

## BARLEY VARIETIES CREATED AND REGISTERED IN ROMANIA DURING 1921-2018 PERIOD

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### Abstract

Nowadays barley (*Hordeum vulgare* L.) has become the fifth crop as importance worldwide. Although barley crop has a high adaptability in different geographic regions, according to FAO data the harvested areas have registered a decreasing trend during last decades at international level, from 83.69 million ha in 1979 to 47.00 million ha in 2017. In Romania, the barley harvested area in the period 1961-2017 registered an increase from 195,500 ha in 1964 to a maximum of 1,017,736 ha in 1991, so that to decrease after that to 455,460 ha in 2017, with a minimum harvested area in the period after 1991 of 317,235 ha in the year 2003.

The objective of the present paper was to analyse the evolution of barley varieties (winter and spring) created and registered in Romania during 1921-2018. In this respect, different informational sources were collected, analysed and a barley varieties database was created since 1960 till 2018.

In Romania, the barley history begins in 1675, when the first mention about barley was made by Nicolae Milescu, but only in 1880 appears some published data about cultivated area. During 1921-2018 period, in Romania has been registered a total number of 149 barley varieties.

Among the winter six-row barley varieties cultivated in Romania, the Miraj variety registered the highest lifespan, being cultivated for 29 years and being cultivated on 1.01 million hectares in 1991. The record lifespan for winter two-row barley was registered by Andreea variety with 23 years, while for spring two-row barley the record was registered by Dvoran variety with 26 years.

**Key words:** barley, varieties, traits, Romania.

### INTRODUCTION

Barley (*Hordeum vulgare* L.) ranks the fifth place as world harvested area, after wheat, maize, rice, and soybeans. It is used as raw material in the malt and beer industry, as feed for livestock, but also as food for human alimentation, either pure or combined with other cereals.

The cereal production (including rice) in the EU was 295.5 million tons in 2018 (about 11.1% of global production). This represented a decrease of 4.6% or 14.4 million tons compared to 2017, due especially to abiotic stress, respectively high-level temperature during the main developmental plant stages registered in many of Central and Southern European regions, while the cultivated areas remained almost the same, being between 55.5 and 55.6 million hectares. To put this in some context, the EU's production of cereals in 2018 was

some 37 million tons lower than the record harvest of 332.6 million tons registered in 2014 (Eurostat database).

In the general context described above regarding the cereal situation in EU, the EU production of barley in 2018 was of 56.7 million tonnes, with a decrease of 2 million tons compared to 2017 (58.7 million tons), the lower harvested production reflecting the drought conditions for growing barley.

Barley is one of the most genetically diverse cereals which is categorized as spring or winter types, two-row or six-row, hulled or hullless by the presence or absence of hull tightly adhering to the grain, and malting or feed by end-use type; therefore, breeding programs depend on high level of genetic diversity which provides a significant opportunity for achieving progress (Gozukirmizi & Karlik, 2017). All barley breeding programs have as main objective to develop new genotypes that have some

improvement over existing variety traits like yield potential, resistance to biotic and abiotic stress factors as well as proper end-use quality. Also, one of the main barley breeding objectives is creation of barley varieties suitable for malt and beer production (Matthies et al., 2014) because the key to success in the seed and seed market for malt and beer industry depends to quality parameters of barley variety (Križanova et al., 2010).

The obtained results until present, concerning the latest Romanian winter barley varieties registered in Romanian Official Catalogue of the Varieties and Plant Species, had demonstrated a significant progress regarding the stability of yield potential and also stability of grain quality parameters (Vasilescu et al., 2014). Practically, the Romanian barley breeding program has been developed many barley varieties with increased yielding potential and significant improvements regarding the resistance to biotic and abiotic stress factors.

Usually, after minimum of 8 years from crossing genotypes, breeders choose the best lines depending on their traits (high yield potential, improved quality, presence of different genes for resistance to biotic and abiotic stress factors), and introduce them into the official testing procedures for official registration of that lines in the countries they are testing them. After that, lines have to pass minimum two years DUS (D-distinctiveness, U-uniformity, S-stability) and three years VCU (Value for Cultivation and Use) tests to be allowed for official registration.

The Romanian Official Catalogue of the Varieties and Plant Species represents a real support for farmers, due to a professional and constantly evaluation system for new barley varieties registration, developed to ensure the cultivation of only performant varieties.

Regarding the research methods used to obtain the barley varieties, these are different from a barley breeding program to another. In the present time, there are used two methods: conventional breeding and *bulbosum* method. Bulbosum method consists in the interspecific hybridization of cultivated barley (*Hordeum vulgare* L.) with *Hordeum bulbosum* L. (Kasha & Kao, 1970). Scientists and breeders rapidly adopted the bulbosum method because DH

(doubled haploids) provide several advantages over standard selection and breeding methods (Devaux, 2003).

Since 1992, a program for the induction and production of haploids lines was initiated in winter six-row and two-row barley Romanian breeding program by using the *bulbosum* method. The principle was adapted and developed at National Agricultural Research and Development Institute of Fundulea (NARDI Fundulea), Romania, in order to ensure the achievement of absolute genetic uniformity (which corresponds with requested criteria DUS and VCU). This represented an approach to obtain a significant improvement of seed quality parameters.

Compared to the conventional breeding method (based on individual selection), whose cycles amount to 10-12 years, the new method leads to a significant shortening of the duration for obtaining new winter barley varieties, up to 5 years (Bude and Vasilescu, 2007).

In Romania, the high barley level yield and the yield quality are highly dependent on the grown variety and climatic conditions during vegetation period.

The objective of the present paper was to analyse the evolution of barley varieties (winter and spring) created and registered in Romania during 1921-2018.

## MATERIALS AND METHODS

The analyse of the barley varieties (winter and spring) created and registered in Romania during 1921-2018 was made by studding the collection of the Romanian Official Catalogue of the Varieties of Plant Species and different documentation sources. The Romanian Official Catalogue is annually updated, and therefore, in order to be registered, all barley genotype needs to achieve preliminary tests (DUS and VCU) to the State Institute for Variety Testing and Registration from Romania.

To accomplish the paper objective, a database was created with all winter barley varieties (two-row and six-row barley varieties), facultative (six-row barley varieties) and spring barley varieties (two-row barley varieties) registered and included into the Romania Official Catalogue of the Varieties of Plant Species (from 1960 up to 2018). The database

was helpful to calculate the number of barley varieties (winter, facultative and spring) registered during the entire analysed period, the lifespan of them (number of years that the barley varieties were officially allowed to be cultivated since 1960 up to 2018). Also this gave us the possibility to discover the history of this cereal crop in Romania (Drăghici et al., 1975).

Three main analysed periods were the following:

- 1921-1944 period, which represents the beginnings of agricultural research in Romania due to foundation of Institute of Agronomic Research of Romania (I.C.A.R.) in May 1927. This was the beginning of an unprecedented development of agricultural research in Romania.
- 1945-1980 period, when starting with the year 1962, the activity of creation of winter barley varieties was taken over by the Research Institute for Cereal and Industrial Crops from Fundulea - ICCPT Fundulea (the present National Agricultural Research and Development Institute from Fundulea - NARDI Fundulea), and in 1968 the first winter barley variety was obtained (winter six-row barley variety namely Intensiv 1).
- 1981-2018 period, when in barley breeding program there was used a new barley germplasm from different continents, and the registered barley varieties as number and origin drastically has changed. In 2007, Romania joined the European Union and all the new winter and spring barley registered varieties had to fulfill distinctiveness, uniformity and stability criteria.

## RESULTS AND DISCUSSIONS

### Period 1921-1944

At the beginning of the 10<sup>th</sup> century, there was a significant demographic increase that has led to the development of agriculture in the southeastern areas of the Carpathians. However, the first mentions referring to the barley crop appear in the notes of Nicolae Milescu from 1675-1678.

Another mention was made in 1868 by Ion Ionescu de la Brad, stating that although the soil provides good growing conditions for millet, barley and oat crops, the areas cultivated

with them did not provide the necessary products (Drăghici et al., 1975).

Petre Sebeşanu Aurelian mentioned in 1875 that barley ranks the 3<sup>rd</sup> place as cultivated area in Romania, after wheat and maize, at that time being cultivated on 250,000 hectares.

The beginnings of agricultural research in Romania, from the second half of the 19<sup>th</sup> century and especially at the beginning of the 20<sup>th</sup> century, were due to the great agronomists such as Gheorghe Ionescu-Şişeşti, Teodor Seidel, Traian Săvulescu, Wilhelm Karl W. Knechtel and many others who have integrated Romanian agricultural sciences into the modernization current that was manifested at that time throughout the world. On this basis, the Institute of Agronomic Research of Romania (I.C.A.R.) was established by law no. 1205, voted on 4 May 1927.

In 1927, Nowacki mentioned that during 1922-1926 period, barley was cultivated on an area of over 1.7 million hectares, ranking third place after maize and wheat. Another important mention was that barley areas were occupied 94.5% with spring varieties and only 5.5% were sown with winter varieties (Nowacki, 1927). These data are confirmed by Munteanu (1929), who also mentioned that the most cultivated varieties at that time were Chevalier, Hanna and Imperial, these varieties being the best acclimatized to the Romanian conditions.

In the period preceding the establishment of ICAR (1921-1927), Walter Mader and Friedrich Dotzler created at Cenad farm, from Timiş county (located into West of Romania), the first barley Romanian varieties, respectively the spring two-row varieties named Sămînţa nr. 3 and Cenad 375 and the winter six-row varieties named Sămînţa nr. 112, Cenad 395 and Extensiv 1. These varieties were created by individual selection from the Banat local populations (Bude & Vasilescu, 2007)

In the decade 1930-1940, maize and some technical plants expanded extensively in Romania. As a consequence, the areas cultivated with barley fell in order to reach 839,200 ha in the period 1934-1938, preserving approximately the same proportion between the spring and winter cultivated barley. At that time, an average yield of 720 kg/ha was achieved, with an annual production of about 600,000 tonnes (Drăghici et al., 1975).

Both in the years of World War II and thereafter, from a quantitative point of view, a little quantity of seeds of the cultivated varieties was produced, and therefore the barley cultivated areas decreased drastically.

In 1940, at the Experimental Stations Cluj and Câmpia Turzii, there was created the spring two-row barley variety named Cluj 123. Two years later, in the Iași county, there was created the spring two-row barley variety Tg. Frumos 240. In the same year, at Cenad Experimental Station, a facultative six-row barley variety was created by Ecaterina Constantinescu, namely Cenad 396, which represented a cross between Cenad 395 and Extensiv 1 varieties.

### **Period 1945-1980**

In 1949, at the Breeding Plant Section from the Research Agricultural Institute of Bucharest, there was created the spring barley variety with four rows, namely I.C.A.R. 143.

In 1959, at Cenad Experimental Station, Șiclovan obtained the six-row barley variety named Cenad 345 (facultative barley variety). This variety was characterised by increased resistance to frost, which led to the expansion of the winter barley in Romania. Also, in 1960 there was registered a new spring two-row barley variety, named Perfecta.

The success of the Fundulea Maize Research Institute's initiatives, with direct and immediate economic effects in the Romanian agriculture, has created a tendency to gradually expand the concerns of this Institute.

In 1961, on May 22, the Fundulea Maize Research Institute was unified with the Institute of Agronomic Research of Romania, forming the Institute of Agricultural Research (ICA Bucharest-Fundulea), which becomes in May 1962 (by law no. 1/1962, art. 26) Research Institute for Cereals and Industrial Plants, located in Fundulea, Călărași county (ICCPT Fundulea). The Institute was subordinated to the Central Institute for Agricultural Research (ICCA), as the head of all agricultural research in Romania, a function subsequently taken over by the Academy of Agricultural and Forestry Sciences (ASAS, 1969).

Starting with the year 1962, the activity of creation of varieties of winter barley was taken over by ICCPT Fundulea, and in 1968 the first winter six-row barley, named Intensiv 1, was

obtained. This barley variety was the most widespread in Romania and occupied over 80% of the cultivated area with winter barley. Two years earlier (1966), there were registered in the Romania Official Catalogue of the Varieties of Plant Species another two spring varieties, Karlsberg and Proctor.

During 1971-1974 period, in the Romanian Official Catalogue of the Varieties of Plant Species, there were registered seven winter six-row barley varieties (Caracal 6, Cluj 230, Ager, Intensiv 2, Miraj, Nr. 1050, and Pamina), five winter two-row varieties (Beta with two rows, Gloria, Sofia 3, Sofia 4, and Azuga) and five spring two-row variety (Dvoran, Alsa, Elgina, MK 42, and Taplani).

In 1973, the first six-row facultative barley variety was created at ICCPT Fundulea, this being named Intensiv 2. In comparison to the Intensiv 1 barley variety, this was imposed into practice because it could be sown in the spring as well, this variety occupying at that time about 5% from the total cultivated barley area in Romania.

Azuga is the first local winter two-row variety created by ICCPT Fundulea by crossing a winter two-row barley variety with a spring two-row barley variety. In the same year (1974), there was obtained the winter six-row barley variety named Miraj, both varieties being introduced into production, respectively they were started to be cultivated in 1974.

Azuga variety was characterized by superior technological quality, but the level of resistance to frost was lower, this being recommended for cultivation only in the plain areas of the western part of Romania, as well as in Muntenia and Oltenia regions. On the other hand, Miraj variety, only 5 years after its approval, has replaced all the other barley varieties usually sown in the autumn.

In 1980, Miraj variety was cultivated on over 900,000 hectares, this representing the largest cultivated area by a winter six-row barley variety until present days. The generalization of the Miraj variety over the entire Romanian area cultivated with barley in 5 years since its approval has been a remarkable contribution to the agricultural production increase. At the same time, the Miraj variety was grown on large areas in countries such as Bulgaria and Turkey.

In the 1975-1980 period, only two winter six-row barley variety were registered (Robur and Valja), one winter two-row barley variety in 1977, named Victoria (which has achieved an increased yield level above the Azuga variety), eight spring two-row barley varieties (Ametist, Triumph, Peast, Belfor, Pauline, Favorit, Rapid, and Spartan) and 4 winter two-row varieties (Kelibia, Novosadski 290, Kristal, and Ladoga).

In 1961, the barley cultivated area in Romania was of 284,000 ha and since 1965 up to 1980 it has been registered an increase from 232,771 ha to 809,457 ha (Figure 1).

An historical barley cultivated area in Romania was registered in 1981 and 1982 with 916,975 ha and 943,061 ha, respectively, followed then by a slight decrease.

The average barley yield (Figure 2) also increased from 1,648 kg/ha to a maximum of 3,193 kg/ha in 1978 (Eurostat database).

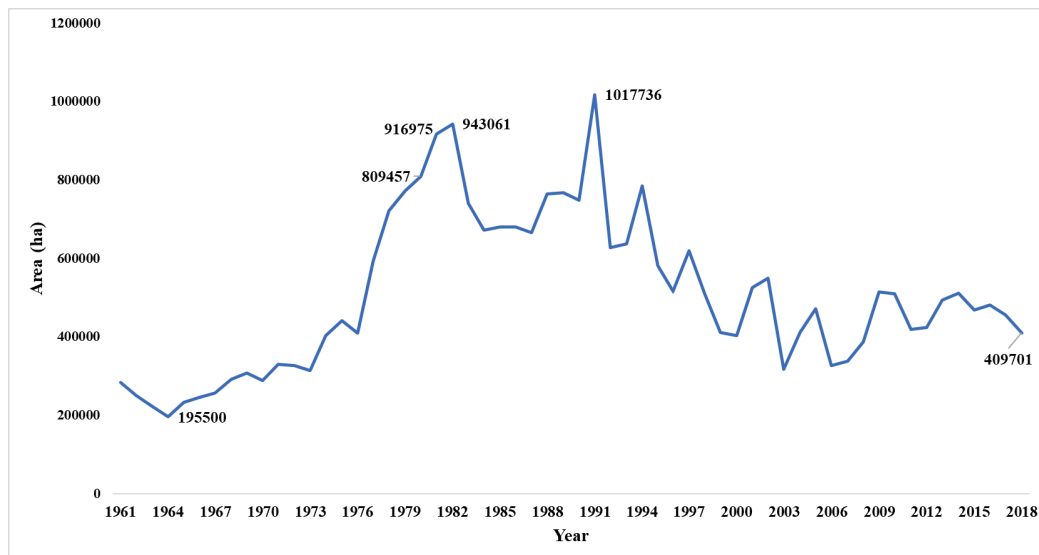


Figure 1. Evolution of barley cultivated area in Romania, during the 1961-2018 period

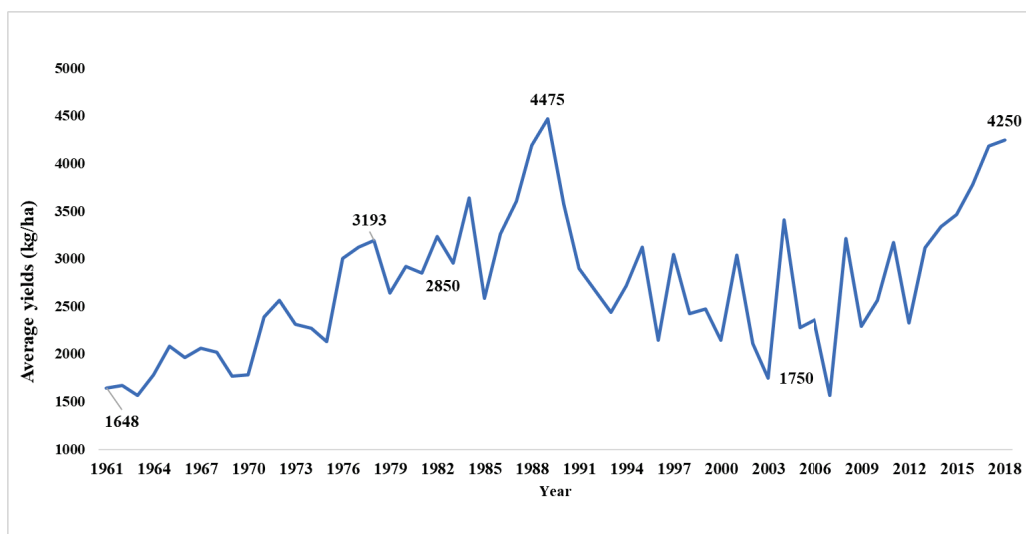


Figure 2. Evolution of barley average yield in Romania, during the 1961-2018 period

Regarding the number of registered barley varieties in the Romanian Official Catalogue of the Varieties of Plant Species, during the analysed period, there were registered a number of 15 spring two-row varieties, 7 winter two-row varieties and 12 winter six-row varieties.

### **Period 1981-2018**

During this period, there were registered more spring varieties comparing with winter barley six and two-row varieties.

In 1981, five barley varieties were registered, respectively: the winter six-row barley varieties Productiv and Novisad 27; the winter two-row barley variety Grivița; the spring two-row barley varieties Grit and Koral. The winter six-row barley variety Productiv, with an increased yield potential by more than 150 kg/ha, represented the first step in valuing barley North American germplasm. The achievements in terms of the yield potential of the existing varieties have also generated negative effects in the malt and beer processing industry due to the unevenness of the grains, an essential condition for the malting process, so the improvement targets are suddenly directed towards improving two quality parameters, the size and uniformity of the grains. Also, in the same year, the breeding works brought satisfactory results in the winter two-row barley, combining the precocity with the size of the grains in the winter two-row variety Grivița.

In 1986, there was registered the winter six-row variety Precoce, which despite the fact that it did not record so high yield it was highlighted by superior grain size to the other barley varieties homologated until that time.

In 1992, by individual selection of the Grivița variety and by making an improvement of the resistance to frost and drought, Laura variety was registered, this achieving a yield increase by 7%.

In 1993, winter six-row barley variety Dana was registered, this showing a yield increase by 8% over Miraj variety. Since then up to date, due to the anthocyanin colour of the awn but also to a high yielding capacity, Dana variety was used as check in most of the breeding works. The winter six-row barley variety Amical (previous Adi) was registered in the

same year, and due to its resistance to lodging, it achieved 8-10% higher yield than Miraj variety.

In 1994, the winter two-row barley variety Andreea was registered, this possessing both yield increases due to a higher tilling capacity and quality parameters for raw industry (malt and beer). Also in 1994, by hybridization between the Miraj variety and a Mexican line, followed by individual selection, there was obtained and registered the winter six-row barley variety Mădălin, which is characterized by harvest stability and resistance to the main foliar barley disease. In 18 crop growing conditions, Mădălin variety obtained a higher yield by 8-9% than the check.

In 1996, the Sistem (previous Orizont) winter six-row barley variety was obtained by the same method as Mădălin variety. Sistem variety is characterised by shorter straw that gives to it good resistance to lodging.

In 1998, the Compact winter six-row barley variety was registered, this having dense spikes and being the only local variety belonging to the *paralellum* variety. Also in 1998, the Productiv variety and a German line whose genes with resistance to thermic and hydric stress was combined harmoniously in the winter six-row barley variety Andrei, which in the 14 experimental stations, located in all areas of barley cultivation all over Romania registered a yield increase of nearly 500 kg/ha compared to Dana variety.

Registered in 2000 and tested in 14 agricultural research stations, the winter six-row barley variety Mareșal (previous Regal) confirms the high yield potential and a good resistance to foliar diseases.

Uniformity of grains, yield stability, resistance to main foliar diseases, reduction of growing period, all these attributes are found in facultative six-row barley variety Cardinal FD, registered in 2003 and obtained from a local line combined with a German line. Cardinal FD variety confirmed a yield potential increase by 9-10% over the Dana variety check. One year later (2004), the winter six-row barley variety Univers was registered, this being tested in 42 conditions in 14 different locations, and showing an increase yield by 4% to its successor Dana variety.

During 2012-2017 period, three six-row barley varieties (Ametist, Smarald, and Simbol) were registered in the Romanian Official Catalogue of the Varieties of Plant Species, these having improved agronomic traits. The winter six-row barley variety Ametist (registered in 2012) represents a genetic progress with an increase of grain weight by 2 units compared to other barley genotypes with six rows. Ametist variety combines the size of grains with a superior level of average starch content, with high yield performance (7.5% increase in yield compared to winter two-row barley variety Andreea). The winter two-row barley variety Artemis (registered in 2012) represents a progress regarding the tolerance to pathogenic agent *Pyrenophora teres f. teres* and resistance to lodging.

The facultative six-row barley variety Smarald (registered in 2013) is the first barley variety created by biotechnological method *bulbosum*, which has a remarkable adaptability but also improved resistance to lodging and hydric stress. It is the first variety with a superior stability of quality parameters (average starch content 62.7% and average protein content 11.0%), being suitable as raw material in beer industry.

Winter six-row barley variety Symbol (registered in 2015) is tolerant to *Pyrenophora teres f. teres* pathogen and is distinguished by the particular capacity to achieve high yields at lower plant densities. It has a special flexibility regarding the sowing season, being well adapted to later sowing (in first decade of November), producing higher yields than other Romanian barley varieties under such conditions.

In 2017, two winter barley varieties were registered, respectively the winter six-row barley variety Onix and the winter two-row barley variety Gabriela (the second variety obtained by *bulbosum* method). A year later (2018), another winter six-row barley variety was registered, named Lucian.

Besides the mentioned varieties, according to Romanian Official Catalogue of the Varieties of Plant Species there were registered 14 winter six-row barley varieties, 25 winter two-row barley varieties and 45 spring two-row barley varieties.

In the period 1971-2018 (Figure 3), the number of winter six-row barley varieties registered annually in Romania, varied between 2 (1982, 1983, and 2007 year) and 16 (2008 year).

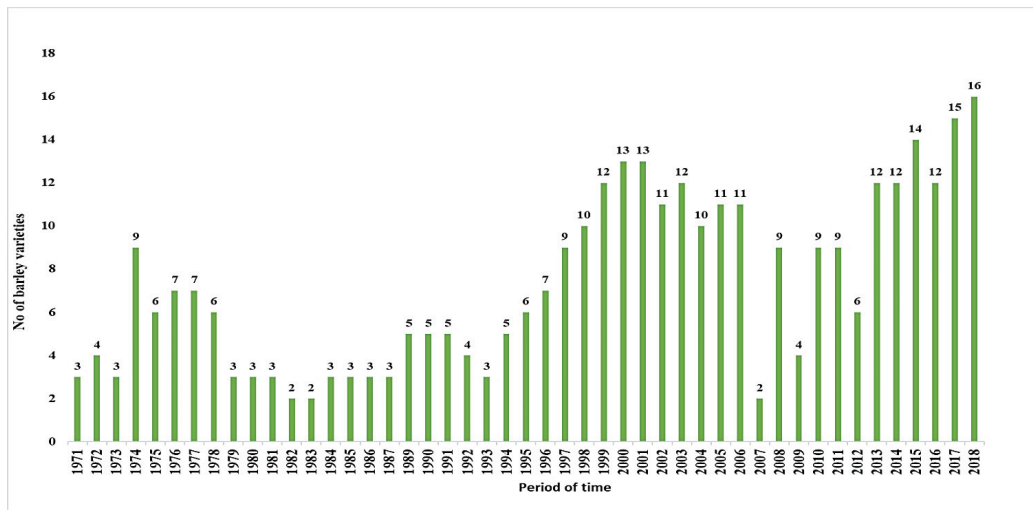


Figure 3. Number of the winter six-row barley varieties registered to be cultivated annually in Romania (included in the Official Catalogues of the Varieties of Plant Species)

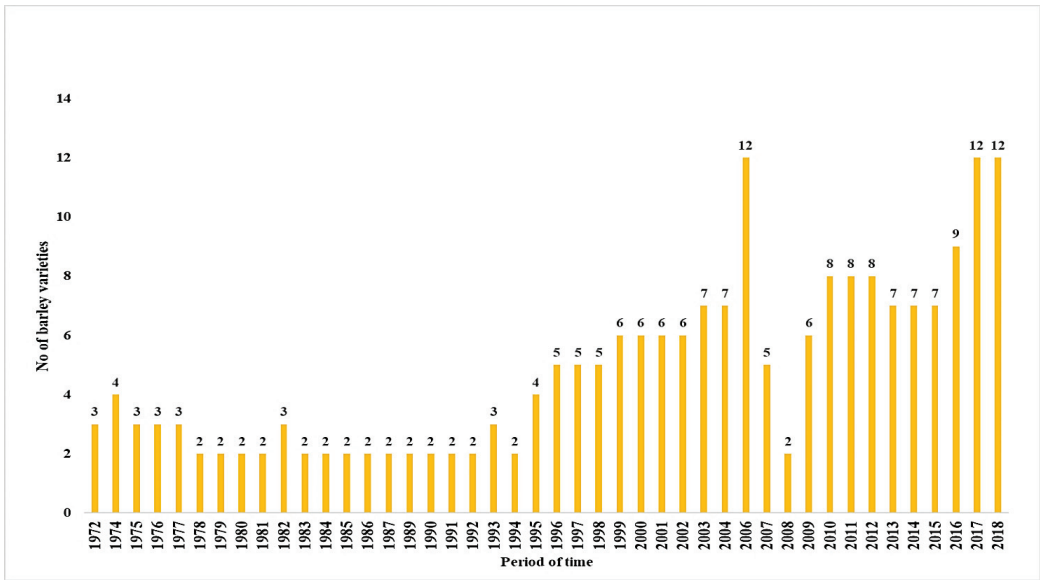


Figure 4. Number of the winter two-row barley varieties registered to be cultivated annually in Romania (included in the Official Catalogues of the Varieties of Plant Species)

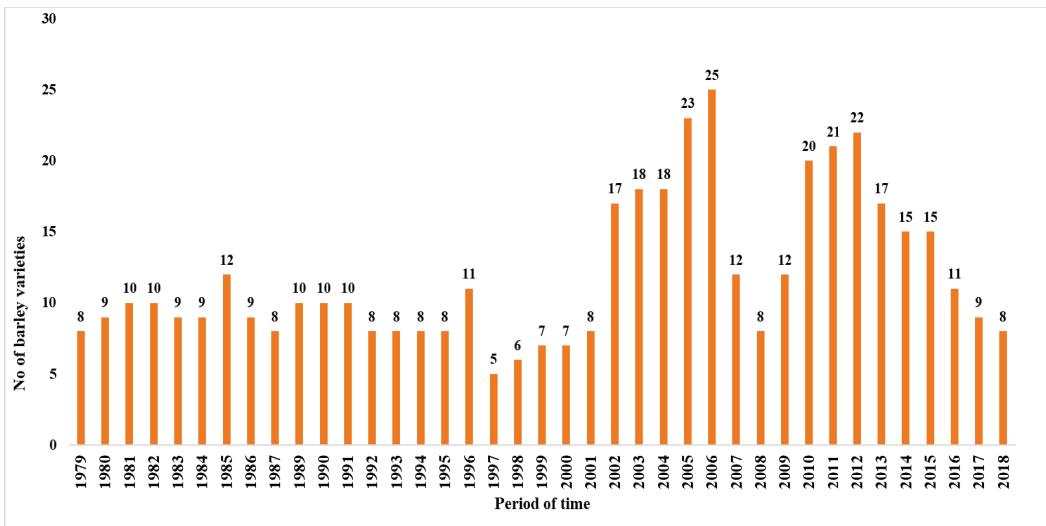


Figure 5. Number of the spring two-row barley varieties registered to be cultivated annually in Romania (included in the Official Catalogues of the Varieties of Plant Species)

During 1972-2018 period, the number of winter two-row barley varieties registered annually in Romania was between 2 and 12 (Figure 4), meanwhile the number of spring two-row barley varieties ranged between 5 and 25 (Figure 5). A decrease of number of barley

varieties occurred in 2007 year when Romania joined the European Union.

The highest barley cultivated area was registered in 1991, with 1,017,736 ha (Figure 1), when the Romanian winter six-row barley variety Miraj was sown on about 900,000 ha. The highest historical average



yield at barley in Romania was registered in 1989, with 4,475 kg/ha (Figure 2). Since then, the average yield varied from year to year. Thus, in 2003, due to lower temperatures and lack of snow cover during winter season, the obtained average yield was only of 1,750 kg/ha. But, the lowest historical average yield at barley in Romania of 1,568 kg/ha was registered in 2007, this year being characterised as one of the most drought year in the cereal vegetation period. In 2018, Romania's production of barley was of 1.8 million tons with a constant increase of total production, the average for the last 10 years being of 1.3 million tons, this representing 3% of total EU barley production (Agriculture, Forestry and Fishery Statistical Book, 2018). In 2018, the cultivated area with barley in Romania was of 409,701 ha (Figure 1), which represents 40.3% from the maximum cultivated area with barley in 1991 (Eurostat database), while the average yield has increased to 4,250 kg/ha (Figure 2). Comparing the obtained results in 1945-1980

analysed period, the number of barley varieties registered was 46, with an average lifespan registered between 5.3 and 9.6 years. Regarding 1981-2018 period, the number of barley varieties increased to 96 and also the average lifespan for winter six-row and two-row barley varieties, meanwhile for spring two-row barley varieties decreased.

For winter six-row barley varieties, the lifespan was in average of 9.1 years, with a variation from 1 to 29 years (Figure 6). The variety with the highest lifespan was Miraj (29 years).

For winter two-row barley varieties, the lifespan was in average of 5.3 years, with a variation from 2 to 23 years (Figure 7). The variety with the highest lifespan was Andreea (23 years).

For spring two-row barley varieties, the lifespan was in average of 9.6 years, with a variation from 2 to 26 years (Figure 8). The variety with the highest lifespan was Dvoran (26 years).

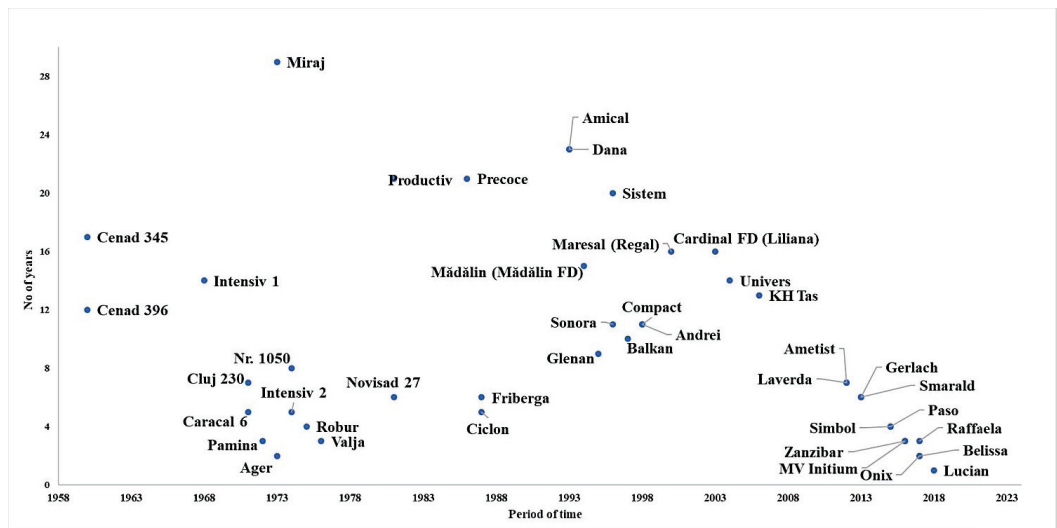


Figure 6. Lifespan of winter six-row barley varieties registered in the Romanian Official Catalogues of the Varieties of Plant Species

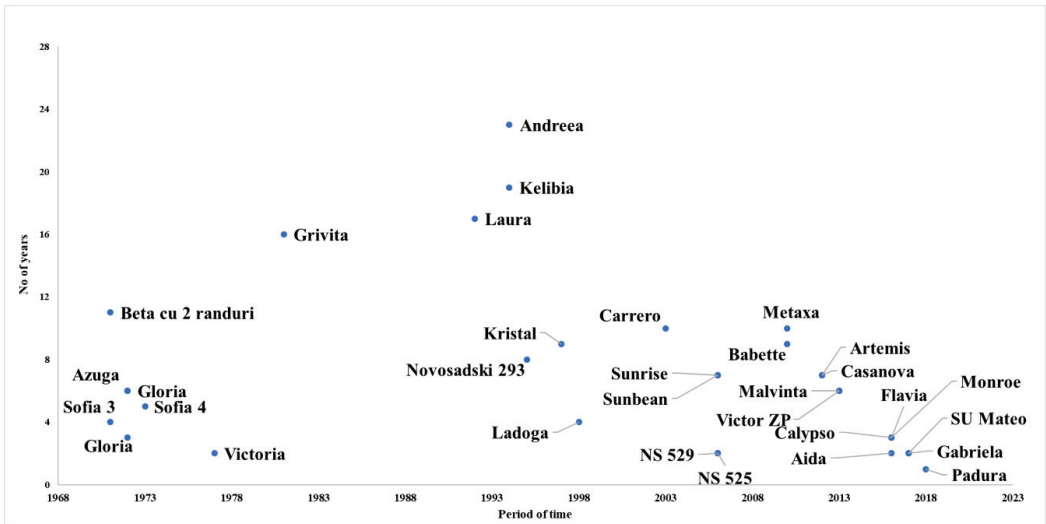


Figure 7. Lifespan of winter two-row barley varieties registered in the Romanian Official Catalogues of the Varieties of Plant Species

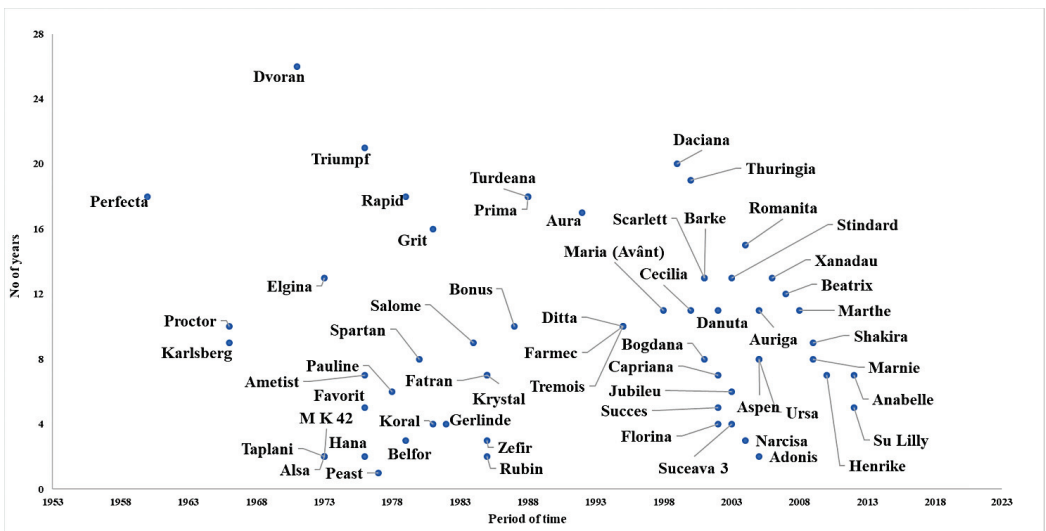


Figure 8. Lifespan of spring two-row barley varieties registered in the Romanian Official Catalogues of the Varieties of Plant Species

## CONCLUSIONS

In Romania, the barley history begins in 1675, when the first mention about barley was made by Nicolae Milescu, but only in 1880 appears some published data about the cultivated area. The registration of 8 barley varieties (4 spring varieties, 3 winter varieties, and 1 facultative variety) during 1921-1944 period, marked an important step in Romanian barley breeding

activity. After obtaining these barley varieties, since 1945 until 1980 the evolution of the barley cultivated area, the number of registered varieties and their type have oscillated.

During 1921-2018 period, in Romania has been registered a total number of 149 barley varieties, out of which: 42 (28.2%) winter six-row barley varieties, 4 (2.7%) facultative six-row barley varieties, 32 (21.5%) winter two-

row barley varieties, and 71 (47.6%) spring two-row barley varieties.

In 1921-1944 period, there were registered 8 barley autochthonous varieties (winter and facultative six-row barley, spring two-row barley), then in the 1945-1980 period, there were registered 46 varieties (9 winter six-row varieties, 3 facultative six-row varieties, 14 winter two-row varieties, and 20 spring two-row varieties).

In 1981-2018 period, the total number of barley varieties registered was of 95. On the first place, there was situated the spring two-row barley with 47 registered varieties, while winter six-row barley ranked the second place with 30 registered varieties, followed by winter two-row barley with 18 registered varieties.

Among the winter six-row barley cultivated varieties in Romania, the Miraj variety registered the highest lifespan, being cultivated for 29 years, this being followed by Dana, Amical, Productiv, Precoce, and Cardinal FD varieties. Also, Miraj variety registered the highest cultivated area in Romania, respectively 1.01 million hectares in 1991.

The record lifespan for winter two-row barley belongs to Andreea variety with 23 years, followed by varieties Laura with 17 years and Grivița with 16 years.

The lifespan of spring two-row barley varieties was closely to above mentioned data, Dvoran variety being cultivated for 26 years, Triumph for 21 years and Daciana for 20 years.

The average lifespan of the winter six and two-row barley varieties, increased during the last 38 years, with 1 and 1.1 years respectively, meanwhile the average lifespan for spring two-row barley decreased with 1.2 years.

## REFERENCES

- Agriculture, Forestry and Fishery Statistical Book, 2018. Retrieved from <https://ec.europa.eu/eurostat>
- Bude, Al., Vasilescu, L. (2007). Rezultate obținute în ameliorarea orzului de toamnă la Fundulea. *Analele I.N.C.D.A. Fundulea, LXXV*, 83–93.
- Devaux, P. (2003). The *Hordeum bulbosum* (L.) method. In M. Maluszynski et al. (Ed.), *Doubled Haploid Production in Crop Plants* (15–19). IAEA.
- Drăghici, L., Bude, Al., Sipoș, Gh., Tușa, C. (1975). *Orzul*. Editura Academiei Republicii Socialiste România.
- Eurostat database, <https://ec.europa.eu>.
- FAO database, <http://www.fao.org/faostat/en>
- Gozukirmizi, N., Karlik, E. (2017). Barley (*Hordeum vulgare* L.) Improvement Past, Present and Future. In Makoto Kanauchi (Ed.), *Brewing Technology* (49–78), IntechOpen.
- INCDA Fundulea, 2017. 60 de ani de cercetare științifică în sprijinul agriculturii, I.C.C.P.-I.N.C.D.A. Fundulea, 1957-2017. Editura Total Publishing, pp. 28–30.
- Kasha, K. J., Kao, K. N. (1970). High Frequency Haploid Production in Barley (*Hordeum vulgare* L.). *Nature*, 225, 874–876.
- Križanova, K., Psota, V., Slezziak, E., Žofajova, A., Gubiš, J. (2010). Spring Barley Breeding for Malting Quality. *Potravinarstvo*, 4(2), 39–44.
- Matthies, I.E., Malosetti, M. Roder, M.S., van Eeuwijk, F. (2014). Genome Wide Association Mapping for Kernel and Malting Quality Traits Using Historical European Barley Records. *PLoS ONE* 9(11), e110046.
- Munteanu, A. (1929). Production végétale. En: *La Roumanie agricole* (pp. 88-93). XIVme Congrès International d'Agriculture, Bucarest, 7, 8 et 10 Juin.
- Nowacki, A. (1927). *Cultivarea cerealelor*. Cartea Românească, Cluj.
- Petre Sebeșanu, A. (1875). *Terra nostra. Schițe economice asupra României*. Typographia Laboratorilor Romani, București.
- Vasilescu, L., Alionte, E., Bude, Al. (2014). Comportarea unor soiuri și linii de orz de toamnă la INCDA Fundulea în perioada 2008-2013, sub aspectul stabilității producției și calității. *Analele I.N.C.D.A. Fundulea, LXXXII*, 69–82.