SITUATION OF GARLIC IN ROMANIA

SITUAȚIA CULTIVĂRII USTUROIULUI ÎN ROMÂNIA

MUNTEANU N.*[1]
*Corresponding author e-mail: nmunte@uaiasi.ro

Abstract*. The paper presents a general picture of on the garlic culture in Romania. The main goal is to evaluate the development possibilities of this crops when the garlic has become a high commercial competition product at national level and world one. The paper contains six distinct sections:* (1) *recent short history,* (2) *traditional zones for garlic cultivation,* (3) *areas and production,* (4) *garlic asortment,* (5*) cultivation technology and* (6) *marketing and selling problems.*
Keywords: crop history, traditional zones, garlic assortment, cultivation technology

Rezumat*. Lucrarea prezintă un tablou general asupra culturii usturoiului în România, având ca principal scop să evalueze posibilitățile de dezvoltare ale acesteia, în circumstanțele actuale în care usturoiul a devenit un produs de mare competiție comercială atât la nivel național, cât şi mondial. Lucrarea este structurată în şase secțiuni:* (1) *scurtă istorie recentă,* (2) *zone tradiționale pentru cultivarea usturoiului,* (3) *suprafețe şi producții,* (4)*sortimentul de usturoi,* (5*) tehnologia de cultivare şi* (6) *probeme de piață şi valorificare.*
Cuvinte cheie: istoria culturii, zone tradiționale, sortimentul de usturoi, tehnologia de cultivare

1. RECENT SHORT HISTORY

Although the garlic crop, in Romania has existed since the pre-Roman period, documented information about it appeared in the 19th century, when certain culinary recipes containing garlic, became popular. The development of towns increased the market demands for garlic since it was a traditional product to the population.

These circumstances stimulated and increased the interest of the farmersfor garlic; and the garlic crop area expanded, mainly in zones with favorable environmental conditions, and where certain traditions and experiences existed as well. A significant increase in garlic crop area was documented after the immigration of Bulgarian and Serbian growers. The growers rented the fertilized lands for vegetable crops, including garlic. They bought seeds, and employed migrant workers and in some cases local workers for garlic farming.

In comparison with other agricultural crops, vegetable crops are more difficult to farm, as they require a great deal of work and care. Usually,

[1]University of Agricultural Sciences and Veterinary Medicine Iasi, Romania

peasants who own a small land area were employed to work on the vegetable crop lands. In these circumstances, in certain regions with favorable environmental conditions (sandy-loam, fertile soils, irrigation facilities and a suitable climate etc.), the so-called traditional zones for garlic crop were developed. Under these circumstances, some local grades of garlic local populations as well as certain foreign origin (mainly from the Balcanic Peninsula) garlic varieties were introduced.

As a result, a well organized garlic market emerged. These traditional zones have been developed and spread, under objective conditions, in almost all the vegetable growing regions of the country. Although these traditional zones for garlic crops have been developed, the total yield at the national level was not sufficient to satisfy the market needs of the entire country, mainly from the large towns.

Rural populations from outside the traditional zones, in most cases, produced garlic for their own use in their family gardens, even though the yield was under 200 – 300 g/m^2.

During the socialist regime (mainly 1960 – 1989), most of the agricultural production cooperatives had been obligated to cultivate garlic, even if they were not experienced in it.

However, the state strategy had as itsmain objective to satisfy the needs of the food industry and consumer population. So, the expansion of the area cultivated with garlic crops was considered to be a sure means to increase the total national production. At the same time, special national research and development programs for this crop had been established, including the improvement of assortment (by importing new varieties from Spain and Turkey), the improvement of cultural practices and new management of the crop etc. Despite these measures, the yield/ha did not significantly increase, remaining in the limits of 1.5 – 3.5 t/ha.

The most efficient measure for increasing the production at a national level was managerial, which stimulated the workers to get a higher yield/ha. According to this new management, a worker received a certain percentage of garlic crops, with the obligation to give to the cooperative a fixed yield (60 – 80%) from the planned yield. The remaining yield was considered as a payment. This managerial measure assured garlic production for the cooperative and was very stimulating for the workers. Sometimes, this payment was very advantageous for the workers. For instance, for 1000 m^2, and an obligation of 400 kg to the cooperative, a worker could get a good yield of 800 kg, so he could receive 400 kg of garlic as payment. From this payment, he could sell a part to the cooperative, and another could be sold on the free market at an official

price or on the black market at a very high price. This system was applied only in the traditional zones, employing very good professional workers.

Nowadays, the garlic crop in Romania is, more or less, spread over the same locations as it was before 1990, but the largest areas are situated in the traditional zones. In these zones, in a village the cultivated area could be approximately 50 – 100 ha; but in the rest of the country, the garlic crop areas vary between 0.5 and 15 – 20 ha. Under these circumstances, in Romania, approximately 10 000 ha are cultivated, as commercial areas, with an average production of 5 t/ha. By comparison, at the world level, the yield is about 18 t/ha, with the highest productions in China and Egypt (over 20 t/ha).

One of the most recent problems of the garlic production in Romania is an economic issue, determined by the relatively small production/ha and high competition because of the large quantity of imported garlic. The main objective of commercial units in importing garlic is to meet market demands, and to get a good profit.

2. TRADITIONAL ZONES FOR GARLIC CULTIVATION

The natural, economic, social and historical conditions have determined the establishment and development of so-called traditional zones or regions for garlic cultivation.

These zones have been known since the end of the 19^{th} century. During that time, these zones were increased in area. An expansion of the cultivation area and extensive development of garlic production was a primary goal of the Romanian state during the socialist period. However, in recent years, the cultivation zones have returned to their initial size. This fact is demonstrated by the reduced area cultivated with garlic at the present time, which is around 10,000 ha.

Special studies, carried out during the 70's and 80's, demonstrated that soil and climatic potential of the agrarian land was higher (by 2-3 times) for the garlic crop. The lands that could be cultivated with garlic are more or less overlapped with the lands cultivated with onion crops.

An increase in the cultivated areas with garlic crops must be achieved through technological, economic, social and even political measures.

A short view on the agricultural crop map of Romania highlights the fact that the traditional zones for garlic crops are spread in all the regions of Romania, in which favorable conditions determine their establishment and development.

The traditional zones for garlic cultivation could be defined by:

- soil conditions (light or medium light, with good fertile soil);
- a specific assortment, usually containing 2 - 3 cultivars;
- a certain tradition, respectively, experience and cultivation practices.

The well-known traditional zones for garlic cultivation in Romania are the following, in the order of location on the map:

- Cenad – Şeitin, in Timiş and Arad counties;
- Măldăraşu de Câmpie, in Mureş county;
- Craiova - Işalnița-Amaradia, in Dolj county;
- Fălcoiu - Cioroiu, in Olt county;
- Dărăşti - Ciolpani, in Ilfov county;
- RâmnicuSărat – Buzău, in Buzău county;
- Răchiteni – Tămăşeni, in Iaşi and Neamț counties;
- Copălău, in Botoşani county.

The zones were named based on the main localities in which the garlic is cultivated. For this reason, the zones do not refer strictly to these locations, but to a larger territory.

These traditional zones cover over 70% of cultivated area with garlic and account for probably over 80% of total production in Romania. The actual potential of production of garlic is 3-4 times higher.

The traditional zones are included in larger areas, according to the certain zoning of garlic crops developed by the Economic General Direction of Horticulture, from the Ministry of Agriculture, published in the 1980's. This zoning underlined the fact that garlic could be cultivated more or less in the same areas as onion crop. Based on this zoning, the area for garlic could be 2-3 times higher.

It was noted that the area cultivated with garlic increased by 20-30% during the recent period, comparedwith the past 70 years, but the yield had a smaller increase. This could be explained by the fact that garlic producer in the traditional zone are more professional than producers in the larger zones. The professional garlic producers passed on their professional work from generation to generation, till this day.

3. AREAS AND PRODUCTIONS

The areas and production of garlic in Romania, during a50-years period, continuously increased, but could never satisfy the consumption needs.

According to statistical data, as well as informal data, there is an obvious disproportion between a much higher demand and an unsatisfactory supply.

Until the 1960's, the Romanian population was predominantly rural (over 70%), so the consumption needs for garlic were satisfied from their family gardens. After that period, when strong industrialization started, followed by a significant increase of the urban population, the market demands for garlic consistently and abruptly increased.

After the 60's a significant development of the food industry occurred, resulting in the demands for garlic substantially increasing. Because of the increase of urban population and needs in the food industry, the garlic market became more unbalanced. According to statistical data, it is clear that areas of production did not increase in a proper rate, which could satisfy market demands.

During 1962 – 1970, the cultivated area with garlic had an average of 7 500 ha, with a total production which varied between 9 000 and 2 500 tons; this means an average production under 3t/ha.

During the 1971 – 1980 period, the area was approximately 6 200 ha, and the total yield varied between 18 and 28 thousand tons, with an average yield of up to 4t/ha.

The 1981 – 1989 period is remarkable because of a significant increase in area: the areas reached 7-8 thousands hectares, and the total production had the variable amounts between 27 and 47 thousand tons, respectively an average production of approximately 5t/ha or even more.

The period of 1962 – 1990 is well known as the socialist agriculture period, when the state coordinated every resource: materials, money and workers. Many national programs were planned, including agriculture, to optimize the production and to increase the economic efficiency. For garlic crops, some of the measures to improve the situation of low efficiency and unsatisfactory yields were: the expansion of the areas cultivated with garlic, a new zoning for this crop, introduction of a new assortment of garlic seeds, improvement of garlic "seed" production by scientific selection methods, and a new managerial system to stimulate the garlic growers.

The new managerial system offered to pay the workers that grew garlic with a certain fraction from the total planned yield. In fact, usually, the average yield was of 5t/ha, and the payment was to give the worker a fraction of 25-30% from this planned yield. The workers were motivated because, by growing garlic through hard work, the yield could reach up to8-9 t/ha. Workers would sell the garlic either to the agricultural

cooperative or they would find another way of selling it in the black market for a very high price. It could be considered that this managerial plan was the key measure for increasing the total yield at national level (for instance 46 600 tons, in 1989).

After 1990, socialist influence on the land began to disappear; the great majority of agricultural land owners received back their historical properties. As for the workers they started to grow garlic under new economic and social terms: grow as much as they could within their family land and valorizedthe yields through certain acquisition centers or preferred to sell on the free market at very good prices. The high demands of the market for garlic, including supermarkets, were always a good opportunity for Romanian garlic growers to get a good profit.

Under these new conditions, the area and production of garlic crops significantly increased.

Between 1991-2000, the area reached ahistoricalmaximum of 12-14 thousands ha, and production increased from 32 210 tons (in 1991) to 84 542 tons (in 1999), with an average of about 5.5 t/ha.

After 2000, the area was reduced to approximately 10 000 ha, with a total production varying between 50 thousand tons (in 2007) and 82 thousand tons (in 2001).

In 2016, according to the website www.factfish.com, Romania is at 16th place, taking into account the areas cultivated with garlic, on the 23rd place for production (54 389 tons) and on the 71st place, from the point of view of the average production (5326 kg/ha).

The available data demonstrates that the average yield/ha in Romania is high. This fact is demonstrated by some experimental data with an average production of 10-12 t/ha. In this respect, it is important to note that the average production is 18 915 kg/ha, at a global level. China's production was 26 t/ha, Egypt - 23 t/ha, Russia -9 t/ha and Greece -7 t/ha.

As a general conclusion, usage of technology to help grow the garlic crop and doubling the size of the land area would double the production. In another section of this report, it is highlighted that the crop technology is more or less similar with the ecological/organic one with reduced yields, because of the use of non-intensive cultural practices.

4. GARLIC ASSORTMENT

The garlic cultivated in Romania, is the same as the one cultivated all around the world, belongs to the species *Allium sativum* L. (Brewster, 1994). It's originally from the Central Asiatic mountain zone, a related species -

A. longicuspis Rgl. is also cultivated. *A. sativum* is exclusively vegetative propagated-consisting of garlic cloves, but *A. longicuspis* could be propagated by seeds.

Garlic clones exist that are adapted to many ecological areas through their responses of growth and bulbing to temperature and photoperiod, their cold hardiness and duration of bulb dormancy (Takogi, 1990, cited by Brewster, 1994).

Garlic is categorized according to size, weight, color, cover leaf number, the size and number of bulbils on bulb, number and vigourof green leaves, etc. A special characteristic is either the presence or absence of stalk with an inflorescence in the apex; the inflorescence contains, exclusively, small bulbils which could be a mean for vegetative multiplication.

According to UPOV (Union for Protection of Varietal Origin), there are many other distinctivenesscharacteristics which could be more detailed. According to certain commercial characteristics, it is well known that there are two garlic groups and numerous garlic types. For instance, in the USA, certain specialists or garlic growers elaborated such a classification, with two groups: the softneck garlic and hardneck garlic. The softneck garlic group consists of the clones without floral stalk, but the hardneck garlic group belongs to the cloves with floral stalk.

These two groups contain more types, which were registered at Orie′s Garlic (http://wwworiesfarmfresh.om/garlic). Here is a comprehensive list of all varieties cultivated here along with their culinary attributes and suggestions for use.

a) The Softneck Group

- **The Artichoke Type** (cloves form in layers similar in shape to an artichoke) contains the following varieties: California Early, Early Rep Italian, Inchelium Red, K′s Bockyord, Lorz Italian, Lukak, Oregan Blue, Polish white, Red Toch, Susanville and Transilvania.

- **TheSilverskin Type** (can be stored for a long period of time) includes the following cultivars: California Selected, Nootka Rose, Sicilian Silver and Silver White.

b) The Hardneck Group

- **The Creole Type** (with origin in Spain, small size, good flavor) has four cultivars: Ago Rogo, Burgundy, Creole Red and Native Creole.

- **The Porcelain Type** (with satiny white bulb wrappers, large cloves) contains a large number of cultivars: Armenian, Georgian Crystal, Georgian Fire, German White Stiffneck, Iowa German White, Leningrad, Music and Romanian Red.

- **The Standard Purple Stripe Type** (is more or less similar to the Standard Purple, but the bulb wrappers are sometimes glossy) has only two cultivars: Brown Tempestand and Purple Glazer.

- **The Marbled Purple Stripe** (is a subgroup of Standard Purple that tends to have fewer yet larger cloves) contains three cultivars: Khabar, Metechi and Northe.

- **The Elephant Garlic** is considered a mega sized bulb garlic and has a mild flavor.

Usually, in each country, there are certain classifications, more or less technical, or scientifically grounded. In general, the market establishes different groups, types, forms etc. According to commercial criteria, to satisfy consumer expectations, classifications of garlic are: large – small garlic, white – red – streaky garlic, autumn – spring garlic, softneck – hardneck garlic, Romanian – Russian – Turkish – Chinese garlic and so on.

In principle, the assortments remained the same, but each cultivar is nowadays much more spread out, compared with the period before the 50' – 70's. According to the information from technical and scientific literature, it is clear that in the United States of America, a much diversified assortment is cultivated, containing cultivars from all over the world. This situation was perhaps created, in some cases, systematically and orderly but, more often, because of the free market and high free circulation of the people. This circulation has allowed an evident exchange of information and even biological material. The exchange of biological material was done motivated by the agronomic and alimentary values of the cultivars.

These values are determined by the specific genetic characteristics, but in many cases there are highly influenced by the proper ecological conditions of the culture zone. In this assessment, it must be borne in mind that cultivars are clones, so the environment is very important in the cultivar expression, and the so-called ecological plasticity is low. In the same time, applied cultivation technology is of great importance in assessing the garlic bulb quality. In this respect, the following types of technology are known: traditional non–intensive, conventional - more or less intensive, or organic/biological/ ecologic.

When a cultivar from a different region of the world is exported to another region with similar environmental conditions, it is considered as a well adapted cultivar. For example, the cultivars Red Romanian or Transilvania, originating from Romania, are grown in USA. If the environment of a new region does not ensure the original requirements of a cultivar, this cultivar will not be used by the growers of that new region.

The garlic cultivars from Italy, Spain or Turkey that could not be grown in Romania are well known. Perhaps some of the imported cultivars got good environmental conditions and became adopted cultivars, but systematic evidence does not exist or is difficult to be constructed.

The cultivated assortment from Romania, in the last 50 – 60 years is relatively diverse, containing local populations from the traditional zones, but also some cultivars were legally or illegally brought to Romania by different growers.

The legal cultivars assortment or the assortment from the Official List, issued by the Order of the Ministry of Agriculture, is based on the State Institute for Testing and Varieties Introduction recommendation. The introduction of a certain cultivar in the Official List is done after proper tests are carried out, established according to the specific procedures, similar to international ones, based on the recommendations of OECD (The Organization of Economic Cooperation and Development), UPOV (The International Union for the Protection of New Varieties), ISF (International Seed Federation) and ISTA (International Seed Testing Association).

The Official List contains the name of the new cultivar, introduction time and the name of the maintainer. The maintainer has the obligation to proceed to conservative selection and basic seed producing and, also, is the owner of the new cultivar with the property rights, according to the national legislation. The basic seed is multiplied in the specialized commercial farms. If the basic seed is not produced, the cultivar is erased from the List. According to the official legislation, in Romania only the cultivars from the Official List can be multiplied and cultivated. Growers can, under their responsibility, use their own seeds or planting material for their own production.

Based on the existent information from different sources (Official Lists, books, brochures, etc.) an evolution of the garlic assortment in Romania could be available.

During the 50's, Dumitrescu *et al*. (1956) presented and recommended four garlic cultivars: Alb de vară, Roz timpuriu, Roşu and De Cenad.

For the next period, Mihalache and Balaşa (1961) recommended the following cultivars: De Cenad, Roşu de toamnă, De Albania and De Moldova.

Maier (1967) presented three cultivars: De Cenad and Alb de Cenad, De Craiova and Roşu de Moldova.

Torje and Perceali (1967) officially presented only two cultivars, for the period of 1966-1970, for all the administrative regions of Romania: Alb de Cenad and De Moldova, as spring and autumn cultivars. The same authors, in 1967, presented and recommended along the other two, the cultivar De Işalnița.

Balaşa (1973) presented in his textbook „Legumicultura" (Vegetable Growing) four cultivars: De Cenad, De Işalnița, De Moldova and De Rovigo. The last one is an Italian cultivar, which after 3 – 4 years, disappeared from Romania.

Indrea *et al*. (1979) mentioned the following cultivars: De Cenad, De Moldova, Timpuriu, Amarandia 26 and De Işalnița.

After three years, Ceauşescu*et al.* (1982 and 1984) characterized and recommended the following cultivars for Romania: De Cenad, De Işalnița, Amarandia, De Moldova and De Rovigo.

The Official List from 1990 recommended a larger assortment: spring cultivars –Cenad, Dărăşti, Râmnicu Sărat; autumn cultivars – Cioroiu, Moldova and DărăştiIlfov; Rocambale garlic – De Bucovina.

In their textbook, Butnariu *et al*. (1990) presented a complete characterization of the garlic assortment cultivated in Romania. At that time, information on the garlic crops stated *Allium sativum* contains two subspecies: *sagittatum* and *vulgare*.

The subspecies *sagittatum* contains two groups of ecological forms – continental form and South Mediterranean premaritime one.

The continental form of *sagittatum* has its origin in North Hindustan, Afghanistan and Persia. The plants form floral stalks and the inflorescences have adventitious bulbils, get high yields and, from an ecological point of view, this form is an autumn kind and has a good resistance to the drought weather and low temperatures. In Romania this form is represented by De Ciolpani, De Moldova and De Bucovina cultivars.

The premaritime form originates from Turkey and Spain. The plants form floral stalks and the inflorescences contain adventitious bulbils. It has a high yield and an autumn ecological form, but it is susceptible to drought and low temperature. In Romania, it is represented by Turkish and Spanish cultivars.

The subspecies *vulgare* contains, also, two groups of ecological forms: the continental form and Est-Mediterranean premaritime forms.

The continental form of *vulgare* originates from Caucasus and Carpathian mountain regions. The plants do not form floral stalk and their yield is low. It is a spring ecological form with a good resistance to drought and low temperature. The bulbs are small and have a long storage

period. It is represented, in Romania, by the cultivars De Cenad, De Dărăşti, De RâmnicuSărat and De Copălău.

The premaritime *vulgare* form has an East-European origin and does not form floral stalk. It is an autumn ecological form, has a reduced resistance to drought and low temperature and has good storage features. It is well represented by the Amaradia, De Işalnița, De Seitin and De Cenad (autumn form) cultivars.

Stoian (1995) has recommended for the ecological/biological crops the following cultivars: De Dărăşti, De Cenad, De Moldova and De Bucovina.

Dumitrescu *et al.* (1998) presented and recommended a traditional and well known assortment in Romania and registered in the Official List in 1995: De Dărăsti, De Cenad, De Cioroiu, DărăştiIlfov, De Moldova, Favorit, Record, and De Bucovina.

Popescu and Atanasiu (2000) recommended the two known groups of cultivars, the spring and autumn kinds.

A cultivars assortment similar to the one presented by Dumitrescu*et al.* (1998), was also presented in the book of Stan and Munteanu (2001): De Dărăşti and De Cenad – as spring cultivars, and De Cioroiu, DărăştiIlfov and De Moldova – as autumn cultivars.

The last Official List of the varieties cultivated in Romania (in 2018), include only three authorized garlic cultivars: Ager (from 2009), Claudiu (from 2010) and Eduard (from 2010).

In conclusion, over 10 garlic cultivars were used in Romania and is still being used till this day. But, legally not all of the cultivars currently are in the official List.

Most of the cultivars belong to the "local population" categories and do not have the official maintainers and a scientific conservative selection scheme is not done anywhere, also, the basic seeds are not produced. Maintenance and multiplication of the local populations are done by empirical methods, rigorous enough, but not scientific, in whichonly the best produced plants with a good health are selected.

The existence and use of the local populations is typical in the traditional zones. From this point, it is possible to advance by the official registration and a special research program for the conservative selection and basic seed producing.

A detailed characterization of the processed garlic cultivars which were recommended and/or processed in the official list is based on the available information from existent scientific literature. This description is

not followed strictly according to UPOV recommendations, but it is more in accordance with the technological and commercial needs/ exigency.

As an accepted rule, this description is done following the Butnaru *et al*. (1990) recommendations.

a. Cultivars with floral stalks (the commercial hardneck type)

a1. The Asiatic - central continental group – with drought and low temperature resistance:

- **De Ciolpani:** autumn cultivar, early, with medium bulb (25-35 g), having round shape, flattened at base, with white-grey color of external covered leaves; each bulb contains 8-12 bulbils of curved shape, and blunt peak and of rose-yellowish color. It is recommended for the autumn crop, for green garlic (spring-summer period), as well as dried garlic (autumn and late winter period). The taste is pungent, pleasant. The yield potential is about 5-6 t/ha.

- **De Moldova:** it is an autumn cultivar, semi-late, with large bulbs (30-40 g), of a white or white with violet nuance color. Each bulb contains 7-11 bulbs of white-yellowish color. It is cultivated as autumn garlic for green garlic, but, mainly, for dried garlic, with good storage capacity. The taste is pleasant, balanced and pungent. Yield potential is about 6-8 t/ha.

- **De Bucovina:** it is an autumn, late cultivar, with a flattened globulous bulb, of external white-grey color, of large size (40-55 g); a bulb contains an average of 6-10 large well wrapped bulbils, a little bit curved, with a white-yellowish skin color. It is recommended for green or dried garlic, having a good storage quality. The taste is light pungent and the yield potential is very high (10-12 t/ha).

In addition there are also cultivars with uncertain populations that are well appreciated by the growers and consumers. For instance, Red of Moldova might be the same as Red Romania garlic from USA.

a2. The premaritime, South Mediterraneangroup (Turkey, Spain)

This group includes garlic strains from Turkey, Spain and Italy, but could not be recognized as specific cultivars. The group contains autumn cultivars, susceptible to drought and low temperatures, but with a good yield production.

b.Cultivars withoutfloral stalk (commercial softneck cultivars)

b1. **The continental group (Caucasian and Carpathian mountains),** with spring cultivars.

- **De Cenad** is a semi-late cultivar, of large to medium size (25-35 g), asymmetric-globulous, flattened at the base, with a white and silver reflection. Each bulb contains 8-15 bulbils of medium size. It is cultivated as a spring cultivar, but can be cultivated in autumn too. It has a good storage quality, a pleasant persistent taste, with a strong aroma. The yield potential is around 5-7 t/ha.

- **De Dărăşti** is a semi-late, cultivar, with a bulb of a globulous pyramidal shape, with a white-rose external color, having a small size (20-30 g), with small cloves (10-12). It has a good resistance to drought and low temperature and has good storage qualities. The yield potential is about 3-4 t/ha.

- **De RâmnicuSărat** is a semi-late cultivar, with medium size bulbs (circa 25 g) and white-pink color. The cloves are small, 10-12/ bulb and have white-yellowish color. The bulbs are very well wrapped and have a good storage capacity, during the winter, until late spring. The taste is pungent, pleasant and persistent. Yield potential is 4-6 t/ha. It is recommended as a spring cultivar, but could have good results as an autumn cultivar as well.

b2. The premaritime East- Mediterranean group (South East European) contains dedicated autumn cultivars.

-De Işalnița is a semi-late cultivar, with white -grey color bulbs, well wrapped, of big size (30-40 g), and 12-14 white-yellowish bulbils and very hot taste. The yield potential is great (6-8 t/ha) and it is recommended for autumn crop for green garlic and, mainly, for the preserved food industry.

-De Craiova/ De Amaradia is an autumn or spring cultivar, of a medium size (25-35 g) bulb. The bulb is round – elongated, of white color, with thin-elongated 10-12 bulbils; the taste is persistent pungent. The yield potential is medium (4-5 t/ha).

-De Cenadand **De Şeitin** are two autumn local populations, with medium-large bulbs of white color, more or less similar to the spring ecological form of De Cenad cultivar, but with larger bulbs (30-40 g).

-Roşu de Moldova (Red of Moldova) is an autumn, but also a spring cultivar, according to the applied technology. It is well known in Neamt and Iasi counties. The bulb is spherical – flattened and of white-gray color with reddish reflections. The bulbils are small and edged, with rose-violet color. It is resistant to drought and low temperature. Bulb size is big (35-45 g). Yield potential is good (5-6 t/ha).

As a conclusion, assortment is rather diverse, according to the four ecological groups, the autumn and spring forms, with floral stalk or without floral stalk (softneck), of white colors with many nuances and white-rose or white-reddish, with small, medium and large or even very large, varied between 25 mm (15-30 g) and 50 mm (40 - 50 g). According to the applied technology, the dimensions vary.

In Romania, as it will be shown in the next section, a non-intensive traditional cultivation system is used for the garlic crop. It cannot explore at a high level the cultivar's agro productive potential, but it achieves a yield more or less similar to an ecological/organic crop. For each cultivar, yield potential/ha depends on cultivar type (spring or autumn), the bulb

size (weight) and number of bulbils/bulb, in the conditions of an optimal number of plants/ha, using a certain technology.

From the processed data, it is evident that the spring type has smaller bulbs (15 – 40 g) and the autumn type has bigger bulbs (25 – 50 g). Important thing is the fact that in the same cultivar, in the same plot, the bulb in size varies. For instance, for spring cultivar with an annual yield of 7500 t/ha, a medium bulb size is about 25 g, but it can vary from 15 g to 35 g, and over 60-70% of bulbs have a weight under 30 g. An autumn cultivar can have a yield of 10 – 12 t/ha, with average size of bulb of 40g. The bulb weight could be between 25 g and 50 g, and the majority of 60 – 70 % has over 30 g.

For the commercial purpose, a distribution of the garlic yield on the different size grades would be very useful. Recent research is not available on the estimated quantities of these grades. So, a proper estimation is possible only from a theoretical point of view, taking into consideration the limits of size variation and average size of the two garlic variety types (spring and autumn). In the table below, an estimation of quantities of the two garlic types on the different size grades is shown. This estimation is based on field interviews with a number of garlic farmers across various key garlic growing regions in Romania.

Table 1

Distribution of garlic yield on the size grades

Spring variety (*vulgare* ssp.)			**Autumn variety (*sagittatum* ssp.)**		
size (g)	**%**	**quantity (kg)**	**size (g)**	**%**	**quantity (kg)**
> 15	2.5	188	> 25	2.5	300
15-20	7.5	562	25-30	7.5	900
20-25	20	1500	30-35	20	2400
25-30	35	2625	35-40	35	4200
30-35	25	1875	40-45	25	3000
35-40	7.5	563	45-50	7.5	900
<40	2.5	187	<50	2.5	300
TOTAL	**100**	**7500**	**TOTAL**	**100**	**12000**

5. CULTIVATION TECHNOLOGY

The cultivation technology covers the main activities flux, in a certain succession, in general, in chronological order, which assures the achievement of an optimal yield, by adjusting environmental conditions, according to the plants' needs.

The garlic cultivation technologies are relatively diverse, according to the intensification level, respectively to the use or non-use of energy and materials inputs. The main intensive factors are: proper cultivars, irrigation, mechanization and fertilization.

According to technological factors, cultivation systems are divided into two categories – conventional ones (intensive or non-intensive) and non-conventional ones (ecological/ organic/biological).

In Romania, the majority of garlic crops are grown, by the non-intensive method, but the crops are not officially certified as ecological, according to the National and International recommendations and, in this situation, the yield cannot be valorized on the market as an ecological product.

Moreover, the main technological elements of the garlic crops, will be synthetically presented, in the specific conditions from Romania.

-Land selection. This stage is considered to be the most important one for garlic crops, including the following steps: selection of bulbs, preparation of planting material, moment or time of planting, planting design, planting depth etc.

By land selection, the growers strictly respect a proper crop rotation of 4-5 years, to prevent specific diseases and pests attack/damage. The plants for bulbs, tubers, roots and for pulses (beans and peas) must be avoided.

-Land preparation. This technological stage is a common one for vegetable crops. If the garlic crops will be established in autumn season, then land preparation must be finished before the 10-15th of October, when cloves planting has to start. If the planting season will be planned for spring, land preparation could be later.

Between other operations, land preparation includes an organic fertilization using about 30-50 t/ha of farm manure or, better, mature compost; chemical fertilizers are usually not used.

Crop establishment. Garlic crop can be recommended to be established on all the agrarian lands of the country, but the commercial crops are carriedout in the so-called traditional zones, as soon as it was processed in a dedicated section of them. It is important to know that these

traditional zones are defined by specific pedo-climatic conditions which confer a finger-print on the bulb quality.

Material selection consists of a cultivar chosen specifically for a certain traditional zone; good quality bulbs selection means that the bulbs for planting must be specific to the selected cultivar, to have a medium of large size, to be well wrapped, free of diseases or pests and good root system, strongly fixed on the bulb.

Selected bulbs are detached in bulbils/cloves. The most recommended bulbils for the plantings must not be from the center of the bulbs. Detaching the bulbs is made a few days before planting.

There are two planting seasons, autumn or spring, according to ecological cultivar groups. The autumn planting is done between the 15th of October and the 15th of November, until the beginning of winter, the bulbils start in vegetation, but do not arise.

The spring planting is done early in the spring, when there are good environmental conditions for planting, but not laterthan the 15-th-20-th of April.

Lately, based on the growers' experience, in certain traditional zones, they plant spring garlic in the ground in autumn. The main constraints of the spring garlic are the low resistance to the cold temperatures, during winter time.

As for the green garlic, the crop is planted during autumn time in the open field or in plastic houses.

The establishment design of the crops is executed in parallel rows, with a distance of 20 – 25 cm between them, and 10 – 12 cm between plants on row; crop density varies between 400 – 450 thousand plants/ha.

Planting in the ground is done manually with the small drains/drills mechanically opening on the planned row. The drill depth is about 6 – 10 cm, and bulbils are fixed on the bottom of the drill. After that, the bulbils are covered with soil or the drills are closed. The work is finished with a light fixture.

Caring practices. The main goal of these practices is to permanently adjust the environmental conditions to the plant requirements to optimize these relations and, finally, to get a maximum yield.

The first step in caring practices is a light hoeing done with a rake, when the plants have a height of 5 – 6 cm. This operation is repeated 2 – 3 times, after 7 – 10 days. The aim of this step is to destroy the small and young weeds and the soil crust. Also, the soil becomes more aerate and warmer; so, in this way the young garlic plants grow much better.

After these light hoeings, the other 3 – 4 manual hoeings are done between and on the rows of the plants. The hoeings could be done in parallel with mechanical hoeing, if proper equipment exists. The hoeing is considered the key operation for a sure success of the garlic crops.

The weeding is another work that is done at any time when it is necessary. The weeding is always needed because of the farm manure used, with a great weed seeds reserves.

An important work in assuring a good success of the crop is irrigation, mainly, in the drought periods.

As a rule, the growers do not use chemical fertilizers, because of the great quantity of organic fertilizers, but some of the farmers applied 1 – 2 chemical fertilizations, based on complex fertilizers (NPK) or ammonium nitrate.

The final step in the field is harvesting, which will be usually done during June – July.

By a critical assessment of the technology above, it is easy to observe that only ploughing, form manure transport, drill opening and yield transport are done by using mechanical means, but most of the operations are manually done. In this situation much more works could be mechanically done, with a substantially decrease of cost. Some of these works are the following: planting of the bulbils, harrowing of the young crops for weeding, followed by the mechanical hoeing (using different cultivators), phytosanitary treatments against weeds, pests and diseases.

Harvesting. The last step of the cultivation technology-harvesting is a very important step because it includes transferring the crop from the field, to a vegetable product which can be sold to consumers.

The goods for the consumers, ensures a real possibility to evaluate the investment done during one year, by its quantity and quality. For this reason, a special attention must be paid to the harvesting process, because special risks can arise, usually determined by the unfavorable environment conditions (for instance, long duration rains).

The main steps of the garlic harvesting are the following: optimum moment for harvesting, harvesting technique, yield conditioning for temporary storage to complete post-harvest maturation of the bulbs. The garlic growers are familiar with these steps and always accomplish them at optimum level.

Harvesting time starts when the leaves become yellow and dry at the lower half and the false stem breakdown. In this vegetation stage, the bulbs have maximum size and are well wrapped by the external leaves.

Eventually, the quality of the bulbs could be tested by making a correlation between the above ground and underground parts of the plants. If harvesting is done too early, it determines a difficult post-harvest maturation and temporary storage will take place, but a later harvesting will determine the detachment of the bulbs and increase the pests' incidents.

Usually, the autumn garlic cultivars are harvested in the first half of June, but in the spring they are harvested one month later, in the first half of July.

Harvest techniques are quite simple and consist of digging the soil together with the bulb and detaching or lifting the plants (leaves, stalks and bulb) from the soil. The entire plants are put on the soil in rows or in small bunch for 1 – 2 weeks to air and dry. It is recommended that bulbs of the plant should not be in direct contact with the sun rays, because of forced dehydration and scalds/burns.

After that, the plants are bound in 20 – 30 sheaves and then transported under very well aerated shelters for final maturation of the bulbs. The bulbs are stored in well ventilated storehouses as sheaves (with dried leaves and stalks) or as so-called garlic lines of 10 – 12 bulbs or garlic garlands.

The preparations of garlic for the market are done a few days or weeks before commercialization. The preparation consists of a careful selection of the bulbs according to their size, general aspect and health. The best bulbs are prepared in lines or garlands by three strands plaiting and the other ones are prepared to be sold in bulk. The roots of bulbs are cut at the bulb base level and the leaves and stalk are shortened at 2 – 3 cm. The bulbs for bulk selling are packaged in 6 – 10 kg boxes or net sacks.

6. MARKETING AND SELLING PROBLEMS

In the economic and political circumstances after 1990, and the free market principles promotion. The Romanian garlic market imported products, mainly in the situation when the imported prices were under the prices of Romanian producers. The hypermarkets are interested to sell more and more at low prices, according to consumers' needs.

In such new conditions, a majority of garlic sold on the Romanian market are imported ones.

During 2011-16, a majority of imported garlic are from Holland, Hungary and Czech Republic. An interesting fact is that Holland does not

produce garlic, they import Garlic from China then they export it to Romania.

During the same period, Romania exported different garlic quantities, varying between 704.5 tones, in 2009, and 80.4 tones, in 2016, or 37.7 tones, in 2017. The fluctuations are very high and depend, mainly, on the conditions in overseas market.

Because of international garlic market circumstances, a high influx of Chinese garlic is evident. For this reason, some protective measures for the domestic garlic production in Romania have been undertaken by levying national and European taxes, as well as by educating consumers about the differences between the quality of Romanian and Chinese garlic.

In Romania, small garlic producers do not seem to be affected by the garlic import, because of the traditional quality of the Romanian garlic (Cioroiu, Cenad, Moldova, Copălău garlic and so on).

Currently, in Romania, two commercial methods are used for the garlic production. One is done by the commercial societies specialized as acquisition centers to achieve the large quantities for the supermarkets or even export. Another one is done by the producers, by selling their own produce from home or on the local open markets. A lot of farmers prefer selling their own goods which is considered more profitable, including varying prices, according to market demand and offer.

The best profit is achieved by selling the garlic lines or garlands. Garlic in bulk is, usually, sold on two dimension qualities, according to the EU rules for large garlic (40 – 50 mm) and small garlic (30 – 40 mm). The product of these qualities there are in supermarkets, according to the European standards, including the Romanian ones (see the Rule CE No. 2288/97 of the European Commission from November 18/1997, for the garlic commercial standards). According to this rule, garlic must meet the quality requirements for three categories: Extra, I quality and II quality. For Extra category, minimum diameter is 45 mm, but for categories I and II, the minimum diameter is 30 mm.

Some locally produced garlic that does not qualify to be commercialized in the hypermarkets would be because the sizes of these are not in accordance with the EU rules. Usually this garlic is sold in the local markets, with a good price.

In the biggest hypermarkets, the Romanian garlic is sold in bulk (in boxes or sacks), as Extra or First categories, nearby, on the same shelf alongside garlic of the same standard categories – Extra & First - from China and Spain, which are packaged attractively. It is unclear what the

price difference between Romanian is and Chinese garlic since it varies based on negotiations.

Most of Romanian garlic is categorized either in the in Second or First quality and rarely in the Extra quality category. In the same time, the Chinese garlic mainly is of Extra and First Quality category. In this situation in clear that local grown garlic (of small size) are significantly cheaper as compared to the big size of Chinese garlic.

A special problem is generated because of the smuggled garlic from China. There are some non-official information that would explain the high price of garlic reported in official Romanian documents is on account of costly (big size) Chinese garlic that is illegally smuggled into the country.

It is all known that China is the greatest garlic producer in the world (80% of the world′s output), according to FAO. Garlic in Europa is mainly produced in Spain, but also in France, Italy, Hungary, Romania and Bulgaria. Chinese garlic is often misdeclared as imports originating in countries, in which the EU has preferential arrangements in place, where normal customs duty do not apply.

In order to protect domestic producers, the EU introduced an import duty of 9.6 percent together with an excise duty of EUR 1,200 per ton on imported garlic in 2001. The excise duty is applied when the import quota of 59,000 Tons is exceeded. China is permitted to export 34,000 tons to the EU. This was considered a good measure for the European garlic producers, including the Romanian garlic ones.

Due to a 9.6 percent duty on imported garlic, dishonest exporters sneak tons of cheap Chinese garlic into EU. The garlic is smuggled in by ship through Norway, a non – EU country, where it is transported to EU .

Many examples of the smuggling garlic are shown on the media (journals, newspapers etc.). For some of them smuggled garlic is comparable with smuggled drugs

The illicit trade of garlic simply manifests the human greed. Sometimes, garlic produced in China is smuggled to Romania or Hungaria, and then re-smuggled to the French market. There it is further transformed into French garlic, introduced in the processed food sector. Then in the composition of French dishes it is labeled: certified or sold and consumed, in France or abroad (Montet and Ray, 2017).

By scientific and technological cooperation, special traceability program would detect the origin of raw materials and so it could stop or discourage smuggling. Many national or international authorities are involved in preventing garlic smuggling, for the benefit of the national garlic producers and consumers as well.

Anyway, garlic crops and garlic produces are and will be an interesting and fascinating subject.

CONCLUSIONS

Garlic crop in Romania is know from the pre-Roman period, but had a slow development mainly in the family garden.

Commercial crops were developed in the last century, when the urban population ant food industry increased in a high rate.

A specific development of garlic production occurred mainly in so called traditional zones, but the area and yield were and are under the natural potential: about 10.000ha and 50-60 thousands tons.

Assortments in rather diverse and consists in well adapted cultivars to the environmental conditions of traditional zones, including the softneck and hardneck cultivars or the spring and autumn cultivars.

Cultivation technology is not intensive one, but more or less similar to organic system, but the crops are not certified as organic.

The main characteristic off the marketing and selling is a high competitions between garlic from Romania and abroad; the smuggling phenomenon is also present.

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