Results of the use of biologically active substances in hops production in 2017

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A large part of the Czech Republic has faced an uneven distribution of rainfall during the growing season of most agricultural crops in recent years. The amount and distribution of precipitation is a significant problem in the Žatec region, where the most important part of hops production in the Czech Republic is concentrated. The Žatec area is situated in the rainfall zone of the Ore Mountains and the Doupov Hills. Hop plants have to cope with stress in the form of droughts during the growing season, even several times during the growing season and often for a long time. Due to the changing climate, hop plants often suffer not only from water deficiency in the soil but also severe temperature fluctuations. In 2017, for example, there were three heat waves with temperatures above 35°C which were repeated during the month of July. The lack of moisture can be compensated for by supplementary irrigation in the cultivation of hops, but in the Czech Republic irrigation is only used for about one fifth of hop gardens. One way to at least partially eliminate these stresses is to treat hop plants with suitable biologically active substances.

The trial results in 2017 show that the most biologically active substance is **Lexenzym**, which is humic acid and fulvic acid concentrated and enriched with precursors, phytohormones, vitamins and enzymes. Very similar results have been achieved by **Lexin**, a liquid concentrate of humic acids, fulvic acids and auxins. It stimulates, for example, the division of cells and their long-term growth. Its positive influence has also been observed in the formation of vascular bundles, the formation and growth of roots and other anatomical-morphological properties that can be seen in the plants, including an increase in their yield and quality. **Lignohumát Max** and **Ascophyllum nodosum** seaweed extract have also shown very good results. Lignohumát Max is based on humus acids and is formed during the process of organic waste transformation in wood processing. It contains only the active parts of the humic spectrum, namely humic acids and fulvic acids in a 1:1 ratio. Free cytokinins, purine bases and their nucleosides, abscisic acid and, for example, indolyl-3-acetic acid have been found in Ascophyllum nodosum. Seaweeds also contain all of the major plant nutrients, trace elements and a wide range of vitamins (e.g.: B, C, D, E, K, niacin) that can be used by plants. These algae also contain alginic acid, amino acids and mannitol.

Figure1: Experimental variants

Boiling point	Product name	Dose
1	Control - sprayed with clean water	x
2	Lignohumát Max	0,4 l/ha
3	Lexin	0,25 l/ha
4	Lexenzym	0,25 l/ha
5	Ascophyllum nodosum	0.5kg/ha

In 2017, an experiment was carried out on MK Agro's hop farm in Čínov, located in the Žatec hop area, in the district of Louny. The hop field is flat, medium Phaeozems, with a humus content of about 2%, an area of 1.46 ha, planted in 2015, with a buckle 280 x 110 cm, Osvald clone 72, north-south oriented rows. Experimental variants were not irrigated during the growing season.

Biologically active substances were applied twice over a 3-week period. The first application was on 7. 7. 2017. The second application of the biologically active substances was performed on 25. 7. 2017. For both applications, the dose of the preparation as given in Figure 1 was chosen. The total amount of water per hectare was 2000:l. The applications were carried out in the morning, under conditions favourable for the use of plant protection products. All other agrotechnical and conservation interventions in the experimental hop gardens were uniform and regular. After the application of the biologically active substances, the chlorophyll content of vine leaves and shoot leaves was monitored at two intervals after each application; after one week and after two weeks. During the harvest, each of the variants was monitored for cone yields and alpha bitter acids content. The content of alpha bitter acids was also established about two weeks before harvesting.

It can be seen in the Figure 2 and 3 that the application of biologically active substances has a positive effect on the chlorophyll content in both vine leaves and shoot leaves. Following the first application of biologically active substances, the positive effects occurred in the second week after application, but in all the experimental variants the increase in chlorophyll content was significant, especially in shoot leaves, thus in the developmental younger leaves. The Lexin and Lexenzym treated variants had the greatest effect, with an increase in chlorophyll content in shoot leaves compared to untreated controls of 20% and 16%, respectively.

Following the second application, the biologically active substances appeared to have the largest increase in chlorophyll content in shoot leaves as early as a week after application. The most effective was Lexin with an increase in the chlorophyll content of 20% over the control; and Lexenzym with an increase in the chlorophyll content of 15%. The increased content of chlorophyll in the runners was observed even two weeks after the application of biologically active substances, i.e. about two weeks before harvesting. The second application

had a positive effect on the chlorophyll content of vine leaves, but the effect was approximately one-week after the runners.

Figure 2: Chlorophyll content in rel. % of the control for each of the variants - one and two weeks after the first application.

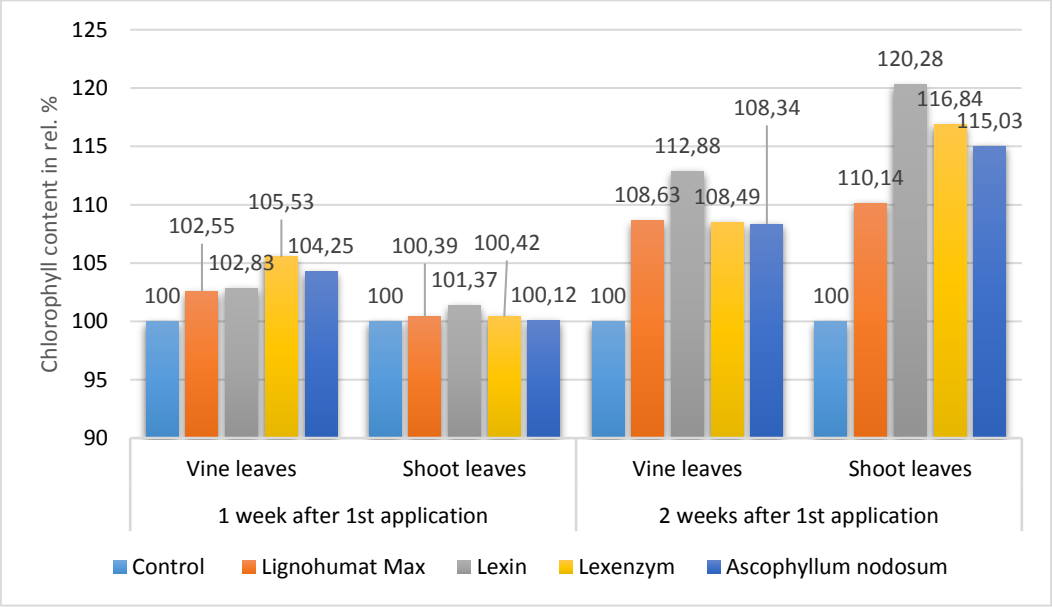
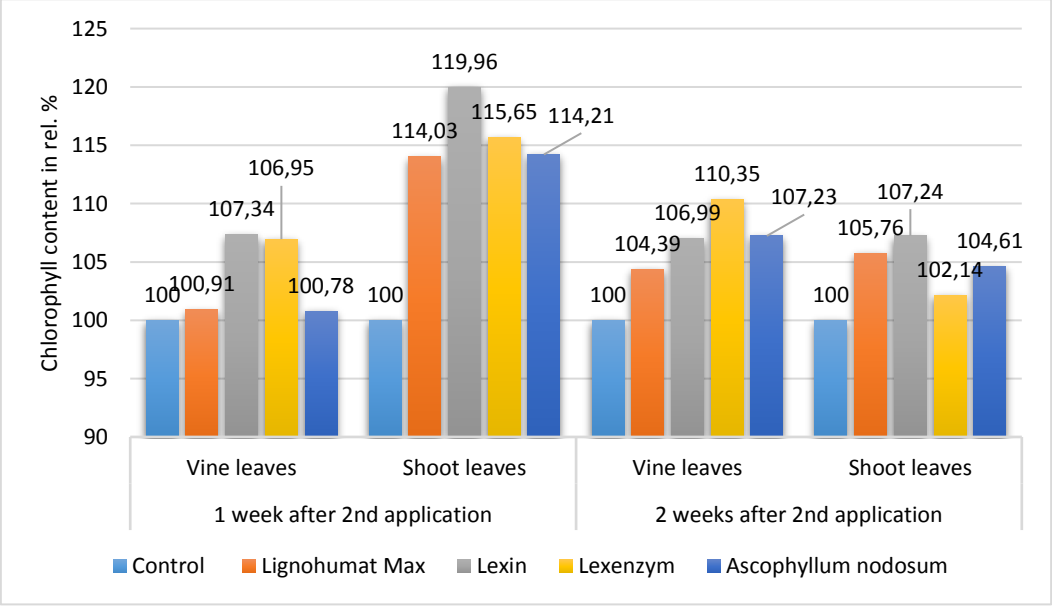


Figure 3: Chlorophyll content in rel. % of the controls for each of the variants - one and two weeks after the second application.



From the results of the chemical analyses of the harvested hop cones, the application of biologically active substances has been very positive for the formation of alpha bitter acids. The highest levels of alpha bitter acids had cones treated with Lexenzym, Lexin and Ascophyllum nodosum extracts. In Lexenzym and Lexin, there was a significantly higher content of alpha bitter acids not only at harvest time but also 14 days before the harvest. The Lexin and Lexenzym versions also achieved the highest yield. The Lexenzym treated variants averaged nearly a 26% higher yield of dry hops compared to the untreated control. For Lexin treated variants, the yield was 23% higher than the untreated control.

Figure 4: Bitter alpha acid content for each of the variants - two weeks before harvest and at harvest.

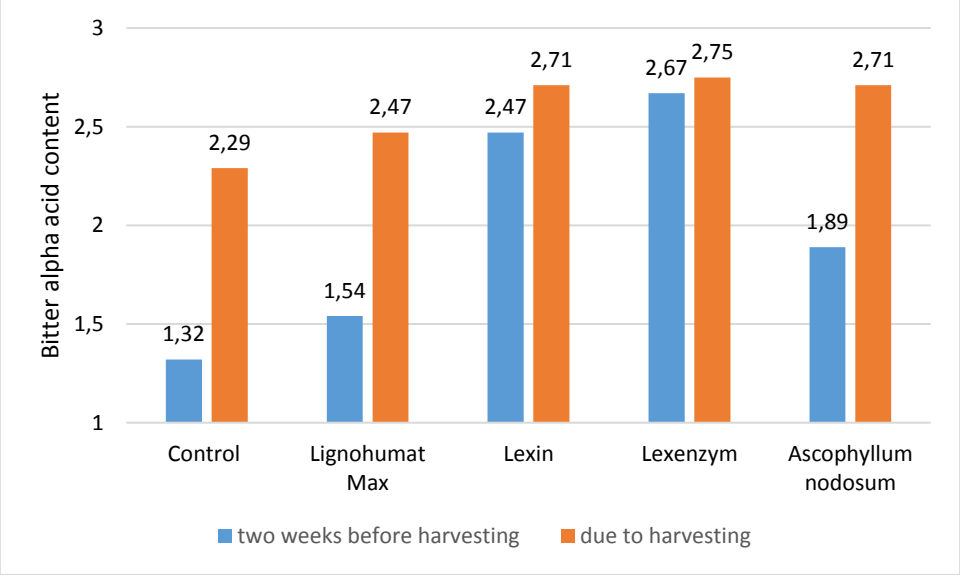
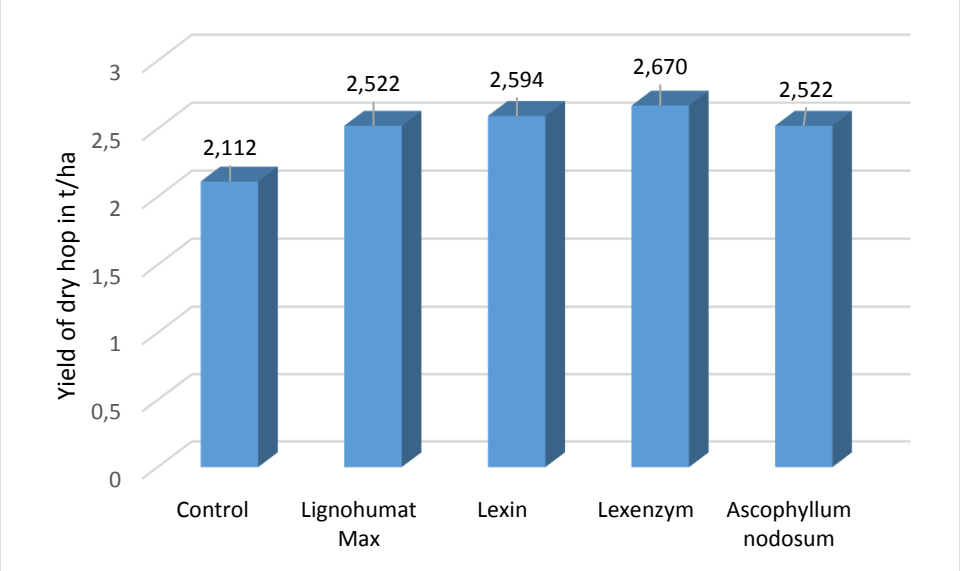


Figure 5: Yield of dry hop cones in individual variants.



From the experimental results described above, the application of biologically active substances led to an increase in chlorophyll content in leaves with all the products used in 2017, which ultimately had a significant effect on the yield of the cones and their qualitative

parameters, in particular the content of alpha bitter acids. All of the biologically active substances that were used, can be applied without causing any problems with plant protection products and the only financial expense is the price of the product itself. The results show that the best-acting formula was a mixture of humic and fulvic acids enriched with phytohormone precursors, vitamins and enzymes (i.e. Lexenzym) and a mixture of humic acids, fulvic acids and auxins (i.e. Lexin). Due to the low cost of treatment with these products, their use was highly effective economically in growing hops in 2017. The experimental results in 2017 fully correspond to the results of past years, for example, in 2016, when using Lexin at the Ročov locality, the yield of dry hops increased by 13% and by 24% with Lexenzym compared to the untreated control.