

Hops in Scotland

A Rough Guide for Growers





1 Cone showing lupulin glands

INTRODUCTION

The increasing interest in craft brewing and the development of premium beers has led to a growing interest in the provenance of raw materials, with a desire by many brewers to focus on locally-grown high-quality ingredients. Whilst barley from Scotland is relatively easily sourced, there has until recently been little interest in growing hops here due to the perceived climatic problems, although historically hops were grown in Scotland on a small scale up to the mid-19th century. In order to investigate the potential opportunities for growing hops in Scotland, a small trial was established at the James Hutton Institute in 2014, using protected cropping techniques. This guide is based on the outcomes and information gained from the trial.

HOPS IN BREWING

Hops (*Humulus lupulus L.*) are perennial plants that grow vigorously during the warmer months, with the crop harvested in September/October before the shoots are cut back to the rootstock during the autumn after harvest. Hops are dioecious (ie. with male and female plants), and cones are formed on female plants. The formation of cones does not require the presence of male plants to produce pollen, and therefore only female plants are grown commercially in the UK. The hop plant produces stems called bines, with abrasive hairs that enable them to climb up support strings or nets.

The desirable compounds in brewing come from the lupulin glands with the hop cones (1). These contain the α -acids that confer bitterness to the beer produced, and also a complex mixture of volatile oils that vary in composition between varieties. Both the α -acids and the volatiles are key to the quality of the eventual brew, depending on the hop additions in the brewing process.

PLANT MATERIAL AND TRAINING SYSTEMS

It is essential that good quality plants are sourced at the outset, to ensure that the plantation gets off to the best possible start. There is a large range of available varieties, some of which are dwarf types, and the choice of variety depends on their intended purpose as all have their own characteristics in terms of quality. It should also be noted that some varieties are covered by plant variety rights, requiring royalties to be paid on them.

Hops are planted around 1.5m apart, although higher density plantings are possible. In their first year, the plants are allowed to establish rather than produce a full crop, so the second year's crop is generally the first that should be expected by growers. Hops can continue to crop for 10-20 years after planting if the plants remain healthy.

Shoots begin to emerge in April from the underground rhizome (2), and once growth is advanced, support for the bines should be put in place. Strings (2-3 per plant) or netting can both work well. Bines can then be trained up each string (3), taking care to ensure that the shoots are emerging from the rhizome below ground level to reduce stem breakages when the wind blows.



2 *Emerging shoots, May 2018*



3 *Bines halfway up string, July 2018*

GROUND PREPARATION FOR PLANTING

We prepared the ground by cultivating ploughed ground with a rotovator before using bed-forming ploughs to produce raised beds. Before planting the hops by hand, we ran over the beds with a shaper to consolidate the beds and ensure a fine and compact seed bed.

AGRONOMIC REQUIREMENTS

Fertiliser recommendation is based on soil status – our soils at the Institute are high in phosphate and moderate in potash, and this was reflected in the fertiliser regime as no phosphate was applied. A dressing of Muriate of Potash (MOP) was applied in late March to supply potash requirement. Nitrogen was applied as ammonium sulphate in three equal dressings in late March, mid-May and late June. Further information on fertiliser requirements can be found on the AHDB website – (ahdb.org.uk/documents/RB209/RB209_Section7.pdf)

Irrigation was programmed for 4 x 10 minute watering periods through the course of the day. This was however altered throughout the season to fit the crop's requirements.

DISEASE AND PEST PROBLEMS

The most serious problem encountered during the Institute trial was downy mildew (*Pseudoperonospora humuli*). This can establish as a systemic infection in the rhizome, after which it is very difficult to eradicate completely, so rogueing of infected shoots and plants is essential. It first appears as infected shoots growing directly from the base of the plant (4), and these produce inoculum that infects further shoots very quickly. Plantation hygiene is critical, although there are some fungicides that can be used to support this. Potassium phosphite ('Farm Fos') for systemic infection and cymoxanil (as 'Option') mixed with copper oxychloride for secondary infections is generally used commercially, and a post-harvest application of phosphites to the cut stems within 1-2 days of harvest is also effective. Varieties vary in their resistance to downy mildew, and new plantings should focus where possible on those with some level of resistance to this damaging disease.

Another serious disease that must be considered when establishing hops is soil-borne Verticillium wilt (*V. albo-atrum*), which can be devastating to hop plantations. The control measures are mainly based on hygiene within the plantation, to prevent the potential transfer of inoculum in soil from

outside, and the planting of certified disease-free stocks.

A potentially serious threat from outside the UK is Hop Stunt Viroid, which is widespread in the USA and Asia. It is therefore essential that growers plant only hops from Plant Health Propagation Scheme registered nurseries, to prevent this disease from gaining a foothold in the UK.

The most serious pest encountered in the trial was the damson hop aphid (*Phorodon humuli*). This aphid migrates into hops from late spring onwards, and besides direct physical damage such as reduced vigour and loss of yield, the aphids produce copious amounts of honeydew that is then colonised by sooty mould fungi (5). This can quickly reduce cone quality and ruin the crop's marketability, especially if the attack occurs at a late stage of cone development. Various control chemicals are available, although resistance to these is a problem with this aphid. However, in sheltered or protected cropping environments, biological control using predators such as ladybirds, lacewings, parasitic wasps and hoverflies may be worth considering, although their use in commercial hop yards has been limited to date.



4 Downy mildew in emerging shoot, May 2018



5 Sooty mould fungi following aphid attack, Sept 2017

Hops are harvested in late September/early October in Scotland (6), and the point of readiness to harvest can be assessed by taking a cone, compressing it and listening for a 'popping' sound or a rustling as the tissues dry out. The bines are cut off ca. 1 m above ground level and can then be harvested in situ or brought to a harvester based elsewhere on the farm.

The harvesting of hop cones represents the biggest hurdle to be overcome regarding the financial viability of hop production. Each plant can yield up to 2.5kg of hops, and handpicking a single plant can take around three hours, making harvesting by hand only viable for plantations comprising of just a few plants. However, for larger plantations up to 1ha, small static harvesters capable of harvesting hops can be obtained in Europe, from manufacturers such as Wolf (wolfharvester.com). Larger machines are also available for more extensive plantations. The use of mechanical harvesting is clearly a major advantage to growers, in both the time and cost implications, and also gives the option of machine-sharing between growers.

Most brewers will require an estimate of α -acid levels in the harvested hops, to enable them to make the best use of the hops in the brewing process according to the bitterness that is required. This usually requires the hops to be sent for analysis at a suitably equipped laboratory. More detailed analysis of hop oils can also be undertaken, to ascertain the likely aromatic effects of the cones on the eventual beer. The systems and protocols to do this are in place at the Institute and James Hutton Limited.

6 *Hops ready to dry*



POST-HARVEST

Getting the crop to the brewers depends on the type of hop product that is required. For green (fresh) hops, which are increasingly used in some popular harvest beers, the cones should be with the brewers for use within 6-8 hours of harvest to prevent any deterioration. For dried hops, the drying process needs to begin as soon as possible after harvest.

Drying and storage of cones needs to be done in a controlled manner as soon as possible after harvest, to limit any deterioration. Drying using warm air requires slow air movement and only moderate temperatures to prevent degradation of the cone quality. After drying, the hops can be bagged. The hops can be vacuum-packed (7) or pelleted and stored in a cold store/freezer until required



7 *Hops vacuum packed*

POST-HARVEST DUTIES

Many of the autumn procedures on hops relate to cleaning up the plantation to reduce potential pest and disease carry-over into the subsequent cropping season. All remaining bines and leaves should be removed, and further cutting back of bines should leave only 2-3 cm above the soil.

FUTURE PERSPECTIVES

There is a clear opportunity for locally-grown hops to supply the rapidly expanding craft brewing sector in Scotland, although it is highly unlikely that hop production in Scotland could meet the needs of the large mainstream brewers. The choice of variety for growers should be decided upon after discussions with potential customers in the craft brewing sector and according to what plants are available. Scaling up from the Institute trial will undoubtedly highlight further issues that need to be addressed in setting up a Scottish hop supply chain, but hopefully the work done to date at the Institute has demonstrated the underlying feasibility and potential of growing hops commercially in Scotland.

Acknowledgements

Funding for the hops work at the James Hutton Institute from the Scottish Government Rural and Environment Science and Analytical Services Division (RESAS) is gratefully acknowledged.

Advice and information from Dr. Peter Darby of Wye Hops Ltd. greatly assisted the establishment of the Institute hop trial.

St. Andrews Brewing Company brewed and marketed beer ['Harvest Ale' and 'Local Hero' (8)] using Institute hops.

Further information

James Hutton Institute www.hutton.ac.uk

British Hop Association www.britishhops.org.uk General information about hops, growing and new developments. Also contains pages on the breeding work at Wye Hops.

A Plus Hops www.aplus-hops.co.uk Suppliers of certified hop plants.

International Centre for Brewing and Distilling, Heriot Watt University www.icbd.hw.ac.uk

Koppert UK (www.koppert.com) develop biological control systems for a range of crops worldwide.

Hutchinsons Crop Production Specialists (www.hhltd.co.uk) Advice and supply including crop protection products, biological control products and all aspects of plant nutrition (including fertigation).

