

Editorial

DATA REGARDING THE EVOLUTION OF HOP CULTIVATED IN ROMANIA

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Abstract: Hop is used worldwide and in Romania since ancient times. This paper presents: the origin, usage and evolution of hop crop. This plant is cultivated in order to ensure the necessary of cones (female inflorescences) for the beer industry, although the plant has other uses like: young shoots - as food (soups, salads, etc.), and cones - for therapeutic or aromatic purposes. In this paper we mention the period since when hops were cultivated and initiated in our country, then details how this culture has evolved to the present day. The evolution of hop crop in Romania is presented according to the following structure: the existing culture at the beginning of the 20th century; between the two world wars; in the period 1950-1970; the development of hop cultivation between 1970 and 1990 and the situation of hop cultivation after 1990 until 2020. It mentions the age of the use and initiation of hop cultivation in our country, then details how this culture has evolved to the present day.

Keywords: evolution of hop culture, hops, Romania.

1. Indications concerning the origin, use and initiation of hop cultivation.

Cultivated hops (*Humulus lupulus* L., ssp. *europaeus* Ryb., var. *culta* Ryb.) is a perennial plant, voluble, unisexual-dioecious, cross pollinated, comes from the spontaneous hops (*H. lupulus* L., ssp. *europaeus* Ryb., var. *spontaneae* Ryb.), taken in culture (Rybacek *et al.*, 1980). In a way of multiplication, there is not a big biological difference between the two

varieties of hops (spontaneous and cultivated). By plant breeding the cultivated hop, it was obtained many varieties with a higher numbers of cones per plant, more cone bracts and a finer rachis, a higher lupine content, richer in alpha acids and more aromatic than the spontaneous form.

Regarding the geographical area of hops, opinions are divided, mentioning the following areas: the mountainous area of the Mediterranean coast (Vavilov, 1935, quoted by Ceapoiu and Potlog, 1960), Europe and Central Asia (Jukovski, 1953), Eurasia (Velican, 1965), the fertile valleys of the Caucasus and the Black Sea coast (Vent *et al.*, 1963), the last opinion being more widely accepted today. From this genetic centre of the species, cultivated hops it was spread mainly in the areas of western and central Europe (III-V century), through migratory peoples, especially the Slavs, who used it to flavour drinks obtained from barley (Vent *et al.*, 1963; Kohlmann and Kastner, 1975).

The use of hops has been known since antiquity, first harvested from the spontaneous flora, then as a cultivated plant. Ancient writers mention the hop cones (female inflorescences of the plant) were used in the beverages aromatization, in the manufacture of beer and for medicinal purposes and in the treatment of diseases and pathological conditions also the young shoots from the head of the stump were used as food in different forms (soups, salads).

There are data attesting the use of hop cones, 3-5 thousand years BC, in the preparation of drinks by the Babylonians, Egyptians, etc. (Linke and Rebl, 1958). Indo-European populations used hops in brewing beer since ancient times. Plius the Elder (23-79 AD) made the first written mention of the cultivation and use of hops in Europe, in the work "Naturalis Historia", showing the use of young shoots (in the form of salad) and cones (in the preparation of soft drinks). The Romans and Greeks knew about beer, but they valued wine much more, which they had consumed since ancient times. For the Germans from the north of the Roman Empire, beer was their favourite drink, which they made from barley, oak bark and hop cones, initially from spontaneous flora (Linke and Rebl, 1958; Kohlmann and Kastner, 1975; Rybacek *et al.*, 1980; Salontai *et al.*, 1983 and 2002; Muntean, 2000b and 2003).

Hop crops have been cultivated in central and western Europe since the 7th century, and are later attested in writing. One document (from 736) attest the existence of a hop crop in the Hallertau area (Germany), another document (from 768) refers to a hop crop from France (in the Paris area),

others refer to hops grown in the Spalt region (8th century), as well as in Bohemia (year 859) (Linke and Rebl, 1958; Velican, 1965). Later, hop cultivation was also reported in Russia (10th century), England (12th century), North America (1629) etc. (Linke and Rebl, 1958; Vent *et al.*, 1963; Kohlmann and Kastner, 1975).

Hop cultivation is linked to the existence and development of the beer industry, although hop cones have also been used for medicinal or aromatic purposes for a long time (Muntean, 1990). As the beer industry developed, the area with hop culture increased, especially in the wetter and cooler areas of Europe, at the “periphery” of vine cultivation (Velican, 1965).

The hop cones (female inflorescences) are a raw material indispensable in the beer industry. They imprint the known characteristics of beer: foam, specific taste and aroma, clarity and colour, ensuring its preservability. These properties are given mainly by lupulin who is produced by cones and which contains bitter substances (bitter acids and resins), volatile oils and tannins, large amounts of tannins are also found in the rachis. No other chemical (natural or synthetic) could not replace the lupulin from hop cones to achieve the physico-chemical and gustatory properties of beer (Kohlmann and Kastner, 1975; Berzescu *et al.*, 1981; Salontai *et al.*, 1983 and 2002; Muntean *et al.*, 1995, 2001, 2003, 2008 and 2011).

2. Use and initiation of hop culture in Romania

2.1. The age of hop use in Romania. As in the countries of Central and Western Europe, in Romania, hops were used first from the spontaneous flora, then the cultivated one. The Latin poet Publius Vergilius Maro (70-19 BC) points out in *Georgica*, III, 379-380, that the Dacian from north of the Danube, produced and consumed beer, a drink prepared from barley (Suceveanu, 1998; Bărbulescu, 2001), to which they probably added either hops from the flora spontaneous, or grown in the garden system. After the conquest of Dacia by the Romans it was mentioned that they brought with them also the agricultural experience, the culture and the use of some plants. It is not excluded that from those times in Dacia, hops were used harvested from flora spontaneous or from culture, a system practiced by the Romans, as mentioned by Pliny the Old (23-79 AC) and other ancient authors.

The use of hops harvested from spontaneous flora and then that obtained from culture is mentioned in writings since the 14th century in

Transylvania, then in Moldova (15th century) and in Muntenia (16th century). Written documents on the cultivation of hops in our country date back to the 16th century (1570), although probably the first crops in the garden system were established in the 14th-15th century in the three Romanian principalities (Salontai and Muntean, 1973; Salontai, 1987 and 1999; Muntean, 1993a and 2005). The first written attestation regarding beer and brewers in our country dates from 1366, in a document from Transylvania, in which mentions the participation of “Andrew the miller and Jacob the brewer from Cluj” in a peasant uprising from the county of Florești (near Cluj) and of the craftsmen from Cluj (Bălan and Mihăilescu 1985). In a monographic study, Pascu *et al.* (1974) noted that in the Middle Ages “Cluj was inhabited by a large German population and many could not do without beer and brewers. And they really didn't miss it, because the brewers (braxatores) from Cluj were mentioned in 1366”, as shown above.

Next it shows that “Their number will increase in the coming centuries”, so that in the 16th century “brewers keep up as number and activity with bakers. Their number also increases the amount of beer; cheap beer at the expense of the modest population” (Pascu *et al.*, 1974). Around the beginning of the 18th century, the first breweries were established in Romania (Iorga, 1927).

Written documents on brewing have been known in Moldova since 1402 where the voivode Alexandru cel Bun ceded to the Moldovița Monastery between other, a brewery (‘sladniță’), and in Muntenia in 1522, when voivode Radu de Afumați received significant quantities of beer from the people of Brașov (Bălan and Mihăilescu, 1985).

2.2. The first hop crops in Romania. Hop crops were mentioned in the 16th century in Transylvania, on feudal or church domains, where beer was also produced with hops from spontaneous flora, from cultures or brought from other countries. Thus, it is recorded that at the Diocese of Alba-Iulia (in 1520) “beer was produced in the yard”, and on the Satu-Mare county (in 1570) there is also a brewery (Domus braxatoria), “the beer house where they are big barrels (*dolea maiora*)” (Prodan, 1968). A first written statement attesting to the cultivation of hops in the garden system, is the one from the records of the Satu-Mare domain, from 1570, in which it is recorded the procurement of hops for beer production, purchased and from the ‘hop garden’ (ex. *horto lupulario*), and in 1572 hops were also used “in the garden near Someș in Satu-Mare” (Prodan, 1968).

The name 'hop garden' was also used in the following centuries. Thus, at the end of the 19th century, G. Maior wrote in a paper about 'The establishment of the hop garden' (Maior, 1898).

In Moldova, Dimitrie Cantemir refers to hops in 'Descriptio Moldaviae' (1716), and in Wallachia, Ion Ionescu from Brad in 'Culture project for exploitation of Pantelimon county' (1865) and in 'Elementary Lessons in Agriculture' (1870).

In the work 'Descriptio Moldaviae' (1716), D. Cantemir presenting (in chap. XVIII) customs of engagement and wedding in Moldova and show that in the church the priest utters a wedding prayer, change the wedding rings, place wreaths on the head of the two bridegrooms, then wear them through the church, while the singers, sing the usual song on this occasion. "During this time relatives scatter money, nuts and small pieces of dried hop among those around them, to show through such parables, that he prays to God for the fruitfulness of hops and a nuts" (Cantemir, 1716), having here probably the meaning of the fruitfulness of plants useful to human, in general. Among these symbols is the hop that represents something in life of the villagers at that time, being probably even cultivated through gardens by some of them.

Ion Ionescu from Brad, in 'Elementary Lessons in Agriculture' (1870), mentions that "hop is a plant that is cultivated for female side of the flower..." ("Male flowers are of no use"), he makes some references to biology and requirements of the plant, as well as the type of cultivation, concluding with the specification that "the bitterest hops, is the best" (Ionescu de la Brad, 1865 and 1870). Ion Ionescu de la Brad supported the introduction of hops in our country, a fact proved by the proposal for the establishment of a hop plantation, made in 'Cultivation project for the exploitation of the county Pantelimon' (1865).

Among the first hop plantations in our country, we mention that from a 'iugăr' (0.58 ha), established in Cluj around 1860, with quality hops brought from abroad, on the field that became the property of the Institute of Agronomic Education in Cluj, once with its establishment (1869) (Chirițescu-Arva, 1927; Șerban, 1938). M. Chirițescu-Arva (1927) mentions that the Cluj Academy of Agriculture owns a hops ('hop garden'), belonging to the Department of Phytotechnics, used for teaching and study purposes, as well as analysis laboratories, systematic dryers with artificial heat for drying medicinal plants products and hops (Chirițescu-Arva, 1927). The production of hop cones was capitalized, by sale to the breweries from

Cluj, being well appreciated qualitatively. Thus, at an exhibition of hops from Budapest were highlighted (won the 3rd prize) cones from ‘Golding’ variety also called ‘Brambling Early’, from the group of white-green hops (Velican, 1965).

Hops, also called ‘Northern vine’ (Popovici and Cipăianu, 1912) with reference to the climatic requirements, meets favourable growing conditions in wetter and cooler areas, conditions in which the first cultures were established in our country as well. The quoted authors refer to the importance of female hop plants (which produce lupulin) and mentions the varieties found in culture: ‘De Saaz’ (Bohemia), ‘Styria’ (Austria) and ‘De Spalt’ (Bavaria). In Muntenia in those times existed breweries and possibly hop crops.

On valley Târnavă Mare, in the Sighișoara area, hops were brought and cultivated, especially by the Saxons, from about 1870, “where its culture spread well and increased in dimensions”, G. Maior showed in 1898, and further notes that “For Transylvania the autumnal hops of Württemberg proved to be superior to that of Saaz and superior even to that original, grown in Württemberg”. This culture occupies currently in Transylvania only 237 cadastrals ‘iugăr’ quot” (Maior, 1898). The same author shows, at the end of the 19th century and quot “beer consumption increases in all countries and states from year to year, and especially after the devastation of the vineyards by the *phylloxera*” (Maior, 1898).

3. The evolution of hop cultivation in Romania (between 1900-2020)

3.1. Hop culture in the early 20th century. Hop cultivation in our country spread until around the First World War, with areas of 70-140 ha between 1890 and 1910. In 1907 it is recorded that around Sighișoara 142 ha of hops were cultivated (Abraham and Ursu, 1957; Borzea and Ursu, 1975).

Around the First World War, the area cultivated with hops in Romania was about 400 ha, located around Sighișoara. During and after World War I, in the interwar period, the area under hops decreased due to weak interest manifested by farmers, but also by the massive *Pseudoperonospora humuli* attack from 1926. “Farmers who cultivated hops were forced to restore the destroyed plantations by introducing new varieties into the culture, who were much more resistant to *Pseudoperonospora*

humuli, and at the same time to fight *Pseudoperonospora humuli* with what they have at hand” (Abraham and Ursu, 1957).

3.2. The situation of hop cultivation between the two world wars.

Between the two world wars period, from 1929 to 1934 were mentioned in the culture 16-107 ha with hops with a production of cones between 3-12 q/ha. According to the data communicated in the doctoral thesis by Veronica Unțanu (1980), in Romania in the year 1936, hops were cultivated on 50 ha, with an average production of 6.8 q/ha.

Due to the poor maintenance of hop plantations and especially the attack of diseases and pests, the cultivation of this plant decreases, reaching in 1939 about 20 ha, the entire surface being in Târnava Mare county, in the Sighișoara area. Hops remained in culture on small areas until the end of the interwar period (the area cultivated being between 8 and 20 ha), as well as later (until the 50s), reaching in 1948 only 8.8 ha (Abraham and Ursu, 1957; Borza and Ursu, 1975).

The situation in which the hop culture become in Romania between the two world wars period was also determined by the position of brewers in relation with the local production of cones, after as follows, reproduced after Abraham and Ursu (1957): “Interests the brewers of the time were divided and made the hop plantations not be rebuilt on a healthy basis. Thus, some manufacturers aimed to obtain as much as possible larger productions of hop cones, because breweries were in great need of this premium material and the quantities produced in our country were very small. For these manufacturers was more advantageous to purchase hop cones produced in the country, even if they were of lower quality because their price was lower than that of imported ones. On the contrary, other breweries supported the import of hop cones, because as a result of the import they increased personal income. Moreover, imported hop cones were exempt from duties and the hop cones produced in the country, when exported, were subject to a custom duty. This situation has kept the price of indigenous hop cones very low even below cost price, which led manufacturers to neglect quality and produces only as large quantities as possible. This situation led to the even greater decline of hop plantations, the production of cones being of lower grades. Thus, it was formed the opinion of the brewing technicians that the indigenous hops are worthless and do not deserve to be used in brewing, although both the land and the climate of our country offered favourable conditions for this culture”.

“After the Second World War, until 1950, were still in cultivation 8.8 ha of hops, 4 ha at I.A.S. Sighișoara and 4.8 ha in the private sector.” (Borzea and Ursu, 1975).

3.3 Hop culture between 1950 and 1970. The first large hop plantations were created in 1950, in the state agricultural enterprises Rupea (Brașov county), Sighișoara and Albești (Mureș county) and Dumbrăveni (Sibiu county), realizing a total of 800 ha (Borzea and Ursu, 1975; Rusu, 1978), but these plantations did not have a technical-economic study and were not located on the most suitable lands. Out of 800 ha with hops, about 750 ha were planted on sloping lands, poorly productive and without possibilities to irrigate them (Borzea and Ursu, 1975). The biological planting material for these plantations was brought from Belgium and Czechoslovakia and in some cases was of poor quality. Over the years, the stumps became ill and the virus attack spread on about 80% of the plantations, leading to the degeneration of the planted material and the appearance of gaps in plantations (Borzea and Ursu, 1975). The plantations established until 1970 had wooden pillars not impregnated as a support system (which rotted after 5-6 years). The distance between the rows was on average 1.67 m, and the works were done manually or with animals. Productions made in the years 1950-1970, were between 170-670 kg/ha, due to the mentioned causes.

3.4. Development of hop culture between 1970 and 1990. In the period 1970-1976, have been made large investments, based on the development program of beer industry in Romania, developed by the Ministry of Agriculture and Food Industry, having as effect the appearance of over 1000 ha of new plantations, with a new metallic trellis support system, which allowed the widespread introduction of mechanization (Rusu, 1978). Based on this program was developed also the systematic research on this plant through a national program from 1972.

The national scientific research program ‘Hop culture’, established by the Academy of Agricultural and Forestry Sciences (in 1972), was awarded for the realization of the Faculty of Agriculture, especially the Department of Phytotechnics at the University of Agricultural Sciences and Veterinary Medicine (Agronomic Institute, until 1991) Cluj-Napoca.

Was taken into consideration the area of influence of the University, with favourable conditions for hop cultivation (hop plantations are located

in Transylvania), as well as the fact that research on this plant has been initiated, with known results (before 1972), at the Department of Phytotechnics of Cluj. We mention in this meaning, the first works on the biology and quality of the hop harvest, made by teachers from the Cluj Phytotechnics: Sanda CERNEA, Alexandru SALONTAI and Leon Sorin MUNTEAN (Cernea *et al.*, 1967-1968; Salontai *et al.*, 1969).

The main objective of this scientific research program was the introduction of technical-scientific progress in the cultivation of hops in our country, to ensure the necessary of hops for the Romanian beer industry from its own production and eliminate the imported hops cones (Salontai and Muntean, 1973, 1987 and 1990). This research program was initiated with the support of prof. dr. doc. Vasile VELICAN and coordinated - with notable results - by prof. dr. Alexandru SALONTAI (until 1997), then by prof. dr. Leon Sorin MUNTEAN. Since 1993, hop cultivation research has taken place in the "Research Centre for Hops and Medicinal Plants", from USAMV Cluj-Napoca who was established on the basis of Decision of the University Senate of 6.12.1993 (Decision Of the Rector of USA Cluj-Napoca no.84, of March 24, 1994), reconfirmed by the USAMV Cluj-Napoca Senate (25.10.2005) and coordinated (since its establishment) by prof. univ. dr. Leon Sorin MUNTEAN. Under the support of this centre, the magazine 'Hop and Medicinal Plants' is published from the year 1993 (Muntean, 1993b, 2000a and 2008). In hops was conducted research of biology and ecology, plant breeding and modernization of culture technology on ecological principles, etc. Results with practical applicability were introduced into production in the new hop plantations (established after 1970).

The new plantations were made with imported productive varieties. Except for the variety 'Saaz', the other imported varieties, 'Northern Brewer', 'Huller Bitterer', 'Record' and 'Brewers Gold', ensured good yields with a high content of bitter acids. Between 1971 and 1984 in Romania the area with hops culture increased by 1000 ha, this can be seen from the data presented in Table 1 (after Rusu, 1984). Hops have been cultivated in the pedo-climatic areas of Transylvania favourable to this plant, in the counties: Mureş, Braşov, Sibiu, Cluj, Alba and Hunedoara.

In 1977 the average production per ha increase as the result of introduction in hop cultivation technology the local and foreign scientific achievements.

Table 1

Area and production of hops in Romania (1975-1984)

| Year | 1975 | 1977 | 1982 | 1984 |
|-------------------------|------|------|------|------|
| Area (ha) | 907 | 1050 | 1566 | 1750 |
| Cone production (kg/ha) | 352 | 1160 | 1200 | 1225 |

The hops crops in Romania increased until 1990, when it reached 2620 ha, from which 2350 ha with fruit, with an average production per country of 1.1 t/ha, some units obtaining 1.5-2 t/ha (Muntean, 2015). In 1990, Romania was among the top ten cultivating countries of hops worldwide.

3.5. Hop cultivation in the period 1990-2020. Unfortunately, after 1990 the hop areas and production decreased significantly (in 1995 there were 1727 ha with fruit, in 2000 less than 500 ha, and currently about 240 ha are cultivated), one of the causes being the massive import of extract and hop granules by the big breweries in the country, privatized with majority foreign capital, making the Romanian hops production remain in stock, disturbing the financial situation of producers. By deforestation of the Romanian hop plantations, they remained with unused trellis, facilities and spaces for hop cultivation.

The lack of local hops has led to the import of this product and significant currency efforts. The hop import, has undesirable financial implications, for both breweries, as well as for hop growers and led to: cessation of investment works (new plantations, procurement of machines and equipment, etc.) due to the lack of own financial resources of the units and excessively high payments on bank loans; deforestation of large areas with hop without replanting others, leading to a drastic decrease in fruiting areas; usage of planting material with low biological value; lack of care works because of low funds, which led to a decrease in the production etc. (Ioanid, 1993; Muntean, 1996 and 1999).

Table 2 shows the area and the production of hops in Romania, between 1960 and 2010 (Muntean, 2015) and in 2020 (Mora, 2020).

Table 2

Area and production of hops in Romania (1960-2000)

| Year | Area with fruit (ha) | Total cone production (t) | Average cones production (t/ha) |
|------|----------------------|---------------------------|---------------------------------|
| 1960 | 536 | 225 | 0.5 |
| 1970 | 867 | 234 | 0.3 |
| 1980 | 1400 | 1470 | 1.1 |
| 1990 | 2350 | 2650 | 1.1 |
| 1995 | 1727 | 1657 | 1 |
| 2000 | 230 | 332 | 1.2 |
| 2010 | 240 | 300 | 1.2 |
| 2020 | 241 | 220 | 1 |

The current hop cultivation units in Romania are located in three counties (Mureş, Alba and Sibiu) shown below, with the area of hops on fruit and the production of cones, in 2020 (Mora, 2020):

* Mureş county: S.C. Moragroind SRL (138 ha, with a total production of 145 t cones); S.C. Hoptrade SRL (53 ha, with a total production of 35 t cones);

* Alba county: Horticola Aiud SRL (32 ha, with a total production of 25 t cones);

* Sibiu county: Agrosiro Serv Impex SRL (18 ha, with a total production of 15 t cones).

The hop heritage in our country is an important source of income for agricultural companies and an internal source of insurance with raw material (dry cones of hops, pellets or concentrated liquid extract) for the beer industry. This heritage is located in a favourable pedo-climatic zone and includes a high value of investments (metal trellis, machines and equipment for the whole technological flow and buildings), offering good conditions in order to achieve the proposed strategic objective, to ensure from the intern production, the need of dry cones for the Romanian beer industry and the elimination of imports.

In the strategy of restoring the hop heritage and developing the culture of this plant in our country we must start from the current situation in hop farms, taking the required measures, differentiated from a case-by-

case. Thus in all situations it is necessary to realize: mass plantations corresponding to the mechanization of the culture and endowments with the required equipment for a complete processing to the finished product (pressed and packed dry cones or processed in the form of granules); planting native and foreign varieties recommended for our country, using rooted material, free of viruses; applying the cultivation technologies that can allow the realization of high production of quality and profitable.

We hope that the decision-making forums in the field of agriculture will take the appropriate measures for Romania to become one of the major hop-growing countries, given the particularly favourable ecological conditions for hops in our country, the base material existing on farms (metal trellis, machines and equipment specific to hop cultivation), as well as the specialists in research and production.

References

1. Abraham, P., Ursu I. (1957). Cultura hameiului, EAS, București.
2. Bălan, St., Mihăilescu St. N. (1985). Istoria științei și tehnicii în România – date cronologice, Ed. Academiei, București.
3. Bărbulescu, Maria (2001). Viața rurală în Dobrogea romană (sec. I-III, P.CHR.), Muzeul de Istorie Națională și Arheologie, Constanța, p. 204.
4. Berzescu, P. *et al.* (1981). Tehnologia berii și a malțului, Ed. Ceres, București.
5. Borzea, I., Ursu I. (1975). Lucrările primului Simpozion Cultura Hameiului în România, p. 7-13.
6. Camentir, D. (1716). *Descriptio Moldaviae*, Ed. Minerva, 1981, București.
7. Ceapoiu, N., Potlog A.S. (1960). Ameliorarea plantelor agricole, vol. I, EAS, București.
8. Cernea, Sanda, Salontai, Al., Muntean, L.S. (1967-1968). Lucrări științifice Inst. Agr. Cluj, seria Agricultură, vol. 23-24, p. 233-245.
9. Chirițescu-Arva, M. (1927). Academia de Agricultură, l'Academie d'Agriculture Cluj, Roumanie, Tipografia "Cartea Românească", SA Cluj.
10. Ionescu, I. de la Brad (1865, 1870). În Opere agricole, vol. I, de A. Vasiliu și col. 1968, Ed. Academiei, București.
11. Ioanid, Al. (1993). Lucrările celui de-al VII-lea Simpozion Cultura

- hameiului în România, p.28-32.
12. Iorga, N. (1927). Istoria industriilor în România, București.
 13. Jukovski, P.M. (1953). Botanica, Ed. de Stat, București.
 14. Kohlmann, H., Kastner, A. (1975). Der Hopfen, Hopfen Verlag Wolnzack, Germania.
 15. Linke, W., Rebl A. (1958). La culture de houblon, DUNOD, Paris.
 16. Maior, G. (1898). Manual de agricultură rațională, Fitotehnia, București.
 17. Mora, A.E. (2020). Surface and hop production in Romania, Association of Hop Producers in Romania.
 18. Muntean, L.S. (1990). Plante medicinale și aromatice cultivate în România, Ed. Dacia Cluj-Napoca.
 19. Muntean, L.S. (1993a). Fitotehnie, vol. II (cap. Hameiul), Tipo Agronomia Cluj- Napoca.
 20. Muntean, L.S. (1993b). Hameiul și plantele medicinale, an I, nr.1, p.8-15 and nr.2 p.9-20.
 21. Muntean, L.S. (1995, 2001, 2003). Hameiul în Fitotehnie (L.S. Muntean *et al.*), Editura Didactică și Pedagogică, București (1995), Ed. Ion Ionescu de la Brad, Iași (2001 și 2003).
 22. Muntean, L.S. (1996). Hameiul și plantele medicinale, an IV, nr. 1-2(7-8), p. 9-18.
 23. Muntean, L.S. (1999). Hameiul și plantele medicinale, an VII, nr. 1-2(13-14), p. 9-16.
 24. Muntean, L.S. (2000a). Buletinul USAMV Cluj-N., Vol. 54, seria Agricultură, p. 5-10.
 25. Muntean, L.S. (2000b). Hameiul și plantele medicinale, an VIII, nr.1-2 (15-16), p. 5-17.
 26. Muntean, L.S. (2002). Hameiul și plantele medicinale, an X, nr. 1-2 (19-20), p. 13-34.
 27. Muntean, L.S., Muntean L., Muntean S., (2003). Mic tratat de Fitotehnie, vol. 3, Ed. Risoprint, Cluj-Napoca.
 28. Muntean L.S. (2005). Hameiul și plantele medicinale, an XIII, vol.1-2 (25-26), p.11-30.
 29. Muntean L.S. (2008). Hop and Medicinal Plants, year XVI, No.1-2, Hameiul și plantele medicinale, an XVI, vol.1-2 (31-32), p.26-29.
 30. Muntean, L.S. (2008, 2011). Hameiul în Fitotehnie (L.S. Muntean *et al.*), Ed. AcademicPres Cluj-Napoca (2008) și Ed. Risoprint

- Cluj-Napoca (2011, 2014).
31. Muntean, L.S. (2015). Hop and Medicinal Plants, year XXIII, No.1-2, p.7-26.
 32. Pascu, ST. *et al.* (1974). Istoria Clujului, I.P. Cluj.
 33. Popovici, M., Cipăianu, G. (1912). Manual de agricultură, București.
 34. Prodan, P. (1968). Iobăgia în Transilvania în secolul al XVI, vol. II, Ed. Academiei Române, București.
 35. Rusu, C. (1978). Lucrările celui de-al II-lea Simpozion Cultura Hameiului în România, p. 7-11.
 36. Rusu, C. (1984). Lucrările celui de-al IV-lea Simpozion Cultura Hameiului în România, p. 9-15.
 37. Rybacek, V. *et al.* (1980). Chmelasrtvi, Praha.
 38. Salontai, Al., Cernea Sanda, Muntean, L.S. (1969). Lucrări științifice Inst. Agr. Cluj, seria Agricultură, vol. XXV, p. 159-162.
 39. Salontai, Al., Muntean, L.S. (1973). Probleme agricole, nr. 6, p. 34-40.
 40. Salontai, Al., Bobeș, I., Perju, T. (1983). Cultura hameiului, Ed. Ceres, București.
 41. Salontai, Al. (1987). Lucrările celui de-al V-lea Simpozion Cultura Hameiului în România, Tipo. Agronomia, p. 13-20.
 42. Salontai, Al., Muntean, L.S. (1987). Lucrările celui de-al V-lea Simpozion Cultura Hameiului în România, Tipo. Agronomia, p. 27-34.
 43. Salontai, Al., Muntean, L.S. (1990). Lucrările celui de-al VI-lea Simpozion Cultura Hameiului în România, Tipo. Agronomia, p. 9-16.
 44. Salontai, Al. (1999). Hameiul și plantele medicinale, an VII, nr. 1-2(13-14), p. 17-28.
 45. Salontai, Al., Muste S., Tofană M., Puia C., Bunescu H. (2002). Hameiul, Ed. Risoprint, Cluj-Napoca.
 46. Suceveanu, Al. (1998). Fântânel - contribuții la studiul vieții rurale în Dobrogea romană, Ed. Academiei Române, București, p. 73.
 47. Șerban, M. (1938). Dare de seamă, 1918-1939, Academia de Înalte Studii Agronomice Cluj.
 48. Unțanu, Veronica (1980). Cercetări privind combaterea integrată a micozelor hameiului la Ferma Seleuș IAS Sighișoara, Teză de doctorat, Institut Agronomic Cluj- Napoca.
 49. Velican, V. (1965). Hameiul în Fitotehnie, vol. II, EAS, București.
 50. Vent, L. *et al.* (1963). Chmelarstvi, Praha.

51. *** Decision of the UAS Senate Cluj-Napoca of 6.12.1993 regarding the establishment of the “Hop Culture and Medicinal Plants Research Center” (CCCHPM) (in the university).
- 52.*** Decision of the Rector of UAS Cluj-Napoca, no.84 from 24.03.1994 (with reference to the establishment CCCHPM).
- 53.*** Decision of the UASMV Cluj-Napoca Senate of 25.10.2005, regarding the analysis and accreditation of the Hops Culture and Medicinal Plants Research Centre.
54. *** Statistical yearbook of Romania, 1980-2020.
55. *** Production Yearbook, FAO Roma, 2020.