An Apparatus for Pressure Injection of Solutions into Trees

by Thomas W. Jones
and Garold F. Gregory

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NORTHEASTERN FOREST EXPERIMENT STATION, UPPER DARBY, PA.
FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE
WARREN T. DOOLITTLE, DIRECTOR

THE AUTHORS

THOMAS W. JONES received a bachelor of science degree in plant pathology from the University of Maryland and a master of forestry degree from Yale University. He has been employed in forest disease research with the U.S. Department of Agriculture since 1949 and has been with the Forest Service since 1953. He is now Project Leader at the Northeastern Forest Experiment Station's Forest Insect and Disease Laboratory at Delaware, Ohio.

GAROLD F. GREGORY received a bachelor of science degree in agriculture from Kansas State University, a master's degree in plant physiology from Iowa State University, and a doctorate degree from Cornell University in plant pathology. He has been employed in forest disease research with the U.S. Forest Service since 1962. He is now a Principal Plant Pathologist at the Northeastern Forest Experiment Station's Forest Insect and Disease Laboratory in Delaware, Ohio.

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AN APPARATUS FOR PRESSURE INJECTION OF SOLUTIONS INTO TREES

We have devised an apparatus for injecting solutions under pressure into trees. This apparatus should permit rapid introduction of certain systemic fungicides, insecticides, herbicides, etc. directly into the xylem and should facilitate their distribution throughout the tree.

A unique and important feature of the apparatus is that solutions can be injected into the outermost xylem tissues. This is accomplished by feeding the solution under pressure through an injection head clamped against the surface of the sapwood to cover a small hole cut to penetrate the outer two or three annual rings. Rapid uptake and distribution of solutions is facilitated because maximum fluid movement occurs in the outer sapwood, and injected chemicals tend to move throughout the current wood and into the foliage and roots.

THE INJECTOR APPARATUS

The apparatus consists of the injection head attached to a small hydraulic jack, a belt to hold the apparatus in place on the tree, a gasket to provide a seal between the head and sapwood surface, a fluid supply hose with a valve near the injector head, a solution reservoir, a pressure regulator, and a supply of compressed gas.

The injection head (fig. 1) was machined from a steel rod 1 1/8 inches in diameter and 5 1/2 inches long. Half the length of the rod was turned down to about a 3/4-inch diameter so that it would fit snugly into a hydraulic jack, as described later. A centered hole, 5/8 inch in diameter by 2 1/4 inches deep, was drilled lengthwise into the rod from the large end.

A second hole, 7/16 inch in diameter, was drilled radially in the side of the rod 1 3/4 inches from the large end and deep enough to open into the bottom of the lengthwise hole. This second hole was threaded to accept a nominal 1/4-inch galvanized iron pipe that was 5 inches long. A 1/4-inch pipe union was attached to the pipe, a tapered hose fitting was screwed into the union, and the fluid supply hose was clamped onto the hose fitting.

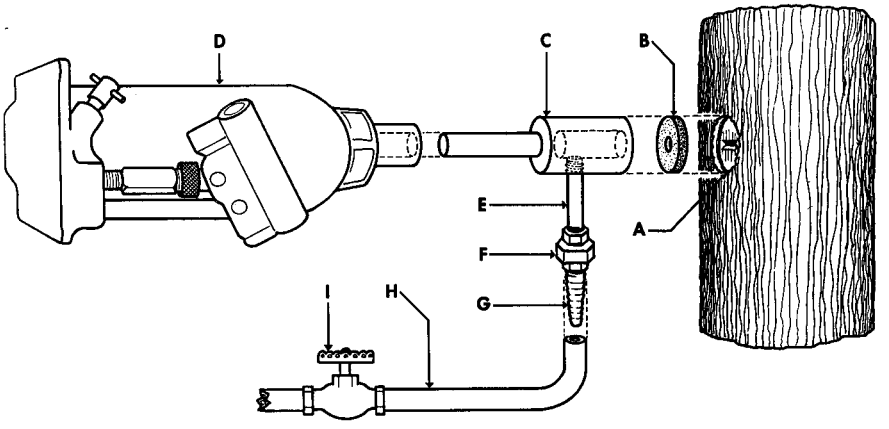


Figure 1.--The injector apparatus.

(A) Prepared injection site on tree with 1 3/8-inch-diameter hole cut through bark and wedge-shaped hole two or three annual rings deep.

(B) Neoprene gasket, 1-1/4 inches in diameter by 1/8 inch thick with 3/16 inch hole in center.

(C) Injector head machined from 1 1/8-inch steel rod 5 1/2 inches long; half the length of the rod turned down to fit into hydraulic jack; centered hole, 5/8 inch in diameter by 2 1/4 inches deep drilled lengthwise into rod from large end; second hole, 7/16 inch in diameter drilled radially in side of rod 1 3/4 inches from large end, deep enough to open into bottom of longitudinal hole, and threaded to accept nominal 1/4-inch galvanized iron pipe.

(D) Hydraulic jack, 1 1/2 ton with threaded extension removed from ram.

(E) Galvanized iron pipe, nominal 1/4 inch by 5 inches long, threaded at both ends.

(F) Pipe union, 1/4 inch.

(G) Tapered hose fitting.

(H) Fluid supply hose from reservoir to injector head, 3/8-inch nylon reinforced clear polyvinyl chloride tubing.

(I) Gate valve.

The threaded extension was removed from the ram of a 1 1/2-ton hydraulic jack, and the turned down end of the injection head was inserted in its place. The belt used to hold the injection apparatus in place was an automobile seat belt; the two halves were sewed firmly together to make a single belt with male and female buckle components at opposite ends. The round neoprene gasket, 1 1/4 inches in diameter by 1/8-inch thick with a 3/16-inch hole cut through the center, was used to seal the injector to the tree.

The 50-foot solution supply hose was 3/8-inch nylon reinforced clear polyvinyl chloride tubing of 225 p.s.i. test with a gate valve near the injector end. The fluid reservoir was a 2-foot section of 4-inch pipe with fittings at one end for connecting the fluid supply hose and with fittings at the other end for connecting the pressure source. As a pressure source, we first used a hand-pumped garden sprayer equipped with a pressure gage; but now we use a cylinder of compressed nitrogen equipped with a pressure regulator. Regulated air compressors should also be satisfactory.

USING THE INJECTOR APPARATUS

The procedure for using the injector apparatus is as follows: A round hole, about 1 3/8 inches in diameter, is cut at a convenient height--usually 2 to 3 feet above the ground--through the bark of the tree to be treated. We used a bow punch for this, but a chisel can also be used. To prevent leakage, it is important that all of the bark be removed but that none of the sapwood is cut.

In the center of the exposed sapwood, a wedge-shaped hole is cut by making a downward sloping cut and an upward sloping cut with a 1/2-inch chisel (fig. 2). The hole should be two or three annual rings deep. The neoprene gasket is placed in the hole in the bark. Next, the injector head with jack attached is placed into position with the belt passing across the base of the jack and around the tree (fig. 3). Then the injector head can be pressed firmly against the gasket by pumping the jack.

It is essential that the belt be adjusted up or down the tree to provide uniform pressure against the gasketed sapwood surface so that the jack does not tip up or down. This operation can be simplified by placing the injector on

Figure 2.--The prepared injection site.

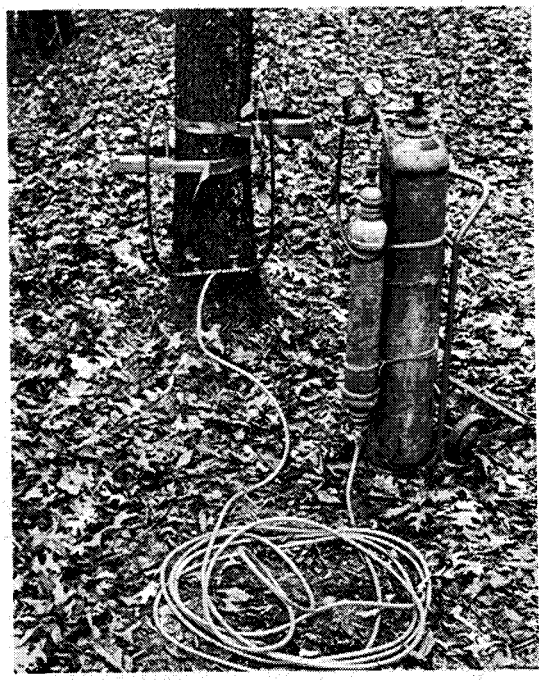
Figure 3.--The injector head in place.

the tree with the pipe to which the supply hose is attached pointing upward. The belt is adjusted so that the jack has a slight tendency to tip up when it is pumped. A wedge of wood inserted between the pipe and the tree will counteract this tendency, resulting in a secure installation.

The supply hose, with the valve closed, can now be loosely attached to the injector at the union. The solution to be injected is poured into the reservoir, the pressure source is connected, and a small amount of pressure is applied to the solution. The gate valve is opened slightly, allowing the solution to flow through the hose, thereby forcing out the air. When all the air has been expelled and the supply line and injection head are filled, the union is tightened, the valve is opened wide, and full injection pressure is applied to the solution (fig. 4). We have used up to 96 p.s.i. pressure without leakage, and we believe that higher pressures may be used if needed.

Movement of the last of the solution through the clear supply hose will indicate when injection is completed. Addition of a small quantity of soluble dye may be desirable for colorless solutions. The injection site should be coated with a tree wound dressing after the pressure injector is removed from the tree.

Figure 4.--The injection apparatus in use.



More than one injector can be connected to a single fluid reservoir. A manifold can be made at the end of the supply hose with tees and additional short lengths of tubing so that several injectors on a tree can be operated simultaneously. A separate shut-off valve for each injector is desirable.

We are now assembling several pressure injection units, each consisting of a small cylinder of compressed gas and lightweight plastic solution reservoir mounted on a packboard and equipped with four injectors. These will be extremely portable and will cost less than $200 each.

PERFORMANCE OF THE INJECTOR APPARATUS

We have used the injector apparatus to inject dye solutions and suspensions and solutions of benomyl fungicide into elms (*Ulmus americana* L.), oaks (*Quercus coccinea* Muench., *Q. rubra* L., and *Q. velutina* Lam.), and maples (*Acer saccharum* Marsh.).

A solution of azosulfamide dye in water (0.5 percent) was injected into red oaks in late September and in mid-November. Injection rate was 5 to 10 minutes per liter per injection site in September and was 10 to 15 minutes per liter per injection site in November.

Dye distribution was quite different on the two dates. Two liters of dye injected into an 8-inch d.b.h. red oak on 30 September 1971, were immediately distributed throughout the tree in the current sapwood and leaves and at least in some roots. In contrast, 4 liters of dye injected into a 12-inch d.b.h. red oak on 18 November 1971, moved up the bole a maximum of only 27 feet. Injection of dye in elm and maple was not checked in September; but in November, it was not very rapid--less than 1 liter per injection site per hour. In elm, the dye moved up the bole a maximum of 15.5 feet; and in maple, it moved up only 8 feet.

It has not been possible to inject very much benomyl suspension into trees. Apparently, the particulates clog vascular elements of the tree near the injection site. Our best result was injection of 565 milliliters of a 13.35 grams per liter suspension of benomyl in water into a red oak in 2 hours.

Benomyl solutions, on the other hand, have been readily injected into oak, elm, and to a lesser extent, into maple; and a subsequent movement of fungitoxicant into branches was detected.[1,2] Injection rate varied with the solution used and the tree species being treated; but 1 liter per injection site in 15 minutes in oaks, 1 liter per injection site in 30 minutes in elms, and 500 milliliters per injection site in 1 hour in maples are typical injection rates during the dormant season. More rapid injection and distribution of injected solution during the growing season are anticipated.

DISCUSSION

The apparatus we have devised provides an effective, simple, and economical means for putting solutions into trees. It should enhance the possibility of therapy for diseased trees and protection of trees from fungus infection with systemic fungicides. It might also be used with systemic insecticides, herbicides, and perhaps even hormones and nutrients.

Injecting pesticides or other chemicals directly into trees has many advantages over foliar spray or soil applications. Entry of prescribed dosages is assured, treatment schedules may be followed regardless of wind and rain, smaller quantities of chemical are required, and their placement and subsequent movement are highly controlled. Thus this method is not only economically advantageous, but also largely avoids the environmental pollution hazards inherent in other methods of application.

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[1]Gregory, Garold F., Thomas W. Jones, and Percy McWain. Injection of benomyl into elm, oak, and maple. USDA Forest Serv. Res. Paper NE-232, 9 pp. NE. Forest Exp. Sta., Upper Darby, Pa. 1971.

[2]McWain, Percy, and Garold F. Gregory. Solubilization of benomyl for xylem injection in vascular wilt disease control. USDA Forest Serv. Res. Paper NE-234, 6 pp. NE. Forest Exp. Sta., Upper Darby, Pa. 1971.

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1971. An apparatus for pressure injection of solutions into trees. NE. Forest Exp. Sta., Upper Darby, Pa. 7 pp., illus. (USDA Forest Serv. Res. Paper NE-233)

The construction and use of an apparatus for injecting solutions under pressure into trees is described. A unique and important feature of the apparatus is that it permits injection of solutions into the outermost sapwood. It has been used to inject dye solutions and solubilized benomyl into elm, oak, and maple.

Caution about Pesticides

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.