

**SCIENTIFIC COMMISSION OF THE INTERNATIONAL  
HOP GROWERS' CONVENTION**  
**COMMISSION SCIENTIFIQUE DU COMITE INTERNATIONAL  
DE LA CULTURE DU HOUBLON**  
**WISSENSCHAFTLICHE KOMMISSION DES INTERNATIONALEN  
HOPFENBAUBÜROS**

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**Minutes of the Lecture Part**

**Scientific Commission of the I.H.G.C., Canterbury, England, 5-7 August 2001**

61 scientists from 16 different countries met in Canterbury, England, 5-7 August 2001 to discuss latest results in hop research, to exchange experience and to bring home innovative ideas.

In 24 papers and 13 posters scientists presented their work covering the following topics:

- Hop protection and harmonization
- Gene-based methods in hop research
- Hop diseases and pests – latest reports
- Hop breeding
- Hop quality and chemistry

**Session I: Plant Protection and efforts to harmonization**

Recent efforts to harmonize international hop chemical residue standards and to coordinate research activities in testing and in the approval of new pesticides between Europe and the USA were reviewed and new aggressive strategies to proceed were shown. The IR 4 project which has been very successful in the USA now also tries to assist growers across the US borders e.g. German growers in obtaining registration of agricultural pesticides for minor crops such as hops. Investigations to determine the efficacy of Fosetyl-AI (Aliette) to control downy mildew also help to support farmers in making their decisions for a reasonable application of pesticides.

**Session II: New gene based techniques in hop research**

New perspectives in breeding are opened up by genetic engineering: In Japan, the Czech Republic, Slovenia, Portugal and in Germany research activities are focused to establish basic techniques which are crucial to improve hop quality and resistance via gene transfer. Efficient protocols for transformation and regeneration are needed as well as suitable genes which control key pathways of aroma and bitter compounds or which confer fungal resistance.

In the genome analytical field there are numerous efforts to explore the genetic makeup of hops using PCR-based methods. In developing high throughput techniques for microsatellites a very efficient new marker system is provided in hops which can be used to address various genetic issues. At current research is focused on the detection of DNA markers closely linked to disease and pest resistance. The „genetic fingerprint” is applied in many ways: for the characterization of hops and for the detection of variability, but also for the identification of pathogenic fungi.

### **Session III: Diseases and pests**

Hop powdery mildew (*Sphaerotheca humuli* Burr.) has become a serious problem in producing quality hops in almost all hop growing regions of Europe and the USA. In order to assess the infection potential of *S. humuli* populations occurring in various hop growing regions virulence analyses have been conducted. In this way also the effectiveness of resistance genes utilized in breeding could be evaluated. In addition, a risk infection forecasting index has been developed using weather data in an effort to develop economical control measures for the management of hop powdery mildew. Besides powdery mildew other fungi also cause damage on hops. In Poland and the USA *Fusarium* species have been observed in connection with cone tip blight and root rot. In Slovenia since 1998 drastic damage has been caused by the progressive form of *Verticillium* wilt. Only strict quarantine conditions can prevent further spread of this disease.

The impact of virus and viroid infection on yield and brewing quality has been investigated in various hop varieties in more details. It became obvious that damage strongly depends on the genotype.

In order to reduce the application of pesticides and acaricides, various options of biological plant protection are being tested. Natural enemies - *Typhlodromus pyri* and *Phytoseiulus* against the two spotted red spider mite and specific ladybirds against Damson hop aphid – are deployed. This biological control in combination with integrated pest management using pesticides that do not harm the beneficial fauna is a promising concept for the future. A new perspective of non-pesticidal control of damson-hop aphid is opened up by an English aphid –resistant genotype.

Part of an integrated strategy to control red spider mite is a new developed threshold system for *Tetranychus urticae* with allows to drastically reduce the application of acaricides.

### **Session IV: Hop breeding**

In breeding the objectives are directed to meet the demands of the market, of growers and brewers. Main emphasis in new varieties is put on aroma and bitter quality with high to very high  $\alpha$ -acid contents, low cohumulone content combined with high yield and good disease resistance. Traits based on single genes are increasingly important, especially as first targets for new breeding techniques and approaches. Well characterized breeding populations are a prerequisite for the identification of molecular markers closely linked to specific characters which paves the way for marker assisted selection.

In China only recently large scale commercial growing of hops has started with cv. “Tsing Tao” being grown on 90% of the total hop acreage. Growing of hops on low trellis systems showed advantages in several aspects. In the Czech Republic in contrast to the former clonal selection nowadays crossbreeding is performed. Studies on the heredity of important traits should provide insight into the options to improve features via cross breeding. In New Zealand and Australia development of seedless triploid cultivars is first priority. Tetraploid parents - spontaneous sexually derived tetraploids or after the application of colchicines - are a prerequisite in this procedure to obtain triploids. To verify tetraploids from seedling populations flow cytometry proved to be a fast and reliable method for chromosome counting. Interesting differences have become evident in the ploidy level of various tissues of an individual plant following colchicine treatment.

In South Africa the objective are clearly fixed: development of aroma and super alpha hops adapted to the Southern hemisphere and also dual varieties combining aroma and bitter quality. Low cohumulone breeding lines will be integrated in new breeding programmes.

## **Session IV: HOP CHEMISTRY AND QUALITY**

Applying the SPME (solid phase microextraction) a second procedure besides steam distillation is now available for the analysis of essential oils. The system has been optimized. Despite significantly different ways in preparing the hop samples for both extraction procedures data obtained after GC (gas chromatographic) analysis were comparable, even when evaluated by using the Min-Max model of essential oils - a model which is well established for the identification of varieties and for the assessment of hop aroma quality.

Hop is harvested at its technical ripeness. Now investigations clearly revealed significant differences in compounds essential in brewing when hop cones are harvested at the physiological and technical ripeness respectively.

The content of auxin in its free or conjugated form has been determined in various tissues of different hop varieties using the HPLC and GC mass spectroscopy. Auxin as phytohormone regulates various developmental processes and among other things also cell division. These studies should give insight which form of the auxin is prevailing in fast growing tissue and varieties.

All papers and posters presented clearly demonstrated that all hop research institutes and joint universities are working with great commitment and that their results are very promising. The work of the Scientific Commission is the basis for the development of new hop varieties and of new environmentally-beneficial and cost-effective production techniques. Thus this research increases the international competitiveness of hop growers and brewers.

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