Because of the importance of having a cost-effective commercial tissue culture method, with as few steps as possible, attempts are being made to establish plantlets out of culture using micro-cuttings directly from the proliferation medium. Using the pumice mix and high humidity tent, shoots dipped in 500 to 1500 mg/l IBA at exflasking had initially a lower survival rate than those undipped. Although some root development did occur, survival rates were greatly improved if IBA treatments were delayed for at least two weeks after exflasking. Root development also occurred in 20% of the plantlets which had not been dipped in IBA, indicating the IBA in the tissue culture medium may be contributing to this.

Studies based on the foregoing are continuing.

LITERATURE CITED

1 Ben-Jaacov, J and E Dax 1981. *In vitro* propagation of *Grevillea rosmarinifolia* *HortScience* 16(3)·309-310.

2 Gorst, J R , R A Bourne, S E Hardaker, A.E. Richards, S Dircks and R.A de Fossard, 1978 Tissue culture propagation of two *Grevillea* hybrids *Proc Inter Plant Prop Soc.* 28 435-446.

3 Mullins, M G , P Nixon, I Desailly and I.A. Stewart 1982 Development of the waratah *(Telopea speciosissima)* as a cut flower crop Univ. Sydney, Dept Agron. Hort Sci., Research Report 10

4. Mullins, M.G., P. Nixon, and I A Stewart, 1981. Development of the waratah *(Telopea speciosissima)* as an ornamental crop Univ Sydney, Dept. Agron Hort. Sci , Research Report 9

5 Seelye, J F 1983 Waratah — Micropropagation. N.Z. Ministry of Agriculture and Fisheries Agr Res Div Annual Report 1982-83: 176

6 Seelye, J.F. 1983. The rapid propagation of the NSW waratah Combined Meeting 8th Nitr Fix Workshop and 4th Biennial Meeting N Z IAPTC Palmerston North, N.Z., Abstract 47

VEGETATIVE PROPAGATION AND DEVELOPMENT OF *SOPHORA MICROPHYLLA* AIT.

STEPHEN M. BUTCHER and SHEILA M.N. WOOD

Horticultural Research Centre
Research Division
Ministry of Agriculture and Fisheries
Levin

INTRODUCTION

The genus *Sophora* is in the family Papilionaceae, and consists of about 30 species of temperate and subtropical trees and shrubs (1) of wide distribution. Three species are found in New Zealand, *S. tetraptera*, *S. prostrata*, and *S. microphylla*.

S. tetraptera, J.F. Mill is a small to medium-sized tree up to 10 m tall growing from sea level to 450 m. The leaflets are large (3 cm long) and the flowers, which appear in the spring — October and November, are large and pale yellow with wings longer than the standard. This species does not have a juvenile form and usually flowers in four to five years from seed.

S. prostrata J. Buchan is a low-land bush of approximately 0.5 to 2.0 m tall. It forms a low hummock with densely intertangled divaricated orange-brown rigid branches and bears small (25 mm) orange/yellow flowers.

S. microphylla Ait. is a small tree up to 10 m tall found from sea level to 700 m. It is the most variable and hardy of the three species. *S. microphylla* usually exhibits a juvenile non-flowering phase which has been reported to last up to 17 years when grown from seed. The juvenile plant forms a dense tangled bush with small leaves and is similar in habit to *S. prostrata*. The flowers are generally large and bright yellow with wings the same length as the standard which is distinctly notched at the tip. The flowering time is variable with some plants being in full flower in winter (June or July) while others are as late as early summer (November). Two varieties within *S. microphylla* are recognised.

S. microphylla var. *longicarinata* is a tree up to 5 m tall with 10 to 20 cm long leaves each having 20 to 40 pairs of leaflets. *S. microphylla* var. *fulvida* is a small tree (up to 3 m tall) with 8 to 10 cm long leaves bearing up to 50 pairs of small leaflets. Both varieties grow true from seed and do not exhibit the juvenile form.

S. microphylla shows greater potential than *S. tetraptera* for the selection of superior forms suitable for use as specimen trees, tub and pot plants, due to its wide diversity of form and flowering times, the brightly coloured flowers and the greater degree of hardiness. A collection of ecotypes of *Sophora* from around New Zealand (and one *S. microphylla* from Chile) was obtained from the Botany Division of the Department of Scientific and Industrial Research and established at Levin by the late Mr. G.N.J. Goldie (2). One type of *S. microphylla*, grown from seed collected from Stephens Island, exhibited particularly early flowering (May) and a dwarf habit (1.5 m tall after five years). Further seed was collected from Stephens Island and the subsequent trees planted in the seedling grove at Levin. This collection shows a high degree of variability in form, habit, and foliage colour. Selections of superior forms from the grove began in 1982.

Three early selections from the ecotype grove, now named 'Earlygold', 'Goldie's Mantle', and 'Goldilocks' have been released to the nursery industry. The cultivar, 'Earlygold' has been registered for Plant Variety Rights in New Zealand. This cultivar and its seed-grown progeny are being used as the basis for further breeding programmes including inter- and intra-specific crosses and the use of gamma irradiation.

The first requirement of a selection programme is the development of a method of vegetative propagation. Goldie (2) showed that several grafting methods, as well as cuttings, could be used to propagate *S. microphylla*. The cutting propagation method described proved to be difficult to implement on a commercial scale, since a low percentage strike rate was reported. Cutting propagation has been further investigated, using propagating conditions similar to those likely to be found in commercial operations. Flowering and control of plant form in containers has also been studied.

PROPAGATION

Experiment 1: Time of taking cuttings.

Method. Cuttings 15 cm long were taken from field-grown stock plants of 'Earlygold', 'Goldie's Mantle' and 'Goldilocks' at three or four week intervals from May, 1982 to June, 1984. The cuttings were stripped of their lower leaves, given a single wound, dipped in IBA/talc (Seradix 3) and inserted 3 cm into a 50.50 "Fibremix" bark:pumice medium in trays. The cuttings and tray were then drenched with a 1.5 g/l solution of Benlate fungicide before being placed under mist with 20°C bottom heat at the cutting base. The number of dead, callused, or rooted cuttings were counted after six weeks. Those cuttings that were callused but not rooted after six weeks generally rooted after 8 to 10 weeks. The trial design was a randomised block with five replications.

Results: The results for 'Earlygold', 'Goldie's Mantle' and 'Goldilocks' are given in Figures 1, 2, and 3, respectively. Approximately 100% rooting could be achieved using this system when cuttings were taken in winter — June, July, or August. Cuttings should be semi-hard and this is dependent on weather conditions. The drop in rooting percentage during the second season was probably due to a lack of suitable cutting material. This effect was particularly noticeable in 'Goldilocks'.

The results for the three cultivars were averaged at each propagation time and graphed against monthly weather data. While rooting appeared to be poorly correlated with day-length (Figure 4), it appeared to be well correlated with dry-

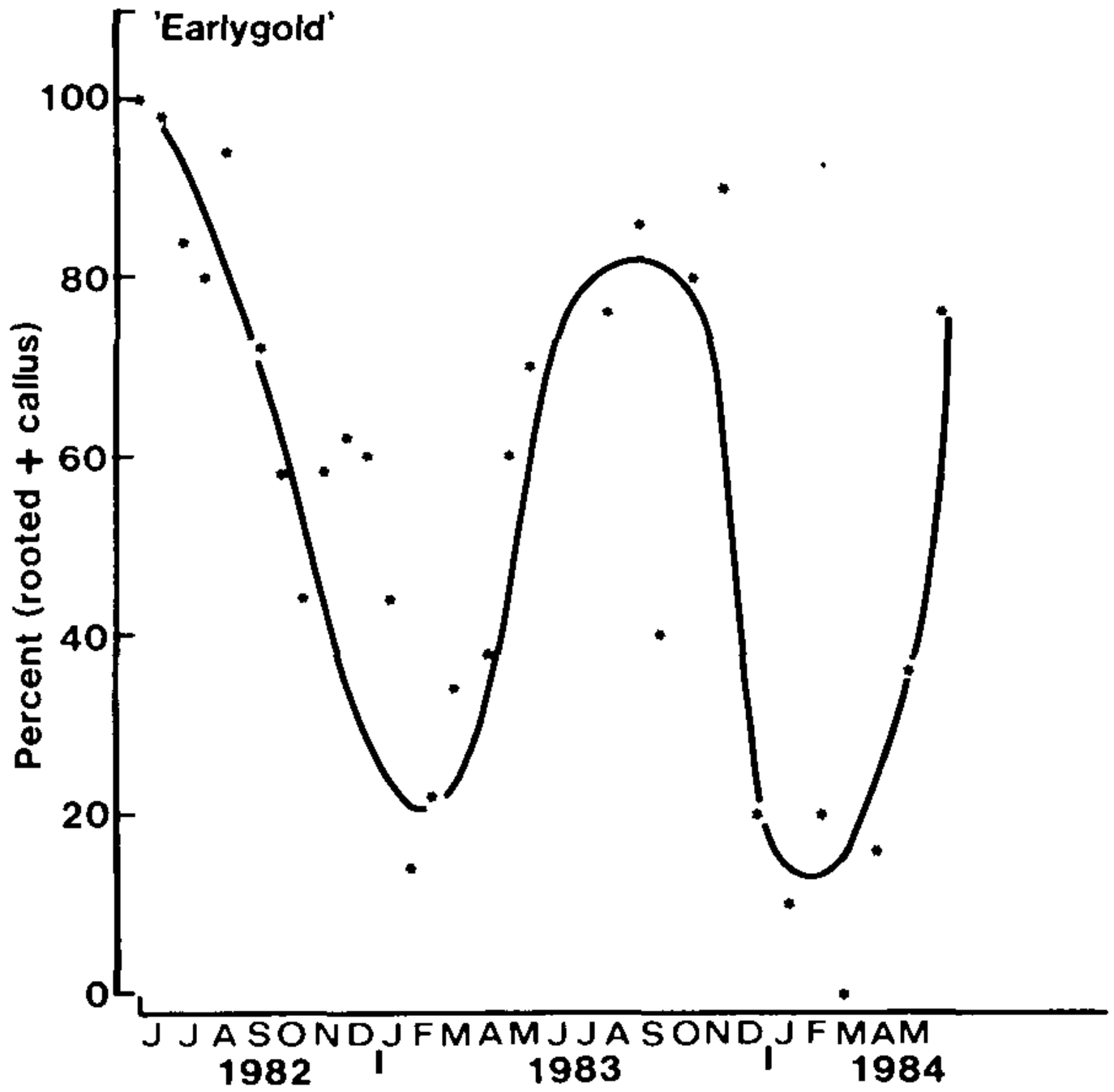

Figure 1. Percent rooted + callused cuttings of *S microphylla* 'Earlygold', versus time of taking cuttings

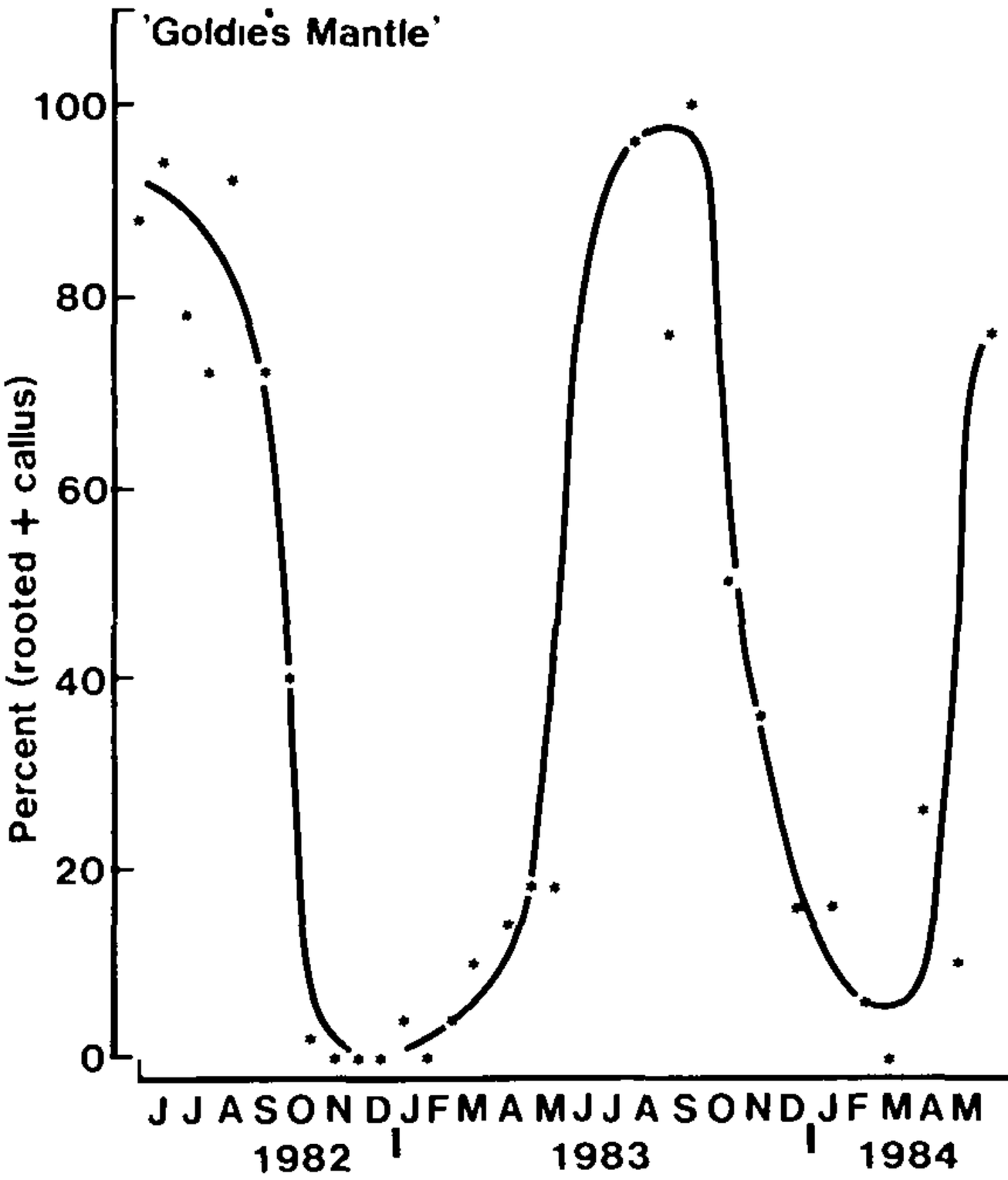

Figure 2. Percent rooted + callused cuttings of *S microphylla* 'Goldie's Mantle', versus time of taking cuttings.

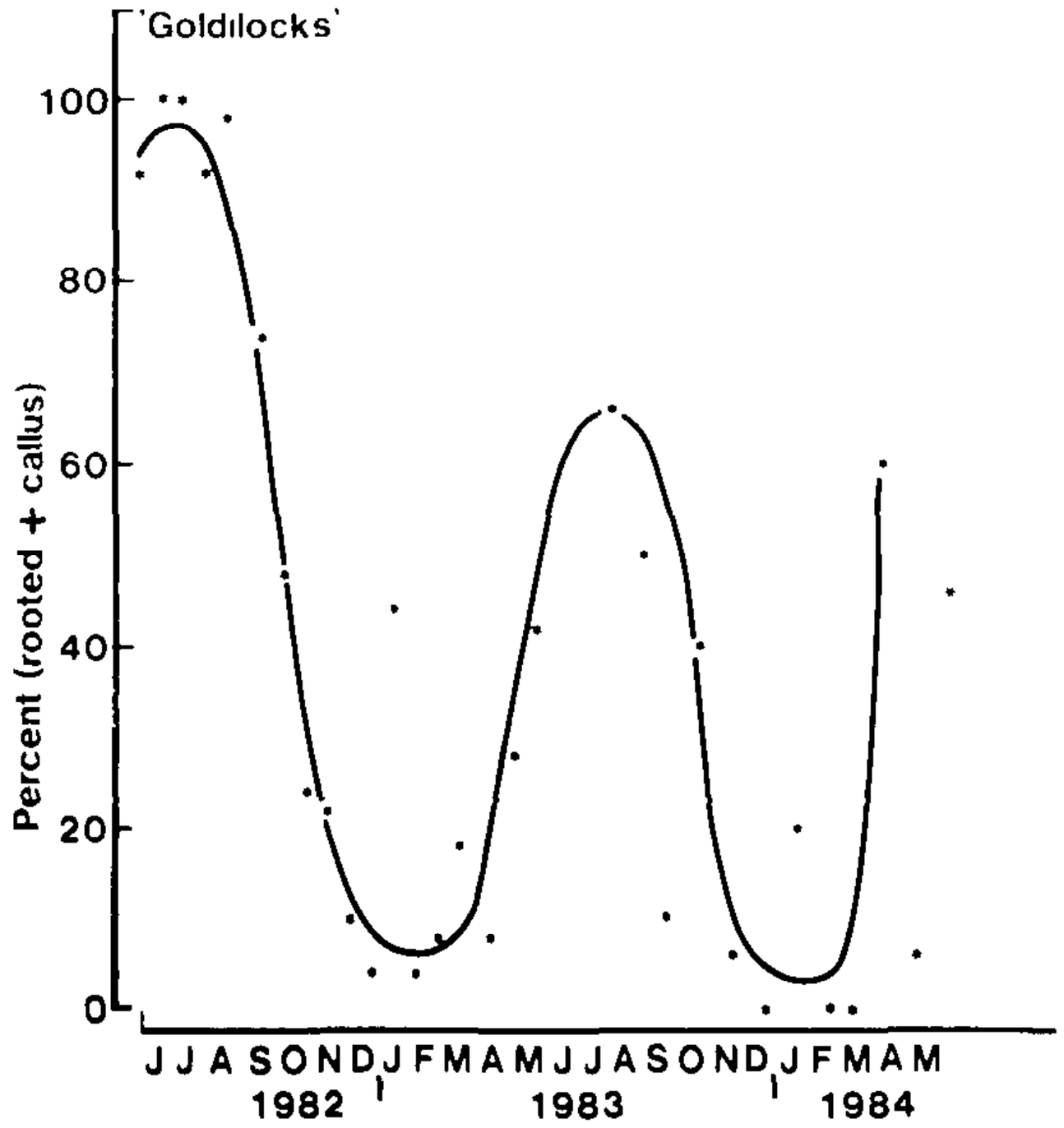

Figure 3. Percent rooted + callused cuttings of *S. microphylla* 'Goldilocks', versus time of taking cuttings.

bulb temperature (Figure 5), and the monthly total number of sunshine hours (Figure 6), but not with the monthly total radiation (Figure 7), or with open pan evaporation (Figure 8). Investigations are continuing with the aim of predicting periods of high propagatability.

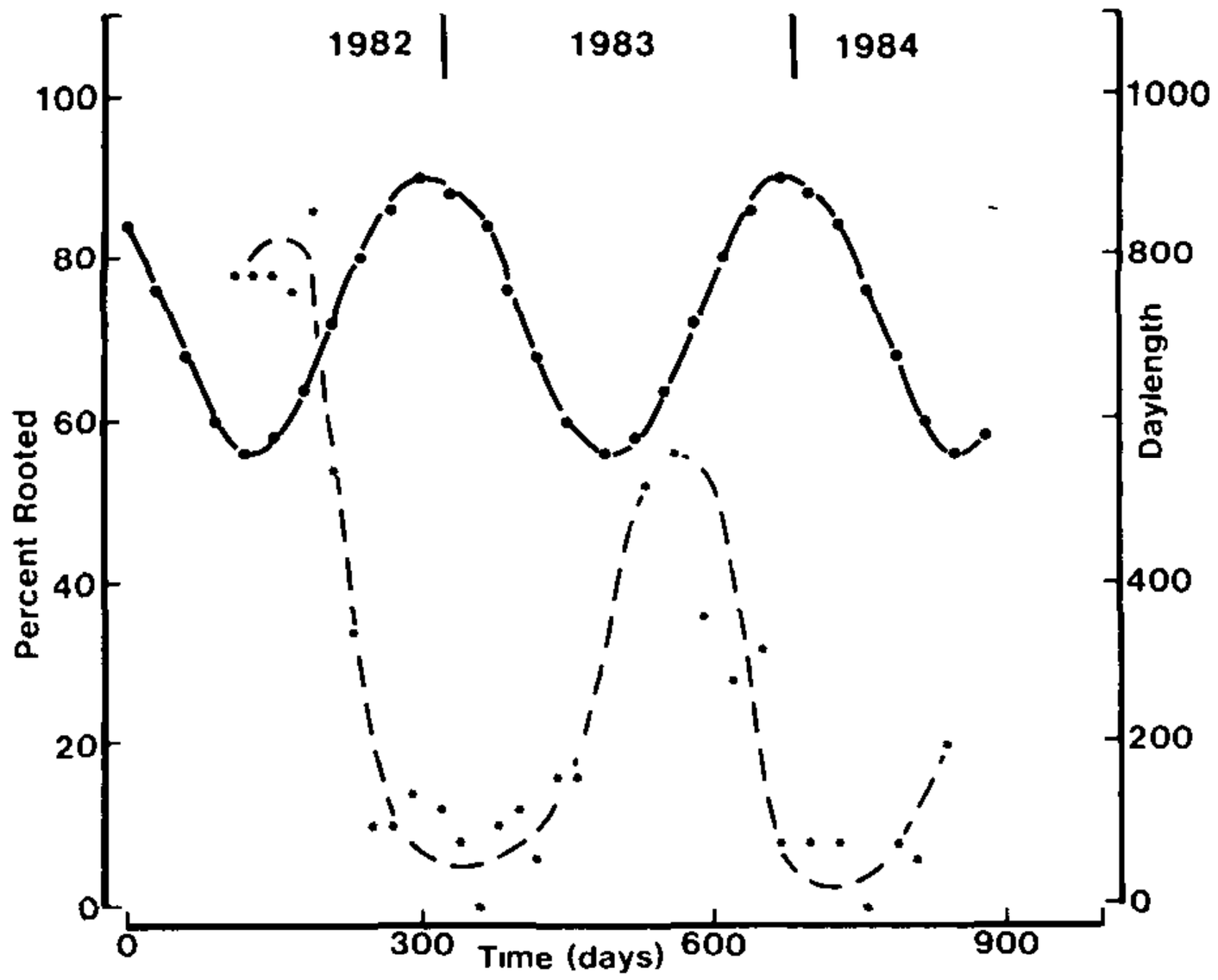

Figure 4. Percentage of *S microphylla* cuttings rooted and the day-length at Levin, versus time ● day-length, * percent rooted

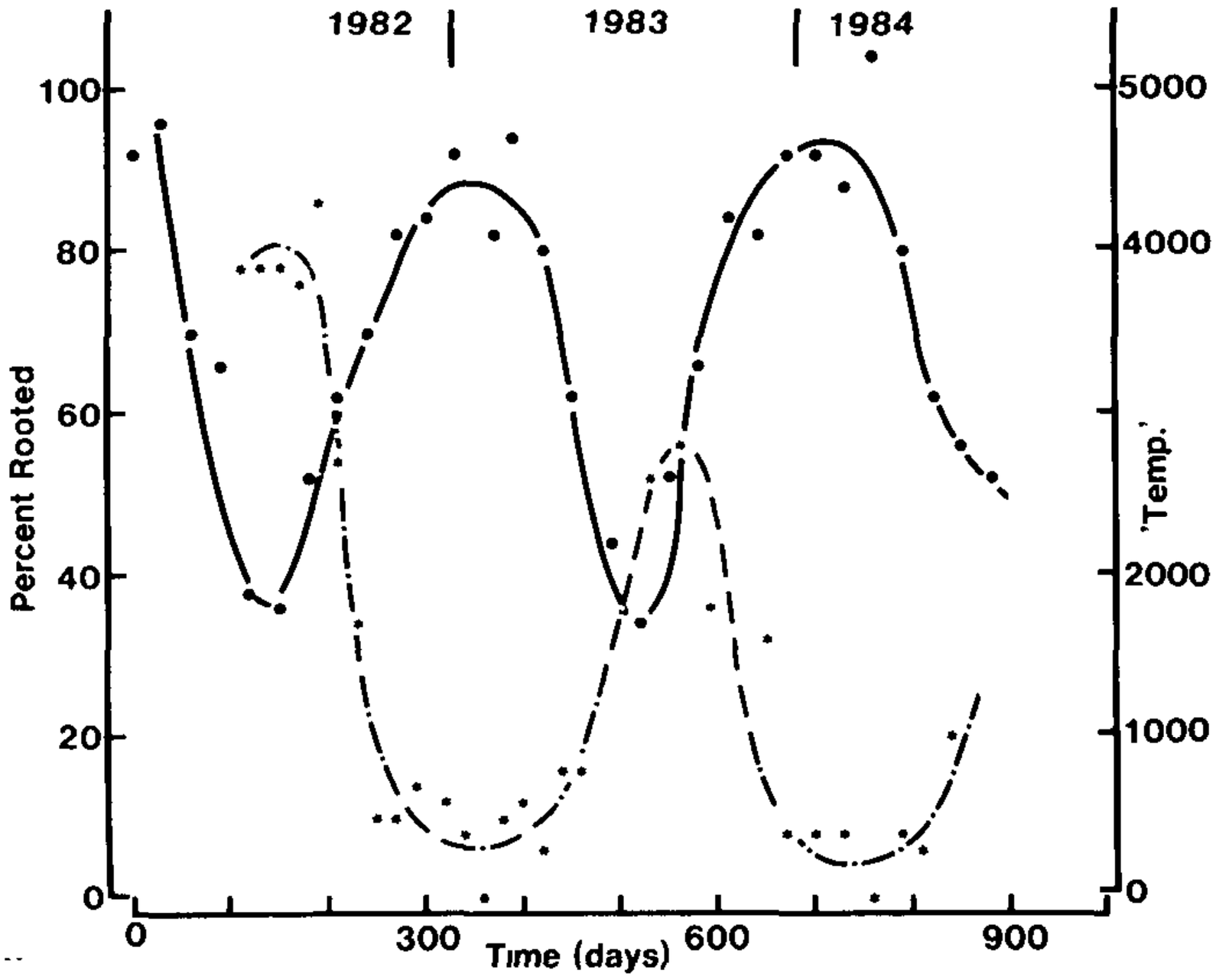

Figure 5. Percentage of *S microphylla* cuttings rooted and the dry-bulb temperature (monthly totals of the dry-bulb temperature reading at 9.00 a m every morning), versus time. ● dry-bulb temperature, * percent rooted

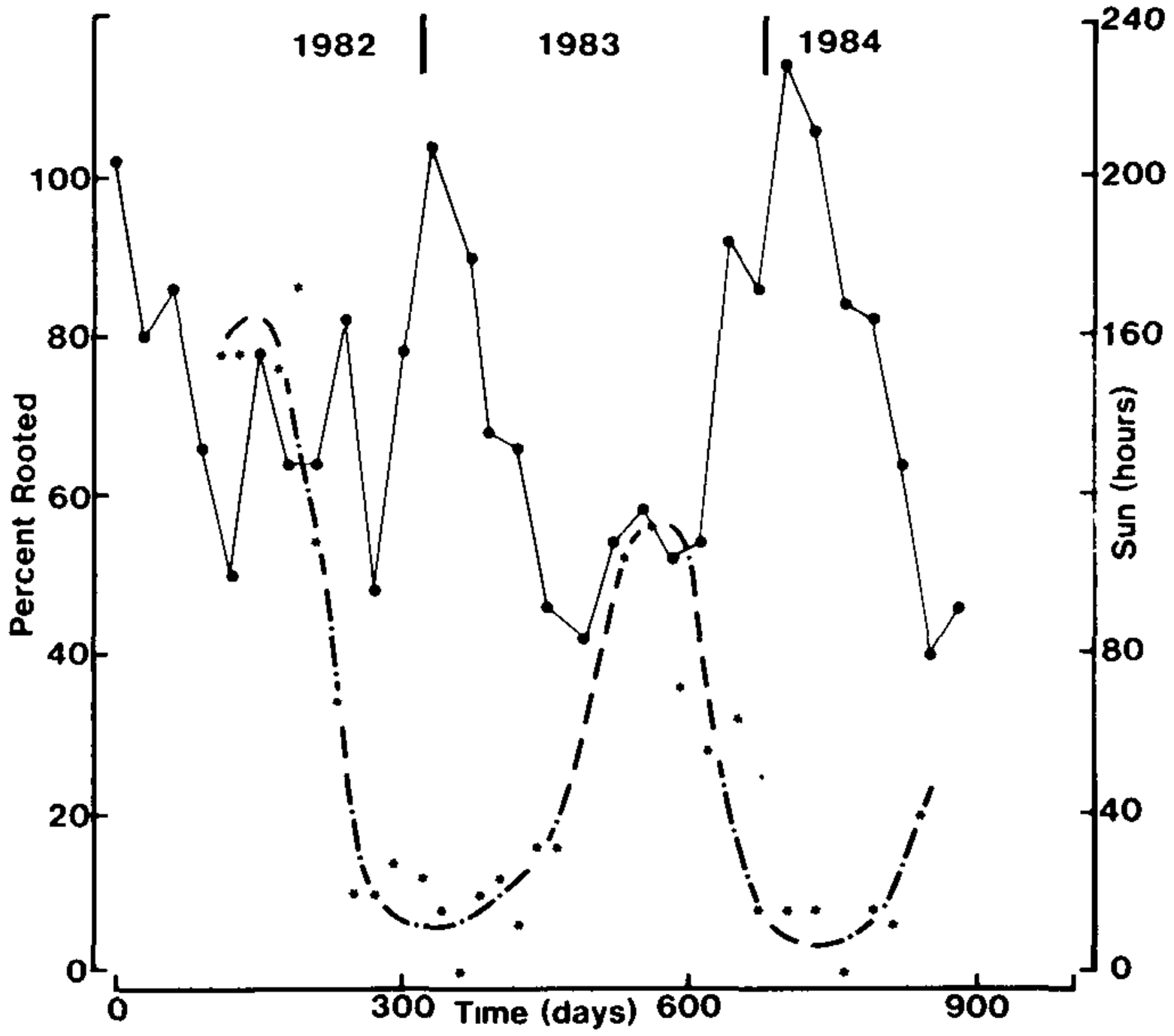

Figure 6. Percentage of *S. microphylla* cuttings rooted and the monthly totals of sunshine hours, versus time. ● monthly totals of sunshine hours; * percent rooted

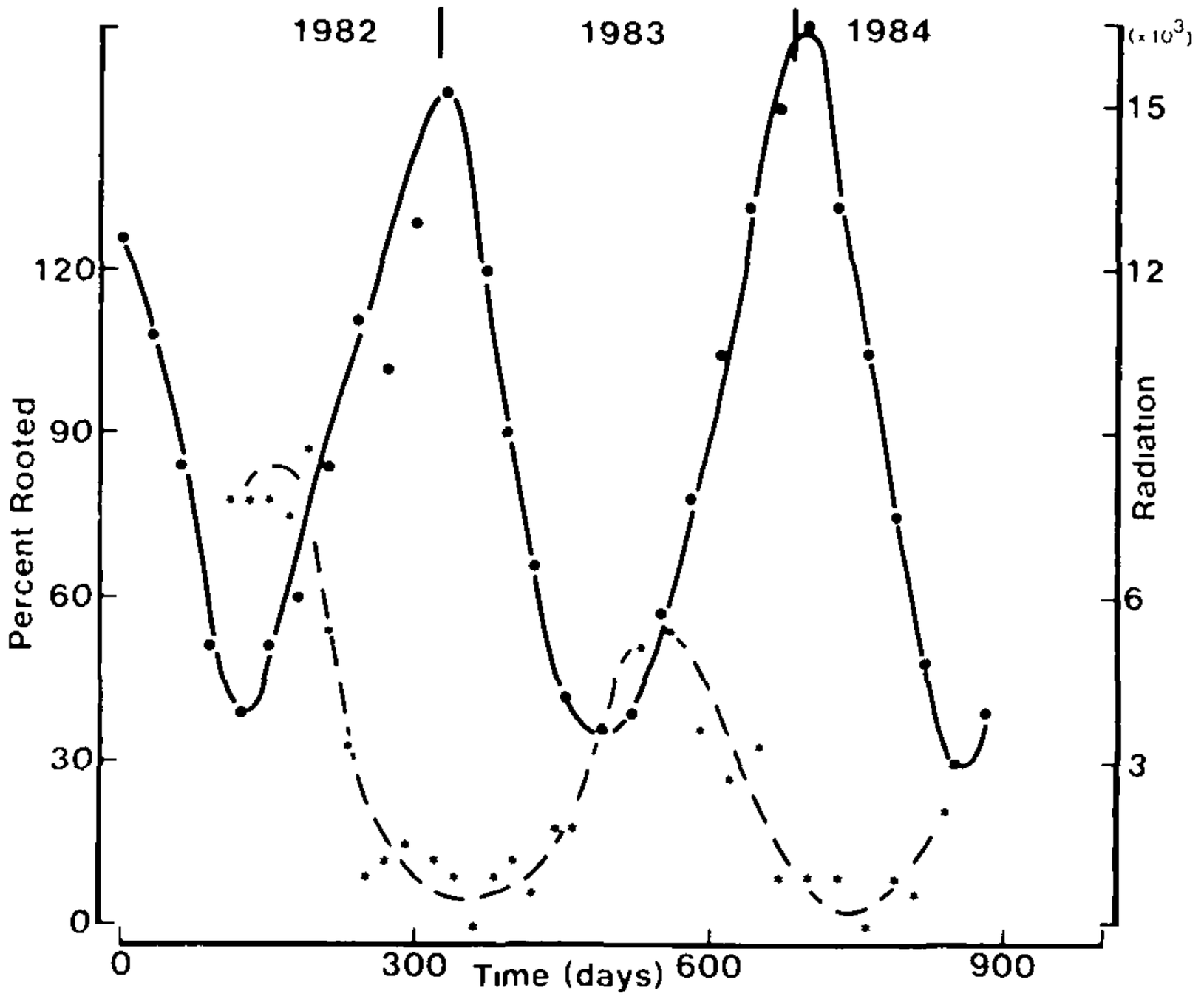

Figure 7. Pecentage of S *microphylla* cuttings rooted and the monthly total radiation levels (Langleys), versus time ● radiation totals, * percent rooted

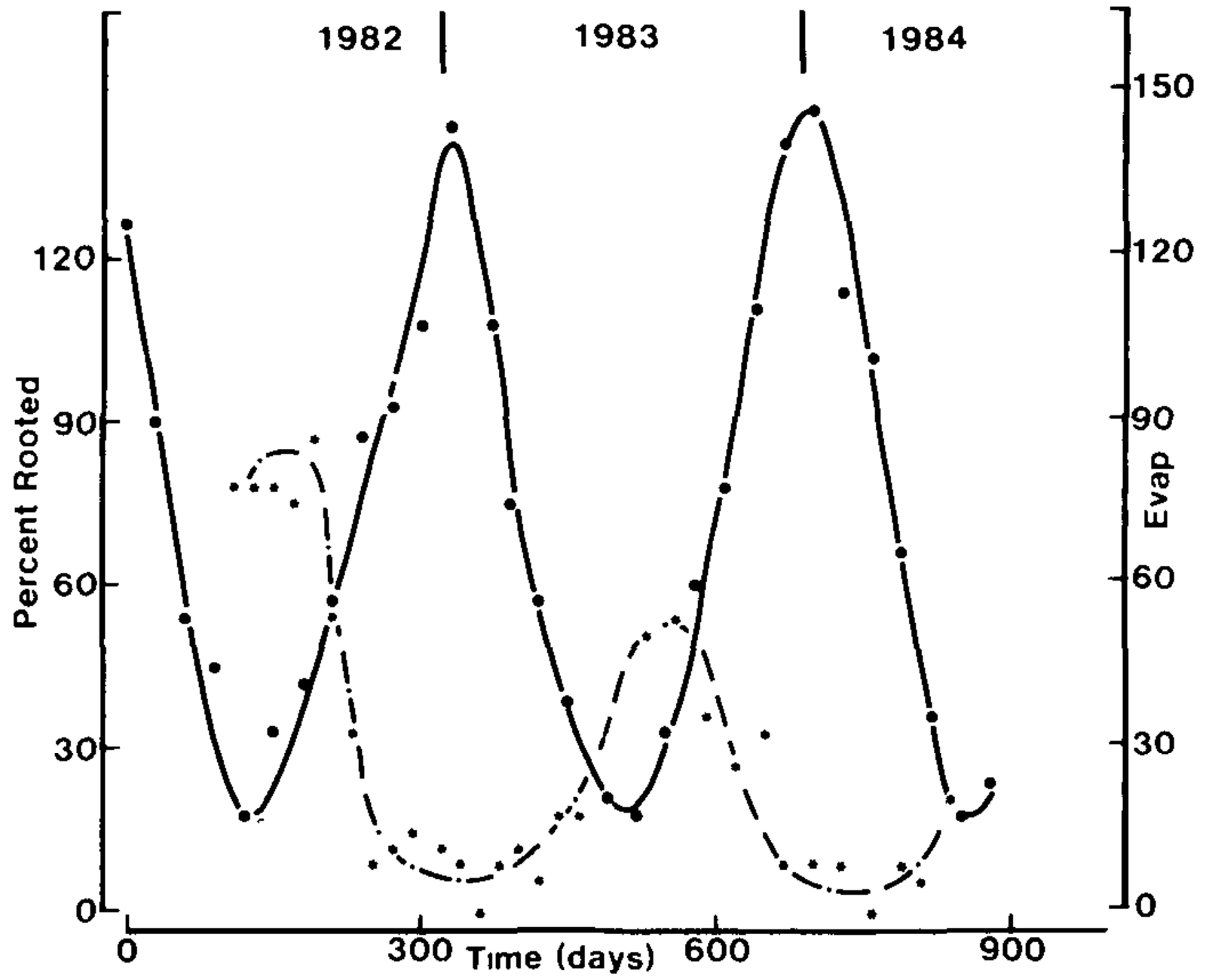

Figure 8. Percentage of S *microphylla* cuttings rooted and the monthly total open pan evaporation (× 0 1 mm), versus time ● open pan evaporation, * percent rooted

Experiment 2: Fertilised propagation mixes

Method: Cuttings of *S. microphylla*, 'Earlygold' were prepared as described previously and placed in a 50:50 "Fibremix" bark:pumice medium, containing 0, 0.5 and 1.0 times the following fertiliser regime:

	kg/m³
Osmocote 3 to 4 month (14.6 1 11 6)	4.5
Dolomite lime	5 0
Superphosphate	1 0
Calcium ammonium nitrate	0 2
Fritted trace elements	0 4

Trial design was a randomised block with five replications.

Results: No significant increases in the rooting or initial survival was found using fertilised propagation mixes.

Experiment 3: Fungicides and cutting sterilisation

Method S. microphylla 'Earlygold' cuttings, prepared as directed previously, were subjected to factorial combinations of the following pre- and post-sticking treatments:

Pre-treatments	Post-treatments	
control	control	repeated applications every seven days
50% ethanol dip, 5 sec	Benlate 1 g/l	
0 3% sodium hypochlorite dip, 30 min	Ridomil	
0 6% sodium hypochlorite dip, 30 min	Thiram	
	Sumisclex	

Trial design was a 4 × 5 factorial with five cuttings per plot.

Results: Significantly better survival of plants was achieved using no pre-sticking treatments, followed by Ridomil, Thiram, or Sumisclex rather than the control or Benlate treatments If 0.3% pre-sticking treatment was used, only Ridomil post-treatment was better than the control or Benlate treatments

FLOWERING IN POTS

Successfully rooted cuttings of *S. microphylla* will flower in the following season on very small plants (10 to 12 cm), making attractive small pot plants. Cuttings taken from floriflorus cultivars such as 'Goldilocks' make very attractive tub plants. To be a successful pot plant, the "shelf-life" of a flowering plant must be reasonably long and the plant must withstand conditions experienced in the home. Similarly, the plant form must be attractive. To evaluate the usefulness of *S. microphylla* cultivars in this regard, trials using plant growth regula-

tors to control plant form, and the "shelf-life" of flowering plants were conducted.

Experiment 4: Shelf-life of potted S. microphylla

Method. Potted plants of *S. microphylla* 'Goldilocks' were placed in a shelf-life room at 20°C and 70 to 80% relative humidity with fluorescent lighting. Floral development was assessed using a rating system for flower bud development from tight-bud to fully-open flower to abscission.

Results: Plants with very tight flower buds developed normally and gave a display life of approximately two weeks. Floral development appeared to be normal with seed pods beginning to develop. The foliage withstood the conditions well and new shoots had commenced elongating. The display period was limited by floral abscission but larger plants with more flowers should extend this.

Experiment 5: The use of plant growth regulators to control plant form.

Method: Three rates of Alar (2550, 5100, and 7650 ppm a.i.), maleic hydrazide (60, 120, and 240 ppm a.i.), Ethrel (1440, 2880, and 4320 ppm a.i.), Cycocel (2250, 4400, and 6750 ppm a.i.), and glyphosate (Roundup) (360, 1080, and 1800 ppm a.i.), plus a control (water) were sprayed on to three-week-old *S. microphylla* seedlings three times at intervals of three weeks. The height of each plant was measured initially, prior to each treatment, and three weeks after the completion of the treatments. Trial design was a randomised block with four replications.

Results: Alar, Ethrel, maleic hydrazide and glyphosate significantly reduced the growth of *S. microphylla* seedlings compared to the control or Cycocel. However, phytotoxicity was observed at the two higher rates of glyphosate and tissue damage, distortion, or leaf drop occurred when Ethrel and maleic hydrazide was used. Alar was an effective plant growth regulator on *S. microphylla*.

CONCLUSIONS

S. microphylla cuttings of 'Earlygold', 'Goldie's Mantle', and 'Goldilocks' can be successfully propagated by cuttings in a semi-hard state in late winter, corresponding to the months June, July and August at Levin. Better survival of cuttings could be achieved using Ridomil, Thiram, and Sumisclex sprays than with Benlate.

S. microphylla plants in containers make attractive flowering pot plants and respond to applications of Alar. The development of *S. microphylla* is continuing with the aim of further

improving the propagation and in controlling flowering in containers.

Acknowledgement. We wish to thank Mrs J Cunningham for the able technical assistance given in this project.

LITERATURE CITED

1 Allan, H H 1961· Flora of New Zealand Vol 1, R.E Owen, Government Printer, Wellington, New Zealand

2. Goldie, G N 1976 Description and propagation of the New Zealand *Sophora* species *Proc. Inter Plant Prop. Soc* 26 356-360