# Disease of Brussels Sprouts

## ion Service and Experiment Station in San Mateo County

California's 4–5 million dollar Brussels sprouts
ın Mateo County in 1954 as a result of an inte-
under actual field conditions within the county.
ıd are an example of the policy of the Experiment
ıes in an effort to solve county problems. In this
ıia Experiment Station departments of Plant Pa-
Crops joined with the Extension Service in a
ınomical chemical control procedure, improve-
ınicals and a breeding program to develop a re-

*Director of California Agricultural Experiment Station*
*irector of California Agricultural Extension Service*

## disease is goal
## Brussels sprouts

**rles M. Rick and Donald Y. Perkins**

**ısted with the clubroot organism. ıss generation. *Right:* susceptible ıublike malformations.**

when various lines of sprouts and related crops of the cabbage species — *Brassica oleracea* — were tested for resistance in heavily infested soil at Half Moon Bay. One of the lines of cabbage tested remained completely free of the disease throughout the season despite severe damage to adjacent plantings of susceptible lines.

Crosses were attempted between the resistant cabbage and the best available strains of Brussels sprouts, and since these crops are interfertile, abundant seed was produced. The resulting hybrid —$F_1$—generation was also grown under conditions of heavy infection in 1953 and, like its cabbage parent, was found to be completely free of clubroot symptoms. This hybrid is intermediate between the two parents in such vegetative characteristics as height of stalk, development of axillary buds, and size and shape of leaf.

Having gained this evidence of dominance of clubroot resistance, the $F_1$ hybrid was backcrossed to Brussels sprouts. These crosses were again successful in

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## liquid drop valve for transplanters conserves chemicals and setting water

**Norman B. Akesson and Ralph R. Parks**

**Experiments** in San Mateo County showed that a metered amount of a mercuric chloride solution applied—by hand—to the roots of Brussels sprouts at the time of transplanting would control the clubroot disease sufficiently for an economic crop return.

A mechanical transplanter that would meter the liquid carrying the chemical accurately and rapidly to the immediate vicinity of the plant root would conserve both chemical and water and make possible large-scale treatment at a reasonable cost, but most mechanical transplanters discharge a continuous stream of water in the plant row. However, one type of machine in use does have a simple interrupted drop valve system. Work was started with this machine to develop a transplanter liquid drop valve which would meter the setting water solution. A simulated transplanter with a drop valve setup—using the simple gravity flow system—was made to provide a maximum of one pint liquid drop per second, which—when planting on 36″ intervals at about two miles per hour—is equivalent to 7.5 gallons per minute flow.

The source of gravity flow was a 55-gallon barrel lying on its side at about 30″ above the valve. Thus when the barrel is full, the head is 51″—21″ diameter—and when nearly empty, the head is 30″.

The flow of liquid through a hose with the various couplings, adapters—from hose coupling to pipe—and valves is shown for three sizes of hose in the graph on page 11. The hose lengths plotted are for 10′ plus the appropriate couplings to connect the hoses to ordinary pipe fittings. The couplings are the limiting orifice—smallest openings—in the system. Hose coupling to pipe adapters—nipple type—and gate-type valves of the same ID—inside diameter—as the hose, have little or no further flow restricting effect on the system. The table in the next column gives the ID sizes for various components to be used with the hose size specified. Connecting a ¾″ ID hose, for example, to a pipe by slipping the hose over a ½″—ID 16/32″—pipe

| Component | Nominal or identifying size | | |
|---|---|---|---|
| | ⅝″ | ¾″ | 1″ |
| | Actual ID inches | | |
| Hose | 20/32 | 24/32 | 32/32 |
| Hose coupling | 18/32 | 21/32 | 28/32 |
| Nipple type adapter, hose to pipe | use 3/4 size | 21/32 | 30/32 |
| Pipe size to which adapter connects | use 3/4 size | 26/32 | 33/32 |

would cause a drop in the flow because of the wall thickness of the pipe. A ¾″ hose coupling—21/32″ ID—should be used to maintain the flow.

The drop valve assembly was constructed with simple plumbing parts and a minimum of welded joints. No machining was necessary.

Rapid flowout properly timed to the transplanter is the essential aim of the system. This reduces the distance the material covers in the ground. For example, at two miles per hour, if the valve is open 0.53 second—equivalent to 1.5 pints of material flow—approximately 1.5′ of ground is covered, or on 3′ plantings one half of the row length is wetted. At 0.38-second valve timing—1.25 pints—about 1′ is wetted or only

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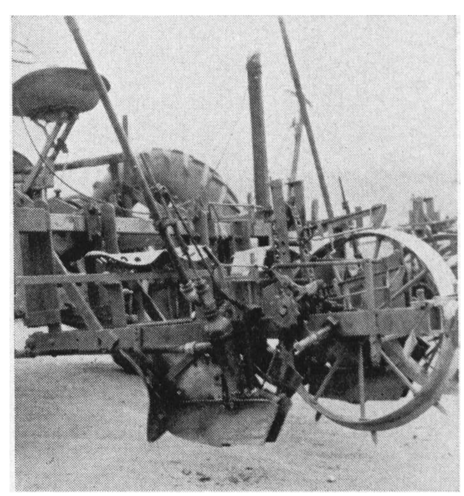
**Transplanter with drop valve installed.**



well as for the aforementioned horticultural characters, the latter varying between the extremes of Brussels sprouts and the $F_1$ hybrid. Approximately 1% of the plants was judged to be of excellent Brussels sprouts type, and 2% or 3% of acceptable type. Resistance seems to appear at random with respect to horticultural type, so that it was possible to select for further breeding certain symptomless plants that aproached the Brussels sprouts type.

Simultaneous with this work on Brussels sprouts, the initial crosses were made to transfer clubroot resistance to broccoli and cauliflower. Outbreaks of clubroot in areas of production of these crops have not been observed, but hybrid seed has been produced and placed in optimum storage conditions preparatory to the possibility that a need for breeding resistance in these crops might arise in the near future.

Progress up to the present time in developing strains of Brussels sprouts resistant to clubroot has been encouraging; nevertheless, the work has only begun and further development will depend upon the nature of inheritance of resistance, the success in maintaining a high level of infection in test plots, and other factors.

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*Donald Y. Perkins was Junior Olericulturist, University of California, Davis, when these tests were conducted.*

*Dr. J. C. Walker, of the University of Wisconsin, provided the strain of cabbage that was the source of clubroot resistance in this work.*

*The above progress report was based on Research Project 906F.*

## DROP VALVE

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1/3 of the row length. The valve should have sufficient capacity to hold the maximum drop required. The 6″ nipple, 2.5″ in diameter, plus the bell reducer, adequately handles the one-pint maximum specified for this job. Adequate venting to prevent air lock is necessary. This vent should be separated from the liquid feed line and raised sufficiently high to prevent liquid slopping over the top. Venting of the discharge tube from the valve with a short piece of pipe was found desirable.

The flow path past the valve and seat should be of uniform area for maximum flow with minimum parts size. When the cylinder ID is taken at 2.5″, the valve seat can be a 1.5″ × 2″ reducer bushing. This bushing has an ID of 1.75″ and an OD of about 2.5″. The rubber valve is cut to a scant 2″ ID to seat in the 1.75″ hole.

To check the entire system further, the complete mock-up, tank, hose, and valve were assembled and operated by means of an adjustable cam lift device. The cam was set to operate at 40 drops per minute—about two thirds of the original requirement of one drop per second—which at one pint per drop exacts a flow requirement of 5 gpm—gallons per minute. A 3/4″ hose system will allow a flow of about 6.2 gpm at 42″ head and 4.9 gpm at 27.5″ head. At this speed of one drop per 1.5 seconds—40 drops per minute—the flow was found to be about 1.25 pints per drop at 42″ head, and one pint at 27.5″, which is very close to the maximum flow rate of a 3/4″ system. A one-inch hose and connections would be needed for the original requirement of one drop per second—one pint per drop—7.5 gpm—at this head.

The cross guide should have 1/8″ clearance in the 2.5″ nipple and should also be free on the valve rod. The cross guide is essential to permit accurate seating of the valve. The valve itself was made from a No. 10 1/2 rubber laboratory cork cut to shape by drilling and bolting it on a short rod and cutting with a powered sander or coarse emery wheel on a lathe. The 30° faces seem to give the best results, being steep enough to seat easily without undue jamming.

The tube from the bottom of the valve to the planting area should be as short as possible, vented and made of light gage metal or conduit. It should be welded to the outside of the valve and not threaded into the seat which would reduce the effective discharge opening.

The mercuric chloride solution — added to the transplant water — is more or less corrosive to all metals, but if the liquid valve drop is assembled with grease—or nonhardening pipe compound—it can be easily taken apart for checking and cleaning. The machine should be flushed with clean water after each day's use, and at the end of the season the valve should be disassembled and oiled.

The metered liquid applied by the valve drop conserves water and chemicals—when added for disease control—and increases the efficiency of the transplanting operation.

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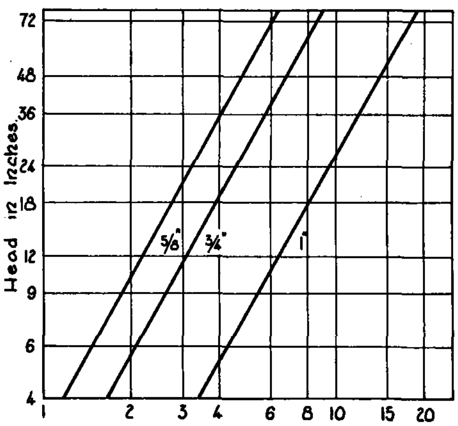
**Discharge**

**G.P.M. 10′ of hose and couplings.**




**Cross-section view of an improved transplanter liquid drop valve.**