LET YOUR PALMTOP DO THE SPRAYING - A FUNCTIONAL, COMPUTERIZED PLOT SPRAY SYSTEM

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Abstract

A computer controlled spray system provides optimum precision during pesticide application and provides for environmentally clean handling of rinsate and excess pesticide mixtures remaining in the system following pesticide application. The computer driven controller automatically prepares the system at boot-up for attachment of a bottle of spray mixture. On cue from the operator the system is pressurized and paused to allow the operator to check for leaks. On second operator cue, all spray, rinse, and purge operations are automatically governed by the computer program. Manual override is available at any time. The system provides flexibility for upgrading or addition of other helps such as sensors to record temperature and humidity.

Introduction

Reed et. al. (1996) described the initial concept and prototype of the computerized spray system and reviewed development of the basic system developed by Reed and Grant (1990). In brief, the system consists of a pressurized spray mixture container equipped with a compressed air inlet, an outlet to the spray boom, and an inlet for water. Valves govern the flow of air or water in the system, and direct the flow of spray mixture through the spray nozzles or through purge valves at the ends of the spray boom.

The bottle containing the spray mixture is rotated to an upside-down position before spraying and rinsing to insure complete use of all spray mixture and to allow thorough rinsing by water prior to changing chemicals. Rinsing is facilitated by using spray nozzle bodies with a diaphragm valve that prevents spraying when pressure drops below about seven psi. When the purge valves are open at the ends of the boom, pressure is reduced, spraying through the nozzles is restricted, and the fluid moves out of the boom and can be directed to a collection tank for proper disposal.

Discussion

The computer controlled system uses a commercially available palmtop computer (HP200, Hewlett Packard) and a specially designed electronic controller for operation of the spray procedures. The computer is connected to the controller via the serial port. A program written in 'C' code and then compiled allows communication between the computer program or the keyboard and the controller. When the controller receives an input, it switches one or more electrically operated solenoid valves that shunt compressed air to turn on or off the compressed air-activated valves that govern the air, water rinse, spray or purge sequences. Depending on the sequence of the computer program that is active at any one time, the valves are turned on or off to produce a depressurized, spray, rinse or purge situation as indicated in the table below.

Use of the computer to operate the valves reduces the number of manual switchings for the spraying and rinsing sequence of each treatment from eleven to two compared to the noncomputerized system. After the system is depressurized and a bottle of spray mixture is loaded, a single keystroke pressurizes the system (turns the air on and closes all other valves). The system then pauses to allow the operator to check for leaks. If all is well, another single keystroke initiates the remainder of the program and automates all other valve operations required to spray, rinse, and purge the system, and finally return it to a depressurized state. Each operation is described on the screen while that operation is in progress. With this system, a plot can be sprayed and the system prepared for the next treatment in less than a minute and a half.

The use of the palmtop with a standard DOS operating system provides extreme flexibility in programming. As currently programmed, a starting menu allows you to choose the settings of the previously sprayed trial, or to reset the number of rinse cycles, the width of the spray boom (4-row or 8-row), or the amount of time for each of the following parameters: spray time (related to plot length), time needed to purge remaining spray mixture from the boom and nozzles, time required for water rinse, time required for purging the rinsate, time the purge valves close during rinsing and purging to allow water or air to spray through the nozzles, and the length of time the air is allowed to blow the system and nozzles free of rinse water. Thus the program can be adapted to different boom designs and nozzle configurations.

The system currently keeps track of the number of treatments sprayed. It can be programmed to record to file the time each plot is sprayed. By programming it to utilize the list of random treatment numbers assigned to field plots, it could print the treatment (bottle) number and associated plot number on the screen for operator verification prior to spraying. Since the palmtop can communicate directly with a PC, these lists could be downloaded from a PC prior to going to the field, or they could be transferred to a PCMCIA type I or type II memory card to be inserted in the palmtop on the spray tractor. Temperature and relative humidity sensors could also be attached to allow these

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ambient weather parameters to be recorded as each plot is sprayed. The possibilities are numerous for improving not only spray precision, but record keeping as well.

Safety has been increased with the new system. The operator can spend much more time observing the system looking for problems instead of operating valves. The system also helps avoid the state of fatigue that occurs during numerous replications of repetitious procedures, thus reducing judgmental errors. There is a large panic button on the system that instantly shuts the system down in case of a problem, and if the computer were to fail, there are three back-up methods to operate the system: 1) manual switching of electrical switches to operate the solenoid valves; 2) manual switching of the solenoid valve bodies; or 3) manual switching of the air activated valves for air, water, spray or purge. The last method would require the operator to get off the tractor to manually turn the valves mounted on the boom.

Finally, the system can be adapted to the multiple tank concept used by many pesticide researchers. This system would have one on-board, pressurized spray container for each treatment in a trial instead of each plot, each containing sufficient spray mixture to apply the required number of replicates for each treatment. Unlike similar standard systems, however, the computerized version would readily allow the spraying of sequential plots with random treatments by providing a computer controlled boom rinse between treatments. Normally, researchers using this type of system spray all replicates with one treatment, then all replicates of the next treatment and so on. Besides being scientifically unsound, this type of system requires bare alleys between plots for tractor navigation. These are difficult to maintain, inhibit irrigation, and leave alley-effects in the following season's crop. Operator error would be reduced with the computerized version of this system because the computer, if programmed correctly, would never become confused as to which of the tanks needs to be turned on to spray a particular plot as occurs with human operators. Most importantly, the computer-driven, multiple-tank system could be controlled from within an air conditioned cab without operator contact with valves, hoses or tanks other than during initial loading procedures. It would also provide means to purge and rinse the tanks and system as described above for the single bottle spray system, reducing operator contact with toxic compounds or their residues.

The computer driven system opens new vistas of both safety and precision for small plot pesticide application and provides for extreme flexibility in facilitating nearly any conceivable spray system.

References

Reed, J. T., and R. R. Grant. 1990. An inexpensive device for rapid change, application and rinse of tractor applied chemicals during small plot efficacy trials. Proc. Beltwide cotton Prod. Research Conf. pp. 262-265.

Reed, J. T., Filip To, and Mark Stevens. 1996. A computerized system for precise application of pesticides in small plots. Proc. Beltwide Cotton Conf. pp516-517.

Table 1. Valves conditions controlled by the computer to check the pressurized system (Ready), spray, rinse, purge and depressurize (to load another spray container).

SYSTEM STATE	AIR VALVE	WATER VALVE	SPRAY VALVE	PURGE VALVE
READY	ON	OFF	OFF	OFF
SPRAY	ON	OFF	ON	OFF
RINSE`	OFF	ON	ON	ON/OFF
PURGE	ON	OFF	ON	ON/OFF
DEPRESSURIZE	OFF	OFF	ON	ON