

HOP REPORT – CROP 2019



Bohemia Hop a.s.



**BO
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HOP**

The situation during the crop year

Forecast of the production

Trends on hop market

Pesticide residues



THE SITUATION DURING THE CROP YEAR AND THE QUALITY:

Development of the Weather and the Situation in Production 2019

The monthly Hop Reports 2019, published on a regular basis on the web sites of Bohemia Hop, a.s. Žatec – www.bohemiahop.cz are enclosed to this Report. Tables 1 and 2 indicate summarized data concerning the whole vegetation period (April–August), compared to the same period in 2018 and to the 30 years' long-term average (1981–2010).

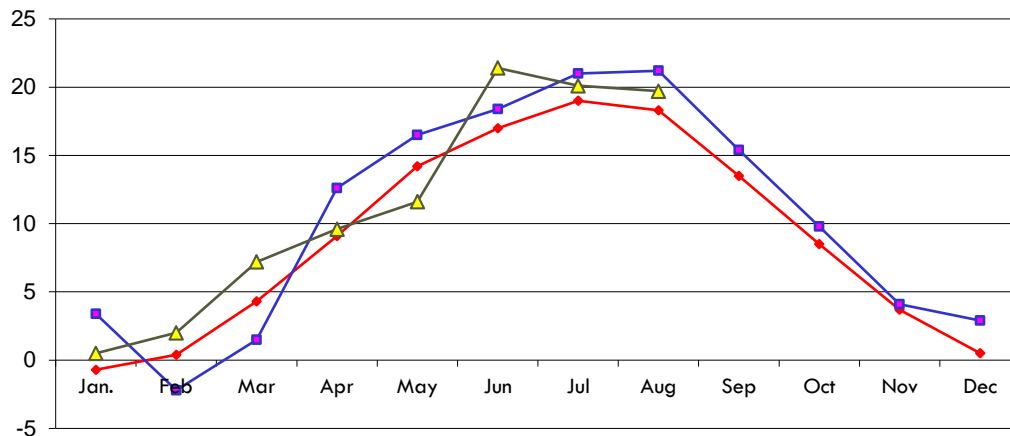
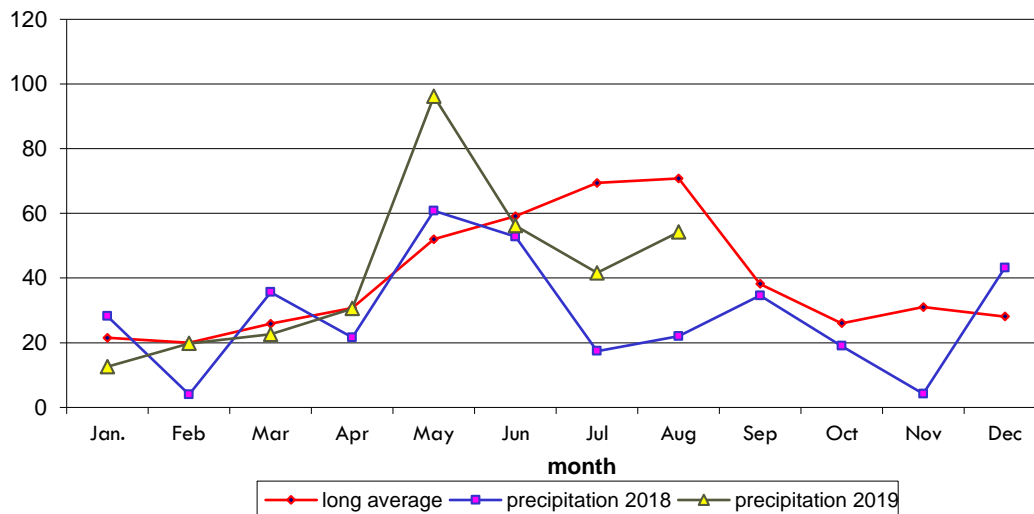
Table 1 – Temperature (°C):

Month	Average temperature °C		Difference + -	30-year average	Difference + -
	2018	2019			
April	12,60	9,60	- 3,00	9,10	+ 0,50
May	16,50	11,60	- 4,90	14,20	- 2,60
June	18,20	21,40	+ 3,20	17,00	+ 4,40
July	21,00	20,10	- 0,90	19,00	+ 1,10
August	21,20	19,70	- 1,50	18,30	+ 1,40
Total	89,50	82,40	- 7,10	77,60	+ 4,80

Table 2 – Precipitations (mm):

Month	Total precip.per month		Difference + -	30-year average	Difference + -
	2018	2019			
April	21,60	30,60	+ 9,00	30,70	- 0,10
May	60,80	96,20	+35,40	52,00	+ 44,20
June	52,80	56,20	+ 3,40	59,10	- 2,90
July	17,40	41,60	+24,20	69,40	- 27,80
August	22,00	54,20	+32,20	70,80	- 16,60
Total	174,60	278,80	+ 104,20	282,00	- 3,20

The data indicated above are accompanied by graphs illustrating the average temperatures and the total of the precipitations per month, covering period of January to August 2018 and 2019. (Graphs 1 and 2).

Graph 1 – Temperature in 2018 and 2019 compared to a long-term average**Graph 2 – Precipitation in 2018 and 2019 compared to a long-term average**

The weather of the first trimester of 2019 was characterized by the increase of average temperatures of individual months in comparison to 2018 (excluding January) as well as to the long-term average.

Noticeable differences in temperatures were recorded in March. The average monthly temperature this year was 5,7°C higher than in the previous year and 2,9°C higher than the long-term average. This March was the warmest month in the last several years. The highest temperature exceeded the limit of 20°C, precisely 21,8°C. On the other hand, the night temperatures during the same period were below zero (from -0,3°C up to -2,4°C).

As far as the precipitations are concerned, the first trimester of 2019 was below the long-term normal levels. Compared to previous years, when there was no snow cover in our region during the winters, this year we experienced snowfalls that reached 15-20 cm and occurred in early February. The snow cover melted after one week.

The temperatures in **April** were of average. However, they came to the level of above 20°C towards the end of the second and the middle of the third decade. In contrast, the precipitation was far below average as the situation before April 26 was disastrous. The precipitations before that day amounted only 0,4 mm. The rainfalls, substantial for the vegetation, came only after that day and the situation was saved by the rainfalls, which came on April 29, with 23,4 mm of water.

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Contrary to previous year, the first half of **May** 2019 was characterized by very low temperatures. The monthly average temperature (till 20th May) was around 9,9°C, which was 4,3°C below the long-term average for May. Low temperatures were promising that the old Czech proverb “cold May – Paradise in barn” would come truth. The warming came only in the third decade of May. Still, the average temperature of this May stayed below the long-term average. The state of the precipitation was positively influenced by the rainfalls between May 20 and the end of the month. The precipitations during that time amounted 82 mm that represents 85,2% of the total monthly rainfalls. In comparison to the long-term average it makes 185 %.

After climatically promising May, the weather in **June** was unfortunately very similar to previous years, which means dry and hot weather. Particularly adverse situation developed when monthly temperature average reached the value of 21,4 °C, exceeding the long-term average of 17 °C by 4,4 °C. Together with unevenly distributed rains, which were mostly of stormy nature, they had a very negative impact to the growth and development of hops. That seemed to be quite promising in this year. Critical situation reached the peak primarily during the second half of June (after June 17, 2019), when the precipitations decreased to zero.

Not even **July** was optimal as far as the development of climatic conditions is concerned. Even though the temperatures during two first decades corresponded to the long-term averages for that periods, during the third decade (and especially in its first half the temperatures) reached the tropical levels over 30°C. The precipitations in July were deeply below long-term average. The first rains (after a month) came on July 12 and 13. They were not significant – only 7,6 mm. Further rains came on July 21, they were of stormy character and the rainfalls varied between 12 and 20 mm. Nevertheless, these rains did not compensate the moisture deficit and did not improve the critical situation of the moisture content in the soil.

Also, in this year's **August** the average temperature exceeded the long-term average, namely by 2, 9°C. Especially the last week of August was extraordinary warm – maximum daily temperature reached more than 30°C every day. The precipitations dropped only in the first two decades in August. The rains, nevertheless, were of stormy character with big differences among individual localities. These precipitations raised hopes of improvement of the situation in hops production.

Quality: Alpha Contents in Original, Aroma, the Appearance of the Cones, the Pests

The nature of the weather allowed hop growers to perform spring work in hop gardens in the usual times, in some location even earlier. The spring work in hop gardens started in the beginning of March with harrowing. During the last decade of March, the growers started with the pruning of the hops of hybrid varieties.

The weather conditions enabled the growers to carry out the spring works in hop gardens as usual. The **pruning** of hops took place in habitual time thanks to the weather without rains. The growers then could regulate their time schedule of cutting the hops as necessary. The cutting of hops was followed fluently by the stringing and embedding of training wires. Due to the state of the vegetation the **training** of hops started with the hybrid varieties, especially with the variety Sládek, during the last decade of April. The beginning of the training of our principal variety – the Saaz hops – started around 1 May.

Cold weather during the first two decades of May had a negative impact on the growth of hops and therefore it influenced also one of the most important operations in hop gardens, i.e. the training of hops. This phenomenon was evident especially by the hops, which was cut around April 20, 2019, and later. Thus, it concerned mainly growth of young hops. Slow development of hops in that period caused difficulties with the employment of the temporary workers, contracted for this operation to be done in usual time. This year the situation was diametrically different from 2018, when hops training took place already by the end of April, i.e. 2 to 3 weeks before the usual time of the hops training. The warming in the third decade then encouraged the elongating growth of hops and the hops were trained by the end of May.

The growth and the development of hops during the **first two decades of June were very good** and corresponded to the optimal development of hops in that period. In the last decade, however, due to influence of high daily temperatures, the stretching growth has slowed down. Part of the hop gardens, especially those that were cut in later date (April 20 to April 25, 2019), and where the deeper cut was done, did not reach the height of trellis. View to the fact that in this year the hops in previous month

did not start considerably to blossom, we supposed that the stretching growth would continue also in July. However, the conditions were decrease in temperatures and significant precipitations in the first decade of July.

The discontinuation of the elongation growth due to heats by the end of June had an impact to the situation in July. The habit of the hop plants improved, nonetheless in some areas the hops did not grow according to the expectations and a part of the plants did not reach even the height of the trellis. The hops started to **blossom** during the first decade of July. The starting of flowering was evaluated as good. During the second half of the month the hops began to create the cones. However, for a satisfactory formation of cones a sufficient precipitation will be necessary. For the good cone creation, a large amount of rain was necessary as the rainfalls during June and July were not sufficient.

Climatic condition in August and especially the **rainfalls during the first two decades of the month improved the situation of hop gardens**. The deployment of the flowers was very good; however, the creation of cones did not reach the expected level and the cones remained relatively small. The harvest started by individual growers in relatively wide period between August 15, 2019 and August 25, 2019. Due to insufficient cone creation we expect an average crop in this year. The first results of laboratory tests of content of alpha acids show slightly above-average values. That is why we expect better-than-average content of alpha bitter compounds in comparison with the average of previous five years, especially in case of Saaz. As far as the hybrid varieties is concerned, we still do not have sufficient data for making a quality estimation.

As a result of this chapter, we would like to emphasize that the **health state of the hops is very good** and it does not show any harmful agents. The colour is good, the creation of cone as well as the size of cones is slightly smaller. The aroma corresponds to normal.

Chemical Protection of the Hops

The chemical protection of the hops in **April** was concentrated on the elimination of **downy mildew** of hops (*Pseudoperonospora humuli* Miy et Takah.), **Alfalfa snout** weevil (*Otiorrhynchus ligustrici* L.) and **Flea beetle** (*Psylliodes attenuata* Koch).

Downy mildew of hops (*Pseudoperonospora humuli* Miy et Takah.) – although the weather was not favourable for the spreading of Downy mildew of hops, the growers were recommended to use the preparation Aliette 80 WG in order to eliminate the primary infection. Provided the infection is stronger, it was recommended to repeat the treatment after 14 to 21 days. At the same time also the preparation Profiler could be used in this year. In previous year the application of this preparation was complicated due to missing MRL for the active substance fluopicolide in Japan.

Alfalfa snout weevil (*Otiorrhynchus ligustrici* L.) – farmers' own monitoring of this pest was recommended in individual hop gardens according to their locations, and the treatment was carried on where the number of five beetles on 100 plants was found out. The treatment was done by the preparation Actara 25 WG.

Flea beetle (*Psylliodes attenuata* Koch) – the harmfulness threshold of flea beetle is considered when 5–10% of the leaf blade is damaged. The harmful effects of this beetle is increasing due to gradual warming. The preparation Actara 25 WG was used as well. By the spring treatment against this pest we also prevent the laying of eggs by the Flea beetles' females and an occurrence of a new generation.

As far as downy mildew of hops (*Pseudoperonospora humuli* Miy et Takah.) is concerned, there was no problem in the two first decades in May. It was recommended to carry out the second treatment of hops by the preparation Aliette 80 WG and alternatively by the preparations Curzate K or Revus.

The first rare occurrence of **hop aphid** was detected in the beginning of the second half of month. The growers were recommended to carry out the treatment by the preparation Teppeki. Cold weather was also adverse for the development of red spider mite (*Tetranychus urticae* Koch).

The weather development during the last decade of May and the first half of June 2019 created convenient condition for the development and the dissemination of the downy mildew of hops (*Pseudoperonospora humuli* Miy et Takah.). Therefore, the first and the second treatment against the secondary infection of this disease were carried out. For the treatment of the hop gardens

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the preparations in compliance with The Methodology for Hop Protection in 2019 were used, i.e. the preparations Ridomil Gold Combi Pepite, Folpan Gold, Bellis or Ortiva. The hop gardens, where the critical number of 50 hop aphids per leaf in upper leaf floors was exceeded, were treated by the preparations Teppeki or Plenum. The nature of the weather in June was optimal also for the development of **red spider mite** (*Tetranychus urticae* Koch), which appeared relatively soon in this year. The hop gardens, endangered by this pest, were treated with the preparations Nissorun 10 WP or Ortus 5SC.

The infection of downy mildew of hops (*Pseudoperonospora humuli* Miy et Takah.) was of no importance in July. As precautions, it was suggested to carry out the treatment of the hop gardens by the preparations Bellis, Ortiva, Revus, or Orvego. By using of the preparations Movento 150 OD or 100 SC in the beginning of the month, the occurrence of hop aphid (*Phorodon humuli* Schrank) was practically eliminated. In view of its long residua effectiveness of 4 to 6 weeks it should keep red spider mite (*Tetranychus urticae* Koch) below the level of economical harmfulness until the beginning of the harvest. When evaluating the health state of hops in August, we noted it as very good.

Following Table 3 demonstrates the results of alpha-bitter substances in hops according to individual regions and varieties, as analysed in the laboratory of Chmelařství, co-operative Žatec.

Table 3 – Contents of alpha acids (in Original Material) according to varieties and regions (in %); (according to EBC 7.4)

Region	Saaz	Sladek	Premiant
Saaz	3,50		
Auscha	3,30		
Tirschitz	3,60		
Czech Rep. Average	3,48	5,80	7,20

Obs.: The results of the analyses of other varieties are still not available

Estimation of Acreage and Yields According to Regions

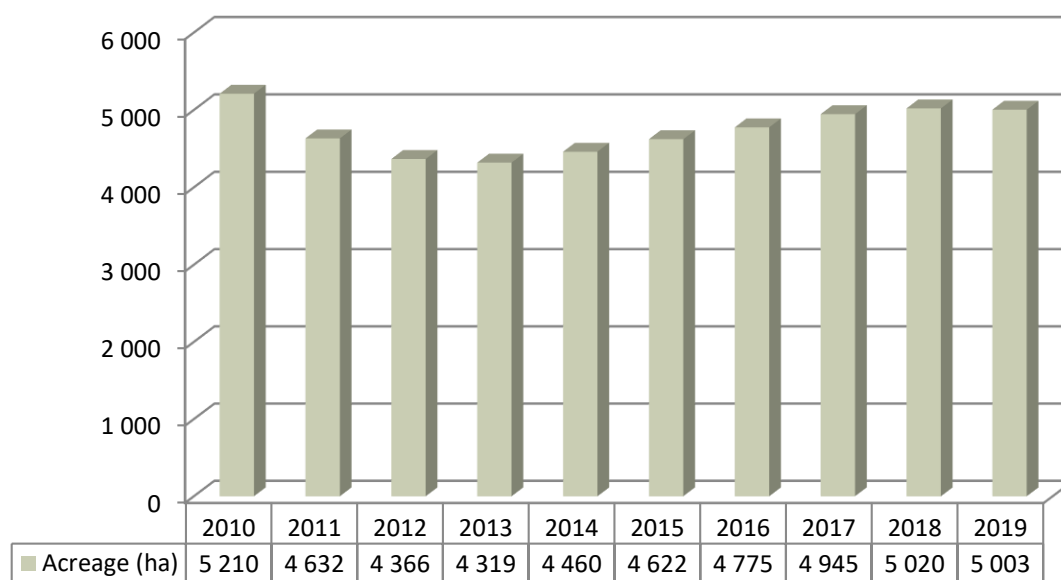
The harvested acreage in 2019 is shown in following Table 4. The data indicated were kindly supplied by ÚKZUZ Žatec (data up to 20th August, 2019).

Table 4 – The acreage of hop gardens in the Czech republic (ha)

Region	Acreage (ha) Aug 20, 2018	Acreage (ha) Aug 20, 2019
Saaz Total	3856	3869
Saaz/Saaz	3395	3361
Auscha Total	535	513
Saaz/Auscha	458	426
Tirschitz Total	629	621
Saaz/Tirschitz	496	475
Czech Rep. Total	5020	5003
Saaz Hops Total	4349	4262

The trend of increase of acreage has stopped. The total acreage dropped from 5020 hectares to 5003 hectares. This was caused by termination of hop growing in AGRO Hořka company in Auscha region.

In order to illustrate the development of the acreage of hop gardens in the Czech Republic we enclose the graph covering the period of 2009–2019. Graph 3.

Graph 3 - The development of the acreage of hop gardens in the Czech republic

It is very complicated to make the estimations of the production of hops in the Czech Republic in this year, view to differentness of the beginning of the harvest by individual growers, due to interruptions of the harvest because of non-creation of the cones, and due to big variation among the hop gardens. The exact results will be known after the summarization of individual “Producers declaration about the number and the weight of marked packing with hops according to the cadastral territories and varieties of hops”, which will be made out by ÚKZÚZ Žatec.

Table 5 - Estimation of the crop according to regions (total)

Region Variety/Region	Acreage (ha)	Production* (tons)	Yield* (Ton per ha)
Saaz Total	3869	4940	1,28
Saaz/Saaz	3361	3870	1,15
Auscha Total	513	910	1,77
Saaz/Auscha	426	725	1,7
Tirschitz Total	621	850	1,37
Saaz/Tirschitz	475	570	1,2
Czech Rep. Total	5003	6700	1,34
Saaz Hops Total	4262	5165	1,21

FORECAST OF FURTHER DEVELOPMENT

Expected Replacement of the Varieties and Hypothetic Production of Individual Varieties

Table 6 - Comparison as per the variety composition in 2018–2019

Variety	2019 Acreage (ha)	2018 Acreage (ha)	2019-2018 Difference (ha)
Saaz	4262	4349	-87
Agnus	58	42	16
Kazbek	33	34	-1
Premiant	193	170	23
Sládek	344	320	24
Saaz Late	47	46	1
Saaz Special	41	34	7
Others	25	25	0
Czech Hops Total	5003	5020	-17

Expectation of the Planting of New Varieties and the Yields

According to the information from the producers of rootstocks the growers keep the interest in Saaz variety and then also in varieties Premiant and Sládek. Of the bitter hop varieties, the most required by the growers is the Agnus variety. The quantity of the ordered rhizomes represents the area of 270 ha in this year. In majority of cases it will be used for the renovation of the growth, especially with Saaz variety. With varieties Premiant and Sládek we recorded a slight increase in acreage.

Expected production areas

Table 7 - Composition of individual varieties on harvested area in 2018 and in 2019 (ha)

Supplement to this table (Table 7) is Graph 4

Variety	2019 Acreage (ha)	Share (%)	2018 Acreage (ha)	Share (%)
Saaz	4262	85,19%	4349	86,63%
Agnus	58	1,16%	42	0,84%
Kazbek	33	0,66%	34	0,68%
Premiant	193	3,86%	170	3,39%
Sládek	344	6,88%	320	6,37%
Saaz Late	47	0,94%	46	0,92%
Saaz Special	41	0,82%	34	0,68%
Others	25	0,50%	25	0,50%
Czech Hops Total	5003	100,00%	5020	100,00%

TRENDS ON HOP MARKET

The 2018 harvest is practically sold out, only a small amount of Kazbek variety remains in stock. As to 2019 harvest, we still await the final volume from the purchasing. So far, due to fluctuations in yields of individual suppliers, the total quantity is only estimated. However, even now we dare to say that we will be able to fulfil all closed contracts in the category of fine aroma hops as well as other varieties. Eventually, we will hopefully be able to meet smaller demands over contracted quantities. The contracting for future harvests continues successfully, going from 2020 onwards to 2025.

Japanese market: Regular market reports show that the Japanese market recorded a steady decline in total beer production. The decline in the beer category is partly balanced by the rise in new brands. Despite this decline we expect to add contract quantities for the next 5 years.

Chinese market: The Chinese market is stabilizing and shifting demands from cheap, lower category beers to those with a higher content of quality raw materials. This fact reflects the still growing demand for our varieties on this market.

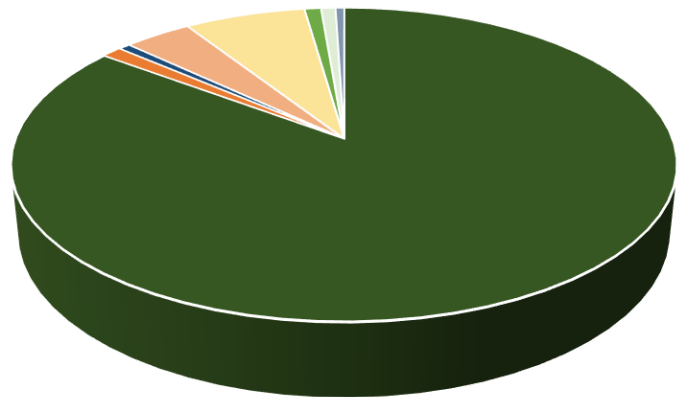
U.S.A: The segment of craft breweries using quality raw materials is still growing. Despite the fact that most of the consumption is directed to the American flavour varieties, we can see an increasing number of orders, especially for Saaz.

South America: Given the recently signed EU – Mercosur Trade Agreement, we expect an increase in supply after the agreement will have been ratified by the national parliaments of the EU countries. Gradual interest of brewers to brew bottom-fermented beers from quality raw materials is also present here.

New long-term contracts have been concluded with large brewery groups. We can also state that the number of long-term contracts, often reaching the year 2025, is growing satisfactorily both in the portfolio of Saaz and other Czech varieties. On the special hop varieties market, we see a growing interest in the **Kazbek** variety both on the domestic market and also internationally, also by large breweries for their special beers.

According to published statistics, the **Czech brewing industry** is doing well again this year (similarly as in the previous year) both in export and domestic consumption. Therefore, we expect stable demand for our hops. We will try to satisfy the demand in accordance with the result of the hop harvest this year.

The growing number of craft breweries is also another source of sales for us. The total number of breweries in the Czech Republic is now close to number 500.



■ Saaz ■ Agnus ■ Kazbek ■ Premiant ■ Sladek ■ Saaz Late ■ Others

PESTICIDE RESIDUES

Supplement to the instruction regarding spraying within previous year

Fundamental trends of the hop protection, as well as protection of other agriculture commodities are fully subject to the rules valid in European Union.

Newly used pesticides

By comparison of the Methodology of the Hop Protection in 2019 and 2018 we registered the inclusion of new preparations compared to 2018.

Name of preparation	Agent	Effectiveness
Movento 100SC	spirotetramat	hop aphid, red spider mite
Sivanto prime	flupyradifurone	hop aphid
Folpan Gold	folpet + metalaxyl M	downy mildew
Grifon SC	hydroxid Cu + oxychlorid Cu	downy mildew

The preparations excluded from the Methodology 2019 in comparison to 2018:

Name of preparation	Agent	Effectiveness
Confidor 200OD	imidacloprid	hop aphid
Warrant 700WG	imidacloprid	hop aphid
Curenox 50	oxychlorid – Cu	downy mildew
Kuprikol 50	oxychlorid – Cu	downy mildew
Funguran – OH 50WP	hydroxid Cu	downy mildew
Champion 50WP	hydroxid Cu	downy mildew
Pergado F	folpet + mandipropamid	downy mildew

Control system for pesticide residues

Hop Research Institute, s.r.o. Žatec did not receive any instructions in order to change the control system of pesticide residues. Therefore, it goes on in compliance with the present trends.

Connection to EUROFINS SOFIA GmbH Berlin, an international certified laboratory, continues and in compliance with the facilities of the laboratory we extend also the spectrum of analyses of active substances.

Simultaneously, in this year we extended the cooperation with Hop Research Institute s.r.o. Žatec, which is equipped – since 2016 – with new laboratory facilities for analyses of pesticide residues. Moreover, from this year onwards, the Institute has been officially certified for pesticide residue analysis.

Protection of hops in the crop year 2019

The protection of hops carried out by our suppliers was subject to the Methodology of the Protection of Hops for the year 2019 and of the List of the Preparations Approved for the Protection of Hops in 2019, issued for the companies Chmelařství, co-operative Žatec, and Bohemia Hop, a.s. Žatec.

In the purchase contracts for dried hops concluded with the suppliers there is an obligatory deadline for sending of the “List” until the 31st March to the growers. We therefore need to know possible requirements for the adaptation of allowed chemical preparations before that day, preferably up to 28th of February.