SOME OBSERVATIONS ON GREENHOUSE COMPUTER INSTALLATION

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The experiences we have had in the past 2 years may be of value to those interested in, or planning, installation of computer controls. There are a few things one does not find in advertisements, books or trade articles. It is like horse trading. Unless you know enough to ask, the seller is not likely to tell you. In the case of greenhouse controls, there are very few individuals having the knowledge in instrumentation, signal control and computers to point out the major pitfalls.

An obvious point is that computers and their related digital acquisition/control peripherals do not mix well in the greenhouse environment. One should figure on remote control, with the major electronic equipment in a secure, environmentally controlled, room. It should not be behind the boiler or in the pesticide room. The equipment should be protected against anything that may be injected into the greenhouse atmosphere. Certain types of equipment will go bonkers with cigarette smoke. After all, a $30,000 investment deserves some consideration. If one must get into equipment for adjustments, it is well nigh impossible to hermetically seal an enclosure which has to be opened. That is expensive.

A second major point is that greenhouses are extremely "noisy". That is, electronic noise. Depending upon the type of circuit, a single power contactor can literally blow things into hysterics. Interestingly enough, breaker opening is likely to be more severe than closure. Sensors with high impedance outputs are particularly susceptible unless carefully shielded, filtered and grounded. Signal lines should never be run parallel with power lines, and separation should be a minimum three feet or more unless adequately shielded. Signal lines should cross power lines at 90° angles, and the two conductors in the signal line twisted with a "lay" of about 3 to 5 centimeters. Signal cables should not be spliced. One may find it necessary to go to the standard 4-20 milliampere industrial current loop for data acquisition and control. This is more expensive. Still more expensive is frequency conversion (FM), and the ultra-ultra method, secure against anything including nuclear detonations, is fiber optics. Some investigation of areas, from the standpoint of radio frequency interference, should be made when locating control equipment. Measuring systems should have as high a common mode rejection as possible — preferably more than 60 decibels, certainly not less that 30 dB at 60 Hertz power frequency.

The most common measurement is temperature. Of the systems available, thermocouples are probably cheapest for short runs. Although purchase of ready-made couples can run the cost up to $30 or more each, thermocouples can be home-made for the price of time to weld and insulate them. Up to about 200 feet, thermocouples represent a low impedance source. Beyond 200 feet, wire resistance, especially with small conductor cable, is likely to increase interference. The special cables required are likely to be expensive ($1.00 to $3.00 per foot for multiconductor). All other temperature measuring systems require an outside power source. The most accurate are platinum resistance detectors (RTDs), although other metals are available. One can obtain almost any configuration at prices ranging from $17.00 to $150.00 each. However, these, as well as thermistors, require three conductor cable. Thermistors usually have the highest change per degree (greatest sensitivity). If resistance of the thermistor is high enough, two conductor cable may be possible. Costs range from $10.00 to $50.00 or more for thermistors. Diodes are among the more recent introductions, with costs in the $10.00 to $20.00 range. They have a linear, and relatively high, output. Response times of RTDs are generally the longest, with thermistors and thermocouples having the fastest response times (time to reach 63.2% of final temperature), depending upon how the units are made. For very long distances, one may find it necessary to digitize the signal for transfer to the computer for processing. Generally, a signal level of less than 100 millivolts, from a source of more than 500 ohms, is likely to be susceptible to electronic interference in the greenhouse.

A final observation at this time, is that we are beginning to see that implementation equipment with fewer than three stages of heating or cooling is not likely worth the effort to computerize. Computer capabilities cannot be used to the fullest extent unless the implementation system the computer controls is capable of many stages of modulation. One or two stages of heating or cooling is guilding the lily from the standpoint of precision environmental control.

Obviously, a computer system should be capable of reestablishing control in the event of a power failure. The power supply must conform with the manufacturers' specifications, and, for safety, the system should be protected against power surges as may occur with lightning. There appear to be instances where there can be a partial failure of a system with low voltages (e.g. keyboard begins to malfunction, whereas a program continues to run). Keyboards, storage files, and other controls, must be secure against unauthorized tampering. We have enough problems with well-intentioned employees diddling with thermostat dials, let alone randomly punching keys on a high price installation.

The question may be asked: "How much precision and accuracy do I require to maximize profit?" We do not know, except that general observations seem to indicate that many existing systems are pretty gross, and that the potential is there to provide significantly improved returns from computerization.