

## Hop Propagation in Australia

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### INTRODUCTION

The hop, *Humulus lupulus*, is a dioecious, perennial, climbing vine used as a flavouring in beer. The female hop “cone” contains resins and essential oils that give beer its bitterness and contribute the hop flavour (Neve, 1991).

Hops were originally introduced to Australia by the early settlers and was grown around Sydney. Sydney’s climate did not enable the production of high yielding, good quality crops, and hop production soon moved to Victoria and Tasmania where climatic conditions were more favourable (Pearce, 1976).

The Australian hop industry of today is located in north east Victoria and Tasmania. The total commercial area in Australia is at present 1160 hectares, with Victoria growing 330 ha, and Tasmania 830 ha. This area produces annually 3000 tonnes, with a gross value of A \$16 million. Australia exports approximately two-thirds of the hop crop to a range of overseas countries. The other third is sold to the Australian domestic breweries. Australian Hop Marketers (A.H.M.), the largest hop grower in Australia, grows 60% of the Australian crop, and markets 80%.

### HOP PROPAGATION

**Seed.** Hops are easily propagated from seed. However, this method is not suitable for commercial purposes, but is used in hop breeding. Hop is a dioecious plant, and seeds produce males and females—usually one third male and two thirds female. Male plants produce no cones, and are of no commercial value. Seedlings lack uniformity, with many having inferior commercial characteristics. Also a seedling takes longer to reach maturity than do plants produced by other methods. Therefore, in order to ensure uniformity of the commercial characteristics like yield and brewing quality, hop plants are always produced by vegetative propagation. A hop field is planted with clonal material of one cultivar (Burgess, 1964).

**Strap Cuttings.** In Australia the traditional method of propagation is to cover the base of the hop vine with earth towards the middle of the season. This process is called hilling up because the earth mounds look like small hills. Hilling causes the covered bases of the vines to thicken and develop perennial buds. In winter these thickened vine bases are cut off to produce what is called a strap cutting. These are either planted straight into the hop garden, two to three cuttings per hole, or into cool storage for planting at a later date.

Sometimes these strap cuttings are placed into a nursery for one year to produce a “bedded set” or “yearling.” Yearlings establish more quickly and have a greater strike rate (Neve, 1991). Hilling is limited by the number of vines produced in the previous season. Hence, the number of strap cuttings produced is low, and the rate of multiplication by this method of hop propagation is slow (Burgess, 1964). The traditional method of hilling up is still used by some growers who just want small

amounts of planting material to replace missing plants in existing gardens. Due to the increased demand for large quantities of planting material by the larger growers like A.H.M., new methods of propagation have been developed.

**Ground Layering.** Ground layering is a quick method of achieving large quantities of planting material. This method can take place in a commercial field but, due to the large loss in yield, this method usually occurs in a nursery. Strap cuttings are planted and grown on for one year to produce nursery yearlings. In the second year, instead of hilling up these hops or removing the yearlings, the whole vine is laid along the ground. The lowered vine is then covered with soil, leaving only the tip exposed. This tip is trained up a string. During the season the covered vine thickens, producing perennial buds and roots at each node along the vine. In winter the thickened vine is dug and cut into single-node sections. Ground layering is an ideal method of producing large quantities of identical clonal hop planting material.

**Aerial Layering.** An alternative to ground layering is aerial layering. This technique consists of wrapping the lower portion of a vine with black polythene, or a fertiliser bag, and filling this sleeve with either potting mix, soil, or sphagnum moss. The covered section of the vine thickens to produce perennial buds and roots at each node. In winter the sleeve and soil medium are removed to reveal the thickened hop vines. These are cut into single-node sections ready for planting. The advantage of aerial layering is that layering is easily performed in a commercial hop field because only the bottom section of the vine is covered. In aerial layering the top section is harvested as normal and the hop cones collected.

**Softwood Cuttings.** A more rapid and intensive method of hop propagation is via *softwood cuttings*. As a mature hop plant grows it produces more than enough shoots needed for commercial hop production. Each year, only nine of the strongest shoots or runners are trained up three strings. This leaves a large amount of unused vegetative material readily available for propagation. Each shoot contains a number of nodes with each node having two axil buds. These extra shoots are collected from the field and cut into single-node cuttings. Each cutting consists of two leaves and two axil buds with a short length of stem 3 to 4 cm in length. The cuttings are stuck into a soilless medium on a mist bench, with the axil buds and the two leaves pointing upwards. After 10 to 14 days the cuttings have rooted and are removed from the bench. They are then potted, hardened off, and allowed to grow for 2 weeks. The whole process takes a minimum of 4 weeks and one hop plant can produce about 200 rooted cuttings in that period. This is a great improvement on the other slower hop propagation techniques.

The advantage of this form of rapid multiplication is that new cultivars can be multiplied quickly for large scale planting. Only a very small initial nuclear stock is required to commence the process each season. It is possible to ensure that each new hop plant is true to type and, more importantly, free from viruses. Due to the large number of parent stock in the older methods of hop propagation, there is no check on the virus status of the propagated material, and viruses easily spread (Neve, 1991).



A minor variation on cutting propagation is used in some countries for hop propagation. Hop cuttings are collected, cut up as in mist propagation, and planted into a soilless medium. Instead of mist, the cuttings are covered with plastic sheeting to control wilting. After two weeks the propagated cuttings have rooted and the buds have started to grow (Legrand, 1988).

**Tissue Culture.** Another method of rapid propagation is tissue culture. This has not been adopted in Australia, but it has been used in other countries, e.g., South Africa. Tissue culture offers little advantage with hops, because hops can be propagated rapidly and successfully by mist propagation. Shoot-tip culture is used in the United States, and in Australia to a smaller extent, to eliminate viruses from new and old hop cultivars, but only on parent material (Probasco, 1986).

### COMMERCIAL HOP PROPAGATION

A.H.M. last year propagated 240,000 hops—mainly new cultivars for its four company farms—by mist propagation. The Victorian Hop Research Station uses the mist propagation technique. Shoots are collected from mother plants in the field, or in pots, and placed into water. Each shoot is cut into single-node sections, with each cutting having one to two leaves and two axillary buds. The cuttings are dipped into a phosphorous acid fungicide to help control fungal outbreaks. After the fungicide dip, the hop cuttings are stuck into Jiffy 517 peat pots. The peat pot contains a soilless medium (peatmoss, fine gravel, lime, and slow-release fertiliser [15N, 4.8P, 10.8K, 1.2Mg, plus trace elements]) which is drenched with a phosphorous acid fungicide. The cuttings are placed under mist for 10 to 14 days. During winter and early spring propagation benches are maintained at 18 to 21C, air temperature at 21C, and daylength 16 h. Summer and late spring propagation occur in two poly tunnels with automatic misting systems. After 14 days, the mist is turned off and the cuttings are hardened. At this stage the shoots are actively growing and the roots are starting to extend out of the peat pot wall. Depending on the use for the new rooted hop cuttings, they will either be planted in a nursery or potted. Rooted cuttings for the nursery are planted close together and the new shoots trained up strings. These are left to grow for one year to develop into yearlings. Yearlings will be left in the nursery for either more propagation (i.e., layering), or planted into the hop garden. The potted cuttings are for planting into the hop garden in the same year that they are propagated. The potting mix used is 3 composted pine bark : 1 coarse sand : 1 peatmoss (by volume) to which lime, and slow-release fertiliser (15N, 4.8P, 10.8K, 1.2Mg, plus trace elements) has been added. The cuttings are potted into 5-in. plastic pots and allowed to grow for 2 weeks before they are available for planting.

The other hop propagation techniques, such as hilling and layering, are used commercially to propagate smaller amounts. This material is mainly used to replace missing and weak plants in the hop garden. These techniques are sometimes used to propagate small quantities of new cultivars. Hilling and layering are popular with many growers, because no special equipment is needed and these methods are cheaper than mist propagation. Prices vary according to the cultivar propagated. Some cultivars are difficult to propagate, because of susceptibility to fungal infection. The following prices outline the costs involved in propagating a strong triploid hop:

Type of hop cutting	Cost each
Layered cuttings from a nursery	15¢
Strap cutting from nursery yearlings	20¢
Misted cuttings not potted	40¢
Misted cuttings potted and grown on	65¢
Nursery yearlings	95¢

Propagation by seed is used in hop breeding to develop new cultivars. Female hop plants are selected for their desirable characteristics, including high yield and quality. A paper sleeve is placed over the female flowers to stop open pollination. Selected male pollen is added to the sleeves around early January. At harvest in March the sleeves are collected and the seeds extracted from the cones. The collected seed is labelled and stored in a refrigerator for 8 weeks to overcome dormancy. The seeds are then chemically sterilised and planted into the same soilless medium used for mist propagation. An air temperature of 21 to 23C and a daylength of 16 h are maintained during germination. The seeds quickly germinate and grow into small seedlings. At this stage the seedlings are potted and grown on for planting into a breeding garden. Each year approximately 5000 seeds are sown. About 3000 seedlings are selected and planted into the breeding garden at the Hop Research Station. Hop breeding is a slow process, and a new cultivar takes on average 10 years to develop.

## CONCLUSION

Hop propagation is only a small part of the hop industry, but it is essential to the development of high-quality and high-yielding crops. Mist propagation is essential in the production of virus free planting material. Good propagation techniques develop true-to-type, virus-free planting material which gives the Australian hop industry an edge over its competitors.

## LITERATURE CITED

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