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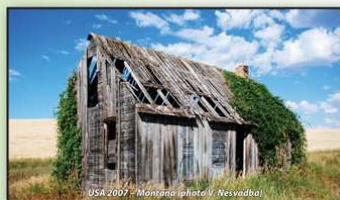
VARIABILITY OF WILD HOPS

(*HUMULUS LUPULUS* L.)



RESULTS

Wild hops are very important natural source for hop breeding. Their importance has increased recently because of the utilization within crossing aimed at tolerance and resistance to biotic and abiotic factors. The main objective of this work was to obtain new genotypes showing resistance to fungal diseases, drought, hot weather conditions, etc. Therefore, just the hop plants, which did not show any symptoms of downy and powdery mildew in their natural habitats were chosen. To be sampled they had to show good growing characteristics, productivity, aroma, optimal chemical structures in hop cones, etc. Assessment of those hops has been carried out since 2006. The collection of 103 wild hops was selected in 2010 to extend evaluation of variability. These plants have been planted altogether in a hop garden. Contents and structure of hop resins are reviewed in Table 1.



In 2010 we analyzed 18 samples of wild hops taking from the original habitat. One sample was brought from Kyrgyz. It showed alpha acid content 2.21%, but beta acid content was higher (4.14%). Four samples were obtained within the international cooperation with University of SS. Cyril and Methodius, Faculty of Natural Sciences in Slovakia. They have their origin from the vicinity of Pezinok and Piešťany. Good for the breeding work seems to be a wild hop sampled near the river Váh with good content of alpha acids (3.55%) and very low percentage (15.40% rel.) of cohumulone. Czech hops have their origin in North Bohemia. The highest content of alpha acids (4.45%) was found out in a hop plant sampled near the village of Trebusín (Ústek hop region). Six wild hops were obtained within the expedition aimed at the collection of wild hops in North-Osetia. Hop plant sampled near the village of Mozdog had the highest content of alpha acids within this group, (8.87%). Wild hop from Achsarish showed also high alpha content (6.67%). These hops seem to be valuable genetic material.

Table 2: Contents and structure of hop resins in wild hops harvested at the original habitat in 2010

LOCALITY	ALPHA ACIDS (% w/w)	BETA ACIDS (% w/w)	COHUMULONE (% rel.)	COLUPULONE (% rel.)
CR Sulečice 3	2.02	4.09	20.8	41.7
CR Trebusín 1	4.45	3.37	21.4	51.8
CR Trebusín 2	2.01	3.20	25.2	41.4
CR Česká Lípa	2.29	4.77	24.6	43.4
CR Libochovice	2.31	3.56	26.3	42.3
Slovakia Piešťany 1	2.87	2.44	22.0	52.7
Slovakia Piešťany 2	3.55	2.40	15.4	49.5
Slovakia Piešťany 3	2.22	2.75	18.1	52.2
Slovakia Pezinok	2.25	2.79	23.1	46.4
Caucasus Alagir	3.22	2.57	25.9	47.7
Caucasus Vladikavkaz 1	4.51	2.00	22.3	42.6
Caucasus Elchotova	3.59	1.90	18.6	40.1
Caucasus Vladikavkaz Tereg	3.59	1.62	9.7	38.7
Caucasus Achsarisar	6.67	2.26	17.1	34.9
Caucasus Mozdog	8.87	2.45	17.4	38.1
Kyrgyz Bishkek	2.21	4.14	23.6	45.6

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INTRODUCTION

Wild hops are very important within breeding programs. They are typical of wide genetic variability and thus they enrich the collection of hop genetic resources. Many wild hops have been selected by natural selection and in this way they have obtained some important characteristics. These features are utilized in breeding aimed at tolerance and resistance to diseases, pests and drought. A great deal of contemporary breeding material is over-bred and depression is obvious. Wild hops used in breeding programs help to split progenies showing high vitality.

Wild hops show genetic, chemical and phenotype variability. It is necessary to transfer wild hops into field conditions to confirm that needed characteristics are based genetically and not influenced by environment. It is very difficult to assess tolerance and resistance, as the infection pressure in hop-yards is much higher than in natural habitats of wild hops. Hop Research Institute in Zatec takes wild hops collection trips every year. Its gene fund contains wild hops from Europe: Czech Republic, Austria, Belgium, France, Spain, Switzerland, etc. A great number of these plants have their origin in Caucasus as well as in North America (US, Canada). In 2008 we managed to get wild hops from Kirghizia in Asia.

METHODS

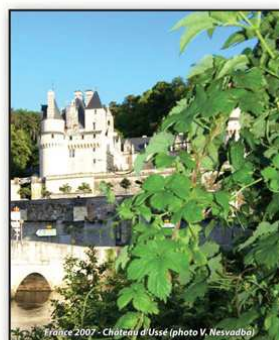
PLANT MATERIAL - Monitoring of wild hops occurrence is carried out every year. In spring new localities are searched for and leaves sampled to do DNA analyses. Later since August to October these wild hops are evaluated (descriptions, occurrence of pests and diseases). Hop cones are sampled in perspective wild hops to carry out chemical analyses. After the assessment is finished perspective wild hops are selected and planted in a special hop-yard. Descriptions as well as chemical analyses are made in this stage as well. The aim is to confirm the characteristics, which were the plants sampled for in their natural biotopes. This assessment process was performed in the period 2005 - 2010. Totally 136 wild hops were researched.

CHEMICAL ANALYSES - Dry cones of the tested wild hops were used for chemical analyses aimed at hop resins and essential oils determination during four years. Hop resins were determined according to EBC 7.7, method by liquid chromatography (HPLC) on the column Nucleosil RP C₁₈ (Macherey-Nagel, Germany, 5 µm, 250 x 4 mm) using chromatograph SHIMADZU LC 20A (Shimadzu, Japan) with diode array detectors (DAD) according to Novak et al. (2006) and Krofta (2003). Hop essential oils were estimated from vacuum concentrated, water distilled samples by gas chromatography (GC) on capillary column DB 5 (Chromservis, CR, 30 m x 0.25 mm x 0.25 µm film thickness) using gas chromatograph Varian 3400 in the connection with mass detector Finnigan ITD 800 according to Krofta (2003). Compound identification was based on the comparison of GC retention indices and mass spectra with those of authentic compounds. Semi-quantitative evaluation of hop oils composition was performed on the basis of peak areas of individual components and expressed relatively to the total integrated area of all substances involved.



Table 1: Variability in the contents and structure of hop resins (2006 - 2010)

PARAMETER	ALPHA ACIDS (% w/w)	BETA ACIDS (% w/w)	RATIO ALPHA/BETA	COHUMULONE (% rel.)	COLUPULONE (% rel.)
Minimum	0.10	0.14	0.09	13.6	29.8
Maximum	8.87	8.23	2.07	64.6	82.9
Mean	2.16	3.12	0.74	32.6	49.8
Coef. variability (%)	59.4	41.8	50.1	46.2	36.3



SUMMARY

Numerous original wild hops are used also for brew tests at North-Osetia State University in Vladikavkaz. Department of Biotechnologies at the Faculty of Natural Sciences in University of SS. Cyril and Methodius in Trnava also utilizes this original wild material for research work. University of Agriculture in Bishkek has started recognition of wild hops at the territory of Kyrgyz Republic. The activities of the above-mentioned subjects are the reason why Hop Research Institute in Zatec has begun to cooperate with them on the base of mutual agreements.

Wild hops are very important for genetic resources and hop breeding. Genotypes with wide genetic variability are valuable material for the collection of genetic resources. Many important characteristics of these hops are utilized within breeding programs. Since 2007 wild hops have been used for breeding in Hop Research Institute in Zatec as well. The obtained results show that the variability of wild hops not only among the localities but also within them. Mainly this variability is the base for hop research within the above-mentioned subjects. It is necessary to realize that these are only results from one year's research. Nevertheless, it is historically the first comparison of the original wild hops within four countries.

ACKNOWLEDGEMENT:

This work was supported by the Ministry of Education, Youth and Sports of CR in project M6832: "The search of wild hop populations in North Osetia region" and "National Program of Conservation and Utilization of Genetic Resources in Plants and Biodiversity" (MZE 33083/03-300 6.2.1) issued by Czech Ministry of Agriculture