# ROOTING CUTTINGS OF 'SWAN HILL' FRUITLESS OLIVE

*Olea europaea* 'Swan Hill' is difficult to root. However in each of five different lots, rooting of 80% was obtained. Rooting percentages of 60% to 80% were obtained in 10 other treatments. The mean rooting for all ten treatments in June 1970 was 64.5%. General trends indicate that auxin (IBA) concentrations of 1000 ppm may be adequate with softwood cuttings and 2000 ppm adequate with semi-hardwood cuttings, and that higher concentrations may be detrimental. Wounding may be beneficial with softwood cuttings under some conditions and it does not appear to be detrimental under any circumstance. The sensitivity of 'Swan Hill' in rooting response to season and auxin concentration might be used as a tool to develop methods of determining the time to take cuttings for best rooting response. 'Swan Hill' can be rooted satisfactorily from softwood or semi-hardwood cuttings. Because of the relatively long time required for rooting, care must be used to minimize algae growth on cuttings and flats, to select the most vigorous cuttings, and to exercise care in hardening-off and transplanting.

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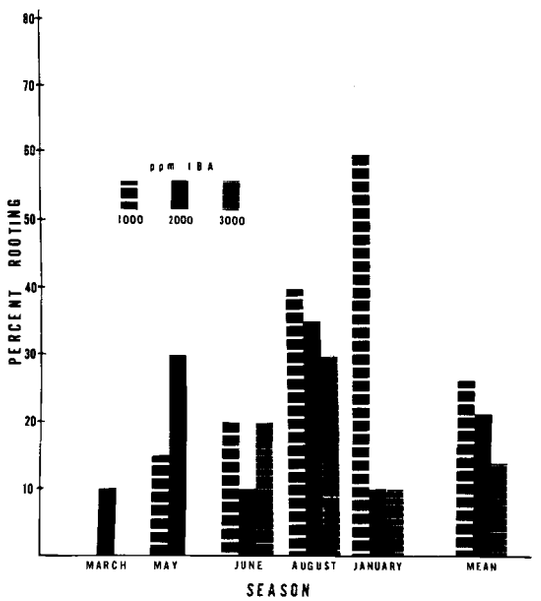
THE 'SWAN HILL' FRUITLESS OLIVE (*Olea europaea* 'Swan Hill') was introduced into the United States by Hudson T. Hartmann in 1961. This tree, discovered in Australia, was found to produce predominantly staminate flowers (Hartmann, 1967) and the few perfect flowers formed fail to develop into fruits. Scion wood was sent to California and grafted onto Mission olive understock. Hartmann attempted to root cuttings during the midsummer, using 4,000 ppm IBA and intermittent mist, a treatment which gives good results with most olive cultivars. No rooting resulted from two separate trials with a total of 400 cuttings.

## Propagation

Propagation of 'Swan Hill' has been by side grafting pencil thick scions onto seedling or cutting rootstocks during the spring, but success has been variable. A grafting trial in April 1968 at the Saratoga Horticultural Foundation, Saratoga, California was unsatisfactory with less than six percent take resulting from over 300 grafts. Failure may have been due to differences in scion and rootstock size, condition of stocks or other factors. In 1968 a preliminary rooting trial was conducted comparing 2 IBA concentrations, 2,000 vs. 4,000 ppm and two media, perlite vs. sand:peat. The only rooting occurred in the sand and peat medium with cuttings treated with 2000 ppm IBA, it appeared 4000 ppm IBA was too high a concentration for this clone.

GRAPH 1. SEASONAL AND HORMONAL EFFECT ON ROOTING TIP CUTTINGS OF 'SWAN HILL' FRUITLESS OLIVE. 1969.




## 1969 EXPERIMENTS

On the basis of 1968 results, additional experiments were conducted in 1969 to investigate the effects of season, hormone concentration and wounding on rooting of 'Swan Hill' olive. Cuttings were taken approximately the first of January, March, May, June and in mid-August. Three concentrations of IBA, 1000, 2000 and 3000 ppm, were applied by a 5-second quick dip (50:50, alcohol: water) to wounded and non-wounded cuttings. On the first four dates, cuttings were wounded by making four vertical slits in the basal one inch of the cutting. In August the wound was made by taking a 2" slice of bark from one side at the base of the cutting. Five cuttings per treatment were used in January and March and 10 per treatment thereafter except as noted.

Cuttings were stuck in the sand-peat medium under intermittent mist with $\pm$ 70° bottom heat, except that in March a 50:50 peat:perlite medium was used in an attempt to reduce algae growth.

The August experiment was expanded to include three types of cutting wood. In addition to the terminal cuttings, semi-hardwood (6 to 12" increment from the tip) and hardwood (12-18" increment from the tip) cuttings were added. These received the three hormone and two wounding treatments. Only five of the semi-hardwood and hardwood cuttings were used per treatment.

**Rooting response of 'Swan Hill' fruitless olive to auxin treatment, wounding, age of wood and season, 1970.**

| Treatment | | | | Number rooted† | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| IBA ppm | Wound | Wood* | Indole | Feb. | Apr. | June | Aug. | Oct. | Total |
| 1000 | No | T | — | 0 | 6 | 15 | 0 | 0 | 21 |
| 1000 | Yes | T | — | 0 | 0 | 13 | 1 | 0 | 14 |
| 2000 | No | T | — | 1 | 4 | 14 | 2 | 1 | 22 |
| 2000 | Yes | T | — | 1 | 2 | 16 | 2 | 1 | 22 |
| 1000 | No | S—H | — | 0 | 3 | 12 | 0 | 0 | 15 |
| 1000 | Yes | S—H | — | 4 | 5 | 9 | 0 | 0 | 18 |
| 2000 | No | S—H | — | 2 | 8 | 12 | 0 | 3 | 25 |
| 2000 | Yes | S—H | — | 0 | 10 | 14 | 0 | 0 | 24 |
| 2000 | No | S—H | $5 \times 10^{-4}$ M | 0 | 3 | 15 | 1 | 1 | 20 |
| 2000 | No | S—H | $1 \times 10^{-3}$ M | 1 | 2 | 9 | 1 | 3 | 16 |
| | | | Totals | 9 | 43 | 129 | 7 | 9 | |

*T — terminal; S-H — semi-hardwood, 6 to 12" increment behind tip.
†20 cuttings per treatment.

### Effect of season

The seasonal effect on rooting tip cuttings is shown in graph 1. The mean of the three auxin treatments showed a high rooting percentage (26.7% ) in January, lowest (3.3% ) in March and increased to the highest (35% ) in August. The low rooting in March was possibly a confounding of differences in medium and seasonal effect.

### Effect of auxin

The mean rooting percentage (combining seasonal and wounding effects) for tip cuttings was 26.2 for 1000 ppm, 21.2 for 2000 ppm and 13.7 for 3000 ppm as shown in graph 1. Interaction between season and auxin concentration appears to exist however. When cuttings rooted with difficulty (March and May) 2000 ppm was most effective, but when rooting percentages increased (January and August) 1000 ppm was most effective. The reduction in rooting at 3000 ppm would seem to confirm that the high concentration of 4000 ppm, used in 1968, was inhibitory.

The August study with different ages of cutting wood showed an interesting relationship between age of wood and auxin concentration (graph 2). Rooting of softwood (terminal) cuttings decreased with increase in auxin concentration. Semi-hardwood (6 to 12" increment from the tip) cuttings rooted best at 2000 ppm IBA and hardwood cuttings rooted equally well at either 2000 or 3000 ppm IBA. The semi-hardwood cuttings rooted 80% whether wounded or not.

### Effect of wounding

Wounding resulted in an increase in rooting (combined data from auxin treatments) in four of the five times cuttings were taken (graph 3). The only month benefits of wounding could not be determined was in March when only one non-wounded and no wounded cuttings rooted. There appeared to be a strong seasonal effect with wounding which was not apparent in the non-wounded treatments. This effect is indicated by the data (graph 3) for May, June and August. Overall, wounding doubled the rooting percentage of terminal cuttings.

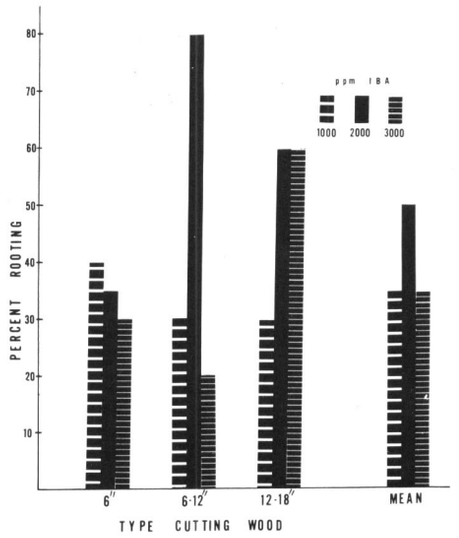
### Effect of age of wood

The response to wounding of different ages of wood was striking and somewhat unexpected. Wounding markedly increased rooting of softwood cuttings but there was little difference between wounded and non-wounded treatments in semi-hardwood and hardwood cuttings (graph 4). A possible explanation is that sufficient laterals were removed from the older cuttings to substitute for the deliberate wounding. The softwood (terminal) cuttings were not branched and lower leaves were removed without wounding.

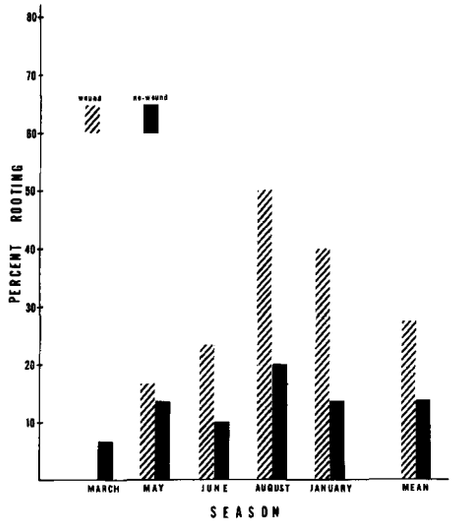
## 1970 EXPERIMENTS

Additional trials were conducted in 1970 with larger numbers of cuttings. IBA concentrations were reduced to two, 1000 and 2000 ppm, applied as before. Wounding was done by making a 1 1/2" slice on one side at the base of the cutting. Two types of cuttings, softwood (terminal) and semi-hardwood (6 to 12" increment from the tip) were used. Two treatments using semi-hardwood cuttings were added using indole as a substitute for wounding. These involved a 15-hour soak of the basal 3/4" in indole at concentrations of 5 x $10^{-4}$ M (5.85 mg/100 ml) and 1 x $10^{-3}$ M (11.7

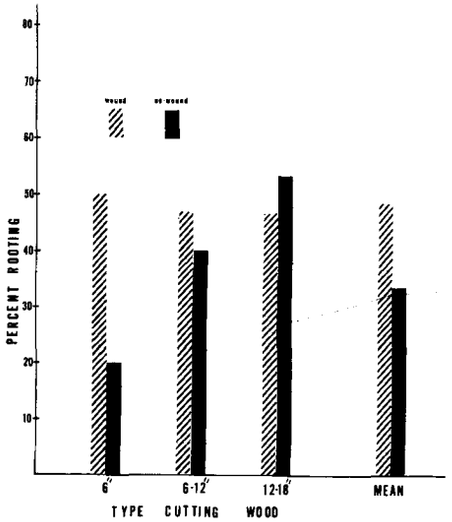
GRAPH 2. EFFECT OF DIFFERENT IBA CONCENTRATIONS ON 6" TERMINAL, SEMI-HARDWOOD (6 TO 12" INCREMENT FROM TIP), AND HARDWOOD (12-18" INCREMENT FROM TIP) CUTTING WOOD OF 'SWAN HILL' FRUITLESS OLIVE. AUGUST 1969.




GRAPH 3. SEASONAL AND WOUNDING EFFECT ON ROOTING TIP CUTTINGS OF 'SWAN HILL' FRUITLESS OLIVE. 1969.




GRAPH 4. EFFECT OF WOUNDING ON 6" TERMINAL, SEMI-HARDWOOD (6 to 12" INCREMENT FROM TIP), AND HARDWOOD (12-18" INCREMENT FROM TIP) CUTTING WOOD OF 'SWAN HILL' FRUITLESS OLIVE. AUGUST 1969.



mg/100 ml) followed by a quick dip in 2000 ppm IBA. All cuttings were stuck in sand-peat medium under intermittent mist with bottom heat, as in 1969. Twenty cuttings divided into two replications of ten were used for each treatment.

Cuttings were taken about the first of February, April, June, August and October, and rooting results were taken periodically beginning about two months after sticking and continuing until no additional rooting occurred, a period of one to two months.

**Effect of season**

Time of taking cuttings had marked effect on rooting response but the peak rooting was with cuttings taken in June rather than in August as in 1969 (see table). There was no exact counterpart of the January 1969 lot, but cuttings taken in February did not root well.

The cause of the shift of peak rooting from cuttings taken August (1969) to those taken in June (1970) cannot be determined. The spring and summer weather patterns were quite different these two years. Undoubtedly the range of conditions under which this clone of olive will root is limited.

**Effect of auxin concentration**

Again in 1970, 2000 ppm IBA resulted in better rooting of semihardwood cuttings than did 1000 ppm (see table). However for softwood cuttings the 2000 ppm treatment was slightly superior to the 1000 ppm which was in contrast to 1969 results. Overall auxin concentration of 2000 ppm gave better rooting than 1000 ppm. The addition of indole was of no benefit and may actually have been detrimental.

**Effect of wounding**

In contrast to 1969 results, wounding was of no benefit with terminal cuttings. When all data are pooled, the differences between wounding and no wounding were small (see table).

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# DRIP IRRIGATI EXPERIMENTS AVOCADOS *in San Diego*

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A NEW APPROACH TO IRRIGATION, called drip irrigation, was developed in Israel in recent years. Under the leadership of Professor Dan Goldberg, Head, Department of Irrigation, Hebrew University, this system has now been tested for 10 years and developed to its present stage. About 10,000 acres of commercially grown vegetables, field crops, and fruit trees are being irrigated by drip irrigation in that country today.

Because of the good results with drip irrigation in Israel, an irrigation project was initiated on avocados in San Diego County. The system was designed by an Israeli engineer, Dr. Baruch Gornat, who was visiting and studying in California. It was built in Israel to Dr. Gornat's design and was imported into this country and installed in June, 1970, on an avocado orchard located near Bonsall in northern San Diego County.

The purpose of the test is to compare drip irrigation with the sprinkler method now commonly used in avocado orchards. Evaluation of the two methods will include: (1) A comparison of the growth and productivity; (2) A study to determine if satisfactory soil salinity for avocado growth can be maintained under drip irrigation; (3) A comparison of total annual costs for drip and sprinkler irrigation; (4) A study to determine if avocado trees are more, or less, susceptible to avocado root rot (Phytophthora cinnamoni) under drip irrigation; (5) A study to determinine if the drip irrigation equipment will perform properly and will satisfactorily wet the soils in which these avocados are growing.

The soil is a complex of Vista sandy loam soil and Fallbrook fine sandy loam with scattered rock outcroppings. The orchard is equipped with a permanent P.V.C. irrigation system for sprinkling with a riser to each tree. The trees were planted on June 1, 1970, and consisted of two varieties, Hass and Reed.

**Test plot**

The five-acre test plot was divided into eight blocks, four under drip irrigation and four under sprinklers. The two varieties, Hass and Reed, were evenly divided in each block. The 673 trees were planted 15 x 20 ft in blocks. Three hundred and forty nine trees were drip irrigated and 324 were sprinkled. Two tensiometer stations, each having instruments at 12 and 24-inch depths, were placed within each block. Initially the 12-inch instruments were inserted into the balls of the newly planted trees.

The drip irrigation system includes a fertilizer tank, filter, water meter, irrigation controller, pressure regulator, pressure gauges, flexible hose for submains and laterals, and the emitters. The system operates at 15 pounds per square inch and each emitter discharges approximately one gallon per hour. Three emitters are placed at each tree—one near the trunk and the other two on