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Propagation of *Euphorbia esula* L. for leafy spurge biocontrol agents

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Leafy spurge biocontrol agents presently require live plant material to complete their life cycle in the greenhouse. To mass rear insects, the optimum leafy spurge growing conditions in the greenhouse must be determined. The purpose of this research was to determine the optimum temperature, fertilizer rate and timing of application, growth media, and water quality to maximize leafy spurge shoot and root growth.

The plants were propagated by cutting 65 to 75 mm of stem from the apex portion of the plant. All but the upper 4 to 5 leaves were stripped from the stem. Then cuttings were dipped into 0.2% powdered NAA and planted into conical tubes (1.5 inch in diameter by 8 inches long) containing a mixture of peat and perlite. The plants were misted for 10 days. Then the plants were selected for uniformity prior to each experiment.

The plants were harvested and stem height, diameter, and dry weight were determined 36 days after treatment. An electronic caliper was used to measure the stem diameter about 20 mm from the stem cut. Roots were carefully washed to remove soil, and root diameter and dry weight were determined. The diameter of the largest true root and not the callus of the stem was measured. Each experiment was repeated.

Leafy spurge growth at 20, 23, 27, and 30° C was determined in separate greenhouses. There were 24 plants per treatment. The stem height and dry weight increased as temperature increased but root growth declined (Table 1). Root dry weight averaged 240 mg/plant at 20° C compared to only 190 mg/plant at 30° C. The optimum growth of both shoots and roots was 27° C and plants in all subsequent experiments were grown at this temperature.

Watering plants with tap or distilled water generally did not affect growth, although shoot dry weight was higher when tap water was used (Table 1). Plants were watered with tap water in all subsequent experiments.

For the two fertilizer experiments, water-soluble commercial fertilizer mixtures of 23-19-17, 15-30-15, and 36-6-6 were used. Each fertilizer was applied at 0, 100, 200, 400, 800, and 1600 lb N/A (100 lb/A equals 12.8 mg N/plant) in the rate study. No plants grew when fertilized at 1600 lb/A (Table 1). There was an increase in shoot and root growth with all three fertilizer types up to N rate of 200 lb/A, then growth declined. The time of

application study consisted of three fertilizers applied either 100 lb N/A once at the beginning of the experiment, 50 lb/A twice (at the beginning and 2.5 weeks later) or 20 lb/A weekly. All plants except the control received 100 lb N/A by the end of the experiment. Plant growth was similar regardless of the timing of application (Table 1).

Table 1. Effect of temperature, water source, nitrogen rate, timing of nitrogen application, and potting media on leafy spurge growth in the greenhouse.

Growth parameter	Height	Shoot diameter	Dry weight	Root diameter	Dry weight
Temperature	(mm)	(mm)	(mg)	(mm)	(mg)
(C)					
20	87	1.2	160	1	240
23	88	1.2	150	0.9	200
27	100	1.3	210	0.9	230
30	109	1.3	210	0.9	190
LSD (0.05)	10	0.1	21	0.1	23
Water source					
Tap	130	1.4	290	0.9	220
Distilled	130	1.3	230	0.8	200
LSD (0.05)	NS	0.1	31	0.1	NS
Nitrogen rate					
(lb/A)					
0	80	1.3	170	0.7	180
100	170	1.8	450	1	310
200	190	1.9	530	1	310
400	180	1.8	490	1	240
800	85	1.7	170	0.3	80
1600	0	0	0	0	0
LSD (0.05)	27	0.2	78	0.1	48
Timing of N application					
(lb/A)					
0	60	1	90	0.8	80
100 once	160	1.7	450	1.1	360
50 twice	160	1.6	470	1.1	350
20 weekly	160	1.6	450	1.1	360
LSD (0.05)	14	0.1	49	0.1	79
Potting media					
Potting soil	180	1.7	490	1.0	330
Sunshine mix	150	1.4	360	0.9	290
Sand	80	0.9	150	0.7	140
Peat moss	0	0	0	0	0
LSD (0.05)	22	0.2	56	0.2	48

The effect of media on leafy spurge growth was determined using a commercial potting soil mix, a peat and perlite mixture (Sunshine Mix No.1, Fisons Western Corporation, Downers Grove, IL), sand, and peat moss. All plants were fertilized weekly with a 15-30-15 fertilizer at 20 lb N/A. The plants in sand were kept in the mist chamber during the entire experiment but did not grow vigorously. No plants grew in the peat moss. The

plants growing in potting soil were taller with more shoot and root biomass than those in the peat and perlite mixture (Table 1). The cost of the soil was approximately 2.8 cents/tube compared to 1.4 cents/tube with the peat and perlite mixture.

In summary, the leafy spurge plants grew best in the greenhouse at 27°C with 200 lb N/A and in a potting soil mixture.