'White Butterfly' to *X. campestris* pv. *syngonii* (Table 3). Although plant appearance differed among treatments (data not shown) sensitivity to the pathogen was not affected. Growth of these two organisms at different temperatures indicates that the two sets of isolates were different. This is also supported by two recently published reports of Syngonium blight from New York (2) and Florida (1).

Table 3. Effect of preinoculation light level on development of Xanthomonas blight of *Syngonium podophyllum* 'White Butterfly' in the greenhouse.

	Mean percentage of leaf area with symptoms[z]		
Light level ft-c.	Test 1 September 22	Test 2 June 4	Test 3 August 12
5000	14.5	80.0[y]	23.0
3500	17.0	72.0	19.4
2700	12.5	69.0	23.0
1600	24.0	70.0	16.5

[z]Means are given for ten plants per light level.

[y]Significant differences among treatments occurred in Test 2 only (analysis of variance P = 0.05).

Significance to the Nursery Industry

Because low temperature reduces syngonium blight disease severity, growers will be able to better control this disease by maintaining temperatures at less than 24°C (75°F) or higher than 30°C (86°F). Alternatively, bactericides can be applied during periods when the temperature is between 24 and 30°C (75 and 86°F). Since preinoculation light levels do not affect susceptibility, growers can produce plants at light levels optimum for plant production without increasing susceptibility to this bacterial pathogen.

Literature Cited

1. Chase, A.R., P.S. Randhawa and R.H. Lawson. 1988. A new disease of *Syngonium podophyllum* 'White Butterfly' caused by a pathovar of *Xanthomonas campestris*. Plant Disease 72:74–78.

2. Dickey, R.S. and C.H. Zumoff. 1987. Bacterial leaf blight of *Syngonium* caused by a pathovar of *Xanthomonas campestris*. Phytopathology 77:1257–1262.

3. McCulloch, L. and P.P. Pirone. 1939. Bacterial leaf spot of *Dieffenbachia*. Phytopathology 29:956–962.

A Dibble Fertilizer Applicator for Containers in Nursery Beds[1]

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Abstract

A machine to punch dibble holes in multiple filled containers and simultaneously to meter fertilizer has been designed, built and tested. The machine handles up to 12 containers at a time in beds 6 containers wide. Transported and powered by a tractor, this machine straddles the containers in a nursery bed. Alignment of the mechanism over the containers and the dibble operation itself are accomplished hydraulically. Force and speed of the dibbles are adjustable. Uniformity of metering is good, with coefficients of variation in the range of 2 to 3%.

Index words: dibble, fertilizer application, metering

Introduction

Research on placement of fertilizers in containers has given somewhat variable results. In one test, dibble application of Osmocote resulted in better plant growth than did incorporation for 4 cultivars of azaleas, and 2 hollies, and equal results with 3 other species (2). In another test comparing dibble application with surface application, surface application resulted in better growth for 3 cultivars of azaleas, but dibble application gave better results for 3 other species (3). In several cases, dibble application has given better growth than larger amounts of incorporated fertilizer (3, 4); however, in 2 tests with sulfur-coated urea, surface application gave better growth than dibbling or incorporation (1, 3).

Although dibble application does not consistently lead to improved growth, it can offer some operational advantages to the grower. Containers can be filled and placed weeks

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or months in advance of planting without the leaching losses that would occur with incorporation. Dibble application eliminates the possibility of fertilizer being washed out the tops of the containers during heavy rain—a problem that can occur with surface application.

Dibble application of fertilizer by manual means is labor-intensive and subject to human error in metering. An automatic device for metering precise amounts of fertlizer into dibble holes while the containers are on the potting machine has been developed and tested (5). Some growers, however, prefer to fill the containers with media and set the containers on the beds, coming back later to open the dibble holes and apply fertilizer. This procedure allows them to do the container filling and placement during slack times, then plant rapidly at the optimum time. A field machine is needed to speed up this operation, to reduce the manual labor required, and to meter fertilizer more precisely.

Materials and Methods

The basic design consists of a tractor-drawn machine which will straddle the beds of containers and punch dibble holes when stopped over rows of containers in the beds (Fig. 1).

Since the tractor driver is unlikely to be able to guide the machine closely enough to position the dibble punches exactly over the centers of the containers, provision is made for manually-controlled final alignment of the unit prior to punching. The dibble/fertilizer mechanism is mounted on a moving subframe with 2 degrees of freedom relative to the main frame of the machine. The subframe can be moved laterally or longitudinally through a range of about 0.3 m (12 in). The movement is accomplished hydraulically with two cylinders controlled by an operator walking beside the machine. These two degrees of movement allow exact alignment of the dibble punches over the centers of the containers. The tractor driver thus needs only to align the machine laterally within plus or minus 0.15 m (6 in) and stop within 0.15 m (6 in) of the desired point (Fig. 2).

The actual dibble opening is accomplished by a set of dibble punches mounted on a platen that is raised and lowered hydraulically. Interchangeable platens are used to accommodate different container sizes and arrangements. Either straight or staggered arrangements of containers can be used. The current prototype will handle beds up to six containers

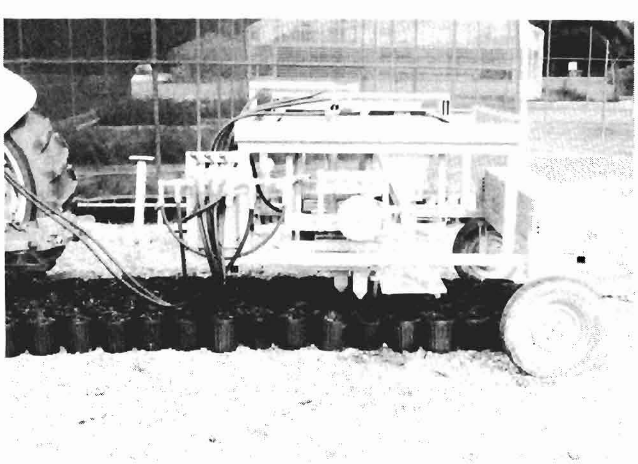

Fig. 1. **Overall view of dibble fertilizer applicator.**

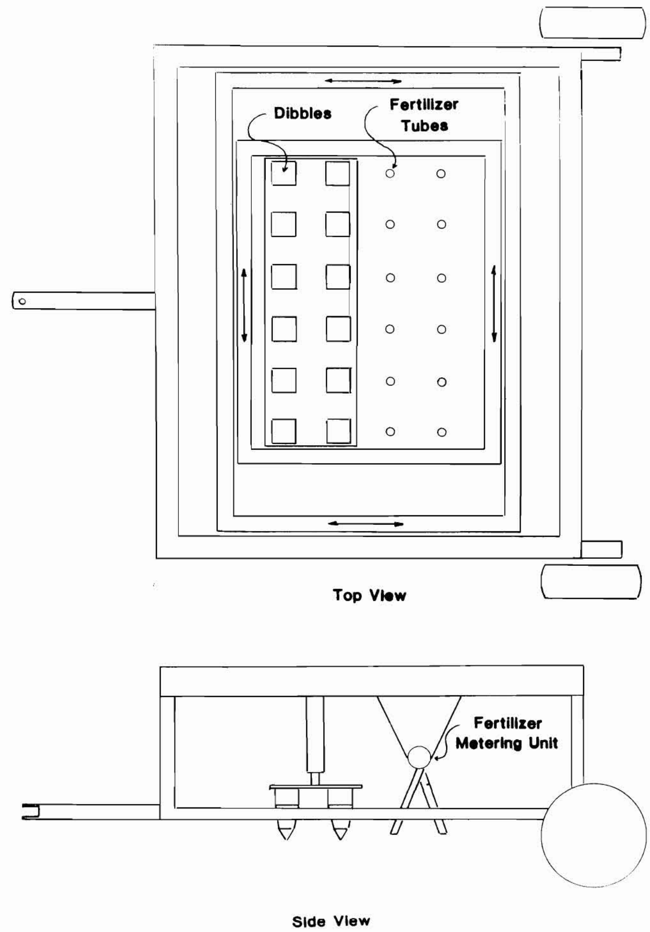

Fig. 2. **Schematic (top and side views) of moving carriage system and fertilizer metering systems.**

wide and will punch and fertilize two rows at once. The prototype unit will handle 17 cm or 19 cm (6.75-in or 7.5-in) diameter containers, for a maximum bed width of 1.14 m (45 in).

Initial height of the platen can be varied to handle different bed and container heights. Height adjustment is accomplished through the wheel mounting at the rear, and leveling the front with the tractor 3-point hitch. This system requires that the machine be attached to a 3-point hitch drawbar rather than to a fixed tractor drawbar.

A fertilizer metering unit is attached to the movable subframe (Fig. 2, 3). The fertilizer unit meters up to 12 charges at once, so that the same number of containers can be fertilized as are punched with each stroke. A cable attached to the dibble platen frame rotates a metering rotor in the fertilizer hopper 180 degrees for each stroke of the platen. This rotation drops a charge of fertilizer down each of 12 tubes. The tubes are mounted to the rear of the platen area. Although the fertilizer unit moves longitudinally and laterally with the subframe, it does not move vertically with the platen. The location of the drop tubes must be adjusted to match the container size and arrangement. A series of plywood templates are interchanged to hold the drop tubes in the correct position for each container arrangement.

The actual metering system consists of an ABS plastic rotor inside a stainless steel tube. Corrosion-resistant materials are used to reduce damage from the fertilizer. Metering cups are milled into the rotor. Rate changes are accomplished by changing rotors. The aluminum hopper is designed to allow easy emptying and clean-out through a door in the rear (Fig. 3).

The dibble opening and fertilizing are done in two separate but simultaneous operations. The platen moves down and opens holes in up to 12 containers. Simultaneously, the fertilizer system drops charges into the previous 12 containers that were punched on the last stroke. The machine is then moved ahead two rows and the process repeated. At the beginning of the bed, the fertilizer system is locked out while the first two rows are punched. At the end of the bed, an extra punch stroke is needed to fertilize the last two rows of containers.

A schematic of the hydraulic system is shown in Figure 4. An adjustable pressure relief valve is provided so that the operator can limit the maximum pressure applied to the containers. An adjustable flow restrictor is also provided so that the speed of hydraulic operation can be reduced. When the machine is used with a tractor having a high hydraulic flow capacity, operation of the cylinders is too fast for adequate control. Restricting the flow reduces the speed to an appropriate level.

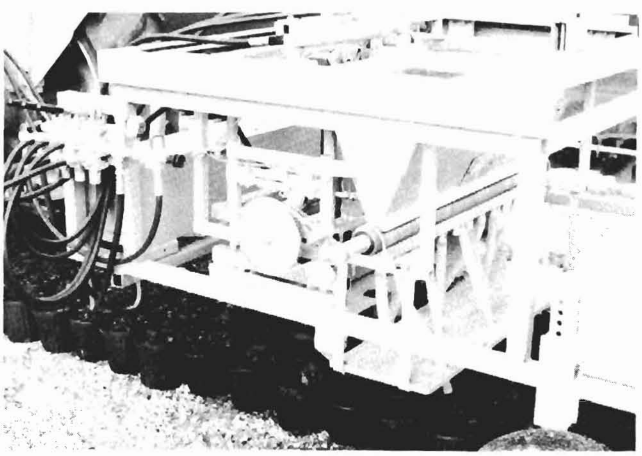

Fig. 3. Detail of fertilizer applicator triggering mechanism.

Results and Discussion

The prototype machine was constructed by the Agricultural Engineering Department, and laboratory tests were performed before field testing at the Burden Research Plantation, Baton Rouge, LA.

Two fertilizer materials were used for tests of metering uniformity, granular super phosphate and Osmocote 17N-3P-9.9K (17-7-12). Super phosphate was the standard fertilizer spreader test material used in the Agricultural Engineering Laboratory, and the Osmocote material was the primary material to be used in the field. The physical properties of the materials are shown in Table 1.

The fertilizer metering system was tested in the laboratory by collecting and weighing the discharge from each of the 12 tubes for 10 cycles. Metering was uniform in both the direction of travel and across the width of the machine. The coefficient of variation for the super phosphate was 2.7%, with a mean delivery rate of 31.2 g (0.069 lb). With Osmocote, the mean rate was 27.4 g (0.060 lb) and the coefficient of variation was 3.3%. The nominal (desired) rate in this case was 27.0 g, so the mean metering error was 1.5%.

Table 1. Sieve analysis of fertilizers used for testing.

	Percent retained on sieve	
Sieve size	Super phosphate	Osmocote 17-7-12
8	37.8	61.9
10	24.6	22.0
14	29.9	14.7
16	4.9	0.5
18	1.6	0.2
35	1.1	0.4
pan	0.2	0.2

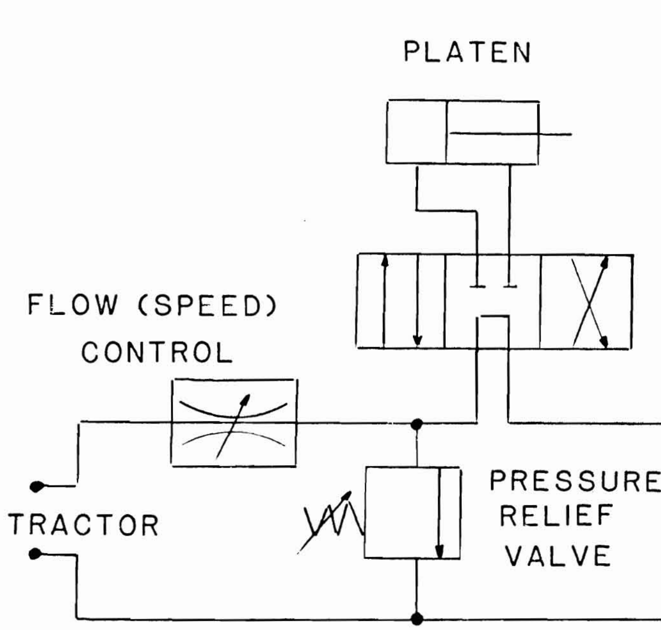

Fig. 4. Schematic of hydraulic system.

Field operation was evaluated by punching and fertilizing cans filled with moist composted pine bark potting medium. Initial testing showed the need for an improved dibble shape. The original dibble was shaped like the manually-operated dibble punch that had previously been used. That configuration was adequate for manual operation where the punch was slammed down at high speed, but was not adequate for the slow, steady travel of the hydraulic unit. A new dibble configuration with a longer taper and a sharp point was developed (Fig. 5). The low-speed force required to make an adequate hole with the new dibble was found to be approximately 50% of the force with the original dibble; 57 kg vs. 113 kg (125 lb vs. 250 lb).

Operation of the unit in the field with the revised dibbles was successful. Operation was easy, the dibble holes were well shaped, and fertilizer was metered consistently. The operating rate was estimated to be 10 seconds per cycle, or 72 containers per minute in beds 6 containers wide.

Significance to the Nursery Industry

The dibble fertilizer applicator constructed by the Louisiana Agricultural Experiment Station provides a precise way for nursery personnel to open dibble holes and meter fertilizer into containers after they are placed in the beds. The machine is versatile in that it can be adapted to a wide range of container sizes and spacings. The machine minimizes the operator skill required and also reduces labor compared to the separate manual operations of opening dibble holes and metering in fertilizer. The simple machine can be constructed by a small manufacturer or local fabrication shop. Precision of metering is very good.

The major problem with the system is the lack of uniformity in nursery beds. If the bed is not level, or if the containers are not precisely spaced, the dibble holes will vary in depth or location in the containers.

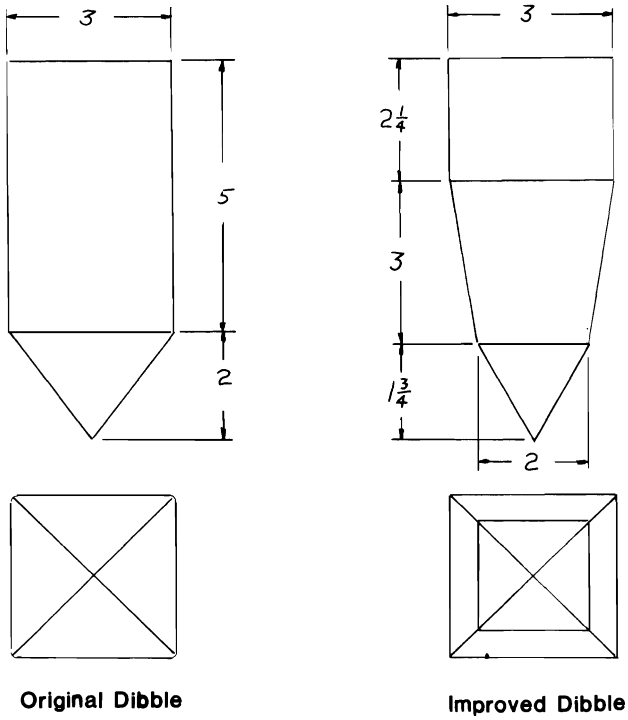

Fig. 5. Geometry of original and improved dibbles

Literature Cited

1. Cobb, G.S. and G.A. Holt. 1984. Fertilizer application techniques for container-grown woody ornamentals. Proc. Southern Nur. Assoc. Res. Conf. 29:35–39.

2. Meadows, W.A. and D.L. Fuller. 1983. Relative effectiveness of dibble applied vs. incorporated Osmocote for container-grown woody ornamentals. Proc. Southern Nur. Assoc. Res. Conf. 28:63–66.

3. Meadows, W.A. and D.L. Fuller. 1984. Plant quality and leachate effluent as affected by rate and placement of Osmocote and SREF on container-grown woody ornamentals. Proc. Southern Nur. Assoc. Res. Conf. 29:75–79.

4. Meadows, W.A. and D.L. Fuller. 1984. Osmocote rate and placement studies in transplanting one pint potted woody ornamental liners to 3 gallon containers. Proc. Southern Nur. Assoc. Res. Conf. 29:70–72.

5. Parish, R.L., R.J. Constantin, W.L. Brown and D.W. Wells. 1986. Automated fertilizer applicator for potting machines. J. Environ. Hort. 4:91–94.