 in. (30 cm) intervals laterally. This intermittent deposition allows for a wide rate range since areas between injector bursts can be varied, as can the amount of each burst, so that very low rates can be accomplished by either reducing the amount deposited at each point source or by extending the interval between point sources. See illustration below:

With all fumigant products using Symmetry, MPS depositions over time coalesce to result in uniform fumigant saturation in soil at target concentrations that control weeds and soil borne diseases. The exceptions are where widely spaced point source fumigant

epicenters can occur where tree or vines are planted. While the current machines are being constructed to apply a variety of fumigant products including Telone, Chloropicrin, DMDS, Metham Sodium, etc.), our work has focused on Midas. This was due to the relatively low usage rates of this product and the inherent difficulty in obtaining precision with equipment designed for use with methyl bromide. Conventional methyl bromide usage rates are 300-400% higher than Midas, depending on whether VIF or conventional plastic mulches are used.

In addition to the uniform low rate capabilities of this technology, other characteristics have also become apparent or been designed into the machines. These include prevention of dripping of fumigant from shanks when tractors turn at field ends; the presence of several failsafe devices on board that prevent injectors from functioning unless they are under the soil surface; The integration of GPS with the system which allows Variable Rate applications in the field which can focus higher rates of fumigant on areas of historical pest pressure; and reduction in fumigant rates in or near sensitive areas adjacent to treated fields. To test these characteristics, we have treated raised beds and sampled ambient fumigant levels where tractors are operating and in soils at the ends of field runs where plastic mulch is buried. In addition, three major flux studies were conducted in 2007 using Symmetry technology where extensive ambient air monitoring was conducted under GLP. These trials were placed in Michigan, Georgia and Central Florida and results of the rate accuracy are presented in Table 1.

**Table 1.** Fumigant rates of large block GLP applications using Symmetry raised bed applicator in three sites for use in determination of MIDAS flux in different geographic locations.

Rates of Midas

Site	Target	Range	Average	% of Target	Comments
Dover, FL	150	144-154	147	98%	None
Bainbridge, GA	150	151.5-156	153	102%	Rolling terrain
Hart, MI	150	142-175	159	106.2%	Nighttime freezing temperatures caused product flow problems

While most Symmetry studies and field trials ran satisfactorily, the majority of engineering challenges come from the electronic injectors themselves. The original Symmetry machines utilized automotive fuel injectors constructed of stainless steel and molded chemical resistant plastic. We have continued working with these components until all Teflon injectors can be installed, which is the focus of our efforts currently

Nevertheless, the specific rate range of each machine is dependant on the type of injector used and the density of the product injected. With respect to minimum and maximum rates possible with Symmetry, in 2008 trials, raised bed equipment configurations have applied as little as 1 qt/ac of MIDAS (5 lb) to as high as 15 g/ac (300 lb) repeatedly with less than 5% variance from target. Higher rates would require larger injectors, which are available commercially in stainless configuration.

In summary, Symmetry technology development has moved from early prototype testing to larger scale applications to commercial fields following expanded Midas registrations. We are currently working on improving injector reliability through PTFE plastic designs and making the equipment and computer interfacing simpler for commercial use. The remaining development work is being conducted in both Florida and California with multiple prototypes built for commercial applicators in primary fumigant usage areas of the US.