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Hungarian and french garlic varieties' vegetative growing on the country of Hanság

CSILLA GOMBKÖTŐ – JÓZSEF IVÁNCSICS

University of West Hungary, Faculty of Agriculture and Food Sciences
Institute of Plant Science
Mosonmagyaróvár

SUMMARY

The production of garlic is increasing in the world. In our days some 2 million tons of garlic is grown, and it's listed the worlds most important twenty vegetable.
In Hungary the cultivation of this plant comes true on a relatively narrow area (Makó and its surroundings, and Dusnok and its surroundings). Our aim was with this study to prove the fact that this plant can be safety cultivated on the country of Hanság in Kisalföld, we would like to point out the economic importance of this plant, and set it into more attention for the exports opportunity.
We involved more species in our experiments. Four winter garlic, *(Makói őszi, Thermidrome, Sprint, Arno)* and a spring garlic *(GK Lelexír)* were examined. With our experiments we would like to select from these varieties which can be produced more safety on the foresaid region.
Keywords: garlic, *Allium sativum*, french and hungarian varieties.

INTRODUCTION

The garlic is a very considerable plant for the horticultural section, its average yield can reach the 10–15 t/ha.
The production of garlic is growing in the world. In our days some 2 million tons of garlic is grown, and it's listed the worlds most important twenty vegetable. On his provenance, in Asia it is produced with the largest quantity which is centered upon China. In Europe there are three important state of garlic growing: Spain, France and Italy (*Table 1.* and *Table 2.*).
Large quantity of garlic is produced by Argentina, Egypt, Mexico and California in the USA.
On the biggest part of Hungary the proper environmental conditions are given for the realisation of the efficient garlic growing, despite of this the growing is concentrated on a relatively narrow area: Makó and his surrounding, and the surrounding of Dusnok which can be found in Bács-Kiskun county.

Table 1. The harvested field of the garlic in the EU countries (1000 ha)

	1999	2000	2001	2002	2003	2004
Bohemia	1.5	1.4	1.0	0.4	0.4	0.0
Ésthonia	0.0	0.1	0.0	0.0	0.0	0.0
France	4.0	3.8	3.8	4.0	3.9	
Greece	1.8	2.0	1.8	1.9	1.9	1.9
Latvia	0.1	0.1	0.2	0.3	0.4	
Lithuania					0.2	0.1
Hungary	1.8	1.9	1.7	1.6	1.3	
Malta			0.1			
Italy	3.6	3.7	3.9	3.2	3.1	3.0
Spain	23.9	24.1	24.0	23.9	23.5	21.7
Slovakia	1.1	1.1	0.1	0.1	0.1	
Slovenia	0.1	0.1	0.1	0.1	0.1	

Source: Eurostat (*http://epp.eurostat.ec.europa.eu*)

Table 2. The harvested quantity of the garlic in the EU countries (1000 t)

	1999	2000	2001	2002	2003	2004
Austria	0.1	0.1	0.2	0.2	0.2	0.2
Bohemia	7.7	7.1	5.4	2.2	1.0	0.6
Ésthonia	0.1	0.1	0.1	0.1	0.1	
Finnland	0.0	0.1	0.1	0.0	0.0	
France	30.7	30.2	30.5	31.7	26.7	
Greece	13.2	17.2	13.8	15.7	15.1	15.1
Latvia	0.3	0.2	0.7	0.9	1.2	
Lithuania					1.9	1.1
Hungary	13.6	13.8	13.0	10.1	6.8	
Malta	1.0	1.1	0.6	0.5	0.8	0.8
Italy	30.5	31.6	34.5	28.1	25.3	26.5
Spain	178.1	187.0	175.1	194.7	188.9	157.1
Slovakia	5.3	4.3	0.3	0.3	0.3	
Slovenia	0.8	0.5	0.3	0.3	0.3	

Source: Eurostat (*http://epp.eurostat.ec.europa.eu*)

Table 3. shows that the quantity of the produced garlic in Hungary has a considerable decreasing compared to the previous years. It was caused by the cheap imported garlic from the Chinese markets. In European Commission occurred the matter of discussion that the importation of the garlic should have to be made subject to licence from the third countries, this would be able to regulate the present quota system, could get the hungarian garlic production into a forefront again, which is popular in abroad, and has a excellent quality.
Quasi 40–50% of the hungarian garlic production is exported, 25–30% of garlic gets to realization on inland (population use, industrial processing), the residual stays at the producers for the next year to reproductive material (*Mártonffy* 2000).

Table 3. Main data of garlic production in Hungary
(holdings, total)

	1996–2000	2001	2002	2003	2004	2005
The total production of garlic (ton)	15981	13016	10065	6761	8360	9681
Production of garlic on arable land (ton)	12568	10168	7519	4257	6043	7471
Harvested arable land area of garlic (ha)	1929	1657	1645	1259	889	1295
Average yields of garlic (kg/ha)	6520	6140	4570	3380	6800	5770

Source: KSH (www.ksh.hu)

95% of the exported garlic is grown in Makó and on its surroundings, which is about 5000–7000 tons per year. On Bátya and Dusnok produced garlic is used by the meat processing firms on inland. *Makói őszi* and *GK Lelexír* (*Makói tavaszi*) are qualified as "hungaricum", based on production traditions and the special values.

The groups of garlic varieties

We can group the garlic varieties in two ways: by the time of planting there are winter and spring varieties.
We may relate generally that the average yield of the winter varieties is bigger at the spring varieties, and the bulbs are bigger also. Those disadvantage is, that those are shorter time storable, and they don't have so much aroma.
From a morphological view there are softneck varieties (*Allium sativum* convar. *sativum*) the cloves settle down in diffused position. The cloves of the hardneck garlic (*Allium sativum* convar. *ophioscordon*) settle down in a regular circle around the scape which is often topped with a cluster of small round propagules called bulbils. These can be used for multiplying. From the bulbils grow in the first year a bulb that contains one clove.

Materials and methods

The characterisation of the varieties involved by us in our experiment

Winter varieties

Makói őszi: it's a softnecked (*Allium sativum* convar. *sativum*), Hungarian garlic. Because its good seasoning value it's qualified as hungaricum. Its vegetative parts are bushy with medium green coloured leafs. The plant is 60–70 cm high. The weight of its bulb is 50–60 g, consists of 6–8 pieces of clove. The covers are greyish-white colour, well closing. The growing period is medium large. It must be planted anyway until the middle of October, that overwinter with rich vegetation. The variety has excellent antifreeze feature. It likes

the meadow clay soils with middle hard character and the soils along the rivers. It can be harvested at the end of June. By optimal growing technology the average yield ca be even 15–20 t/ha.

Sprint: it's a hardnecked, french variety. Its scape with bulbils is 100–120 cm long in June. That variety can be planted also by bulbils, which are between the flowers of garlic (*Becker-Dillingen* 1956). The foliage is rich. Its leaves are 80–90 cm high, and wide. Its bulbs have huge size, and the cover is lilac striped. The variety has a fast shooting, and a vigourous increase, because of this can be perished by freezing in Hungary. We can avoid this by planting at the latest time as possible (middle-, end of November), and/or we use mulch. The dormancy of the cloves is very short. From the examined varieties the *Sprint* was harvested the earliest: in optimal environmental conditions already on the prime–middle of June. 1–2 weeks before the harvest it's expedient to break the scape, so we can get better yield. Beside the distinguished average yield it is shorter time storable, than the others winter garlic.

Thermidrome: it belongs to the *Allium sativum* var. *sativum* also, it's a french variety. The foliage is rich, with medium-green letters. The bulbs are big, 50–60 g, with regular forms. The cover is white, with pale pink patches. On all of the area of Hungary can be successfully cultivated, because it tolerates the extreme areas. It can be planted also in autumn and in spring, but only the case of autumn planting gives bigger crop. It can be harvested at end of the June at the same time as the variety *Makói őszi*.

Arno: it's a French softnecked garlic. Its foliage is not exaggeratedly rich, with a deep green colour. Its large bulbs are standing on more clove circles, it has numerous cloves (15–20 pieces) with a longish form. The colour of the cover is pinkish-white. The shooting is slow: needs at least 8–10 week in the meteorological conditions of Hungary. The variety overwinters very well, the danger of freezing is small. It can be harvested somewhat later as the other winter garlics, soon early, middle of July. Its yield can even reach 10–12 t/ha. Its beneficial characteristic is, that it's storable for a long time.

Vernal kind: *GK Lelexír (= Makói tavaszi):* state-recognized, Makó garlic. It was improved with clone selection from a landscape variety. It belongs to the softnecked garlics*(Allium sativum convar. sativum)*. It has lower growth (40–50 cm) than the *Makói őszi*, its foliage is thinner, has middle-green coloured leaves. The cloves stand in a bulb with 30–50 g weight, and those one are surrounded by white coloured closed covers. It must be planted as early as possible in March, so the yield can be 10–15 t/ha. We can get round to the harvesting early–middle of July. Its beneficial characteristicis, that it's excellently storable (even next year April–May), and its seasoning value is over the average (*Iváncsics* and *Gombkötő* 2007).

Results

Our experiments were set in Hanságliget, the type of the soil was peat meadow soil. Meadow soils which can be found in Hanság are old moorland bottoms, from which ones

the peaty stratas were carried away by the wind and only the clayey stratas were left. The high underground water-level ensures the favorable water supply of the vegetation help with this the quick and rich growth of the plants. The humus is black coloured and sticks the grains of soils to Polyhedron form together (*Stefanovits* 1956).

Based on the soil survey results of nutrient planning we strewed onto the area N:P:K = 120:100:150 kg/ha of agent.

Garlic plants respond to day length and form a bulb under long days, regardless of the plant's size. (*Splittstoesser* 1990). We have planted the varieties in the following times:

– Winter varieties: 7–10 October,

– *GK Lelexír (Makói tavaszi):* 10–12 March.

The depth of the planting by the winter varieties were 7–8 cm, by the spring varieties 4–6 cm. Line width x stem distance = 30 cm x 8–12 cm, depending on that exterior,- inside, or middle cloves were planting. In the case of the cloves from the exterior circle we used a bigger stem distance (12 cm), because these can develop bulbs with bigger mass, and with more cloves. Opposite this by the middle cloves of the bulb we planted on a smaller stem distance (8 cm). At first the observed varieties were involved in an examination based on the shooting vigour and the winter increase intensity. We evaluated shooting percentage more times together with the examination of the plant altitudes. Between the examined varieties the cloves got to evaluation based on the position of the cloves inside the bulb (exterior, middle and inside cloves). The examination of shooting percentage was made by us with linear metre measuring, in a four repetitions of random block arrangement. We defined the number of plants of the linear metres. The growing intensity was evaluated by assigned 10–10 plants, measured the altitude from the ground with mm accuracy in four repetitions.

Table 4. shows the dates of harvests. The data process was made with the spreadsheet program Microsoft Excel. We set the average values of the measured results in a table, and column on a diagram, or we illustrated it on a line graph. The received values was evaluated by one-way analysis of variance at a $P_{5\%}$ probability level, and by the measurement of the mass of the bulbs we used Two sample t-test variance analysis at a $P_{5\%}$ probability level. (*Sváb* 1973).

Table 4. Dates of the harvests

Sprint	07 June 2007
Thermidrome	15 June 2007
Makói őszi	20 June 2007
Arno	06 July 2007
GK Lelexír	15 July 2007

The examination results of the shooting percentage

We indicated the measured values in *Table 5.* In this table it is showed, that the shooting percentages between the examinations show a considerable difference, outstanding is the fast shooting of the french variety *Sprint,* but *Arno* proved to have very slow shooting. The cloves of *Makói őszi* showed good rising, while the *Thermidrome* realized late the desired shooting percentage, and hatched slightly drawling what means, that the dormancy is relatively short.

Table 5. Shooting percentage in the culture of Hanságliget
(Hanságliget, 2006–2007)

	3 December 2006	**22 December 2006**	**20 January 2007**
Sprint	97.62%	100.00%	100.00%
Thermidrome (SE)	54.76%	61.90%	78.57%
Arno	19.05%	26.19%	90.48%
Makói őszi	93.52%	97.62%	98.41%
Thermidrome	57.41%	69.97%	87.83%
$SD_{5\%}$	3.56		

From the results of the one-way analisys of variance we can deduce that the calculated F value is bigger, than the critical F value on a $P_{5\%}$ probability level between the examined varieties by the shooting percentage we received a significant difference where the $SD_{5\%}$ is 3.56. According to the examined garlics we can say, that where the shooting percentage is higher than 3.56% it can be ascribe to the characteristic of the garlic.

We can relate that after the accomplishment of the analysis of variance, during the period 03 December 2006 and 18 February 2007, the calculated F value was higher than the F critical value, because of these there was a significant difference between the examined varieties at $P_{5\%}$ probability level. The value of the $SD_{5\%}$ is 0.045. The measured altitude difference of the examined varieties in the concrete time can be owing to the growing vigour of the varieties, in the case when we received larger variance than 0.045%. By the measured values after 18 February 2007 we didn't find a significant difference between the examined varieties on a $P_{5\%}$ probability level.

By the varieties *Makói őszi* and *Thermidrome* we made an other examination to the finding out of the fact, what differences are between the planting of the cloves from the exterior, middle, or from the inner circles of cloves by the case of shooting percentage and growing vigour. But after the accomplishment of the analyses of variance on a $P_{5\%}$ probability level we did not find a significant difference (*Figure 1.*).

It is clear from *Figure 2.* that from the examined varieties the intensity of the vegetative growing of the *Sprint* and *Thermidrome Super Elit* is significant over in the periods of examination time December–January. In the following period (January–March) we did not experience a considerable difference between the garlics, moreover in March the varieties

obtained the same intensity. From the period of March–April the values of the varieties started to pull apart. Again the *Sprint* has been growing fastest which was followed by the *Thermidrome SE*, in the case of the variety *Arno* however we experienced that it was underdeveloped as the other varieties.

Figure 1. The altitude of the vegetative parts of the examined garlics in different times (mm) (Hanságliget, 2006–2007)

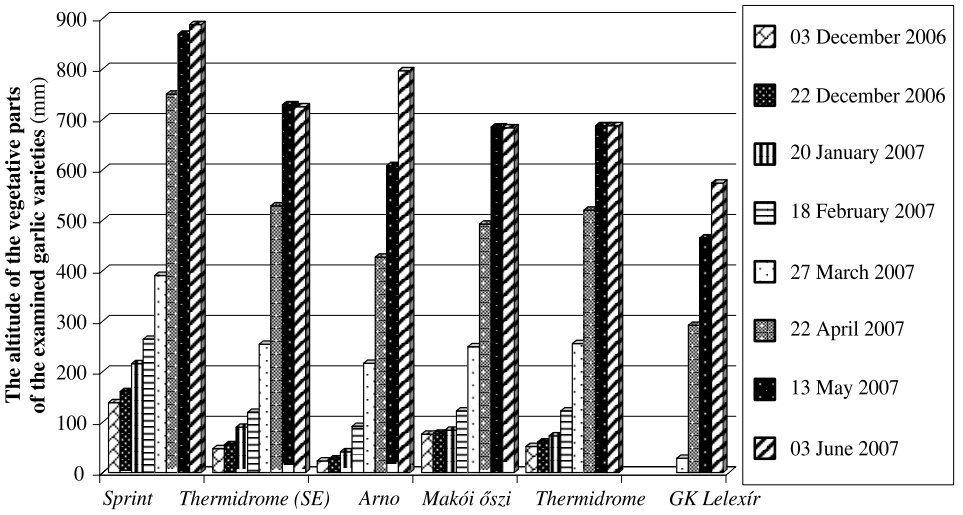
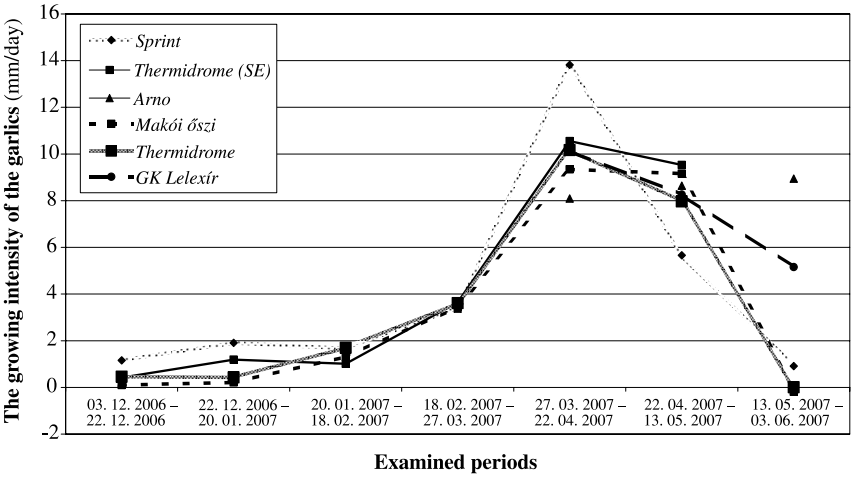


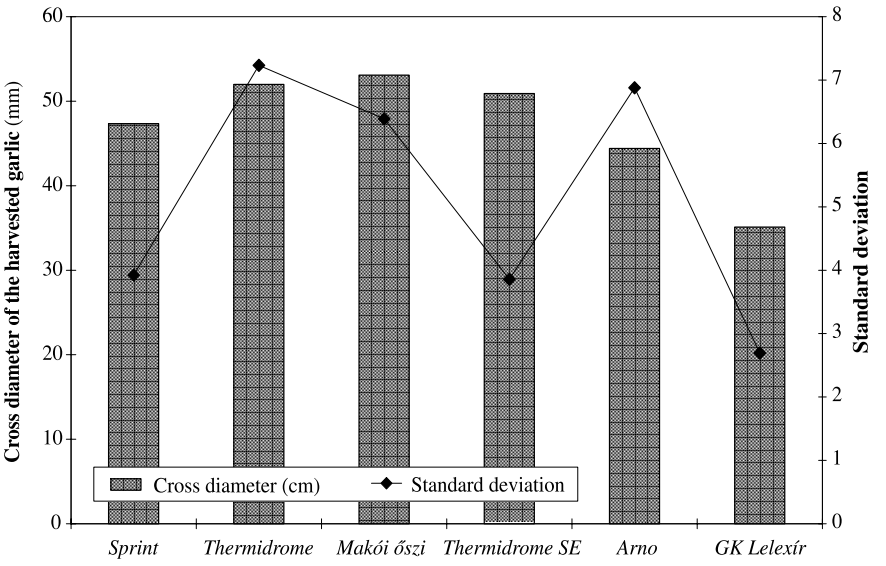
Figure 2. The growing intensity of garlic varieties involved in the examination (mm/day) (Hanságliget, 2006–2007)



In the following, late vernal period the growing intensity of *Sprint* relapsed consumedly, as well as by the other varieties the vegetative development slowed down. In the last examination time all the examined varieties finished the growing, they started to mellow, except the *Arno*, and the *GK Lelexír.* The development of *Arno* and *GK Lelexír* in this period can be explained with a longer growing time and with a ripening in later time (*Iváncsics* and *Gombkötő* 2007).

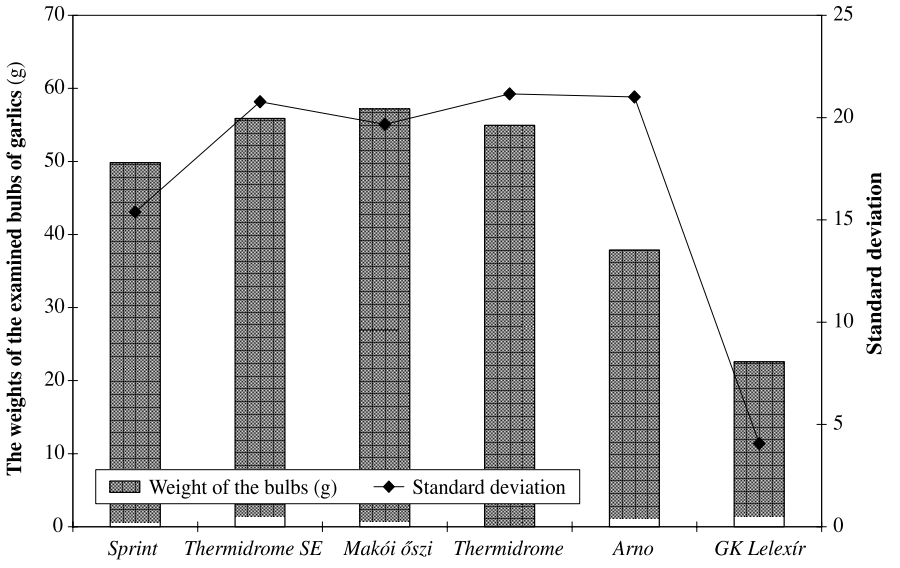
In the course of the measurement we cut the bulbs of garlic into two parts, we measured the cross diameter with a ruler (mm). After we made the one-way analysis of variance we didn't find a significant difference between the examined varieties at a $P_{5\%}$ probability level. It is clear from the diagram that the largest cross diameter has the variety *Makói őszi,* but we received very similar values in the case of french *Thermidrome*. It's manifested well from the diagram, that – how it was expected – the vernal *GK Lelexír* has the smallest diameter from the varieties. By *Thermidrome Super elite*, and by *GK Lelexír* varieties we found a low standard deviation, which indicates the uniformity of the culture (*Figure 3*.).

Figure 3. The cross diameter of the harvested garlic ones (mm)
(Hanságliget, 2007)



From *Figure 4.* it's manifested well, that we received largest weight values in the case of the *Thermidromes* and *Makói őszis* bulbs. By the variety *GK Lelexír* the weight of the bulbs was very small, however the standard deviation was small too, which indicates the uniformity of the culture. In the case of *Arno* this fact couldn't be told out. By this variety beside the small weight we have got a high standard deviation value, which indicates that the culture was not uniform.

Figure 4. The average value of the weights of the harvested bulbs of garlic (g) (Hanságliget, 2007)



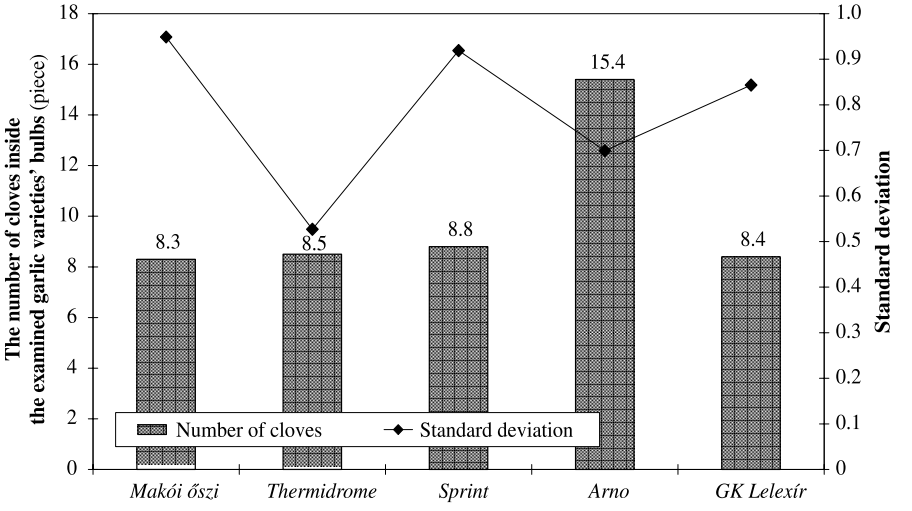
After the measurement of the weight of the bulbs of garlic we used two sample t-test variance analysis on a $P_{5\%}$ probability level. *Table 6.* shows that in which case of the examined garlics was found significant difference between the varieties.

Table 6. The significance – examination from the values of the weight of the bulbs of garlic

	Sprint	***Thermidrome SE***	***Makói őszi***	***Thermidrome***	***Arno***	***GK Lelexír***
Sprint		–	–	–	–	+
Thermidrome SE	–		–	–	+	+
Makói őszi	–	–		–	+	+
Thermidrome	–	–	–		+	+
Arno	–	+	+	+		+
GK Lelexír	+	+	+	+	+	

From *Figure 5.* we can appoint well, that in the case of the varieties *Makói őszi, Thermidrome, Sprint* and *GK Lelexír* can be found only 8–9 pieces of cloves, the number of cloves inside the bulb of *Arno* is prominently high (15–16 pieces). However when we confer this value with the value which we have got by the case of the weight of the bulbs of *Arno,* we can draw the inference, that the cloves by this variety are much smaller as by the other ones.

Figure 5. The number of cloves inside the bulbs of the examined garlic varieties (piece)



Magyar és francia fokhagymafajták vegetativ fejlődése a hansági termőtájban

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A világ fokhagymatermelése növekszik. Napjainkban mintegy 2 millió tonna fokhagymát termesztenek, és a világ legfontosabb húsz zöldségfajtája között van.
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Vizsgálataink során több fajtát vontunk be kísérleteinkbe, melyek között négy őszi *(Makói őszi, Thermidrome, Sprint, Arno)* és egy tavaszi *(GK Lelexír)* ültetésű. Kísérleteinkkel ezen fajtákból szeretnénk kiválasztani azokat, amelyek biztonsággal termeszthetők a fent említett termőtájon.
Kulcsszavak: fokhagyma, *Allium sativum*, francia és magyar fajták.

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www.ksh.hu

Address of the authors – A szerzők levélcíme:

GOMBKÖTŐ Csilla – IVÁNCSICS József
University of West Hungary
Faculty of Agricultural and Food Sciences
Institute of Plant Sciences
H-9201 Mosonmagyaróvár