# A FERTILIZER INJECTION SYSTEM

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## INTRODUCTION

In recent years there have been rapid gains of knowledge in the fields of growing plants under stress. The coming of age of container growing has caused us to question many of our previous values and to investigate areas and industries, that seem quite foreign to us, for the answers. Some of the areas in question we have discussed at this meeting, such as winter protection. Others, such as the medium requirements brought about by the short soil columns in cans, is causing quite a stir in the wood processing industries as they see a large potential market for their wood by-products. In California, redwood sawdust has gone from a material which the mills were glad to see you haul away to a rather high priced item of short supply today because Dr. O. A. Matkin, of Soil and Plant Laboratory, Inc. developed its use as a soil amendment. Another area which is still undergoing a revolution is that of plant nutrition and how to supply it. It has become increasingly obvious that if you are to compete in the field of container growing with the California nurserymen, then you must produce the plant in the shortest possible time. One of the requirements to achieve this is to try to maintain an optimum fertility level at all times. The level that you consider optimum may well change from week to week as the season develop but the goal does not.

In searching for a means of doing this we were very dependent upon Dr. Fred Peterson, of the Soil and Plant Laboratory, Inc., who with the assistance of Mr. Ed Kott, of the Milton Roy Company, developed the electrical component type proportioning system, previously utilized exclusively in industrial process control applications. I will try to illustrate and explain the operational characteristics of the system and show what advantages it has.

## SYSTEM GOALS

Prior to our installation of the injection system our method for fertilizing container stock, after that which was incorporated in the initial medium, was to top dress. There were a number of problems with this method though; high labor costs and the very slow reaction time after getting the results of soil tests from the laboratory, were the most serious objections. During our very short growing season we cannot afford to have the plants below optimum fertility for the period of days it takes to apply fertilizer by hand. Slow release fertilizers could be used but they again require a lot of labor to apply and you loose control of the fertility program as soon as you put it on. It seemed obvious that we had to come to a constant feed through the irrigation system as the plants need for fertilizer was related to it's water use.

Some of the equipment requirements for constant feed through the irrigation were: 1) Dependable operation, 2) Ease of Ratio Adjustment, 3) Automatic Maintenance of Constant Ratio, 4) Optional Accessories, 5) Engineering Service, and 6) Economy. To go in to some of these points in greater detail — The pump had to be *dependable,* designed to handle very corrosive chemicals, and had to be able to pass some solids without damage. It had to be ruggedly constructed for industrial-type service to give long life and reliable operation without costly maintenance.

The system had to have ease of ratio adjustment. The *strength* of solution delivered to the plants had to be adjustable over a wide range by simply turning a micrometer control on the pump. No premixing of various fertilizer solution strengths could be tolerated to the labor factor and the possibility of errors.

It might be desireable to have *accessories available* for the basic fertilizer system such as conductivity monitering equipment on the main irrigation line to shut the equipment down so as to protect against overfertilization; automatic low flow cut off; solution tank low-level alarm system; and anti siphon devices between the pump and the main line.

The automatic maintenance of a constant fertilizer-to-water ratio, once the pump is set, is required to be automatically and accurately maintained over the entire flow range for which the system is designed.

It is important that the manufacturer of the injector have an engineering interest in developing its hardware for fertilizer applications.

Even though the cost must be evaluated on the basis of the useful life of a system rather than upon the initial cost, the total cost still had to be within reach of our industry members.

## 3 SUB SYSTEMS FLOW SENSING

There are three sub systems into which the components that we arrived at can be divided. The first sub system is the flow sensing. Two methods are currently being used. Where the water supply is free of sediment or suspended material such as fine sand, water meters, equiped with an electrical pulse generator can be used. These devices produce an electrical pulse signal with frequency proportionate to flow. If the water is not clear, flow must be sensed by a differential pressure producing device. This device, in the case of our system, consists of a plate with a two inch hole in it inserted in the three inch main line. As the water rushes through the smaller hole it produces higher pressure on the pump side and lower pressure on the irrigation side of the orifice plate. Small tubes transmit these signals to the telemetering equipment. The system has a flow rate range-ability of 10:1 with a precision of plus or minus 2%. In our system this means that the equipment will start injecting fertilizer at a flow as low as 15 G.P.M. and keep injecting the same proportion of fertilizer per gallon up to a flow of 150 G.P.M., Range ability as high as 25:1 can be had but at a much greater cost. Flow sensors are available in sizes to accommodate ½″ pipe up to and including 48″ pipe, with flow rates from 20 G.P.M. (gallons per minute) to thousands of G.P.M.

## TELEMETERING

The second subsystem is the telemetering or transmitting equipment. Once a physical signal of a measurable type is developed by the flow sensor, this signal must be interpreted. The telemeter causes the injection pump to work more or less on a 15 second cycle depending on the flow through the main line. Within the telemetering box is a device that automatically turns the equipment on when it senses a flow rate over 15 G.P.M. and off when it drops below that figure. This is very useful to us as the equipment is remote from the water pump controls and clocks.

## PUMP

The third subsystem is the pump, which was selected to meet requirements with respect to capacity, type, and materials of construction. Our pump is a duplex type; that is, there are two independent sides to the pump, one for nitrogen and the other for potassium, each of which has the ability, when set at 100% to pump, under continuous operation, 18 gallons per hour of fertilizer. Each head is individually adjustable, with a micrometer device, from 0 to 100%. The fertilizer concentrations in the solution tanks remain the same all year and soil test reports simply indicate a new setting for each of the micrometer adjustments. If we have several days of rain which lower the fertility level in the containers by leaching, this equipment allows us to bring the fertility level back to normal by simply putting on a ½″ of additional water, as soon as it stops raining with both vernier adjustments set at 100% and then returning them to their previous settings. Special applications, such as iron, are easy to make by simply removing one of the lines from the solution tank and switching it to a special tank. This equipment can also be adapted to apply concentrate sulfuric acid, to overcome a bicarbonate content in poor water, if this is needed.

The solution tanks are 80 gallons each capacity. We dump 400# of ammonium nitrate into one tank and 100# of Murate of Potash in the other. A rather normal setting would be 20% on the nitrogen and 40% on the Potassium. One filling of the Nitrogen tank will feed about 150,000 gallons of line irrigation water. The Ammonium Nitrate is 33% and the Muriate of Potash 60%.

The system costs between $2-4,000.00 dollars, depending on how fancy it is, and has an expected life of ten years. On the credit side should be listed the return one must expect from increased productivity and the savings one must expect from reduced labor and increased efficiency of application of fertilizer materials. We feel that to start a container growing nursery today, one of the first items you would need would be a fork lift and the second would be a good injection system. The manufacturer of this equipment is the Milton Roy Company, Philadelphia, Pa.

KEN REISCH: We will now have some time for questions.

HENRY KNOX: Very briefly, we have a large greenhouse operation and find the Ferto-jet from California very satisfactory. It is a strictly mechanical apparatus with the exception of the electricity required for the motor driving the pump. It is a double action piston. With our system it is set up to a ratio 1 to 100, one part fertilizer to 100 parts water. This does necessitate adjustment of the amount of fertilizer put into your concentrate tank. It will operate at a complete range from a hose which will take about ½ gallon per minute to the maximum capacity of the line. We use a high pressure water pump which increases our water pressure to 150 p.s.i. and we found other injectors would not function at these high pressures. This system has worked well for us over the past 4 years with little maintenance. The cost for us in Canada was $525, including duty.

KEN REISCH: Thank you Mr. Henry. The florist industry has been using this system successfully for years.

BEN DAVIS: I would like to ask Dr. Tukey what kind of fertilizer he used on the fall applications.

HAROLD TUKEY: We used ammonium nitrate, potassium dihydrogen phosphate, and also potassium sulfate.

BEN DAVIS: What about using a commercial grade of fertilizer?

HAROLD TUKEY: I see no reason why you could not.

CASE HOOGENDOORN: Do you consider the best time to fertilize nursery stock, November?

HAROLD TUKEY: In Ithaca we usually say the latter part of October, November, early of part of December for our weather.

VOICE: In what tissues is the fertilizer stored after it is taken up in the fall.

HAROLD TUKEY: Most of this material supplied accumulates just behind the buds. With the first break in the weather it moves in rather quickly.

JOHN ROLLER: What happens during warm periods, say in January, with this food stored right behind the bud? Does that increase the danger of winter damage?

HAROLD TUKEY: Whether there is more or a quicker break from fall fertilized plants is a question. I don't think that fall application makes a plant any more susceptible to winter injury. In fact just the opposite, fall applications seem to make a plant more winter hardy. But, if you get an unusual season and things begin to break in winter, definitely they will get clipped.