Irrigation experiments with hop on sandy and loamy soils in the Hallertau

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Introduction
Predictions of climate change and drought spells, like in summer 2003, have raised the question whether supplementary irrigation is needed in the hop growing regions of Germany. Whereas for other hop growing regions such as the Yakima valley in the US and Saaz in the Czech Republic, it is well established that irrigation stabilizes and increases yield and quality of hop, such knowledge is scant in the hop growing regions of Germany. A three-years-irrigation experiment with different irrigation regimes was therefore conducted on two sites with sandy and loamy soil and started in 2012 to investigate whether:
1) an objective irrigation management with soil water tension (SWT) or soil water content based measurements is feasible
2) irrigation increases the yield and alpha-acid content of hop
3) Drippers should be installed aboveground or subsurface?

Materials and Methods
Two field trials with six different treatments were established in early 2012 in hop fields with the variety Herkules. The experiments differed only in soil type.

Six different water regimes were compared:

- Non-irrigated Control
- low SWT (<150 hPa), aboveground AG150
- medium SWT (<300 hPa), aboveground AG300
- increased SWT (<600 hPa), aboveground AG600
- medium SWT (<300 hPa), subsurface beside the row SSR300
- medium SWT (<300 hPa), subsurface in the middle of rows SS300

with six replicates each.

SWT was measured with Watermark (WM) sensors within the row, between the plants and under a dripper at 30 cm and 60 cm soil depth.

The sensors installed in 30 cm soil depth were used for the irrigation decision. The treatments with subsurface drip lines received irrigation comparably as the medium irrigated treatment AG300. Irrigation started at the end of June or beginning of July after plowing the plant rows. Each measuring was thrice replicated.

Results and Discussion
Soil tension measurements
SWT measurements were mostly consistent but not well suited for irrigation scheduling due to a less reliable prediction of the water demand. Since SWT measurements reflect only a small rooting volume they are of limited usefulness to predict the plant’s water demand, which was further corroborated by root excavations.

Water output
SWTs at 150 – 600 hPa thresholds resulted in too small amounts of water given to the plants. For the intensively irrigated treatment AG150 the water supply was therefore increased in 2014.

Yield and Quality
Yield or alpha-acid contents of the irrigated treatments did not increase throughout the three years compared to the non-irrigated treatment. Furthermore the evaluation in 2013, being temporarily a very dry year, was compromised by hail and only to a limited degree assessable. In general, the years 2012-2014 reflected average conditions in terms of rainfall and other meteorological conditions.

Conclusion
Irrigation was not required in the investigated sites in the Hallertau. With average and uniform rainfall occurring during the growing season, additional water does not increase yield and the alpha acid content.

It is expected that only in very dry years or on sites where soil compaction hinders a widespread root development, irrigation may be required for enhancing plant growth. Neither advantages nor disadvantages of aboveground or subsurface positioning of drip lines were evident.

Drip irrigation may not be the optimal technique to withstand drought spells in the Hallertau since root growth may be stimulated in shallow soil zones and rain might be used less effective. Further research is required to substantiate this.

Acknowledgement
We want to thank the hop farmers Stefan Wohrmann and Eduard Huber, for their support and providing us with the opportunity to investigate the influence of irrigation on their sites. We also thank Sebastian Grünberger, Felix König, Florian Huber and Monika Pichlmeyer for their help during the irrigation experiment. Moreover we want to thank the both teams of the Hop Research Center and Plant nutrition. This study was funded by the Deutsche Bundesstiftung Umwelt (DBU) Az.: 27866 and the Hopfenverbesserungsgenossenschaft e.G. (HVG)

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