Innovative Pesticide Application Equipment at Wight Nurseries

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INTRODUCTION

New technologies warrant consideration for our Pest Management Program that help us improve deposition, increase efficacy, and allow more precise and reduced pesticide usage. It is our policy to look for new and refined methods for applying pesticides that enable us to become better stewards to our environment, while maintaining the option to use pesticides in the work place. The Quality Control Department at Wight Nurseries in Cairo, Georgia is currently utilizing two custom-built pieces of equipment that better fit our pest management goals. They are an air-assisted electrostatic boom sprayer and an air-assisted boom herbicide applicator. This paper will describe these two pieces of equipment and their benefits to our pest management program.

ELECTROSTATIC BOOM SPRAYER

Perceived Benefits. In the spring of 1996 our Division I Hawthorn Trail Facility acquired a custom built 7.6-m (25 ft) boom sprayer designed by Electrostatic Spraying Systems (ESS) to be used in the pest management program. After viewing a similar applicator it was our opinion that such a device had a number of benefits to justify the initial cost of the sprayer — advantages we felt would pay back our investment over time. Major benefits included:

- Reduction of pesticide usage with increased deposition, resulting in lower application rates, while applying lower carrier volumes per acre;
- Improved efficacy due to a higher percentage of the pesticide solution reaching the target zone;
- Increased uniformity compared to conventional style hose-rig applicators;
- Reduction in labor cost due to the utilization of a sole operator as opposed to multiple person teams that are required with the hose-rig applicators;
- Increased worker safety and comfort due to the use of an enclosed air conditioned tractor equipped with a filtration system;
- Increased worker productivity — with this climate control tractor rig, conventional personal protective equipment (which is uncomfortable and stressful to employees under high temperature field conditions) was not required.

ESS Boom Design and Operation. The criteria for custom-building this pesticide applicator was based on the needs of our nursery facility. Criteria included: terrace width, maximum and minimum plant height, irrigation system type and sprinkler heights and locations, width of roads, and other site specific variables.

The 7.6-m (25 ft) boom is powered by a 75-hp enclosed-cab tractor complete with a charcoal air filtration system that provides operator safety and comfort. The hydraulic system of the tractor supports the operation of the boom and has 1.2 m (4 ft) of vertical movement. The entire boom assembly can be manually adjusted to give an overall clearance range 0.3 to 2.7 m (1 to 9 ft). The boom also has the ability to fold forward along the length of the tractor to facilitate navigation during transport. The boom can also be pivoted at its axis allowing the operator to match the incline of the terrace being treated. The mechanical agitation of the unit is also powered by this same hydraulic system.

The spray solution is delivered to the nozzles by a small diaphragm pump at 15 psi which allows push-on style fittings to be used that are easy to work with. The pesticide is propelled by an air-assist system that is derived from a power take-off (PTO)-driven compressor mounted on the sprayer. This compressor supplies air at 30 to 40 psi at a high speed which when traveling through the nozzle shears the liquid into small particles that are charged as they pass by an electrode at the nozzle tip. The air-assisted pesticide is propelled into the plant canopy as a dense fog-like spray that gives good uniform coverage and penetration which is effective with even very dense plant canopies. Also, the upper threshold of wind tolerance is much greater than with conventional equipment. The tractor speed is set at 3.2 km h^{-1} (2 mi h^{-1}) which allows for an application rate of 183 liters ha^{-1} (19 gal A^{-1}). The 757 liters (200 gal) tank capacity allows for the operator to treat approximately 3.9 ha (10 A) of production between refills. This is a labor saving feature because there is less mixing, filling-up, and daily travel time required.

The application rates of the pesticides being used must be calculated by the amount of material to be applied per acre. This rate is derived by taking the standard labeled rate and reducing it by one-third. All foliar nutrients, fungicides, and insecticides are applied in this manner. It is standard protocol to buffer the pH of the water carrier, and we prefer to use a product on the market that will indicate when the proper pH has been obtained by turning the water carrier pink. This buffering procedure is done before any pesticides are added to the tank. In order to effectively use wettable powders, it is very important that they remain in suspension in the spray tank — not only to insure an even application rate, but also to minimize clogging of the small orifice sizes that are utilized with the low-pressure liquid system. For this reason, a suspension agent is used to ensure effective use with these types of pesticides. As a consequence, we have found that all chemical formulations can be used — as long as the proper application procedures are followed and vital end-of-day cleaning is performed. The cleaning process involves running clear water through the system to remove all pesticides, then using a tank cleaner to more thoroughly cleanse the system. The operator also cleans a few key parts of the liquid delivery system. There is a monthly cleaning schedule that includes the removal and cleaning of all nozzles on the boom. Daily cleaning procedures take the applicator about 30 to 45 min if done properly, and must not be missed to ensure efficient utilization of the machine.

Effectiveness and Efficiency. The boom sprayer has been in operation for 18 months and it is possible to review its performance and compare it to the previous program, which primarily utilized conventional-style hose rigs requiring two- and three-person teams to operate.

It is our opinion that our pest management has been excellent as a result of the sole

utilization of the boom sprayer. This nursery site has large numbers of *Ilex crenata* that historically have high susceptibility to mite infestations. This piece of equipment has effectively controlled mite populations and no hose rig applications have been necessary since the machine has been in use. The same can be said for our disease control which has been good.

A significant goal achieved has been the reduction of annual pesticide usage on the nursery which resulted in a dramatic reduction in pesticide expenditures. The main reason for these savings is the fact that we are using 33% less chemical in all applications, with no perceived reduction in pest control. This carries the saving straight to the bottom line! Key labor savings occurred with the elimination of two applicators from the pest maintenance program, and a decrease in the amount of time required to treat a given acre. As a result of these savings the nursery was able to recover the initial investment in the ESS boom sprayer within the first year of use.

AIR-ASSISTED HERBICIDE BOOM

Introduction. Through many years of evolution at Wight Nurseries the weed control program has developed many approaches. The most predominate means of has been manual weeding. This has included more exotic means such as the use of geese that forage the nursery and feed on weed species, and more importantly, the use of pre-emergent herbicides that has offered varying degrees of success. The application methods of pre-emergent herbicides have varied through the years to include such means as broadcast spreaders, hand shakers, airplanes, and liquid formulations. Since a strong pre-emergence program is a vital component in producing a quality product at minimal cost, we at Wight Nurseries are continually looking for improved methods of application.

In 1995 a team from Wight Nurseries, toured Bailey's Nursery in Saint Paul, Minnesota and was given a demonstration of a boom-style herbicide rig that was being used at their nursery. This particular unit had a 14.6-m (48-ft) boom that could not be folded, but had the ability to change boom height by hydraulically raising the entire trailer assembly. We saw potential in this boom applicator and subsequently had a custom-made applicator manufactured.

Perceived Benefits. This air-assisted herbicide boom applicator is used at our Hawthorn Trail Facility where the previous mode of application consisted of a multiperson team applying the herbicide with Warren Broadcast Spreaders. This is a very common system within the nursery industry and when managed closely can deliver desired rates of application. However, the ability to obtain complete uniformity in the treatment area is difficult since the rate of application can vary from one applicator to another. Also, it is possible to have over- and under-application within the area being treated due to the frequent stopping and starting that is required and the subsequent lack of a proper overlap that occurs. Teams range from one to four people with the conventional Warren Broadcast Spreaders and the manual application process can be very time consuming, and navigation is difficult through the beds of plant material. For these reasons it was believed that a boom style applicator would benefit us with improved coverage and uniformity, resulting in better weed control. Furthermore, the calibration of the application would be easier and remain more consistent, which would decrease herbicide usage by over-application, and improve weed control since proper labeled rates would

be used, avoiding improper application rates of the past. Labor would be reduced since only a single operator would be needed and the time required to treat a given acre would be reduced.

Boom Design and Operation. The herbicide applicator was also custom built by ESS and designed specifically for our Hawthorn Trail Facility. The general design of the applicator is relatively simple when compared to the Electrostatic sprayer. It mainly consists of a trailer, a hopper, a distribution chamber that has distribution hoses connected to it, and a 7.6-m (25-ft) boom that supports the tubes over the terrace. The material is gravity feed from the hopper into the distribution chamber, and air assisted through the tubes before being distributed.

The hopper is manufactured by Valmer, a Canadian company, and was initially designed for insecticide applications in agronomic row crops. It has a capacity of 239 kg (525 lb) and is able to treat 2.1 ha (5.25 A) with a label rate of 115 kg ha^{-1}(100 lb A^{-1}) or 1.04 ha (2.63 A) with a label rate of 231 kg ha^{-1} (200 lb A^{-1}). Since the material is gravity feed, the hopper is mounted at the highest point on the trailer to insure that it remains above the boom at all times. When that material leaves the hopper it enters a distribution chamber that equally distributes the material between a series of 15 hoses that carry the material to varying positions along the boom so a wide band application can be made. When the material exits the tubes it is dispersed by a deflection shield causing a fan like pattern that when grouped together along the boom creates a 7.6-m (25-ft) band application. The PTO-driven fan creates sufficient force to carry the material through the length of the boom and also helps the herbicide penetrate dense canopy and reach the target zone.

Calibration of equipment is obtained by utilization of a gearing mechanism that allows for the variation of the rate of dispersal from the hopper. Once this gear is in place, it is synchronized with the tractor speed by a ground wheel that operates the hopper — and couples the rate of dispersal with the speed of the tractor. In other words, the tractor speed can change and the rate of application will also change proportionately, thus allowing constant application of material. This is an important criteria since the tractor speed must change as it begins or ends a terrace and yet the herbicide application rate remains constant. The applicator is currently calibrated to deliver a rate of 115 kg ha^{-1}(100 lb A^{-1}) and when a label rate of 230 kg ha^{-1} (200 lb A^{-1}) is required the operator makes a second pass with the machine over the terrace to achieve this higher rate.

The boom height can be adjusted hydraulically and also boom pitch can be varied to enable the operator to adjust for unlevel terrain. The boom can be folded up along the length of the tractor to facilitate navigation around the nursery.

Effectiveness and Efficiency. This piece of equipment has been a tremendous asset to our herbicide program. Plans are to look into ways of utilizing it in other locations in addition to our Hawthorn Trail Facility. Our weed control has improved and the ease of herbicide application makes it a pleasure to work with. Although we have not seen any major differences in the amount of herbicide being used, it is apparent that our application goals have been met if not exceeded. There has been a reduction in labor required and the only locations we now use individual broadcast spreaders are in those areas of the facility that can not be accessed by the boom — such as shade structures and propagation areas.