and Crop Sci. Soc. Fla. Proc. 44:49–53.

7. Zazueta, F. S., A. G. Smajstrla and D. S. Harrison. 1984. Microcomputer control of irrigation systems. 1: Hardware and software considerations. *Soil and Crop Sci. Soc. of Fla. Pro.* 43:123–129.

UNIFORMITY ANALYSIS OF VARIOUS TYPES OF MIST PROPAGATION NOZZLES

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Abstract: Fourteen different types of nozzles were evaluated for mist propagation. Spacing recommendations are presented for 85 percent or better coefficient of uniformity under the nozzle. Growers can take this information to construct their own mist propagation beds.

REVIEW OF LITERATURE

Today several different types of mist nozzles are available for propagation. Stoltz *et al.* (2) evaluated 10 different types of nozzles used in propagation at that time. They expressed the common problem of wear, which results in larger particle size and increased flow rate. Since then a new line of durable hard-plastic nozzles has been introduced. The hard-plastic nozzles are less expensive and will not wear as fast as metal ones. Sumner and Gibson (3) evaluated seven nozzles used in mist propagation. Four were of durable plastic. Their findings indicate that these durable-plastic nozzles are fairly uniform for spacings tested.

MATERIALS AND METHODS

Fourteen different types of nozzles were tested. Table 1 lists nozzle types and their description. The information in parenthesis denotes nozzle orifice size (large to small). Nozzles were evaluated for uniformity by collecting water in one fluid-ounce containers in a straight line spaced at 6 in. intervals with the first located 6 in. from the nozzle. The nozzles were all mounted on 18 in. risers along with a pressure gauge to determine the pressure at the nozzle. Water collected in each container was then measured. Data was collected at pressure settings of 20, 40, and 60 psi. Droplet particle size was estimated by using water-sensitive paper. Droplets were measured with a hand lens using a known scale.

Table 1. Types of mist nozzles evaluated.

Number	Description	Type
1	Dramm Nifty (brown)	Deflection
2	Dramm Perfect (blue, grey)	Deflection
3	Eddy Mist	Deflection
4	Floral Mist (0.031, 0.020)	Deflection
5	Microjet (white, green, black)	Deflection
6	Naan 7102 Mister (white, green, black)	Deflection
7	Naan 7102 Mini Sprinkler (white, green, black)	Rotating
8	Rainbird Micro-Bird Spinner (orange, green, black)	Rotating
9	Rainbird Micro-Mister (orange, green, black)	Deflection
10	Rainbird CPR Series 360° (spray nozzle #4)	Deflection
11	Roberts Spot-Spinner (avocado)	Rotating
12	Roberts Spinner-Sprinkler (nozzle #2)	Rotating
13	Solcor 8000 HP Micro-Dan Sprinkler (blue, grey, violet)	Rotating
14	Solcor 7000C Micro-Dan Sprayer (blue, grey, violet)	Deflection

Data collected on nozzles' discharge uniformity was used to determine appropriate spacing of nozzles at that particular pressure setting. A uniformity coefficient (CU) was used (1) to give a numerical expression to serve as an index of the uniformity. This expression is defined by the equation:

$$CU = 100 \times (1.0 - \frac{X}{m \times n})$$

in which **X** is the deviation of individual observations from the mean value **m**, and **n** is the number of observations from the mean value. An absolutely uniform application is then represented by a uniformity coefficient of 100%, a less uniform application by some lower percentage.

RESULTS

On the days data was collected, temperatures ranged from 85 to 105°F. All nozzles were tested in enclosed environment. This alleviated the problem of excessive drift of mist due to wind.

Table 2 presents the recommended spacing, spray diameter, and uniformity coefficient for the nozzles tested. Uniformity coefficient was calculated for several spacings of each nozzle. The spacing of nozzles was determined for a CU starting at 85%. Any spacing less than the stated spacing will give a better uniformity coefficient. The spray diameter was the diameter of mist pattern collected. It is recommended that bed width should be at least 60 to 70% of spray diameter.

Table 2. Recommended spacing and spray diameters for nozzles.

Nozzle	Pressure (psi)	Spacing (ft)	Spray Diameter (ft)	CU (%)
Dramm				
Nifty (brown)	60	4.5	12.0	90.0
	40	4.0	11.0	90.7
	20	3.0	9.0	88.6
Perfect (blue)	60	6.0	24.0	89.5
	40	5.0	22.0	91.3
	20	4.0	17.0	88.3
Perfect (gray)	60	6.0	17.0	91.1
	40	3.5	12.0	87.6
	20	3.5	14.0	87.4
Eddy Mist	60	4.5	14.0	89.2
	40	4.0	13.0	90.0
	20	3.0	12.0	91.5
Floral mist (.031)	60	2.5	8.0	92.2
	40	2.5	5.0	90.0
	20	2.5	5.0	89.0
Floral mist (.020)	60	2.5	6.0	89.0
	40	2.5	6.0	88.7
	20	1.5	5.0	99.0
Microjet (white)	60	4.5	19.0	93.4
	40	4.0	17.0	90.1
	20	3.5	15.0	86.5
Microjet (green)	60	3.5	12.0	86.7
	40	2.5	11.0	91.2
	20	2.0	10.0	96.0
Microjet (black)	60	3.0	8.0	89.2
	40	2.5	8.0	85.5
	20	2.0	7.0	92.0
Naan				
7102 Mister (white)	60	4.5	16.0	87.4
	40	5.0	15.0	95.2
	20	4.0	13.0	87.0
7102 Mister (green)	60	4.0	12.0	90.4
	40	3.5	11.0	91.5
	20	3.0	9.0	96.4
7102 Mister (black)	60	3.5	14.0	92.6
	40	3.0	13.0	91.8
	20	3.5	12.0	99.3
7102 Mini Sprinkler (white)	60	10.0	27.0	83.0
	40	9.5	27.0	81.0
	20	6.0	26.0	83.0
7102 Mini Sprinkler (green)	60	9.0	26.0	79.8
	40	9.0	25.0	85.6
	20	6.5	24.0	87.4
7102 Mini Sprinkler (black)	60	6.5	23.0	77.5
	40	7.0	22.0	70.0
	20	6.0	19.0	53.0

Nozzle	Pressure (psi)	Spacing (ft)	Spray Diameter (ft)	CU (%)
Rainbird				
Micro-Bird Spinner	60	9.0	25.0	87.0
(orange)	40	10.0	27.0	90.4
	20	9.5	28.0	89.4
Micro-Bird Spinner	60	7.5	22.0	88.9
(green)	40	6.5	21.0	88.8
	20	5.0	21.0	93.0
Micro-Bird Spinner	40	5.0	12.0	90.4
(black)	40	5.0	11.0	90.0
	20	3.0	6.0	96.8
Micro-Bird Mister	60	3.0	18.0	89.9
(orange)	40	4.5	16.0	86.7
	20	4.0	13.0	90.6
Micro-Bird Mister	60	4.0	13.0	85.6
(green)	40	3.5	13.0	84.4
	20	3.0	11.0	89.6
Micro-Bird Mister	60	3.0	10.0	89.7
(black)	40	2.0	10.0	87.6
	20	2.5	8.0	97.6
CPR Series 360°	60	5.0	17.0	93.3
Spray Nozzle (#4)	40	4.0	16.0	84.0
	20	7.0	16.0	84.3
Roberts				
Spot-Spinner	60	4.0	21.0	89.2
(Avocado)	40	3.5	22.0	88.6
	20	2.5	24.0	58.0
Spinner-Sprinkler	60	5.0	23.0	90.4
(No. 2 Nozzle)	40	5.0	23.0	88.3
	20	8.0	25.0	91.1
Solcor				
8000HP Micro-Dan	60	15.0	34.0	85.8
Sprinkler (blue)	40	17.0	34.0	91.7
8000HP Micro-Dan	60	10.5	25.0	88.5
Sprinkler (grey)	40	8.0	24.0	88.7
8000HP Micro-Dan	60	6.0	21.0	83.1
Sprinkler (violet)	40	6.0	20.0	70.5
7000C Micro-Dan	60	4.5	19.0	89.8
Sprayer (blue)	40	3.5	18.0	92.8
7000C Micro-Dan	60	3.5	12.0	88.7
Sprayer (violet)	40	2.5	10.0	81.9
7000C Micro-Dan	60	3.5	12.0	88.7
Sprayer (grey)	40	3.0	11.0	90.1

A mist is defined as a droplet size of 50 to 100 microns. A fine drizzle is classified as a droplet size of 80 to 150 microns. For propagation, a particle size of 50 to 150 microns is desirable. Data for each of the nozzles tested, giving the droplet size range (microns), and the majority of droplets produced by the nozzle at the stated pressure, is available from the author.

DISCUSSION

All nozzles except Rainbird Micro-Bird Spinner, Rainbird CPR Series 360°, and Roberts Spot-Spinner produce acceptable particle size and distribution. These nozzles would be appropriate for irrigation only. The Dramm Nifty (brown), Eddy Mist, Microjet (white), Naan 7102 Mister, and Solcor 7000C Micro Dan sprayer performed exceptionally well at around 40 psi. The Rainbird Micro-Bird Mister (orange, green) and Roberts Spinner-Sprinkler (No. 2) also gave good results at a higher pressure of 60 psi. All other nozzles would be appropriate for mist propagation with spacing recommended.

LITERATURE CITED

1. Sprinkler Irrigation Association, 1975. Sprinkler Irrigation. *4th edition.*
2. Stoltz, L. P., L. N. Walker, and F. A. Duncan. 1977. Mist nozzles. *Proc. Inter. Plant Prop. Soc.*, 27:449–454.
3. Sumner, P. E. and J. D. Gibson. 1985. Uniformity analysis of various types of mist propagation nozzles. *Proc. SNA Research Conf.* 30: 176–170.

MASS PRODUCTION OF TREES IN GRO-BAGS

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Thorobred Trees produces trees in root-control, field-grow containers on approximately 100 acres in north central Florida. We have been container growers of plants and small trees for 13 years. For the last three years, we have planted approximately 80,000 trees in Gro-bags, 14-, 18-, and 24-inch. We are growing around 35 cultivars of trees for landscape use in the southeastern United States.

Early in 1983 after hearing Dr. Carl Whitcomb present a program on field growing in root-control containers, we decided to try some for ourselves. We planted 1200 trees in 14- and 16-in. Gro-bags. We planted some in our potting soil mix consisting of pine bark, native peat, and coarse sand; some in a blend of potting soil and native sand, and the majority in just native sand. In the first winter the 1983 Christmas freeze devastated about 30% of our container stock, but we had no damage or loss in our bag tree area. The trees planted in native sand grew off much better than the others.