HUNGARIAN AGRICULTURAL RESEARCH

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- breeding and commercialization of field crops;
- improvement of production technology; and
- production and sale of seeds representing high genetic value.

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Zoltán Kováts[1]

Breeding Of Outdoor Ornamental Plants Adapting Well To Climatic Changes

The possible *effects* and *phenomena* of climate change have been discussed for several decades by tens of thousands of scientists of various disciplines with increasing frequency and intensity and involving more and mores fields.

Agriculture, including horticulture, is particularly affected by these changes.

The opinions relating to the issue are quite diverse. Many people agree that the Earth's climate is warming, however, it is also often projected that increase in the occurrence of extreme weather events may cause as severe damage as the rise in temperature.

The solutions suggested to counteract these trends are highly variable and documented by countless publications. In the present essay we examine the question from the aspects of plant breeding, particularly that of the improving of ornamental plants. As for the problem of climate change, it is the breeding of outdoor ornamental plants that are important, of course. In Hungary, herbaceous seed-propagated plants developed in the country for more than half a century are of main interest. The varieties created by this research work have proved to be successful in both domestic and foreign markets.

The improvement of tolerance to drought and heat is the most important breeding aim of all. Hungary has continental climate with extreme temperature values, and the amount of precipitation here is less than in the regions of Europe where most of the research was conducted in the 19th and 20th century. In the past, the breeding of outdoor – mainly annual – ornamental plants was carried out in Germany, the Netherlands and Great Britain under more humid, cooler and more uniform weather conditions.

Alcea rosea

Alcea rosea

These varieties were imported to and used widely in Hungary, but the intensive research work started in the 1950s demonstrated that most of them are not really suitable for use here. The concept that drought tolerance is required principally with the intention of saving water has turned out to be wrong. It was proved that the duration of blooming of several ornamental plant species was shorter in Hungary than in countries with oceanic climate because the vital functions of plants were accelerated by the higher temperature and stronger solar radiation, resulting in faster

Alcea biennis

Alcea rosea Balaton

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Tithonia rotundifolia

seed maturing. The producers in Hungary actually took advantage of this phenomenon, and the seeds of ornamental plants sown in Western and Northern European countries were produced here in most of the 20th century.

Nevertheless, very few of the foreign varieties were suitable in all respects for outdoor use in Hungary. Due to the acceleration of vital functions mentioned above, the varieties developed abroad was rarely in flower all through the summer. In addition, the varieties of the limited number of species available did not provide enough variegation which is, for obvious reasons, an essential aesthetic requirement for ornamental plant production.

The breeding of annual ornamental plants began by the comprehensive variety examination mentioned earlier, and the first results were quite promising. In the beginning, relatively few species were involved in the investigations. The first subject of breeding was Alcea rosea, and varieties with the exceptional trait of bursting into flower even in the first year were developed and marketed as Hungarian variety group. They also had more branches and larger number of flowers than the biennial varieties commonly used beforehand, and became known later in foreign countries as Hungarian Hollyhock. By crossing the distinctive individual plants of these varieties with a species autochthonous in Hungary *(Alcea biennis),* a new variety group in seven different colours was created. These plants were shorter (100 cm) and had more branches than any of the varieties previously used, and produced an even greater flower mass, bringing international recognition to them. They were traded in Hungary as Balaton series and were introduced to foreign markets as the purple-pink Silver Puffs (All-America Selections Award Winner), and as Majorette,

Cosmos sulphureus tetraploid and diploid

a colour mixture of colour-stable varieties (A.A.S. Award Winner, 1975).

These varieties were able to flower throughout the summer in Hungary and, owing to their novelty, established the appreciation of Hungarian varieties abroad.

The second species involved in the breeding activity was the Callistephus chinensis. Its seed was previously propagated in Hungary, being a major export article at that time. The number of registered Hungarian varieties reached 40 from which around 30 were granted the Fleuroselect Award. Due to the strong non-branched stems of the varieties bred in Hungary, they have become and are still the most demanded commercial varieties in Western Europe.

Registered Rudbeckia varieties were also developed, including the Fleuroselect Gold Medal Winners 'Prairie Sun' and 'Cappuccino', both used worldwide. As a result of comprehensive breeding work, further varieties are continuously improved and launched on the market. Being tetraploid, all of them are in bloom for much longer than the diploids used earlier. Beside chromosome doubling, their tolerance to drought is attributable to their origin of the Northern American prairies with extreme climate.

Some new varieties of Tithonia rotundifolia have also become Hungarian specialities as the height of the Fleuroselect-awarded Goldfinger is only 100 cm as opposed to the former 200 cm long varieties. Fiesta del Sol growing to the height of 50 cm was also granted with this award.

These varieties are not only distinguished by their drought tolerance but they withstand wind as well, making them ideal for using in flower beds. The high-

Celosia plumosa New Look (bikavér)

Celosia plumosa Aranybika

Celosia plumosa Főnix

stem variety was unsuitable for this purpose.

The two dwarf varieties of Cosmos sulphureus are popular all over the world primarily because they produce a lot of branches. Cosmic Orange and Cosmic Yellow were awarded by both Fleuroselect and A.A.S.

The first tetraploid variety, Carioca, was developed from this species, which is regarded as extraordinarily innovation worldwide. It is 80 cm high and as a consequence of chromosome doubling has more durable flowers, stronger stems and larger blooms than the diploid varieties previously widespread in the USA. It was granted with Fleuroselect Award in 2006.

The varieties of Celosia are also regarded as Hungarian specialities. The large number of branches makes it perfect for flower beds, contrary to the previously well-liked Japanese varieties which – due to their small size – are more suitable for being planted in pots or tubs. Several of the Celosia varieties bred by in our institute were awarded by Fleuroselect and A.A.S. All are tolerant to drought and bloom for a long period producing abundant flowers.

A hollyhock variety group generated by crossing the Althaea officinalis, a wild species in Hungary, the Alcea rosea varieties developed previously can be considered as the most unique novelty. The varieties of the group are superior in several traits to the varieties known up to now, and they are the only varieties that are resistant to hollyhock rust (Puccinia malvacearum). They are completely winter-hardy. These varieties are sterile, therefore, they do not produce seeds, resulting in continuous flowering. Previously, we propagated them via cuttings, but now the more effective method of micropropagation is used.

This new variety group, being an intergeneric hybrid between Alcea and Althaea, is of high importance not only in terms of use but from scientific aspects as well. The development of several new traits is attributable to the application of the method of intergeneric hybridisation.

We intend to use this breeding technique more often in the future, which is greatly assisted by the micropropagation procedure without which such crossings did not seem to be successful.

These new hollyhock varieties highly tolerant to extreme climatic conditions encourage the use of this method for the breeding of other species as well.

Alcea x Althea Háros

Alcea x Althea Háros (purple in background)

Gaillardia pulchella

Among our registered varieties that can adapt well to extreme weather, several varieties of Gaillardia pulchella is also worthy of note. In addition to their drought tolerance, they – contrary to the previously used varieties widespread in home gardens – are suitable for flower beds due also to their round shape and great flower mass. Red, yellow and bicolour varieties were created, which have gained international recognition as well.

Diverse breeding practices

The most important factor is the native area (original place of growth) of the breeding material. The use of the right breeding material has often proved to be successful for the purposes of improving drought tolerance of Hungarian varieties, such as in the case of Alcea biennis growing wild in Hungary or Rudbeckia hirta indigenous in the North American prairies.

In many cases, for instance in those of Rudbeckia hirta and Cosmos sulphureus, the method of polyploidization was effective. Varieties improved this way show increased tolerance to various stress factors (heat, drought, extreme cold) and, at the same time, comply with the other main objective of breeding: they flower for a longer time, which is attributable also to their more vigorous character being inherent in polyploids.

Polyploid varieties of plants that are not susceptible to frost damage (Rudbeckia) can stand extreme cold better and reliably overwinter, resulting in safer seed propagation due to the early seed maturing in the second year.

The third method applies the selection of more robust plants in the population as their regeneration after temporary stress events, mainly droughty periods, is always superior to that of the plants with average development.

This procedure was especially useful for Tagetes patula. The varieties bred have more branches and, therefore, produce more flowers than the previously common foreign varieties selected for earliness. In addition, the flowering of all the early maturing foreign varieties lasts shorter.

The Hungarian varieties can be complemented with foreign varieties that are unable to demonstrate their advantage of being tolerant to drought and flowering continuously in places with more humid, cooler climate. Such varieties include those of Verbena rigida, Verbena bonariensis, Senecio cineraria, Salvia farinacea and Zinnia linearis which can tolerate extreme climatic conditions well and bears flowers in colours that varieties of other species bred in Hungary lack, for instance blue and blue-violet providing nice harmony with the yellow and orange blooms of Rudbeckia, Tagetes, Tithonia or Cosmos sulphureus.

In conclusion, it can be stated that one of the most reliable yet previously less often applied approaches to the adaptation to extreme climatic conditions is the development of varieties suitable for such circumstances by plant breeding practices. Such breeding programmes are most practical to be carried out at places with extreme weather conditions, or involving plants autochthonous in areas with such climate.

Varieties developed under various climatic conditions can also be tested in regions with extreme weather i.e. areas with continental climate, which has almost always been neglected under the pressure of continuous innovation typical to our age. Our examinations demonstrated that ornamentals delightful under extreme weather conditions always perform really well also in areas with more uniform climate.

By reason of the information contained herein, breeding and variety examination of ornamental plants in Hungary is still going to play an important role in the future in terms of developing plants adaptable to the unpredictable changes in the climate.

The institute has been breeding ornamental – primarily annual – plant varieties since 1950.

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Domestication Events of Grape (Vitis vinifera) from Antiquity and the Middle Ages in Hungary from Growers' Viewpoint

Morphological reconstruction of ancient grapes (*Vitis vinifera)* based on archaeological seed remains provide insight into the domestication and cultivation events of grapes in Hungary. Ancient grape seeds were excavated at Roman and Medieval archaeological sites in Hungary and analyzed by LM (Light Microscopy) and SEM (Scanning Electron Microscopy). Excavation sites included Budapest (*Aquincum*; 2nd–4th CENT. A.D. Hungary) and Keszthely (Fenékpuszta) of Roman Age (5th CENT. A.D., Hungary); and Gyır (Ece; 11–12th CENT. A.D., Hungary), Debrecen (13th CENT. A.D., Hungary) and the King's Palace of the Árpád Dynasty at the Castle of Buda, Budapest (15th CENT. A.D., Hungary) of the Middle Ages. Ancient seeds were compared to thirty current grape varieties of similar seed size, shape, and morphology. The modern grape variety *Vitis vinifera* cv. '*kék bakator*' (*syn.*: '*Blue Bocca d'Oro*'; '*aranybogyó*') was found most similar in seed morphology to one of the ancient samples (15th CENT. Debrecen, Hungary) which indicates the antiquity of this cultivar.

The genus Vitis

Species of the plant family *Vitaceae* are woody climbers comprising 13–17 genera: Acareosperma; Ampelocissus, Ampelopsis (pepper-vines); Cayratia; Cissus (treebines); Clematicissus; Cyphostemma; Leea; *Muscadinia*; Nothocissus; Parthenocissus; Pterisanthes; Pterocissus; Rhoicissus; Tetrastigma; Vitis (grapes); and Yua of about 700 species (Facsar 1970; Terpó 1976). The genus *Vitis* consists of about 60 inter-fertile species including about fifteen species of agronomic importance (Table 1). Of them, *V. vinifera* ($2n = 4\times = 38$) is the only species which is indigenous to Eurasia, with a relatively small nuclear (nuDNA) genome size of $0.475–0.5\times10^9$ DNA base pair (bp); and a 160,928 bp of chloroplast cpDNA (Jansen *et al*. 2006) and a regular size of higher plant mtDNA (1–400,000 bp). Most genera of family *Vitaceae* have 2n = 38 chromosomes (n = 19), but species of Muscadinia, Ampelocissus, Parthenocissus, and Ampelopsis have 2n = 40 (n = 20) chromosomes, and species of the genus Cissus has 2n = 24 (n = 12) chromosomes.

Changes in seed ('pip') shape, wild grapes have rounder pips with short beaks, while seeds of cultivated grape tend to be more elongated with longer beaks. Seed morphology indicates that domestication of grape (*Vitis vinifera*) began with the Eurasian wild grape (*V. sylvestris)* about 5,500–5,000 B.P. (before present) in southwest Asia and southern Transcaucasia (Armenia and Georgia). Seeds of *Vitaceae* are easily identified from a suite of unique and distinctive morphological characters (particularly a pair of ventral in folds and a dorsal chalazal scar).

The wild, dioecious ancestor form of *V. vinifera* ssp. *silvestris* (syn.: *V. silvestris*) still coexists with the cultivated, hermaphrodite flower form of *V. vinifera* ssp. v*inifera* (syn. *V. vinifera*) in Eurasia and North Africa (This *et al*. 2006). Today, thousands of cultivars have been developed which are generally classified in three main groups according to their final production, as wine grapes, table grapes including modern seedless grapes, and raisins.

Genetically, dioecy in wild grape is encoded by a single gene; female individuals are homogametic carrying homozygous recessive pistil-*su*ppressor alleles (su^msu^m) which suppress the development of anthers (and pollen). Male plants are heterozygous (SU^Fsu^m) carrying a dominant pistil-suppressing Su^F allele.

The shift, under domestication, to bisexual (hermaphrodism) flowers took place via a single mutation to SU^+_m which is also dominant over su resulting in two genotypes of hermaphroditc grape types (SU^+su^m and SU^+SU^+).

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Domestication events in the genus Vitis

The oldest (8,400 B.P.) wild grape (*Vitis sylvestris*) seeds (about 3 mm long) were excavated in Turkey, at Nevali Çori (NÇ) located near the Turkish city of Urfa (37°60'N, 38°70'E, 490 m above sea level) on the slope of a Euphrates side valley, Hilvan province. The first convincing evidence of *Vitis vinifera* seeds with indications of grape cultivation were also uncovered in Turkey at Kurban Höyük (5.700–5.200 B.P. non-calibrated radiocarbon time), followed by the early Bronze Age samples (3,200–1900 B.P.) along the Jordan Valley, at *Tell Shuna* (Jordan; Chalcoitic), *Jericho* (Cisjordan; early Bronze Age), and *Arad* (Israel, early Bronze Age) (Jacquat and Martinoli 1999). Ancient grape seeds were also excavated at Semma (Sudan) 3,500 B.P.

The earliest evidence of wine production (jars from Godin) was found in Iran (Hajji Firuz Tepe site in the Zagros Mountains) about 7,400–7,000 B.P. (This *et al*. 2006) and 5,500 4,900 B.P. Greek, Latin, and Egypt vine amphoras with gelyfied vine remains were found in the hulls of sunken ships sunk, similar to the famous shipwreck remains at Uluburun near Kas (Turkey). Grape cultivation gradually spread to Mesopotamia, Assyria, and Egypt (about 5,500–5,000 B.P.), and further west along the Mediterranean to Phoenicia, Greece, North Africa and then to the entire Roman Empire north to Pannonia (Hungary) and German tribes. Viticulture also spread eastward along the Silk Road and it reached China and Japan in 3,200 B.P.

Grape were introduced to the Americas by European colonists starting from the 16th CENT. after either the early Chinese explorer Zheng He (1405–1435), or Columbus voyages (first: Aug. 3 1492 to March 15 1493; second: Sept. 25 1493 to June 11 1495; third: May 30 1498 to Nov. 15 1500; fourth: May 11 1502 to Nov. 7 1504). The first plantations in North America were established on the West Coast by Spanish missionaries and later by Hungarian viticulturists like Ágoston Haraszty who is considered the '*father of California's grape-growing industry*'. Haraszty imported 200,000 grape cuttings from Europe from 1849, including grape varieties from his native Hungary. With the passing of time, Haraszty developed over half a million California acres to viticulture, making wine growing second to orange production in the state's agricultural economy. In recognition of his merits, Haraszty was named California's State Commissioner of Viticulture (Sisa 2006).

European grape formed hybrids with native *Vitis* species growing in North America. Some of these hybrids became resistant to *Phyloxera* (an insect pest), which devastated European vineyards in the 1880s, and supplied resistant rootstocks for replantations. This event indicates that the diversity of grape genome has been narrowed twice; first by the Biblical

flood, followed by the re plantation of Noah 'the first vintner' (Genesis 9) on Mount Ararat, and second by *Phyloxera* (This *et al*. 2002). Unlike the genome for dioecious *V. sylvestris*, genetic diversity of grape has been narrowing continuously as the result of vegetative propagation either by rooting of twigs, or by grafting.

In Hungary, the earliest wild grape (*Vitis sylvestris*) seed remains were found at Tiszapolgár (5,300 B.C.) and the earliest *Vitis vinifera* at Sopron (1,300 B.C.), which dates the origins of grape cultivations to the late Bronze Age *(Table 2, Fig. 1).*

Table 1. *Vitis species (1–27), hybrids (1–9) and gene bank samples (1–12)*

Vitis species	*Vitis* hybrids*	*Vitis* gene bank samples
1. *Vitis acerifolia*	1. V. arizonica x V. rupestris	1. Vitis sp.
2. Vitis aestivalis	2. V. berlandieri x V. riparia	2. Vitis sp. 196-17
3. Vitis amurensis	3. V. berlandieri x V. rupestris	3. Vitis sp. 216-N
4. Vitis arizonica	4. V. berlandieri x V. vinifera	4. Vitis sp. 44-53M
5. Vitis bashanica	5. V. cinerea x V. riparia	5. Vitis sp. 8007
6. Vitis berlandieri	6. V. cinerea x V. rupestris	6. Vitis sp. 8658
7. Vitis betulifolia	7. V. labrusca x V. vinifera	7. Vitis sp. cv. 'Norton'
8. Vitis bryoniifolia	8. V. pseudoreticulata x V. vinifera	8. Vitis sp. CWD 96.70
9. Vitis cinerea *(downy grape)*	9. V. riparia x V. rupestris	9. Vitis sp. Nie 372
10. Vitis davidii		10. Vitis sp. Nie 415
11. Vitis flexuosa	* Interspecific hybrids registered in Hungary (2006):	11. Vitis sp. NL-
12. Vitis heyneana		12. Vitis sp. Qiu
13. Vitis kelungnsis		
14. Vitis labrusca *(Concord grape)*	*'Bianka'; 'Csillám'; 'Duna gyöngye'; 'Esther'; 'Fanny'; 'Göcseji zamatos'; 'Kunleány'; 'Medina; 'Nero'; 'Odysseus'; 'Orpheus'; 'Platina'; 'Pannon frankos'; 'Pölöskei muskotály'; 'Refrén'; 'Taurus'; 'Teréz'; 'Viktória gyöngye'; 'Zalagyöngye'.*	
15. Vitis piasezkii		
16. Vitis popenoei *(totoloche grape)*		
17. Vitis pseudoreticulata		
18. Vitis quinquangularis		
19. Vitis riparia *(riverbank grape)*		
20. Vitis rotundifolia *(fox grape)*		
21. Vitis rupestris *(rock grape)*		
22. Vitis shuttleworthii *(callose*		
23. Vitis sinocinere		
24. Vitis thunbergi		
25. Vitis tiliifolia		
26. Vitis vinifera *(wine grape)*		
27. Vitis yeshanensis		

The earliest wine residue in Hungary dates back to 700 B.C. (at Fehérvárcsurgó), which places the beginnings of wine making to the Iron Age. Thus, there is evidence that both grape cultivation and wine making date to well before to the Roman period in Hungary.

How to recover ancient DNA

Excavated and wet-sieved sediment samples of the study presented were processed by flotation followed by seed sorting and identification in the laboratory according to Gyulai *et al.* (2001, 2006). For SEM analysis, seeds were air dried, fixed in glutaraldehyde (5% w/v in phosphate buffer 0.07 M, pH 7.2) and washed three times in the same buffer for 10 minutes. Samples were then desiccated in acetone concentration series (10–50–70–90–100%), dehydrated at the CO_2 critical point (Blazers CDC 020), and covered with gold (30 nm). Seeds were examined and photographed using a TESLA BS-300 scanning electron microscope *(Fig. 2)* as described by Gyulai *et al.* (2006). For LM analysis, a Leica microscope (# 301–371.010) was used. For comparative analysis seeds of thirty current *Vitis* cultivars *(Fig. 3)* were applied.

Morphological reconstruction of ancient grapes

Ancient grape seeds of the study presented were compared to current grape varieties of similar seed size, shape, and anatomy, and analyzed by LM and SEM *(Fig. 2)*.

Based on seed morphology, the 15th CENT. seeds (Budapest, Hungary) were similar to the currently grown grape variety '*kék bakator*' ('Blue Bocca d'Oro') *(Fig. 2, Fig. 3),* which is one of the oldest varieties grown in Hungary and Italy, as the etymology of its name *Bocca d'Oro* (*aranybogyó*) suggests. Other seed samples of obvious ancient type with short seed beaks from the Roman (2nd–4th CENT. A.D., #1 and #2 Fig. 2) and medieval age (13th CENT., Debrecen, #4 *Fig. 2*) showed no such similarity to any of the thirty currently grown grape varieties analyzed (Fig 3). Seed sample from the 11th –12th CENT. (#3 Fig. 2) showed incomparably unique genotype. Ancient DNA (aDNA) were also extracted from the seeds according to Gyulai *et al.* (2006), Szabó *et al.* (2005), and Lágler *et al.* (2005) and amplified by WGA (Genomplex, Whole Genome Amplification, Sigma WGA-2) with a 5–9 fold amplification rate of total genomes, and analyzed by *Vitis*-specific primer pairs (results presented elsewhere).

Table 2. *Vitis (V. sylvestris, V. vinifera and V. sp.) and wine remains (pieces #) excavated in Hungary*

Ages		Excavation sites (Hungary)	*Vitis vinifera*	*Vitis sylvestris*	*Vitis* sp.
5,300 - 4,700 B.C. (Middle Neolithic)	1.	Magyaratád			10[C]
4,700 - 4,300 B.C. (Late Neolithic)	2.	Tiszapolgár-Csőszhalom		1[C]	
3,500 - 3,000 B.C. (Late Copper Age)	3.	Szombathely-Sé		1[C]	
	4.	Kompolt-Kistéri tanya		18[C]	
1,300 - 900 B.C. (Late Bronze Age)	5.	Békés-Várdomb			10[C]
	6.	Dunakeszi-Székesdűlő		2	
	7.	Ludas, Varjú-dűlő		2[C]	
	8.	Mosonmagyaróvár-Németdűlő		3	
900 - 500 B.C. (Early Iron Age; Hallstatt)	9.	Sopron-Krautacker 1	1		
	10.	Fehérvárcsurgó-Eresztvény	W		
	11.	Sopron-Krautacker3	2	1	
	12.	Sopron-Krautacker6	9		
5th - 1st CENT. A.D. (Late Iron Age; La Tène)	13.	Zagersdorf	3		
	14.	Budapest-Corvin tér			1[C]
	15.	***Budapest (Aquincum), Kaszásdűlő***	6,108		
1st – mid 5th CENT. A.D. (Roman age)	16.	Budapest (Kunigunda str)	W		
	17.	Budapest (Bécsi str 69-71)			i
	18.	Budapest (Vörösvári str 20-22)			13; 1[C]
	19.	Dunaújváros (***Intercisa***)	W		
1st - mid 5th CENT. A.D. (Barbaricum)	***20.***	***Keszthely-Fenékpuszta***	33[C]		1[C]
	21.	Budapest (Bécsi str 44)	3		
	22.	Szekszárd	W		
	23.	Tác-Fövenypuszta (*Gorsium*)	3		x
	24.	Budapest (XIV. reg. Paskál park)	1[C]		
	25.	Gyomaendrőd (Endrőd 170)		1[C]	
	26.	Kiskundorozsma-Nagyszék		1[C]	
6th - 8th CENT. A.D. (Awarian Age)	27.	Keszthely-Fenékpuszta	2[C]		
	28.	Budakalász	L		
	29.	Fonyód-Bélatelep	255		
	30.	Fényed-Szegerdő			10[C]
8st - 9th CENT. A.D (Late Migration periode; Caroling Age)	31.	Zalavár-Vársziget parkoló	127[C]		
	32.	**Győr (Ece)**	28[P]		
895 A.D. - 1,301 A.D. (Hungarian conquest - Árpád Age)	33.	Gyomaendrőd (Endrőd 170)		1[C]	
	34.	Rákoskeresztúr		3	
	35.	**Debrecen (Kölcsey Cultur-Centre)**	24		
1,301 – 15th CENT. A.D. (Hungarian Kingdom)	***36.***	***Budapest (St György sq Teleki Palace)***	210686		
	37.	Budapest (Kapucinusok 16)	192151		
	38.	Budapest (Bécsi str 34-36)	14773		
	39.	Budapest (Honvéd FŐP)	43170	1	
	40.	Budapest (Hunyadi János str 22)	1341		
	41.	Budapest (Dísz sq 8)	1233		
	42.	Budapest (Hess András sq 1)	365		
	43.	Budapest (Úri str 40)	66		
	44.	Budapest (Színház str)	4		
	45.	Baj-Öregkovács-Hill	3		
	46.	Budapest (Dísz sq 10)	x		
16th - 17th CENT. A.D. (Late Medieval; Hungarian Kingdom to Turkish occupation)	47.	Budapest (Medve str 13)	4954		
	48.	Hollókő-Castle	47[C]		150[C]
	49.	Kereki-Fehérkő Castel	x		
	50.	Külsővat	2[P]		
	51.	Lászlófalva-Szentkirály	5		
	52.	Nagyvázsony-Csepely	65[C]		12[C]
	53.	Pápa (Deák Ferenc str)	x		
	54.	Pápa (Hantai str)	12		
	55.	Pécs (Med School)	22[C]		
	56.	Sopron (L str 7)			8
	57.	Sopron (Templom str 14)			10[C]
	58.	Sümeg (Castle)	xx		
	59.	Szarvasgede	x[C]		
	60.	Szécsény-Plébániatemplom	693; 42[F]		
	61.	Székesfehérvár (Palotai str 5)	15[C]		
	62.	Vác (Széchenyi str 3-7)	44349[F]		
	63.	Visegrád (*Mathias Palace*)	52		

([C]carbonized seeds; [F]berry fragments; [P]petrified seeds; i – imprints; L – leather wine holder; W – wine residues); (x: pieces 1–10). (excavation sites studied are indicated in bold)

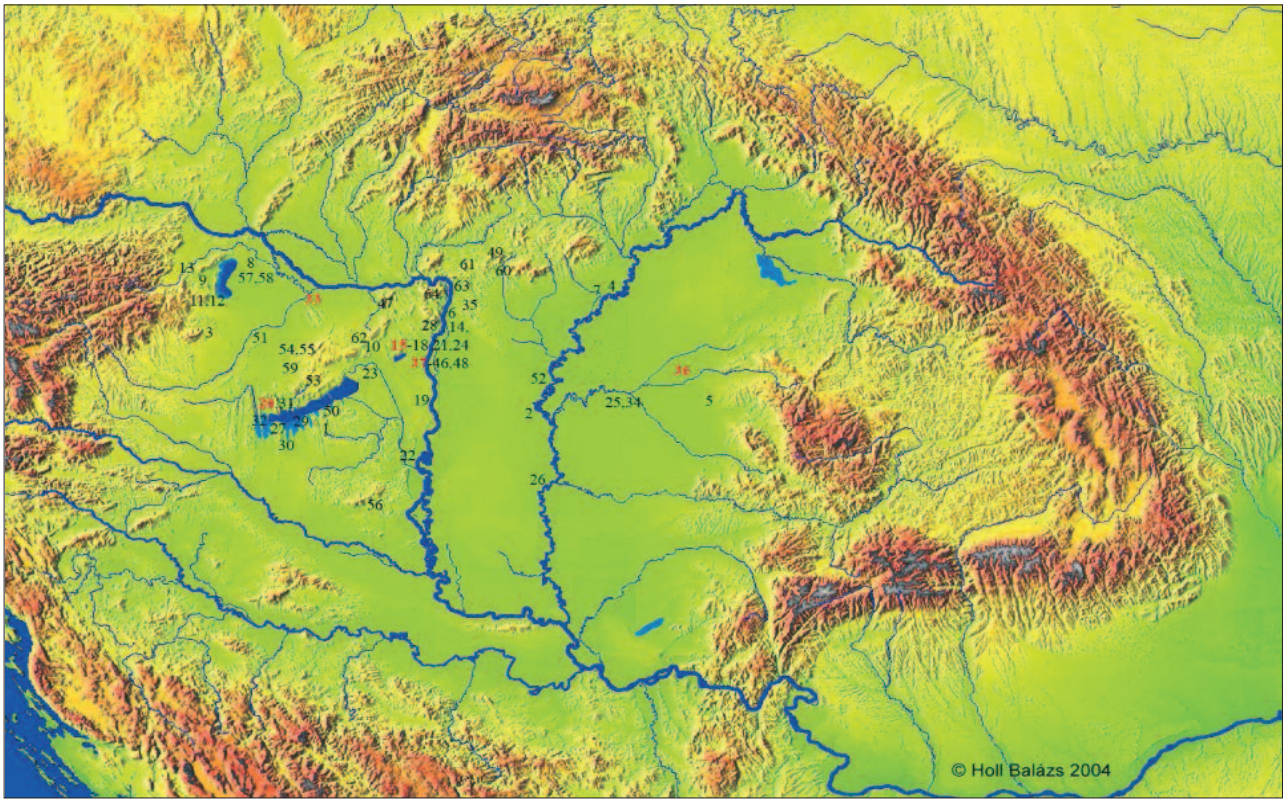


Figure 1: *Archaeological sites of Hungary where Vitis seeds were excavated listed in Table 2.*

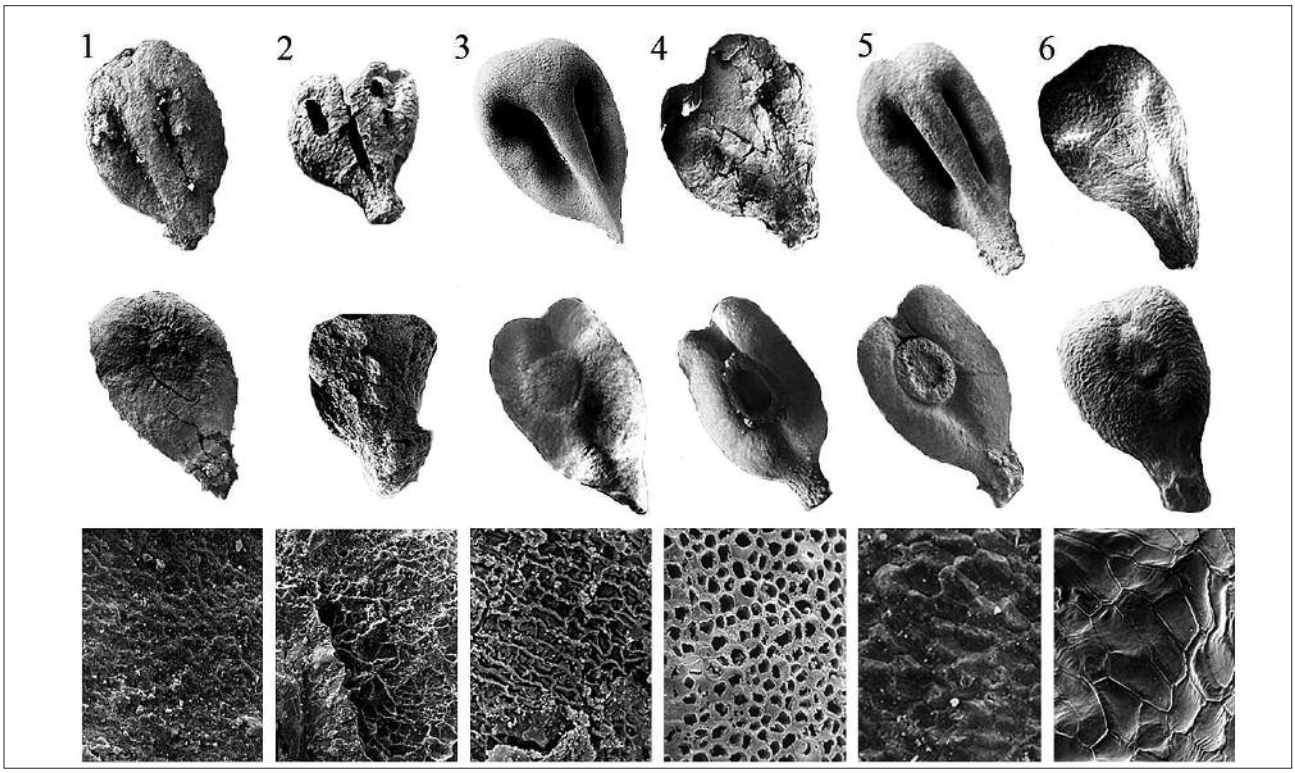


Figure 2: *Morphology of ancient Vitis seeds excavated in Hungary. SEM micrographs of seeds excavated at a 4th Roman Villa at Budapest (Aquincum, Hungary) (2nd – CENT., A.D.)* ***(1);*** *and Keszthely (5th CENT. A.D., Fenékpuszta, Hungary)* ***(2);*** *a vineyard site near Gyır (Ece, Hungary) (11–12th CENT.)* ***(3);*** *Debrecen (Hungary) (13th CENT.)* ***(4);*** *and at the King's Palace of Árpád Dinasty in the Castle of Buda (Budapest, Hungary) (15th CENT.)* ***(5).*** *The SEM micrograph of seeds of the contemporary Vitis vinifera cv. 'kék bakator' is also shown (6). Upper (ventral view) and middle (dorsal view) rows show seeds morphology at 20 x magnification. Bottom row shows seed coat textures at 500 x magnification*

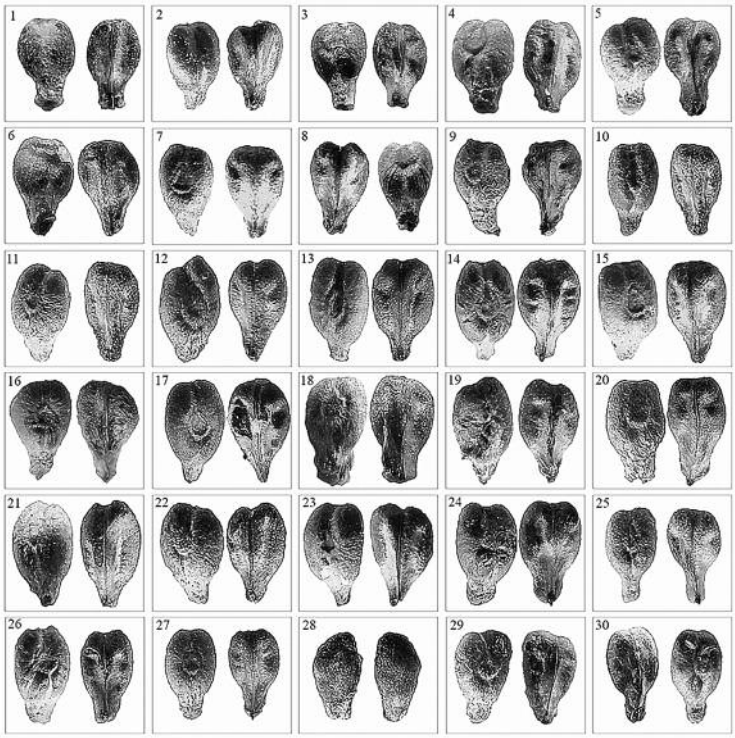
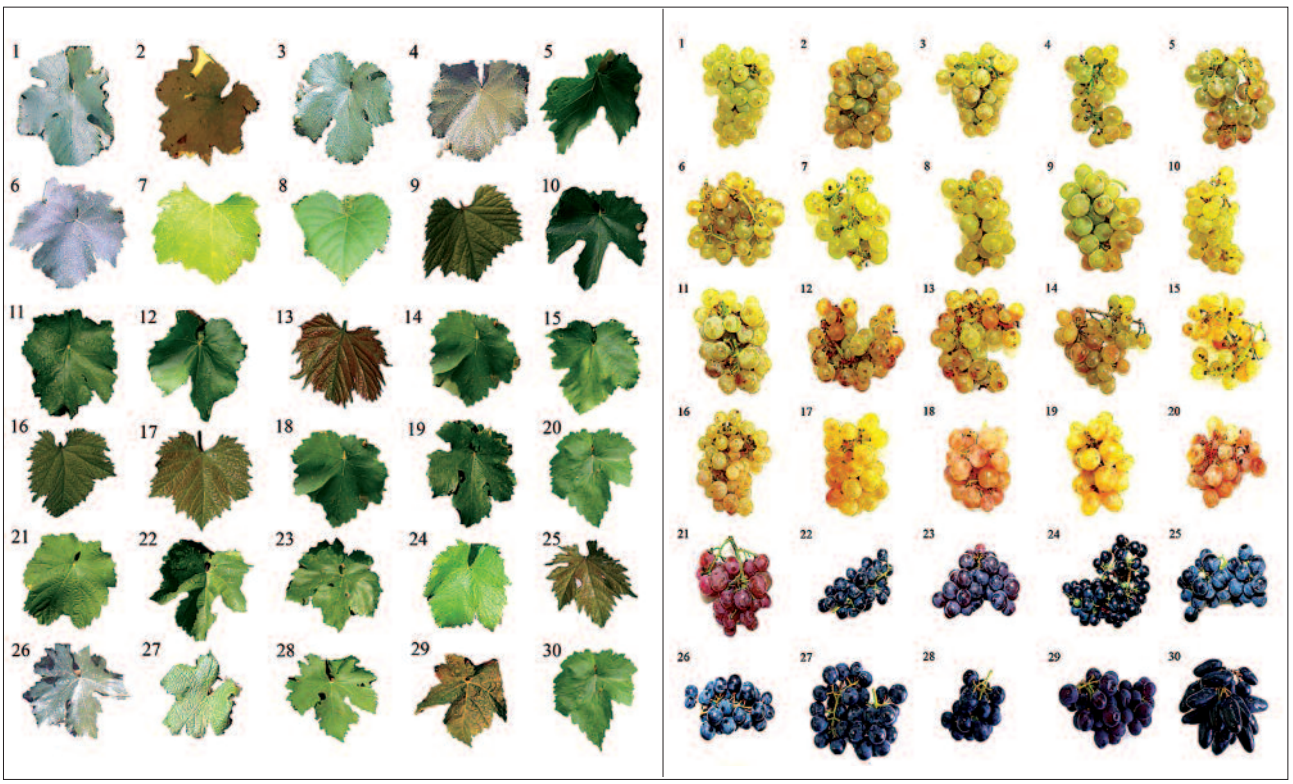


Figure 3: *Seed, grape and leaf morphology of current grapes (Vitis vinifera, but #8 and #21) grown in Keszthely (Hungary) used for comparative analysis.*
1. *'Rajnai rizling' NI-378;* ***2.*** *'Leányka';* ***3.*** *'Zöldszilváni';* ***4.*** *'Ezerfürtű';* ***5.*** *'Juhfark';* ***6.*** *'Chasselas blanc K-15';* ***7.*** *'Kunleány';* ***8.*** *V. riparia x V. rupestris;* ***9.*** *'Narancsízű';* ***10.*** *'Fehér lisztes'* ***11.*** *'Mirkpvacsa';* ***12.*** *'Hárslevelű';* ***13.*** *'Változó góhér';* ***14.*** *'Sárfehér';* ***15.*** *'Kéknyelű';* ***16.*** *'Csabagyöngye';* ***17.*** *'Mátyás király';* ***18.*** *'Fehér járdovány';* ***19.*** *'Kossuth';* ***20.*** *'Piros gohér';* ***21.*** *V. vinivera 'Aramon' x V. riparia 143 B';* ***22.*** *'Bakó';* ***23.*** *'Visnivi rami';* ***24.*** *'Kékfrankos';* ***25.*** *'Kék bakator';* ***26.*** *'Oportó';* ***27.*** *'Szürkebarát D 34';* ***28.*** *'Kismis vatkana';* ***29.*** *'Piros szlanka';* ***30.*** *'Suvenir'*



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Korzenszky, P., Judák, E.

New technological possibilities for modifying particle size in feed production

Quality of feed is one of the most decisive parameters of animal keeping technologies. The selection and determination of the proper nutrient composition is the task of those specialised in animal husbandry. Because of the different physiological characteristics of different animal species only the variety specific feeding can be the right solution. As a result of inter-specific differences, considerable differences exist between feed compositions. The amount, proportion and size of the ingredients have definite influence on the optimal feed utilization of the given animal species, the determination of which requires well-planned experimental design.

The variety makes no difference in digestibility trials with pigs. Live weight is preferably maintained in the 40–80 kg range, but the use of animals with a body weight as much as 80–120 kg might also be required. The minimum number of pigs involved in the experiment is three and the literature suggests three parallel repetitions as customary in the technical field. The experiment is composed of a pre- and post-section of 5 days, respectively. Researchers KIDDER and MANNERS (1978) observed that it took an average of 20 hours for 5% of the material to be excreted and 60 hours for 95% to be excreted. Animals have to be placed in special cages as the collection of the urine and faeces have to be permitted in a quantitative manner. The cages should be put in a room where a temperature of 18–20 ^{o}C, a relative humidity of 60–70% and suitable ventilation can be ensured.

The direct digestibility trial, when the feed is provided alone, is based on the comparison of the amounts of nutrients ingested and excreted and the difference of the two is called apparent digestibility.

Indirect digestibility trial is carried out giving a so-called basic feed to eat. The basic feed influences the digestibility of the feed to be tested and vica versa. This is what the literature calls combined digestibility. *Table 1* shows the composition of the recommended basic feed mix in indirect digestibility trials with pigs. [5]

In order to produce basic feed it is necessary to comminute the individual components. This operation aims at permitting digestive fluids to have a better access to nutrients and to facilitate the mixing of feed components into a homogeneous mass. Comminution has the disadvantage that the oxidation of the plant oil that is no longer in a bound state will occur earlier than in the intact grain. Starch of feeds in a finely-milled state will be broken down too quickly in the rumen of ruminants, thereby creating an acidic pH in the rumen and this way disfavouring ruminal fermentation. Also, finely ground feeds that are susceptible to becoming sticky will adhere to the palate and will cause a poorer feed intake. A meal ground too fine will increase the risk of development of oesophageal ulcer in swine.

According to the recommendations of the Hungarian Feed Codex published in 1990 the following particle sizes have to be used in the manufacturing of the given products.

The effect of particle size on feed conversion in pig feeding is illustrated in *Table 3*.

Data of the prescriptions *(Table 2)* and the experimental results (Table 3) do not coincide in every case. In practice, following the prescriptions, the tendency is to try to produce a smaller particle size

Table 1: *Composition of recommended basic feed mix in indirect digestibility trials with pigs [5]*

Components	**%**
Corn	40.8
Wheat	20.0
Barley	20.0
Extruded soy bean	16.0
Other (MCP, feed lime, common salt, premix)	3.2

[1]Szent István University, Faculty of Mechanical Engineering

Table 2: *Some recommendations based on the Hungarian Feed Codex published in 1990*

Feed name	Standard	Particle size ranges
Feeds of animal origin	MSZ 21340-86T	80% below 2 mm 20% between 2–3 mm
Feed meal from wheat	MSZ 08-1358-81	100% below 0.67 mm
Ground rye for feed purposes	MSZ 08-1367-81	100% between 0.32–1.6 mm
Feed meal from corn	Feed Codex I. '84	80% below 0.8 mm

Table 3: *The effect of particle size on feed conversion of pigs [6]*

Particle size (mm)	Feed conversion efficiency (kg/kg)
> 1	3.00
0.9–0.7	2.92
0.7–0.6	2.76

in order to ensure the improved utilization and better homogeneity of the feed mix.

In the case of a traditional milling of agricultural products farms apply the accustomed old 'well proven' settings with their existing devices. However, in connection with the changes that have taken place in the energy sector and in the field of food safety, it is worthwhile to consider the setting up of a more economical and more flexibly applicable system which can be integrated with the existing one.

At greater farms, the electronic machinery designed earlier with a very great factor of safety requires considerable financial resources in advance on an annual basis. With a minimal investment, regular monthly expenses can be reduced by equipping electric motors with frequency drives. Thereby a softer start and a controllable input/output performance can be achieved. There are a lot of manufacturers on the market offering these products in wide ranges of performance.

In the case of conventional arrangements a suitable screen is fitted prior to the onset of milling in order to set the output, i.e. the desired particle size. For the prevention of eventual overloading during operation the position of the bolt lock is modified at the place where the material enters, with the intervention of the operator.

The modification of revolution number is not a customary solution in the field of milling of agricultural products. Our investigation aims at demonstrating that through the alteration of the peripheral hammer speed the same particle size can be produced as with the traditional change of screen. For the purpose of the measurements the existing hammer mill was equipped with measuring devices. The input and output parameters of the experiment are illustrated in *Figure 1*. [4]

The original design was completed with a frequency drive, marked in bold in the figure, suitable for changing the number of revolutions, with devices signalling the number of revolutions (n_1, n_2), a torque meter (M_2), a thermometer (T), a bolt lock position transducer (A incoming) and with a load cell (m) for measuring the weight of the meal coming out. The conditions of the gravity feed and discharge were not changed and I used a sieve with the same mesh size for the same series of experiments. Measurement results were recorded using a data collector measuring over eight parallel channels with a high speed

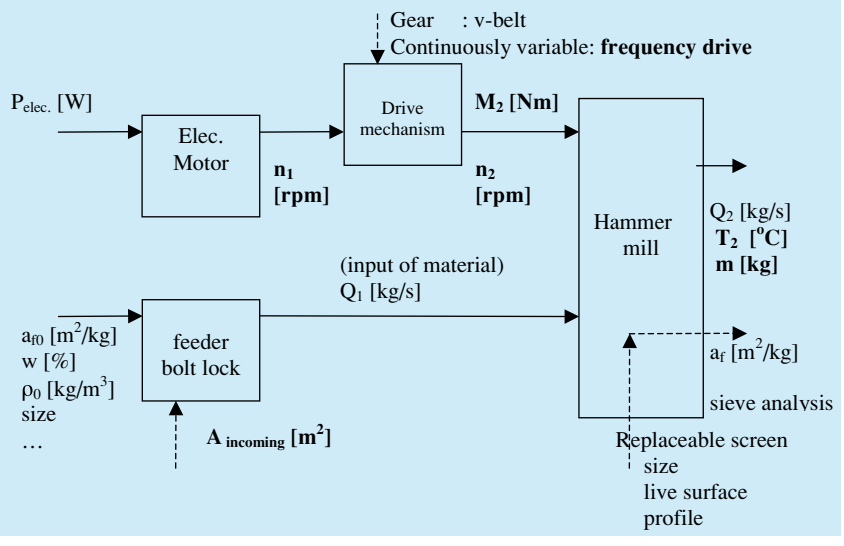

Figure 1: *Design of the experimental apparatus, input, output variables and parameters*

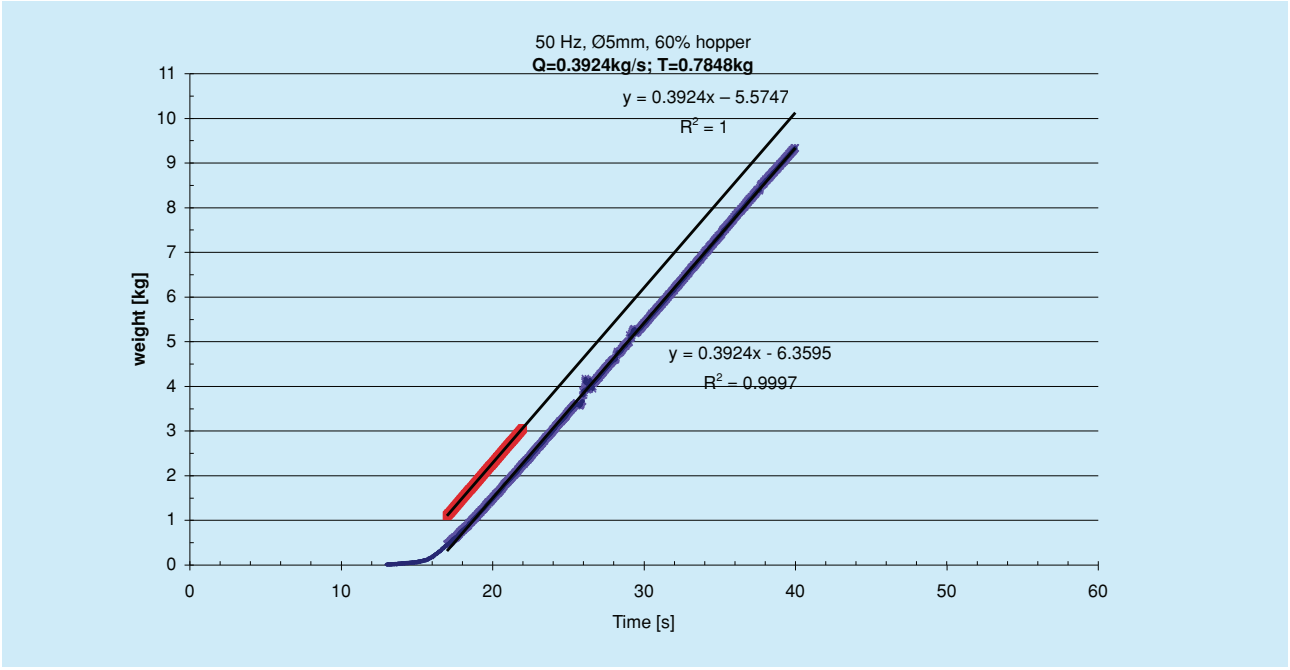

Figure 2: *Eight-channel data collector and frequency drive applied*

sampling (50Hz). The data collector and the frequency drive applied are illustrated in *Figure 2*.

In the processing of the data, phenomena taking place at identical moments had to be illustrated over time. The basis of the simultaneous representation of the different amounts was provided by the database comprising 56,000 entries per measurement. *Figure 3* illustrates the data obtained in one of the measurement settings. When establishing the settings, it was usually the peripheral speed of the hammer that was changed in order to permit the comparison. [3]

In *Figure 3* you can see that it was only after the ninth second when the stabilized phase of milling began and in the preceding phase, it took some time until the motor and the axis of the mill, according to a previously determined characteristic, assumed the working RPMs. In the

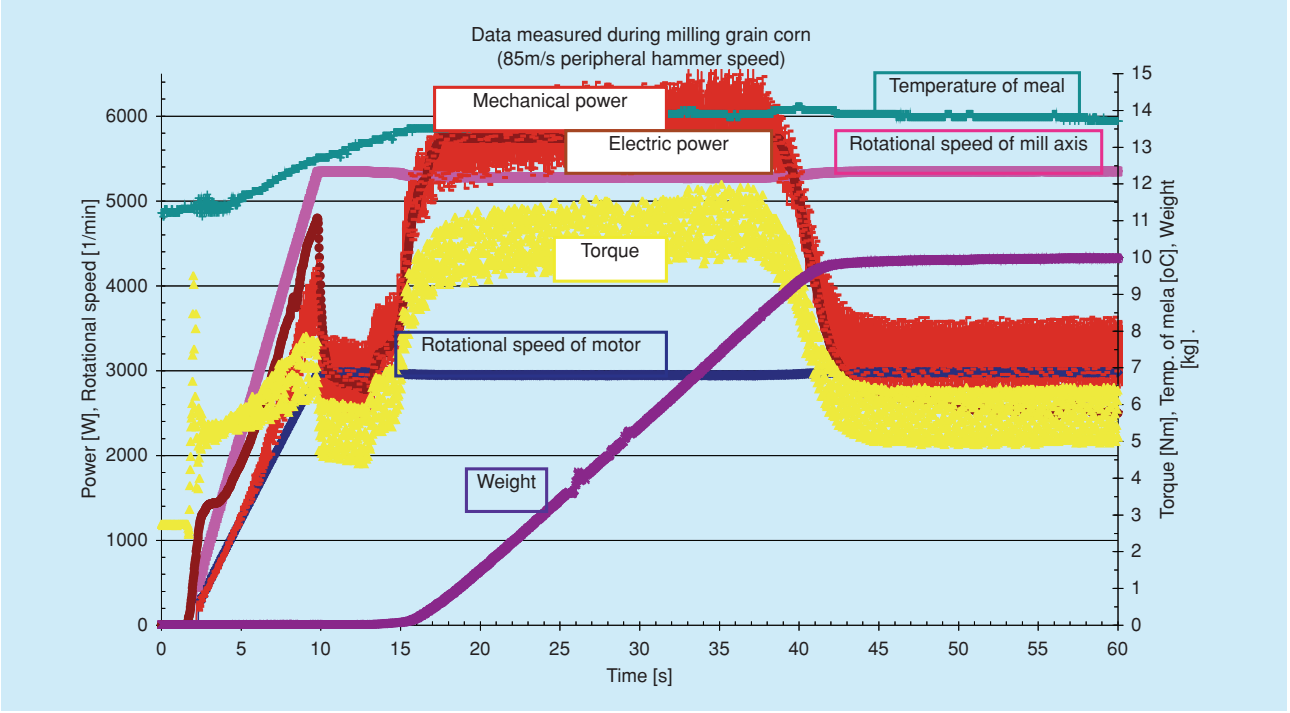

Figure 3: *Temporal distribution of data measured during milling grain corn*

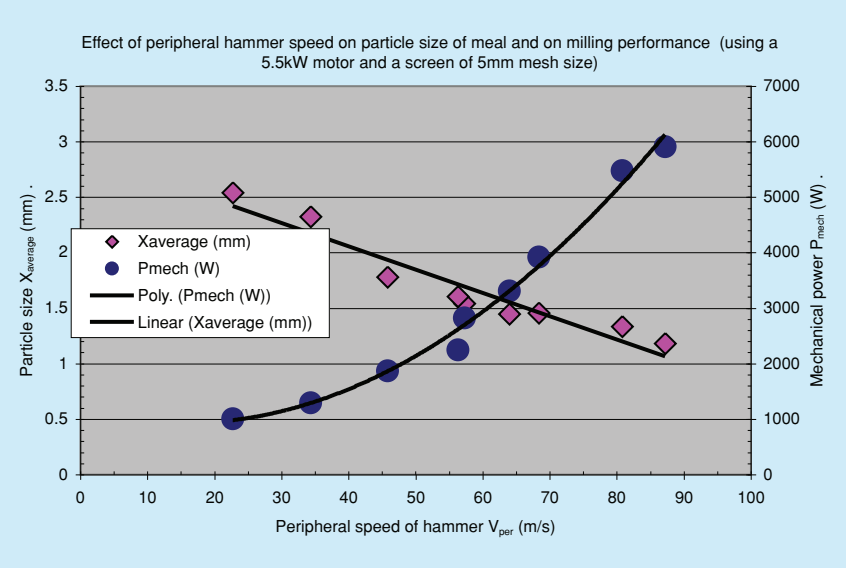

Figure 4: *With increase in peripheral hammer speed average particle size (x average) decreases and mechanical power (Pmech) requirement increases*

thirteenth second, as a result of the sudden opening of the bolt lock, real milling started and the mechanical torque measurable on the axis was increased and therefore also the mechanical power, as well as the electric power taken from the grid. After the fifteenth second, the first comminuted particles appeared at the output of the mill which were captured on a weighing scale. During the process of comminution, the particles in the work space warmed up from the initial 11 °C to 14 °C.

I used sieve analysis for the qualification of the meal produced and from the data obtained in this way I determined the average particle size belonging to the respective settings.

The method described above was carried out with three repetitions per treatment according to the experimental plan using different peripheral hammer speeds.

Experimental results show that by means of a continuously variable regulation of the number of revolutions, without any stop and change of screen plates, the same output particle size can be achieved as in the case of the traditional change of sieves. *Figure 4* is an illustration of the effect of the increase in the number of revolutions of the hammer mill on particle size (× average) and on the mechanical power (P_{mech}) measured on the axis of the mill.

The working number of revolutions (v_{per}=80m/s) of the mill fitted with a 5.5kW motor was accompanied by an average particle size of 1.3 mm, while the slower hammer speed (v_{per}=20m/s) was accompanied by a particle size of 2.5 mm. Within the range of these two numbers of revolutions, with a continuously variable regulation, a meal of any average particle size desired can be produced.

Based on the results of the experiment, a linear relationship can be seen between the increase in the peripheral speed of the hammer and the increase in meal fineness. A greater number of revolutions also involves a greater impulse force in the case of the same geometry, thereby the comminution energy produced is also greater. [2]

The continuously variable regulation of the number of revolutions is most easily carried out by using a frequency drive.

A satisfactory growth of livestock requires as a minimum condition that feeds are available in the required quantity and quality. One of the parameters influencing quality is the average particle size of feed. The possibility to adjust particle size during comminution can open up new perspectives for the improvement of economic indicators of feed production. The continuously variable particle size output can be a new perspective field for the technological improvement of feed production.

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Gutermuth, Á., Pedryc, A.[1]

The possible source of resistance against blossom blight (Monilia laxa Ehr.) in apricot

Blossom blight caused by *Monilia laxa* (Ehr.) is the most important fungal disease in Hungarian apricot orchards. The cultivars traditionally grown in the country are susceptible to *Monilia laxa* (Ehr.) at various rates. Totally resistant cultivars are not known. Chemical treatments against blossom blight during the flowering time are expensive, increase chemical pollution and often are not sufficient in defeating infection. In 2004 for example in the flatland area 3, while in the hilly region in Gönc 2 fungicide applications were necessary for decreasing the damages caused by disease however it did not provide full prevention(Drén et al. 2007). The reason of the inefficiency might be the latent infection and fungicide resistance. There are two different forms of the infection of apricot twigs by *Monilia laxa*. The well known and often described twig infection usually occurs during the rainy period and starts from the fungi penetrated flowers. In case of the second form the pathogen infected tissues of the twigs are assumed to be the source of the spreading of disease. This phenomena was described in sour cherry (Guido and Thomas, 2006) and observed in apricot orchards as well. These "latent" or "early" twig blight symptoms are already detectable at the time of full blossoming even under dry weather conditions. The core of the problem is that the fungicide treatments are recommended and useful just to control the flowers' infection.

Development of the disease resistant cultivar would be the most effective and safety solution for the plant protection both for the environmental and economic reasons.

Importance of that the above was emphasised even in the first apricot breeding program in Hungary launched by Gyula Magyar in the 1930's. The main aim of his breeding activity was to increase resistance to frost and blossom blight (Pedryc, 2003, Pedryc, 1992). Among cultivars at present the choice the conventional Hungarian cultivars like 'Gönci magyarkajszi' have a limited tolerance to the fungal infection but the majority of foreign cultivars is more susceptible to blossom blight than the locally selected cultivars. Unfortunately the field resistant cultivars are not commercially accepted because of the inadequate quality of fruit in contrast to many moderately resistant or susceptible cultivars which satisfy requirements of the modern market.

In the experimental orchards of the Department of Genetics and Plant Breeding during the last 5 years there were carried out consistent evaluation of twig infection on trees representing apricot cultivars from different geographical regions. Monitoring studies revealed that the single year of evaluation of the naturally infected trees and determination of the resistance level does not provide reliable results. Response to infection even in case of the same cultivar under variable, year depending weather conditions could be different. Further difficulties derived from uncertainty during ranking degree of the natural infection which is strongly influenced by the level of twig and fruit contamination occurred in the previous years. It is important to note that there is no significant correlation between the number of the primarily infected flowers and the amount of twigs damaged by disease. The latent infected twigs are the centres of the flower buds infection even before the blossoming time. The long term (five years) monitoring can decrease the influence of the yearly changing weather conditions and allows qualifying cultivars on the base of genetically determined differences.

Screening of the resistance level of the cultivar assortment in the collection of department was carried out by the scoring of symptoms into the following groups:

0 Totally resistant: flowers are destroyed but the mycelium cannot spread through the stem to the phloem of the twig, the pathogen did not destruct the branches.

1 Tolerant: flowers are destroyed and the phloem of the shoots is injured. The spot of damaged tissue is smaller than 10 mm

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around the peduncle. This group contains also the genotypes which raise the flower buds on spurs so the amount of the destroyed shoots is imperceptible (functional resistance).

2 Semi sensitive: the amount of the destroyed flowers is less than 20% of the total fruit set. Most of the hybrids and cultivars of the experimental orchard belong to this group.

3 Sensitive: more than 20% of the flowers are destroyed every year. This level of symptoms appears even if the blossoming period is dry.

Results of the evaluation are shown in *Table 1 and Figure 1*.

Table 1. *Groups of Monilia resistance / susceptibility among different apricot genotypes*

(0) Totally resistance	(1) Tolerant	(2) Semi sensitive	(3) Sensitive
Hybrid 1/33 (*P. cerasifera* x *P. armeniaca*)	Zard	Nikitszkij	Ceglédi óriás
P. salicina Methley	Pannónia	Konzervnij pozdnij	Mari de Csanad
P. salicina considering Burbank	Magyarkajszi C.235	Harmat	Mandulakajszi
P. dasycarpa	Venusz	Konkurencia	Goldrich
P. cerasifera 23/22	Gönci magyarkajszi	Ceglédi arany	Ceglédi bíborkajszi
			Harcot
			Orange red
			Korai zamatos
			Ceglédi Piroska

The next step of the study was to determine the genetic background of resistance and clarifying the particular mechanisms of infection. According to the widely accepted explanation, the infection process begins when conidia enters the pistils through the stigmata. The base of this theory is rooted in the infection mechanism of *Monilia laxa* in sour cherry where stigmata is completely destroyed following the penetration of the pathogen. Accordingly, we supposed that the key of the resistance could be in the pistils or in the secretum. Observing flowers used in the crosses carried out as the part of the apricot breeding work going on at the department, it was clearly visible that emasculated and hand-pollinated flowers did not show any symptoms of the *Monilia* infection. The same opinion was reported by Bulgarian breeders (Tzonev and Yamaguchi, 1999). According to their experiences the pathogen cannot penetrate the forced pollinated pistil of emasculated flowers. Their hypothesis, explaining this observation, was that the pollinated pistils produce protective substances, which do not allow the infection

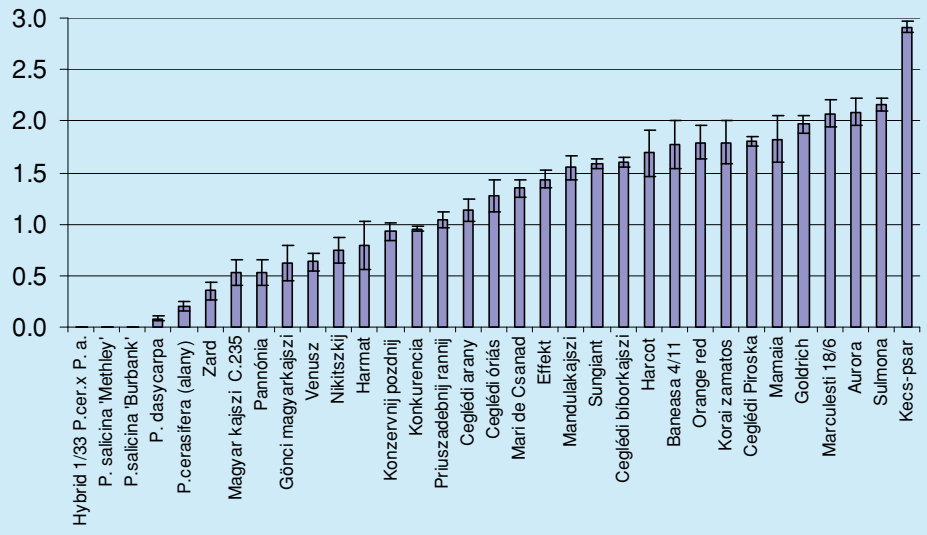

Figure 1. *Ranking of apricot cultivars considering their susceptibility to Monilia laxa (Szigetcsép, 2004–2009).*
The totally resistant cultivars got 0 and the most susceptible cultivars got 3.

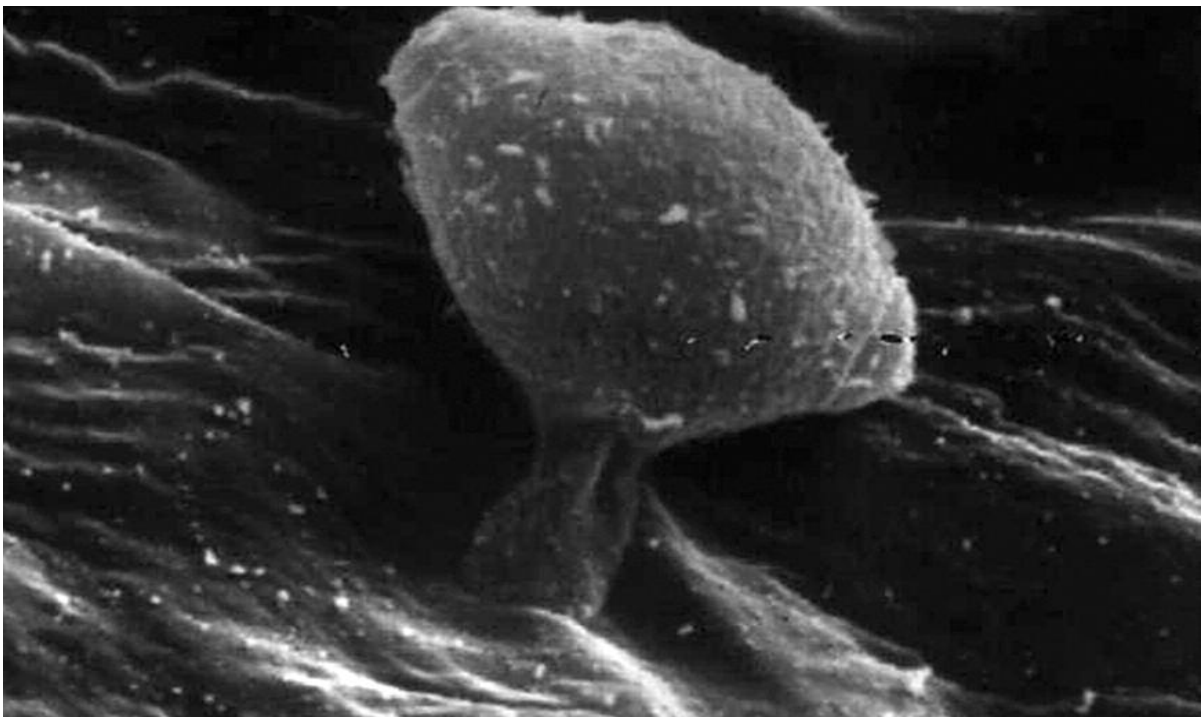

Figure 2. *Conidia germinated on the petal's surface and penetrate across the cuticle*

and also stops the pathogen in other flower parts. According to Holb (2003) all parts of the *Prunus* flowers are sensitive but the sensitivity of the stigmata was not emphasised.

Results of the infections carried out at the Department of Genetics and Plant Breeding under natural and artificial (*in vitro*) conditions indicate that penetration of the pathogen has never occurred through the stigmata. Moreover, stigmata of the totally destroyed flowers remain alive for the longest time. Artificially infected stigmata of the emasculated and hand pollinated flowers also showed fully resistance in the experiments. According to the results obtained from the natural and artificial infection study it was established that the start point of infection are petals. Furthermore, the germinated conidia easily could penetrate through the cuticle of the petals *(Figure 2, 3, 4)*. This assumption was partly confirmed by the tissue structure of floral organs. The resistance of the emasculated and forced pollinated flowers may be due to the removal of petals and anthers.

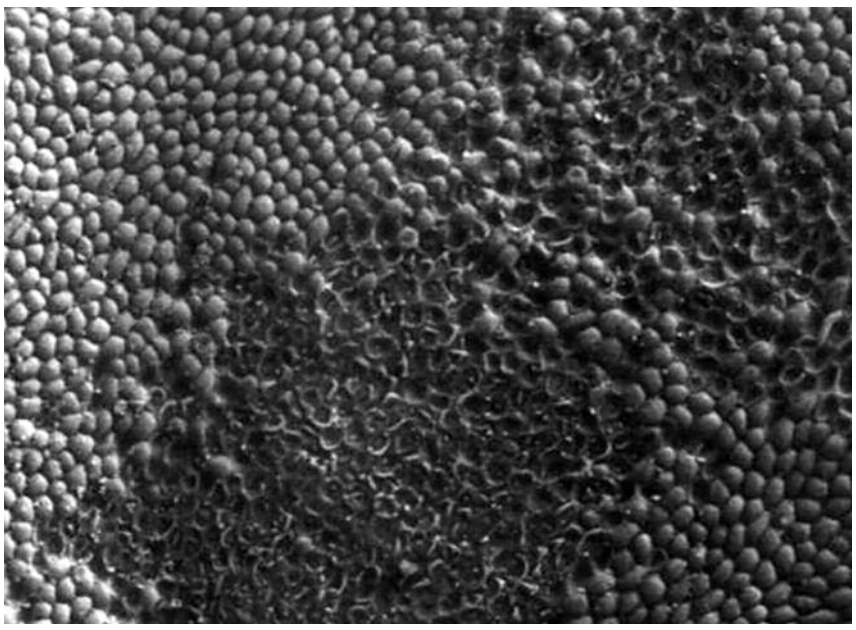

Figure 3. *Destroyed petal tissue shows the way of the mycelium growth*

Study on the mechanism of infection was completed by the investigation of the flower of *Prunus salicina*, *P. cerasifera*, *P. dasycarpa* and *P. mume*. All of the tested *Prunus* flowers were destroyed by the fungus but stigmata survived for the longest time.

In case of the resistant genotypes inoculation of the flowers on twigs wasn't succeed by the injuring of twig's phloem. Contrary to that spreading of the disease in the twigs tissue of sensitive cultivars were very quick. For further testing of the resistance the artificial infection was carried out on the shoots. .

Figure 4. *Through the influenced hypanthia the fungi can reach the twig's phloem*

According to the results it was found that *P. cerasifera* and *P. cerasifera* x *P. armeniaca* hybrids are fully resistant. Between the examined apricot genotypes we noticed differences but absolutely resistant genotype was not detected. Beside of those active resistance responds some other reasons are also responsible for the level of the susceptibility. The most important is the tree's morphology. The structure of the trees depends on the genetic background but also on the growing technology.

The degree of twig damage in case of long twigs developing individuals is relatively higher, because just one destroyed flower on the basal side might cause the death of the entire twig. On the other hand the same number of the infected flowers can cause only irrelevant damage on the trees with flower buds located mainly on short spurs. It seems that the susceptibility levels in different genotypes could be rather explained by the resistance of branches than of the number of infected flowers.

In the last two decades *Monilia* appeared as a notorious pathogen and caused twig blight regularly on apricot. To avoid this loss beside chemical treatments the long term solution is host resistance. The growing technology also gives some opportunity in the disease protection. Intensive pruning increases the ratio of the long, more vulnerable fruit bearing parts of the crone. Basing on our investigation of the way of infection it could be established that the time of the fungicides application has to correlate with the appearing of petals.

We show the differences in sensibility between some cultivars, which may be the principle of selecting the proper cultivar. We described the potential diploid resistance sources of *Prunus species* as *P. salicina, P. cerasifera* and *P. dasycarpa*.

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Babo, T.[1], L. Kocsis[2]

Babo Branch Cordon System as a new approach in modern viticulture

Grapevine pruning – reasons and biological basis

Grape existed on the Earth before human beings appeared. As far as we know viticulture developed together with humans. No one knows when pruning first started, but one of the reasons could be to get fruit close to the ground, thus making fruit collection easier for ancient mankind. Pruning controls yield in viticulture. 80–90% of cane produced by vine-stock is pruned during plant dormancy in winter. The result of such intervention is increase in yield, in length of aerial shoots, and decrease in number of clusters.

As viticulture and science emerged our knowledge was extended regarding the effect of the pruning. Pongracz (1978) summarized the most important reasons for pruning (single small letters, like a.,) and the biological basis of pruning (double small letters like aa.,) as follows:

a., To afford every young vine development above ground proportionate to its vigor and to the development of its root system.

b., To provide new wood, i.e. one year-old canes, for bearers at the desired places.

c., To regulate and ensure the production of grapes, as regards both quantity and quality, by leaving the correct number of fruit on the vine according to its capacity.

d., To establish and maintain vines in a desired shape that will prevent damage during maintenance operation.

e., To concentrate the activities of the vine into its permanent arms and bearing units.

f., To remove worn-out and injured parts of old vines.

aa., The fertile fruit of the vine occurred on the one – year-old – canes that arise from two-year-old wood.

bb., On a cane the fertility of the fruit increases the farther they are removed from the base of the cane.

cc., Excessively vigorous canes are not only less fruitful, but the fruitful grapes are farther up on the canes.

dd., Canes with short internodes usually possess more fertile eyes than those with long internodes.

ee., Only well-ripened canes that have borne well during the previous season should be used as bearers.

ff., Every vine can properly nourish and ripen only a certain number of bunches and canes, and this is proportional to its vigor Hence every vine must be pruned on the basis of its own condition."

What is the Babo Branch Cordon System?

The Babo Branch Cordon System (BBCS) more or less fulfills all the above mentioned requirements, however, slightly differently than we usually prune. The BBCS vine-stock shape is obtained by high-cordon cultivation. Cluster reduction is achieved by removing budding shoots and their gemmules within. This increases the number of branches produced, but reduces their lengths. Since fewer canes appear, pruning can be omitted. A greater portion of the plant's energy is channeled to fruit and less to cane production. Depending on the cluster load of vine-stock, the plant's energy boosts the quality or quantity of yield.

Let us see one by one how this training system fulfills the requirements of Pongracz's sentences.

a., The development of the young vine is similar to any other training systems. The young cane has to be cut back one or two buds and the trunk and the arm should be treated as the required form. In our case it should be let to grow up, as high the cordon arms will be about 180 cm high, and the length depends on the vine spacing; it could be 1m to 2.5 m according to the variety and soil conditions. The above ground parts and the root system will develop parallel.

b., The new canes possible will develop where buds exists on the one year old cane, as the branches positioned vertically and the young shoots removed in a certain area of the canes the shoots will develop in certain places on the vine.

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c., The vine stock themselves regulate the number of clusters, however as we remove young shoots at first in spring and just the remaining buds will produce and this is more closely optimized to the vines stock capacity than any other pruning methods.

d., The desired shape of the stock could be maintained well with the strict process of bud selection.

e., The vine physiologically will serve the required amount of photo synthetically produced organic matter to the fruit because of the fertile seed production and store all the required components in the wooden part which needs to support living. It has enough canopy to do so.

f., Every year the old dried parts of the canes will partially fall out, however, of course sometimes it is necessary to remove dead wooden parts.

aa., We always have enough on two year old parts to develop yearly shoots.

bb., Fertility will be more even, only a short section of the cane matures well. Therefore it looks like two bud pruning method is applied sometimes.

cc., There are no excessively vigorous canes on the stock.

dd., We have high numbers of short internode canes.

ee., As the canes are short and because their number is high and cluster development occur on it, thus they ripen very well.

ff., These methods fulfill, as vine vigor is a vital part of maintenance and quality yield production, even if the quantity is great as well.

Establishment of the Babo Branch Cordon System

We begin by erecting a support structure. Support columns are placed three meters apart and three support wires are strung between the columns. One wire is strung on top of the columns (160 – 190 cm high), the second wire about 30 cm below, and the third about 25–30 cm above ground. The top wire supports the cordon branch and the other two wires support the shoots coming from the cordon branch. During the first couple of years of cultivation we nurture vine-stock and cordon branch development; cordon branches will grow close to one another and eventually touch. At 8–10 cm apart on the cordon branches (at the nodes where shoots appear) we cultivate shoots to grow downwards and eventually reach the ground. In the following spring we remove about half of the canes that grew on the branches. Those canes that remain should be about 25–35 cm apart; these we trim to 25 cm above ground and fix them vertically to the support wires. *(Fig. 1)*

Fig. 1: *Vine-stocks in third year of BBCS cultivation Monterey, California vineyard Chardonnay grapes (year 2002)*

50% of canes have been pruned. We left vines 25 (35) cm apart reaching towards the ground. This fostered uniform appearance of new buds.

Fig. 2: *On harvested vines we find short branches in the spring of the fourth year of cultivation. Monterey, California vineyard Chardonnay grapes (year 2003)*

Branches on harvested vines are cut back to three bud-lengths. These now we call productive vines.

We control yield by rubbing off light-colored (winter) buds. On vine-stock producing small clusters we leave more, those producing large clusters fewer light-colored buds. Width of the swath rubbed clean by purpose designed machinery is adjustable by positioning the appropriate brushes *(Fig. 4)*

Near the rubbed off main shoots we find smaller auxiliary shoots. These will be barren higher up on the branch, but those near the ground will produce fruit. *(Fig. 6)* Fewer clusters aid fecundity of shorter branches.

We leave harvested branches on vine-stock. *(Fig. 2).* In a few years these branches will grow short length fruit-bearing vines *(Fig. 3).* Sugar content of fruit and area of foliage will depend on how much we thinned out buds. Foliage should be kept thin to permit sunshine reaching the fruit, even at the cost of trimming new shoots.

Fig. 3: *BBCS cordon branch vine-stock at budding (Sopron – Oldenburg, 2005)*

Due to abundance of shoots canes grow short. Those shaded by foliage grow shorter yet than those in sunlight. New shoots naturally seek sunlight. Vine-stocks on photo have not been pruned in dormant winter months. Pruning is not needed.

Fig. 4: *Controlling yield in BBCS-method vineyard in California. Spring of 2003*

Special tractor driven rotating brushes rub off swelling main buds on vine-stocks. Width of swath can be adjusted even while machinery is in motion.

Comparison of the BBCS to the Single Curtain(SC) vine training system

Five basic parameters of yield production were compared in an experiment in Keszthely. The experiment was set up with 10 repetitions with the variety cv Italian Riesling. The single curtain system was pruned from two short canes and three to four 6–9 bud canes, depends on the vigor of the stock. The BBCS was managed as

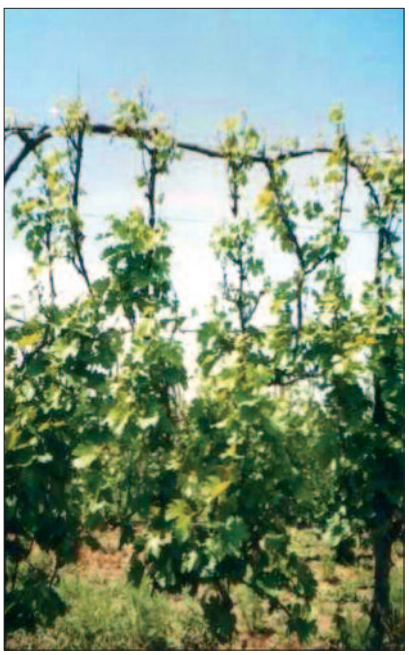

Fig. 5: *A short time after buds have been rubbed off new foliage and short vines appear. (Sopron, Leanyka grapes, year 1999)*

Fig. 6: *Even from main buds we get short vines (Monterey, California, 2004) Chardonnay grapes*

In the un-brushed areas we get full clusters of grapes.

described above. All the other cultivation was the same during the year. The yield production, the number and weight of the cluster, the accumulated sugar content and the acid content were measured. All the parameters were differentiated by the length of the hardened wooden part of the cane by the harvest time. In this way three categories were obtained; under 30 cm, 30 to 60 cm and above 60 cm. The results are presented in the *table 1*.

Economic evaluation of BBCS

The economic evaluation was carried out in California, for in earlier times large areas were cultivated according to BBCS, while other training systems were available for comparison. In *Table 2* we have summarized all the data which we received from our US partner.

Finally let us mention a few advantages from our experience:

Removing buds is easier than pruning canes.

We do not need to collect canes or to use any other tool to cultivate into the soil.

- Thin canopy easy to reach.
- The shoot growth is a short period, less expensive chemicals (contact fungicide) are sufficient.
- High yield with good quality.
- Limited to no canopy management during vegetation.
- Higher resistance and regeneration after hail damage (short film is available on **www. agro-inform.hu** about these results).

The biggest advantage could be the full mechanization of the technology.

Table 1: *The yield production on single curtain and BBCS vine-stocks*

Quantity and quality parameters	<30 cm length of the ripened canes		30–60 cm length of the ripened canes		60< cm length of the ripened canes		Average of ten stock	
	SC	BBCS	SC	BBCS	SC	BBCS	SC	BBCS
Yield %, kg/m^2	28%	23%	31%	20%	41%	57%	1.58	1.15
Number of cluster %, /m	36%	33%	31%	22%	33%	46%	30.7	30.3
Cluster weight g	0.12	0.072	0.144	0.094	0.181	0.137	0.15	0.10
Sugar content g/l	181.9	202.1	178.6	196.5	181.9	193.0	180.8	197.2
Acid content g/l	7.77	7.01	7.58	7.19	7.74	7.73	7.70	7.31

Table 2: *Economic evaluation of the BBCS*

ECONOMIC ADVANTAGES:

Parameters:	**Conservativ**		**Branch-Cordon**	
Yield	8,5	Ton/acre	13,7	Ton/acre
Total Cost	4201	USD/acre	3832	USD/acre
Selling prise	900	USD/Ton	900	USD/Ton
Investment to a parcell	30000	USD/acre	30000	USD/acre
Anual royalty	Free of charge for my friend Mr. Steve McIntyre			
Size of the parcel	1 acre			

"A" Version: Higher level of the production on the same size of parcel

Two versions, how to get more profit with branch-cordon system

VERSION A: PRODUCTION ON ORIGINAL SIZE PRODUCING ACREAGE
VERSION B: PRODUCTION ON REDUCED SIZE PRODUCING ACREAGE

A: Extraprofit on original size producing acres with new technology		7650	USD/acre
Savings :		369	USD/acre
A: Extra profit:		**8019**	**USD/acre**

B: Extraprofit: with same volume of production on reduced size parcel

Level of reducing size of producing acres in %		#HIV!	%
B: Extraprofit=costs savings /reduced acreage/less costs/ :		**#HIV!**	**USD/acre**

	investment USD/acre	**profit/year USD/acre/**	**prof./inv. %**
Investtment-profit-profit rate: Conservativ vinyard	20000	1200	6,00
Branch cordon extra inv: 500 USD/year for 12 years	6000	8019	133,65
Total investment-profit-profit rate	**26000**	**9219**	**35,46**

Advantages of Babo Branch Cordon System:

less manual labor
more frost damage resistency
higher resistency:diseases and parasites
machine controled yield
/regulated crop
minimal vestment
invest
follows market fluctuations/quantity-quality

Kozma, P.,[1] Werner, J.,[1] Forgács, B.[1]

Evaluation and clone selection of 'Hungarica' grapevine cultivars to increase the range of choice of grape varieties for quality wine production

Old 'Hungarica' grapevine varieties still play a decisive role in Hungarian viticulture. These varieties include those autochthonous in the Carpathian basin, naturalized in Hungary or developed by successful Hungarian grape breeders.

The majority of white and red wine varieties cultivated on large areas in Hungary are 'Hungarica' grapes. Kékfrankos is the grapevine cultivar grown on the largest area in the country, followed by the white wine variety Olasz rizling. There has been a great upsurge in the propagation of international (premium) varieties from 1990 as emphasis was placed on the production of quality wines. In order to achieve success, every wine region aims at offering products of supreme quality and, in order to create their own image, having special products with unique characteristics. Since land race cultivars provide an option to accomplish this goal, the demand has increased for old cultivars already withdrawn from cultivation and major Hungarian land race and regional varieties still grown in the country. In the past, almost all the varieties cultivated in Hungary were of the type Pontus which are sensitive to weather conditions and have special needs, making them unsuitable for mass production. These varieties were unable to perform well in machine-cultivated plantations with wide row spacing and low plant density, and as a consequence their cultivation was abandoned or reduced to a minor area.

Figure 1: *Csókaszőlő* Photo: János Werner

The grape gene bank established by the Research Institute for Viticulture and Oenology of the University of Pécs, which is one of the world's largest grape gene banks, stores nearly 1400 items (wild species, varieties, clones, breeding materials). The Institute managed to collect old grapevine varieties in the 1950s before they disappeared from the vineyards. The candidate varieties of the main cultivars selected during grapevine variety research and clone selection as well as the diversity revealed during these trials were successfully preserved.

Reintroduction of old 'Hungarica' grape varieties into cultivation

The old cultivars of the Carpathian basin stored in the Institute's gene bank were re-evaluated during 1998–2001 to determine which of them are able to meet the requirements of quality production and thus appropriate for being reintroduced into cultivation under the present conditions. Research is being carried out to assess the 104 old

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varieties and – in international cooperation – to prepare their morphological description. The environmental conditions in Hungary are primarily suitable for the production of quality white wine. The majority (80%) of grape varieties cultivated before the phylloxera epidemic in the 19th century were white wine varieties. Except the Kadarka cultivar, originating from the Balkans, which was once grown on large areas and the less important Kék Bakator cultivar, no other old Hungarian red wine varieties were found to offer high quality, making its widespread cultivation reasonable *(Table 1)*.

On the basis of the results of our variety assessment research of several years, the Csókaszőlő cultivar *(Figure 1)* with its high must degree and medium acid content showed superior traits. Csókaszőlő gave excellent quality, spicy, full-flavoured, fragrant, full-bodied, harmonious red wine with velvety tannin content. The outstanding harvest results of the variety presented in *Table 2* was later confirmed by other experiments as well (S.-né Éles; A. Lőrincz; Zs. Varga, 2008). After propagating the 10 vine-plants preserved in the gene bank, the variety is evaluated in multi location experiments in several wine regions of the country (Balatonboglár, Eger, Etyek-Buda, Szekszárd, Villány, Zala). With its unique character and taste, the Csókaszőlő cultivar may contribute to the highly demanded increase of the range of grapevine choice.

Table 1: *Harvest results of 'Hungarica' red wine grape varieties (1998–2008)*
Pécs, Research Institute for Viticulture and Oenology – Central site

Variety	Yield (kg/m²)	Must degree (Mm°)	Titratable acidity (g/l)	Bunch rot (%)	Date of harvest
Ágasfark	1.5	16.1	9.0	17	7-Oct
Bajor, feketefájú	0.9	17.6	7.4	6	20-Oct
Bajor, kék	1.8	16.4	9.7	9	2-Oct
Bakator, kék	1.7	15.4	11.7	22	27-Sep
Bakszem	0.5	17.1	9.7	29	3-Oct
Csókaszőlő	0.8	20.2	9.4	1	20-Sep
Fekete balafánt	0.8	16.6	8.4	13	7-Oct
Gorombaszőlő	0.2	16.9	11.8	1	4-Oct
Halápi	1.0	18.3	8.9	23	5-Oct
Járdovány, fekete	0.2	18.4	8.5	0	16-Oct
Kadarka	1.1	17.2	8.7	37	1-Oct
Kéklőpiros	1.6	14.3	9.5	7	11-Oct
Ködös	1.7	15.7	8.9	9	5-Oct
Pécsi dinka	0.6	18.1	6.6	11	11-Oct
Purcsin	0.5	17.8	12.3	12	10-Oct
Tótika	1.8	15.5	7.7	18	10-Oct

Table 2: *Harvest results of the Csókaszőlő cultivar*
Pécs, Research Institute for Viticulture and Oenology – Central site

Year	Yield (kg/m²)	Must degree (Mm°)	Titratable acidity (g/l)	Bunch rot (%)	Date of harvest
1998	0.3	19.5	7.7	0	30-Sep
1999	0.8	24.1	8.1	0	18-Oct
2000	1.0	22.5	7.3	0	26-Sep
2001	1.2	18.4	9.9	0	12-Sep
2002	0.6	21.0	11.6	0	4-Sep
2003	1.2	20.3	8.6	0	18-Aug
2004	1.3	18.9	10.8	0	22-Sep
2005	0.8	16.9	13.3	7	23-Sep
2006	0.6	18.1	12.0	0	19-Sep
2007	0.9	20.4	6.6	0	28-Aug
2008	0.5	22.0	7.6	0	20-Oct
Average	**0.8**	**20.2**	**9.4**	**1**	**20-Sep**

Clone selection of 'Hungarica' grapevine varieties

The clone selection of old 'Hungarica' grape varieties is one of the priority tasks of the Institute, the achievements of which are summarised in *Table 3*.

A new selection cycle was started in 2001 to define variants and clones better suiting the requirements of quality production. First, old plantations with great diversity of form were quested *(Figure 2)*. The findings of explorations on the cultivars Kadarka, Olasz rizling and Furmint are summed up hereunder.

Kadarka

Selection was carried out to find plants less sensitive to bunch rot which have loose clusters, small or medium sized berries, thicker skin, deeper and more uniform colouring of berries. Another important requirement was that the vines with the above

mentioned traits – when cultivated together – should provide a wine of distinctive characteristics *(Figure 3)*. During our examinations the variability of the stock was also determined, and 56 plants were assigned for further tests *(Figure 4)*.

The performance, cluster type, berry colour and degree of bunch rotting of these plants were recorded, and the average weight of clusters, the sugar and acid content and pH value of must was measured. To evaluate the performance of the chosen plants, the data were analysed on the basis of the correlations between the examined parameters. *Figure 5* demonstrates the connection between the yield and sugar content of the must of Kadarka parent vines.

On the basis of the examinations, 17 parent vines were found to be suitable for the selection programme (the reference numbers were generated by adding 100 to the number of vine-plant: P.102., P.108., P.109., P.111., P.114., P.115., P.117., P.122., P.123., P.124., P.125.,

Table 3: *Registered and candidate 'Hungarica' varieties and clones developed by the Institute*

Number	Variety, clone	Year of registration
1.	Cirfandli	1956
2.	Csomorika	1998
3.	Furmint P.51	1969
4.	Hárslevelű P.41	1971
5.	Királyleányka	1973
6.	Kadarka P.9	1969
7.	Olasz rizling P.2	2003
8.	Furmint P.14	2008
9.	Furmint P.26	2008
10.	Furmint P.27	2008
11.	Bakator	2008
		Year of application
12.	Olasz rizling SK.54	2003
13.	Olasz rizling P.10	2004
14.	Cirfandli P.123	2004
15.	Csókaszőlő	2004
16.	Sárfehér	2004

Figure 2: *Highly variable Kadarka plantation of over the age of 80 years*

Table 4: *Wine appreciation results (average score, rank) of candidate clones selected in medium plot experiments*
Szekszárd, 2007

Klón	Átlagos (100 pontos bírálat):	Helyezés
Kadarka P.124	87,3	**1**
Kadarka P.122	84,2	**2**
Kadarka P.173	83,9	**3**
Virághegyi kadarka	83,4	**4**
Kadarka P.167	83,3	**5**
Kadarka P.123	82,7	**6**
Kadarka P.147	81,1	**7**
Kadarka P.172	81,1	**8**
Szagos kadarka	79,4	**9**
Kadarka P.102	78,6	**10**
Kadarka P.165	77,7	**11**
Kadarka P.9	77,1	**12**

Figure 3: *Kadarka plant with loose clusters and deep coloured small berries*

Figure 4: *Kadarka plant assigned for further tests*

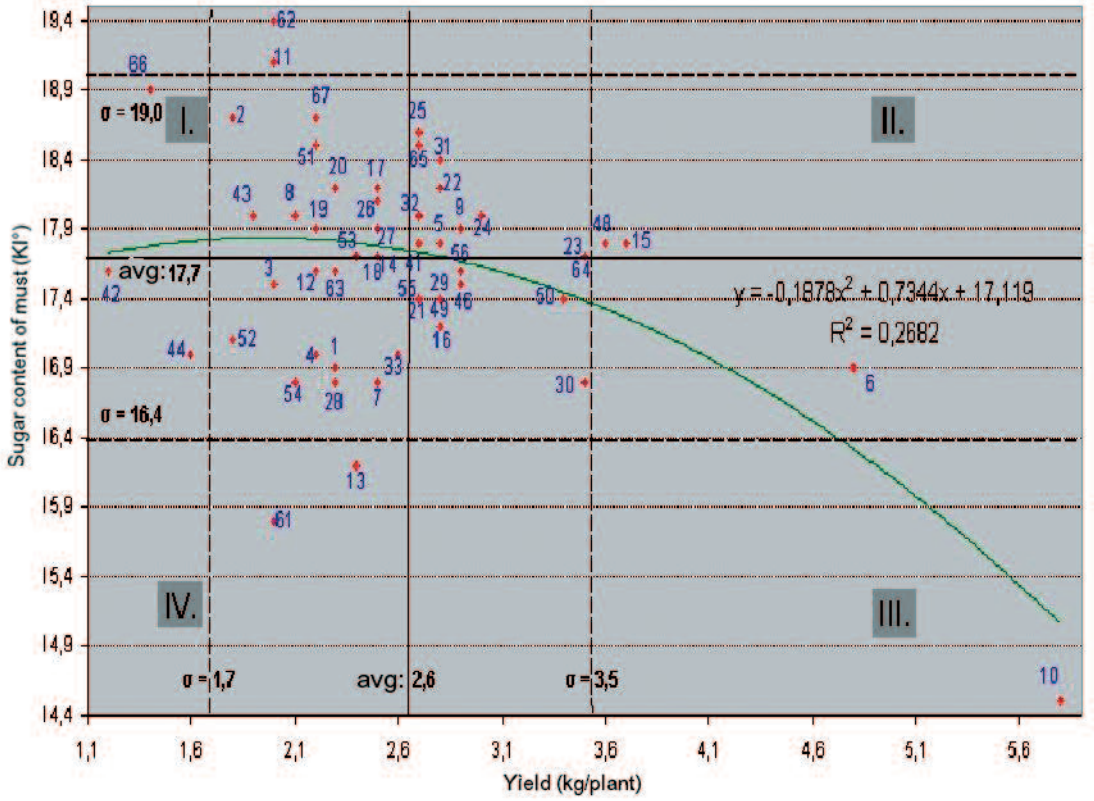

Figure 5: *Connection between the yield and sugar content of the must of parent vines (2001–2006) Szekszárd*

P.131., P.143., P.147., P.165., P.166., P.167.).

The selected candidate clones were examined in comparative experiments in Szekszárd including the different Kadarka variants from the gene bank as well as clones, variants from other vineyards (P172, P173, Virághegyi kadarka, Mészi kadarka) and the Csókaszőlő cultivar. Both the harvest results of the grapes examined in 2007 and 2008 and the appreciation of the experimental wines confirm that the traits of the selected candidate clones are superior to those of the registered P.9 Kadarka clone *(Table 4)*.

Analyses performed with molecular markers verify the

Figure 6: *Olasz rizling P.2/41 candidate sub-clone*
Photo: János Werner

Figure 7: *Hólyagos Furmint P.42*
Photo: János Werner

ampelographic characterisation of variants and confirm that old Kadarka plantations were highly variable and contained varieties possibly originated from the Balkans (Olasz kadarka, Virághegyi kadarka, Török kadarka) as well as seedlings developed locally (Mészi kadarka), together giving the complex, uniquely full-flavoured and famous Kadarka wine.

Olasz rizling

The Olasz rizling cultivar, one of the most reliable varieties, is principally cultivated in Hungary and the neighbouring countries. Its selection began as long ago as in 1951 in Pécs. The registered P.2 clone is one of the most widespread clones in the country. In addition to other domestic and foreign clones, it is important to select variants that maintain the original quality of the P.2 clone but are able to accumulate more sugar, ripen earlier, less sensitive to bunch rot and have looser clusters and smaller berries. The selection programme was started by assessing the variability of an old plantation and a stock originating from Fruska Gora (Republic of Serbia), an important production region of the variety for a long time past. Our observations revealed significant variability in the examined stock of the P.2 clone, and 75 parent vines were assigned for further trials *(Figure 6)* to analyse the correlations between yield, the sugar and acid content of must and the average weight of clusters. Significant variability was found in the population for most of the examined parameters. Among the vines evaluated, the quality parameters of 16 plants were significantly better than the stock average. The degree of must produced from the clusters of these plants exceeded the stock average by more than 1.0 Oe°, and the acid content of must was above 7.0 g/l *(Table 5)*. Further valuable clones were discovered in the stock originating from Fruska Gora and the Institute's gene bank as well. The P.10 clone of Cifra rizling, ripening 2–3 weeks earlier than the base variety, deserves special attention. The best vines were multiplied and multi location experiments were set up in different wine regions of the country (Mátraalja, Pannonhalma-Sokoróalja, Pécs, Somló, Tolna) to evaluate the performance of candidate sub-clones under various ecological conditions.

Furmint

Furmint, being dominant in Tokaj-hegyalja and Somló and cultivated also in the wine regions of Pécs and Villány, is one of the most important 'Hungarica' varieties. The quality or special quality wine produced from this variety is aromatic, a bit tartish and has high titratable acid content. Its yield is greatly influenced by the fertility of its flowers of different types or type variants. The base variety is genitally degraded, therefore, produces incomplete clusters. At present, clones of the variety (Kt.4., P.14., P.26, P.27, P.51, T.85, T.92) are available for planting.

The profound studying and selection of the Furmint variety group was started with the Változó and the Fehér varieties in 1950 in Pécs under the direction of Márton Németh, and as a result, numerous clones were developed from the sub varieties of the Változó and Fehér varieties *(Table 6)*.

Table 5: *Average harvest results of the most valuable selected vine-plants (2001–2008) Olasz rizling P.2 – Pécs*

date of harvest in the average of 8 years: 9 October

Ref. number of plant	Yield (kg/plant)	Dev.	Must degree (Oe°)	Dev.	Must acid (g/l)	Dev.	Aver. cluster weight (g)	Dev.
2	6.4	2.1	20.1	1.2	7.3	1.1	144	24
4	5.4	1.2	20.1	1.7	7.5	1.2	143	27
6	6.1	2.1	20.6	1.4	7.0	1.2	142	28
7	6.6	1.9	19.2	0.7	7.6	1.0	153	30
10	5.0	2.1	20.0	1.6	7.3	1.2	132	51
11	4.5	1.8	19.9	0.9	7.3	1.2	148	31
14	4.0	1.9	20.2	1.7	7.6	1.1	104	38
15	3.5	2.0	20.7	1.1	7.0	1.2	124	47
16	4.6	2.1	20.2	1.1	8.2	1.5	115	37
23	3.7	2.7	20.3	1.8	7.3	1.3	111	39
29	6.0	2.4	19.8	2.2	7.6	1.4	130	45
30	4.5	1.7	20.1	1.7	7.0	1.3	124	39
37	5.6	3.2	19.8	2.0	7.7	1.5	150	34
41	4.1	2.3	21.1	2.1	7.4	2.0	132	33
54	3.9	2.1	19.7	1.0	7.8	1.1	91	41
61	5.6	2.7	19.5	1.7	7.2	1.5	101	53
Average of selected clones (75 plants)	**5.0**	**2.1**	**20.1**	**1.5**	**7.4**	**1.3**	**128**	**37**
Stock average	**4.8**	**2.4**	**19.0**	**1.8**	**7.5**	**1.3**	**127**	**38**

Table 6: *Varieties and sub varieties belonging to the Furmint variety group, and the clones selected from them by Márton Németh (P.=Pécs)*

Variety	Variety group	Sub variety	Clone
Furmint	Fehér (white)	Nemes	P.1, P. 2, P. 4
		Hólyagos	P. 25, P. 26, P. 37, P. 38, P. 39, P. 40, P. 41, P. 42, P. 43, P. 44
		Vigályos	P. 14, P. 19
		Arany	P. 5
		Madárkás	P. 11
		Ligetes	P. 7
		Csillagvirágú	P. 22
		Rongyos	P. 24, P. 27, P. 28, P. 29, P. 30, P. 31
		Kereszteslevelű	–
	Változó (variable)	Rövidfürtű	P. 35, P. 36
		Hosszúfürtű	P. 32, P. 33
	Piros (Red)	Lazafürtű	–
		Tömöttfürtű	–

Based on the variants selected from these old stocks and preserved in the gene bank *(Figure 7),* our Institute set up a new research programme with the objective to create the so-called 'great dry Furmint wine' which can be introduced to the world market. To achieve this aim, the variants' values have to be revealed and evaluated, and the viticultural and wine production technologies have to be developed. This research programme is proposed to be carried out in our plantations located in the Tokaj, Somló and Zala wine regions.

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Irma Orova[1]

Bass and ARIMA Models in New Product Forecasting with Applications

New product forecasting is an important topic both in production and marketing. This study provides a brief summary of the new product forecasting objectives and techniques. The deterministic Bass (1969) model is widely influential in marketing and management science since the model parameters characterise the diffusion process and support the comparison of different products and countries as well. The application of the stochastic ARIMA models is quite new in this field. The spread of a new Hungarian product was investigated using the Bass and ARIMA models on representative sales data. Bass model parameters were determined on monthly, quarterly and annual data both by OLE and NLLS regressions. Difference was found in the Bass parameters: NLLS regression gave 75% lower values in average for the innovation parameters of the OLS regression results. NLLS regression gave the better quality of fitting according to the square of the *Pearson* product moment correlation coefficients of the fittings (0,84 on average contrary to the 0,55 average value of the OLE regression). Results inspire the importance of the reference of the scale of the time series and the regression method in publishing the Bass parameters. SARIMA (2,1,2)(0,12,0) empirical model provided the best fit on the time series. As the life-time of the products decrease, the short term forecast by the ARIMA holds greater importance in the future.

New products spread on the market and assure profit for the companies. Research indicates that 70% of today's manufactured goods will be obsolete in six years. Twenty-six percent of revenue at engineering companies is earned from products less than three years old. Companies with strong (enabling) R&D strategies are 73% more profitable (Singh). Thus new product forecasting is an important topic both in the production and marketing perspectives. The limited amount of data for the analysis, the inability to fully capture market complexity, market penetration rate, are some of the special difficulties of the new product forecasting (Kahn, 2006).

New product is a form of innovation. "Innovation is an idea, a practice, or an object that is perceived as new by an individual or other unit of adoption" by Rogers (2003), one of the first researchers of the spread of innovation.

In the other words, Kahn (2006), who investigate new product forecasting in the view of knowledge management says, that "product can describe any company offering: product, service, idea, because these are intertwined in our time".

Different types of new products exist: cost improvement, product improvement, line extensions, market extensions, new uses, new category entry, new-to-the-world.

Forecasting objectives are of level, time horizon, interval and form (Kahn, 2006).

New Product Forecasting Techniques

Kahn (2006) sorts forecasting techniques into three groups: qualitative, market research and quantitative techniques. This work deals with two quantitative methods a) deterministic diffusion model and b) stochastic time series models.

"Diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system" by Rogers, the founder of the Diffusion of Innovations Theory. Rogers furthers Tarde's "laws of imitation" and says: "most innovations have an S-shaped rate of adoption" regarding the cumulative adoptions or sales during the time on more than 200 observations (Rogers, 2003).

The first purchase *Bass (1969) model* is a very influential mathematical model in marketing and management science. Innovators buy by the mass-media mechanism and the imitators by word-of mouth in this model, basing on Rogers' Diffusion of Innovations Theory. It is the only diffusion model that gives not only excellent forecasts (even on few data), but it gives model parameters (innovation and imitation) that characterize the diffusion process

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and makes possible to compare different diffusions even in different countries.

The basic assumption of the Bass (1969) model is that an initial purchase will be made at time *t*, given that no purchase has been made, is a linear function of the number of previous buyers. The new adopter is one from the potential market. The probability of the new adoption is a conditional likelihood this way and can be determined by Bayes theorems.

Further assumptions of the Basic Bass Model: diffusion process is binary (consumer either adopts, or waits to adopt); maximum potential number of buyers (N) is constant; eventually all N will buy the product; there is no repeat purchase, or replacement purchase; the impact of the word-of-mouth is independent of adoption time; innovation is considered independent of substitutes. Marketing strategies supporting the innovation are not explicitly included in the model.

Estimation. Bass (1969) advises to utilise the OLE regression on the discrete form of the model to determine the parameters:

$$Y(T) = mp + (q - p)N(T-1) - \frac{q}{m}N(T-1)^2 + \varepsilon_T = a + bN(T-1) + cN(t-1)^2 + \varepsilon_T$$

where:

Y(T) number of new adoptions in interval T
N (T-1) cumulative number of adoptions through *t <T-1*

p coefficient of innovation (the probability of the first adoption in *t=0*; external influence or advertising effect)

q coefficient of imitation (internal influence or word-of-mouth effect)

ε_T additive error term, the mean of it is supposed 0.

The above equation for Y(T) assumes that the time intervals are equal.

Regression results *a, b, c* and the innovation and imitation parameters and the potential market offer itself.

NLLS (non-linear least squares estimation) is proposed as alternative estimation by Srinivasan and Mason (1986). It is the estimation technique that has recently become the standard in diffusion research. The basic relation of this estimation is the next adoption function:

$$Y(t) = m\frac{(p+q)^2}{p}\frac{e^{-(p+q)t}}{(1+\frac{q}{p}e^{-(p+q)t})^2}$$

where:
Y(t) is the adoption at moment *t*.

*Stochastic time series model*s were applied first by engineers and physicists about 40 years ago, but they are commonly used in listing estimation at Stock Exchange today. This model acts as a black box, which means we may only be able to know about what happens rather than why something happens. Time series (TS) modelling does not base on economic process (Ramanathan 2002).

TS is usually modelled the sum or product of the next three components: *trend* – when there is a long term increase or decrease in the data, *seasonal* – when a series is influenced by seasonal factor and recurs on a regular periodic basis, *stochastic* – the random effect.

Structures of the TS models

a) The complex ARMA (p, q) – the combination of the auto-regressive (AR) and moving-average (MA) models – represents the present value of the time series in the function of its previous values plus of the present and previous random variables as follows

$$Y_T = \underbrace{\alpha_1 Y_{T-1} + \alpha_2 Y_{T-2} + \ldots + \alpha_p Y_{T-p}} + \upsilon_T \underbrace{- \beta_1 \upsilon_{T-1} - \beta_2 \upsilon_{T-2} - \ldots - \beta_q \upsilon_{T-q}}$$

where:

Y_T – original TS data, the observation in the time period *T*

μ_T – stochastic variable in the time period *T*

p – the order of the auto-regression

q – the order of the moving-average process

The ARMA model can be fitted only on stationary time series. A TS is said to be stationary if its underlying generating process is based on a constant mean and constant variance with the auto-correlation function essentially constant through time. Most economic TS are not stationary, meaning they often have trend or seasonal components. To utilize the ARMA model, the trend must be removed by differencing the original TS one or more times and then fit the ARMA model. Seasonal differencing can remove a seasonal component as well.

b) ARIMA (p, d, q) (auto-regressive, integrated, moving average) model is the most complex model, including trend removing, where *d* means how much TS has to be differencing to remove trend component.

c) When a time series has strong seasonality a slightly different type of ARIMA (p, d, q) process is used, which is often called SARIMA (p, d, q) (P, D, Q), where S denote seasonal. In this model, not only are there possible AR, I, and MA terms for the data, but there is also a second set of AR, I, and MA terms that take into account the seasonality of the data.

Box and Jenkins – the pioneers in TS modelling – advise a three step iteration process for estimation

ARIMA model to make forecasts: identification, estimation, diagnostics (Ramanathan, 2002).

Bass (1969) diffusion model – providing excellent long term forecasts even on few data - is usually used for forecasting the spread of new products in marketing science to compare diffusion processes even on international platform. Difficulties occur in Bass-model fitting if the growth process is very slow.

The short term forecasting ARIMA models are new in modelling the diffusion process of new products since TS forecast techniques spread through the great counting capacities of the personal computers in the last decade. Box and Jenkins propounded at least 50 observations for performing TS analysis e.g. ARIMA. (Ramanathan, 2002).

Results of Bass and ARIMA models

Among other researches applying Bass model, Talkudar (2002) analyze the Bass parameters and the potential market size across countries by assembling a novel dataset that captures the diffusion of 6 products in 31 developed and developing countries from Europe, Asia, and North and South America. The average parameters for coefficients for external and internal influence by NLLS regression method are as follows: for p: 0.0010 (developed) and 0.00027 (developing) and for q: 0.5090 (developed) and 0.556 (developing).

Hassan and Nassar (2007) analyzed datasets using time series and Bass diffusion models to forecast the spread of wireless telephone in the United States between 1984 and 1999. Their results show that AR (3) gave better forecasts than the original Bass model by the ratio of the sum of squares deviation between observed and predicted values of the models. This result is explained by the essential difference between these models as follows: How well a diffusion model predicts a given process depends on how well the assumptions are met, while time series models are empirical and flexible, they can be fit any given process.

Kahn researched companies' new product forecasting practices in the USA in 2002. His survey is based on a data set of 168 respondents from a cross section of industries. He found that generally the diffusion models are used by 2% of all the responding firms across all types of new product and ARMA/ARIMA models are utilised by only 1% of them. Diffusion models are used mainly at market extensions, new category entries and new-to-the-world products and sometimes at line extension. The ARMA/ARIMA models are used at cost- and product improvements, line- and market extensions.

Benchmarking research finds that new product forecast accuracy one year after the launch is slightly above 50 percent on average – including all types of forecasting techniques (Kahn 2002).

New Alcoholic Drink in Hungary

The diffusion of an alcoholic drink in new, practical package was investigated in Hungary.

This alcoholic drink product was a new category entry because it was a new-to-the company product and new-to the company market in spring of 2004 in Hungary, however it was not new to the general market as it previously existed on the market abroad. This product served as market extension as well, targeting new market segments.

The data represented monthly sales volumes from March of 2004 to March of 2008. The time series show trend and seasonal effect as well. *(Figure 1.)* Quarterly and yearly time series were counted from the original monthly data

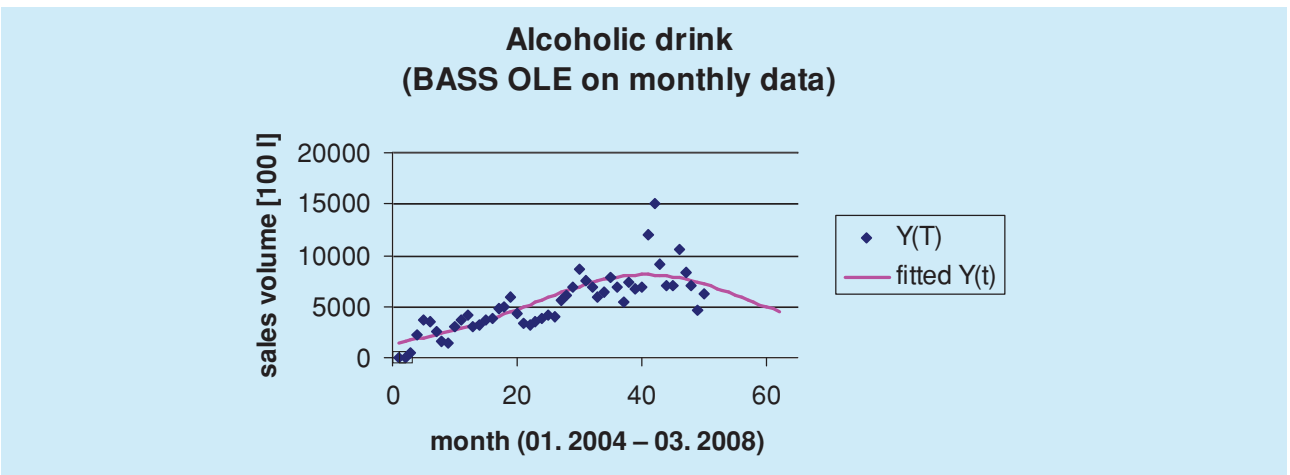

Figure 1: *Sales Volume of the Alcoholic Drink (01. 2004 – 03. 2008) and the fitted Bass Curve on Monthly Data p=0.0034, q=0.0715, m=412497 l*

Table 1: *Results of the Bass model fitting on monthly, quarterly and yearly time series*

	OLE regression		
	monthly	quarterly	yearly
p	0,003416	0,009223	0,046302
q	0,071574	0,237592	1,267566
m	412 497	383 273	297 138
r2	0,662191	0,726573	0,266154

	NLLS regression		
	monthly	quarterly	yearly
p	0,002999	0,005805	0,008121
q	0,070812	0,226382	0,895341
m	423 588	412 546	447 997
r2	0,670000	0,858320	0,982330

(p: innovation parameter, q: imitation parameter, m: market potential, r^2: square of the Pearson product moment correlation coefficients)

series. Bass and ARIMA models were applied on the dataset with computer software: MS Office Excel 2003 and SPSS 11.0.1.

Bass model was fitted on monthly, quarterly and yearly data to determine the model parameters and to forecast the potential market size by: a) OLS on the discrete form of the basic Bass model and b) NLLS on the Y(t) from the analogue Bass model.

The results of OLE and NLLS regressions of the Bass model were summarised in *Table 1*.

The original monthly data, the fitted Bass curve with one year ahead **forecast** by OLE were displayed in *Figure 1*.

The comparison of the results of the OLE and NLS estimation methods were summarised in *Table 2*.

Correlation analysis was carried out on the time interval (t), p, q, m, and R^2 at both regression methods. Results showed that the correlation is significant at the 0.01 level (2 tailed) between p and q parameters, and at the 0.05 level between m and t, p and t, q and t in the case of OLE regression and 0.01 level between q and t while there is 0.05 significant level between R^2 and p at NLLS regression. OLE regression gives the next relation: $q=27{,}848p-0{,}0216$ with $R^2=1$.

ARIMA estimation. Monthly data were taken into consideration to have enough observations (more than 50) for the estimation in ARIMA modelling: The stationarity of the time series was tested by ACF and PACF and the required differencing transformation was made to remove trend component. The three step iteration process was played several times to determine the best ARIMA process. AIC and SBC values of the SPSS output were the base of the diagnostics – the lower were the values the better was the fit. The diagnostic process was completed with the examination of the residuals – if it was a white noise process.

The iteration process resulted the SARIMA (2, 1, 2) (0, 12, 0) seasonal model, the model was described with the next equation:

Goodness of fit: The square of the *Pearson* product moment correlation coefficient between the original and fitted data was 0.85577 for the SARIMA model.

One year ahead **forecast** of the sales volume for the alcoholic drink by SARIMA2,1,2)(0,12,0) are shown in *Figure 2*.

Table 2: *Bass model – the comparison of the NLLS and OLE results*

	NLLS/OLE		
	monthly	quarterly	yearly
p	0,88	0,63	0,18
q	0,99	0,95	0,71
m	1,03	1,08	1,51
R^2	1,01	1,18	3,69

Conclusions

This work involved the deterministic Bass (1969) diffusion and the stochastic ARIMA time series models to model and forecast the spread of a food-stuff in Hungary based on representative monthly sales volumes from between 2004 and 2008. The investigated alcoholic drink was a new category entry. The plot of the monthly sales was ascendant with some seasonality. It seemed to be a successful product.

The deterministic Bass model was fitted by OLE and NLLS on monthly quarterly and yearly data, the resulted parameters were examined. Significant correlation was found between the innovation and imitation parameters by OLE,

$$(Y_t - Y_{t-12}) - (Y_{t-1} - Y_{t-13}) = 0.521218\left[(Y_{t-1} - Y_{t-13}) - (Y_{t-2} - Y_{t-14})\right] - 0.499707\left[(Y_{t-2} - Y_{t-14}) - (Y_{t-3} - Y_{t-15})\right] + \upsilon_t + 0.895715\upsilon_{t-1} - 0.291664\upsilon_{t-2} - 83$$

Control: AIC=655.21, SBC=663.26, and the error was white noise.

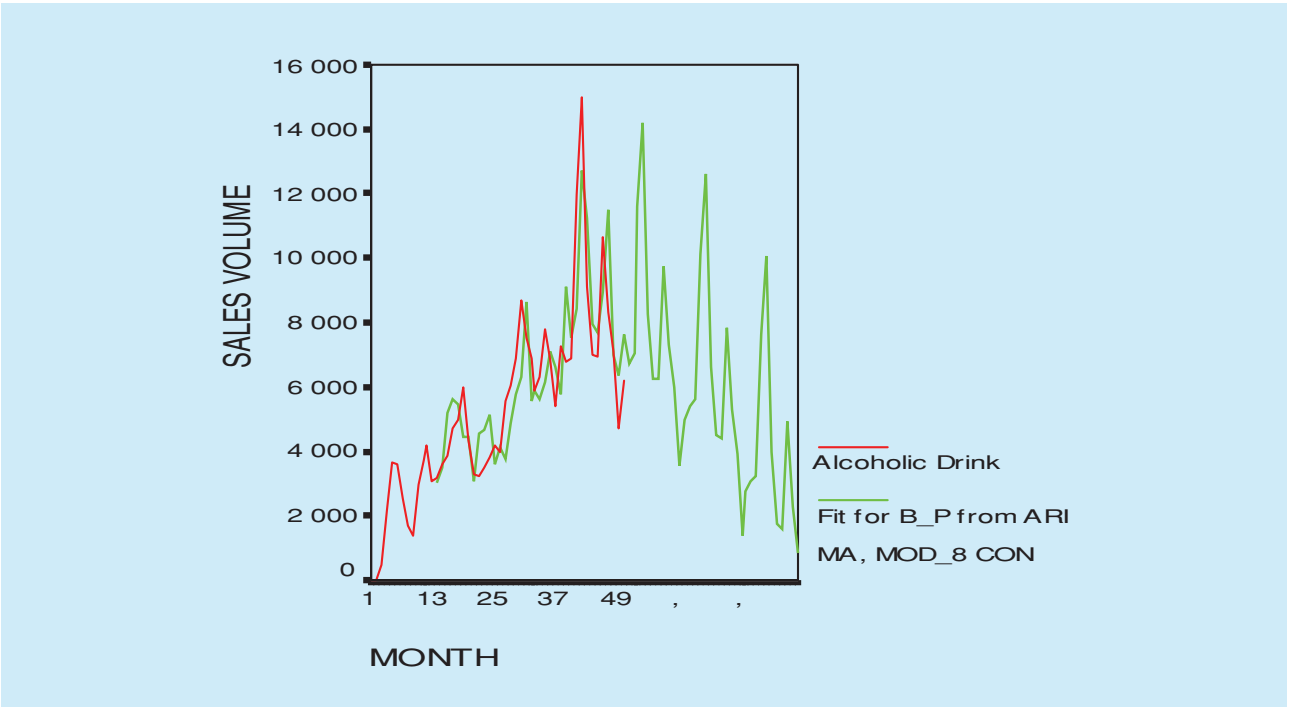

Figure 2: *Forecast of the Alcoholic Drink, Model: SARIMA (2, 1, 2) (0,1 2,0)*

and between the innovation parameter and the time interval in the case of both regression methods. I have not read about these types of significant correlations in the scientific publications yet, but I can show this relation on simulated time series as well.

NLLS regression gave 75% lower values in average for the innovation parameter, quite the same (97% in average) for the imitation parameters then OLE regression and 3–8% greater values for the estimated potential market size. (Not regarding the yearly time series – OLE resulted very bad fitting on yearly data: R^2=0.27) NLLS regression gave better quality of fitting according to the square of the *Pearson* product moment correlation coefficients of the fittings (R^2=0,76 on average contrary to the R^2=0,69 average value of the OLE regression).

Results inspire the importance of the reference of the scale of the time series and the regression method in publishing the Bass parameters to compare Bass parameters of different products and the diffusion process in different countries.

The stochastic SARIMA (2, 1, 2) (0,1 2,0) gave the best fitting (R^2=0.85577). The purchase of the previous month had an increasing effect on the amount of the purchase of the current month, but the pre-previous had a regressive one as >0 and <0. The random effect was high in Hungary according to the last parameter of the model in the spread of the new packed alcoholic drink.

Diffusion models for the long term forecasting of the new product were often used and referred to in scientific publications. The utilization of ARIMA models is new in the short term forecast in this field, however, the significance of short time forecasting is growing as the lifetime of the products is getting shorter and shorter.

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North–South Scientific Cooperation

A physiological and molecular approach to understanding the mode of action of smoke on germination and growth

Fire is a major environmental selective force that influences plant communities in many parts of the world. Reproductive strategies have evolved as an adaptation to the various factors generated by and/or associated with fire. This is particularly true for seeds, in which strategies have evolved that respond to both physical and chemical germination cues that may be associated with fires. Some of these cues are of a primary nature, while others may play a secondary or permissive role in the germination process. Smoke, released from burning vegetation, has been shown in recent years to be an important factor in promoting dormancy release. It contains a chemical signal that triggers germination of both fire climax and non-fire climax species from different parts of the world. The role of smoke is probably a very old development and serves as an additional protection mechanism to ensure germination at optimal times for seedling survival.

Smoke is used in horticulture to stimulate seed germination of wildflower species and can break dormancy and improve seed germination of vegetable crops, such as lettuce and celery. Smoke

Figure 1: *A grassland fire in the KwaZulu-Natal midlands, South Africa*

Figure 2: *Apparatus for producing smoke-saturated water*

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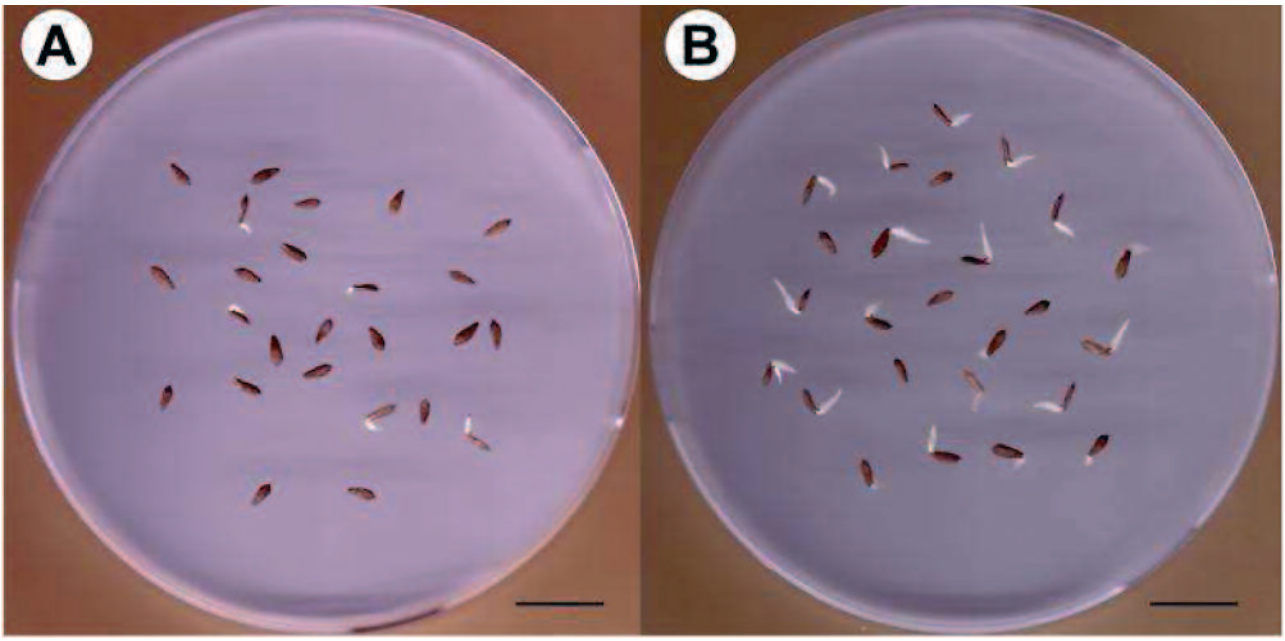

Figure 3: *Germination response observed with light-sensitive Grand Rapids lettuce seeds after 24 h in the dark at 25 °C. (A) Distilled water control, (B) Treatment with smoked-derived compound, 3-methyl-2H-furo[2,3-c]pyran-2-one at 10^{-9} M. Scale bars, 10 mm.*

application is effective on many seeds that have a light requirement for germination. It can be applied to seeds immediately before sowing or the seeds may be pre-treated and stored until conditions are appropriate for sowing. Both aerosol smoke and smoke solutions are active in this respect. The recent identification of the active compound, 3-methyl-2*H*-furo[2,3-*c*]pyran-2-one, now provides a way forward to determine the mechanism/s of action and a greater understanding of the physiological processes which are involved.

The overall effect of smoke is that it seems to sensitize the seeds to exogenous plant hormones. Smoke interacts with gibberellins, cytokinins, abscisic acid and ethylene in seeds. Smoke may influence the biosynthesis or metabolism of gibberellins and other plant hormones, may interact with the phytochrome system and hormone receptors or may change membrane permeability, thereby enhancing transport of phytohormones to their sites of action. The smoke-derived compound, 3-methyl-2*H*-furo [2,3-*c*]pyran-2-one, promotes growth in seedlings of several species and pollen tube germination possibly by affecting water uptake and imbibition. Several aspects of the effect of smoke on germination and growth are subject to investigation using tools of molecular biology.

Figure 4: *The effect of smoke water (SW, 1/500 dilution) and the smoke-derived compound 3-methyl-2H-furo[2,3-c]pyran-2-one (SC, 10^{-7} M) on early seedling stages of tomato. Seeds were incubated at 25 °C in the dark for 6 days. Scale bar, 10 mm*

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From page 2

Plant species

- bred at the company currently as well
  - winter and spring types of bread and durum wheat, barley, triticale and oats; and winter rye;
  - corn, grain sorghum, silage sorghum and Sudan grass;
  - sunflower, winter rapeseed, soybean, linseed, millet, Hungarian millet and buckwheat;
- under the variety ownership of the company
  - broomcorn, onion, garlic, peanut, castor oil plant, pumpkin and amaranth.

Main spheres of activity

- Conventional breeding is an efficient tool to breed cultivars presenting good quality, high yield, disease and pest resistance, drought tolerance and winter hardiness, and to develop a range of cultivars to be used as food, feed, and bioenergy sources or industrial crops.
- The applied research work done at the company has resulted in 85 PVPs, patents, and 19 pending patents, respectively, giving a chance to implement biological progress in agriculture. 39 variety candidates and experimental hybrids are being tested in the domestic official trials of the Central Agricultural Office and 27 abroad (in 7 countries).
- Research in plant physiology, phytopathology, biotechnology, molecular biology, tissue culture, the assessment of grain composition and analytical tests enhance the realization of breeding goals.
- Production technological researches, such as long-term fertilization trials, chemical plant protection experiments (application of fungicides, herbicides and insecticides) are carried out to support sustainable agriculture and environmental protection. The results reflect reliably the response of new stocks, lines, plant varieties and hybrids and the efficacy of chemicals. Based on the results, our research workers elaborate the variety specific intensive, semi-intensive, organic and precision crop production technologies for various soil types.
- The quality parameters of F1 hybrid seed, basic seed, and first and second grade certified seed produced at our seed plants are excellent. The seed conditioning is assured by the ISO 9001:2001 standard.
- Dietetic and diabetic food products and recipes have been developed at the company influencing beneficially the life quality of patients having certain alimentary diseases.

The dietetic product family FE-MINI involves 23 gluten-free food products with low protein and phenylalanine content for patients suffering from celiac disease, renal failure or phenylketonurea (PKU).

The diabetic baking and farinaceous industrial product family DIABET-MIX (a joint patent with Diabet Trade Ltd.) includes flour and additive mixtures, bread and noodles for diabetic patients and people wishing to lose weight.

Sites where breeding work is done

Breeding work is realized in a proper integration at the headquarters in Szeged, research station in Táplánszentkereszt, and five minor research stations (Kiszombor, Fülöpszállás, Kiskundorozsma, Szeged-Öthalom, Szeged-Kecskéstelep).

These locations represent various climatic conditions, soil types and other environmental factors in Hungary. The breeding work and the selection at these locations has allowed the improvement of plant varieties with broad adaptability and their seed production in top quality. Field trials and breeder's seed multiplication can be accomplished on 1700 hectares of land (mainly in Kiszombor-Dénes-major) at own management.

Company history

The decision to establish the company in 1904 was followed by laying its corner stone in 1914, and its opening in 1924. The research work started as a matter of fact on 26th October 1924.

The legal predecessors of Cereal Research Non-Profit Ltd. (2009) were:

- Royal Hungarian Lowland Agricultural Institute (1924–1949)
- Agricultural Experimental Institute of Szeged (later: of South Lowland) (1950–1969)
- Cereal Research Institute (1970-1997)
- Cereal Research Non-Profit Company (1997–2008)

Well-established scientific and technical background

- The efficient scientific and research activity, well-known and appreciated in foreign countries as well, can be attributed to 60 highly qualified research workers with 1 member of HAS, 5 academic doctors; and 18 candidates and scientists with Ph.D. degree, respectively, among them. Research workers participate both in the domestic and foreign scientific public life in numerous associations and corporations, and they are also co-operators in joint projects with foreign partners.
- The operating capital of Cereal Research Non-Profit Ltd. amounts to more than one billion HUF. The level of mechanization, instrumentation and computerization ensures the technical conditions of compatible crop improvement and the efficient continuation of goal-oriented laboratory analysis.
- The success in participation in R&D projects has been guaranteed by the scientific and research activity of our company. The company has participated in 23 funded R&D projects since 2000, with 3 EU projects among them.
- Farmers may rely on our extension service for crop production. The company publishes the journal Kutatás és Marketing (Research and Marketing) and the quarterly Cereal Research Communications.
- The company's research workers have authored or co-authored more than one thousand scientific and popular scientific articles in the past decade.
- Online information is available on the company at their website (http://www.gabonakutato.hu) and on that of Farmit Agroportal (http://www.farmit.hu).
- Being visiting lecturers of universities (SzIE, SzTE, DE) and professors of the affiliated doctoral departments, the company's research workers have integrated researches and agricultural education.
- The breeding, marketing, seed multiplication and sale of crops is based on a network of more than 200 domestic partners and 50 foreign companies and institutions embracing the research and market sphere.
- The company's innovations and novel products were awarded the Grand Prize of the Hungarian Innovation Foundation, the Prize for Agrarian Innovation of the Ministry of Agriculture and Rural Development (3 times), and the Prize for Innovation of OMFB (Committee of National Technical Development). At agricultural exhibitions, our commitment to high quality has been acknowledged by receiving the Grand Prize for Produce, Prize for Produce (3 times), Extra Award, and the Prize of the Plant Production Branch of the Ministry of Agriculture and Rural Development in the past five years. The international recognition of the company is highlighted by the Prize for Seed of International Exhibition in Canada and the International Trophy for Seed Export.

Data demonstrating the company's major achievements from the start

- Totally 370 plant varieties were registered during the period from 1929 to 2009, the distribution of which is as follows:

➢ 1929–1975:	29
➢ 1976–2000:	250
➢ 2001–2004:	48
➢ 2005–2009:	43

- The total number of registrations can be broken down to cultivars as follows:

corn	120
wheat	85
barley	20
sunflower	54
sorghum	20
linseed	15
winter rapeseed	10
oats	6
seasoning paprika	5
miscellaneous cultivars	35

- Patents and PVPs:

➢ Total number of patents:	161
➢ Total number of patents pending:	21
➢ Patents and PVPs in force in September 2009:	88

János Matuz

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