Enhancing Precision Through Better Sprayer Design

One of the implicit goals of integrated pest management (IPM) programs is to add precision to turf management. The implementation of IPM begins with detailed records resulting from a comprehensive scouting program. The records will indicate location and population of specific pests. Once a pest reduces turfgrass quality, some form of pest management must be implemented. But, how precise are control methods? How time consuming are the management programs?

Pest control programs can be cultural, biological or chemical based. Mowing height can be increased to relieve stress, an organism can be introduced to antagonize a pest and reduce injury, or chemicals can be applied. While many strive for cultural and biological control, ultimately, chemical control is the cornerstone of modern pest management programs.

Application 101

The 1998 Virginia Turfgrass Industry Survey reported that the 318 golf courses in the state spent about $9 million on pesticides. The same courses spent another $4.5 million on the pesticide application, or approximately 5% of total labor expenses. Of course, mowing represents the largest portion of labor expenses, at 38%. Still, after mowing and irrigation (7%), pesticide application is the largest labor expense.

The labor involved in applying pesticides is more than simply operating the sprayer. Once a sprayer is properly calibrated to deliver the proper amount of material, pesticide handling follows. After application, the tank has to be triple rinsed, nozzles cleaned and rinsate managed. Often, pesticide handling occurs in dedicated areas to minimize the potential movement of concentrate that could contaminate water. Such handling areas can be costly, especially if large volumes of rinsate are to be handled.

Little has changed over the years in the basics of pesticide application. A tank is filled with water, pesticide is mixed in, then pumped under pressure to pipes that deliver it to nozzles and apply it to the turf. The amount of pesticide applied is determined by the mix concentration, pressure, ground speed, and nozzle type. Innovations have made applications more consistent and parts more durable but these have been evolutionary, not revolutionary.

Application Precision

Production agriculture has utilized a variety of new technologies to enhance pesticide application efficiency and reduce environmental pollution. One popular method has been the use of global positioning systems and geographic information systems (GPS/GIS). This technology identifies site-specific information that can regulate pesticide application.

Often referred to as precision agriculture, this approach has led to significant reductions in pesticide use with little or no added labor costs. This system is starting to be applied to turf management but has met with limited acceptance outside the irrigation field. The GPS/GIS approach could work for fairway turf, but the site-specificity of putting greens is on a smaller scale, creating practical challenges.

Direct-Injection

When Walt Smith, assistant superintendent at Missoula (Mont.) Country Club, wanted to make weekly light applications of materials easier, he found nothing on the market to meet his needs. He questioned why he was constrained by having to mix all the products in the tank with the water.

Mixing products in the tank limits the ability to alter application rates in the field. It leaves superintendents with no ability to apply different products to different areas. The only way to do so now is to mix up a separate tank. But this requires a significant amount of cleanup time to rinse a 100 gallon sprayer. In fact, studies from the Royal Agricultural College in Cirencester, U.K., conducted by Prof. Andrew Landers, found that decontaminating a 150 gallon sprayer required 500 gallons of water and took an hour. Interestingly, about 0.5 ounces of active ingredient remained in the tank.

At Missoula CC, Smith decided to revolutionize the application procedure. He procured various spray components that would be configured to allow the application of four different products without mixing them in the tank with the water. This type of system has been used in agriculture and also tested at Cornell University's Robert Trent Jones Golf Course.

The heart of the system is a proportional

continued on page 17

Program Spotlight

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Sprayer Design

continued from page 7

injector similar in concept to what homeowners use as hose-end applicators. Small amounts of chemical are injected into the spray line immediately prior to the solution leaving the nozzle. This allows the operator to select the products to apply during the application. It reduces the time and space dedicated to pesticide handling and reduces clean up because the large water volume in the tank is not mixed with product.

From an IPM perspective, a direct injection sprayer can utilize precise records, possibly including GPS/GIS information, that can treat small areas with only the products needed. For example, if the back corner of a putting green is prone to pythium blight and the walk-on/walk-off area is prone to dollar spot, they will require different chemicals—especially as each area does not suffer the other disease.

Traditionally, the entire green is treated for pythium with a traditional sprayer. Then, the chipping area beyond the green is treated for dollar spot. This is done either by tank mixing products or with two sprayers. A direct injection sprayer, by contrast, allows the operator to apply one active ingredient to one area and another ingredient to a separate area, resulting in significant overall reductions in pesticide use without any reduction in turfgrass quality. The right product can be applied at the correct rate to the affected area. For example, Smith reported in the March/April issue of the *USGA Green Section Record* that Missoula CC has reduced applicator exposure to pesticides, sprays 17 acres in 2.5 hours, using only 25 gallons of water to decontaminate a 100 gallon system.

Oddly, this approach has not received much attention from golf course superintendents. It is not widely used in the industry. In a raw survey of sprayer companies at the 2002 GCSAA show, I found only one out of ten companies were aware of this technology. It is possible that superintendents would be wary of not treating an entire green if a disease is noticed in one area, or possibly that most treat preventively to avoid the possibility of injury that would require curative control. Still, the labor reduction and environmental benefits of eliminating large volumes of material should be welcomed.

The Future

As superintendents become familiar with their golf courses, they are able to predict specific problem areas or observe subtle color changes that might require fertilization. This familiarity is as much an art as a science because many of the pest and nutrient challenges are not well understood or scientifically predictable. In the end, the action might require chemical application. As mentioned previously, this is not always as precise as we might like.

Researchers at Oklahoma State University, led by Professor Greg Bell, have been investigating the use of optical sensing and variable rate technology to more precisely apply fertilizer based on turf nutrient needs. The optical sensing devices are mounted on the sprayer and are able to assess the color and the tissue nitrogen level in one half square foot increments.

Once the sensors assess the nutrient needs a signal is sent to a system that controls the application rate. The rate is adjusted accordingly and applies the amount of material needed to bring the turf to sufficient nitrogen content. The device used by the OSU researchers had the ability to apply 15 different rates of fertilizer.

The system has been evaluated for weed control in agriculture. The optical units can detect different plant species and apply herbicide only where an undesirable species is present. It might be possible in the future to detect pathogen infection before disease symptoms are obvious, allowing disease control before injury and potential overall reductions from site specific management.

With all the attention paid to reducing pesticide use in turf, little attention seems to be focused on application systems. This seems odd with so little success achieved with biological control of turf pests, increased turf stress that creates new pest challenges, and development of pesticide resistance from chronic use.

Real reductions in pesticide amounts could be realized when an effective scouting program is used in conjunction with GPS/GIS and more precise sprayer technology. With small investments in equipment, significant labor reductions, maintain turf quality and reduced risk to the environment, we could have a revolution in pest management.

Frank S. Rossi

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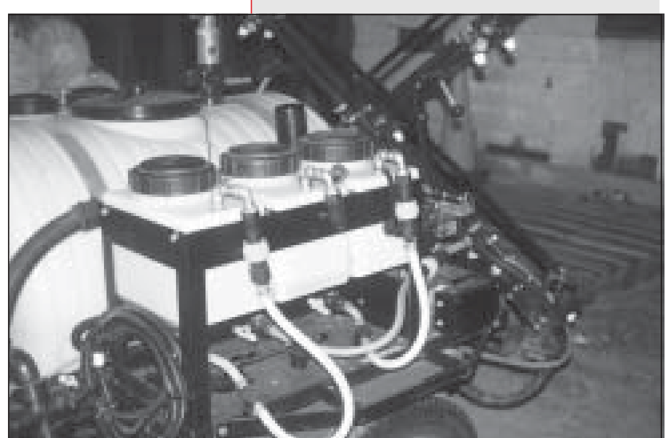

Side view of prototype injection sprayer donated to the Bethpage project by Toro and Raven Technologies.