

*Reprinted with permission from: 1987 Leafy Spurge Annual Meeting. Fargo, North Dakota. July 8-9, 1987. pp. 30-34.*

*Published by: Great Plains Agricultural Council: Leafy Spurge Symposium.*

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## **Problems with artificial media for greenhouse plants of leafy spurge**

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Leafy spurge plants have been grown and maintained in greenhouses of the Metabolism and Radiation Research Laboratory for eight years. Some of the same accessions have been maintained for the entire duration by occasional transplanting of roots, or by taking apical portions of vigorous shoots and transplanting them after they have rooted. This study was undertaken to determine if there were other media that would be more appropriate and perhaps more convenient to maintain plants for experiments requiring large numbers of uniform plants.

Plants were grown in a variety of potting media for several months to determine those that will give optimum growth of uniform plants for experimental purposes and for the long term maintenance of plants under greenhouse conditions. All plants were obtained from apical cuttings of a single accession: 1978 MI 001 collected in Michigan. Ten cm long cuttings were rooted in vermiculite watered with 1/4 strength Hoagland's nutrient solution with chelated iron. Then they were transplanted to several media (Table 1) in 10 cm plastic pots, placed into stainless steel trays and watered as needed with the same nutrient solution. Eight plants were used per treatment. When the plants were large enough, five plants were selected and transplanted to 18 cm plastic pots to the same medium and to different media. The media tested were: vermiculite (Terralite<sup>®</sup> horticultural grade), Sunshine Mix (a commercial mixture of limestone and sphagnum moss), soil (a mixture of 3 parts sandy loam soil and 1 part peat moss), washed sand, or to a mixture of Sunshine Mix and the soil (50% of each v/v). In the last experiment a second source of Sunshine Mix was included to compare to the Sunshine Mix used in the previous experiments. Plant growth was monitored by measuring plant height and counting the number of stems per pot. At the time of transplanting to the various media, the shoots were cut off and weighed. The roots were then tested for subsequent growth from already developed subterranean buds and newly formed buds. Growth was monitored again, shoots were cut off once more and new stems developed. At the end of the experiments the roots and newly grown stems were weighed separately, the number of shoot buds on the roots was determined, and the plants were discarded. Measurements of pH of the nutrient media in which the plants were grown were taken weekly for a one month period during the second experiment.

Cuttings grown in Sunshine Mix (SM) or a mixture of soil/SM (50% each, v/v) initially grew about as well or better than those cuttings grown in vermiculite, soil or sand (Table 1). The cuttings grew fairly uniformly in the various media. However, upon sub-

sequent transfer to the same or alternate media, some obvious differences appeared; cuttings transferred from Sunshine Mix or to 50% soil/SM grew noticeably poorer than the other plants in two out of three experiments (Tables 1 to 3). Plant heights, numbers of stems, shoot and root fresh weights and numbers of root buds were all reduced significantly in this treatment, compared to plants maintained in vermiculite (which generally gave the most vigorous growth of all the treatments). Variations in the data were often large; standard deviations ranged from 2% to 83% of the mean values, with the great majority being less than 50% of the mean values.

The results of the second experiment were more complex because all plants transplanted to Sunshine Mix or the 50% soil/SM grew very poorly initially. They died when they were clipped off for the regrowth test. Other treatments that grew poorly in this experiment were: (a) plants in vermiculite transplanted to soil, to sand, and to the 50% mixture; (b) plants in Sunshine Mix transplanted to all other media; (c) plants in soil transplanted to soil, to sand and to the 50% mixture; (d) plants in the 50% mixture transplanted to Sunshine Mix, to soil and to sand. Therefore, it appears that the plants were generally less vigorous than in the first experiment.

In the third experiment, the results were even more variable and difficult to interpret. In this case the only plants that grew well upon transplanting were those grown in vermiculite for the entire experiment. Most of the plants grew poorly after they were transplanted into the various media. A large number of them died. The vermiculite-grown plants had shoots that averaged 59 cm high with 9 tillers, shoot fresh weight of 43 g, root fresh weight of 39 g and 150 buds on the roots (Table 3). However, even one of these plants died after the last transplanting. In comparison, plants grown in all other media were reduced in all parameters, and dead plants were observed in all but three of the treatments.

Part of the reason for the poor growth in Sunshine Mix may have been due to the lower pH, which was measured weekly over a one month period during the second experiment. The pH in Sunshine Mix ranged from 5.9 to 6.4, whereas the pH of the vermiculite ranged from 6.1 (initial) to 8.4. The pH ranges of the other media were: 6.3 to 6.7 for soil, 6.3 to 6.8 for the soil-Sunshine Mix, and 7.0 to 7.4 for the sand. This aspect has not been pursued further.

## Conclusions

Vermiculite watered with Hoagland's nutrient proved to be the best medium for growing leafy spurge plants when they were grown as described above. Other media (such as Sunshine Mix) initially looked good, but upon subsequent transplantings growth was poor. The initial vigor of the shoots may have occurred at the expense of the root system, so that subsequent transplantings may have had a root system that was not developed enough to withstand the shock of transplanting. Perhaps the vigor of the cuttings obtained from this accession diminished with time. The reasons for the loss of vigor of the plants with time are unknown, although it is possible that the time of the year in which the experiments were run may have had a greater influence on the growth than anticipated. The first experiment was run during the summer of 1986 when leafy spurge in

the field is growing luxuriantly. The second experiment was in the fall, and the third one was during the winter. Although they were all under somewhat controlled environments (greenhouse), the light, temperature and day length were not identical. The plants maintained in vermiculite were generally in better condition than the others in all three experiments, although one plant died even in that medium in experiment 3. Perhaps the stems were cut off too soon after transplanting to allow sufficient vigor to develop, especially for plants grown during the winter months (experiment 3).

In general, the Sunshine Mix appears to be a poor medium for continued maintenance of leafy spurge plants; bud development on the roots was particularly poor on those plants maintained in that medium with or without the addition of soil.

**Table 1. Growth and development of leafy spurge plants grown in various media and transferred to the same or different media. Cuttings were obtained from shoot apices grown in vermiculite and transferred to the same or different media on 6/26/86. The stems were cut off on 7/23/86 and the regrowth was measured on 10/19/86.**

Medium	Date, 1986									
	5/27	6/20	6/26	Growth to 7/23		Growth from 7/23 to 10/9				
	Stem	Stem		Avg.	No.	Avg.		Sht.	Rt.	
	Ht. <sup>a</sup>	Ht.	Trf. to	Ht.	Stems	Ht.	No.	FW	FW	No. Rt
	(cm)	(cm)		(cm)		(cm)	Stems	(g)	(g)	Buds
Vermic.	5.0	9.2	Vermic.	22	12	24	1.7	25	35	41
			Sunmix.	26	14	22	8	13	22	5
			Soil/peat	15	26	17	28	14	22	21
			50:50 <sup>b</sup>	28	20	15	13	10	14	2
			Sand	15	18	21	24	16	28	9
Sunmix	5.1	11.2	Vermic.	18	8	22	14	16	15	14
			Sunmix	22	4	10	2	3	3	1
			Soil/peat	16	16	17	19	11	17	8
			50:50	21	8	14	3	5	7	1
			Sand	13	11	17	14	11	23	13
Soil/ peat	5.2	6.7	Vermic.	18	6	21	11	16	14	6
			Sunmix	28	7	23	7	14	18	5
			Soil/peat	15	8	19	12	12	14	33
			50:50	26	10	20	11	14	18	6
			Sand	11	6	19	11	11	16	12
Sand	5.6	9.4	Vermic.	20	11	23	18	24	25	13
			Sunmix	25	14	19	7	12	18	4
			Soil/peat	12	12	16	19	14	18	23
			50:50	29	13	20	22	18	27	5
			Sand	22	10	20	18	15	28	42
Avg.	5.2									

<sup>a</sup>Abbreviations are: Ht. = height; Trf.=transferred; Avg.=average; No. = number; Sht.=shoot; Rt.=root; FW = fresh weight.

<sup>b</sup>Soil/Sunshine Mix (50% each).

**Table 2. Growth and development of leafy spurge plants grown in various media. Cuttings were obtained from shoot apices, grown in vermiculite and transferred to the same or different media on 9/4/86; cut back on 9/4/86 and 11/3/86.**

Date, 1986										
Initial Growth Medium	9/3	Trf. to:	Growth 9/4 to 11/3			Growth 11/3 to 12/22				
	Stem Ht. <sup>a</sup> (cm)		Avg. Ht. (cm)	No. Stems	Sht. FW (g)	Avg. Ht. (cm)	No. Stems	Sht. FW (g)	Rt. FW (g)	No. Rt. Buds
Vermic.	37	Vermic.	29	12	16	35	14	26	28	68
		Sunmix.	34	7	21	36	9	20	25	53
		Soil	19	9	3	21	4	5	9	24
		50:50	15	5	3	7	2	1	4	12
		Sand	16	8	3	12	3	1	11	31
Sunmix	41	Vermic.	15	3	4	9	3	4	4	5
		Sunmix	2	0	0.1	0	0	0	0	0
		Soil	11	5	2	12	3	2	5	14
		50:50	6	1	0.4	0	0	0	0	0
		Sand	14	5	4	6	3	1	8	18
Soil	28	Vermic.	33	5	10	31	6	14	18	38
		Sunmix	32	7	19	28	11	14	24	52
		Soil	19	6	3	21	4	5	8	19
		50:50	31	10	17	22	8	9	20	41
		Sand	21	6	6	18	3	3	10	9
50:50	34	Vermic.	19	6	9	16	7	10	12	18
		Sunmix	17	2	5	9	3	3	6	16
		Soil	9	6	1	8	4	2	5	9
		50:50	26	6	11	28	8	14	18	40
		Sand	7	2	1	3	0.2	1	2	3
Sand	27	Vermic.	28	3	7	36	5	14	11	26
		Sunmix	34	4	12	32	8	20	20	61
		Soil	15	6	2	24	5	9	13	31
		50:50	38	5	15	36	7	16	20	43
		Sand	14	2	1	19	2	3	4	11

<sup>a</sup>Abbreviations as in Table 1.

**Table 3. Growth and development of leafy spurge plants grown in various media. Cuttings were obtained from shoot tips, grown in vermiculite and transferred to the same or different media on 12/18/86; cut back on 1/21/87.**

Initial Growth Medium	Trf. to <sup>a</sup>	Growth 1/21 to 5/4/87					
		Avg. Ht. (cm)	No. Stems	Sht. FW (g)	Rt. FW (g)	No. Rt. Buds	No. Dead Plants
Vermic.	Vermic.	59	9	43	39	150	1
	Sunmix	23	3	6	9	88	3
	Soil	29	2	6	9	74	1
	50:50	37	4	9	10	46	1
	Sand	17	3	1	3	2	1
	SUSM <sup>b</sup>	23	3	4	5	20	1
Sunmix	Vermic.	13	2	2	3	4	2
	Sunmix	30	2	5	7	27	1
	Soil	24	3	6	9	59	0
	50:50	29	6	7	9	55	3
	Sand	18	3	2	4	4	1
	SUSM	34	3	8	7	21	3
Soil	Vermic.	17	3	2	5	8	0
	Sunmix	43	2	9	13	67	2
	Soil	23	33	5	7	34	2
	50:50	30	3	8	8	57	1
	Sand	9	5	1	2	1	2
	SUSM	25	2	5	6	31	1
Sand	Vermic.	20	2	4	7	7	1
	Sunmix	46	3	7	10	57	2
	Soil	27	3	5	6	55	1
	50:50	34	3	8	9	35	1
	Sand	15	3	1	3	4	3
	SUSM	16	2	1	3	11	0
50:50	Vermic.	6	1	0.1	1	1	3
	Sunmix	19	2	3	5	39	3
	Soil	26	2	4	8	48	2
	50:50	30	2	4	8	48	2
	Sand	14	2	1	3	0	4
	SUSM	8	1	0.3	0.4	0	3
SUSM	Vermic.	4	3	0.1	1	1	4
	Sunmix	21	1	2	3	22	4
	Soil	19	3	3	4	47	3
	50:50	0	0	0	0	0	5
	Sand	9	1	0.4	2	6	4
	SUSM	0	0	0	0	0	5

<sup>a</sup>Abbreviations as in Table 1.

<sup>b</sup>Sunshine Mix obtained from N. D. State Univ. Agronomy Dept.